Indicators of fragility in the UK corporate sector

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Abstract

The determinants of the aggregate corporate liquidation rate in the United Kingdom are estimated from a sample of quarterly data using an autoregressive distributed lag (ARDL) approach which allows for non-stationarity of the variables. The paper investigates what the appropriate measures of indebtedness are, and examines whether the unprecedented spike in the corporate liquidation rate in the United Kingdom in 1992 caused a breakdown in the relationship between the variables. The debt-to-GDP ratio, the real interest rate, deviations of GDP from trend and real wages are found to be long-run determinants of the liquidation rate. The birth rate of new companies, an index of property prices and nominal interest rates have significant short-term effects. The estimated equation is robust to changes in the sample period. The rapidly increasing level of indebtedness in the late 1980s was the main determinant of the subsequent increase in the liquidation rate. The decrease in the liquidation rate after 1992 was primarily due to lower real interest rates, lower real wages and the cyclical recovery of GDP.

Summary

This paper investigates the determinants of corporate failures in the United Kingdom using aggregate time series data. It is part of a continuing programme of empirical research being undertaken in the Bank of England's Domestic Finance Division on the causes and consequences of financial health or distress in the UK corporate sector (see, for example, Benito and Vlieghe (2000) using micro-data).

Corporate failures are important in several respects. A high *ex post* corporate failure rate might be evidence of a financially fragile corporate sector, which may have important macroeconomic consequences. When firms are financially fragile, problems of asymmetric information between firms and their lenders are likely to become worse. This could result in an inefficiently high rate of corporate failure. Corporate failures may also affect bank capital: if realised losses on the corporate loan book are unanticipated, bank capital is eroded, thereby weakening the banking system. For these reasons, it is important to understand what drives corporate liquidations, and this is the objective of this paper.

A stylised model of the firm is derived. This model suggests that the corporate failure rate should be determined by profits, by the level of indebtedness, and, if firms face borrowing constraints, by the level of inflation. As there is no single perfect measure for profits or indebtedness, a range of variables that may proxy for these determinants is explored.

The main findings are the following. Capital gearing ratios based on the market value of the company's assets are found to be marginally less satisfactory in explaining corporate failures than are ratios that measure debt relative to the replacement cost of assets or relative to GDP. Furthermore, the determinants of profits (real wages, aggregate demand, real interest rates) have better explanatory power than aggregate profits. This may be because aggregate profit levels mask important differences in profitability between firms.

Property prices are found to have a significant short-run effect on company failures, which is consistent with the important role property plays as collateral for corporate borrowing. The birth rate of new companies is also found to have a significant short-run effect on company failure. This is consistent with other evidence that new companies are more likely to fail than more experienced ones.

Real interest rates, rather than nominal interest rates, are found to be a significant long-run determinant of corporate failure. This is consistent with the debt-deflation theory. The additional short-run effect of nominal interest rates is consistent with the adverse effect of higher inflation on company cash flows in the presence of borrowing constraints or non-neutralities in the tax system.

The spread of corporate bond yields over government bond yields does not predict corporate failures well. This may be due to the fact that corporate bond spreads are determined more by liquidity factors, especially during periods of low bond market issuance, than by investors' assessment of default risk. Moreover, bond-issuing corporates may not be a representative sample of the corporate sector as a whole.

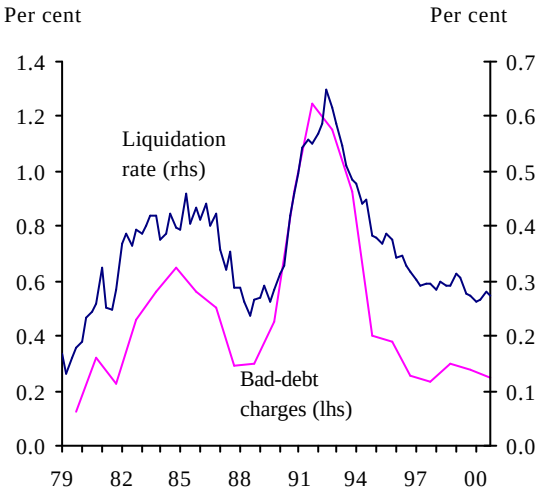
The empirical relationship between the liquidation rate, debt levels, the interest rate and profitability has been surprisingly stable over time. But variation in the liquidation rate has been driven by variation in different explanatory factors over the sample period. Whereas the rise in the liquidation rate in the early 1990s is attributed primarily to rapidly increasing levels of indebtedness, the decline after 1992 is explained largely by falling real wages, the cyclical recovery of GDP relative to trend and falling real interest rates.

1 Introduction

The role of the corporate sector in transmitting or amplifying shocks has been addressed in both theoretical and empirical work. This body of work, which will be briefly reviewed, broadly concludes that a corporate sector that is financially fragile is more likely to play a role in deepening and prolonging recessions, and may even provide the trigger for a recession to become a financial crisis. In recent years, the crises in East Asia have illustrated the contribution of the corporate sector to the depth and duration of recessions (see, for example, Hussain and Wihlborg (1999)).

This paper investigates the determinants of corporate failures in the United Kingdom using aggregate time series data. It is part of a continuing programme of empirical research being undertaken in the Bank of England's Domestic Finance Division on the causes and consequences of financial health or distress in the UK corporate sector (see, for example, Benito and Vlieghe (2000) using micro-data).

Chart 1: Bank bad-debt charges (relative to assets) and the liquidation rate of non-financial companies



Sources: ONS and annual accounts of major British banking groups. See appendix for details of calculation.

Corporate failures are important in several respects. A high *ex post* corporate failure rate might be evidence of a financially fragile corporate sector, which has important macroeconomic and welfare consequences as described in Section 2. Corporate failures may affect bank capital: if realised losses on the corporate loan book are unanticipated, bank capital is eroded, thereby weakening the banking system. Corporate failures may therefore be an indicator of the state of banks' loan books, as illustrated in Chart 1.

If corporate failures are due to insolvency, a welfare loss arises from the direct administrative costs of bankruptcy. Although the administrative costs are paid to insolvency professionals who may be using their resources efficiently, this economy is inferior, from a welfare perspective, to a situation where bankruptcy is costless. This is because in an economy with costless bankruptcy, the resources that would have been used in sorting out bankruptcies can now be used for other

productive ends, and lenders do not need to be compensated for the possibility of having to incur the costs of bankruptcy. The higher the level of corporate failures, the more resources are diverted to pay for the administrative costs of bankruptcy. If corporate failures are due to illiquidity rather than insolvency, they represent an additional welfare loss if the assets have a degree of specificity, ie if they are more productive within the firm than when transferred to another owner. But some level of corporate failures may also be welfare-enhancing, by transferring resources from inefficient to efficient firms.

While the welfare aspects of corporate failures justify studying them in more detail, the welfare implications of corporate failures are not measured or studied in this paper. The focus is on finding the determinants of corporate failures in order to understand their behaviour in the long term and across the business cycle.

