A quantitative framework for commercial property and its relationship to the analysis of the financial stability of the corporate sector

John Whitley
and
Richard Windram

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E-mail: john.whitley@bankofengland.co.uk

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Abstract

This paper develops a quantitative framework for analysis of the UK commercial property sector and the possible implications for the financial stability of this sector, and for the corporate sector as a whole. There is little previous empirical literature. But where there is, models have either studied particular markets or have developed single-equation approaches. Lack of suitable data has been a major impediment. In this paper a model of the real estate sector is constructed using econometric analysis of rental values and bank lending, supplemented by a calibrated model of the remainder of the financial accounts of real estate companies (using data for private and public real estate companies). Using related work on company-failure models, it is possible to extend the analysis to provide an equation for the probability of default of real estate companies. The empirical results fail to find a role for borrowing costs in the bank lending equation before 1999, but unless borrowing costs are included after this period, the equation breaks down and systematically underestimates the growth in lending to real estate from then on. Various potential explanations are examined for this breakdown, including the importance of sale and lease-backs. The estimated rental equation appears more stable. The historical tracking performance of the estimated real estate model fails to capture the full extent of the swings in capital values and bank lending in the early 1990s. This is attributed to shifts in the discount rate applied to property income, possibly reflecting a temporary shift in risk premia during this period. The property sector links to the rest of the private non-financial corporate sector through its role as collateral. Since the property model relies partly on macroeconomic influences it can be used in conjunction with macro models to provide forecasts of property values and the probability of default of property companies. Simulations that use this model with the Bank of England macroeconometric model show not only the sensitivity of the probability of default of real estate companies to selected macroeconomic shocks, but also the potential links between the commercial property sector and the financial health of the rest of the corporate sector.

Key words: Commercial property, real estate sector, probability of default, bank lending, econometric modelling.

Summary

In the past property-related lending has been a significant cause of losses for UK financial institutions and the property cycle has been assigned a role in accentuating the general business cycle. Whereas the role of residential property has been well documented in terms of the transmission of shocks and its relationship to the overall macroeconomy, this has not been the case for commercial property.

This paper sets out a quantitative framework for considering the implications of commercial property developments for the financial stability of the corporate sector. It builds on previous work extending the Bank of England's macroeconometric model to the household and corporate sector's balance sheets by constructing a model of real estate companies and linking this model into the aggregate corporate sector through the role of property as collateral. Previous modelling work on commercial property has focused on market studies or used single-equation relationships. Few studies have attempted to link the commercial property market to financial markets, and even fewer to the rest of the macroeconomy. Lack of suitable data has been a major constraint on attempts to model the commercial property sector.

In this paper we attempt to fill this gap. Data for more than 1,000 real estate companies are used to calibrate the financial accounts of real estate companies. We then combine various rules of thumb that are consistent with these accounts with econometric analysis to build an overall simple model of real estate companies' behaviour, related to macroeconomic factors. One of the reasons why previous modelling attempts have not been developed for practical forecasting and projections is that the models have required projections of other variables that are either related to the property market itself, or are difficult to project. The principal objective is to ensure that the model is capable of being used for both forecasting and simulation, either in isolation, or in combination with a wider macroeconomic model.

Econometric analysis of rental income and bank lending is the main behavioural element in the real estate model. The bank lending equation does not find a consistent role for borrowing costs relative to returns from property over the whole sample period. However, the gap between property yields and the base rate appears to explain a large proportion of the growth of bank lending after 1999. Without allowing for this influence, the equation appears to break down. Sale and lease-back deals between non real estate and real estate companies also appear to have

boosted bank lending after 1999. This model can be used to derive an estimated probability of default for real estate companies, drawing upon other research being developed within the Bank of England on corporate failure. Further work on data and on possible supply influences might help to resolve the puzzles highlighted in this paper.

A dynamic simulation of the property model starting in 1990 illustrates the overall performance of the model. The model fails to capture all the cyclicality of capital values and bank lending since 1990. This can be traced back to a failure to predict changes in the discount rate applied to rental income during this period, and may reflect a (temporary) change in risk premia. The model itself does not include an explicit treatment of expectations or risk premia. Future work might usefully examine the role of alternative expectations mechanisms.

An important feature of the work is that it enables the specification of the role of commercial property in influencing the financial health of the overall corporate sector. The key link between the real estate model and the rest of the corporate sector is through the capital value of commercial property. Capital values are derived from rental flows using a simple discount model. Changes in capital values are found to affect aggregate corporate liquidations, because they alter the collateral security that backs corporate loans. Simulations of changes in macro variables using the Bank of England's macroeconometric model illustrate the importance of this property link and the potential for adverse developments in the commercial property sector to amplify the sensitivity of corporate default to macroeconomic shocks. So, although there are no feedbacks to broader macroeconomic aggregates, the model enables further quantification of financial stability risks.

