

FINANCIAL STABILITY AND MONETARY POLICY – A FRAMEWORK

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Abstract

The paper presents a stylised framework to analyse conditions under which monetary policy contributes to amplified movements in the housing market. Extending work by Hyun Shin (2005), the paper analyses self enforcing feedback mechanisms resulting in amplifier effects in a credit constrained economy. The paper characterizes conditions for asymmetric effects, causing systemic crises. By injecting liquidity, monetary policy can prevent a meltdown. Anticipating such a response, private agents are encouraged to take higher risks. Provision of liquidity works as a public good, but it may create potential conflicts with other policy objectives and may give incentives to build up leverage with a high systemic exposure to small probability events.

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1. Introduction

Monetary Policy has been extremely successful during the past 15 years: Worldwide, consumer price stability has been reduced steadily during that period; inflation seems to be well under control. Judging by the criterion of fighting inflation, the performance of central banks has been stunningly impressive. Whereas for a long time they have been accused to suffer from the problem of dynamic inconsistency (the temptation to give in to incentives to carry out surprise inflation), the credibility of central banks now seems to be at their highest level. Following the advice of modern macroeconomic theory which provides a sound welfare theoretical framework for price stability, most modern central banks try to stabilise the price level by steering aggregate demand via changes in nominal respectively real interest rates. The New Neoclassical Synthesis (see *Michael Woodford 2003*) provides a well established framework for this way of monetary policy, pointing out the crucial role of commitment in order to effectively influence long term real interest rates by signalling in advance the intended path of nominal rates. According to prominent proponents of this framework like Woodford, money supply plays no significant part in that context.

But just at a time when central bank practise seems to converge with theory, there is increasing concern among practitioners that an excessively generous provision of liquidity contributes to excessive asset price movements (increases in equity and housing prices) endangering financial stability. The fear that loose monetary policy contributes to a rise in asset price with the risk of a serious breakdown poses a new challenge for monetary policy. The paper tries to sketch a macro framework to think about the impact of stability concerns on monetary policy. As an extension of recent work by *Hyun Shin (2005)*, it provides a stylized model as a base for understanding the relation between monetary policy and financial stability. The model demonstrates that recent financial innovations may have made financial markets more efficient on average, but they are likely to result in more drastic failures if things go really wrong. Public provision of liquidity by central banks in periods of financial distress can prevent inefficient liquidation; but it may aggravate the problem: Relying on support in times of financial distress will encourage leveraged institutions to engage in even greater risks.

During the last decades, a surge of innovations in the theory of finance and unprecedented growth in information technologies expanded dramatically the ability of the financial sector to spread risks. One might conjecture that the evolution towards more efficient and globally integrated financial markets makes the world a safer place. Recent trends in financial innovation, including the substantial expansion of access to consumer credit and the capacity for homeowners to borrow against the equity in their homes, the greater use of financial instruments for transferring and mitigating risk – all these features seem to move financial intermediation closer towards the neoclassical paradigm of smooth and frictionless markets as modelled a long time ago in the Arrow Debreu paradigm.²

But even though recent advances in information technology enlarge the scope for risk sharing and so contribute towards smoothing and absorbing real shocks in normal times, there is a crucial difference to the paradigm of frictionless markets: Incentive problems prevalent in inter-temporal delegation prevent the implementation of standard contingent contracts. It is well known that the threat of inefficient liquidation present in standard debt contracts may provide an adequate incentive scheme in the presence of asymmetric information. The use of debt contracts allowing for inefficient liquidation in some contingencies gives incentives to report correct information about the true state of the world. More generally, a fragile capital structure is meant to encourage conservative risk attitudes (see *Diamond/Rajan 2005*). Informational frictions also motivate the use of high powered contracts. Managers rewarded by performance related payments have an incentive to engage in a high leverage ratio, even if this runs the risk to overemphasise short term concerns. When paid according to relative performance, managers may engage in herding behaviour.

Debt contracts provide powerful amplification mechanisms: Changes in current or expected monetary policy, by affecting asset values, have a direct impact on balance sheets of financial institutions. But the change in balance sheet conditions leads to responses aggravating the initial impact on asset prices. Since *Bernanke/Gertler (1989)*, it is well known that balance sheet effects

² See *Alan Greenspan (2005)*: "Innovation has brought about a multitude of new products, such as subprime loans and niche credit programs for immigrants. . . . Where once more-marginal applicants would simply have been denied credit, lenders are now able to quite efficiently judge the risk posed by individual applicants and to price that risk appropriately. These improvements have led to rapid growth in subprime mortgage lending . . . fostering constructive innovation that is both responsive to market demand and beneficial to consumers."

may aggravate fluctuations. High asset prices raise the value of collateral and so lower the cost of financing additional investment. This financial accelerator may cause pro cyclical feedback effects. More efficient instruments to assess the market value of financial claims allow for a much speedier transmission of asset price movements into balance sheets, resulting in stronger feedback effects. In itself, this need not be a matter of concern: Monetary policy could comfortably rely on more powerful transmission mechanisms. As long as the central bank is aware of amplified responses, it can dampen volatility efficiently. By fine tuning interest rate movements, amplification effects are smoothed, allowing for effective stabilisation policy.

The key problem, however, is a crucial asymmetry: under certain conditions, a fall in asset prices, by forcing inefficient liquidation resulting in the breakdown of key financial institutions, may have dramatic repercussions on the whole economy. So there is the danger that, beyond some threshold, the virtuous cycle turns into vicious cycle – the risk of a financial meltdown. The recent trend towards securitisation, at first sight, seems to get around some of these problems, shifting risks towards long term investment institutions with highly diversified portfolios. So risks should to be passed on to those who have the best abilities to cope with them, reducing the need for inefficient liquidation. It turns out, however, that exactly those highly leveraged institutions which are issuing these securitised papers usually increase their exposure to systemic risk (for empirical evidence, see *Franke/Krahen* 2005). Securitisation has a stabilising impact with respect to systemic risk only if that risk is shifted towards non-leveraged agents. It seems, however, that a high share of the most risky portion of the transactions initiated by leveraged financial intermediaries is not diversified away but kept within the leveraged industry. Thus, the shift towards more market oriented financing runs the risk to create a false sense of complacency.

