# Corporate liquidations
## in the United Kingdom

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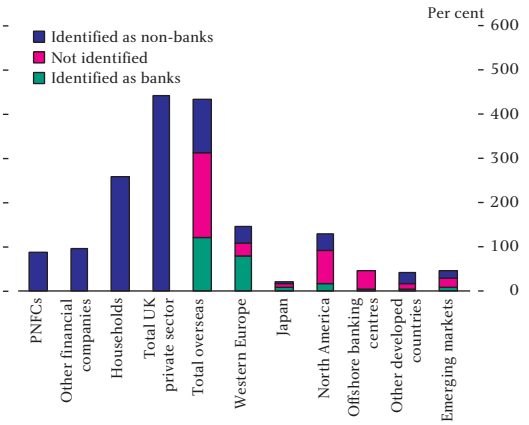
Understanding the factors determining corporate liquidations is one ingredient of prudent banking. This article investigates these in a UK context. It suggests that the substantial rise in corporate liquidations during the recession in the early 1990s mainly reflected deteriorating company finances, including a marked build-up of indebtedness. In the subsequent recovery, however, rising GDP relative to trend and other macroeconomic factors seem to have had greater explanatory power than changes in company finances in accounting for the fall in the corporate liquidations rate to its currently low level.

**CHART 1 ILLUSTRATES** UK-owned banks' on-balance-sheet exposures to different sectors as a proportion of total regulatory capital. At end-December 2000, exposures of UK-owned banks to the private non-financial corporate (PNFC) sector represented 87 per cent of capital.

**Chart 1:**
**UK-owned banks' domestic and overseas exposures**[(a)]




Source: Bank of England.

**(a)** Figures are a percentage of bank capital.

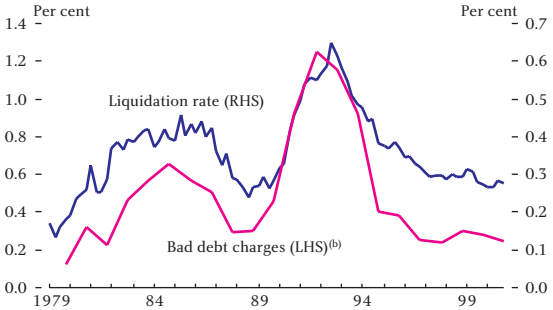
Given this, the treatment of these exposures from the point of view of provisions and capital cover is clearly important. Provisions have generally tended to be set to cover banks against losses that have crystallised, although there is of course an important debate about the use of anticipatory (ie forward-looking) provisions. To the extent that losses are expected at the time a loan is made, they should be reflected in the margin charged on the loan, with capital set to cover unexpected losses (Jackson and Lodge (2000)). To the extent that conditions affecting creditworthiness subsequently change, both any forward-looking provisions and capital cover against unexpected losses may need to be revised. It is encouraging that in recent years many large banks have made increasing use of internal models that incorporate a variety of indicators of the risk of credit deterioration to determine their economic capital. Such indicators include the probabilities associated with changes in credit ratings (transition matrices, see below), corporate bond spreads, equity price volatilities and measures of corporate gearing (see Nickell et al (2001a, b)). These internal models, which differentiate credit risk more precisely, will become a central feature of regulatory capital determination following the implementation of the proposed new Basel Accord (see Jackson (2001)).

Liquidation is an extreme form of credit impairment. In general, the process of credit impairment (or improvement) may be summarised by a transition matrix of ratings. Such a transition matrix may be based on ratings provided by rating agencies or credit grades that result from a bank's internal assessment procedure. A transition matrix gives the probability that a loan of any given rating (or internal grade) will have the same rating in the next period, will be

**1:** The work reported in this article was undertaken while the author was in the Domestic Finance Division, as part of the work programme of the Bank's Financial Stability area on calibrating risks to financial stability.

downgraded or upgraded, or will go into default. The lower the initial rating, the higher the probability that the borrower will default in the next period. In some cases, default will be followed by corporate liquidation. In other cases, a debt restructuring may follow, which, if successful, allows the borrower to continue its activities and avoid liquidation. In any event, default will directly affect bank capital if it is unanticipated and therefore not already allowed for in banks' pricing and provisioning policies. The relationship between bank bad debt charges and corporate liquidations is illustrated in Chart 2.

**Chart 2:**
**Bank bad debt charges and liquidations[a]**




Sources: ONS and Bank of England.