1. Introduction

Property markets are relevant to monetary stability and financial stability, but the focus of this paper is more on the second of these. Property lending and investment are important elements in banks' and fund managers' portfolios. Residential mortgage lending, for example, which is almost entirely by UK-based banks and building societies, currently totals around £600 billion. Bank lending to the real estate sector amounts to a further £60-£70 billion (6.4% of total lending), and most of this goes to the commercial property sector. But estimates of total commercial property lending would be much higher if they include lending where commercial property is used as collateral. In the past, poor lending decisions and high levels of property-related debt have led to strains on UK banks.[(1)] Data for branch-based lending by a major UK bank suggest that the stock of provisions against loans to property companies rose sharply during the early 1990s recession, reaching a peak of around 7% at the end of 1992.[(2)]

Changes in property values can also have important macroeconomic effects. There are various mechanisms that have been suggested in the literature. They can be considered under four headings. First, there are factors that might increase the amplitude of property cycles by emphasising the role of fixed supply in the short run and swings in investor optimism (for example, Carey (1990) and Herring and Wachter (1999)).

Second, there are approaches that highlight the cyclical role of credit availability. For example, Stiglitz (1992) links the property market to credit markets, arguing that information asymmetries in financial markets, and shifts in lenders' trade-offs between risk and return during the business cycle, lead to pro-cyclical changes in the availability of credit.

Third, a strand of the literature focuses on the effect of property prices on lending. For example, Kiyotaki and Moore (1997) stress the collateral aspect of property. With greater collateral, lenders might be prepared to lend more for any given level of risk, and hence increase their

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[(1)] Following the property-related problems of the early 1990s, the Bank established its Property Forum. The Forum brings together representatives of investors, lenders, occupiers, and researchers, as well as officials from the Bank, HMT, the FSA and ODPM. The Forum meets quarterly; and its work is supported by a regular round of liaison meetings with lenders and other participants in the property market. This helps the Bank to monitor current developments and to identify underlying structural issues.

[(2)] Drawing on data initially used for an earlier period in Davis (1993).

willingness to lend to real estate projects. To the extent that this induces an over-supply of both credit and available property, it can lead to a fall in property prices, whether from the market adjustment itself or from a macroeconomic shock. The fall in the value of the collateral may cause lenders subsequently to tighten or withdraw credit.

Finally, changes in the supply of finance might lead to the financial failure of property companies and of other companies who have financed borrowing on the basis of collateral against property. Such failure may then impinge on the financial health of the banking sector itself, possibly leading to systematic financial loss.

It is from the perspective of the last two of these elements, both of which might give rise to systemic risk, that this paper is motivated.

Previous empirical modelling of commercial property markets has looked at studies of specific markets, or has derived single-equation estimates for rental values (for example, Rosen (1984), Hekman (1985), Wheaton (1987), Wheaton, Torto and Evans (1997), Hendershott, Lizieri and Matysiak (1997) and Hetherington (1988)). This paper attempts to take this work further by developing an empirical model of the commercial property market, or more strictly, a model of real estate companies and their probability of default. The property market is linked to the rest of the corporate sector through the role of property as collateral. These explicit channels link the property sector to macroeconomic factors, and to the potential losses for the financial system. The scale of exposures of the UK banks to commercial property (real estate lending accounted for around 30% of lending to all private non-financial companies (PNFCs) in early 2003), together with the higher risks of default implied by historical experience, imply that more explicit quantitative study of this sector is worthwhile on its own account. Moreover, since commercial property values may influence the cost or availability of debt finance for all corporates through its role as collateral, an explicit model of capital values has other advantages. If we were interested only in property values, and hence this second role, then a simple approach to generating projections of capital values might suffice.[(3)]

The approach developed is based principally on aggregate time series data. But, in the absence of stock data, we have also used data on over 1,000 real estate companies to provide benchmark

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[(3)]For example, by relating them to residential property prices, even though this correlation is weak (see Chart 1).

estimates of these stocks and some of the flows required in the model. We then combine various rules of thumb derived from these accounts with econometric analysis to build an overall model of real estate companies' behaviour. One of the reasons why previous modelling attempts have not been developed for practical forecasting and projections is that the models have required projections of other variables that are either related to the property market itself or are difficult to forecast. The objective of this paper is to ensure that the model is capable of being used for both forecasting and simulation, especially in combination with a wider macroeconomic model that generates estimates of broad macroeconomic factors such as the level of demand and interest rates.

