

Basel Rules, endogenous Money Growth, Financial Accumulation and Debt Crisis

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Abstract

A Basel-type bank regulation regime has the side effect of endogenous money growth. The growth rate turns out to be inversely proportional to the required minimum capital/asset ratio. This money growth contributes to avoiding debt crises, as opposed to non-bank lending which increases debt but not money stock, and is therefore dangerous in the long run. The phenomenon of banks selling loans onwards is also examined. It is shown that this doesn't only decrease the bank's risk, it may also imply steeper asset growth for the selling bank.

1 Introduction

Today's international regulation regimes for banks are less of the reserve requirement type and more based on requirements on banks to be robust against insolvency, by demanding that a bank's claims on others must exceed others' claims on the bank by some reasonable margin. Banks are required to stay above a given lower bound for their capital/asset ratio, also incorporating some risk weighing of different types of assets. Since the only (acknowledged) rationale for this banking regulation regime is robustness against insolvency, it is of interest to examine whether there are side effects, and whether these are benign or not. This paper shows that a Basel-type regime implies the important side effect of endogenous money growth. It turns out that the growth rate is inversely proportional to the required minimum capital/asset ratio.

The model to be discussed is very simple, as indicated by the assumptions done. Hopefully, it still embodies the properties needed for the analysis to be valid. In the first stage, all banks are aggregated into one unit. This aggregate of banks (called "the Bank" with a capital B) has one type of asset, which is the aggregate of loans to households and non-bank firms. Its liabilities are the aggregate of deposits. We initially abstract from the presence of a government, a central bank and high-powered money (reserves). We also until further notice ignore the Basel rules for risk weighting of different types of assets. We assume that there is no currency in circulation, so that money stock is simply the aggregate of deposits. Until further notice we assume that all lending is done by banks.

In later stages we introduce a central bank, reserves and risk-weighting, and the systemic impact of highly-g geared non-bank financial institutions. Finally the phenomenon of banks selling loans onwards is examined.

2 A generic bank model without a Central Bank

The model is defined in continuous time. "\$" is used as a symbol for one unit of generic money. Brackets are used to signify denomination. Denomination for money flows is then $[\$/y]$ (where "y" means "year"), and for stocks it is $[\$]$. Empty brackets $[\]$ signify a dimensionless entity. All monetary entities are in nominal terms. We define the following variables and parameters:

$A(t), L(t)$ = assets, liabilities $[\$]$. Note that L = money stock, as stated above

κ = the required minimum capital/asset ratio $[\]$

i_A = interest rate on assets (= loans) $[1/y]$.

i_L = interest rate on liabilities (= deposits = money) [1/y]; $i_L < i_A$

i = “equivalent net interest rate” (explained below) [1/y]

r = loan repayment rate [1/y]. r is defined such that the loan repayment flow is proportional to the loan; we have $rA(t)$. This is unconventional, since repayment schemes are usually of the bond- or annuity type. But for our analysis this is acceptable.

λ = loss rate [1/y]; a flow $\lambda A(t)$ is written off due to borrowers defaulting on their loans

β = share of net interest income that is left for banks after they have paid their expenses including wages []; $0 < \beta < 1$

l = flow of new loans [\$/y]

We assume that banks lend as much as they are allowed to, i.e. they (manage to) stay at the lower limit κ . This presupposes that the general mood among lenders and borrowers is not very pessimistic (when both sides or one side hold back). Then we have

$$\kappa = \frac{A - L}{A}, \text{ or } A - L = \kappa A, \text{ or } L = (1 - \kappa)A \quad (1)$$

(A variable’s dependency on time t is here and in the following mostly implied and not indicated.)

The differential equation for asset change is

$$\dot{A} = l - \lambda A - rA \quad (2)$$

(We use dot notation for time derivatives; \dot{A} is the same as $\frac{dA}{dt}$.)

The differential equation for liability change is

$$\dot{L} = l - rA - \beta(i_A A - i_L L) \quad (3)$$

Note that net Bank income $\beta(i_A A - i_L L)$ appears with a minus sign in \dot{L} , not with a plus sign in \dot{A} : net income to the aggregate of banks appears in the form of reduced deposits. Using the rightmost equation in (1), the last term in (3) becomes

$$-\beta[i_A - i_L(1 - \kappa)]A = -\beta i A, \text{ where } i = i_A - i_L(1 - \kappa), \quad (4)$$

where i may be termed an “equivalent net interest rate”. In i we now also include all types of fees on borrowers and depositors. These fees are assumed proportional to A and L , and may therefore be considered to represent an extra interest-like income for the Bank.