Relative to other studies of aggregate coporate failures, the particular focus of this paper is in the following areas. The econometric approach is more general and imposes fewer prior restrictions. We focus on the optimal choice of the variables used in previous studies, in terms of goodness of fit and stability of the relationship over time, using a dataset that includes the 1990s recession and the subsequent recovery. Some new explanatory variables are explored, which have not appeared in previous studies. Finally, the relative contribution of the variables to past recessions and recoveries is analysed.

To analyse corporate liquidations this paper uses 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 and therefore the stability of the financial system. Unfortunately, no aggregate data are available in the United Kingdom on the size of liquidated companies.

The paper is organised as follows: Section 2 highlights some key papers on the role of the corporate sector in macroeconomic fluctuations; Section 3 reviews the literature on corporate failures in the United Kingdom; Section 4 presents the empirical results; and Section 5 concludes.

2 Why does corporate sector 'health' matter in the macroeconomy?

The earliest reference in explaining the role of the corporate sector in financial crises is Fisher's (1933) analysis of the interaction between indebtedness and price level disturbances. The essence of Fisher's theory was that firms that are highly indebted come under financial pressure when the economy slows down. To satisfy creditors, they are forced to sell assets and reduce deposits to repay loans. The asset sales result in falling asset values, which reduce all firms' net worth, and therefore increase the probability of bankruptcy. The reduction of deposits and repayment of loans results in a money velocity shock, which causes a fall in the price level, which feeds back to firms'

net worth via a higher real debt burden on firms with fixed-rate debt. If the fall in the price level is accompanied by an increase in real interest rates, it will also affect firms with variable-rate debt.

Fisher's theme was picked up and discarded several times in the 40 years following its publication (see the extensive literature reviews by Gertler (1988) and Freixas and Rochet (1997)), but enjoyed a revival after the late 1970s with authors such as Mishkin (1978) and Bernanke (1983), who presented evidence that the debt burden of the non-financial sector played a key role in the Great Depression. In this same period theoretical advances were made in the fields of moral hazard and adverse selection in credit markets. Key studies in this area were Akerlof (1970), Jaffee and Russell (1976) and Stiglitz and Weiss (1981), who analysed the interaction between the incentives of lenders and borrowers. A series of models in the 1980s and 1990s integrated the micro and macro strands of credit market theories, to provide a role for corporate financial structure in macroeconomic fluctuations.

Mankiw (1986), for example, showed how a small increase in the interest rate can cause a collapse of credit markets in the presence of asymmetric information, and therefore result in a financial crisis. Bernanke and Gertler (1990) present a model where a fall in borrowers' net worth can exclude them entirely from access to credit, with an accompanying collapse in investment demand. Kiyotaki and Moore (1997) show how collateral value affects credit limits, and therefore investment demand, which amplifies and prolongs macroeconomic fluctuations.

The financial position of the corporate sector therefore matters because it influences banks' *willingness* to lend. That, depending on the particular model studied, may be sufficient to affect aggregate demand directly, if firms are credit-constrained, or alternatively may increase the cost of intermediation, thereby making it uneconomic for firms to borrow. Both of these mechanisms lead to a higher probability of corporate failure: the first, because a credit constrained firm may have insufficient cash flow to pay interest on its debt (failure due to illiquidity); the second, because the increased cost of intermediation represents an increase in the effective interest rate faced by borrowers, which reduces the value of the firm (failure due to insolvency). Note that, for this process to generate a welfare loss, it is not necessary for firms actually to fail, nor is it necessary for the fragility to be experienced by the whole sector. A state of heightened fragility at a single firm will in itself lead to inefficient allocation of resources. This is not only due to a reduction in available credit which causes valuable investment opportunities to be missed, but also because resources devoted to 'staying afloat', eg to the cost of renegotiating debt contracts, are crowding out resources required for production (see, *inter alia*, Myers (1993)).

3 Overview of previous studies of aggregate corporate liquidations

Wadhwani (1986) examined the determinants of corporate liquidations to test the hypothesis that inflation plays a significant role. Firms financed by variable-rate debt should not, in theory, be affected by inflation in a perfectly indexed economy, because the increase in interest payments due to higher nominal rates can be financed by an increase in debt, to match the increase in the nominal value of assets. In the absence of perfect capital markets, however, firms may be unable to

increase their borrowing, and therefore face a cash flow shortage as the increase in interest payments is proportionally larger than the increase in revenues.

To test this hypothesis, Wadhwani regressed the liquidation rate of firms (as measured by the ratio of compulsory and creditors' voluntary liquidations divided by the number of active companies on the register) on a number of macroeconomic and financial variables. He found that real wages, real input prices, capital gearing (using market values), the real interest rate, the nominal interest rate and measures of aggregate demand are significant. The rate of new company registrations is not reported in the final specification and a measure of the standard deviation of prices was not significant. The fact that both real and nominal interest rates are significant is taken as evidence that inflation directly affects the liquidation rate.

Hudson (1986) estimated separate equations for compulsory liquidations, creditors' voluntary liquidations and members' voluntary liquidations (where the shareholders or, effectively, the directors decide to liquidate a solvent company). For our purposes, the first two are of interest. In a specification that is conceptually similar to Wadhwani, Hudson used measures of profitability, the real interest rate and the birth rate of new companies. He found a negative coefficient on the real interest rate, interpreted as evidence for adverse selection in credit markets: at higher rates, only high risk borrowers will find it worthwhile to borrow, and these are more likely to be borrowers in distress. Therefore, at high real rates credit is diverted to distressed firms, which are therefore less likely to fail. Hudson found significant coefficients for a lagged structure of birth rates, which is consistent with the stylised fact that younger (ie less experienced) firms are more likely to fail.

Davis (1987) based his analysis on Wadhwani's theoretical model. Instead of capital gearing, Davis used the debt/GNP ratio, and otherwise included the same explanatory variables as Wadhwani. The sample period was 1969-83, with annual data. Davis used an error-correction specification to avoid the spurious regression problem associated with non-stationary data. He also specified the model in logs, which has the rather desirable property that, under worse macroeconomic conditions, a given adverse change in any of the variables will result in a larger change in the number of insolvencies. He found nominal interest rates, real GNP, real input prices and the debt/GNP ratio to be significant, but not real interest rates. Davis also experimented with various debt ratios, but found that the debt/GNP ratio was more significant than the debt/equity ratio, the variable used by Wadhwani for a different sample period.

Cuthbertson and Hudson (1996) analysed the determinants of compulsory liquidations only. They used as independent variables a measure of profitability, interest gearing (as joint proxy for nominal interest rates and capital gearing) and the lagged birth rate of new companies. Using quarterly data from 1972 to 1989, they found profitability and birth rate significant in levels, but interest gearing only significant in differences, suggesting that it has only a short-run effect and does not influence the steady-state liquidation rate. They also included a shift dummy in 1988 to allow for a temporary effect of the 1985-86 reforms of the insolvency regime (in particular, the introduction of Administration from December 1986). This dummy was found to be significant, indicating that the reforms resulted in a temporary reduction in the liquidation rate.

