EXTERNAL FINANCING OF US CORPORATIONS: ARE LOANS AND SECURITIES COMPLEMENTS OR SUBSTITUTES?

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Abstract: "Multiple avenues of intermediation" (Greenspan 2000) suggest substitutability of corporate loan and bond finance which smooths external financing flows. Holmstrom and Tirole (1997) stress complementarity; for most firms bank finance and consequent monitoring is essential for bond finance. Econometric work based on their model is consistent with complementarity both on average over time and during financial crises, and for levels and volatilities. It implies that "multiple avenues" may not be effective as a buffer in a bank credit crunch, and hence supply-side blockages of bank credit may impact on real activity. There are important implications for regulation, not least Basel II.

JEL Classification Numbers: E44, G30

Keywords: Financial markets and the macroeconomy, corporate finance

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Non technical summary

"Multiple avenues of intermediation" – availability of debt securities issuance for corporations as well as bank borrowing - are currently only available in a subset of OECD countries. The benefits of having such a choice have been emphasised by Greenspan (1999, 2000) who suggested it helped protect the US economy when either banks or debt securities markets suffered financial problems, as the unaffected market moved to counteract a supply-side decline in credit granted by the market in crisis. Ongoing development of securities markets and suggests debt-securities financing and the possibility of "multiple avenues" will be of growing importance across the world in coming years.

Traditional theories of intermediation, in common with "multiple avenues", stress substitution between loans and securities. However, Holmstrom and Tirole (1997) emphasise complementarity from bank (informed) to securities (uninformed) financing. Complementarity suggests a more complex pattern than the simple view of multiple avenues. Notably, it casts doubt on whether bond issuance can fully substitute for bank lending when banking systems enter a crisis.

We seek evidence on such complementarity in the US. We choose the US since it is the main example of a country with active private debt securities markets as well as banks. Following the theoretical model of Holmstrom and Tirole, we estimate simultaneously equations for loan and bond financing, with dependent variables being both the levels and (for some estimates) volatilities of real financing flows. These give a baseline pattern for testing complementarity between direct and indirect debt financing. We also assess by use of dummy variables whether there are extra-cyclical effects arising from financial crises.

We show that US bond and banking markets behave strongly in line with the theory, highlighting the complementarity of bank lending and bond issuance, but not vice versa, both in first and second moments. They also indicate that changes in equity values have a marked impact on the corporate financing choice. Furthermore, in crises significant deviations from normal financing behaviour are observed, consistent with predictions of the model about credit crunch (affecting lending directly) and a savings squeeze (affecting bond issuance directly). Only in the latter case can the "other market" compensate with flows of new financing. Consistent with this, estimation of a multivariate GARCH model suggests that volatility in bank lending affects bond volatility positively but a shock to bonds damps the volatility of bank loans.

Our work suggests "multiple avenues" are not a simple matter of substitution. Securities issuance will have difficulties in offsetting a decline in bank lending because of the need for bank monitoring prior to bond issuance for much of the corporate sector. An important policy implication is that any financial regulation or market failure which increases the volatility of bank lending will also lead to wider destabilisation of corporate financing. In this context, there has been widespread criticism of proposals to amend the 1988 Basel Accord, including the possibility it will increase procyclicality of bank lending. Our work suggests that this will in turn reduce scope for affected companies to issue bonds.

1   Introduction

"Multiple avenues of intermediation" for corporations – featuring extensive availability of debt securities issuance as well as bank borrowing as a source of external debt financing - are currently only available in a subset of OECD countries (particularly the US and Canada), as shown in Davis (2001). The benefits of having such a choice have been emphasised by Alan Greenspan (1999, 2000) who suggested that "multiple avenues" helped to protect the US economy during periods when either banks or debt securities markets suffered from financial problems. In 1990-1 and 1998, for example, he suggested that the unaffected market moved to counteract a supply-side decline in credit granted by the market in crisis. By preventing a major funding gap from arising, the effects of financial turbulence on the macroeconomy were diminished. The ongoing development of securities markets and growth of institutional investors suggests that debt-securities financing and the possibility of "multiple avenues" will be of growing importance across the world in coming years. For example, following this logic, Asian countries were recommended to set up bond markets in the wake of the 1997-8 crisis (Knight 1998); corporate financing in the eurozone is also considered to be benefiting from development of bond markets.

Traditional theories of intermediation, in common with the approach of "multiple avenues" stress substitution between loans and securities. However, recent theoretical work such as Holmstrom and Tirole (1997) has emphasised the complementarity from bank (informed) to securities (uninformed) financing for corporations both in normal times and during crises. Complementarity may suggest a more complex pattern than the simple view of multiple avenues. Notably, it casts doubt on whether bond issuance can fully substitute for bank lending when banking systems enter a crisis.

In this context, the aim of this paper is to seek evidence on the complementarity of loans and securities in aggregate external credit-market borrowing by the corporate sector in the United States. We choose the US since it is the main example of a country with active private debt securities markets as well as banks. The empirical specification is based on the theoretical model of intermediation and loanable funds from Holmstrom and Tirole (op cit). Our empirical method is to estimate simultaneously equations for the determinants of loan and bond financing for the corporate sector, with dependent variables being both the levels and (for some estimates) volatilities of real financing flows. These give a baseline pattern for testing complementarity between direct and indirect debt financing. In this framework,

following Greenspan's suggestion, we also assess by use of dummy variables for crisis periods whether there are extra-cyclical effects arising from financial crises, which may imply a supply-side blockage in the market affected and an offsetting shift in financing to the unaffected market. The results are consistent with complementarity from bank lending to bond issue both on average over time and in periods of financial crisis, and imply that "multiple avenues" may not be effective as a buffer when a bank credit crunch occurs. There are important implications for regulation of bank capital adequacy.

The paper is structured as follows. In Section 2 we provide a selective theoretical introduction of issues in external financing and the loan-bond choice. In Section 3 we outline the Holmstrom-Tirole model which is the basis of our empirical work, and in Section 4 we outline extant empirical work on the bond-loan choice. In Section 5 we consider the empirical data for our study, in terms of financial flow variables, other macroeconomic variables and financial crises over which smoothing is to be assessed. In Section 6 we set out our empirical specification and give our main empirical results. Section 7 draws conclusions.

2 Theory of external financing and its composition

We begin by reviewing issues in the external financing of corporations. Standard macroeconomic theory suggest that fixed investment and other corporate expenditures vary cyclically, and are also affected by interest rates. As regards the sources of funds to finance such expenditures, the traditional "pecking order" view of corporate finance (Myers 1984) suggests that external debt finance, either in the form of securities or lending, ranks highly for borrowing firms as a source of funds, and hence demand for it is also closely linked to the cycle and interest rates. Internal funds are cheaper, but are generally limited by the scale of expenditures (including dividends) that tend to outstrip such internal funds increasingly during a cyclical upturn – while cash flows shrink in a downturn. Whereas in principle equity issuance is also a feasible alternative, firms tend to see it as costly and less desirable than debt, while investors often see equity issuance as an adverse signal about the firm. A further alternative, the run-down of liquidity, is limited by the need for precautionary levels of such liquidity to be maintained to avoid liquidity crises.