Under normal conditions, the incentive mechanisms of debt contracts help to implement a smoother, more efficient allocation. They work as a powerful disciplinary device in the presence of idiosyncratic risk. In contrast, in the face of aggregate shocks, there are good reasons to try to prevent inefficient liquidation by providing sufficient public liquidity: as long as these shocks cannot be diversified and are not subject to moral hazard concerns, injection of liquidity works as a public good (see *Holmström/Tirole* 1998 and *Goodhart/Illing* 2002). The simple distinction between idiosyncratic and aggregate risk, however, becomes blurred in the context of fire sales: When the stability of large leveraged institutions is at stake, the disciplinary device of default, by triggering fire sales, might result in a financial meltdown.

The non-linearities involved in times of crises are likely to motivate asymmetric reactions of monetary policy. Private agents, anticipating such an asymmetric response, may be encouraged to take excessive risks, thus building up stronger imbalances and so aggravating the underlying asymmetry (see *Illing* 2004). In order to prevent excessive risk taking, the central bank may be inclined to commit itself not to follow an asymmetric policy. But in view of the social costs involved in times of financial crisis, such a commitment hardly seems to be credible. Thus, the issue of dynamic inconsistency for central banks comes back in a new context, now being based on concerns about financial stability. The problem is not that firms will build up excessively high individual leverage positions, but rather that leverage will exhibit a high systemic component: Managers have strong incentives to engage in similar trading strategies creating high systemic risk exposure for small probability events.

Given the non-linearities, optimal second best policy is likely to be characterised by trying to prevent the building up of financial fragility rather than engaging in an extremely costly commitment not to intervene when faced with the risk of a financial meltdown. Moreover, additional instruments such as prudent regulation of financial markets may help to implement a policy closer to the first best outcome. Analysing these issues thoroughly would require a carefully modelling of the non-linearities involved in a dynamic context. The present paper is just a first step: it tries to sketch a framework for a tractable macro approach taking into account systemic risk, focussing in section 3 on characterising conditions creating the asymmetry between booms and busts.

The next section presents the model of amplifier effects as developed by *Shin* (2005). It essentially models a highly stylized specification of a bank's balance sheet channel. The incentive of bank managers to maintain some minimum level of leverage can create a positive feedback between asset prices and lending. The market value of banks loans is a function of the price of the underlying asset. A higher market value improves the bank's balance sheet. Attempting to restore leverage, the bank is willing to expand its deposits in order to increase its lending. The increase in lending to the young drives up the price of the underlying asset. This way, an initial increase in the market value of loans will be reinforced by feedback mechanisms. Fundamental price, creditworthiness and the level of debt are interrelated. So, a lower interest rate driving up the market value of loans will result in a property boom.

As argued by Shin, capital adequacy requirements have the reverse effect on the way down: The incentive to maintain some minimum level of capital adequacy creates a feedback mechanism between falling asset prices and reduced lending. The attempt to liquidate assets in order to fulfil some preset equity ratio drives down asset prices, reducing the market value of loans. Thus, it may reinforce the fall in asset prices. In that sense, as *Shin (2005)* suggests, “*booms can be understood as a mirror image of liquidity drains.*”

But despite the formal equivalence of the mechanism, there are important differences on the way up and down in an economy with market imperfections: Default forces inefficient liquidations. In the stylized model considered here (a pure endowment economy), this is captured by a redirection of assets to agents which have a much lower valuation; in general, as a straightforward generalisation, forced liquidation will also have repercussions on real production.

The present paper focuses on characterizing conditions for asymmetric effects and analyses the implication for monetary policy. Section 3 works out as key criteria for financial fragility: a) the extent of debt exposure (in particular of financial intermediaries); b) the degree of illiquidity and c) the nature of contracts (fixed nominal claims). It shows that if the required capital adequacy ratio is less than the inverse of the desired leverage ratio plus one, bank equity provides a cushion against small shocks to the economy. As long as only a small share of mortgage holders is defaulting, losses will be absorbed by the erosion of bank equity. For large shocks, however, banks are forced to liquidate assets in order to restore capital adequacy. With assets being illiquid, fire sales may wipe out bank's capital and lead to a breakdown of financial intermediation.

To some extent, new financial instruments (like securitisation) mitigate the asymmetry of the effects: losses arising from the default of mortgage holders simply drive down the market value of the securitised loans held by pension funds. As long as this fall in market value does not affect the solvency of leveraged institutions, risks are spread more widely, no longer being concentrated in the banking sector. But due to problems of asymmetric information, usually the issuing institutions, being highly leveraged, let it be banks, hedge funds or Freddie Macs, keep the most risky tranches of the loans they initiated. So at some point, when low event risks materialise, fund managers will be forced to minimise losses by selling bad loans. Thus, the trigger mechanism of fire sales is bound to set in again, now even more forcefully.

2. Amplifying effects on credit constrained markets

In a frictionless neoclassical world with a well functioning complete set of markets, shocks to the fundamental system are dampened by smooth price adjustments. But things can work quite differently in an economy with imperfect markets: in such an economy, amplifying rather than dampening effects may prevail.

Recent innovations seem to make financial markets more efficient. One might conjecture that, finally, reality comes closer to the perfect world designed by the theory of complete markets. Even though this intuition turns out to be confirmed in quiet times, some features suggest that in certain circumstances just the opposite may be true: smoother markets may create endogenous volatility. The underlying reason, pointed out by *Shin (2005)*, is fairly simple: more efficient instruments to assess the market value of financial claims allow for a much speedier transmission of asset price movements into balance sheets. In an economy with market imperfections, balance sheets work as an incentive device. Stronger movements of balance sheets may create feedback effects amplifying changes in asset prices. These amplifications can, under some conditions, endanger systemic financial stability.

Let us first consider how the value of assets is determined in a credit constrained economy with interconnected markets. What is the impact of exogenous shocks to the value of loans? Since balance sheets of agents are interconnected, the value of claims against one agent depends on value of her claims against others, creating endogenous counterparty risk. The default of one party may create contagion effects via spillovers on the balance sheets of others. With a network of interlinkages, the net exposure of the system is quite hard to assess. Recent work attempts to simulate domino effects on the interbank market. Usually, these simulations exhibit fairly little contagion (see *Eichberger/Summer (2005)*; *Upper/Worms (2003)*). But such simulations neglect an important feedback effect: The market value of illiquid asset depends on the selling pressure created by debt exposure: fire sales will dampen the price of the fundamental asset, creating externalities.