In this paper we use the Bank's medium-term macroeconometric model (MTMM) to illustrate some of the links from macroeconomic shocks through the property sector to implications for defaults in the overall non-financial corporate sector, and hence for the stability of the financial system as a whole. Benito, Whitley and Young (2001) have drawn out the possible implications from the MTMM for UK corporate and household balance sheets, and have derived probabilities of default for these sectors, consistent with the macroeconomic conditions. Residential property is treated explicitly in the MTMM and, through changes in housing wealth, plays a key role in the transmission of monetary policy. However, even in the extension of the model by Benito, Whitley and Young, commercial property plays no particular role, being implicit in the private non-financial sector. Related work developing the role of collateral in residential property markets has been undertaken by Aoki, Proudman and Vlieghe (2001). Given significant differences in the financing of residential and commercial sectors, as well as in the relative importance of rental and owner-occupation, models of residential lending and property markets cannot be readily translated into a model of commercial property.[(4)]

In turn, models of general corporate behaviour are also less appropriate for real estate borrowing and activity, as discussed below in the next section of the paper where we set out why we might distinguish commercial property from other parts of UK private corporate activity. The following section briefly describes previous empirical work on property models. A relatively simple framework is developed that describes the property sector and its interactions with the rest of the corporate sector. We then give further details of the underlying components and describe some

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[(4)]For example, borrowing for commercial reasons involves both investment and development by property companies, institutional investors or financial institutions who might be classed as professionals. In contrast most borrowing for residential housing is for direct occupation by households.

empirical estimates, including a calibration of the balance sheet of real estate companies. These estimates are then used to generate some simulation results, designed to illustrate the quantitative relevance of the property sector. The final section draws conclusions and suggestions for further work.

2. What is special about commercial property?

We begin with some stylised facts. The importance of bank lending related to commercial property has been described above. Property companies stand out from other non-financial companies in terms of their dependence on bank borrowing. Our estimates derived from company accounts data show the capital gearing of quoted property (real estate) companies was around 40% in 2000, compared with around 26% for other private non-financial companies. The financial importance of commercial property (30% of outstanding lending to PNFCs by UK banks) far outweighs its relative importance in overall economic activity (the direct contribution to GDP, or value-added, is currently around 1.7%, although indirect effects that capture the dependence of other sectors on real estate intermediaries might increase this to 5% (BPF (2002)).[5] This motivates the focus on the indebtedness of real estate companies and their probability of failure in this paper.

Although the historical pattern of commercial property capital value growth shows some superficial similarity to residential value cycles (see Chart 1) this is largely the result of the 1990-92 downturn. In subsequent periods the pattern of values in the two sectors has been quite different: in particular in 1994, when capital value growth was quite high but residential value growth was negligible; and since 2000 when capital value growth has been falling but residential values have increased rapidly. That suggests that different factors are at work in the two sectors. An important consideration, however, is that commercial property capital values are synthetic in that they are estimated from valuations rather than based on transactions. The low level of transactions makes it difficult to verify whether these valuations are unbiased estimate of market prices.

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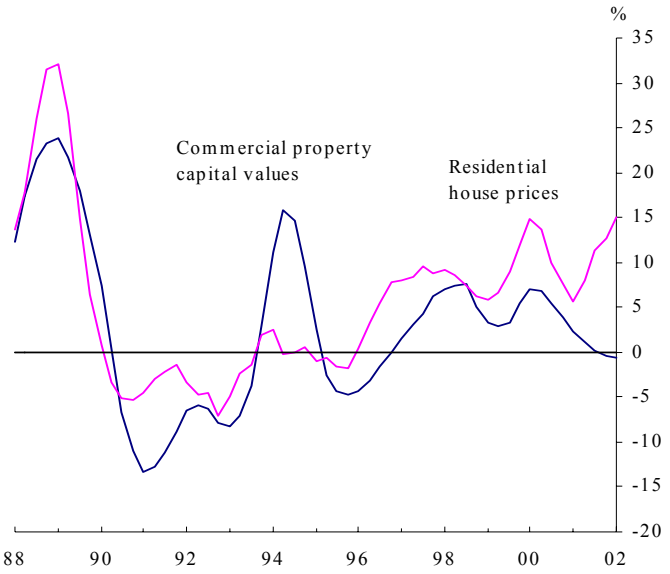
[5] SIC 92:70 defines real estate activities as development of residential or commercial buildings, buying and selling of own real estate, letting of own property, and real estate activities on a fee or contract basis (including intermediation in buying, selling, renting and appraising real estate).

One possible approach to modelling the commercial property sector is to explain the behaviour of real estate companies in exactly the same way as that of other private non-financial companies.