Whereas traditional macroeconomic theory is confined to demand side considerations as set out above, the theory of finance suggests that the supply of external debt finance, be it intermediated or not, is problematic. This is a consequence of asymmetric information

between borrowers and lenders and the inability of lenders to write complete contracts covering borrowers' behaviour in every eventuality. These give rise to the well known agency problems of the debt contract, linked to adverse selection in advance of lending and moral hazard after the financing has taken place. These effects may vary over time, giving rise to cyclical changes in credit supply in equilibrium.

For example, Mishkin (1991) suggests that variations in agency costs affecting credit supply may occur via a number of channels, prompting potentially sharp changes in the availability of external finance, particularly for firms with little collateral to pledge. If interest rates rise due to monetary tightening or merely to balance the credit market, adverse selection may increase sharply, giving rise to a substantial decline in credit availability. Furthermore, a decrease in the valuation of assets (e.g. a stock market decline provoked by a change in future profit expectations), by lowering collateral values, sharply increases adverse selection and moral hazard for lenders. Reductions in credit supply will impinge more on low-quality borrowers for whom there is asymmetric information.

Such patterns are said to give rise to a "financial accelerator" (Bernanke, Gertler and Gilchrist 1996) as changes in cash flow or asset prices over the cycle give rise to pro-cyclical feedback effects of agency costs on the cost of external finance and hence on real corporate expenditures. This will operate particularly via borrowers whose net worth is most heavily affected during a recession, and for borrowers whose activities are riskier or harder to monitor.

The theories of corporate finance, agency costs and the financial accelerator outlined above tend to apply to debt finance in general rather than distinguishing intermediated and non-intermediated finance. Hence they need to be supplemented in order to understand the forces underlying the choice of borrowers between banks and securities as a source of such external finance, as well as possible asymmetries in credit rationing. There are a number of "theories of intermediation" (Davis and Mayer 1991) that cast light on this issue, highlighting in general the monitoring advantages of banks to offset a higher price of loans and the consequent substitutability between bank and bond finance for higher quality firms. As a corollary they suggest that the determinants of intermediated and market financing may differ significantly, benefiting those firms able to access both types of finance.

Notably, following the discussion above, the existence of *asymmetries of information* between borrowers and lenders gives rise to difficulties in screening the quality of entrepreneurs and firms to avoid adverse selection (Leland and Pyle 1977) and monitoring their performance to minimise moral hazard (Diamond 1984). Leland and Pyle suggested that intermediaries can communicate proprietary information at lower cost than borrowers, and then sell claims to diversified portfolios of these assets to investors. Diamond suggests that financial intermediaries act as delegated monitors to overcome asymmetric information, whereby diversification reduces monitoring costs. A corollary is that market finance is only available to borrowers with a reputation (Diamond 1991) as it is a capital asset which would depreciate if firms act opportunistically. Hence, banks will serve small firms with low levels of public information, while larger firms with a higher degree of public information will have the option to be served by securities markets. Substitution can occur between loans and bonds for the latter only but there is no element of complementarity for either type of firm.

Theories of intermediation based on control also highlight the incompleteness of loan contracts and suggest that intermediaries are better able to influence the behaviour of borrowers while a loan is outstanding and seize assets or restructure in the case of default than markets (Bolton 1990). The corollary of control theory is that a higher degree of risk in a transaction (linked for example to low net worth of the borrower) will tend to be accompanied by bank financing, as banks are better able to influence the behaviour of borrowers while a loan is outstanding and seize assets or restructure in the case of default. Such patterns may potentially be cyclical (since as noted above agency costs rise as interest rates increase and asset prices fall), with firms switching to banks as credit quality declines. Note however that this assumes lower credit quality firms can access securities in the first place - as is feasible if there are high-yield bond markets. Consistent with control theory, Bolton and Freixas (2001) derive a model where firms substitute between loans and securities, based on the idea that bank loans are easier to restructure, while bank loans are relatively expensive due to the cost of equity capital for banks in the context of a capital regulation. Again there is no element of complementarity.

What do theories of intermediation suggest specifically about debt-securities finance? Following Diamond (1991), they broadly assume that it is impossible to provide debt that it is both monitored and tradable. If debt is widely traded, there are free-rider problems in monitoring. Furthermore, there are economies of scale in monitoring, due to fixed costs and the reusability of information. Hence high-risk borrowers requiring monitoring will find it

difficult to issue bonds. Tradeable debt securities on the other hand generate externalities in the asset markets, because they 'complete' the market as they provide liquid security for the lenders. Thus if lenders care about liquidity, capital will be cheaper for borrowers if they can issue liquid forms of debt. Hence, despite the presence of fixed costs involved in issuing a new security, tradable debt will be cheaper for borrowing firms, and all the more so the greater the variety of similar assets traded in the capital markets because they provide greater opportunities for lenders to diversify. This discussion implies a potential role for complementarity since monitoring, permitting bond issuance by higher risk firms, could be provided by banks via their loans to the same firm.

A counter argument can be made for securitisations, which seek to combine monitoring and tradability. Indeed, Bolton and Freixas (2000) use the possibility of securitisation as central to their model of financial markets and corporate finance, in a model where bank loans and bonds are substitutes and not complements. But in our view, they are widely subject to recourse to the original lender, showing the limitations of monitored and traded finance, as discussed in Benveniste and Berger (1987).

3   A model featuring complementarity from loans to bonds

Drawing on the above discussion, Holmstrom and Tirole (1997) derive the conditions under which bank loans and bond issues are complements for the financing of corporate investment projects. We set out relevant aspects of this model in some detail, given it is the basis for our empirical specification.

Investment projects (denoted Io), are initially assumed to be given. Firms can choose different projects with uncertainty regarding the project outcome, and there are also problems of moral hazard, since private benefits to the firm($0<b<B$) are inversely related to the probability of success (P_{sh},(high)> P_{sl} (low)). Firms need to commit some of their own assets to the project as lenders will not advance 100% finance. In this context, firms are divided into three broad categories vis-à-vis their ability to issue corporate debt, depending on their assets A.