Young (1995) focused on the effect on corporate liquidations of interest rates. He argued that what matters is not real interest rates and inflation *per se*, but the extent to which *ex post* inflation and real interest rates differ from their expected levels. He used the gilts term structure to infer nominal interest rate expectations and NIESR[1] inflation forecasts to construct *ex ante* real interest rates. The estimated equation uses the liquidation rate (compulsory and creditors' voluntary liquidations) as the dependent variable. The explanatory variables, which represent an extension of Wadhwani's model, are the growth rate of companies (a proxy for company births), real wages, real input prices, unexpected real interest rate movements, nominal interest rates, various debt ratios, aggregate demand and a dummy to capture the effect of the new Insolvency Acts. He found the following variables to be significant: the unanticipated component of the real interest rate, the growth rate of the number of companies, aggregate demand, real input prices, the nominal interest rate and the ratio of bank debt to the replacement cost of capital. Real wages, the debt/market value ratio, unanticipated inflation, the real interest rate and the Insolvency Act dummy were not significant. He concluded that the higher-than-expected outturn of real interest rates was the primary cause of the large number of liquidations in the early 1980s, whereas rising debt levels, which cause a higher liquidation rate for a given distribution of shocks, were the cause of the rise in liquidations in the early 1990s. He also found evidence for Wadhwani's hypothesis that credit markets do not allow firms to adjust their debt levels for inflation, as the nominal interest rate is found to be significant. Inflation therefore hurts companies on the way up, due to the cash flow problem associated with high nominal interest rates, and on the way down, when a stronger-than-anticipated fall in inflation causes an unanticipated increase in the real interest rate.

Davis (1992) re-estimated his 1987 specification using a longer run of quarterly data (1968-89). The focus of the paper is the predictive power of private-public bond spreads, using a variety of econometric tests. Davis concludes that spreads do not have additional predictive power for defaults over the entire sample period. However, they have significant long and short-run predictive power for the pre-1977 period, when bond markets were more liquid. Spreads have significant short-run predictive power in the post-1977 period, but with the wrong sign. This was interpreted as evidence that factors other than default risk became the primary drivers of bond spreads over this period, owing to low liquidity in the bond market. As is pointed out in the paper, only a small fraction of corporates issue bonds, which may be an additional reason why bond spreads are not a good overall indicator of defaults.

In the United States, similar work has been carried out. Altman (1983), for example, estimated the corporate failure rate as a function of GNP, growth of the money supply and new incorporations, but did not include firm-specific variables. Platt and Platt (1994) used real interest rates, real wage costs, profits earned by sole proprietorships, the change in employment (as a proxy for the business cycle) and new incorporations as explanatory variables. They used a panel data approach, pooling state-level data into farm, industrial, oil-producing and less-industrialised sectors to compare how elasticities with respect to the explanatory variables differ across sectors.

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[1] National Institute of Economic and Social Research.

4 Examination of UK data from 1975 to 1999

4.1 Theoretical model

We use the following model of the firm, which is a stylised version of Wadhwani's (1986) model, in the style of Scott (1981).

A firm is assumed to go bankrupt when

$$\Pi + S < 0$$

where Π is the level of profit and *S* is the expected equity value of the firm (ignoring the profit), which satisfies *S=MV-D*, ie the value of the equity equals the value of the assets minus the value of the debt.

Note that this 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 becomes

$$\Pi + K < 0$$

where *K* is the liquidation value of the firm's assets at the beginning of the period.

If Π is a random variable with cumulative distribution function F(.), mean m_Π and standard deviation s_Π, the probability of bankruptcy is:

$$F\left[\frac{-(m_\Pi + S)}{s_\Pi}\right]$$

(replace *S* with *K* for borrowing-constrained firms).

In other words, the probability of bankruptcy is the probability that losses are so large that they wipe out the entire value of the firm.

To illustrate the use of financial ratios in calculating the probability of failure, note that the variables can be normalised on assets *A*. The probability of bankruptcy then becomes a function of profitability ($\frac{m_\Pi}{A}$), capital gearing ($\frac{S}{A}$ or its commonly used counterpart, $1-\frac{S}{A}$) and a measure of the variability of profits ($\frac{s_\Pi}{A}$).

To decompose changes in profitability, note that it can be written as

$$\Pi = pY - wL - qM - rD$$

where *p* is the output price, *Y* is output, *w* is the wage rate, *L* is the level of employment, *q* is the input price, *M* are raw materials, *r* is the interest rate and *D* is the level of debt.

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.

Let $\dot{p}$ denote the rate of inflation. For firms with access to external capital, the bankruptcy condition becomes

$$(1+\dot{p})(\Pi + S) < 0$$

For firms whose borrowing is constrained, the bankruptcy condition becomes

$$(1+\dot{p})\left[\Pi + K - \frac{\dot{p}}{1+\dot{p}}D\right] < 0$$

The associated bankruptcy condition then becomes

$$F\left(\frac{-m_{\Pi} - K + \frac{\dot{p}}{1+\dot{p}}D}{s_{\Pi}}\right)$$

So the probability of bankruptcy is increasing in inflation, the level of debt and the standard deviation of profits. It is decreasing in expected profits and the value of the firm's capital stock.

[(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.

The term in debt (*D*) is the front-loading effect. It illustrates the increase in debt that would be necessary to achieve *de facto* indexation of the debt burden.

Note that we have so far conducted the analysis without taking taxes into account. In analysing profits, this is justified by the fact that interest payments are tax-deductible, and whether a firm can afford its interest payments therefore depends on pre-tax profits. However, this analysis, including the neutrality of inflation for firms with access to external capital, is only valid if the tax system is fully indexed.[3] In practice, this is not the case. For example, depreciation allowances are fixed in nominal terms as a proportion of historical cost. Taxes will therefore rise in real terms due to inflation. This affects both the value of the firm and the level of profits available to pay interest, even in the absence of borrowing constraints.

Using the model of the firm just presented, the probability of bankruptcy is shown to depend on profits, the level of indebtedness (relative to either the market value or the liquidation value of assets) and inflation. In the literature, the profits variable is often decomposed into variables that are hypothesised to determine profits, such as real input prices, real wages, real aggregate demand and the real interest rate.

4.2 Empirical model

We now turn to the estimation of the empirical model. The definitions of the variables and their deflators are listed in the appendix. As implied by the theoretical model, the variables used are indebtedness and profits, where profits are substituted by its determinants: input prices, real wages, aggregate demand and the real interest rate. The nominal interest rate is included to capture any effects of inflation.