But this would neglect some key distinguishing features of real estate companies: their dependence on an asset that is in relatively inelastic supply and subject to relatively low short-run price elasticity of demand (sticky rents), together with commercial property's role as an investment asset heavily dependent on bank finance. The role of property as collateral for lending adds to the reasons to distinguish this sector from other PNFCs.

Chart 1
Annual growth of commercial property and residential property asset values



Sources: Investment Property Databank, Halifax, Nationwide, Bank of England calculations.
Note: Residential values are derived from an average of the Halifax and Nationwide indices.

Another possible modelling approach is to ignore the presence of real estate companies altogether and treat commercial property as if it were owned directly by the occupiers but purchased with debt, and then allocate the associated imputed rent and debt repayments. Commercial property might then be treated in exactly the same way as residential property. In other words, changes in the value of the asset would affect the net worth of the company and hence its ability to take on debt. The key disadvantages of this approach are twofold. First, it ignores the fact that real estate companies typically have actual debt service commitments on their borrowing to finance property development. Under the imputation approach companies would only 'theoretically' fail to meet any debt service payments. Second, this would conflict with the treatment in the national

accounts where there is no allowance for imputed rent and where real estate companies contribute to overall value added.

The preferred approach that we adopt here is based on the fact that companies can both own and lease property, and on the assumption that the financial behaviour of property and non-property companies is likely to be different, but linked through the role of property as collateral against borrowing. This also facilitates a distinction between debt at risk[(6)] held by property and by non-property companies. This is relevant for an assessment of the pressures on the UK financial system if either the probability of failure is higher for property companies than for other companies, or if the former are more highly geared. The evidence in this paper suggests that both conditions apply. If we distinguish real estate companies from other private non-financial companies, a fully consistent approach would involve revisiting the work of Benito, Whitley and Young (2001). However data do not permit this, and in any case, the small weight of real estate companies in many of the activity variables suggests that any subsequent gains would be minimal.

3. An overall framework

3.1 Previous empirical studies

The two main constraints limiting the supply of published modelling work in this area are the shortage of available data, and the ability to exploit the commercial value of these models by keeping details of them private. In particular, data are more readily available in the United States than in the United Kingdom and this has influenced the types of empirical models developed for the two economies. The relative lack of academic interest in modelling commercial property, together with the higher returns available for its use in commercial activities, imply that information on the models tends not to be made widely available. Ball, Lizieri and MacGregor (1998) survey previous models. They summarise the US literature as predominantly multi-equation or market-based compared with the UK emphasis on single-equation approaches. Key variables that are identified in modelling work tend to be related to aspects of the market: the

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[(6)]Debt at risk is the product of the probability of default and the amount of debt outstanding, see Benito, Whitley and Young (2001).

demand in the user market (occupation demand); the supply in the development market; rents in the user market; and yields in the financing market. Demand in the user market has typically been explained by rents, and proxies for required floor space, such as employment or some other scale variable. Models of supply of space tend to be determined by profitability factors, and so emphasise construction costs, property values and costs of finance. The option value of waiting is explicitly taken into consideration in some approaches (for example, Hendershott *et al* (1997)). Rental values tend to reflect the stickiness of adjustment. The US models (for example, Rosen (1984), Hekman (1985), and Wheaton (1987)) tend to determine rents as the interaction of structural demand and supply influences. In contrast, UK models typically determine rents as a reduced form because data are limited (for example, Hetherington (1988), Key *et al* (1994)). Where more data are available, studies of particular markets have been undertaken. For example, Wheaton *et al* (1997) model the London office market. In these models explicit supply variables are often absent. As noted by Ball *et al* (1998), in equilibrium the rent (or yield) should be equated to the user cost of capital, which comprises the risk-free rate, a risk premium, an allowance for expected depreciation and expected gains or losses. This links the occupier market directly to the cost of finance.

3.2 A simple framework

A schematic plan of the overall framework and links to the corporate sector is set out in Chart 1. The features of the property model contain many of the elements outlined in the previous empirical literature. The main additions are the inclusion of an equation determining bank lending, the specific link between rental and capital values, and the derivation of the probability of default of real estate companies from balance sheet variables.

For those who prefer a more detailed outline an algebraic formulation follows, where estimated or calibrated equations are expressed in functional form, shown by $f(.)$. First we begin with the stylised corporate model.

Simplified corporate model:

PNFC profits = share of (nominal GDP - labour income) **(1.1)**

PNFC net lending = (PNFC profits- investment-dividends- interest payments) **(1.2)**

Net equity finance = (exogenous) **(1.3)**

Debt finance = PNFC net lending - net equity finance **(1.4)**

Stock of debt = existing stock of debt + debt finance **(1.5)**

Interest payments = corporate interest rates * stock of debt **(1.6)**

Corporate interest rates = f (base rate, capital gearing) **(1.7)**

Corporate liquidations = f (GDP, income gearing, property capital values) **(1.8)**

where income gearing is the ratio of interest payments to profits.