The first category consists of firms whose assets exceed (A*):
$$A^* = Io - P_{sh} / r_u (R_T - (B / DP)) \tag{1}$$
where r_u denotes the required return for "un-informed" investors (corporate bond return), R_T is the project's total gross return and DP is a measure of risk, defined as (P_{sh} - P_{sl}). Firms for which this condition is satisfied can directly access the bond market without requiring to

procure a bank loan. Their assets are in effect sufficiently large to offset the maximum private gain (B) arising from moral hazard in the absence of monitoring given the project's total expected return R_T – in other words they do not have an incentive to choose the high risk project.

The second category consists of firms whose assets are smaller that A*, implying that uninformed lenders will require the possible choice of B to be eliminated by monitoring in order to provide them with credit. In this case bank loans, monitored debt, can ensure that the maximum private gain will not exceed b<B. The cost of such monitoring is c_1. In order to access the debt securities markets, this class of firms must first secure a bank loan $I(r_I)$ to finance part of the investment project. Only then can the remainder of the project be financed by an appeal to the bond market. The assets of the firms in this category are greater than or equal to A" where this level is defined as:

$$A'' = Io - I_I(r_I) - (P_{Sh}/r_u)(R_T - (b + c_1)/DP) < A*$$ (2)

where r_I denotes the bank loan rate, and because monitoring is costly $r_I > r_u$. The firms' asset position alleviates the moral hazard problem, and the costly monitoring excludes the maximum private benefit B, from the possible outcomes.

In the third category are firms with asset values below the critical level A'' that cannot get any finance for their investment projects.

Given the set of firms in the second category the economy wide demand for bank loans will depend upon the size distribution of the firms' assets G(A(.)), since all firms demand just the minimum level of costly bank loans I_I needed to be monitored.

$$D_I(r_I, r_u) = [G(A(r_u)) - G(A(r_u, r_I))]I_I(r_I)$$ (3)

The term in the square brackets denotes the number of firms with insufficient assets to access the bond market without having secured a bank loan of size $I_I(r_I)$. In this context, an increase in r_I, the interest rate on bank loans, decreases D because I_I is decreasing in r_I, and $G(A(r_u, r_I))$ is increasing in r_I. So for every r_u there is an r_I that clears the bank loan market. The effect of an increase in r_u depends upon the functions $G(A(\bullet))$, which affect whether aggregate financing demand rises or falls with the bond return.

The total demand for financing via bonds will arise from the firms that possess assets to the value of over A* plus the firms from the second category between A* and A" that have

already secured the required bank loans:

$$D_u(r_I, r_u) = \int_{A(r_u, r_I)}^{A(r_I)} [Io - A - I_I(r_I)]dG(A) + \int_{A(r_I)}^{\infty} (Io - A)dG(A) \qquad (4)$$

This is decreasing in r_u, as a rise in the bond return means that firms with assets which were previously just sufficient to enter the bond market are now ruled out despite having a bank loan, and furthermore firms that before would use bonds only are now forced to use bank loans too; both effects reduce the demand for 'uninformed' external financing. The effect on bond demand of a rise in r_I is ambiguous because a rise in the bank lending rate means that some firms with low assets will drop out of the bond market thus reducing the demand for uninformed capital, whilst firms that relied on bank loans can now demand more uninformed finance as the required size of a monitored loan I_I has been reduced. The complementarity of bank loans and bonds is captured by the firms included in the first term of (4) whose demand for bond financing is conditional on the presence of a bank loan of the appropriate size.

The model above captures the essential complementarities of the sources of corporate financing from the firms' point of view. The supply of funds to the relevant markets is assumed to be given at the time of the decision making by firms. Supply shocks can be incorporated by varying exogenously the funds to corporations either via changes in bank capital affecting availability of loans or by changes in household and foreign savings that may be allocated to corporate bonds. These changes are independent of fluctuations in the relevant yields and are initiated by the stochastic component in the underlying 'supply' equations.

There are three types of financial shock in this framework, namely a credit crunch when banks capital declines, a collateral squeeze where firms' assets are reduced, or a savings squeeze where total saving declines. With endogenous investment, in each case investment falls. In the case of a credit crunch or a savings squeeze the minimum capital required to raise finance A" rises. Meanwhile for a collateral squeeze, A itself falls. In each case a poorly capitalised firm would suffer a lower availability of credit, while the effects on relative quantities in each market and on interest rates may differ.

If there is a collateral squeeze on firms, which reduces the firms' solvency ratio ex hypothesi, then both uninformed and informed investors are less willing to commit funds, owing to moral hazard, and both interest rates fall. Intermediaries' capital ratios rise in this case. However, it might be expected that the supply of securities will fall more than that of loans, given banks are more tolerant of low net worth.

If the supply of intermediary capital falls[2], as in a credit crunch, a lower quantity of informed finance is available to firms, which also means that less uninformed finance can be attracted, because there is less monitoring undertaken. The reduction in uninformed finance lowers the "bond" rate. But the fall in uninformed finance is less than that of informed finance, making the latter relatively scarcer and raising the "bank loan" rate. Since both sources of external funds contract, the firm's solvency ratio increases.

Finally if the supply of savings to securities declines (akin to a bond market crisis) then the "bond rate" rises; firms' solvency ratios rise, as do those of intermediaries, with a relative rise in the availability of informed finance compared to uninformed leading to a fall in the "bank loan" rate.

We seek in Section 6 to construct and estimate an empirical specification which tests the main results of this model concerning the interaction of the two credit markets, relevant to the concept of "multiple avenues". In particular, we test for complementarity between loans and securities via an effect of the level and volatility of issuance in one market on issuance in the other. We also seek to test via the sign and significance of a real share price variable for a differing impact on lending and securities of a situation where firms' collateral (equity) values can vary over the cycle (the collateral squeeze). Furthermore, we test in both markets for the effects of cyclical variations in bank capital and overall saving. Against this background we can identify known periods of credit crunch (supply-side driven reduction in availability of loan finance) and savings squeeze (supply-side reduction in availability of securities finance) by time-dummy variables.

In addition to assessing smoothing directly, we investigate the possible volatility transmission between the two markets. If loans and bonds are substitutes, then the availability of both bank borrowing and bond issuance smooth overall corporate financing and their joint presence should lower the overall volatility of financing. If they are complements volatility may rise. To investigate this hypothesis we augment our 'mean' model by multivariate ARCH and test for the sign and significance of the conditional covariance terms. Accordingly, with

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[2] Such a bank capital crunch is seen as exogenous to the model, for example owing to changes in bank capital regulation. But it could also be endogenised, as is the case in Bolton and Freixas (2001) and in our model where it is driven by bank profitability. Note that they employ an alternative reasoning for the choice of companies between bank and securities finance, based on the idea that bank loans are easier to restructure, while bank loans are relatively expensive due to the cost of equity capital for banks in the context of a capital regulation. The result is substitution rather than complementarity.

substitution, a rise in volatility in one market may correspond to a decline in volatility in the other, thus smoothing overall volatility. On the other hand, with complementarity, if there is a shock to one market raising volatility it should also raise volatility in the other market and hence overall volatility.