It is appropriate at this point to discuss the definition of the real interest rate variable. Empirical studies differ in their definition of the real interest rate. Wadhwani (1986) used the fitted value of the *ex post* real interest rate, arguing that under rational expectations it differs from the *ex ante* real interest rate by a white noise forecast error. Hudson (1986) used the nominal rate minus the most recent known inflation rate, arguing that no reliable survey data exist on inflation expectations for his sample period. Young (1995) decomposes the real interest rate into an *ex ante* and *ex post* component using NIESR inflation forecasts as a proxy for inflation expectations.

To avoid the estimation problems related to the term structure of inflation expectations required for a full treatment of *ex post* and *ex ante* real interest rates, this paper 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.

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[3] For a detailed treatment of the interaction between deductibility of interest payments and depreciation allowances with inflation, see, for example, King (1977).

The *new* variable is the birth rate of new companies. It is intended to capture the fact that young companies have empirically been observed to be more likely to fail than experienced companies (see Altman (1993)). An increase in the birth rate is therefore expected to lead to an increase in the failure rate.

A 0-1 dummy variable (*dum*) was included to capture the possible effect of the 1985-6 Insolvency Acts in reducing the number of companies going into liquidation by facilitating restructuring. The variable takes the value of 1 from 1987 onwards.[4]

The variables used initially are similar to those used by Davis (1992), although the estimation procedure differs in that our specification includes dynamics and long-run variables in the same equation, which reduces the small-sample bias associated with the two step Engle-Granger procedure (see Banerjee *et al* (1993)). Furthermore, we test some non-nested hypotheses concerning the most appropriate variables. In particular, we investigate the consequences of using the net debt/capital stock at market value (*CG*) ratio instead of net debt/GDP (*DEBT*). This will shed some light on whether firms are limited in their borrowing only by the present value of future profits, as reflected in equity prices, or by the collateral value of their assets, as reflected in the replacement cost of capital. Related to this point, we investigate whether there is an additional role for property prices (*PROP*), as property is often the main source of collateral for firms. We also look at the factors influencing profitability more closely. We compare using the determinants of profits, which are assumed to be input prices (*RM*), real wages (*RW*) and the deviations of real GDP from trend (*GDP*), to using a direct measure of profits (*PROF*), which intends to capture all influences on profitability. The relationship of spreads, as well as some survey results, to the corporate failure rate is investigated.

Before estimating the general equation, the order of integration is verified for all the variables under consideration. The sample period for estimation of the model is 1975:1-1999:1 after adjusting for lagged variables. Results are presented in the appendix.

As the null hypothesis of non-stationarity cannot be rejected for any of the variables, we initially estimate an autoregressive distributed lag model (ARDL). We will address the question of cointegration in Section 4.5. The general model is estimated using four lags in each differenced variable.

The empirical model to be estimated is then:

$$\Delta LQRT_t = a_1 LQRT_{t-1} + a_2(L)\Delta LQRT_t + a_3 DEBT_{t-1} + a_4(L)\Delta DEBT_t$$
$$+ a_5 GDP_{t-1} + a_6(L)\Delta GDP_t + a_7 RM_{t-1} + a_8(L)\Delta RM_t + a_9 RW_{t-1}$$
$$+ a_{10}(L)\Delta RW_t + a_{11} I_{t-1} + a_{12}(L)\Delta I_t + a_{13} R_{t-1} + a_{14}(L)\Delta R_t + a_{15} NEW_{t-1}$$
$$+ a_{16}(L)\Delta NEW_t + c + dum$$

[4] The approach differs from that of Cuthbertson and Hudson (1986), who only allowed a temporary effect for the reforms with a dummy taking the value 1 from 1988 Q1 to 1989 Q1 and zero elsewhere.

Before testing down to a parsimonious model, we will investigate alternatives for some of the variables.

4.3 Alternative variables

First, the debt/capital stock at market value (*CG*) ratio is used instead of debt/GDP (*DEBT*). Wadhwani (1986) suggested the market-value-based measure in order to capture the assumption that companies can borrow against the present value of future profits, which is reflected in the market value of their equity. However, the observation that loan covenants often include borrowing restrictions based on book value suggests that the level of indebtedness relevant to the probability of bankruptcy may have to be measured against other variables. Debt *levels* can be expected to increase with the size of the economy and the aggregate size of companies. We need to be able to separate out an increase in debt from an increase in indebtedness. Candidate variables for the denominator of debt ratios are therefore the replacement cost of the capital stock and nominal GDP. However, owing to the fact that the capital stock at replacement cost is in practice a stable proportion of GDP, the debt/GDP and debt/capital stock ratio are 99.7% correlated over our sample period. The debt/GDP ratio is used in this paper because GDP is likely to suffer less from measurement error than the capital stock.

The hypothesis is tested that the original model encompasses[(5)] the model with the debt/capital stock at market value variable. An encompassing model is estimated which contains both sets of variables. A Wald test is performed to test the hypothesis that either set of coefficients equals zero. The results are as follows:

F(*CG*) = 0.36 (Prob 0.90) tests that all coefficients on *CG* are zero
F(*DEBT*) = 0.78 (Prob 0.59) tests that all coefficients on *DEBT* are zero

The test is therefore inconclusive: the exclusion of neither set of variables can be rejected in the presence of the other set. An alternative procedure is to select the model using the lowest value of the Akaike or Schwartz criterion. The results are as follows:

Model with *DEBT*:
Akaike = -2.41 Schwartz = -1.10
Model with *CG*:
Akaike = -2.35 Schwartz = -1.04

The specification using *DEBT* is therefore preferred. This is consistent with the hypothesis that lending decisions are not only made based on the market value of the firm. In other words, when indebtedness increases and equity markets are highly valued – and capital gearing is therefore constant on a market value measure – banks may still reduce their lending supply. Firms are therefore constrained in their access to further capital, and may indeed fail if creditors call in loans as covenants are breached.

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(5) See Johnston and DiNardo (1997), page 281, for a description of the encompassing method.

Next, we investigate various measures of profitability. By using the *RM*, *RW* and *GDP* variables in the original specification, we have tried to capture the determinants of profits. An alternative specification may be to measure profits directly, as measured, for example, by the ratio of gross operating surplus to GDP.

The encompassing test for replacing *GDP*, *RW*, *RM* with *PROF* is again inconclusive. Using the Akaike and Schwartz criteria, the results are as follows:

Model with *GDP*, *RW*, *RM*
Akaike = -2.41 Schwartz = -1.10
Model with PROF
Akaike = -2.28 Schwartz = -1.29

By the Schwartz criterion, which favours parsimonious models, the *PROF* model is preferred as it contains fewer variables. However, by the Akaike criterion, the model with *GDP*, *RW*, *RM* gives a better fit. We note that, even in the presence of the *PROF* variable, *GDP* is still highly significant. *GDP* may therefore capture important variables other than profitability, such as confidence of lenders, which is likely to be highly pro-cyclical. It may also be that overall profit levels mask important differences between firms. Sudden increases in *RW* or *RM* are likely to affect some firms much more than others, which would increase the failure rate, but may not be captured adequately in overall profit levels. In either case, the specification using *GDP*, *RW* and *RM* is preferred.

