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Banking strategy and credit expansion: a post-Keynesian approach

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This paper aims to clarify the relationship between individual banks and banking industry behaviour in credit expansion. The authors argue that the balance sheet structure of an individual bank is only partially determined by its management's decision about how aggressively to expand credit; it is also determined by the balance sheet positions of other banks. This relationship is shown explicitly by a simple disaggregation of the variables that enter into the economy-wide money multiplier. The approach taken here revives the multi-bank approach to banking analysis pioneered by Wallace and Karmel in the 1960s, which is particularly well-suited to integrating micro and macro levels in Keynesian banking analysis.

Key words: Banking behaviour, Banking firms, Business cycle, Credit, Post-Keynesian theory
JEL classifications: E12, E32, E44, G21

1. Introduction

This paper takes on two questions about strategic behaviour and systemic outcomes in banking. First, is there any connection between an individual bank's strategy and the behaviour of the banking system as a whole—and in particular, what are the macroeconomic effects of bank behaviour? Second, how does the stage of the business cycle affect banking strategy (and vice versa)? To answer these questions, this paper:

- Clarifies and extends a remark by Keynes in his *Treatise on Money*, concerning the relationship between individual-bank and banking industry behaviour in credit expansion.
- Explores how to integrate the micro and macro levels in bank behaviour so as to make explicit the mutual causality between banking-firm strategy and aggregate outcomes.
- Examines banks' strategic incentives in different credit-expansion environments, to develop a clearer understanding of how bank behaviour affects business-cycle dynamics.

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This paper shows that the bank's balance sheet is determined not only by its own strategic choices, but also by the decisions and balance-sheet positions of other banks, as stressed by Keynes (1960, published originally in 1930). Reviving an approach pioneered by Wallace and Karmel (1962), this paper makes these points by disaggregating the variables that enter into the simple money multiplier. This opens the way to an integration of the micro and macro levels in Keynesian banking-system analysis, and sheds light on the links between banking strategy and business-cycle dynamics.

2. Keynesian and post-Keynesian ideas about banking: what remains undone?

One of the most fertile fields of analysis opened up by Keynes and the post-Keynesian economists is the study of the relations between banks and economic activity. From the *Treatise on Money*, to *The General Theory*, to the subsequent controversy with Robertson and Ohlin, Keynes pointed out the importance of the banking system in supporting investment. Following Keynes, Minsky (1982, 1986) developed his financial fragility hypothesis. Minsky's writings highlight the relation between the banking system and the trend to financial fragility during the upturn of the business cycle, illustrating how crisis can occur as an endogenous result of these units' own economic dynamics.

Minsky's writings, and many others by heterodox and orthodox theorists, assert that banks are special, in that their activities are both crucial in the economy and non-substitutable with other economic units. This suggests that bank behaviour is important in macroeconomic outcomes; and this in turn poses an analytical challenge: how to connect micro and macroeconomic analysis.

Most studies in recent years have explored the role of bank behaviour in macro outcomes by investigating the actions of a representative bank. This is analytically attractive, as it suggests that insights from microfoundational frameworks can be generalised to the economy as a whole without taking on the distinct challenges of aggregate analysis.[1] One partial exception involves the recent literature on banking contagion effects, which has been spurred by recurrent global financial crises. Modelling contagion effects necessarily requires models with multiple banks. In most of the heterodox and orthodox work on contagion, multiple banks affect one another through linkages that involve either asymmetric information or perceived uncertainty.[2]

2.1 Keynes's ideas about banking

Abstracting from linkages that work through information and confidence channels, however, banks and bank strategies are linked through the very structure of credit creation. Keynes himself noted this connection.

Keynes never wrote an extended tract on banking. Nonetheless, his works over the years are littered with occasional comments and analyses of banks' behaviour. One of his later papers contains the comment that banks hold the key position in the shift of the economic system from a lower to a higher level of economic activity (Keynes, 1973). This point had not been developed much in the *General Theory* (GT). The GT presented a schema for

[1] Two well-known examples of microfoundational, representative-bank frameworks that are used to draw macroeconomic implications are Stiglitz and Weiss (1981) and Mankiw (1986).

[2] Allen and Gale (2000) and Kregel (1998) are representative papers on contagions in banking and financial markets, respectively emphasising how shifts in asymmetric information and in confidence in the face of uncertainty can lead to financial-market breakdowns.

understanding the extent of economic activity at any point in time, using a comparative static approach. The GT appreciated the impact of real time and uncertainty on decision-making, but paid little attention to the dynamics of movement through time. Discussions of financial issues in the GT thus focus on the links between the liquidity role of money, investment decisions and uncertainty.

What Keynes meant by his relatively cryptic post-GT comment is perhaps revealed in a passage in the *Treatise on Money* concerning banks' financing of investment activity. There, Keynes wrote that banks' volume of reserves largely depends on other banks' finance policies—that is, on the growth rate of other banks' loans. Consequently, an individual bank can grow much faster than other banks if it increases its market share of total banking-sector loans. But this bank's rapid-growth strategy will, at the same time, reduce its reserves and strengthen other banks' lending capacity by providing them with more available funds (free reserves). As Keynes (1960, p. 26–7) stated:

> There can be no doubt that, in the most convenient use of language, all deposits are 'created' by the bank holding them. It is certainly not the case that the banks are limited to that depositors should come on their own initiative bringing cash or checks. But it is equally clear that the rate at which an individual bank creates deposits on its own initiative is subject to certain rules and limitations; it must keep step with the other banks and cannot raise its own deposits relatively to the total deposits out of proportion to its quota of the banking business of the country. Finally, the 'pace' common to all the member banks is governed by the aggregate of their reserve resources.

This analytical point finds an echo in Keynes' famous comment that 'bankers would rather hang together than hang separately'. These interrelated points were registered well before the GT was written; and in any case, Keynes' post-GT comment about the role of banks in determining the level of economic activity does not refer back to them explicitly.

2.2 Post-Keynesian ideas about banking

The post-Keynesian approach to banking and financial intermediation views the banking system as a channel through which agents' perceptions of risks, and hence business-cycle fluctuations, both influence and are strongly influenced by non-probabilistic uncertainty. Current data influence the forecasts and confidence of bank and non-bank firms concerning returns from investment. In a monetary economy, even the best forecasts of the future provide agents with no degree of certainty about what decisions (made in advance of outcomes) will best reflect their preferences. Incorporating more data will improve forecast algorithms but not make them less uncertain; the data needed to make agents' forecasts more certain in an absolute sense simply do not exist.

Different perspectives over banks' role in an economy operating under uncertainty have emerged. In the theory of money endogeneity as developed by Moore (1988), Lavoie (1992), and Arestis and Howells (1996), banks accommodate the demand for credit by the non-financial corporate and household sectors. As long as central bank policy is expansionary, the banks' role is to serve as a reliable transmission mechanism for other sectors' consumption and investment spending.

Wray (1990) and Kregel (1997) develop models based more explicitly on Minsky (1982), which emphasise the banks' role in cyclical fluctuations. In their models, banks in uncertain environments base their decisions on conventions rooted in their histories with their customers and also on the average behaviour of other banks. The focus is on average bank behaviour, not individual bank strategy; in effect, all banks are implicitly understood to be following the same strategy vis-à-vis credit expansion. When the banking system as a whole expands credit in these models, each individual bank implicitly does so at the same rate. Because of this 'hang together' mentality, banks' behaviour tends to amplify the scale of economic upswings and downturns. Banks can, in these models, face liquidity shocks just as non-bank units can; and they can also be exposed to adverse conditions in their borrowing markets. When experiencing these conditions, banks contract their credit or slow its growth.[1]

Under either interpretation of banks' behaviour—as reliable transmission mechanisms, or as units sometimes constrained by liquidity risk—bank behaviour has the effect of widening cyclical swings. In the upturn, banks' accommodative behaviour—their willingness to make loans that increase other units' leverage, combined with their relative unconcern about liquidity risk—is a factor that increases cyclical volatility. Bankers' optimistic views about the viability of firms' debt structures, typical of a period of euphoria, leads them to increase their loans in response to firms' rising credit demand. In the downturn, the opposite sequence unfolds.

3. Bank strategic behaviour and financial fragility: a rudimentary approach

The literature summarised in Section 2.2 has not allowed for, nor paid attention to, the impact of differential bank strategies, either on banking-system or business-cycle dynamics. Both Moore's and Minsky's models focus on representative banks. This section introduces bank strategic behaviour over loan expansion and financial fragility. Section 4 traces out the implications of these strategic considerations for the banking system given banks' intertwined balance sheets and outcomes; section 5 then examines implications for overall business-cycle dynamics.

3.1 Bank strategic choice over credit expansion

Banking strategy is introduced here in a rudimentary way.[2] Suppose that there is an equal distribution of banks and of depositors across space in the economy; and suppose further that each bank makes loans primarily to a pool of borrowers located near its branch offices. If depositors earned a uniform return on their deposits, and faced transaction costs, they would place their deposit funds in the nearest bank branch.

If banks had no localised information about their borrowers, and were completely uncertain about the prospects of return on loan projects, then imitating other banks' loan-expansion behaviour—the hang together mentality—would arguably be the safest way for any one bank to compete with other banks, since it guarantees both market-share and institutional reputation. Under these assumptions about bank deposits and loan behaviour, if it were also assumed that each bank has the same number of branches, then all bank balance sheets would be identical.