4   Empirical work on the loan-bond choice

Before moving on to our own empirical work, we note that in contrast to the extensive theoretical work set out above, there has been rather little empirical work on the choice between bank lending and securities issuance by corporations, although there is extensive work on bank lending per se. The key work to date is Kashyap et al (1993) using flow of funds data, using flow of funds data on bank lending and commercial paper. They show that after a tightening of monetary policy, commercial paper issue rises while bank lending is flat, either because firms are rationed from bank lending and increase their demand for commercial paper, or owing to rationing of those categories of borrowers limited to bank lending markets. The result also suggests that investment is affected by a change in the financing mix, even when controlling for interest rates and output, which implies that the substitution that takes place is costly.

A study by Davis and Mayer (1991) used micro data on eurobond and syndicated credit borrowing by large corporations from the US and UK. They found that the relative number of bonds relative to loans is influenced negatively by the dollar short rate, credit quality spreads between corporate and government bonds, the total number of issues in the year/GDP growth and relative maturity. The results were seen to suggest that higher risk in terms of maturities, short rates and credit spreads stimulate bank finance, while bank financing is also more pro-cyclical than bonds. These outturns tend to support the relevance of control theories of intermediation as set out in Section 2. Pro-cyclical bank finance was seen as contrary to the concept of relationship banking, as banks do not appear to be more willing to lend in recessions than bond markets.

An important issue in empirical work on financing choice is identification, since co movements of financial quantities with real variables are not inconsistent with a lack of external financing constraints – they may be capturing demand rather than supply effects in the credit market. In recessions, loan demand falls which supply constraints are also more likely to bind for reasons set out in Section 2. In the Kashyap et al paper cited above,

identification is sought via use of the ratio of bank debt to commercial paper, founded on the idea that shifts in the composition of debt are less clearly linked to shifts in loan demand than to shocks in loan supply. A simple change in loan demand, with no supply shifts, is expected to leave the mix unchanged. A similar methodology is employed in Davis and Mayer. In a paper on bank lending per se, Peek and Rosengren (2000) utilise shocks to bank loan supply in regional US commercial property markets, which originate in the Japanese banking crisis to identify their model. We return to this issue below.

5   Data

The raw material for this work is flow data on funds raised in the credit market by non-financial corporations, drawn from the flow-of-funds data for the US over 1970-1999, deflated by the CPI. Loans are bank loans, mortgages and other loans to companies while bonds include also commercial paper (CP), all at market value. In the estimation, we add the following data items; business fixed investment, real equity returns, BAA corporate bond yields, Treasury bond yields, prime rate, the ratio of bank share prices to the market (Datastream indices), the sum of household and foreign net financial investment as a proportion of GDP, and the Treasury bill yield. In using macro data for the flow of funds to assess what is basically a micro theory, we implicitly assume a continuum of firms within the three asset-categories outlined in Section 3, i.e. A>A*, A*>A>A" and A">A.

We illustrate the flow of funds data in the following Chart and tables. Chart 1 shows that over the period 1970-1999, overall external financing shows a broadly cyclical pattern, reaching peaks in the booms of the early and late 1970s, late 1980s and mid-to-late 1990s; there is no single quarter throughout the period when total credit market borrowing is negative. Securities market financing tends throughout to be larger than lending, although this pattern is accentuated in the 1990s. Whereas net intermediated lending is often negative, notably in 1973-5 and 1990-3, net securities issuance is not – the nearest is at the start of 1994.

Chart 1: US corporate debt securities issuance and intermediated borrowing (1995 prices)
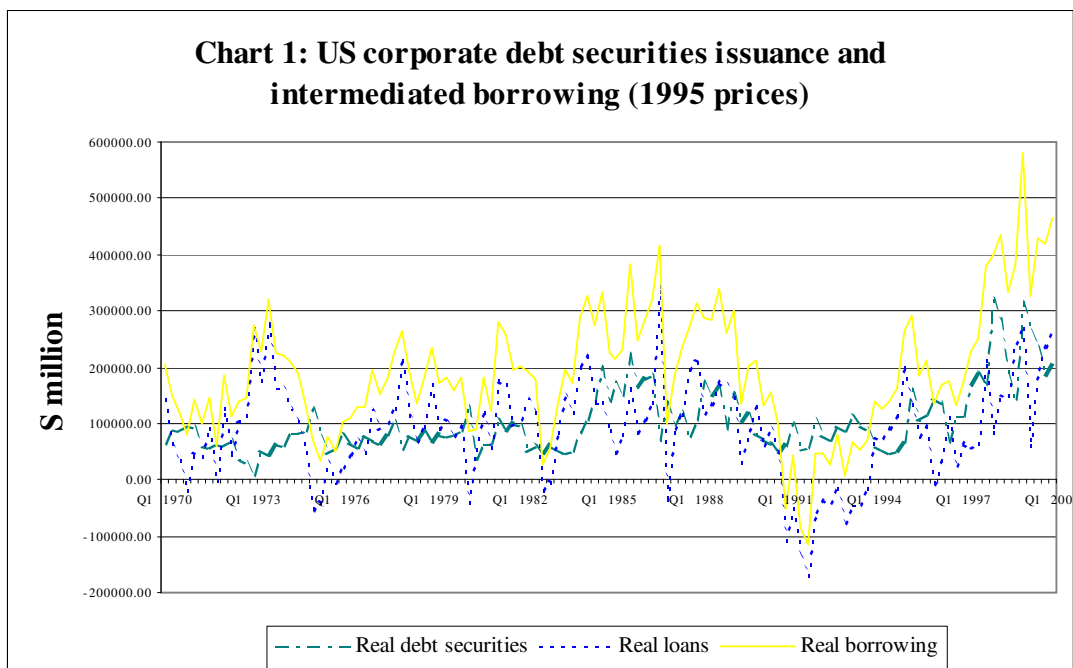
The chart is complemented by simple descriptive statistics (shown in Table 1), which show the size and volatility of the different financing flows relative to GDP since 1970. Credit market financing is an average of 3.2% of GDP, with securities being around half of credit market financing. The proportion of securities issuance is higher since 1985. The right hand side of Table 1 gives an impression of volatilities of the different forms of financing relative to GDP. A point of note is that the cyclical volatility of bond market financing is considerably lower than that of lending. Volatilities relative to GDP tend to be higher since 1985.