4.4 Additional variables

All the variables suggested by the stylised model developed in Section 4.1 have been explored. But richer models may suggest additional important determinants of corporate failures. This section suggests variables that may capture some elements missing from the stylised model.

Survey evidence
In the previous section, it was noted that overall profit levels may mask important differences between firms. Recall from the theoretical model that the importance of profits is that they are the source of funds for expenditure in the absence of external funding. In the CBI's *Quarterly Trends Survey*, some questions deal specifically with the quantity of internal and external funds available to firms. This is directly relevant to the current analysis, because firms that have insufficient internal funds to, say, make capital expenditures are more likely to come under financial pressure when macroeconomic conditions worsen, as they are more reliant on external funds and therefore have a lower 'buffer' against changes in profits. The survey result will obviously be affected by overall profitability, which is already captured by other variables, but it will also be affected by increased differences in profitability between firms. A mean-preserving spread in the cross-sectional distribution of profitability will increase the number of firms having insufficient internal funds. We therefore analyse the results of the survey questions: 'Does shortage of internal funds limit your expenditure?' and 'Does the inability to raise external finance limit your expenditure?'.[(6)]

[(6)] See also Hoggarth and Chrystal (1998) for an analysis of these survey results in the past two recessions.

Adding this survey result to the equation, neither variable is significant, indicating that the information contained in them, if any, is already captured by the other variables.

While the properties of the 'external finance' variable need further examination, the close correlation of the 'internal funds' variable with future values of the liquidation rate (positive) and profitability (negative) imply that it is nevertheless a useful leading indicator of two key variables under consideration.

Property prices

Kiyotaki and Moore (1997) present a model where the value of collateral, offered as security against loans, plays a key role in the persistence and amplification of macroeconomic shocks. We also expect collateral values to play an important role in company failures. At lower levels of collateral, its value is more likely to drop below the value of the loan, prompting the bank to demand repayment, which may cause the firm to fail if no alternative sources of funding are available.

In the model estimated in this paper, some of these effects are already captured by the debt ratio, through its high correlation with capital gearing (measured at replacement cost). However, we propose to add a variable for property prices – the main source of collateral for many firms – as there may be additional explanatory power if fluctuations in the capital stock due to changes in property prices are, in aggregate, offset by changes in other components of the capital stock.

The data suggest that there may be a role for property prices, as the second lag of property prices has a significant coefficient. This appears to be a short-run effect only, as the long-run coefficient is insignificant. The short-run coefficient is negative, as expected. The final estimate of the short-run coefficient of property values in the equation is presented in Section 4.5 when testing down from a general to a parsimonious model.

Exchange rate

If the determinants of profits contain more information than aggregate profits, as was hypothesised earlier, the exchange rate may have additional explanatory power in our model. A real appreciation adversely affects the tradable goods sector, and within this sector it is likely to affect firms to varying degrees according to their reliance on exports, the level of import penetration in the sector, and the particular countries to which a firm exports. A real depreciation may adversely affect firms with foreign currency debt, although this effect would be partially captured by the *DEBT* variable in aggregate.

The coefficients on a trade-weighted real exchange rate index are individually and jointly insignificant. The exchange rate therefore provides no additional explanatory power for the liquidation rate.

Spreads

As pointed out by Wadhwani (1986), the same factors that determine the probability of corporate failure should also determine the spread of the corporate bond yield over the risk free rate, as this spread provides investors with compensation for the default risk. However, while the probability of

bankruptcy is certainly one of the determinants of spreads, there are other factors that determine spreads, which do not necessarily influence the probability of bankruptcy. A change in investors' risk appetite would result in a change in spreads without affecting corporate default risk. Investors may require a higher premium for default risk, ie a general increase in risk aversion. Alternatively, the liquidity premium may change, either due to changed perceptions or due to actual changes in liquidity.

Unlike the explanatory variables used so far, spreads are only a potential leading indicator, not a fundamental determinant of the dependent variable. Nevertheless, as the default premium in spreads is determined by all available information to the market, spreads may offer additional explanatory power in our model. The series used for the calculation of the *SPREAD* variable only allowed a consistent time series back to 1978, which is a slightly shorter sample period than used with the other variables.

Adding the *SPREAD* variable to the equation, following Davis (1992), gives the following result: none of the coefficients is significant at the 5% level. The terms are not jointly significant, which suggests that the low individual significance levels are not merely due to multicollinearity within different lags of spreads. The 3rd lag is significant at the 10% level, but the overall effect does not have the expected sign. This is likely to be the result of the interaction of spreads with other independent variables. However, adding spreads as an explanatory variable is a weak test, as theoretically spreads and the liquidation rate are jointly determined, and the coefficients on spreads therefore are possibly subject to an endogeneity bias.

In the absence of instrumental variables which are correlated with spreads but not with liquidations, the best we can do is to regress spreads on the same set of explanatory variables as liquidations (see also Wadhwani (1986)). If spreads accurately reflect default risk, they should be determined by the same set of variables as the liquidation rate, albeit with a different lag structure. The results are as follows: the significant variables are *GDP* and changes in the nominal interest rate, the real interest rate and the exchange rate. However, the variables enter with the wrong sign. Spreads increase with increases in *GDP* and depreciation of the exchange rate. Changes in nominal interest rates enter with a negative sign, which, combined with the smaller positive coefficient in real interest rates, implies a negative sign on both changes in real interest rates and changes in inflation. Moreover, the equation explains total variation in spreads poorly, with an adjusted R^2 of 0.28.

This procyclicality of spreads is consistent with results such as those of Davis (1992), who suggests that this may be due to the increased supply of corporate bonds during upturns resulting in price falls due to poor liquidity in this market for much of the sample period.

In conclusion, spreads are not well explained by the same set of explanatory variables as liquidations. Spreads therefore contain little useful information to predict liquidations. This could be because spreads are predominantly determined by other factors, such as liquidity. An alternative explanation is that, as bonds are mostly issued by large, highly-rated companies, the spreads on these bonds contain information about the default risk on these companies only, which is not representative for the corporate sector as a whole.

4.5 Parsimonious model

Having explored all possible new variables that could be added to the set of variables commonly used in the literature, we now proceed to test down the general model to a more parsimonious one. After a step-wise reduction of groups of insignificant variables, we obtain a parsimonious equation. Coefficients and diagnostics are given in the appendix. The coefficients have the expected sign and the diagnostics are satisfactory, showing no signs of misspecification.