However, bank strategic choice can lead deposit and loan volumes to differ from this benchmark. Here we define each bank's deposit base as equal to the deposits it receives on the basis of ongoing savings and transaction customer relationships. This deposit base is not identical for each bank: by the use of marketing, attractive deposit rates, and/or branch openings, any bank can increase its deposit market share.

[1] Davidson (1992) defines and discusses the concept of liquidity.

[2] Dymski (1988) introduced a banking model with two sectors pursuing different strategies vis-a-vis loan growth and liquidity risk; however, that model focuses only on sectoral interactions at an aggregated level, not on intra-systemic impacts of differing strategic choice (as the current paper does).

Loan growth also may differ among banks. We now suppose—and maintain throughout our discussion—that each bank has some localised information about its nearby borrowers, not shared with other banks, which suggests that each localised borrower pool has somewhat different risk levels.[1] This assumption of localised information about risk among borrowers, combined with some flexibility in deposit bases among banks, introduces a simple version of strategic diversity. Each bank decides the volume of loans it makes to its borrower base, in the context of its willingness to take risks. Since the credit risks in every bank's loan-market area differ, every bank's best strategy is *not* to imitate other banks' average pace of credit expansion. Those banks with riskier borrowers would certainly face a greater risk of zero or negative profits if they simply 'followed the leader'. Such banks may even hold a significant share of their assets in securities, not loans. The notion that banks might be sensitive to risk suggests the need for a second dimension of banking strategy, regarding banks' approach to risk.

3.2 Risk, financial fragility and bank strategic behaviour

Many contemporary banking models, especially those based on asymmetric information in the credit market, define banking risk as coextensive with credit risk. This ignores an aspect of bank behaviour to which Keynes, and the post-Keynesians cited above, pay considerable attention: the fact that banks function in uncertain, real-time environments. Since banks' role in the economy is in part to provide liquidity on demand to non-bank agents, they are deeply vulnerable to shocks affecting the economy-wide demand for liquidity—over and above their credit risk. Minsky (1982) pointed out that the financial fragility of the banking system can be measured in terms of the banking system's resistance to liquidity shocks.

Here we introduce two indices of banking risk to capture any bank's credit risk and financial fragility. To do this, Table 1 introduces a representative bank balance sheet. Apart from the standard entries of reserves (C), deposits (D), loans (E), and net worth (NW), Table 1 includes interbank loans (T_L) and borrowing (T_B), because our depiction of banking strategy focuses on differential credit expansion. T_L and T_B are, at the level of the banking system, offsetting quantities that temporarily change the location of an equivalent amount of reserves; but at the level of the individual bank, the balance ($T_L - T_B$) can be positive or negative as the bank is a lender or borrower, respectively, in the interbank market.

Here we conceptualise banks' susceptibility to shocks using these balance-sheet elements in the following way. Banks' financial fragility is measured, in a very simple and direct way, by their liquidity risk: how many reserves a bank can afford to lose in the event of a shock before it must seek borrowed funds in possibly unsettled markets. Here we define an index of liquidity as the ratio of reserves to deposits:

$$V_1 = [(C + (T_L - T_B)]/D = \text{reserves} + (\text{net interbank lending})]/\text{deposits}$$

V_1 shows what currency margin a bank has to cover withdrawals from the public or from other banks during cheque clearing (it is assumed that interbank loans are made overnight, that is, very short term). Any bank that has borrowed reserves through the interbank

[1] We could also assume that borrowers are distributed in different localised densities; but the assumption of private information with different risk characteristics is sufficient for our purpose. It could be hypothesised that this localised information overcomes asymmetric-information barriers, or involves lower informational transaction costs. It is not necessary to introduce these details here into our simple analytics, which focus on systematic interconnection rather than information extraction.

Table 1. *Representative bank balance sheet*

Assets	Liabilities
Currency held as reserves (C)	Deposits (D)
Interbank loans (T_L)	Interbank borrowing (T_B)
Loans (E)	Net worth (NW)

market will have a smaller liquidity margin than if its reserves were held against deposits. As V_1 loses value, the bank's liquidity diminishes.

Banks' credit risk is measured by how readily they can absorb losses originating from loan shocks; this, in turn, depends on whether they can write off bad loans against net worth. This risk exposure is readily measured by a simple loan-market leverage index:

$$V_2 = E/NW = (\text{loans/net worth})$$

This index depicts the exposure of bank net worth to potential credit-market losses. It is assumed here that bank net worth (NW) is fixed. Then as a bank lends more, its leverage index increases; this means that the bank is more exposed to credit risk, since the likelihood of problems from bad loan write-offs has also increased. Evidently, the bank's credit risk also depends on its own subjective evaluation, which is in part cycle-determined, as we shall see in Section 6.

Section 4 shows that the more aggressively a bank makes loans, the more exposed it is to liquidity risk as well as to credit risk. This can be seen directly in terms of V_1 and V_2. It is easily shown, using the definitions given above, that:

$$V_2 = 1 + (1 - V_1)(D/NW) \tag{1a}$$

and

$$V_1 = (NW/D)(1 - V_2) + 1 \tag{1b}$$

A bank that chooses to expand credit is at the same time increasing the value of its leverage index (V_2); but as equation (1b) shows, this necessarily reduces its liquidity index (V_1), which means that the bank is more exposed to liquidity risk. Conversely, a bank that sets a liquidity-index target is at the same time determining the leverage index—and the volume of loan-making—that it wants to undertake [as per equation (1a)].

Two polar approaches to bank strategy then emerge in our simple model. At one pole are banks that set targets for credit expansion, absorbing whatever liquidity risk they must in pursuit of this objective. At the other extreme are banks that determine acceptable liquidity-risk levels and restrict loan-market activity in accordance with this prior objective of 'safety first'.[1] The first polar strategy is, of course, familiar as that of liability management (Dymski, 1988; Minsky 1986, chapter 10; Wray 1990). Banks that manage their liabilities are, in essence, deciding on lending targets *before* knowing their deposit

[1] There are some similarities between these banks' approaches to risk and Tobin's (1958) portfolio approach, in which the investor can be defined as a diversifier (risk-aversion behaviour) or risk-lover (profit-maximiser behaviour) according to his/her risk-return preference. However, Tobin conceptualised a competitive equilibrium model, in which no investor changed the parameters of the market in which s/he made choices. The model being developed here develops precisely the opposite case, with an emphasis on bank loan-making rather than generalised wealth-asset portfolios.

volume will cover their loan commitments. If necessary—that is, if loan volume exceeds available resources, these banks turn to short-term borrowing markets to obtain the reserves they need to meet minimal (self determined or regulatorily-mandated) levels—that is, for such a bank, $T_B > T_L$.[1] This sort of behaviour is especially likely in the boom phase of an economic expansion, as noted in Section 6. Since we are working here with a closed-system bank model, we assume that any such borrowing occurs through the interbank market.

This result immediately sheds light on an interesting aspect of our approach in the context of post-Keynesian debates: the debate about whether money creation is endogenous. Our model represents a middle ground between the two extremes of completely endogenous and completely exogenous money creation. Some banks in our model create credit up to the limit imposed by their level of excess reserves—as per the extreme exogenous-money model. Other banks—as per the endogenous-money approach—are willing to create whatever credit is demanded, anticipating that they can raise the required reserves on the market. But even banks in this latter category take borrower risk into account.

In sum, then, assuming that the expected loan rate is higher than other interest rates, strategic choice here involves choosing a location along a spectrum of expected-loan–return/liquidity-risk possibilities; and this choice can be interpreted as choosing a (V_1, V_2) combination that maximises bank utility.[2] Figure 1 presents a simple parameterisation contrasting the two polar approaches to bank strategy imagined here. An 'aggressive' lender chooses a leverage-index value (along the horizontal axis), given its deposit and net worth parameters, and then absorbs whatever liquidity risk (along the vertical axis) this position implies. By contrast, a 'conservative' bank picks a liquidity-risk target and then limits its loan-expansion accordingly (that is, it chooses along the vertical axis, not the horizontal). Overall risk is lowest in the top left corner of Figure 1 and highest in its bottom right corner. Here a scenario is shown which implies interbank loans by the conservative bank to the aggressive bank.

4. Bank strategic behaviour in a multi-bank system approach

We now go a step further in our argument. This section uses a multi-bank systemisation to show that while every bank chooses its own strategy, its balance-sheet structure is only partially determined by its management's strategic decisions. This structure is also determined by the balance-sheet positions of other banks, as first stressed by Keynes (1960). This relationship can be explicitly shown by a stylised disaggregation of the variables in a simple money multiplier.

Our micro/macro approach to banking system analysis closely follows methods pioneered by Wallace and Karmel(1962). These authors also develop a simple multi-bank model, in which banks have different liquidity ratios. Wallace and Karmel use this model to explore whether the money multiplier is affected by differential bank liquidity ratios, and whether aggregate cash reserves change with the level of advances. Our analysis shifts

[1] The level of reserves needed depends on the prevailing institutional and regulatory environment. See, in this connection, Keynes (1960) and Goodhart (1989).

[2] A bank that maximises expected profit will simply choose that level of V_2 that maximises expected profit given expected short-term borrowing rates in the interbank market. Of course, in the real world, bank strategic choices extend well beyond loan growth and liquidity risk. See Dymski (1999).

attention to the implications of multi-bank interactions for banks' credit-expansion strategies and for their financial fragility.