Table 1: Corporate external financing/GDP

	% of GDP	% of GDP since 1985	S.d.% of GDP	S.d.% GDP since 1985
Credit market	3.15	2.92	1.65	1.89
Securities	1.65	1.81	0.72	0.84
Loans	1.50	1.11	1.48	1.44

Table 2 shows in more detail the volatility and correlation of the different financing flows, deflated by the CPI rather than as a ratio to GDP. The volatility measure shown is the coefficient of variation[3].

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[3]   This is the standard deviation divided by the mean. This allows series of different magnitudes to be more readily compared than for the standard deviation alone.

Table 2: Volatility and correlation of real corporate debt financing flows

	Coefficient of variation	Correlations		
		Credit market	Securities	Loans
Credit market	0.59	1.00		
Securities	0.56	0.64	1.00	
Loans	1.01	0.86	0.16	1.00

The coefficient of variation for total credit market financing is lower than that of the subset intermediated lending. It is slightly above the figure for securities financing. Table 2 also shows correlations between the two sub-series and their correlations with total credit market financing. These show that credit market financing in aggregate tends to be more closely correlated with loans than securities issuance, perhaps reflecting greater cyclicality of the former, while the contemporaneous correlation between securities and loans is low at 0.16.

Besides data on flows and prices, we require selection of periods of systemic risk to enable us to test whether market reactions differ during such periods. They are picked on a judgmental basis, with no definite benchmark to define a crisis event. Judgement is in our view inevitable, especially if one wishes to include securities market liquidity crises as well as crises affecting intermediated lending. Some types of financial instability are unsuitable for inclusion. For example, the thrifts crisis entailed long lasting problems in the financial sector which had no clear crisis point, but which could have impacted on the efficiency of intermediation. There have also been regional crises (such as the Texas and New England crises), which did not impact on national credit flows but may have affected regional flows[4]. Even among the shocks considered to have national or international impact, the severity of the impact on the financial system varies strongly. Also the date of onset of the crises, while clear in many cases, must be a matter of debate in others.

With these caveats in mind, the shocks selected are as follows (descriptions are provided in Davis (1995a), (1995b) and (1999)): Franklin National/Herstatt (Q2 1974); the onset of the LDC debt crisis (Q3 1982); the Stock Market Crash (Q4 1987); the bank capital/credit crunch (Q1 1991); the bond market reversal (Q1 1994) and the Russia/LTCM crisis (Q3 1998).

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[4] Even regional crises could benefit from multiple channels, however. Research into the causes and consequences of the Texan crisis (Gunther et al 1995) suggest that the regional economic downturn was a key feature underlying the bank failures, but there was not a strong knock-on effect in terms of a local restriction on credit supply leading to further repercussions on the macroeconomy. Possible reasons for this were that banks and financial intermediaries from outside the area may have provided necessary lending, while businesses were able to make use of commercial paper and other types of securities market financing in national markets.

Note that with the exception of the 1987 stock market crash, 1994 bond market reversal and Russia/LTCM in 1998, all of these events had a principal effect on banks, and hence for "multiple avenues" to be an effective buffer, one would be looking for activity in the bond and CP markets to expand in the wake of them.

6 Empirical estimates

6.1 Econometric Model

The theoretical model of Holmstrom and Tirole discussed in Section 3 suggests that several variables should affect both the flow of bank loans and corporate debt issues. To obtain a time series representation of the two variables in question we have developed and estimated a system of equations. The estimated simultaneous reduced form system consists of two linear[5] equations describing the evolution of the levels of corporate borrowing (in both modes) and (in some of our estimates) two equations of their conditional variances, so as to assess whether there are consistent effects of financial turbulence over time.

The system of equations in quasi-reduced form and BEKK (Engle and Kroner 1993) representation is presented below:

$$RL_t = b_1(L)RB_{t-1} + b_2(L)RL_{t-1} + \theta_1^{'}(L)Z_t + \sum_i \delta_i D_{i,t} + u_{1,t}$$

$$RB_t = b_3(L)RB_{t-1} + b_4(L)RL_{t-1} + \theta_2^{'}(L)Z_t + \sum_i \delta_i^* D_{i,t} + u_{2,t}$$

$$where \begin{bmatrix} u_{1,t} \\ u_{2,t} \end{bmatrix} = u_t \quad N(0, \Omega_t) \text{ and} \qquad (5)^6$$

$$\Omega_t = V'V + \sum_k \sum_i A_{k,i}^{'} u_{t-i} u'_{t-i} A_{k,i} + \sum_k \sum_j B_{k,j}^{'} \Omega_{t-j} B_{k,j}$$

where RL and RB denote the real value of corporate bank loans and bond issues and Z denotes the vector of forcing variables that appear in both 'mean' equations. u_t is a vector of white noise innovation whose covariance structure is described above. The vector $D_{i,t}$ consists of dummies that take the value of 1 during the periods of turbulence (plus the following quarter) that have been identified above, and zero otherwise.

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[5] Variables have to be specified linearly to allow for the fact that flows may at times be negative.
[6] We have also estimated the 'constant conditional correlation' version of the multivariate GARCH model (Bollerslev 1990), see Davis and Ioannidis (2002).

To approximate the theoretical concept of 'required returns to uninformed lenders' as suggested by the model in Section 3, we have included in Z the 'credit quality spread' (QUALS) of corporate over risk-free government bonds, defined as the difference between the BAA 10-year corporate bond yield and the equivalent government bond yield. This indicates the default risk and the relative price of corporate bonds. We expect that this variable will be negatively related to the issuance of corporate bonds, while as noted its relation to bank loan demand is subject to conflicting forces. The 'return' to bank loans (LIQP) is approximated by the difference between the Prime Rate and the Treasury Bill Rate. It represents the 'liquidity premium' over risk free that the banks demand in order to provide loan services. (Of course, Prime is an underestimate of costs to the borrowers, which include the risk premium over Prime and unobserved contractual and monitoring costs.) The liquidity premium is expected to influence negatively the volume of bank loans, and again its effect on the demand by corporations for the issue of debt securities is subject to offsetting effects in the model.

Changes in real asset values (DRA), as shown by real stock market returns, indicate collateral asset values. We expect that they will have positive association with 'bond demand' and they will reduce that for bank loans, since at higher asset values more firms can access bonds without monitoring. Conversely, a low level of DRA indicates a "collateral squeeze". Finally, to capture the influence of fluctuations in investment demand on demand for external finance, we include the cyclical fluctuations of 'real' corporate investment' (RBID). These are taken to be deviation of observed real investment from its Hodrick-Prescott representation. A priori, they are expected to be positively related to the demand for both modes of corporate financing. However, if the bond market finds it hard to assess marginal investment opportunities the effect may be to increase the required return and thus reduce bond issues.