High t-ratios on the long-run coefficients may point to a significant cointegrating relationship. However, there are two potential problems with the approach taken so far. Under the assumption of non-stationarity, the t-ratios do not have standard properties, which makes inference about a cointegrating relationship difficult. Furthermore, any general-to-specific reduction necessarily involves some arbitrariness. To ensure that this has not biased the results, we now examine cointegration formally, in the context of an objective procedure suggested by Pesaran and Shin (1998).

First, we examine whether the explanatory variables can be treated as 'long-run forcing' variables with respect to the corporate failure rate. This is tested by estimating a general dynamic model in differences, and testing whether the addition of the long-run variables can be rejected. The critical values for the variable addition test are tabulated in Pesaran and Pesaran (1997). Each of the explanatory variables is then used in turn as a dependent variable in this procedure.

The results are as follows:

Dependent variable	F-statistic
LQRT	8.98
DEBT	2.46
GDP	1.87
R	1.61
RW	4.64

Critical values assuming non-stationarity: 4.05 (5%), 5.122 (1%).

This supports our approach of treating *DEBT, GDP, R, RW* as long-run forcing variables with respect to *LQRT*,[7] although we note that the hypothesis for *RW* can only be rejected at the 1% level.

The next step is to select the optimal lag structure for the ARDL equation. We use the Schwartz Bayesian criterion (SBC) to select the optimal lag structure, beginning with a maximum of four lags.

[7] We also looked for the number of cointegrating vectors present in this set of variables using the Johansen ML approach. The eigenvalue test and AIC selection criterion indicate two cointegrating vectors, whereas the trace test and SBC selection criterion indicate the presence of one cointegrating vector.

The long-run coefficients can then be estimated, as well as their asymptotic standard errors. The implied long-run equation is:

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

(t-ratios given in parentheses).

The coefficients are very similar to (and certainly insignificantly different from) the long-run coefficients implied by the earlier ARDL equation, which was achieved by standard general-to-specific reduction. Furthermore, the lag structure achieved by maximising the SBC is nearly identical to the one achieved in the earlier equation.[8] Given the above long-run relationship, the equation can now be re-estimated in error-correction form. The coefficient on the error correction term is correctly signed and highly significant and has an estimated value of -0.26 (t-ratio 7.4). The error-correction coefficient measures the 'speed' with which the dependent variable converges to its long-run equilibrium. In this case convergence is relatively rapid: each quarter, the liquidation rate converges by 26% of its deviation from the long-run equilibrium. Further details of the dynamic coefficients and alternative specifications are given in the appendix.

Note that, as the equation is specified in logs, the coefficients are also the long-run elasticities, except for the coefficient on interest rates, which is a semi-elasticity. In other words, an increase in the debt/GDP ratio of 1% will result in an increase in the equilibrium liquidation rate of 0.48%. Similarly, a decrease in the level of GDP of 1% away from its estimated trend level will increase the liquidations rate by 5.59%; a rise in real interest rates of 1 percentage point will increase the liquidations rate by 6.8%; and a rise in unit real wage costs of 1% will increase the liquidations rate by 4.95%.

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% 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;[9] and, using a variety of tests, there is evidence of a long-run relationship between the company liquidations rate and the debt/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.

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[8] The only exception being that all three lags on R were included in the SBC maximising procedure, because the program used does not allow for gaps in the lag structure. However, the second lag was not significant.

[9] 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.

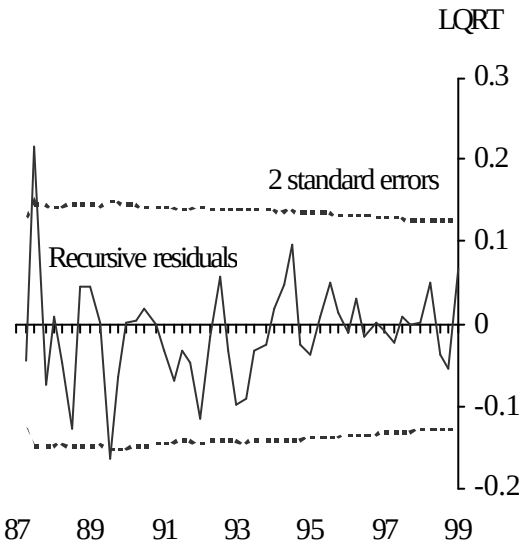
4.6 Stability of the equation

As mentioned in Section 3, previous work on aggregate corporate failure has mostly used data up to the late 1980s, with one paper (Young (1995)) covering data up to 1992. This is an opportunity to investigate whether the unprecedented spike in the failure rate in 1992:3 and the rapid subsequent fall implied a breakdown in the relationship between the variables. In other words, do the coefficients that fit the spike also explain the subsequent reduction in the corporate failure rate?

The Chow forecast test[10] allows us to verify whether the coefficients estimated up to a certain date still allow an adequate fit of the data after this date. Performing a series of Chow forecast tests will reveal the extent of the model's stability.

The equation satisfies the Chow forecast test back to 1987:4 (LR = 52.4 Prob = 0.24), as illustrated in Chart 2 (ie the residuals of the equation using shorter sample periods remain within two error bands of the standard error distribution).

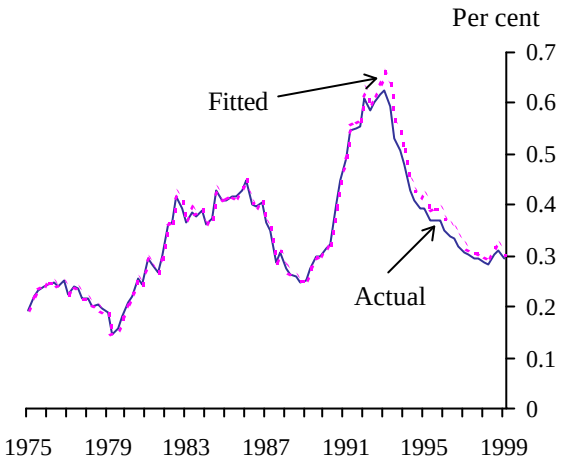
Chart 2: N-step forecast test



This indicates a high degree of stability in the relationship over time, which reinforces our confidence in the validity of the equation. In order to observe the stability of the relationship more directly, we can re-estimate the equation up to 1992:3 (the peak in liquidations) and plot the fitted values for this sub-sample against the fitted values using the full sample period.

[10] See, for example, Johnston and DiNardo (1997).

Chart 3: Fitted values based on sample period 1975-99 vs 1975-92



Sources: ONS and author's calculations.

As can be seen from Chart 3, using the model estimated from the reduced sample period overpredicts the liquidation rate. The average overprediction after 1992:3 is 5.2%. One explanation for such overprediction is that the dummy variable used in the model does not correctly capture the changes in insolvency procedures arising from the Insolvency Acts. For example, the changes in lender attitudes resulting in adoption of the new procedures and more frequent renegotiation of debt contracts may have occurred only gradually, rather than suddenly in 1987. The reduced sample equation therefore gives too little weight to the effect of the new regime, resulting in overprediction.