We substitute (4) in (3), and substitute for L with the the rightmost variant of (1). This gives

$$\dot{A}(1 - \kappa) = l - rA - \beta i A \quad (5)$$

We subtract (5) from (2) and divide the result by κ on both sides. This gives

$$\dot{A}(t) = \frac{\beta i - \lambda}{\kappa} A(t), \quad (6)$$

which has the solution

$$A(t) = A_0 e^{gt}, \quad (7)$$

where we have introduced the aggregate assets growth rate

$$g = \frac{\beta i - \lambda}{\kappa} \quad (8)$$

A_0 is the value of the Bank’s assets at $t = 0$.

We note that g is proportional to the equivalent net interest rate and the Bank’s profit share of income β , which is not surprising. A more interesting result is that the growth rate is *inversely proportional to the capital/asset ratio*. This growth rate also applies to the money stock L , since we have $L = (1 - \kappa)A$ from (1) and may differentiate this on both sides:

$$\dot{L}(t) = (1 - \kappa)gA_0 e^{gt} = \frac{(1 - \kappa)\beta i - (1 - \kappa)\lambda}{\kappa} A_0 e^{gt} \quad (9)$$

We observe that endogenous credit¹ money growth will occur for $\kappa < 1$. This is (as far as this author knows) a non-acknowledged side effect of a Basel-type regime.

Using (3), (4), (7) and (8), the Bank's net lending flow $l - rA$ is

$$l - rA = \dot{L} + \beta(i_A A - i_L L) = (1 - \kappa)gA + \beta i A = \frac{\beta i - (1 - \kappa)\lambda}{\kappa} A_0 e^{gt}, \quad (10)$$

which we will return to further below. Comparing (9) and (10), we note that the net lending flow is somewhat larger than the net money creation flow \dot{L} , which is reasonable since the Bank also lends its own profit flow, and this is not accompanied by creation of net money.

The Bank's profit flow is

$$\beta i A(t) = \beta i A_0 e^{gt}, \quad (11)$$

That this flow grows steeper the lower the capital/asset ratio is, explains banks' wish to operate at the limit κ .

We try a set of numerical values to check out g :

$$i_A = 0.07, i_L = 0.03, \beta = 0.2, \lambda = 0.005 \text{ and } \kappa = 0.08. \quad (12)$$

This gives $g = 4.35$ % per year, which is not unreasonable. Note from (8) that g is very sensitive to λ ; we need $\beta i > \lambda$ for assets to grow at all.

3 Including a Central Bank and a government

We now introduce a central bank (CB) and reserves. It is assumed that banks' deposits with the CB fluctuate with government spending and taxation, and grow due to interest paid for these deposits. Government bonds are in their entirety assumed to be held by banks, and considered to be equivalent with interest-bearing deposits at the CB.

Any CB where the country in question has its own national currency (as opposed to for instance the Euro zone), is constitutionally an arm of the government – the "independence" of CB's that has become the rule in later years is a political construct that may be reversed by the government or national assembly. Thus a government's "debt" that builds up with its CB through deficit spending in excess of the income from selling bonds, is only an accounting and legal convention. In line with this, the government is in this paper considered to be able to spend freely (and thus net create money) by debiting its account(s) at the CB. A possible real-economic impact of this type of net HPM creation is of course inflation, but that is no more an issue than the possible inflationary effect of banks' exponentially increasing net credit money creation, established in the previous section.

We distinguish between risk weight of reserves (zero) and all other assets in the Basel rule (these are for simplicity assigned a 100 % risk weight). We now define:

$R(t)$ = reserves = the Bank's deposit with the CB = high-powered money (HPM) [\$]. We assume that $R > 0$. The Bank's total financial assets are now $A + R$, where A = all other financial assets than reserves.

i_R = interest rate on HPM to banks from the CB. This is an exogenous monetary control variable for the system [1/y]

$\gamma(t)$ = government net spending (= deficit) flow. It may be negative, corresponding to a surplus budget. γ is an exogenous fiscal control variable for the system. [\$/y]