The market value of mortgage loans L_i held by some agent i depends both on the face value of these loans, the nominal debt D_i , and on the market value of his assets A_i . The market value of his assets is a function of the price of the underlying asset P and of the uncertainty in endowments w

required to repay the loans. But it also depends on the value of i 's claims against other agents in the economy, which again depend on the value of their claims against others and so on. Let us write the system of mutual claims, in a shortcut, as L . So we can write $A_i = A_i(L, P, w)$ and

$L_i = f(D_i, A_i(L, P, w))$. Aggregating across all agents, we get:

$L = f(D, A(L, P, w))$. In the financial system as a whole, the set of claims of all agents against each other cancels out. As shown by *Shin* (2005), under fairly general conditions the evaluation of debt in an interconnected system can be related to the value of the underlying fundamental assets in a straightforward way. Applying tools from lattice theory as in *Eisenberg/Noe* (2001), it can be shown that there exists a unique profile of debt prices for given interlinkage of debt. So there is a unique fixed point $L(D, P, w)$. Since the total value of claims against others cancel out against the total value of obligations to others, the equity value of the whole financial system depends only on the assets that are no obligation of any other investor. If the value of fundamentals is unchanged, the equity value of the whole system is constant. Using a comparative static result of *Milgrom/Roberts* (1994), it is straightforward to show that the equity value of the whole financial system is increasing with increasing value of fundamentals. Using this result, it is straightforward to analyse feedback effects caused by exogenous shocks in a simple stylized macro model.

Following *Shin* (2005), we consider an economy with residential property as the only real asset. There are young and old households in the economy. All agents are assumed to be risk neutral. But due to agency problems, risky wage income is not contractable. So young households are credit constrained: They can hold residential housing stock only if financed by borrowing from the banks. Mortgages have to be collateralised. The assets of young households consist of their property, while the mortgage loans to the banks are their liabilities. The difference is their net worth.

Old households are assumed to have no liabilities. Their net worth consists of holding property and deposits (short term claims) at banks. They also own the banks equity. Starting from some initial distribution of property between young and old, there is an upward sloping supply curve of the old for selling property. Housing being an illiquid market, owners are willing to buy additional housing only at much lower prices than they are willing to sell. This endowment effect arises naturally from asymmetric information: if the owner of the house has informational

advantage about characteristics and quality of the property, potential buyers, fearing adverse selection, are prepared to buy only at a discount (for a formalisation, see *Illing 1992*). So there is a kink in the net supply curve of the old at the endowment point (see figure 1). The fact that housing is an illiquid market (the resale value being much lower) is a crucial element in creating asymmetric effects.

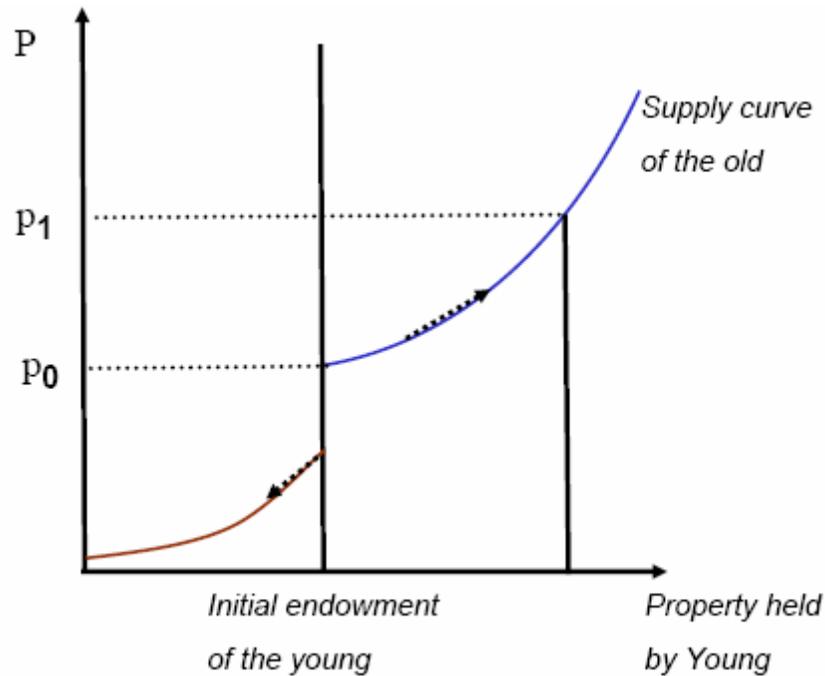


Figure 1

Kinked net supply curve of property

For simplicity, all old are assumed to have a lower willingness to pay for housing than the young (due to the fact that non-contractable consumption value of owning property is higher for those with a longer life span). So in the absence of credit imperfections, a transfer of all property from the old to the young would be efficient. But since the young are credit constrained, they can buy housing only against collateral. Due to credit constraints, banks willingness to lend is based not only on the expected ability of the young to service debt payments (the young's future expected cash flow), but also on the value of property P . If, for some reason, there is an increase in the price of property, banks are willing to engage more strongly in selling mortgages, the value of collateral D being higher. Therefore, with an increasing value of the collateral more young are in a position to buy more housing against mortgage, shifting effective demand upwards. Note that

the induced transfer of housing from old to the young is not, as claimed by *Shin* (2005b), simply a redistribution effect – a shift *within* the Edgeworth box. Since the young have a higher willingness to pay for housing, this movement results in a Pareto-improvement in a credit constrained economy. So rising asset prices may result in a more efficient allocation. The key point, however, is that, when bad shocks occur, this improvement may not just be reversed, but the economy is likely to end up in a much inferior allocation (see section 3 below).

Consider now more closely the banking sector, intermediating between the old and the young. Banks sell mortgage loans to the young, financed by deposits from the old. Let L be the market value of loans. Loans being collateralised, the market value is increasing in the price of property P (see $L(P)$ in figure 2). $L(P)$ is strictly concave since the market value cannot exceed the face value of the loan.