Following the discussion in Section 4, to identify 'exogenous' shifts in the relevant supplies of funds we incorporate in the model variables that capture the availability of funds uniquely for each market, in the spirit of Holmstrom and Tirole. These are included in the presence of specific interest rates applying to each market. For the loan equation the relevant supply variable is the evolution of bank capital as shown by the evolution of bank share prices relative to the overall market. Contraction of bank capital will reduce the overall availability of loans to be allocated to the corporate market, although outturns will also depend on the scope of credit rationing. The bank-relative should not impinge directly on the supply of

corporate bonds. The supply of funds to the market for corporate securities originates in household and foreign savings. Cyclical variations in household and foreign incomes will affect the availability of such funds to the bond market and hence to corporations, but should at most indirectly impact on the supply of loans, given alternative sources of bank liquidity. In this context, the bank share price relative to the market (BANKREL) is expected to be positively correlated with bank loans, since higher profitability gives more scope to raise capital, and it will not be correlated with bond issues. The net financial investment of the household and foreign sectors (HNFNID) will be expected to be positively correlated with bond issues and not correlated with bank lending.

In the light of the above discussion, the main hypotheses to be addressed are as follows:

(1) Are there complementarities between lending and bond issuance? In particular, are loans a precondition for expansion of bond issuance? This will be shown in the conditional mean equation by the significant of the lagged variable for the "other" form of financing, or in the conditional variance equation by significance of the lagged volatility for the "other" form of financing.

(2) Does a collateral squeeze impact differentially on loan and bond financing? This will be shown by the sign and significance of the DRA variable for the change in the real share price.

(3) Can one identify separate supply side variables affecting one variable only, thus allowing the system to be identified? This will be shown by the significance of the bank-relative and savings flow variables only in the loan and bond equation, respectively.

(4) Does a credit crunch in banking or a savings squeeze on bonds impact in an offsetting or common manner on forms of financing? This will be tested by the significance of dummy variables for the periods of systemic risk.

(5) Does having multiple avenues affect the volatility as well as the level of overall financing? The key issue for smoothing is whether an idiosyncratic shock raising volatility in one market corresponds to a lower or higher volatility in the other market.

6.2   Results

All the variables that enter the system were tested for stationarity and were found to be I(0). The results are reported in the table below.

Table 3 : Stationarity Tests :

ADF (lags) / PP (lags); Sample 1970q1 – 1990q4

Variable	Test
RL	-3.74(1) /-5.65(4)
RB	-2.74(1)/-3.87(4)
QUALS	-4.18(1)/-3.90(4)
LIQP	-3.47(1)/-3.61(4) (includes trend)
DRA	-6.89(1)/-8.31(4)
RBID	-3.38(1)/-3.23(4)
BANKREL	-2.86(4)/-2.63(4)
HNFNID	-1.76(4)/-8.38(4)

{critical values for 5%,10% (-2.88,-2.57) and with trend (-3.44, -3.14)}

The optimal lag length of the X-VAR depicted in equation (18) was found to be two following the AIC and FPE criteria. Initially, two lags of each of the Z vector were included in the system, along with the relevant dummy variables. In the 'mean' equations, the variables whose t-statistic was found to be below unity were excluded . The results for the loans and debt securities equation for the period 1970:1-1999:4, estimated by seemingly unrelated regressions are presented below in Table 4

Table 4: Estimates of loan and bond equations (SUR estimation)

Sample 1973q1 2000q1					
Loans			Debt securities		
Variable	Coefficient	T-statistic	Variable	Coefficient	T-statistic
Constant	-33695.54	-0.493735	Constant	-26218.17	-0.821382
RL_{t-1}	0.251021	3.033742	RL_{t-1}	0.160051	3.757683
RL_{t-2}	0.078143	0.931087	RL_{t-2}	0.080873	1.712036
RB_{t-1}	0.243836	1.579030	RB_{t-1}	0.432654	5.389443
RB_{t-2}	0.171599	1.148564	RB_{t-2}	0.323400	3.771534
RBID	3821985.	2.921676	$RBID_{t-2}$	-2629805.	-3.042612
LIQP	-111192.9	-3.234302	LIQP	49226.70	2.828990
DRA	-298358.6	-3.433715	DRA	140180.4	2.847265
$QUALS_{t-4}$	36224.68	3.207545	$QUALS_{t-2}$	-28737.99	-3.441190
$BANKREL_{t-3}$	93072.07	1.922971	$HFNFID_{t-3}$	5.525097	2.872542
D1991Q1	-87398.23	-1.534345	D1982Q4	-55572.04	-1.725750
D1998Q4	107896.9	1.820994	D1998Q3	-101466.2	-3.044432
			D1998Q4	-83128.34	-2.525811

Adjusted R-squared	.568	Adjusted R-squared	.744
D-W stat	2.082	D-W stat	1.964
Mean of dep. Variable	89555.55	Mean of dep. Variable	106173.3
S.E of regression	61138.37	S.E of regression	31603.2

Table 5 : System-Wide Diagnostic Tests ;

Test	p-value
LM(4)	0.0816
LM(12)	0.3031
Normality	0.4060

The equations seem to be well specified, as the diagnostic tests provide no rejection of the null hypothesis of i.i.d errors, as shown in Table 5.

The results are strongly consistent with the model set out in Section 3. They show that there is a positive relation of quantities of each form of finance to their own-lags, and for bonds also to the lagged volume of lending finance. This is not the case for bonds in the loan equation. This illustrates the need for loans in advance of bond issuance to provide monitoring. Complementarity goes only from loans to bonds. We note that there is no significant relation between the flow of loans and lagged bond issuance (banks do not require uninformed investment before they finance firms).

As regards collateral effects, the stock market variable DRA has a positive effect on bond issuance, showing bond investors' strong collateral requirements, while it is negative for bank loans (banks are relatively more willing to finance firms at low asset values). Note that the sign patterns in the equation are not purely "cyclical" with bank loans predominant in a recession and bonds in a boom when credit quality and credit demand is high. This is shown by the deviation of investment from the HP filter RBID being signed positively for loans and negatively for bonds, suggesting that the bond market is unwilling to finance marginal projects in a boom. Hence, in a recession, both investment and stock prices would be low, while signs show that bank financing comes to the fore when investment is high and stock prices low. The equations again thus illustrate the complementarity of the two types of finance, and the willingness of banks to offer higher-risk financing as suggested in the "control" theories.

Concerning the interest rate variables, the own-rates LIQP for loans and QUALS for bonds have a negative effect in the respective equations as predicted in the theory, while they are significantly positive in the other market. We noted that the model highlights conflicting determinants. For the loan market, this may suggest that aggregate credit demand rises with a rise in the bond spread (e.g. at the onset of a recession). For bond market it suggests that the

second effect outlined in Section 3 – that when the loan rate rises firms that relied on bank loans can now demand more uninformed finance as I_I has been reduced – is the dominant one.