**(a)** Data for the liquidation rate and bad debt charges are quaterly to Q4 2000, and annual to 2000 respectively.

**(b)** Data are a percentage of bank assets.

Understanding the factors that determine corporate failures in the United Kingdom is, therefore, important for banks, regulators and the authorities. The growing use of risk-sensitive internal credit risk models should enable banks to make better assessments of the likelihood of default, particularly given a closer monitoring of transitions through the credit risk spectrum. In the rest of this article, we focus exclusively on corporate liquidations, but it needs to be borne in mind that this is only one manifestation of credit quality deterioration.

To analyse corporate liquidations we use the corporate liquidations *rate*, which is the number of liquidations divided by the stock of companies. A measure that takes into account the size of companies would be desirable from the perspective of measuring its importance to banks. But no aggregate data are available in the United Kingdom on the size of liquidated companies.

Chart 2 also shows that the corporate liquidations rate in the United Kingdom has been quite low since the mid-1990s. In that sense, under current conditions, liquidations can be thought of as low probability but potentially high impact events. The analysis below focuses on probability – that is, the determination of the aggregate rate of corporate liquidations – rather than on the impact on banking system capital. The objective is to explain the behaviour of the liquidations rate over time by factors suggested by economic theory and previous empirical studies.

The article first discusses briefly the relevant previous economic literature on corporate liquidations, both theoretical and empirical. It then describes a time-series model in which the determinants of the aggregate corporate liquidations rate in the United Kingdom are estimated from a sample of quarterly data over the period 1975 Q1 to 1999 Q1. We explore the ability of the model to track the behaviour of corporate liquidations over time; the determinants of the substantial increase in liquidations in the late-1980s/early-1990s; and the subsequent decline to current low levels.

## Theory

The theoretical underpinning of the analysis is provided by a stylised version of Wadhwani's (1986) model, in the style of Scott (1981). A firm is assumed to go bankrupt when the sum of its current year profit, $\pi$, and the expected value of equity (excluding current profit), $S$, is negative, such that $\pi + S < 0$. This condition assumes that a firm has access to external capital and can borrow up to its net worth. If a firm is constrained at its current level of borrowing, the bankruptcy condition substitutes the liquidation value of the firm's assets for the expected value of equity.

If $\pi$ is a random variable with cumulative normal distribution function $F(.)$, mean $\mu_\pi$ and standard deviation $\sigma_\pi$, the probability of bankruptcy (for firms able to borrow) is:

$$F\left[\frac{-(\mu_\pi + S)}{\sigma_\pi}\right].$$

The role of certain financial ratios in calculating the probability of failure, and hence the aggregate liquidations rate, emerges by noting that the variables can be normalised on assets, $A$. The probability of bankruptcy is then a function of profitability, as proxied by the mean rate of return on assets

$\left(\frac{\mu_\pi}{A}\right)$, a measure of capital gearing $\left(1-\frac{S}{A}\right)$ and a measure of the variability of the rate of return

on assets ( $\frac{\sigma_{\pi}}{A}$ ).

The discussion so far ignores the effects of inflation. Inflation that is not expected at the time of entry into a debt contract will reduce the real value of a firm's fixed rate debt. However, expected inflation may also have real effects. Wadhwani (1986) notes that when expected inflation rises, firms with floating rate debt experience a negative cash flow effect as their interest payments increase by more than the output price, but the increase in the nominal value of their assets allows them to borrow more in order to offset this negative cash flow effect. As long as firms can borrow against the market value of their assets, expected inflation will be neutral, ie have no real effects. This applies only if firms have access to external capital on the same terms as internal funds, and depreciation is perfectly indexed. In fact, there is a large theoretical (as summarised in Freixas and Rochet (1997)) and empirical literature (eg Schiantarelli (1996)) that investigates whether or not firms are credit constrained and, if so, face an external finance premium in accessing external funds rather than internal finance. If firms are credit constrained, higher expected inflation will increase the probability of default through the negative cash flow effect from higher nominal interest rates – often referred to as the 'front-end loading effect' of inflation on debt. A change to a higher level of expected inflation[2] – and therefore a higher level of nominal interest rates – will then have real effects. The credit channel literature also suggests that higher nominal interest rates will have a greater effect on corporate real activity, other things being equal, the greater the reliance of the corporate sector on external finance – the so-called 'financial accelerator' effect.