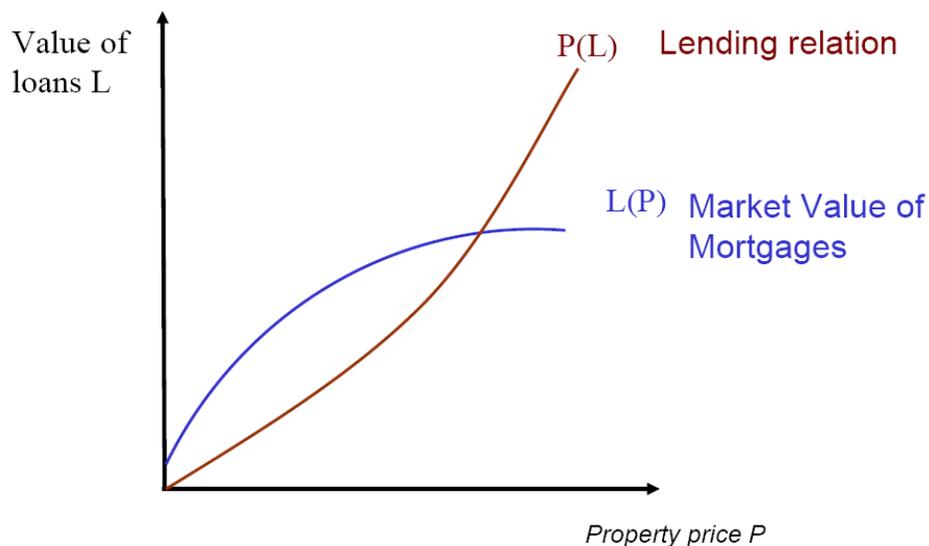


Figure 2

Feedback between market value of loans and property price

The objective of bank managers is to maximise the rate of return on equity of their shareholders (the old). When the market value of loans L goes up, the equity to debt ratio is improving, so reducing the leverage position. With improved bank’s balance sheet, bank managers are willing to extend the provision of loans to the young. This will be true in particular if managers, being

responsive to short term incentives, attempt to restore their initial leverage position. So the amount of credit provided – the face value of debt - is rising in the market value of loans $D(L)$. The induced higher effective demand of the young drives up housing prices P . Higher housing prices raise the market value of loans. Again, balance sheets improve and so leverage is reduced, starting the circle again. The balance sheet channel results in a positive feedback, represented by the upward sloping curve $P(L)$ in figure 2. Market equilibrium is characterised by the intersection of the $P(L)$ and the $L(P)$ curve.

Two features are the key driving forces for the positive feedback mechanisms presented:

- 1) Higher property prices raise the market value of loans $L(P)$. In an economy where balance sheets are evaluated according to market prices, this is immediately reflected in higher net worth of the bank. But even under accounting rules relying on historic values, the improved balance sheet of the banks will be reflected in rising share prices and so an improved equity position.
- 2) The higher net worth induces banks to extend lending in order to extract higher profits. This drives up property prices, captured by the relation $P(L)$.

The $P(L)$ curve has a linear shape when bank managers try to keep some constant leverage position, being responsive to short term incentives. In that case, amplifier effects are particularly strong. More generally, managers will also take into account the increasing risk of default in their lending decisions and so use part of the improved balance position to increase precautionary liquidity holdings. In figure 2, $P(L)$ is drawn as a concave function in the relevant range. For a given risk of wage income, a borrower's default risk is increasing in the face value of debt D . Household i is able to pay back her outstanding debt in the final period only if $D_i(1+r) \leq w_i$. The higher the property price P , the higher the debt exposure of the marginal buyer, so the bank's incentive to increase lending even further will be dampened. Thus, for large enough L , increasing default risk of marginal borrowers makes the curve steeper. Willingness to increase lending is decreasing in the fragility of a bank (its exposure to the risk of bankruptcy of its borrowers). When deciding about its lending policy, however, each single bank ignores the externality imposed on the economy by its own lending decisions (the impact of its own lending on the property price P). In particular, when assessing its own liquidity position, it does not take into

account that by holding additional liquidity it confers positive externalities on other leveraged institutions: it would reduce the risk of a fire sale in case of a liquidity drain (see below).

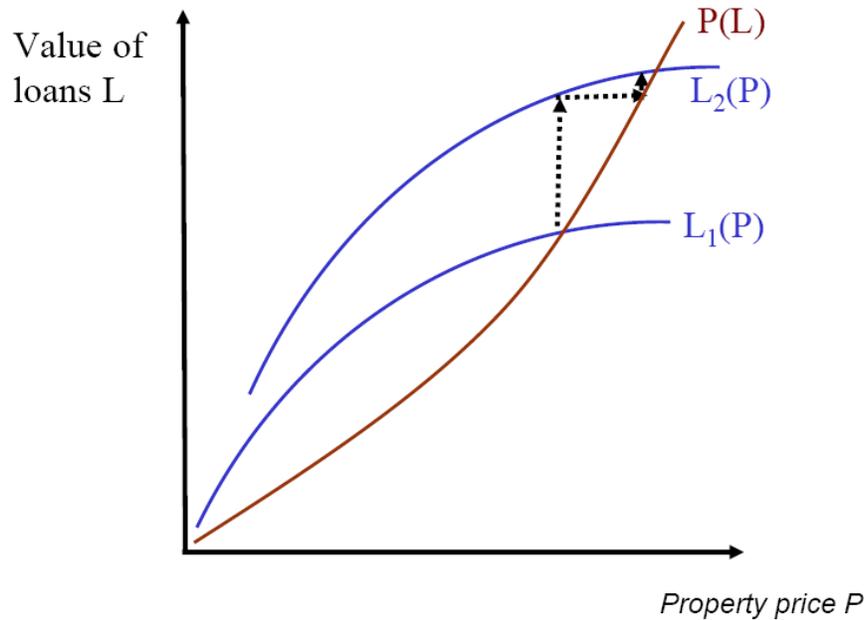


Figure 3

Amplification of lower interest rates

Now the stage is set to analyse the transmission mechanism of monetary policy in this stylised economy. Obviously, the positive feedback described above works as a powerful amplification mechanism. Consider a reduction in nominal interest rates. Since bank assets (collateralised mortgages) are of longer duration than their liabilities (deposits), the market value of mortgage values rises by more than the value of deposits when interest rates are falling. The $L(P)$ curve is shifted upwards (as in figure 3). So the net worth of the banking sector is raised, leverage reduced. Banks respond to the increase in net worth by extending mortgage lending to the young, driving up the price of housing, triggering the amplification mechanism sketched above.