As expected, the variables for bank share prices and household and foreign net financial investment are only significant in the loans and bonds equations, respectively, and with the expected positive signs. Separate Granger Causality tests confirm that these variables are not Granger-caused at 5% by the dependent variables real loans and real bonds[7].

The dummies capture extraordinary shifts in financing not encapsulated in the financial and economic variables, indicating effects of a bank credit crunch or a savings squeeze as set out in the model. Note their significance is in the presence of variables capturing "normal" changes in the relevant variables. The dummy variables suggest significant falls in own-market financing during the crises of 1982 (which affected bond markets); 1991 (the bank capital crunch) and 1998 (the bond market crises after Russia/LTCM). The only case of direct substitution, i.e. an offsetting extraordinary rise in financing in the "unaffected" market, was in 1998, when bank loans rose significantly in excess of the equation predictions to offset falls in bond issuance. This is as one would expect, namely that expensive informed financing is available – bank capital permitting – without uninformed financing, and hence can substitute. On the other hand, the 1991 crisis is also consistent with the model as uninformed finance cannot substitute for informed, given the information problems. Meanwhile in 1982, banks' capital was hit by the LDC debt crisis so they were apparently unable to compensate for a fall in domestic bond finance.

We ran impulse responses on the small VAR system, shocking real bonds and real loans by one standard error. The Chart 2 and 3 below show the responses. The response of real bonds to real loans is quite marked and initially negative while the response of real loans to real bonds is rather small. This is consistent with the suggestion that there is complementarity from loans to bond issues but not vice versa.

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[7] The P-values that Granger Causality tests that X does not cause Y (using 4 lags) are: RLOANS to HFNFID 0.9, RBONDS TO HFNFID 0.08, RLOANS to BANKREL 0.25, RBONDS to BANKREL 0.21.
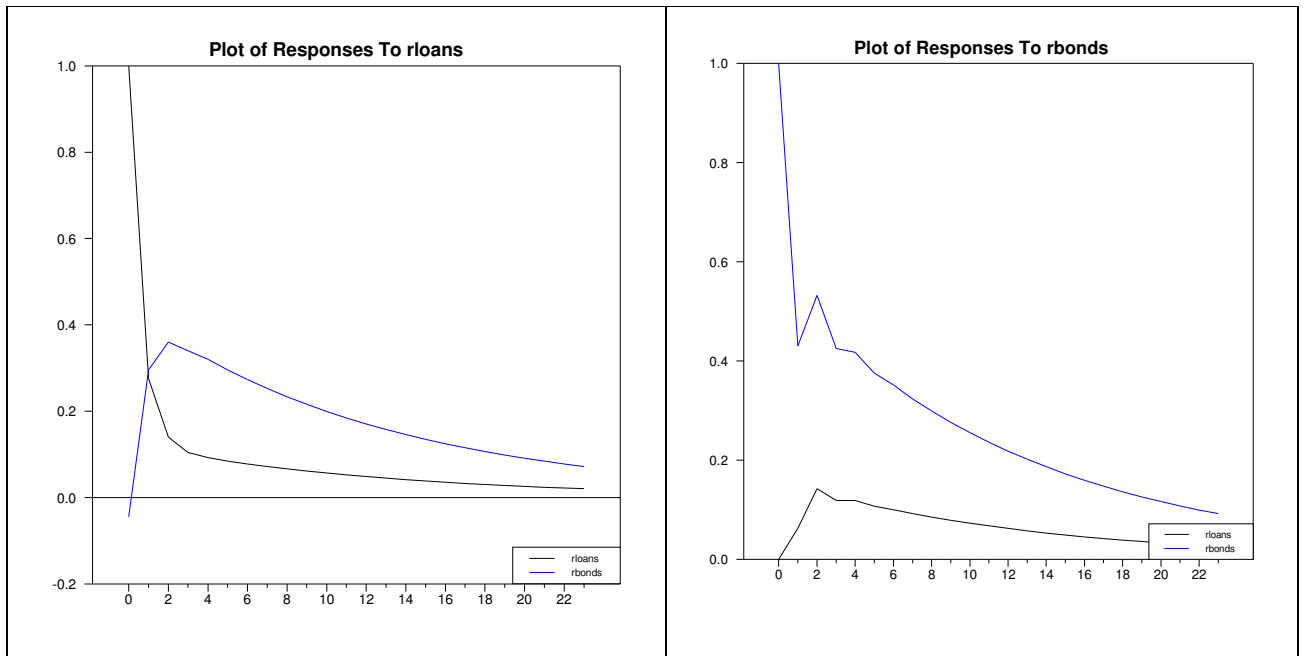
As noted, inclusion of multivariate ARCH terms allows us to enrich the empirical analysis of complementarity by giving an impression of the scope for smoothing in terms of volatilities. Accordingly, further tables below and in Davis and Ioannidis (2002)[8] illustrate the results of simultaneous estimation of M-GARCH with the levels equations. As noted, these test whether there are complementarities in terms of volatility of financing as well as in terms of levels. This gives a more general test of the effect of financial instability than the selected dummy periods.

The conditional variance equations were assumed to be M-GARCH (1,1). The key result is BEKK with dummies only in the mean equation shown in Table 6. In the light of the above results, the lagged bond terms are omitted from the conditional mean equation. GARCH effects are significant in the loan and bond equations, and there is also a significant negative cross effect E_{12} of a shock to loans affecting bond volatility, and also in the opposite direction (E_{21}). The term E_{12} is positive while E_{21} is negative. This is again consistent with the model in that fluctuations in bank lending lead to increase volatility in bond issuance (since monitored finance is essential to permit bond issuance for most firms) while increased conditional volatility of bond issuance leads to damped volatility of bank lending (loans can substitute for bond issues). Smoothing in terms of conditional volatility of overall financing is only indicated for a shock to bond issuance, in other words, while a shock to loans raises volatility

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[8] In Davis and Ioannidis (2002) we show estimates for constant correlation, no dummies in the conditional mean; constant correlation, with dummies in the conditional mean; and BEKK, no dummies in the conditional mean. These do not give reason to revise our basic conclusions.

overall. We note that when GARCH is estimated simultaneously, many of the dummies lose significance, as would be expected, since the volatility captures generalised financial instability.