Property model:

Rent = f (GDP, house prices, base rates) **(1.9)**

Profits = share of rent **(1.10)**

Debt = f (capital values, GDP, property yields, base rate) **(1.11)**

Interest payments = (base rate + exogenous margin)*debt **(1.12)**

Dividends and tax = f (share of profits) **(1.13)**

Capital values = value of rents discounted by property yields **(1.14)**

Property yields = f (gilt yields) **(1.15)**

Value of assets = existing stock revalued by change in capital values **(1.16)**

Probability of default = f (GDP, income gearing, capital gearing) **(1.17)**

where income gearing is as defined above and capital gearing is the ratio of debt to total assets.

Among the relevant macroeconomic variables are measures of overall economic activity (GDP), and official interest rates. Work by Benito, Whitley and Young (2001) extends the Bank of England's quarterly macroeconometric model (MTMM) to a derivation of the balance sheets of the non-financial corporate and household sectors. The implications of these balance sheet variables for corporate debt at risk and the probability of default can then be drawn out using the model of corporate liquidations developed by Vlieghe (2001) in (**1.8**). The 'model' of commercial property uses the macro variables, together with house prices, to drive equations of rental growth and bank lending to real estate ((**1.9**) and (**1.11**)). From these outputs, the main influences on the income and expenditure and balance sheets of property companies can be derived. Given an assumption about property yields, it is possible to use a simple calibrated discount model to derive capital values (**1.14**). This enables an estimate of the probability of default of property companies to be made (**1.17**), along with a measure of debt at risk. Changes in rental growth feed directly into the income and expenditure account of other private non-financial companies but the key link between the commercial property sector and the rest of the corporate sector is through the implications for the value of property collateral held against general PNFC borrowing. Changes in the value of collateral might change borrowing costs for PNFCs. One

route is through the implicit interest rate on debt (see Benito and Whitley (2003), for an empirical account of the relationship between implicit corporate interest rates and measures of capital gearing). Another route is via an explanatory variable entering directly into an equation for corporate liquidations, as shown in (**1.8**) (see, for example Vlieghe (2001)). In this approach, a fall in the value of property reduces the collateral underlying secured loans, thereby prompting lenders to tighten terms or demand repayments, which may cause firms to fail if no alternative sources of finance are available.

In the following sections we break down the components of the framework one by one.

4. Details of the framework

4.1 Commercial property model

To recap, the main estimated parts of the commercial property model are models of rental values, bank lending, property yields ((**1.9**),(**1.11**) and (**1.15**)), and the probability of default of real estate companies (**1.17**). The remainder of the equations are either accounting identities or rules of thumb. A summary version of the aggregate balance sheet of real estate companies (defined as companies with SIC code 70) is set out in Table A. The estimates are derived from company accounts data for both public and private real estate companies, using data supplied by Bureau Van Dijk. Full accounting information for 2001 is available for around 1,000 companies and more partial information for around 2,000 companies. Less than 100 of these companies are quoted. These estimates imply a value of capital gearing of around 55% for all real estate companies compared with around 40% for quoted real estate companies, and 38% for all private non-financial companies. A high proportion of post-tax profits are distributed.

4.2 Rental model

This model, estimated on quarterly data from 1987, explains rental values by cyclical changes in GDP growth, house prices, the private sector capital stock, and a proxy for the user cost of renting commercial property. This is a reduced-form specification. Previous empirical work has highlighted the potential role of activity measures such as GDP and of the user cost of capital. We would expect rental values to be positively related to GDP as a proxy for the demand for space, and negatively related to the private sector capital stock, used here as a proxy for the supply of property. Other studies have not typically considered substitution between the residential and commercial property markets. House prices stand as a proxy for demand in the residential sector.

High demand in that sector may induce a substitution, drawing resources away from the commercial sector (and so, by changing the balance between demand and supply, may mitigate any rise in prices in the residential sector and raise rents in the commercial sector). But this variable is not a measure of the opportunity cost of real estate companies as distinct from construction companies. Real estate companies do not normally engage in residential housing. Rather it represents a broader measure of opportunity costs between commercial property and other uses. Finally, rental values are expected to be positively related to the user cost of renting commercial property. A rise in user cost would be expected to reduce the supply of property, *ceteris paribus*, and hence raise rents.