Capital adequacy requirements create symmetric effects when asset prices are falling. So a tighter monetary policy will now result in an amplified fall of housing prices. Higher interest rates

reduce the market value of loans. Part of the mortgage holders may be driven into default. As long as the solvency constraint is satisfied for all banks, banks net worth will simply be partly eroded. But at some point, when shocks are large enough, the capital adequacy constraint becomes binding for a subset of banks. In that case, raising new equity would be extremely costly. Realistically, in that case the bank is forced to sell part of its holdings of property in order to regain solvency. Now, the reverse mechanism sets in: The attempt to liquidate assets in order to fulfil some preset equity ratio drives down asset prices, reducing the market value of loans even further. Concerted selling pressure leads to endogenous downward response of the price of the fundamental asset. Thus, it may reinforce the fall in asset prices.

The incentive to maintain some minimum level of capital adequacy creates again a feedback mechanism between falling asset prices and reduced lending. In that sense, as *Shin (2005)* suggests, “*booms can be understood as a mirror image of liquidity drains.*” But despite the formal equivalence of the mechanisms, there are important asymmetries on the way up and down in an economy with market imperfections: Default forces inefficient liquidations. Note that the higher the initial increase in asset prices, the higher will be the initial debt exposure of the young, and so the more likely the scenario of default. The next section analyses the impact of these asymmetries.

3. Asymmetries between booms and busts

As discussed in section 2, capital adequacy requirements can create amplifier effects, equivalent to propagation of lending booms via leverage, but in the reverse direction. Nevertheless, the impact on the whole economy may be dramatically different due to costly liquidation. In the stylized model considered here (a pure endowment economy), illiquidity is captured by a kink in the net supply curve of the old (see figure 1): they are willing to buy back housing from the young only at much lower prices than they are willing to sell. Let us now analyse the impact of tightening monetary policy after an extended period of low interest rates. Assume that initially, lax monetary policy contributed to a property boom, increasing the amount of property held by the young from point 0 to 1 in figure 4. Due to the higher collateral value of property as a result of lower interest rates, the young were able to increase their debt exposure. Being credit constrained, even the proportion of those already endowed with housing can take advantage of

lower interest rates both by refinancing (in the absence of prepayment penalties) and by using the increased value of collateral for mortgage equity withdrawals. In a credit constrained economy, the increase in property prices allows for a better smoothing of intertemporal consumption for those among the young holding property.³ But the face value of aggregate debt exposure $D(1+r)$ of the young is bound to increase despite low interest rates. Debt exposure is heterogeneous among the young: The marginal buyers of property, paying the highest price, are those most heavily indebted.

When paying back the credit in the final period, a young agent i can amortize her mortgages only if her wage income w_i is sufficient to cover her debt obligations including interest payments: $D_i(1+r) \leq w_i$. Wage income being stochastic, for a given realization of aggregate wage income, some proportion of the young population may be forced to default. If we assume, to simplify, that wage income is perfectly correlated among all young, those with highest debt exposure will default first. Tightening monetary policy will accelerate default: It raises the burden of those agents with adjustable-rate mortgages; higher interest rates, by dampening the economy, may also trigger a negative wage shock.

As long as only a small share of mortgage holders is defaulting, bank's losses will be absorbed by the erosion of bank equity (driving down the market value of loans). Bank equity provides a cushion against small shocks to the economy, as long as the inverse of the desired leverage ratio plus one exceeds the required capital adequacy ratio. The solvency constraint requires to keep the ratio of equity to market value above some imposed threshold value: $(L-DP)/L = E/L > e^*$ [with DP being banks debt exposure (deposits of old) and $E = L - DP$ as market value of equity]. Due to incentive mechanisms, the debt to equity ratio is likely to be kept above some threshold value (minimum leverage): $DP/E > 1^*$. As long as $e^* < e < 1/(1+I^*)$, shocks can be absorbed by fluctuations of bank equity.

³ In general, when there is heterogeneity among the young w. r. t. willingness to pay, rising property prices may crowd out potential housing demand by part of the population.

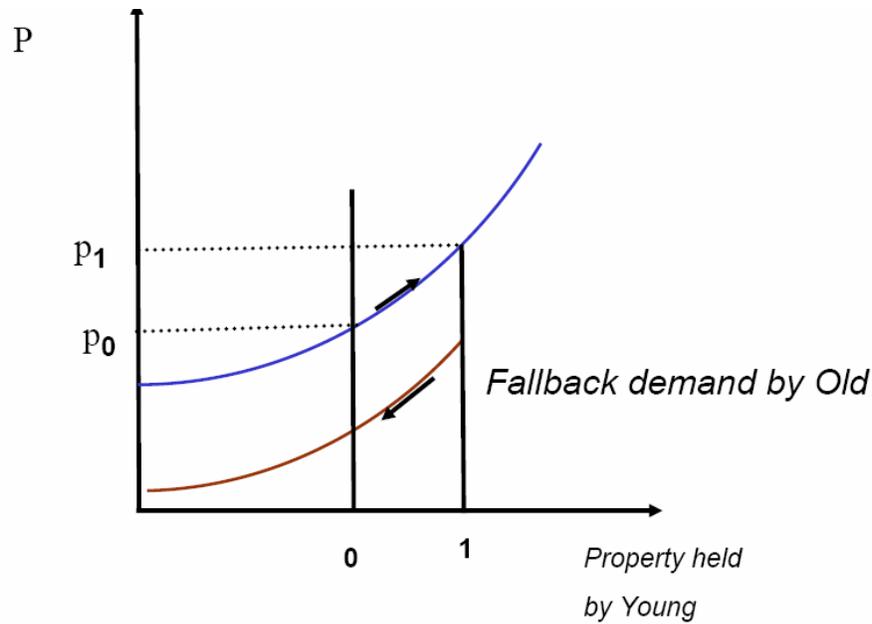


Figure 4

Asymmetries between booms and busts

For sufficiently large shocks, however, things are quite different: in that case, the market value of loans falls deep enough such that the capital adequacy ratio is violated. Now banks are forced to liquidate assets in order to restore their capital adequacy ratio. But assets being illiquid, this can be done only at a discount: The fallback price at which some old are willing to buy back property is below the market price (compare figure 4).