4.7 Liquidation rate compared with its long-run equilibrium

By plotting the actual liquidation rate against the fitted long-run equilibrium, we can analyse which changes in the liquidation rates were due to fundamental changes in the macroeconomic environment or the financial structure of corporates, and which changes were due to short-term dynamics. Examples of short-term dynamics are past changes which have not yet had their full effect, or changes in the birth rate of new firms, nominal interest rates or property prices, which only have a temporary effect. This analysis will also illustrate whether the current level of liquidations is near equilibrium level, or whether it is the result of short-term dynamics. If the long-run explanatory variables remain stable in the near future, the current level of the liquidation rate is expected to converge to the current long-run equilibrium.

Chart 4: Actual liquidation rate and its long-run equilibrium

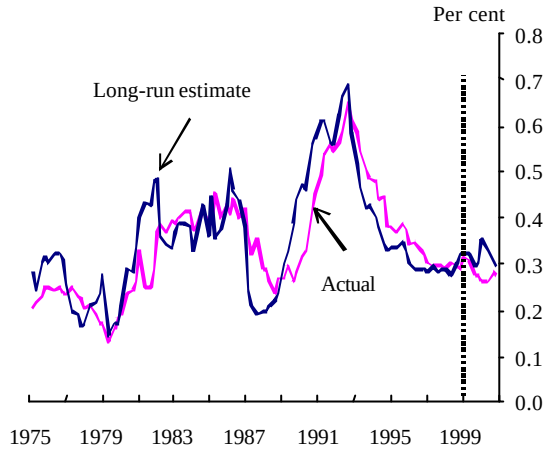


Chart 4 shows that the actual level of corporate liquidations closely follows the long-run equilibrium. The dotted line indicates the end of the sample used for estimation. Deviations from the long-run equilibrium reflect the effect of the short-term variables (nominal interest rates, property prices 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), which implies that most of the deviation from the long run is accounted for by the short-run dynamics of the equation.[(11)]

4.8 Application to the 1990s recession and the subsequent recovery

The preferred equation can be used to decompose the factors driving 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 (see Table A). During the period 1988 Q3 to 1992 Q3, the UK corporate liquidations rate nearly tripled from 0.238% to 0.647% (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 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 the dummy effect suggests that the rise in liquidations was restrained by the adoption of the 1986 Insolvency Act.

[(11)] For the out-of-sample predictions, this ratio is similar at 0.18.

These results can be compared with the factors accounting for the decline in the liquidations rate recorded over the period 1992 Q3 to 1997 Q3,[(12)] during which it fell by 54.1%. 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 A: Contribution of variables to the change in liquidation rate

Time period	1988 Q3 to 1992 Q3	1992 Q3 to 1997 Q3
Change in liquidations (%)	171.3	-54.1
Contributions (pp):		
Debt/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

5 Conclusions

By investigating various alternatives to the models suggested by previous authors, capital gearing ratios based on the market value of the company's assets are found to be marginally less satisfactory in explaining corporate failures than are ratios that measure debt relative to the replacement cost of assets or relative to GDP. Furthermore, the determinants of profits (real wages, aggregate demand, real interest rates) have better explanatory power than aggregate profits. This may be because aggregate profit levels mask important differences in profitability between firms.

Property prices are found to have a significant short-run effect on company failures, which is consistent with the important role property plays as collateral for corporate borrowing. The birth rate of new companies is also found to have a significant short-run effect on company failure. This is consistent with other evidence that new companies are more likely to fail than more experienced ones.

Real interest rates, rather than nominal interest rates, are found to be a significant long-run determinant of corporate failure. This is consistent with the debt-deflation theory. The additional short-run effect of nominal interest rates is consistent with the adverse effect of higher inflation on company cash flows in the presence of borrowing constraints or non-neutralities in the tax system.

[(12)] 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.

The spread of corporate debt yield over the government bond yield does not predict corporate failures well. This may be due to the fact that corporate bond spreads are determined more by liquidity factors, especially during periods of low bond market issuance, than by investors' assessment of default risk. Moreover, bond-issuing corporates may not be a representative sample of the corporate sector as a whole.

The empirical relationship between the liquidation rate, debt levels, the interest rate and profitability has been surprisingly stable over time. But variation in the liquidation rate has been driven by variation in different explanatory factors over the sample period. Whereas the rise in the liquidation rate in the early 1990s is attributed primarily to rapidly increasing levels of indebtedness, the decline after 1992 is explained largely by falling real wages, the cyclical recovery of GDP relative to trend and falling real interest rates.

Appendix: Data definitions and further econometric results

Where data are from National Statistics, the four-letter code is given in parentheses.

LQRT – the number of compulsory liquidations and creditors' voluntary liquidations (AIHV) divided by the number of active companies on register (source: Companies House. Data on number of active companies are annual and linearly interpolated).

GDP – residuals of GDP at constant prices (ABMI) regressed on constant and time trend.

DEBT – gross debt of the PNFC sector minus liquid assets of the PNFC sector (NLBE + NLBI + NKZA - NKJZ) divided by GDP at current market prices (YBHA).

CG – gross debt of the PNFC sector minus liquid assets of the PNFC sector (NLBE + NLBI + NKZA - NKJZ) divided by the market value of PNFC non-financial assets (NYOT).

PROF – gross operating surplus (CAER) divided by GDP at current market prices (YBHA).

PROP – an implicit price deflator for buildings calculated from investment data: ratio of nominal over real gross fixed capital formation in buildings and other structures (DLWS/EQDP). The resulting nominal series is then deflated by the GDP deflator (YBGB).

CBIIF – response balance to the question 'What factors are likely to limit your capital expenditures authorisation over the next twelve months – shortage of internal finance?' (source: CBI *Quarterly Trends Survey*).

CBIEF – response balance to the question 'What factors are likely to limit your capital expenditures authorisation over the next twelve months – availability of external finance?' (source: CBI *Quarterly Trends Survey*).

SPREAD – difference between yield on a quality-adjusted ten-year corporate bond portfolio and the ten-year gilt yield (source: Bank of England calculations).

RW – unit wage cost (LNNK) deflated by the GDP deflator (YBGB).

RM – material and fuel cost (PLKW) deflated by the GDP deflator (YBGB).

RERI – real exchange rate index (source: IMF *International Financial Statistics*).

I – London clearing banks' base rate (AMIH).

R – *ex post* real interest rate, calculated as $\frac{(1+i_t)}{(1+p_{t+1})}$ where the measure of inflation is based on the GDP deflator.

NEW – number of new incorporations (source: Companies House) divided by number of active companies on register.

Bank bad debt charges – bad debt charges of the major British banking groups (MBBG) as a fraction of total assets (source: company annual reports).