The first step in building our ideas about the interaction effects of differential bank strategies is to introduce a multi-bank system approach. This approach works with the banking system as a whole, and shows how, as in the representative-bank case, an initial increase in the monetary base generates a larger increase in the amount of means of payment narrowly defined. Here, means of payment, M1, equals currency plus demand deposits. The monetary base, B, is either held as currency by the public (C_P) or as reserves in the banking system (C). The public prefers to hold the proportion d of M1 in the form of demand deposits (D), and (1 – d) as currency. So $C_P = (1 - d)M1$; and the currency in the banking system then equals $C = B - (1 - d)D$. Within the banking system, banks have a preferred (or mandated) ratio of reserves to deposits of R; so when banks are fully lent, $R = (C/D)$. Then, following the conventional approach, the money multiplier ζ can be defined as $\zeta = 1/[1 - d(1 - R)]$. Consequently, $\Delta M1 = \zeta \Delta B$.

Table 2 can be understood as representing the impact of the money multiplier on the multi-bank system as a whole, or on a representative bank within that system. For our purpose, it is important to see that accompanying the money expansion process is another

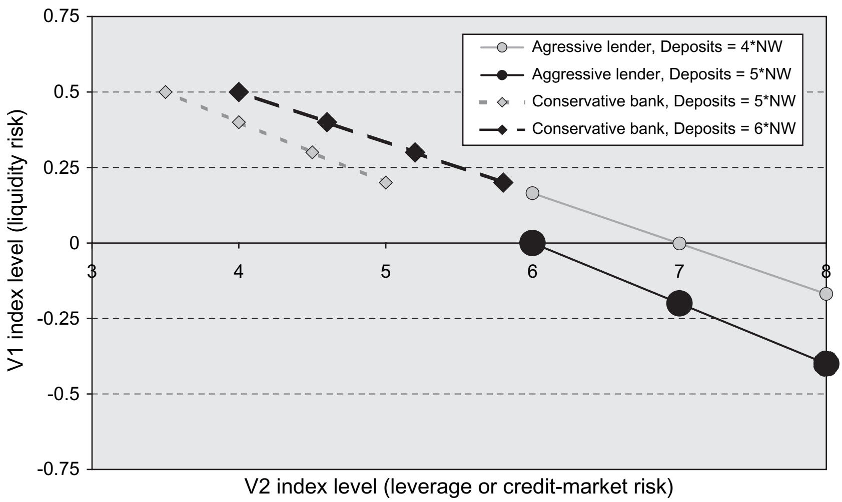


Fig. 1. *Illustrative interactions between liquidity-index (V_1) and leverage-index (V_2) levels for 'aggressive' and 'conservative' banks. Note: these curves depict the behavioural outcomes, respectively, for 'aggressive' banks that choose among leverage-index values ranging from 5 to 8, as per equation (1b), and for 'conservative' banks that choose among liquidity-index values ranging from 0.2 to 0.5. For each bank, the tradeoff between V_1 and V_2 is shown for two different values of the deposit/net worth (NW) ratio.*

Table 2. *Representative bank balance-sheet in a money-multiplier process*

Δ Assets	Δ Liabilities
Currency (held as reserves): R d ζ ΔB	Deposits: d ζ ΔB
Loans: (1 – R) d ζ ΔB	Net Worth: Δ NW = 0

process, implicitly involving the member banks within the banking system. That is, the money multiplier's behavioural coefficients—d and R—determine not only ΔM1 due to ΔB; they also settle the dimensions of each item on the balance sheet for the representative bank. For example, the amount of cash for a representative bank is also a function of d and R.

The conventional view of the money multiplier, which suggests some automatism in the way that money is created, implicitly admits that the structure of the bank system's balance sheet changes during the growth process of M1. For example, balance-sheet change is triggered when the rate of growth of money exceeds that of the bank's net worth. As the banking system begins to make loans, banks' overall assets begin to grow. At the same time, net worth is likely to remain stable in the short run, since the financial results of credit operations—such as net interest revenues—will only affect bank profitability with some lag. But this then implies that bank leverage grows as a result of the money multiplier process. A change of this kind could result from either a change in the monetary base or in the public's or banks's behavioural coefficients (in this simple case, d and R, respectively).

4.1 The disaggregated bank multiplier: the case of different bank strategies

Banks' balance sheets will also be affected systematically in the money-multiplier process by another factor: individual banks' adoption of different strategies regarding credit expansion and liquidity risk within the multi-bank system. Following the discussion of banking strategy in Section 3, here we suppose that banks' strategies have two components: how aggressively to market deposits, and how aggressively to make loans. For simplicity, the first of these choices is assumed to have a gradual effect over time, and thus to have no impact on deposit absorption in the short run; by contrast, the second component of choice can be implemented instantaneously.

Strategic choice in the short run considered here then measures how aggressive each bank is in loan-making, given its deposit base. The more aggressively loans are made, the more credit and liquidity risk the bank takes on, as discussed above.[1] It is important to note that the deposit base can differ from total deposits for every bank, since the latter total includes deposits created in the process of loan creation, in addition to deposits received directly from liability-holders. Since bank liquidity-index and leverage-index choices in response to liquidity and credit risks are linearly related (as per Section 3.2), each bank's strategy can be summarised by its choices over:

Γ_i: deposit attraction of bank 'i' (as a fraction of total deposits D).
R_i: reserve policy of bank 'i'

Note that $\Sigma\Gamma = 1$, since each bank absorbs Γ_i of total deposits. Each Γ_i is considered to be slowly evolving, hence a constant. Then, following the discussion in Section 3, some banks set loan-growth targets and live with the reserve/deposit ratios those targets imply; other banks establish desired reserve/deposit ratios first, limiting liquidity risk, and then make loans insofar as they have excess reserves at any stage of the money-multiplier process.[2]

[1] Our model's dynamics would quickly become more complicated if banks were able to affect deposit retention in the short run (via marketing and promotions, for example)—in such a case, deposit absorption itself would become endogenous.

[2] This simple characterisation of bank's strategic choices, carried over from the previous section, is nonetheless sufficient to generate a difference here between banking strategies. Further, our rudimentary model does not include securities, which typically serve as liquid-earning assets and as part of any bank's defence against liquidity risk. While securities could readily be added here, leaving them out and indicating banks' aggressiveness in loan-making by their differential preferences over reserve-holding makes our model simpler.

With net worth constant, more loan-making involves a reduction of reserves and a fall in the R_i ratio, increasing this bank's levels of both leverage and liquidity risk.

When reserves are injected into the bank system, individual banks make loans and reduce their reserves; the multiplier process begins to run, amplifying total deposits. With increases in demand deposits, both total liabilities and total assets grow. The multiplier process also facilitates more loan growth, since loan volume equals $(1 - R)\ d\ \zeta\ \Delta B$ at any point in time, and since both ζ and $(1 - R)$ are growing. The capacity of any individual bank involved in this process to absorb any adverse shocks falls as this process proceeds and its exposure to liquidity risk rises.

The multiplier (ζ) does not change with the introduction of the individual-bank variables. For example, suppose there is an exogenous increase in the monetary base, ΔB. Each bank will then receive an initial increment in deposits of $\Gamma_i\ d\ \Delta B$. Total deposits in the first round of the multiplier will then be $d\ \Delta B\ \Sigma\Gamma_i$ (or $d\ \Delta B$, as $\Sigma\Gamma_i = 1$). The next step will include new loans $(1 - Ri)\ \Gamma_i\ d\ \Delta B$ for each bank; total loans for all banks will be $d\ \Delta B\ \Sigma(1 - R_i\ \Gamma_i)$. So, new deposits, $\Gamma_i\ d^2\ \Delta B\ \Sigma(1 - R_i)$, will be credited to bank i in the next round, and so on.

Taking the entire multiplier process into account, the money multiplier is $M_i = 1/\{1 - d[(\Sigma(1 - R_i)]\Gamma_i\}$, a disaggregated version of the conventional aggregate multiplier, $\boldsymbol{\zeta} = 1/[1 - d(1 - R)]$.[1] The disaggregated multiplier M_i highlights the fact that the general reserve fraction is an average of the reserve fraction established by each bank firm, taking into account the relative marginal ability of each bank to attract deposits, Γ_i.

This disaggregated approach to the money multiplier shows clearly that the balance sheet of each bank is affected by the expansion strategies adopted by other banks—the point stressed by Keynes (1960). Table 3 shows the balance sheet of bank i at the end of the multiplier process. The balance sheet of bank i will be a function of the public preference's for deposits (d), of the ability of bank i to attract deposits (Γ_i), and of other banks' reserve/deposit ratios. But this observation already implies that when the overall macro parameters of the banking system shift (reserves are injected), bank micro strategies are disrupted or shifted. In Figure 1, the increased systemwide leverage resulting from the money-multiplier process (which increases D) shifts aggressive banks' illustrative (V_1, V_2) curve downward, and conservative banks' (V_1, V_2) illustrative curve to the right. This raises the question, will banks' microstrategies—their individual tradeoffs between V_1 and V_2—change as their parameters are shifted, and if so, how will they change? This question is addressed in Sections 4.5 and 5.