Table A

Financial information for real estate and all private non-financial companies, 2001

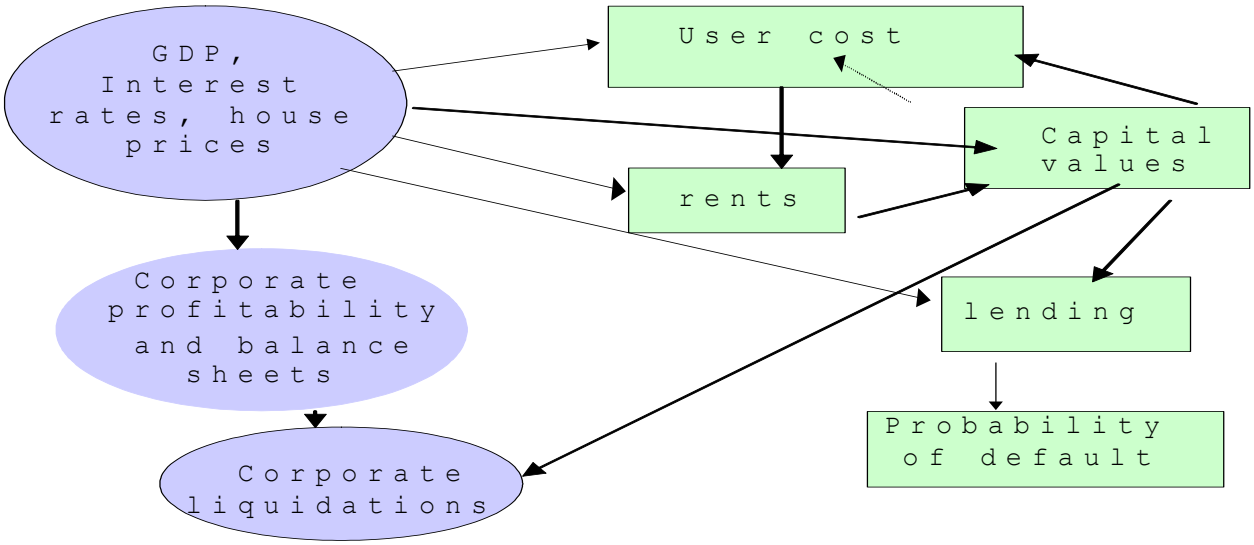
£bn, unless otherwise stated

	Real estate	All private non-financial companies
Income and expenditure account:		
Gross profits	12.0	188.5
Interest paid	5.2	39.6
Tax	1.0	25.6
Dividends	4.1	93.0
Retained profits	1.7	91.7
Balance sheet:		
Assets[(a)]	112.4	1238.0
Debt	62.7	470.4
Capital gearing (ratio of debt to assets)	55.8	38.0

(a) Based on the largest number of accounts giving both asset and debt information.

Sources: Bureau Van Dyck; ONS.

Chart 1
The macroeconomy and commercial property



The model of commercial property rental values can be set out in terms of a simple demand and supply model. The demand for occupier space is given by:

$$D = \alpha - \beta R + \psi Y \qquad \textbf{(1)}$$

where D is the (unobserved) demand for rented property, R is the rental value, and Y is the deviation of GDP from a simple time trend.

The equation for the supply of property by those seeking to rent out property is given by:

$$S = \phi + \delta R - \lambda UC + \rho HP + \zeta K \qquad \textbf{(2)}$$

where S is the (unobserved) supply of rental accommodation, R is the rental value, UC is a measure of the user cost, HP is the level of house prices, and K is the private sector capital stock. *A priori* we expect supply to be positively related to rents. The capital stock is included as a crude proxy for the available supply of commercial property and would therefore, other things being equal, be positively related to S. The 'user cost' is calculated as the interest payments per

unit of the capital stock.[7][8] As the user cost increases, supply would be expected to fall, hence the negative relationship. The use of base rates and aggregate private sector capital stock is clearly a crude assumption in the absence of a time series of the relevant capital stock measure. This user cost term would usually include a measure for expectations of capital gains.[9] Investor expectations play an important role in some of the literature on property cycles, helping to explain periods of financial instability (for example, Herring and Wachter (1999)). These models typically allow for periods of irrationality in the formation of expectations. We can in principle define expectations of capital gains by simple extrapolative or recursive rules and so extend the user cost measure. But these expectations mechanisms would be highly subjective and not capable of direct verification. The sensitivity of the overall property model to different expectations mechanisms is a potential avenue for further work.

Setting **(1)** equal to **(2)** and solving for *R* (rental values) gives:

$$R = \frac{(\alpha - \phi)}{(\delta + \beta)} + \frac{\psi}{(\delta + \beta)} Y + \frac{\lambda}{(\delta + \beta)} UC - \frac{\rho}{(\delta + \beta)} HP - \frac{\zeta}{(\delta + \beta)} K \qquad \textbf{(3)}$$

Equation **(3)** shows that, in this reduced-form expression, commercial property rental values will be positively related to the deviation of GDP from trend and the user cost of renting out commercial property and negatively related to the capital stock. The sign on house prices is ambiguous (see the discussion above).