## Empirical model

These theoretical considerations suggest that, in estimating an empirical model, the explanatory variables should include measures of the share of corporate profits in GDP and corporate indebtedness, together with indicators of both expected and unexpected inflation. Empirical studies often decompose the profit share into its short-run determinants, such as real input prices, real wages, real aggregate demand and the real interest rate. One motivation for using these component variables rather than an aggregate profitability index is that changes in different components of profits may not affect all firms in the same way. A nominal interest rate term is included alongside the real interest rate to capture any cash flow effects of expected inflation.

Empirical studies differ in their definition of the real interest rate variable. Young (1995) argues that only unanticipated changes in the real interest rate matter, because the cost of capital goods fully takes into account anticipated changes in the real interest rate. However, distinguishing anticipated from unanticipated real interest rate changes requires a proxy for companies' inflation expectations at different horizons, which is difficult to estimate. This article therefore uses the short-term *ex post* real interest rate. This variable will reasonably capture unexpected changes in real interest rates (and therefore unexpected changes in inflation) if expected real interest rates are relatively stable. This argument is similar to that used in Bordo et al (2000), who argue that changes in the *ex post* real interest rate most likely reflect forecast errors in inflation.

A number of possible additional influences on corporate liquidations can also be identified. The birth rate of new companies is one, because empirical work has shown that young companies are more likely to fail than experienced companies (Altman (1993)). A zero–one dummy variable (*dum*) is included to capture the possible effect of the 1986 Insolvency Act: by introducing new methods of corporate reorganisation, such as administration and administrative receivership, the act may, *ceteris paribus*, have reduced the number of company liquidations subsequently. We also consider whether there is an additional role for non-residential real estate prices *(PROP)*: given that property is often the main source of collateral for firms, a reduction in property prices may limit their access to further borrowing.

In estimating alternative equations for the liquidations rate, we compare specifications using the determinants of profits, which are assumed to be input prices, real wages and the deviation of real GDP

**2:** If credit constraints are exogenous, it does not matter whether the change in inflation is temporary or permanent: both will have real effects. However, it is likely that a permanent change in the inflation rate will eventually result in a change in credit constraints, ie lenders may change their lending behaviour and reduce credit constraints if they know that the nominal value of borrowers' assets will systematically increase at a higher rate.

from trend, with a direct measure of profits. The initial empirical model to be estimated is, therefore, the following[3]:

$$\Delta LQRT_t = \alpha_1 LQRT_{t-1} + \alpha_2(L)\Delta LQRT_t + \alpha_3 DEBT_{t-1} + \alpha_4(L)\Delta DEBT_t + \alpha_5 GDP_{t-1} + \alpha_6(L)\Delta GDP_t + \alpha_7 RM_{t-1} + \alpha_8(L)\Delta RM_t + \alpha_9 RW_{t-1} + \alpha_{10}(L)\Delta RW_t + \alpha_{11} I_{t-1} + \alpha_{12}(L)\Delta I_t + \alpha_{13} R_{t-1} + \alpha_{14}(L)\Delta R_t + \alpha_{15} NEW_{t-1} + \alpha_{16}(L)\Delta NEW_t + \alpha_{17}(L)\Delta PROP_t + c + dum$$

where $\Delta$ denotes a first-difference, $L$ the lag operator[4], *LQRT* is the corporate liquidations rate, *DEBT* is the net debt-to-GDP ratio, *GDP* is the deviation of GDP from trend (obtained as the residuals of GDP at constant prices, regressed on a constant and time trend), *RM* is a measure of real input prices (material and fuel costs deflated by the GDP deflator), *RW* is real unit wages, *I* is the nominal rate of interest, *R* is a measure of the real interest rate, *NEW* is the birth-rate of new companies, *c* is a constant term and *dum* is the Insolvency Act dummy variable. The variables are included in log form, so that their coefficients represent elasticity estimates. The equation is estimated over the period 1975 Q1 to 1999 Q1.

## Estimation results

Results for the preferred specification are shown in Table 1. This model was selected following the procedure of Pesaran and Shin (1998). This procedure maximises a criterion of 'goodness of fit' by searching over all the combinations of variables, after it has been established that the causation runs from chosen right-hand-side variables to the dependent variable, rather than the reverse. This technique is generally preferred to a general-to-specific approach in the presence of cointegration[5]. As a robustness check, a general-to-specific approach was also considered and produced similar results.