4.2 The effect of a change in bank strategic behaviour: a liability-managing bank

Through-time shifts in the constituent elements of individual banks' balance sheets—emphasising their dynamic, and hence strategic, interdependence—are not only triggered by shifts in monetary policy. Post-Keynesian studies of bank behaviour often emphasise the point that banks make changes to their portfolios to pursue perceived profit opportunities.[2] Here, it is crucially important to see that a significant shift in (one or more) bank(s) strategic behaviour can similarly set this interlocked process of balance-sheet change into motion. Suppose, following the discussion in Section 3, that a large bank shifts from

[1] The formula for M results from the summation $[1 + D\ (1 - \Sigma\ R_i\ \Gamma_i) + D^2\ (1 - \Sigma\ R_i\ \Gamma_i)^2 + \ldots + D^n\ (1 - \Sigma\ R_i\ \Gamma_i)^n]$; that is, $1/\ [1 - D\ (1 - \Sigma\ R_i\ \Gamma_i)]$.

[2] For example, Minsky (1994, p. 156) states: 'In contrast to the orthodox quantity theory of money, the financial instability hypothesis takes banking seriously as a profit-seeking activity. Banks seek profits by financing activity; like all entrepreneurs in a capitalist economy, bankers are aware that innovation assures profits. Thus using the term generically for all intermediaries in finance (whether they be brokers or dealers), bankers are merchants of debt who strive to innovate in the assets they acquire and the liabilities they market.'

a conservative to an aggressive loan-market strategy, adopting a liability-management approach. A shift of this sort will be manifest in imbalances between reserves and deposits. What are the limits for this kind of action?

To illustrate the consequences of liability-managing behaviour, we suppose that a bank 'k' increase its loans by an amount $\underline{E}$. We also suppose that other banks do not change their R_i. So, part of the loans will be deposited in each bank, in an amount $d\,\Gamma i\, M\, \underline{E}$. At the end of the multiplier process, the bank k will have a balance sheet as described in Table 4.

In making loan $\underline{E}$, bank k loses reserves to other banks in an amount equal to its loan expansion. For the banking system as a whole, this loan-making expands the means of payment at the expense of bank k's reserves. From this low point, bank k's reserves begin to grow in proportion to the increase of money that it initiated. At the end of the process, the reserve variation will be $(R_k\, d\, \Gamma_k\, M - 1)\, \underline{E}$. Since $0 < R_k < 1$, $0 < d < 1$, and $0 < \Gamma_k < 1$, the changes in reserves will be negative, but not as great in magnitude as $\underline{E}$. Consequently, if bank k expands its loans while other banks do not, it will lose reserves to the remaining ones, though less than the total amount it first lent. Note that bank k will borrow reserves (in our closed system, through an interbank market) if its reserve volume after loan-making leaves it below its desired reserve ratio R_k.

Conversely, the other banks gain the reserves that bank k loses. Suppose that the remaining banks do not change their R_i's and that the Γ_i's are constant; in this case, other banks' financial structures still change due to the growth in their leverage. As Table 5 shows, bank i loans will rise due to the effect of increased bank k loans ($\underline{E}$). And, since by assumption NW_i does not change, bank i's loan and asset leverage will grow. Note that interbank loans, if they are needed by bank k, will be made by bank i in lieu of loans otherwise made on its own account. If all banks are risk-neutral, this implies that the interbank loan rate will just equal the risk-adjusted return on the marginal loans in the portfolio of banks with less aggressive strategies. If some banks are risk-averse, the interbank loan rate can dip lower.[1]

Table 3. *Balance sheet of bank i at the end of the multiplier process*

Assets	Liabilities
Currency: $R_i\, \Gamma_i\, d\, \Delta B\, \Sigma D^z\, (1 - (\Sigma\, R_i\, \Gamma_i))^z$, or $R_i\, \Gamma_i\, d\, \Delta B\, M$	Deposits: $\Gamma_i\, d\, \Delta B\, \Sigma D^z\, (1 - (\Sigma\, R_i\, \Gamma_i))^z$, or $\Gamma_i\, d\, \Delta B\, M$
Loans: $(1 - R_i)\, \Gamma_i\, d\, \Delta B\, \Sigma\, d^z\, (1 - (\Sigma\, R_i\, \Gamma_i))^z$, or $(1 - R_i)\, \Gamma_i\, d\, \Delta B\, M$	Net worth: $\Delta\, NW_i$ (= 0 in the short run)

Table 4. *Changes in bank k's balance sheet due to its strategy shift*

Assets	Liabilities
Currency: $R_k\, d\, \Gamma_k\, (\Delta B + \underline{E})\, M - \underline{E}$	Deposits: $d\, \Gamma_k\, (\Delta B + \underline{E})\, M$
Loans: $(1 - R_k)\, d\, \Gamma_k (\Delta B + \underline{E}) M + \underline{E}$	Interbank borrowing $(0 \text{ or } T_{Bk})\, NW_k$

[1] We could add further realism by supposing that banks with more conservative loan-expansion strategies might hold securities, and then switch from securities to interbank loans in states of the world where aggressive-strategy banks required such loans. This feature is left out here; see note 10.

Table 5. *Bank i balance sheet*

Assets	Liabilities
Cash: $R_i\ d\ \Gamma_i\ M\ (\Delta B + \underline{E})$	Deposits: $d\ \Gamma_i\ M\ (\Delta B + \underline{E})$
Interbank loans (0 or T_{Li})	
Loans: $(1 - R_i)\ d\ \Gamma_i\ M\ (\Delta B + \underline{E})$	NW_i

4.3 Financial fragility and the interaction between banks' balance sheets

Section 3.2 described two dimensions of the financial fragility of banks: one due to their exposure to liquidity risk, summarised in liquidity index V_1; the other due to their exposure to credit risk, summarised in leverage index V_2. Indeed, it was shown that a bank with an aggressive loan-market strategy, such as bank k, can be understood as choosing a V_2 and accepting whatever value of V_1 is implied in that prior choice. Section 4.1 then showed that shifts in banking system balance sheets imply shifts in every bank's individual balance sheet (and hence in its V_1 and V_2 values). The same point obtains here.

In Table 6, the two indexes (V_1 and V_2) are shown for two stylised banks, i and k, with the expansion strategies sketched out above. This depiction is sufficient to capture the effects of strategic variability in the banking system as a whole. Table 6 shows the results of a comparative statics exercise. The balance-sheet situation of the banks is shown at three points in time: (1) before the initial expansion of monetary base; (2) after the expansion of monetary base; and (3) after bank k autonomously increase its loans by an amount $\underline{E}$.

The *first moment*, the starting point of the exercise, shows the autonomous behavioural strategy adopted by each bank. The V_1 and V_2 of banks i and k are not shown as explicit functions of another banks' influence, since they consider the effects of neither monetary-base expansion nor changes in bank strategies.

The *second moment* shows exactly how the expansion of monetary base modifies the liquidity index and leverage for both banks. Loans are expanded on the basis of each bank's R and Γ; it is assumed here that net worth (NW) does not change. Changes in V_1 depend on the magnitude of total liquid assets (C). Leverage index (V_2) shows that as assets grow, insolvency risk and the bank's leverage index both rise.[1]

The *third moment* evaluates the impact of a one-time increase in loans, $\underline{E}$, by bank k. This action by bank k increases its exposure more than that of bank i. It is assumed here, as in the above discussion, that bank k stakes out a loan-volume target and then seeks to borrow whatever reserves it needs to meet its reserve/deposit requirement (whether self-imposed or set by regulators); here bank k is assumed to require T_{Bk}, and that it obtains these reserves from bank i (which curbs its marginal lending).[2] Bank k ends up with *lower* V_1 and *higher* V_2 than the rest of the banking system, represented here by bank i. In other words, both the liquidity and solvency risk of bank k increases. Also note that while bank i remains more conservative than bank k, the impact of bank k's aggressive loan-making is to make it, too, more leveraged than before, despite its passive strategy of credit expansion.

One can conclude from this analysis that:

[1] We maintain here the assumption that net worth is constant in the short run.

[2] The required condition is that the reserves needed by bank k must be less than the sum of the marginal loans that bank i would otherwise create. If this condition were not met, we would have to assume that bank i initially holds a securities portfolio that it is willing to reduce to provide reserves via interbank loans to bank k. Adding securities here would not add any new insights for our purposes; so they are left out of our model.