The derivation of the growth equation may now be done along the same lines as in the previous section. Remembering the Basel rule that risk weights shall only apply in the denominator, we get

$$\kappa = \frac{A + R - L}{A + 0 \cdot R}, \text{ or } A + R - L = \kappa A, \text{ or } L = (1 - \kappa)A + R \quad (13)$$

The differential equation for non-reserve asset change is

$$\dot{A} = l - \lambda A - rA \quad (14)$$

The differential equation for change in the Bank's reserve part of assets is

¹We distinguish between credit money which is created through bank lending, and Central bank Money (reserves). See next section.

$$\dot{R} = i_R R + \gamma \quad (15)$$

The differential equation for liability change now becomes

$$\dot{L} = l - rA - \beta(i_A A - i_L L) + \gamma, \quad (16)$$

where the second last term in (16) may, using (13), be written as

$$-\beta [i_A - i_L(1 - \kappa)] A + \beta i_L R = -\beta i_A A + \beta i_L R, \text{ where } i = i_A - i_L(1 - \kappa) \text{ as before.} \quad (17)$$

Using (17), (16) becomes

$$\dot{L} = l - rA - \beta i_A A + \beta i_L R + \gamma, \quad (18)$$

We substitute for \dot{L} in (18), using the righthmost variant of (13), and also substitute (15) for \dot{R} . This gives

$$\dot{A}(1 - \kappa) + i_R R + \gamma = l - rA - \beta i_A A + \beta i_L R + \gamma, \quad (19)$$

where γ cancels out on both sides and $i_R R$ may be moved to the right side:

$$\dot{A}(1 - \kappa) = l - rA - \beta i_A A + \beta i_L R - i_R R \quad (20)$$

We subtract (20) from (14) and divide the result by κ on both sides. This gives

$$\dot{A}(t) = gA(t) - \frac{\beta i_L - i_R}{\kappa} R(t), \text{ where } g = \frac{\beta i - \lambda}{\kappa} \quad (21)$$

Compare this to equation (6). The growth equation has a similar structure, but is influenced by the additional variable R , whose growth is decided by the two control variables γ and i_R in (15). We have established that A and L will grow exponentially. For the system to uphold the balance between monetary aggregates, R must grow at the same rate. If R is depleted, banks will increasingly lack reserves for their transactions with each other, with the government and with the public (for notes and coins). This means that γ must be positive, which corresponds to persistent government deficit spending – not through bond sales but through net HPM creation. More precisely, γ and i_R should be such that they, via (15), achieve $R = \theta A$, where the parameter θ is somewhere in the range $0 < \theta \ll 1$. Then (21) becomes

$$\dot{A}(t) = gA(t), \text{ with } g = \frac{\beta i - \lambda - \theta(\beta i_L - i_R)}{\kappa} \quad (22)$$

3.1 A special case: a 100% reserve system

We will now consider the case where reserves have to mirror deposits 100%. This is the famous proposal put forward by, among others, Irving Fisher during the Great Depression. It has been persistently (re)launched to this day by individuals or groups that are more or less considered to belong to the economics "fringe", and has (in this author's opinion: undeservedly) not been considered worth serious discussion by the academic mainstream.

In our model, 100% reserves correspond to $L = R$. Since reserves are not weighted in the denominator of the capital/asset ratio as defined in the Basel rules, this leads to $\kappa = 1$:

$$\kappa = \frac{A + 0}{A} = 1 \quad (23)$$

Using (17) and $\kappa = 1$, (21) becomes

$$\dot{A}(t) = (\beta i_A - \lambda)A(t) - (\beta i_L - i_R)R(t) \quad (24)$$

The right term in (13) differentiated becomes simply

$$\dot{L} = \dot{R} \quad (25)$$

In this case all new money is created via government spending – no new money is created via bank lending. Thus the expression often used by the proponents of a 100% reserve system: "money is spent, not lent, into existence".

Equation (22) now becomes

$$\dot{A}(t) = gA(t), \text{ with } g = \beta i_A - \lambda - \theta(\beta i_L - i_R) \quad (26)$$

We observe that A and L growth will be slower, *cet. par.*

4 Debt crisis?

The aggregate debt service burden on firms and households also grows at the rate g with the above model,

$$(i + r)A(t) = (i + r)A_0e^{gt}, \quad (27)$$

Money stock L grows at the same rate. Introducing money velocity v [$1/y$], we have

$$Y = Lv \quad (28)$$

Assuming that v is fairly constant², nominal GDP, Y [$\$/y$], also grows at the rate g . Then debt (burden) growth and output growth is a perfect side-by-side race. Abstracting from possible inflation issues, this is a harmoniously developing monetary economy. The model at this stage does not allow a scenario where debt and the corresponding repayment and interest burden grow faster than money stock and output.