Adjusted $R^2$ = 0.65
Standard error of the equation = 0.063
Model *F*-Test = 19.2 (*p*-value = 0.00)
Test for autocorrelation: *LM*(4) = 2.74 (*p*-value = 0.60)

**Table 1:**
**Preferred equation for corporate liquidations rate[(a)]**

| Variable | Coefficient | *t*-statistic |
|---|---|---|
| *Constant* | 0.001 | 0.1 |
| $ECM_{t-1}$ | -0.26 | -7.4 |
| $\Delta LQRT_{t-1}$ | -0.26 | -3.6 |
| $\Delta DEBT_t$ | 0.27 | 3.7 |
| $\Delta GDP_t$ | -4.37 | -5.2 |
| $\Delta R_t$ | 0.012 | 2.5 |
| $\Delta R_{t-2}$ | -0.034 | -5.6 |
| $\Delta I_{t-2}$ | 0.022 | 2.7 |
| $\Delta NEW_{t-3}$ | 1.87 | 5.0 |
| $\Delta NEW_{t-4}$ | -1.51 | -5.0 |
| $\Delta PROP_{t-2}$ | -0.66 | -1.7 |

**(a)** Parsimonious equation in error correction form resulting from maximising the Schwartz Bayesian criterion (see Vlieghe (2001)).

The error-correction term (*ECM*) gives the implied long-run equation for corporate liquidations (*t*-ratios in parentheses):

$$LQRT = \underset{(4.66)}{0.48}*DEBT - \underset{(-4.35)}{5.59}*GDP + \underset{(8.30)}{0.068}*R + \underset{(4.98)}{4.95}*RW - \underset{(-21.7)}{7.77} - \underset{(-2.87)}{0.38}*dum$$

As noted above, the coefficients in the equation represent long-run elasticities[6], except for the coefficient on interest rates, which is a semi-elasticity. In other words, an increase in the debt-to-GDP ratio of 1 per cent will, *ceteris paribus*, raise the equilibrium corporate liquidation rate by 0.48 per cent. Similarly, a decrease in the level of GDP of 1 per cent away from its estimated trend level will increase the liquidations rate by 5.59 per cent; a rise in real

**3:** This equation, and the following analysis, is based on the forthcoming Working Paper by Vlieghe (2001). Further details on the estimation are available from this source.

**4:** The difference operator $\Delta$ transforms a variable $x_t$ into its first difference: $x_t - x_{t-1}$. The lag operator transforms $x_t$ to its lagged value: $x_{t-1}$.

**5:** Although individual variables follow a random walk (meaning they do not revert to a long-run average), they may still move together in the long run, ie be cointegrated. If variables follow a random walk but are cointegrated, standard statistical inference techniques, such as *t*-statistics to test whether individual variables are significant in the equation, have different distributions. The Pesaran and Shin (1998) procedure is one way of adjusting standard procedures to allow for the possibility of cointegration.

**6:** The concept of the long run in error-correction models is specific to each equation. The long run is the level that the dependent variable is tending towards, but the actual data may deviate from this level because of factors that have only a temporary influence. The long-run horizon in this case is shorter than the 'long-run' often referred to in macroeconomics, where it is generally used to denote movements that are unrelated to business cycles.

interest rates of 1 percentage point will increase the liquidations rate by 6.8 per cent, and a rise in unit real wage costs of 1 per cent will increase the liquidations rate by 4.95 per cent.

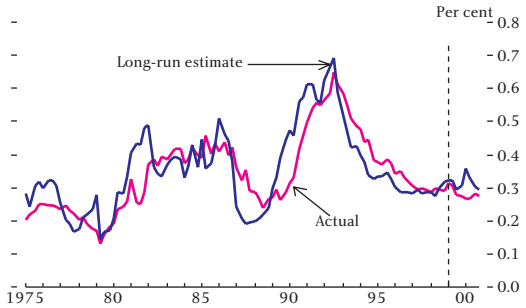
Summarising the results of the estimation procedure, input prices were not found to be significant; the nominal interest rate, the birth rate of new companies and property prices do not appear in the long-run equation but have significant and plausibly-signed short-run coefficients (property prices are significant only at the 10 per cent level); the positive coefficient on the nominal interest rate is consistent with other evidence (Wadhwani (1986), Young (1995)) of an adverse effect of rising inflation on company cash flows[7]; and, using a variety of tests, there is evidence of a long-run relationship between the company liquidations rate and the debt-to-GDP ratio, deviation of real GDP from trend, the real interest rate and real wages. The model fits the data quite well and passes each of the diagnostic tests for misspecification. Each of the variables in the preferred equation is statistically significant at conventional levels and the variables are also signed intuitively.