Table 6. *Bank fragility indexes of bank i and bank k*

Fragility index	Moments (1)		Moments (2)		Moments (3)	
	Bank i	Bank k	Bank i	Bank k	Bank i	Bank k
$\mathbf{V_1}$	C_i / D_i	C_k / D_k	$[R_i \, d \, \Gamma_i \, M \, \Delta B + C_{ii}] / (D_i + d \, \Gamma_i \, M \, \Delta B)$	$[R_k \, d \, \Gamma_k \, M \, \Delta B + C_k] / [D_k + d \, \Gamma_k \, M \, \Delta B]$	$[R_i \, d \, \Gamma_i \, M(\Delta B + \underline{E}) + C_i + T_{Li}] / [D_i + d \, \Gamma_i \, M(\Delta B + \underline{E})]$	$[R_k \, d \, \Gamma_k \, M \, (\Delta B + \underline{E}) — \underline{E} + C_k - T_{Bk}] / [D_i + d \, \Gamma_k \, M(\Delta B + \underline{E})]$
$\mathbf{V_2}$	E_i / NW_k	E_k / NW_k	$[(1 - Ri) \, d \, \Gamma_i \, M\Delta B + E_i] / NW_k$	$[(1 - R_k) \, d \, \Gamma_k \, M \, \Delta B + E_k] / NW_k$	$[(1 - R_i) \, d \, \Gamma_i \, M \, (\Delta B + \underline{E}) + E_i] / NW_i$	$[(1 - R_i) \, d \, \Gamma_k \, M \, (\Delta B + \underline{E}) + \underline{E} + E_k] / NW_k$

1. The risk characteristics of the banking system's balance sheet is affected by the multiplier expansion of money, since bank net worth does not change in the same way as does the monetary base. The conventional multiplier implicitly supposes that banks become more fragile in terms of liquidity and insolvency risk during a monetary expansion.
2. The balance sheets of individual banks, and the risks that each bank faces, depend partially on other banks' portfolio decisions. This result does not derive from banks' refinancing of outstanding defaults (that is, from the ratio of bad loans to total loans), but from banks' own process of money creation.
3. If banks have different rhythms of loan expansion, then *ceteris paribus*, more aggressive banks will lose reserves to other banks, and at the same time will take on more liquidity and insolvency risk. In other words, more aggressive banks will be more financially fragile than other banks—a factor that might impose limits on such banks' loan growth.
4. However, the reason that banks carry any liquidity or solvency risk is that so doing often increases expected profitability: more credit expansion generates greater returns, *ceteris paribus*. In other words, competition for profits by banks leads in the direction of the minimisation of systemic liquidity, with the most aggressive lenders being most exposed to liquidity risk.

5. A numerical simulation of bank k/bank i interactions

The multi-bank system approach developed in the former section can be exemplified with a simulation. Let us consider a bank system with only two groups of banks, denominated as bank i and bank k, in a multi-bank system in which aggregate reserves change with the level of advances. Both banks initially have the same balance sheet totals, as shown in Table 7.

The key aspects of this simulation involve movements of reserves between banks, and banks' evolving levels of loans and deposits. In this simulation, when any bank increases loans, any incremental deposits created thereby will be shared among the two banks according to their rates of deposit absorption. For simplicity, the deposit absorption of the two groups of banks is autonomously determined and equal to 0.5: so each representative bank has an equal share of any new deposit created or destroyed in the banking system. Initially, the strategies of these two banks, as summarised in their reserve-to-deposit ratios, are identical: both maintain these ratios at 0.5. Further, the public is assumed to hold the proportion 0.8 of M1 as deposits.[1] Initially there is no interbank loan market.[2]

5.1 Simulating an increase in credit-market expansion by bank k

We now take advantage of the interactions among loans, leverage, assets and reserves that are built into this simulation exercise to show how a banking system containing more conservative (bank i) and more aggressive (bank k) institutions will be affected if bank k changes its policies so as to expand credit more. Specifically, suppose bank k changes its reserve-to-deposit ratio—while bank i maintain the same one (at 0.5). As discussed in Section 3, bank k here permits its reserve ratio to fall so as to expand credit more [this follows from the fact that a bank's use of V_2 (leverage) as a decision variable makes V_2 (liquidity) a dependent variable]. That is, as bank k increases its loans, it reduces its reserves.

[1] While this reserve-to-deposit ratio is far higher than observed in the real world, none of our results would be affected if a lower ratio were substituted.

[2] Interbank loans are required in two cases, in our bank *i* / bank k approach. First, a bank can 'jump' from a less to a more aggressive loan posture (as when bank k added $\underline{\boldsymbol{E}}$ to its loan volume) only if there exists a mechanism for an abrupt transfer of reserves. Second, interbank loans are also required when bank *k*'s pace of credit expansion is significantly higher than that of bank *i*.

Figure 2 shows how banking-system loans evolve as bank k shifts its reserve ratio. As the reserve ratio decreases (along the horizontal dimension of Figure 2), the loan volume of bank k increases. This reflects its strategic choice. What may be surprising is that the loan volume of the conservative banks—of bank i—also grows, due to the increase in the money multiplier. Bank k's loans grow faster than bank i's loans, increasing bank k's loan-market share.

This first result illustrates that even if the financial policy of bank i does not change, its loans will grow. Of course, there are other possibilities not explored in this simulation, as we shall explore in the next section.

Figure 3 shows that banks' exposure to credit risk will vary with their loan volume. As bank k increases its reserve-to-deposit ratio, the loan-related leverage of both banks grows—though bank k's leverage increases more than bank i's. Conversely, if bank k's reserve ratio falls, both banks' leverage will decrease, but that of bank k will decrease more. In other words, although both banks increase their insolvency risk (V_2) when bank k decreases its reserve ratio, insolvency risk is bigger for bank k than for bank i.

Table 7. *Initial balance sheets and behavioural parameters in the simulation model*

Balance sheets for bank k and bank i			
Reserves	333.33	Demand deposits	666.67
Loans	333.33		
Fixed assets	100.00	Net worth	100.00
Total assets	766.67	Total liabilities	766.67
Initial strategic posture for bank *k* and bank *i*		**Macroeconomic policy and economic-public parameters**	
Reserve-to-deposit ratio	0.5	Monetary base	1000
Deposit absorption of each bank	0.5	Proportion of M1 held as deposits	0.8

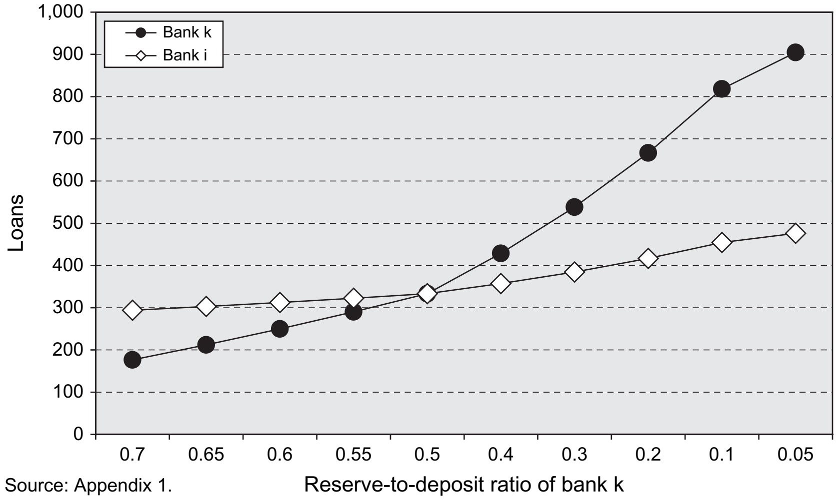
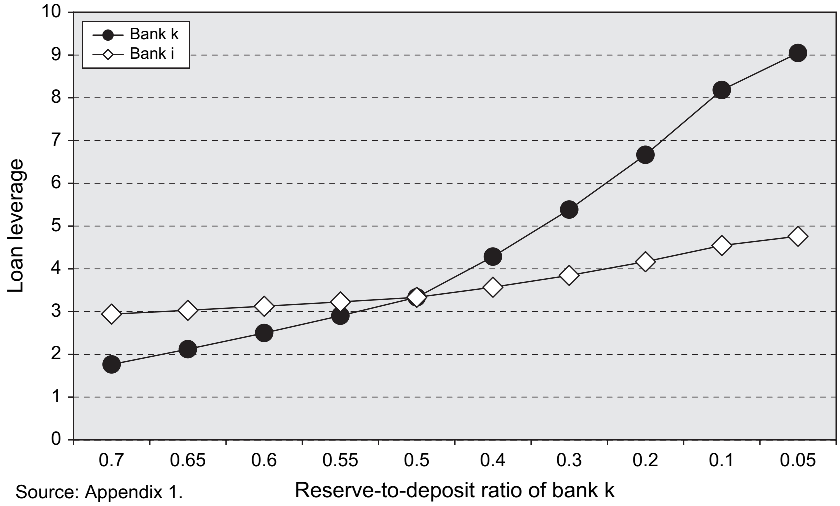


Fig. 2. *Loans of banks k and i for different reserve-to-deposit ratios of bank k*

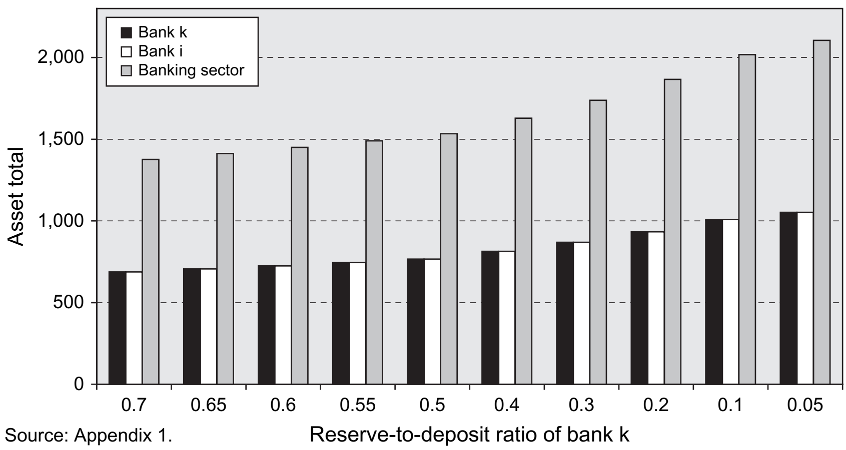
Figure 4 shows that shifts in bank k's reserve ratio lead to changes in total banking-sector assets. As bank k's reserve ratio decreases, the assets of both banks increases in the same rhythm, due to increasing loan volume. This result follows because, by assumption, both banks have the same rate of deposit absorption; if deposit absorption rates differed, so would banks' asset growth rates. This simulation also shows that the banking sector's total assets change with a change in any bank's finance policy. Even banks that maintain a fixed reserve ratio (bank i, here) experience an increase in assets. This result conforms with the simple multiplier model.