But debt crises occur in the real world. The model should be modified to account for this. We will focus on the phenomenon of debt persistently increasing more than GDP, which actually has occurred in OECD countries, and which is possibly the most fundamental (more basic than the housing bubble) cause of today's financial crisis. See figure 1.

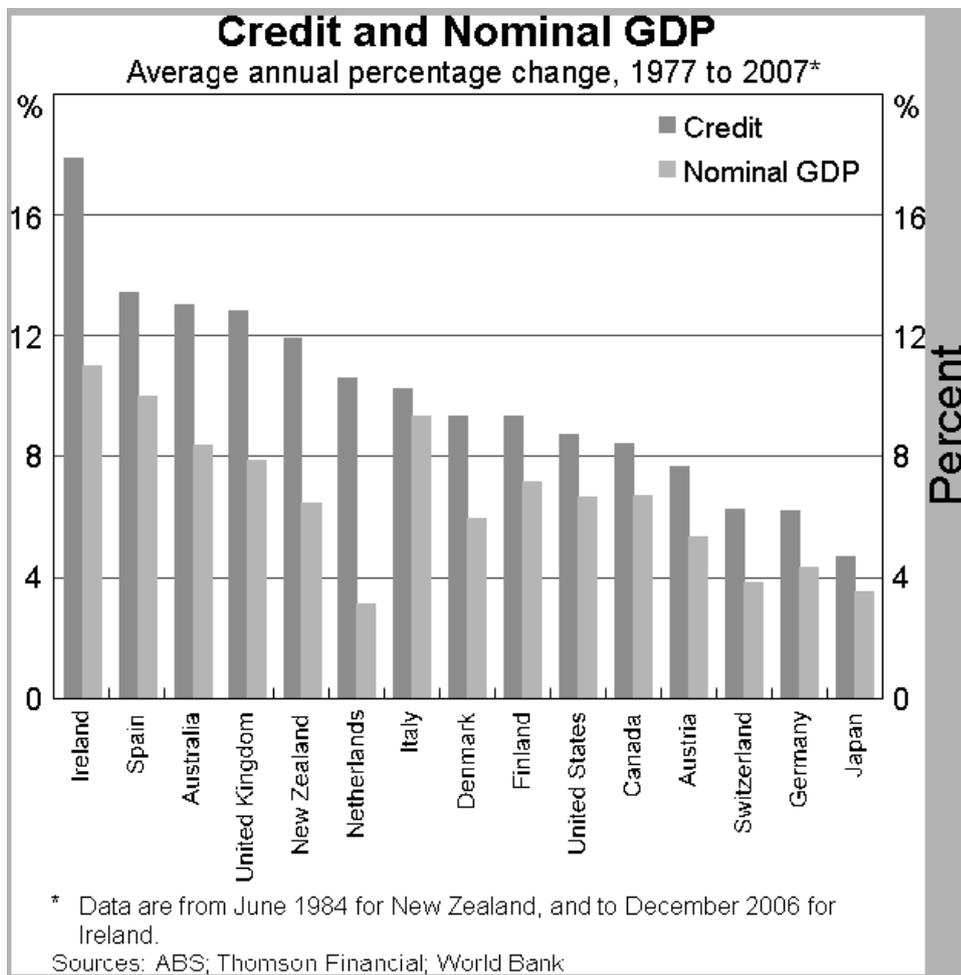


Figure 1: Debt outruns GDP in OECD countries (courtesy: Reserve Bank of Australia)

We introduce an alternative type of lender which has the property that *its assets may accumulate without creation of net credit money*: assume a “Moneylender” operating in parallel with the Bank. We define the Moneylender as an aggregate, consisting of – among others – investment banks and

² v is a behavioural variable for agents in the economy. It is an expression of confidence and will decrease sharply when the economy is impacted by a negative shock, like a stock market crash or a financial crisis. This leads to decreased spending, lending and investment and may set in motion a dangerous downwards spiral where v decreases further.

funds, which borrow money and then lend (re-invest) this money at higher interest/return rates. In the Moneylender category we may also include non-bank agents that receive returns on their investments (property owners, shareholders).