Table 6: BEKK, with dummies in the conditional mean

Conditional Mean					
Loans			Debt securities		
Variable	Coefficient	T-statistic	Variable	Coefficient	T-statistic
Constant	-47904.612	-0.96	Constant	-8092.414	-0.33
RL_{t-1}	0.381	3.43	RL_{t-1}	0.124	3.31
RL_{t-2}	-0.004	-0.04	RL_{t-2}	0.204	5.48
RB_{t-1}			RB_{t-1}	0.529	6.92
RB_{t-2}			RB_{t-2}	0.209	1.70
RBID	4218281.739	4.34	$RBID_{t-2}$	-28869745.541	-3.95
LIQP	-102678.260	-3.40	LIQP	35203.689	2.89
DRA	-221710.239	-2.60	DRA	108919.423	2.86
$QUALS_{t-1}$	52167.587	5.85	$QUALS_{t-2}$	-34701.205	-4.82
$BANKREL_{t-1}$	95256.568	3.17			
$HFNFID_{t-3}$				7.464	4.95
D1991Q1	-93666.52	-0.13	D1982Q4	-60616.350	-1.53
D1998Q4	180898.482	0.54	D1998Q3	-108838.722	-1.80
			D1998Q4	-51435.578	-0.23
Conditional Variance					
Loans			Bonds		
Variable	Coefficient	T-statistic	Variable	Coefficient	T-statistic
Constant	16924.108	2.33	Constant	31668.773	10.46
e^2_{t-1}	0.282	2.34	e^2_{t-4}	0.096	6.6
Cross-effects					
Variable		Coefficient		T-statistic	
Constant		-70.980		-0.07	
E_{12}		0.148		1.80	
E_{21}		-2.022		-5.46	

7 Conclusion

We are able to capture empirically the behaviour of bank lending and bond issuance over a volatile period of US financial history. We have shown that the US bond and banking markets behave strongly in line with the theory as outlined by Holmstrom and Tirole. The results highlight the complementarity of bank lending and bond issuance, but not vice versa, both in first and second moments. They also indicate that changes in equity values have a marked impact on the corporate financing choice, impacting positively on bond issue and negatively

on bank lending. Furthermore, in crises significant deviations from normal financing behaviour are observed, consistent with predictions of the model about credit crunch (affecting lending directly) and a savings squeeze (affecting bond issuance directly). Only in the latter case can the "other market" compensate with flows of new financing. Consistent with this, estimation of a multivariate GARCH equation suggests that volatility in bank lending affects bond volatility positively but a shock to bonds damps the volatility of bank loans. The overall outcome suggests that "multiple avenues" are not a simple matter of substitution of one market for the other. Securities issuance will have difficulties in offsetting a decline in bank lending because of the need for bank monitoring prior to bond issuance for much of the corporate sector.

An important policy implication arises from our results, in that any financial regulation or market failure which increases the volatility of bank lending will also lead to wider destabilisation of corporate financing. In this context, we note that there has been widespread criticism of proposals to amend the 1988 Basel Capital Adequacy Accord, focusing in particular on the possibility it will increase procyclicality of bank lending. For example, Danielsson et al (2001) highlight the fact that falling credit quality in a recession will boost capital adequacy requirements directly, given their link in Basel II to credit ratings, which may in turn increase credit rationing over and above that which would occur in the absence of the new regulation. Our work suggests that this will in turn reduce scope for affected companies to issue bonds.

REFERENCES

Benveniste, Lawrence M and Allen N Berger. "Securitization with Recourse: An Instrument that Offers Uninsured Bank Depositors Sequential Claims", *Journal of Banking & Finance. Vol. 11 (3). p 403-24. September 1987*

Bernanke, Ben S. "Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression", *American Economic Review. Vol. 73 (3). p 257-76. June 1983*

Bernanke, Ben; Mark Gertler and Simon Gilchrist. "The Financial Accelerator and the Flight to Quality" *Review of Economics & Statistics. Vol. 78 (1). p 1-15. February 1996*

Bollerslev, Tim. "Modelling the Coherence in Short-run Nominal Exchange Rates: A Multivariate Generalized ARCH Model" *Review of Economics & Statistics. Vol. 72 (3). p 498-505. August 1990*

Christiano, Lawrence J, Martin Eichenbaum and Charles Evans. "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds" *Review of Economics & Statistics. Vol. 78 (1). p 16-34. February 1996*

Danielsson Jon et al (2001), "An academic response to Basel II", Special Paper No 130, Financial Markets Group, London School of Economics

Davis E Philip, "Debt, financial fragility and systemic risk, revised and expanded version", Oxford University Press, 1995.

Davis E Philip, "Multiple avenues of intermediation, corporate finance and financial stability", IMF Working Paper No 01/115, 2001

Davis E Philip and Christos Ioannidis (2002), "Does the availability of bank borrowing and bond issuance smooth overall corporate financing?" Brunel University Department of Economics and Finance Discussion Paper

Davis E Philip and Colin P Mayer, "Corporate finance in the euromarkets and the economics of intermediation", CEPR Discussion Paper, No. 570, 1991.

Diamond, Douglas W. "Financial Intermediation and Delegated Monitoring" *The Review of Economic Studies. Vol. 51 (3). p 393-414. July 1984*

Diamond, Douglas W and Philip H Dybvig. "Bank Runs, Deposit Insurance, and Liquidity" *Journal of Political Economy. Vol. 91 (3). p 401-19. June 1983*

Engle, Robert F and Kenneth F Kroner. "Multivariate Simultaneous Generalized ARCH" *Econometric Theory. Vol. 11 (1). p 122-50. March 1995*

Greenspan Alan , "Do efficient financial markets mitigate financial crises?", speech to the Financial Markets Conference of the Federal Reserve Bank of Atlanta, 19 October 1999.

Greenspan Alan , "Global challenges", speech to the Financial Crisis Conference, Council on Foreign Relations, New York, 12 July 2000.

Gunther, Jeffery W; Cara S Lown and Kenneth J Robinson. "Bank Credit and Economic Activity: Evidence from the Texas Banking Decline" *Journal of Financial Services Research. Vol. 9 (1). p 31-48. March 1995*.

Holmstrom, Bengt and Jean Tirole. "Financial Intermediation, Loanable Funds, and the Real Sector" *The Quarterly Journal of Economics. Vol. 112 (3). p 663-91. August 1997*

Kashyap, Anil K; Jeremy C Stein and David W Wilcox. "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance" *American Economic Review. Vol. 83 (1). p 78-98. March 1993*

Knight Malcolm, "Developing countries and the globalization of financial markets", IMF Working Paper No WP/98/105, 1998

Leland, Hayne E and David H Pyle. Informational Asymmetries, Financial Structure, and Financial Intermediation *Journal of Finance. Vol. 32 (2). p 371-87. May 1977*

Mishkin, Frederic S. "Asymmetric Information and Financial Crises: A Historical Perspective" *Financial markets and financial crises. Hubbard, R. Glenn, ed., A National Bureau of Economic Research Project Report Chicago and London: University of Chicago Press. p 69-108. 1991.*

Myers, Stewart C. "The Capital Structure Puzzle", *Journal of Finance. Vol. 39 (3). p 575-92. July 1984*