Of course, bank i is not compelled to expand or reduce its loans as an automatic response to expansions or reductions in bank k's loan volume. Suppose instead that bank i maintains a constant loan volume. In this event, when bank k increases its loan volume, bank i will increase its reserve-to-deposit ratio, weakening the monetary multiplier effect. But at the



Source: Appendix 1.

Fig. 3. *Leverage of loans (loans/net worth) for different reserve-to-deposit ratios of bank k*



Source: Appendix 1.

Fig. 4. *Banking assets of bank k and i for different reserve-to-deposit ratios of bank k*

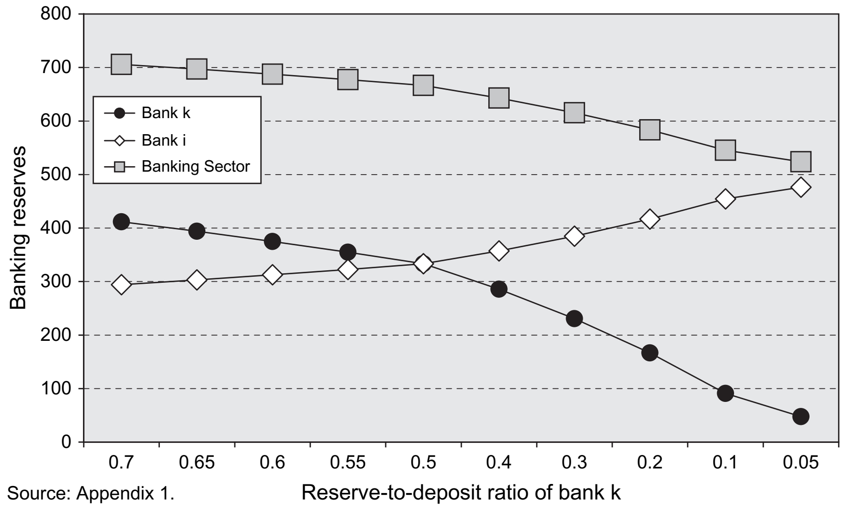
same time, bank i will experience an increase in its assets (just equal to the growth in its reserve volume) due to bank k's loan-volume expansion.

The increase (or reduction) in bank k's reserve ratio causes a transfer of reserves between banks. If bank k's reserve ratio diminishes because it is increasing loan volume, these reserves are released to the public and to banks (here, bank i) that have not changed their reserve ratios. This situation pushes bank k to borrow reserves. As in Section 4.2, this can be done by conceptualising an interbank market that shifts reserves from less to more aggressive lenders.

So bank k's reduction of its reserve ratio increases the banking system's exposure to liquidity risk (by generating more demand deposits with total reserves constant); and the liquidity risk of the aggressive bank k increases *pari passu* as it increases its loans and loses reserves (Figure 5). Conversely, when bank k's reserve ratio increases, reserves elsewhere in the banking system (and those held by the public) are absorbed by bank k; so this bank's exposure to liquidity risk diminishes.

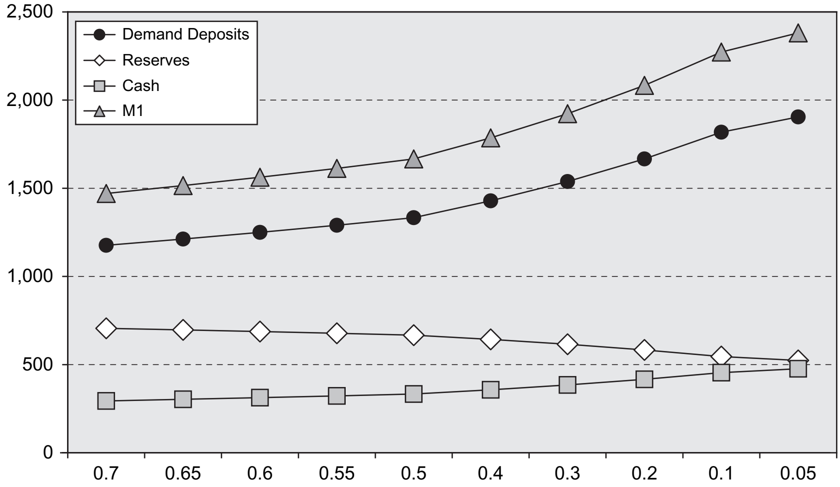
This last result has an important consequence regarding the determination of banking-system liquidity risk. The monetary multiplier suggests that expanding the average reserve ratio diminishes M1. So, if the public's preference for cash/M1 is constant, the public demand for currency also declines. The reserves of the banking system as a whole increase as well. This guarantees a natural defence against bank runs. Alternatively, the reduction of the reserve ratio increases M1. So, if the cash/M1 is maintained constant, the public demand for currency increases (Figure 6). As a result, the banking system as a whole will be more exposed to liquidity risk, *ceteris paribus*.

In sum, this simulation highlights the fact that individual banks' balance sheets are hardly the result of these banks' choices. The behaviour of all banks—of aggregate bank behaviour—is an essential element in determining the size and composition of bank balance sheets. Conversely, this simulation confirms another central point of this paper: aggregate banking-system outcomes are responsive to micro-level strategic choices. Micro and macro analyses interpenetrate.



Source: Appendix 1.

Fig. 5. *Banking reserves of bank k and i for differents reserve-to-deposit ratios of bank k*



Source: Appendix 1.

Fig. 6. *Monetary aggregates*

5.2 Competitive imitation and aggressive bank strategy in a multi-bank system

The exercise in Section 5.1 illustrated balance-sheet interactions between two banks that maintained different credit-expansion strategies. In that simulation, banks implicitly determined their portfolio allocations in the light of their own liquidity positions and goals, without speculating about their competitors' actions. There was some logic to this: in particular, the more rapidly expanding bank, as it grew, surrendered currency reserves to the other banks, whose objective functions implicitly assigned a higher value to the avoidance of liquidity risk.

But interactions between bank strategies are equally possible; indeed, these are foreshadowed in Keynes' 'hang together' phrase. There are two reasons to think that other banks will expand credit more rapidly when bank k implements its aggressive approach. The first is a shift in expected credit risk. If bank i (the 'other' banks) adjusts its credit risk assessment, as is typical in a period of growing euphoria, it is more likely to imitate bank k. In this case, bank i (which is initially in balance) can expand credit simultaneously with bank k, as both banks supply more credit. In Figure 1, as noted, this expansion of credit will, because it increases systemwide deposits (D), shift both banking sectors' (V_1, V_2) curves: the bank k curve shifts downward—in the direction of more liquidity risk; the bank i curve shifts rightward—in the direction of more leverage risk. These shifts would not cause alarm as long as systemic liquidity is available and as conservative banks' evaluation of the disutility from leverage risk falls. Indeed, one feedback from the more expansive strategy of bank i is that bank k regains some of the currency it initially lost; so in the initial stages of a lending-euphoria driven boom, even reserve transfers permit consistent side-by-side expansion of banks i and k, with resultant increases in credit approximately offsetting one another in terms of any impact on the locus of reserves.[1]

[1] Wallace and Karmel (1962, p. 100) also considered this possibility; they observe that 'a banker's reactions to changes in liquidity will be largely determined by the number of competing banks and the share of his bank in the total banking business, the degree of collaboration (explicit or tacit) between the bankers and the assumptions the banker makes about the likely impact of his own cash reserves on his competitors' actions.'

A second factor inducing a system-wide shift toward an expansionary credit strategy is that the formerly conservative banks can, via this shift, attempt to increase their share of the deposit market. As noted in Section 3, bank strategy encompasses both the deposit and the loan market; and loan growth can be one path to deposit growth. The expansionary bank (bank k) may expect to gain more deposits than other banks via its more aggressive strategy. The basis of this expectation is the expanding bank's anticipation that it can disproportionately retain the deposits it creates via either minimum-balance requirements or depositor incentives. But this possibility makes it more likely that other banks will follow the leader bank. By expanding its own loan volume, bank i both protects its share of the deposit base, and minimises the number of unsatisfied borrowers that are ripe for picking by bank k.

Figure 1 shows clearly that bank i (the conservative lender) is shifted rightward, toward more leverage (and leverage risk). Leaving aside its assessment of leverage risk, this bank may, in effect, choose to increase its leverage as one component of a strategy of defending deposit-market share.

Thus, driven by the actions of aggressive competitors, more conservative bankers may, in effect, increase their own liquidity and insolvency risks, whose consequences they still fear, because they do not want to lose their share of the market.[1] The next section adds another dimension to this result—the fact that bank strategic decisions unfold in the context of cyclical fluctuations. Here, our emphasis is on the competitive pressure imposed by aggressive banks (such as k) on more conservative banks (i)—leading the latter to engage in some amount of competitive imitation (or at least avoidance of an explicitly contrarian strategy).