The “Bank” and “Moneylender” are both aggregates. Transactions within each aggregate net to zero. But the Moneylender have an aggregate deposit with the Bank. The Moneylender does not create deposits (money), since the borrower’s increased deposit is canceled by the Moneylender’s decreased deposit – as opposed to the Bank, which creates net deposits, cf. (9). When loans are issued by the Moneylender, debt grows but money does not.

We develop the model as follows:

$A(t), L(t)$ = assets, liabilities as already discussed. L is the aggregate liabilities of the Moneylender, but not money

i_A = interest rate on assets (= loans), similar to the Bank

i_L = interest rate on liabilities, i.e. on the Moneylender’s debt, $i_L < i_A$.

λ = the Moneylender’s loss rate; a flow $\lambda A(t)$ is written off due to borrowers defaulting, as in the Bank model.

Other parameters have the same meaning as in the Bank case. The capital/asset ratio κ is also here kept constant, so that the Moneylender’s liabilities grow proportionally with assets. We have $L = (1 - \kappa)A$, from (1). This decides the net borrowing of the Moneylender. Since there is no minimum κ for the Moneylender mandated by the government, the only thing that keeps the Moneylender from operating with a κ very close to zero, is its evaluation of risk. A common concept used is gearing, which we call ϕ . We have

$$\phi = \frac{L}{A - L} = \frac{(1 - \kappa)A}{A - (1 - \kappa)A} = \frac{1 - \kappa}{\kappa}, \text{ or } \kappa = \frac{1}{1 + \phi} \quad (29)$$

We note that for small κ , ϕ is essentially its inverse. A moneylender with a gearing of 30 (not uncommon) has a capital/asset ratio a bit above 3%.

We will now develop the growth model for the Moneylender. We assume the Moneylender holds no money, so that any money borrowed or received (as part of interest income or repayment) is immediately lent³. The Moneylender’s profit flow is, similar to the Bank case,

$$\beta [i_A - i_L(1 - \kappa)] A = \beta i A, \text{ where } i = i_A - i_L(1 - \kappa) \quad (30)$$

The lending flow from the Moneylender is the sum of its profit flow and its net borrowing flow which it passes on as new loans (“net” in the sense: difference between borrowing flow and repayment flow to creditors). The profit flow plus the net borrowing flow minus losses on loans must equal the assets increase rate, \dot{A} . We have

$$\beta i A + \dot{L} - \lambda A = \beta i A + (1 - \kappa)\dot{A} - \lambda A = \dot{A}, \quad (31)$$

leading to

$$\dot{A}(t) = \frac{\beta i - \lambda}{\kappa} A(t), \quad (32)$$

which is similar to (6).

κ may be chosen very small as mentioned above. By this the Moneylender, following (8), will have a steeper asset and profit growth than the Bank, except when or if the loss rate λ increases significantly. But in the long pre-crisis phase λ is small. Then the Moneylender will persistently increase its share of the financial market in relation to the Bank. This is a possible explanation for the disproportionate growth of aggregate debt related to credit money and GDP, and lays the ground for a grave crisis, even if it may arrive decades into the future.

³This assumption is acceptable for the discussion here. Introducing a buffer stock of money in the Moneylender model does not change long-range accumulation dynamics.

5 Banks selling loans onwards

We have discussed the case where the Moneylender borrows to extend loans. Another common phenomenon in today's financial environment is when a bank sells an existing loan to a moneylender. We shall develop a simple model for this, and discuss what sort of incentives there are for such activity.

We disaggregate the Bank model, so that from now on we are considering an individual bank. This is necessary since a reserve (HPM) increase to one bank is accompanied by a corresponding decrease for another bank – abstracting from government net spending or taxation, and from CB open market operations. The question to be examined is whether a bank – abiding by a Basel-type capital/asset requirement – may achieve a comparable growth in profit flows by holding a certain share of its assets in the form of lower-yield reserves. We assume that such reserves are acquired by selling loans. We have the following entities:

$R(t)$ = the bank's reserves = the bank's deposit with the CB

$\tilde{A}(t)$ = the bank's total financial assets = $A(t) + R(t)$, where $A(t)$ = all other financial assets than reserves

$\tilde{\kappa}$ = an “equivalent” minimum capital/asset ratio [], explained below, $\tilde{\kappa} < \kappa$

i_R = interest rate on HPM to banks from CB [1/y]

l_1 = flow of new bank loans sold on to the Moneylender []; $0 < l_1 < l$

μ = share of notional loan value [], received for a loan sold on to the Moneylender, fees included, $0 \ll \mu < 1$. This implies that the Moneylender may get a rebate even when bank fees are included.