By plotting the actual corporate liquidation rate against the fitted long-run equilibrium, we can analyse the extent to which changes in the liquidations rate over time reflect changes over the long run in the macroeconomic environment or the financial structure of companies, or are instead a consequence of short-run dynamic effects. Short-run dynamic effects include past changes in the long-run variables that have not yet had their full effect, or changes in the birth rate of new firms, nominal interest rates or property prices.

The fitted long-run equilibrium of the liquidations rate is illustrated alongside the actual rate in Chart 3. Note that this extends the actual and predicted values to 2000 Q4, beyond the period used for the estimation, which ends in 1999 Q1 as indicated by the dotted line. This allows an assessment of the out-of-sample predictive ability of the preferred equation[8].

Chart 3 shows that the actual level of corporate liquidations closely follows the long-run equilibrium

**Chart 3:**
**Liquidations rate - actual and long-run estimate**




Sources: DTI and Bank of England.

(see also *Financial Stability Review*, December 2000, page 71). Deviations from the long-run equilibrium reflect the effect of the short-term variables (nominal interest rates, property prices, and the birth rate of new companies), the fact that the long-run variables have their full effect only with a lag, and the residuals. The variance of the equation residual is about one-fifth (0.22) of the variance of the long-run residual (ie the deviation of the liquidations rate from its implied long-run level), which implies that most of the deviation from the long-run level is accounted for by the short-run dynamics of the equation[9].

The coefficient on the error-correction term in Table 1 indicates that the actual rate converges to the long-run solution at a rate of 26 per cent of the gap in each quarter. Three-quarters of the gap is therefore removed in five quarters. In 2000 Q4 the long-run solution to the model was only marginally above the actual rate.

One *caveat* of this reduced-form approach is that it is vulnerable to the Lucas critique: the structure of the economy may have changed over time in important ways. For example, the real interest rate may no longer need to increase by as much as in the past in order to stabilise inflation, given the new monetary policy regime in the United Kingdom since 1997. This would not only change the probability distribution of inflation, the output gap and the real interest rate, but it is likely to affect borrower and lender behaviour as well. All these changes would in turn result in different coefficients on the 'true' equation. However, the estimated equation shows no sign of

**7:** Since the nominal rate is only significant in differences, not levels, a move to a higher (or lower) expected inflation rate is estimated to have only a temporary effect on the liquidations rate.

**8:** The out-of-sample predictions in Chart 3 use actual data as the lagged dependent variable.

**9:** For the out-of-sample predictions, this ratio is similar at 0.18.

instability over the sample period[10], and it has continued to fit the out-of-sample data well. This indicates that, so far, there is no evidence that those aspects of the structure of the economy that are relevant to the determination of the liquidations rate have changed substantially.

## Application to the 1990s recession and the subsequent recovery

The preferred equation can be used to decompose the factors responsible for the substantial increase in the corporate liquidations rate in the late 1980s and early 1990s, associated with the early 1990s recession in the United Kingdom. It can also be used to assess the factors responsible for the subsequent decline in liquidations as the economy recovered from recession (Table 2). During the period 1988 Q3 to 1992 Q3, the UK corporate liquidations rate nearly tripled from 0.238 per cent to 0.647 per cent (quarterly). The increase in corporate indebtedness prior to and during that period, perhaps associated with rapid output growth and financial liberalisation of the mid- to late-1980s, was the most important single explanatory factor. Falling GDP relative to trend, rising real wages and rising real interest rates following the subsequent tightening of monetary policy accounted for a significant part of the increase in liquidations, but they were less important, individually, than the rise in corporate sector indebtedness. Falling property prices also had some effect in raising liquidations, but it is interesting that, as the dummy effect suggests, the rise in liquidations was restrained by the adoption of the 1986 Insolvency Act.

These results can be compared with the factors accounting for the decline in liquidations recorded over the period 1992 Q3 to 1997 Q3[11], during which the rate fell by 54.1 per cent. The rise in the profit share (implied by the fall in the real unit wage) was the single most important factor, with the recovery in GDP relative to trend and the falling real interest rate important to a similar degree in accounting for the reduction in the liquidations rate. Changing corporate sector indebtedness had little cumulative effect as indebtedness fell initially, but then rose again over this period.