Before estimating the model we consider whether there has been any evidence of structural changes in the commercial property market during the 1990s. The most significant changes to the market during the period have been to stamp duty. Although, at first glance, the raising of the lower limit on stamp duty in 1993 appears to have led to an increase in capital values (Chart 2), it is unlikely that these two events are linked since the change applied only to lower-value

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[7]In the absence of a time series on the property capital stock we revalue private sector capital stock in terms of property prices.

[8]We only look at interest payments as a proxy for the cost of bank borrowing. There are a number of forms of alternative finance available in the commercial property market. For example, DTZ's 'Money into Property 2001' states that bank lending to commercial property was £81 billion at end-2000. This compares to institutional equity holdings of £60 billion. Property companies also raised £1.67 billion in securities markets in 2000. Unfortunately, there is a lack of data on the cost of other forms of financing and so we only look at interest payments to provide a crude proxy for financing costs.

[9]Direct information on expected capital gains is not available.

properties and was therefore more likely to have affected residential, rather than commercial property. Later stamp duty changes have coincided with both rises and falls in capital values. Therefore, it does not appear likely that there have been any significant structural changes to the market during this period. Since the capital values equation is not estimated we cannot judge whether changes in stamp duty are associated with unexplained movements in capital values.

The preferred equation for commercial property rental values is shown below. This was derived by testing down from general to specific, eliminating insignificant explanatory variables at successive stages:

$$\Delta \ln \frac{RENT}{PGDP} = \underset{(7.0)}{0.487} + \underset{(4.8)}{0.255}\,\Delta \ln \frac{HOUSE}{PGDP} + \underset{(4.6)}{0.392}\,GDPRESID$$

$$\underset{(5.2)}{-0.119}\left(\ln \frac{RENT}{PGDP}\right)_{-1} + \underset{(2.3)}{0.042}\left(\ln \frac{HOUSE}{PGDP}\right)_{-1}$$

$$\underset{(7.5)}{-0.037}\ln KSTOCK_{-1} \qquad \underset{(3.9)}{+0.024}\left(\ln USERCOST\right)_{-1}$$

T-ratios are shown in brackets.

Estimation period: 1987 Q2 – 2002 Q1. R-bar^2 = 0.93, standard error = 0.5%

Diagnostic tests: Serial correlation F(4)=1.51 [.21], F(1)=0.93 [.34]

White heteroskedasticity adjusted model.

where RENT is the IPD rental values index, PGDP is the GDP deflator, HOUSE is the ODPM house price index, GDPRESID is the deviation of GDP at constant market prices from a simple time trend, KSTOCK is the private sector capital stock, $\frac{RENT}{PGDP}$ *is real rental values,* $\frac{HOUSE}{PGDP}$ *is real house prices, and USERCOST is a measure for the user cost of renting commercial property.[(10)] Subscripts indicate time lags.*

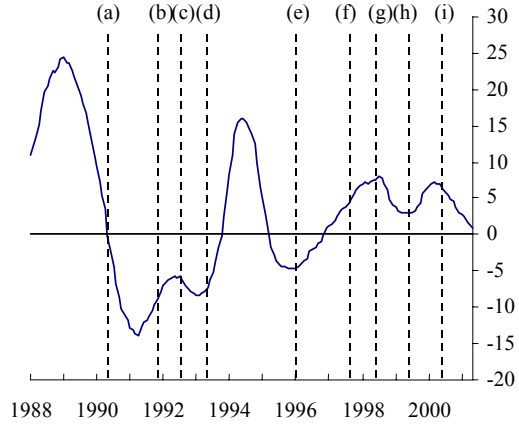
[(10)] The *USERCOST* variable is defined as $\frac{RBASE \times KBUSNH \times CAPITAL}{GDPCURR}$, where *RBASE* is the base rate, *KBUSNH* is the private sector capital stock, *CAPITAL* is the IPD all property capital values index, and *GDPCURR* is GDP at current prices. The *USERCOST* variable aims to provide a measure of the borrowing cost of those who own commercial property. It therefore uses the private sector capital stock as a proxy for the total availability of property, calculates the interest payment using the base rate, and converts into commercial property values using the IPD capital values index relative to GDP at current prices.