ρ : the bank is assumed to follow a strategy of keeping a constant ratio $R/A = \frac{\rho}{1-\rho}$, see (33) below. ρ is the HPM share of the bank's total financial assets \tilde{A} .

Using (13) and the above definitions, we have

$$\kappa = \frac{\tilde{A}(t) - L}{A + 0 \cdot R} = \frac{A + R - L}{A} = \frac{A(1 + \frac{\rho}{1-\rho}) - L}{A}, \text{ or } \frac{A - L}{A} = \kappa - \frac{\rho}{1-\rho} = \tilde{\kappa} \quad (33)$$

Compare this with (1). We have a decrease in κ to a lower minimum capital/asset ratio $\tilde{\kappa}$, as long as we confine ourselves to the regulatory requirements on the non-reserve part of assets A . $\tilde{\kappa}$ will be used as an intermediate parameter which will be dispensed with later on. From (33) we have

$$L = (1 - \tilde{\kappa})A \quad (34)$$

We will now do a similar, but somewhat more complex, derivation as that leading to (7). The differential equation for non-reserve-asset change is now

$$\dot{A} = (l - l_1) - \lambda A - rA \quad (35)$$

The differential equation for liability change is

$$\dot{L} = l - rA - \beta iA \quad (36)$$

where we have again introduced an i ,

$$\beta iA = \beta(i_A A - i_L L) = \beta[i_A - i_L(1 - \tilde{\kappa})]A \quad (37)$$

For reserves R we have

$$\dot{R} = \mu l_1 + \beta i_R R = \frac{\rho}{1-\rho} \dot{A} = \mu l_1 + \beta i_R \frac{\rho}{1-\rho} A \quad (38)$$

which may be solved for l_1 ,

$$l_1 = \frac{\rho}{(1-\rho)\mu} (\dot{A} - \beta i_R A) \quad (39)$$

We substitute (34) and (37) into (36), and subtract both sides of the result from (35). This gives

$$\tilde{\kappa}\dot{A} = (\beta i - \lambda)A - l_1 \quad (40)$$

We substitute (39) for l_1 and $\kappa - \frac{\rho}{1-\rho}$ for $\tilde{\kappa}$, and solve for \dot{A} ,

$$\dot{A} = \frac{\beta(i + \frac{\rho}{(1-\rho)\mu}i_R) - \lambda}{\kappa + \frac{\rho}{1-\rho}(\frac{1-\mu}{\mu})}A \quad (41)$$

which has the solution

$$A(t) = A_0 e^{g_2 t}, \quad (42)$$

where we have again introduced an aggregate assets growth rate

$$g_2 = \frac{\beta(i + \frac{\rho}{(1-\rho)\mu}i_R) - \lambda}{\kappa + \frac{\rho}{1-\rho}(\frac{1-\mu}{\mu})} \quad (43)$$

A_0 is the value of the bank's non-reserve assets at $t = 0$. Note that l_1 has been eliminated in the process and thus plays the role of intermediate variable. This is a consequence of the model and the assumptions made about the other parameters. l_1 may be calculated by substituting (42) into (39)

Total assets have the same growth rate and – using (33) – follow the growth equation

$$\tilde{A}(t) = A_0(1 + \frac{\rho}{1-\rho})e^{g_2 t} = A_0 \frac{1}{1-\rho} e^{g_2 t} \quad (44)$$

Equation (43) is fairly complicated, so we will discuss it based on the graphs in figure 2 next page. We use the parameter values (12), with additional parameters chosen as

$$i_R = 0.03, \quad \rho \text{ in the interval } [0.01 \ 0.5], \quad \mu \text{ in the interval } [0.3 \ 0.99]. \quad (45)$$

We observe from the graphs that above a certain and relatively low value of μ (the value may be shown to be

$$\mu = 1 - \frac{\kappa\beta i_R}{\beta i - \lambda}, \quad (46)$$

which is 0.84 using the values (12)), the asset growth for the bank is now steeper than for the case with no selling of loans onwards; we have $g_2 > g$. Furthermore, this bank gains a higher-quality asset portfolio, since a share of its assets carry no risk. In a situation with increasing risk (i.e. λ is on the rise, or expected to rise), this is an added incentive.