The dashed curve in figure 5 characterises for all property prices P the amount of property a distressed bank has to sell in order to fulfil capital adequacy requirements. If property prices fall dramatically, all of the banks assets have to be liquidated. At the initial property price P_1 , distressed banks are forced to sell a positive amount of property in order to fulfil the required ratio r^* (see figure 5). But the attempt to liquidate property results in a steep fall of property prices, reducing the market value of loans even further. Thus, banks are forced to sell even more property in order to restore capital adequacy; property prices fall even steeper, and so a vicious circle sets in. Rather than coming back to the initial point where the economy started at price P_0 , the fire sales forced by default may result in a dramatic redirection of assets to agents which have

a much lower valuation.⁴ They may wipe out all banks capital and lead to a complete breakdown of financial intermediation.

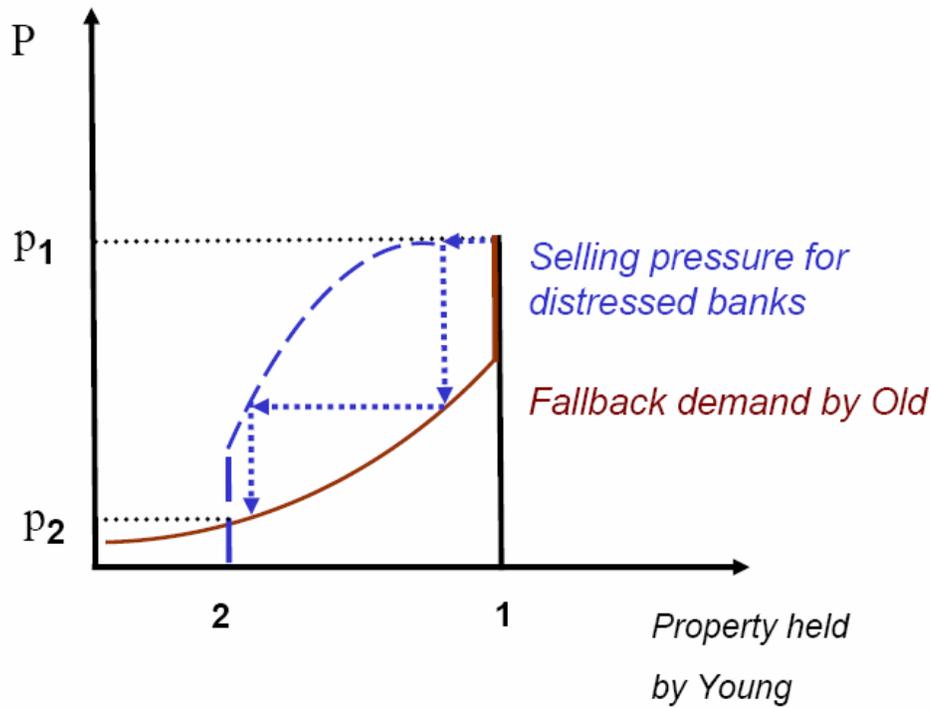


Figure 5

Fire sales with distressed banks

Several features are key ingredients required for triggering such a fire sale: (1) The higher the debt exposure in the economy, the higher the fragility of the economy. The initial boom in property prices creates high debt exposure for marginal buyers; similarly, mortgage equity withdrawals, even though allowing for a smoother consumption path, increase fragility. (2) Even though fixed-rate mortgages can mitigate the negative impact, rising interest rates are likely to make the economy more fragile. (3) The key driving force, however, is leverage of financial institutions. The higher the desired leverage, the lower is the cushion available to absorb shocks by financial intermediaries. The higher the leverage ratio, the more property distressed banks are

⁴ In general, as a straightforward generalisation, forced liquidation will also have repercussions on real production.

forced to sell. As figure 6 illustrates, the selling pressure for sound banks with low leverage is negligible, so in that case no equilibrium with forced liquidation exists.

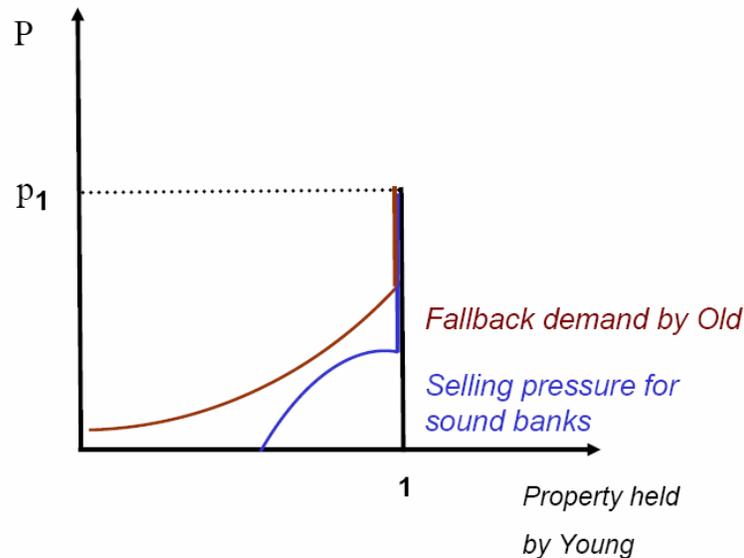


Figure 6

The case of sound banks

(4) Furthermore, the less liquid the assets are (the steeper the fall in property prices required to give the old incentives to buy back property), the stronger the amplification effect.

(5) Finally, a crucial part of the story is the nature of financial contracts: the old put (part of) their income from selling property in bank deposits with fixed nominal claims. If, instead, they would hold their claims as equity shares of the bank, they would share proportionally the losses in market value of defaulted loans, rather than triggering a fire sale with inefficient liquidation.