**Table 2:**
**Contribution of variables to the change in liquidation rate**

| Time period | 1988 Q3 to 1992 Q3 | 1992 Q3 to 1997 Q3 |
|---|---|---|
| Change in liquidations (per cent) | 171.3 | -54.1 |
| Contributions (pp): | | |
| Debt to GDP ratio | 67.3 | -1.8 |
| GDP from trend | 51.0 | -14.2 |
| Real interest rate | 21.8 | -13.4 |
| Nominal interest rate | -2.5 | 2.6 |
| Birth rate of firms | -9.4 | 4.4 |
| Property prices | 9.6 | -3.7 |
| Real unit wage | 42.8 | -25.4 |
| Insolvency Act dummy | -19.1 | 0.0 |
| Residual | 9.8 | -2.7 |

Source: Vlieghe (2001).

Looking forward, this analysis might be useful in two ways. First, by making forecasts of economic and financial conditions, the path of future corporate liquidations can be forecast. Second, by making assumptions about the probability distribution of the economic and financial variables used in this model, banks and policy makers can map out the corresponding expected probability distribution of the liquidations rate. This could be estimated by using the historical distribution of the explanatory variables in calculating margins and provisioning levels. In addition, hypothetical scenarios could be examined for the purposes of stress-testing when calculating economic capital requirements.

## Conclusion

The UK banking sector inevitably has a substantial exposure to the UK private non-financial corporate sector and, historically, bad debt charges have moved with the corporate liquidations rate. This article has considered the behaviour of corporate liquidations in the United Kingdom. The implications for the financial sector depend on the extent to which

**10:** This is analysed in more detail in Vlieghe (2001).

**11:** 1997 Q3 represented the trough of the liquidations rate at the time this equation was initially estimated. The liquidations rate has subsequently reached a slightly lower point in 2000 Q1.

corporate failure is unanticipated and therefore not taken into account in banks' pricing and provisioning policies. It follows that banks (and other providers of finance) need to make provisions for an expected level of corporate failure that is not covered by the margin charged on the finance. Furthermore, banks need to set aside economic capital to cover any unexpected defaults and to revise their provisioning for changes in expected defaults in the light of outturns relative to prior expectations.

**References**


**1**: Altman, E (1993) 'Corporate Financial Distress and Bankruptcy' (2nd ed), Wiley & Sons, NY.

**2**: Bordo, M D, Dueker, M J and Wheelock, D C (2000) 'Aggregate Price Shocks and Financial Stability: An Historical Analysis', NBER Working Paper No. 7652.

**3**: Freixas, X and Rochet, J-C (1997) 'Microeconomics of Banking', MIT Press.

**4**: Jackson, P (2001), 'Bank Capital Standards: the New Basel Accord', *Bank of England Quarterly Bulletin* 41(1), Spring, pages 55–63.

**5**: Jackson, P and Lodge, D (2000) 'Fair Value Accounting, Capital Standards, Expected Loss Provisioning, and Financial Stability', *Bank of England Financial Stability Review*, June, pages 105–125.

**6**: Nickell, P, Perraudin, W and Varotto, S (2001a) 'Ratings Versus Equity-based Credit Risk Models: an Empirical Analysis', Bank of England Working Paper No 132.

**7**: Nickell, P, Perraudin W and Varotto, S (2001b) 'Stability of Ratings Transitions', Bank of England Working Paper No 133.

**8**: Pesaran, M H and Shin, Y (1998) 'An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis', in Strom, S (ed) 'Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium', Cambridge University Press.

**9**: Schiantarelli, F (1996) 'Financing Constraints and Investment: A Critical Survey of the International Evidence', *Oxford Review of Economic Policy* 12(2), pages 70–89.

**10**: Scott, J (1981) 'The Probability of Bankruptcy: A Comparison of Empirical Predictions and Theoretical Models', *Journal of Banking and Finance* 5.

**11**: Vlieghe G W (2001) 'Indicators of Fragility in the UK Corporate Sector' forthcoming, Bank of England Working Paper.

**12**: Wadhwani, S (1986) 'Inflation, Bankruptcy, Default Premia and the Stock Market', *Economic Journal* Vol. 96, pages 120–138.

**13**: Young, G (1995) 'Company Liquidations, Interest Rates and Debt', *The Manchester School* Supplement, Vol 63, pages 57–69.