Many other possibilities regarding market-share and market-competition implications of differential banking strategies can be examined analytically using simple simulation techniques like those introduced here. It is important to note the separate impact of business-cycle pressures on bank behaviour. Keynes' hang-together observation, after all, had more to do with banks' collective reactions to one anothers' business-cycle-influenced credit-market expectations than to banks' struggles for market share. Section 6 turns to the impact of cyclical fluctuations on feedback effects and competitive reactions to strategic initiatives within the banking system.

6. Banking strategy and the business cycle: insights from the simulation model

To clarify how bank behaviour affects business-cycle dynamics, and vice versa, this section explores some aspects of the multi-bank system developed here during the phases of the business cycle often portrayed by Hyman Minsky: stagnation, upturn, downturn and crisis.

According to the financial fragility hypothesis (Minsky, 1982, 1986), the dynamic of economic growth induces firms to become increasingly indebted to expand their investment. In this connection, cyclical fluctuations result from the way that firms finance

[1] According to Kregel (1997, p. 545), 'the decision to lend would in this case be based primarily on convention or average opinion ..., which means by reference to the types of projects other banks are financing ... Thus, over time, bankers will be lending to borrowers they previously would have refused (or would have lent only at higher margins of safety), and they will be concentrating lending to projects in particular areas simply because everyone else is doing so.'

their asset positions: increasing macroeconomic financial fragility in the upturn, for example, is associated with an increase in the number of speculative units. The decision to invest (alternatively, to take an asset position) runs hand-in-hand with the choice of the means of financing. Taken together, these decisions define the economy's vulnerability to adverse changes in the economic situation. An economy will be more or less fragile in the aggregate according to the preponderance of hedge or speculative units. As Dymski and Pollin (1992, p.40) state: 'Minsky argues that there is an inherent tendency for capitalist financial structures to move from states of robustness to fragility over time. This is due to the shift in expectations that occurs over the course of a business cycle, and the way this shift is transmitted through the financial system'.

Cyclical fluctuations are responsive to the influence of current data on bank and non-bank firms' states of expectations and confidence regarding future returns from investment projects. As noted above, the post-Keynesian banking literature emphasises that banks' behaviour amplifies cyclical fluctuations. Our task in this section is to discuss the interaction between banks' strategic behaviour and cyclical upturns and downturns.

Building a bridge from our micro/macro ideas here to a discussion of cyclical fluctuations involves two steps. First, as emphasised above, banks' assessment of and reactions to risks is a key to their strategic behaviour; indeed, we characterised bank strategy (at least in the short run) as involving choices over liquidity risk (V_1) and leverage risk (V_2). Second, we must recognise explicitly that banks' choices regarding these risks are sensitive to their expectations about the future (and responsive to their customers' expectations about the future, as well).

In a post-Keynesian approach, banks are like any other capitalist business, in that they take portfolio decisions based on their expectations regarding profit, in light of their liquidity preference. Like other economic agents, banks' liquidity preferences are determined by expectations formed under Keynesian uncertainty. This means that banks' assessments of the prospects for expanding or preserving wealth in an uncertain world are unstable—they can swing from caution to euphoria. Portfolio choice then involves managing the trade-off between the perceived need for liquidity and expected profitability—embodied here in banks' (V_1, V_2) tradeoff. What is especially emphasised, in this characterisation, is that because banks' decisions are so sensitive to their state of confidence and to inherently unstable expectations, it is banks' liquidity preference that governs their overall reactions: 'For a given state of expectations, banks' liquidity preference will determine the desired profile of the assets they purchase and their prices; that is, the rate of returns each type of asset must offer to compensate for their degree of illiquidity' (Carvalho, 1999, p. 132).[1]

6.1 Stagnation

At the trough of the business cycle, when uncertainty about the future undercuts confidence, current information is dominated by the bankruptcies of indebted firms, while banks (like their borrowers) must contend with delays in contractual payments. Realised profits and profit expectations are still low. Indebtedness is viewed as extremely risky because economic agents still perceive a high degree of uncertainty. Since agents' expectations have deteriorated, the aggregate demand for credit is low. Healthy firms try to adopt a hedge posture: that is, safety margins between profits and financial commitments

[1] Also see Dow (1996) and Paula and Alves (2003, section 2).

are sufficient to ensure that, in all future periods, profits will exceed interest expense and amortisation payments.[1]

Under these conditions, what would happen if the growth rate of an individual bank's loans were to increase faster than the average growth rate of other banks? In this phase of the business cycle, an individual bank (bank k) that increases its loans faster than others (bank i) would lose reserves, assuming no change in its market share of deposits (measured by Γ_i). As a result, this bank's liquidity risk (V_1) would increase; and since bank k's expansion of loans increases its degree of leverage, its insolvency risk (V_2) would also increase. Given the low demand for credit and borrowers' own caution, the expansion-minded bank cannot maintain an aggressive policy by making longer-term loans; it must instead work with borrowers who are interested in accepting its credit offer only for a very short period, and who may require the bank to reduce the interest rate it receives on loans. But such concessions on loan pricing will be yet another source of enhanced liquidity and credit risk for a bank with an aggressive loan-making policy. These systemic implications of rapid loan expansion in a stagnant economy would certainly reinforce the convention instructing banks to be cautious: and adopting a more conservative strategy will tilt this bank's asset portfolio toward short-term and more liquid assets. In effect, high liquidity preference is likely to prevail in banking strategy due to the structural penalties for behaving otherwise.

6.2 Upturn

The beginning of the boom depends crucially on improved expectations about the economy's future prospects by non-bank and bank agents. As agents' state of confidence improves, overall perceptions of risks decline. Increasing profits and capacity utilisation stimulate new investment. As a result, the demand for credit increases. Firms tend to move from a hedge to a speculative posture, reducing their margins of safety in meeting financial commitments.

In the case of banks, improving expectations lead to shifts in liquidity preference, from a more to a less defensive posture. This leads all bankers to adopt a more accommodative posture in reacting to non-bank units' heightened credit demand, based in turn on the latter's more optimistic views about their income-earning prospects and about the viability of their own debt structures. This search for more profits in the upturn induces banks to adopt what Minsky would have called a more speculative posture. Here this involves increasing leverage risk (V_2); and as equations (1a) and (1b) showed, increasing V_2 implies more liquidity risk (V_1), *ceteris paribus*.

Section 5.2 discussed several factors that can lead more conservative banks to engage in more expansionary credit-market behaviour due to competitive imitation effects. Here we add that the banking sector as a whole attempts to augment profits by taking advantage of increases in the demand for credit during a period of business optimism. In short, in a cyclical upturn, expanding loan portfolios lead virtually all banks to boost their leverage, increase their liquidity risk and increasingly use external funds to acquire assets.

[1] Minsky's core terminology for characterising economic units is described in his texts cited here. Briefly, a hedge unit has a positive safety margin because under any interest-rate and revenue scenarios, its cash-flow is sufficient to meet its debt obligations. A speculative unit, in this terminology, is one whose anticipated cash-flow is sufficient to meet its debt obligations (but which may be insufficient in some states of the world). Ponzi units' anticipated cash-flows are insufficient to cover their outstanding debt obligations. Units can be Ponzi due to an unrelenting (and even irrational) tendency to gamble, or due to the collapse of cash flows; their indebtedness grows even when interest rates do not rise.

In this context, what happens to the balance sheet of an individual bank that increases the growth rate of its loans faster than the average loan growth rate? As Section 4.2 has shown, the level of reserves at this bank (k) declines. Further, this bank can sustain an aggressive finance policy only by increasing its liquidity risk (V_1) and leverage risk (V_2)—that is by heightening its own financial fragility. As exemplified in Section 5.1, the rest of the banking sector (bank i) also becomes more fragile (if by less than the increase in bank k's fragility), because it is pulled along by bank k's faster pace of credit expansion. But beyond this passive expansion, as Section 5.2 noted, it is quite possible that the more conservative banks will themselves shift to a more expansionary posture. As discussed there, a more expansionary policy by conservative banks is likely due both to competitive pressures (the defence of market share) and to lower perceived credit risk.

The simulation in Section 5, then, illustrates the synergistic interaction between individual banks' strategic choices and the conventional behaviour of the banking system: individual banks with especially aggressive growth strategies can influence the average growth rate of the entire banking sector even if other banks react passively; and if more conservative banks are induced to become more aggressive lenders, the balance sheets of the banking sector could grow explosively. Under uncertainty, gearing a bank's expansion strategy to the trend in the banking sector is safer, since this guarantees both the bank's market share and its institutional reputation. This analytical situation precisely illustrates Keynes' comment about bankers 'hanging together'.

6.3 Downturn and crisis

During the upturn, the economy becomes more fragile. The extent of borrowers' and lenders' risk in the credit market rises. Fewer economic units have robust financial structures; more units require more financing to maintain their activity levels. Ailing profits force some hedge and speculative units to become Ponzi units, as declining cash flows make it impossible for some economic units to validate their financing arrangements. With safety margins declining systematically, and more financially fragile units, there is a growing range of interest-rate increases that can trigger nonpayment by more borrowers. The economy is less and less capable of absorbing shocks to growth rates or to interest rates. A crisis—leading to a spiral of decline among investment, profits, and asset prices—becomes more likely.