New financial instruments (like securitisation) appear to be a clever instrument to mimic such an efficient way of sharing risk between old and young. When securitised assets are held by pension funds instead of banks, losses arising from the default of mortgage holders simply drive down the market value of securitised loans held by pension funds. When the old hold contributed rather than defined benefit claims against the pension funds, they would directly participate in the market risk of loans. In that case, securitisation reduces the need for inefficient liquidation and

allows the separation of idiosyncratic and systemic risk. Fluctuations in asset prices caused by macro shocks are passed through to the final claimants in the economy (the old).

In view of this argument, it seems that institutions like Fannie Mae and Freddy Mac, by transforming risks in securities, help to limit the risk of fire sales. When banks are retaining just the first-loss piece but sell the senior tranches exhibiting extreme risk, securitisation allows to separate idiosyncratic from systemic risks, with extreme risks being borne by the holders of the senior tranches. This way, securitisation would be an effective way to index debt contracts against macro shocks (see *Hellwig* 1998). The problem is, however, that these highly leveraged institutions usually increase their exposure to systemic risk (see *Franke/Krahn* 2005).

A large share of the most risky tranches of the loans seems to be kept within the industry which initiated them. Part of the loan exposure is transferred to hedge fund clients with significant credit exposure to the originating bank. Furthermore, contracts may be incomplete and opaque, possibly forcing the initiator to buy back the securities under negative performance. So in the case of serious aggregate shocks, the economy will be even more fragile: As soon as managers try to minimise their losses by selling bad loans, again fire sales will be triggered. So again, at some point the trigger mechanism of fire sales is bound to set in – now even more forcefully.

The arguments presented in this section suggest that an evaluation of recent trends in financial innovations have to be evaluated carefully: on average, at least for small shocks, they allow for a relaxation of the frictions imposed in a credit constrained economy and so contribute to a more efficient allocation. In case of severe negative shocks, however, they may accelerate the need of fire sales with disastrous impact on the whole economy. So there is the danger that, beyond some threshold, the virtuous cycle turns into vicious cycle – the risk of a financial meltdown. The non-linearities involved suggest that monetary policy should intervene to prevent such undesirable events. They are likely to trigger asymmetric reactions of monetary policy: Given the high social costs involved in a systemic crisis, there is a strong incentive to lower interest rates whenever there is an imminent risk of fire sales, whereas there seems to be no reason to tighten monetary policy when asset prices are rising.

Private agents, anticipating such an asymmetric response, will be encouraged to take excessive risks, thus building up stronger imbalances and so aggravating the underlying asymmetry. Monetary policy works like a put option, encouraging banks to provide excessive lending even if

aggregate debt exposure is already high. Figure 7 illustrates this effect: As long as monetary policy does not intervene, banks will be reluctant to lend to borrowers with a high debt exposure in view of the implicit default risk. Thus, the inverse of the $P(L)$ curve will be rather inelastic (see the curve $P(L)_1$). In that case, fragile economies are not characterised by powerful amplifier effects; even a strong increase in market value will have hardly any impact on property prices. If, instead, monetary policy is expected to come to rescue in systemic crises, banks can safely discount default risk implied by increased lending. So whenever monetary policy reacts asymmetrically, the inverse of the $L(P)$ curve is more elastic (as $P(L)_2$ in figure 7), resulting in the strong amplifier effects described above even when the economy is very fragile.

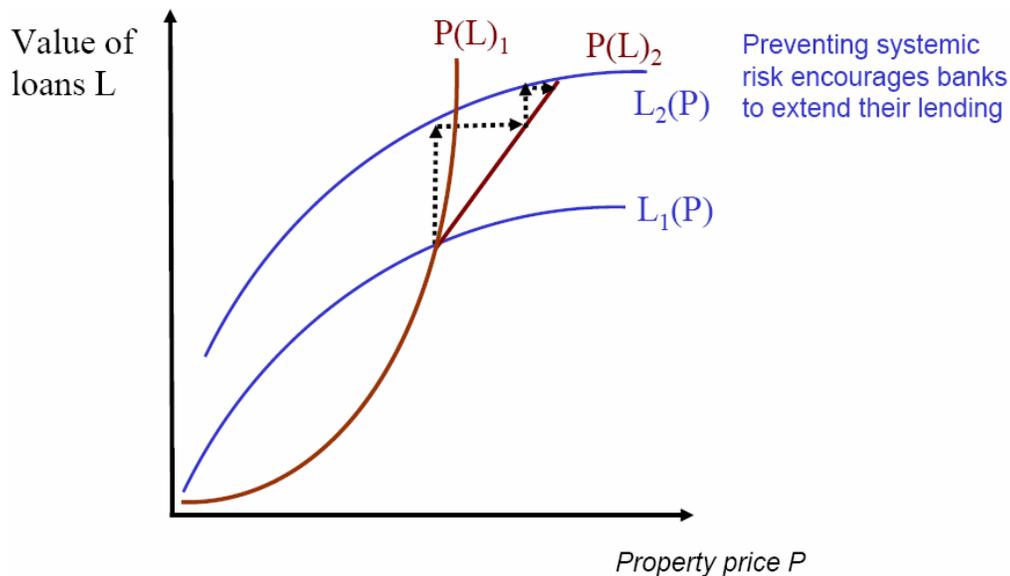


Figure 7

Asymmetric monetary policy as a put option

One has to be careful about evaluating the welfare implications of the higher fragility created. As long as central banks were able to steer the economy efficiently in times of aggregate crises, there would be no real reason for concern. After all, injection of public liquidity in the face of aggregate shocks works as a public good. The fire sale externality outlined above suggests that

private agents have insufficient incentives to provide the adequate level of liquidity: each agent does not take into account the positive externalities conferred on others by holding additional liquidity. Furthermore, for private institutions, there is no incentive to step in as efficient provider of liquidity in emergency cases. As shown by *Allen/ Gale (2005)*, since holding liquidity involves an opportunity cost and the suppliers of liquidity can only recoup this cost by buying assets at fire-sale prices in some states of the world, the private provision of liquidity by arbitrageurs will be inadequate to ensure asset-price stability. If the central bank, by injecting aggregate liquidity in emergency cases, is just correcting for this market failure, the perceived increase in fragility is not real; the higher risks incurred would actually be welfare improving.