We conclude that a bank, due to the rule of zero weighting of reserves in the capital/asset ratio denominator, is given a special incentive to sell its extended loans onwards. In the aggregate however, all banks cannot do this due to reserves being a limited resource. For the Moneylender, the incentives are that loans are offered in a finished package and the loan purchase rebate, which is here expressed by the parameter μ being < 1 . Thus both parties have incentives.

6 Conclusions

We have, based on a few generic and simplified models, tried to chart the basic mechanics of debt and money growth. A clear understanding of this is necessary to enable meaningful discussion of policy proposals related to stabilising financial systems.

We draw the following conclusions:

- Under today's Basel regime, credit money grows endogenously, at an exponential rate. This crucial fact should be recognised.
- Debt build-up at a steeper rate than GDP should be avoided, and curbed through regulatory measures.
- Debt creation by non-bank financial institutions is dangerous in the long run since money is not created along with such loans.

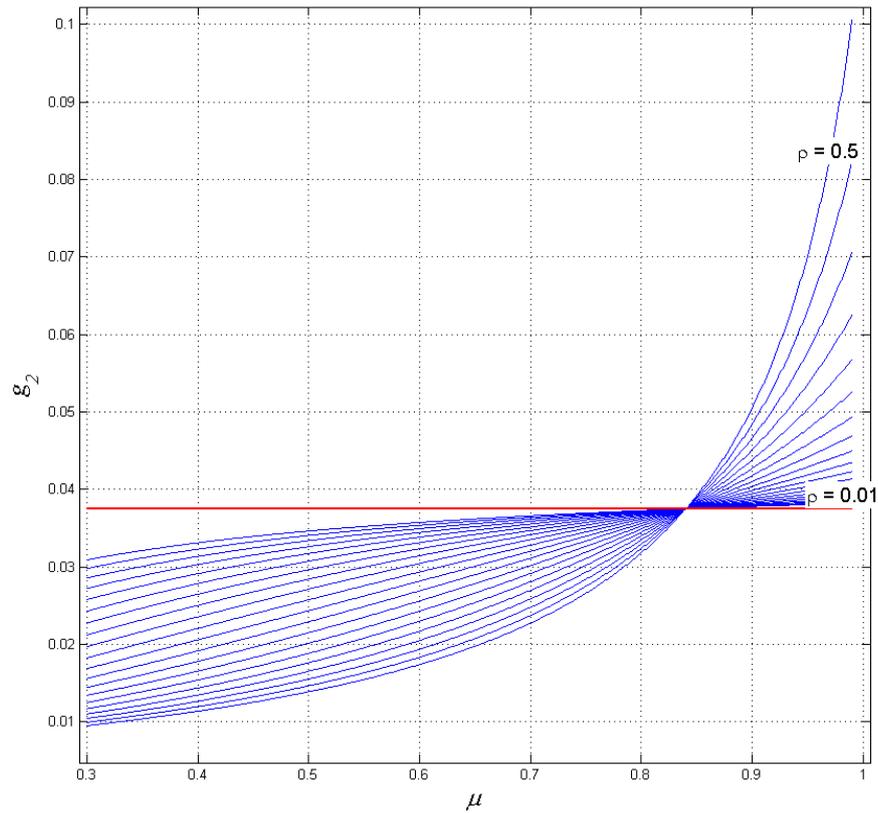


Figure 2: Asset growth rate g_2 as a function of μ and ρ . The horizontal line corresponds to g in (8)

- The required minimum capital asset ratio for banks may be used to control debt growth and could be increased from today's low value. But it can only be changed gradually – it cannot be employed as a short-term regulating instrument.
- Fiscal policy in the form of persistent deficit spending is necessary in an economy where nominal GDP grows. The deficit flow may be varied around its growing exponential reference path and by this also function as a short-term regulating instrument.
- The 100% reserve requirement proposal should be seriously discussed. Such a system will give the government a very direct input via its deficit spending, for regulating money growth.
- Interest rates are not very potent as instruments for regulation. They should instead be kept low and not vary much.
- The extending of bank loans and then selling them to non-bank financial institutions should be curbed.