Table A1: Order of integration of explanatory variables

	ADF (level)	ADF (diff)
LQRT – liquidation rate (log)	-2.69	-3.88
GDP – real GDP (log, detrended)	-2.41	-3.25
DEBT – net debt/GDP (log)	-0.89	-4.60
CG – net debt/cap stock at mkt val (log)	-2.47	-6.01
PROF – operating profit/GDP (log)	-2.23	-3.57
PROP – property prices (log)	-1.83	-3.98
CBIIF – availability of internal finance	-2.83	-8.72
CBIEF – availability of external finance	-1.05	-5.01
SPREAD – spread of corporate bond over gilt yield	-1.48	-10.18
RW – real wages (log)	-2.17	-4.60
RM – real raw materials prices (log)	-0.17	-5.44
RERI – real effective exchange rate index	-1.80	-7.76
I – nominal interest rate	-2.09	-5.03
R – real interest rate	-2.55	-5.00
NEW – birth rate (log)	-1.90	-4.84

Critical values: -3.50 (1%) -2.89 (5%).
Number of lags in ADF test = minimum lags required to eliminate serial correlation in residuals.

Table A2: Parsimonious equation resulting from general-to-specific reduction

Variable	Coefficient	t-stat
C	-2.11	-6.0
DUM	-0.09	-2.6
$LQRT_{t-1}$	-0.27	-5.5
$\cdot LQRT_{t-1}$	-0.24	-3.1
$DEBT_{t-1}$	0.12	4.1
$\cdot DEBT_{t}$	0.25	3.1
GDP_{t-1}	-1.55	-3.4
$\cdot GDP_{t}$	-4.52	-5.2
RW_{t-1}	1.18	4.3
R_{t-1}	0.018	5.4
$\cdot R_{t}$	0.011	2.4
$\cdot R_{t-2}$	-0.034	-5.4
$\cdot I_{t-2}$	0.021	2.4
$\cdot NEW_{t-3}$	1.88	4.5
$\cdot NEW_{t-4}$	-1.50	-4.7
$\cdot PROP_{t-2}$	-0.76	-1.7

adj. R^2 = 0.65
S.E. = 0.063
F = 12.8 (Prob 0.000)
LM(4) = 2.29 (Prob 0.68)
White test for heteroscedasticity = 31.02 (Prob 0.36)
RESET(1) = 3.22 (Prob 0.07)
Jarque-Bera = 3.20 (Prob 0.20)

Table A3: Parsimonious equation in error-correction format resulting from maximising Schwartz-Bayesian criterion

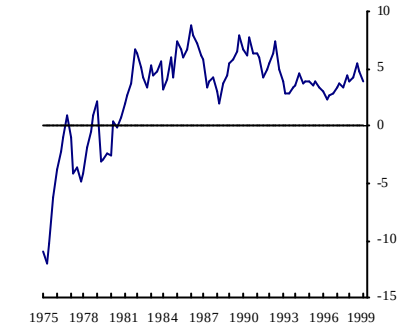
Variable	Coefficient	t-stat
C	-0.001	.09
ECM_{t-1}	-0.26	-7.4
$\cdot LQRT_{t-1}$	-0.26	-3.6
$\cdot DEBT_t$	0.27	3.7
$\cdot GDP_t$	-4.37	-5.2
$\cdot R_t$	0.012	2.5
$\cdot R_{t-2}$	-0.034	-5.6
$\cdot I_{t-2}$	0.022	2.7
$\cdot NEW_{t-3}$	1.87	5.0
$\cdot NEW_{t-4}$	-1.51	-5.0
$\cdot PROP_{t-2}$	-0.66	-1.7

$$ECM_t = LQRT_t - 0.48^* DEBT_t + 5.59^* GDP_t - 0.068\, R_t - 4.95\, RW_t + 7.77 + 0.38^* dum$$

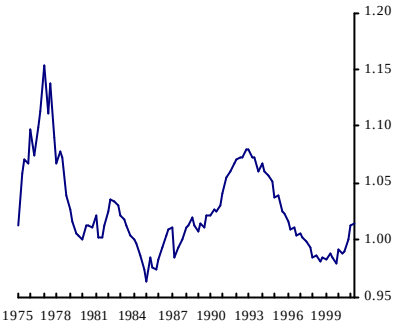
adj. $R^2 = 0.65$
S.E. = 0.063
F = 19.2 (Prob 0.000)
LM(4) = 2.74 (Prob 0.60)
White test for heteroscedasticity = 19.1 (Prob 0.51)
RESET(1) = 3.35 (Prob 0.07)
Jarque-Bera = 2.90 (Prob 0.23)

Significant explanatory variables

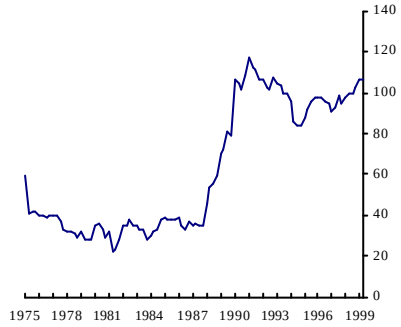
Real interest rate



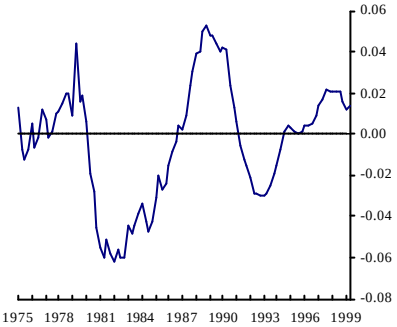
Index of real wages



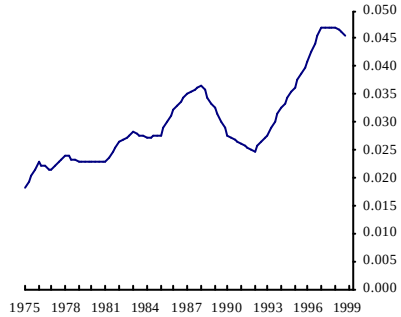
Net debt/GDP ratio



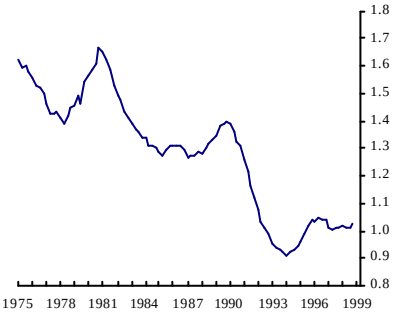
GDP (deviations from trend)



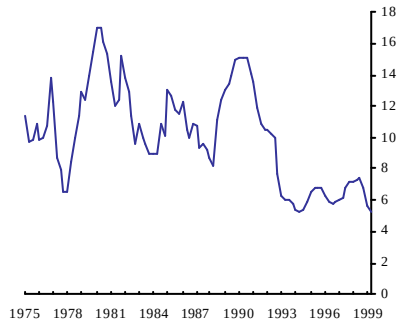
Birth rate of new companies



Index of property prices



Nominal interest rate



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