There are, however, two problems with such a complacent view: First, the simple distinction between idiosyncratic and aggregate risk is no longer clear cut in the context of fire sales: When liquidity is provided whenever the stability of large leveraged institutions is at stake, the default mechanism cannot be an effective incentive device to discipline excessive individual risk taking by managers. The problem is not that firms will try to build up excessively high individual leverage positions, but rather that leverage will exhibit a high systemic component: Managers have strong incentives to engage in similar trading strategies creating high systemic risk exposure for small probability events.

Second, stability concerns may conflict with other policy objectives of the central bank. In view of financial stability issues, a central bank may hesitate to raise interest rates at a pace required to stabilise the economy efficiently (see *Stephan Sauer (2007)* for modelling this trade trade off). If rising rates runs the risk of endangering highly leveraged institutions, the central bank might be caught in an interest rate trap: concerns about financial stability may force the central bank to follow a path of disproportional gradualism. The policy of the Fed in 2004 might be seen as an instructive example (see *Illing 2005*). Encouraged by the Fed's public commitment to follow an extended period of calm policy by statements such as "*policy accommodation can be maintained for a considerable period*", worldwide many institutions built up similar leveraged positions during 2003. The extremely cautious Fed policy⁵ when tightening monetary stance since 2004

⁵ Consider Alan Greenspan's remark before the Joint Economic Committee, U.S. Senate on April 21, 2004: "*Rates must rise at some point to prevent pressures on price inflation from eventually emerging.*" This statement was accompanied by the hint that "*no increase is imminent,*" and similarly by a repeated statement of the Federal Open

suggests that the implementation of a sufficient increase in interest rates may have been delayed until the most precarious leveraged positions have been unwounded. In the presence of incomplete knowledge, central banks may be inclined to act cautiously. Given the asymmetries involved, they are likely to prefer to err in the direction of being too cautious rather than being too tough and so run the risk of a fire sale. In the same vein, during good times, they may have an incentive to raise interest rates above the level needed by stabilisation concerns aiming to have enough ammunition when things get worse. Again, stability concerns may conflict with efficient stabilisation policy.

In view of these risks, the central bank may be inclined to commit itself not to follow an asymmetric policy. But in view of the high social costs involved in times of financial crisis, such a commitment hardly seems to be credible. Given the non-linearities involved, optimal second best policy is likely to be characterised by trying to prevent the building up of financial fragility rather than engaging in an extremely costly commitment not to intervene when faced with the risk of a financial meltdown. Procyclical liquidity requirements could mitigate spillovers and so help to correct these externalities. To analyse this intuition, an extended model is required allowing for endogenous risk taking which will be left to future research.

Market Committee: *“The Committee believes that policy accommodation can be removed at a pace that is likely to be measured.”*

References:

- Allen, Franklin and Douglas Gale (2005), From cash-in-the-market pricing to financial fragility, *Journal of the European Economic Association* 3(2–3); 535–546
- Bernanke, B. and M. Gertler (1989) “Agency Costs, NetWorth, and Business Fluctuations” *American Economic Review*, 79, 14 - 31.
- Diamond, Douglas and Raghuraj Rajan, Liquidity Shortages and Banking Crises, *Journal of Finance* 60 (2), 615-647.
- Eichberger, Jürgen and Martin Summer (2005) “Bank Capital, Liquidity, and Systemic Risk”, *Journal of the European Economic Association* 3(2–3):547–555
- Eisenberg, L. and T. H. Noe (2001) “Systemic Risk in Financial Systems” *Management Science*, 47, 236-249.
- Franke, Günter and Jan Pieter Krahen (2005), “Default Risk Sharing Between Banks and Markets: The Contribution of Collateralized Debt Obligations”, CFS Working Paper 2005/06, Ifk-CFS Frankfurt
- Greenspan, Alan (2005), Consumer Finance, Remarks at the Federal Reserve System’s Fourth Annual Community Affairs Research Conference, Washington, D.C. April 8, 2005
- Goodhart, Charles and Gerhard Illing (eds.) (2002), Financial Crises, Contagion and the Lender of Last Resort: A Reader, Oxford University Press,
- Hellwig, M. (1998), Banks, Markets, and the Allocation of Risks in an Economy, *Journal of Institutional and Theoretical Economics*, 154, 328-345
- Holmström, Bengt and Jean Tirole (1998), Private and Public Supply of Liquidity, *Journal of Political Economy*, 106, 1-40.
- Illing, Gerhard (1992), “Private Information as Transaction Costs: The Coase Theorem Revisited”, *Journal of Institutional and Theoretical Economics* 148, 558-576.
- Illing, Gerhard (2004), “Financial Fragility, Bubbles, and Monetary Policy” in: Sinn, H.-W.; Widgrén, M.; Köthenbürger (Eds), *European Monetary Integration*, Cambridge, MA, MIT Press, pp 141 – 169
- Illing, Gerhard (2005) How to escape contagion in the interest rate trap, in: R. König/ H. Remsperger (Eds.), *Financial Stability and Globalisation*, Deutsche Bundesbank, Frankfurt 2005, 49-62
- Milgrom, P. and J. Roberts (1994), “Comparing Equilibria” *American Economic Review*, 84, 441-459.

- Sauer, Stephan (2007), Liquidity Risk and Monetary Policy, mimeo, LMU University of Munich
- Shin, Hyun Song, (2005a) “Risk and Liquidity in a System Context”, Working Paper, LSE
December 2005
- Shin, Hyun Song, (2005b) “Financial System Liquidity, Asset Prices and Monetary Policy” in:
'The Changing Nature of the Business Cycle,' Reserve Bank of Australia, 312-335
- Upper, Christian and Andreas Worms (2004), “Estimating Bilateral Exposures in the German
Interbank Market: Is there A Danger of Contagion?” *European Economic Review*, Vol.
48/4, 827-849.
- Woodford, Michael (2003), “Interest and Prices: Foundations of a Theory of Monetary Policy”,
Princeton University Press

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