Whether or not a crisis occurs, many formerly reliable payers become bad borrowers, and financial safety margins are reduced. Banks consequently reevaluate borrowers' risks upward, and incorporate these expectations into loan risk premia. The resulting higher rates increase firms' borrowing costs just when refinancing is most needed. Banks refuse to roll over debts, and tighten credit rationing.

So the shocks that trigger cyclical downturns lead banks to revise their expectations just as their state of confidence is shaken. Financial institutions' liquidity preference increases, and leads them to reduce average loan terms, to maintain more surplus reserves, and to purchase liquid assets (such as government securities), and to reduce advances to their customers. Broadly speaking, as the economic outlook grows cloudier and perceived risk grows, banks seek both to avoid mismatching assets and liabilities (to reduce liquidity risk) and to lessen their exposure to credit risk. In Figure 1 terms, both sets of banks seek to move toward the top left corner, with lower (V_1, V_2) combinations.

Our simulation experiment suggests that *ceteris paribus*, the overall decrease in loan volume results in deposit losses for all banks. This moderates the rising liquidity risk of the banking sector (which involves both higher open-market borrowing costs and the threat of a run on deposits). Bank k, the sector that has lent more aggressively, will absorb a larger share of bad loans (realised credit risk due to its higher V_2). At the same time, because its liquidity index was lower, it will face more problems due to realised liquidity risk (V_1) as reserves decline and borrowing markets tighten. At the same time, the aggressive credit-market strategy of bank k in the upturn will have pulled even more conservative banks into more bad loans than they would otherwise have had, and toward more liquidity risk. Now, in the downturn, competitive imitation works the opposite way: as expectations grow bleaker, most banks tend to contract their credit supply. Consequently, the volume of bad loans in the banking system increases, leading to a deterioration in the quality of overall bank credit portfolios. In some situations, this situation can result in a banking crisis.[1]

Whether a fully-fledged financial crisis takes place when a sizeable shock occurs depends upon the efficacy of central bank lender-of-last-resort behaviour, and on whether gross profit flows are sustained by countercyclical government expenditure.[2] The question of countercyclical policy and its continuing effectiveness is beyond the scope of this paper. Regarding central-bank intervention, several points can be made. The central bank can stabilise asset prices (and block the debt deflation spiral) by increasing the volume and types of eligible assets that it can buy from banks, and also by increasing the volume of financial assistance to banks. This impedes debt deflation by limiting the liquidity and default risks that banks face and checking any impulse toward panic.

Our disaggregated multiplier model suggests another way of understanding how the central bank works: it maintains macroeconomic conditions that allow banks to make needed adjustments without experiencing bankruptcies. The central bank can operate like bank k during the downturn—that is, it can expand loans even when the bank system as a whole (bank i) reduces the pace of its loan growth. In effect, the central bank increases its loan volume (its liquidity assistance), increases its purchases of securities (via open market and rediscount operations) and injects reserves into the banking system. Thus, expansionary central-bank policy generates more liquid balance sheets for banks, and provides more liquid assets for loans—as bank i does—without generating a bank crisis.

Central-bank action of this type, if undertaken successfully, can permit banks to make balance-sheet adjustment without more critical macroeconomic side effects. Individual banks' profitability will fall; but the important thing is that the central bank put the banking system into 'stand-by' mode, waiting for signals of better prospects before expanding loans again.

7. Summary and conclusions

In recent years, many economists and management theorists have used the tools of microeconomic analysis and organisation theory to explore the strategic approaches and options of firms (Besanko *et al.*, 2003) and even nation states (Porter 1989). This literature has paid virtually no attention to the influence of the macroeconomic level on firm strategy; and vice versa: the implicit assertion is that if a firm or nation 'gets the microeconomics right,' good macroeconomic (aggregate) outcomes will follow. This apparently undercuts a central proposition in Keynesian economics: aggregate (macroeconomic) relations are central in shaping economic outcomes. But systematic inattention to micro–macro linkages is inappropriate, especially for firms whose market shares are sizable. This paper

[1] A banking crisis is 'a situation in which an increase in the share of nonperforming loans, an increase in losses . . ., and a decrease in the value of investments cause generalized solvency problems in a financial system'. (Sundararajan and Balino, 1991, p. 3).

[2] We might note that the shocks in question can originate with a severe tightening of monetary policy by the central bank (that is, with 'shock therapy') in response to inflationary pressures. In this event, the central bank appears analytically both as the cause of, and the solution to, the moment of crisis.

has used a simple multi-bank approach to show one example of how microeconomic strategies and aggregate conditions are complexly intertwined.

This paper has tried to clarify the relationship between individual-bank and banking-industry behaviour in credit expansion. In our analysis, the balance sheet structure of an individual bank is only partially determined by its strategic choices; it is also determined by the balance sheet positions—and indeed, strategic choices—of other banks. By disaggregating the variables that enter into the simple money multiplier, we have shown that when banks have different rhythms of loan expansion, more aggressive banks lose reserves to other banks and generate higher liquidity and credit risks for the system as a whole.

The sort of experiment done here is of course familiar from classroom exercises with the simple multiplier model. But what has perhaps not been evident in such exercises is that behavioural shifts anywhere in the banking system, if they are of sufficient scale, affect not only banking-system asset volumes, but also the liquidity and insolvency risks borne by every bank within the banking system. Any bank that wants to preserve its liquidity and insolvency risks unchanged must, in effect, actively manage its own portfolio—with further systemic consequences.

So our somewhat tedious demonstration that a behavioural shift somewhere in the banking system can change the parameters of the overall system leads to a methodological point: it shows how thoroughly micro (behavioural) and macro (structural) factors are interlinked in even the simplest setting. This implies that nonlinear and unpredictable feedback processes must always be considered possible. This is not a new point: recall Paul Davidson's careful aggregation of micro-level balance sheets in his *Money and the Real World* (1972). What we have put a sharper point on is that, when a micro model is set in motion, it invariably reacts to—even as it helps mould—macro-level results. This has been utterly forgotten in contemporary equilibrium-based neoclassical macroeconomics.

The paper also used the multi-bank framework developed here to explore the role of banking in the business cycle. Keynes and Minsky have both pointed out that banks' credit-market decisions tend to amplify cyclical volatility. What we have done here in this respect is to show how cyclical forces are, if anything, heightened by shifting expectations and competitive imitation effects. Banks, in effect, move ('hang') together in credit-market decisions for both micro and macro reasons.

This paper has only begun the process of integrating some insights about banking strategy into investigations of the riskiness and economic role of the banking system as a whole. It is especially important to investigate whether the model of banking strategy suggested here pertains primarily to an earlier time, when banks' strategic options were more one-dimensional, or whether it remains relevant for the present era, in which banks' strategies are more diverse and banks' geographic market bases are in flux.

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Appendix 1 *Changes in some banking variables (bank k and i) for different reserve-to-deposit ratios of bank k.*

	Assets			Reserves			Loans		Loans/net worth	
Reserve-to-deposit ratios of bank k	Bank k	Bank i	Banking sector	Bank k	Bank i	Banking sector	Bank k	Bank i	Bank k	Bank i
0.70	688.24	688.24	1376.47	411.76	294.12	705.88	176.47	294.12	1.76	2.94
0.65	706.06	706.06	1412.12	393.94	303.03	696.97	212.12	303.03	2.12	3.03
0.60	725.00	725.00	1450.00	375.00	312.50	687.50	250.00	312.50	2.50	3.13
0.55	745.16	745.16	1490.32	354.84	322.58	677.42	290.32	322.58	2.90	3.23
0.50	766.67	766.67	1533.33	333.33	333.33	666.67	333.33	333.33	3.33	3.33
0.40	814.29	814.29	1628.57	285.71	357.14	642.86	428.57	357.14	4.29	3.57
0.30	869.23	869.23	1738.46	230.77	384.62	615.38	538.46	384.62	5.38	3.85
0.20	933.33	933.33	1866.67	166.67	416.67	583.33	666.67	416.67	6.67	4.17
0.10	1009.09	1009.09	2018.18	90.91	454.55	545.45	818.18	454.55	8.18	4.55
0.05	1052.38	1052.38	2104.76	47.62	476.19	523.81	904.76	476.19	9.05	4.76

Source: Authors' calculation based on Table 7.

Leverage index	V2 = 1 + (1 - V1) (D/NW)							
Conserv. If strategy	D/NW = 5 then	V1 =	0	0.1	0.2	0.3	0.4	0.5
		V2 =	6	5.5	5	4.5	4	3.5
(fix V1, solve for V2)	D/NW = 3 then	V2 =	4	3.7	3.4	3.1	2.8	2.5
	D/NW = 6 then		7	6.4	5.8	5.2	4.6	4
Liquidity index	V1 = [NW/D] (1-V2) + 1							
Aggressive strategy	If NW/D = .2 then	V2 =	3	4	5	6	7	8
(fix V2, solve for V1)		V1 =	0.6	0.4	0.2	0	−0.2	−0.4
	If NW/D = .33 then	V1 =	0.34	0.01	−0.32	−0.65	−0.98	
	If NW/D = .167	V1 =	0.666	0.499	0.332	0.165	−0.002	−0.169
	If NW/D = .25	V1 =	0.5	0.25	0	−0.25	−0.5	−0.75