The sample period is from 1987 Q2 to 2002 Q1. This is due to the availability of data since the IPD index only goes back to 1987. According to this equation, real commercial property rental values are affected by real house prices, with a long-run elasticity of +0.35. We examined the relationship between house prices and rental values to see if there was a high degree of association (see Chart D11 in Appendix D, which shows the ratio of rental values to house prices, indicating a changing relationship over time). The positive coefficient suggests that residential and commercial property are substitutes; as house price rises shift resources into the housing market, the commercial property stock falls and rents rise. Real rental values are also affected by the user cost of renting commercial property (long-run elasticity is +0.21). There is also a strong cyclical factor, since real rental values are significantly and substantially affected by the deviation of GDP from trend. On the supply side, as the capital stock rises, rental values fall (long-run elasticity is –0.31).

Tests of structural stability (Chow test) for the last few quarters of the data period (between 2000 Q2 and 2002 Q1), suggest that the equation has reasonable forecast performance.
Other possible influences were investigated. In particular we looked at other proxy variables for supply, including data on construction orders. But none proved to be statistically significant. We also investigated using different lags but these did not improve the specification of the model.
For the user cost measure, we tried replacing the base rate with the ten-year swap rate, since this might be a better proxy for what borrowers actually pay, but this worsened significantly the specification of the model. An alternative would be to use the equivalent property yield, defined as the present value of projected income (rental) relative to the capital value. Estimates using this measure produce an insignificant and wrong-signed coefficient on this variable. This is not too surprising given some of doubts as to whether the yield variable is representative of the observed cost of property finance, discussed further below.

Chart 2

Commercial property capital values and structural changes in the commercial property market



Source: Investment Property Databank.
(a) Non-domestic business rates reformed.
(b) 1% stamp duty lower limit raised from £30k to £250k.
(c) 1991 stamp duty lower limit increase revoked.
(d) 1% stamp duty lower limit raised from £30k to £60k.
(e) Privity of contract abolished.
(f) Stamp duty increased to 1.5% for properties £250k-£500k and to 2% for £500k+.
(g) Stamp duty increased to 2% for properties £250k-£500k and to 3% for £500k+.
(h) Stamp duty increased to 2.5% for properties £250k-£500k and to 3.5% for £500k+.
(i) Stamp duty increased to 3% for properties £250k-£500k and to 4% for £500k+.

The estimated equation contains some stickiness in adjustment, implying that just under 90% of the adjustment is completed in four years. That is consistent with the institutional arrangements that rents are reviewed (typically) on a five-yearly basis. There has been considerable focus on the role of 'upward-only rent reviews' in the commercial property market and the lease on commercial property frequently specifies that rents can only move upward. We tested the model to see whether these had a significant impact, by distinguishing between positive and negative changes in the explanatory variables. The results showed that there was no significant difference between whether the variable was positive or negative, suggesting that upward-only rent reviews do not exert a restricting effect on the model.

In conclusion, the rentals model appears to work quite well, despite being a fairly basic aggregate model. It is beyond the scope of this paper to investigate whether regional differences in rents

cause changes in aggregate rents, although clearly they might have an influence on the regional demand for property.

4.3 Rental income and pre-tax profits

Rental income is the main component of the pre-tax profits of property companies (for example, rental income accounts for around 60%-70% of pre-tax profits for the two largest quoted property companies - British Land and Land Securities). So these estimates can be used to quantify the implications of changes in macro variables for the pre-tax profits of the real estate sector.

4.4 Bank lending model

The model for lending to real estate[11] is developed from identifying the key factors affecting the financing of commercial property. This turns out to be the weakest part of the property model because of the problems in specifying the supply of loans, and because of the role of the yield gap.

There is little in the way of previous econometric analyses of bank lending to corporates on which we can base the real estate model. Most examples use reduced-form expressions where supply-side variables are largely absent. In particular aggregate data on bank margins (that is, the difference between returns from lending and costs) are not available. Further, it is not clear that models of corporate borrowing are easily transferable to the property sector. For example, the study by Davis (2001) finds that the demand for corporate borrowing is driven by the need for external finance and hence by corporate investment. Since much borrowing by property companies is for investment in existing property rather than development, this framework is not entirely appropriate.

In principle we might express the demand for bank finance by real estate companies by:

$$L^d = \alpha + \beta * Y + \gamma * C + \phi * NAV + \mu * R \qquad \textbf{(4)}$$

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[11] The lending variable excludes lending to construction for the purposes of this paper because the construction measure also includes public and residential work.

Where Y is a measure of derived demand (overall activity); C is a measure of value (capital values); NAV is a measure of the relative attractiveness of equity and debt finance; and R is the relation between property yields and borrowing costs.

The supply of bank finance might then be given by:

$$L^s = \pi^*M + \psi^*CAPITAL \quad \textbf{(5)}$$

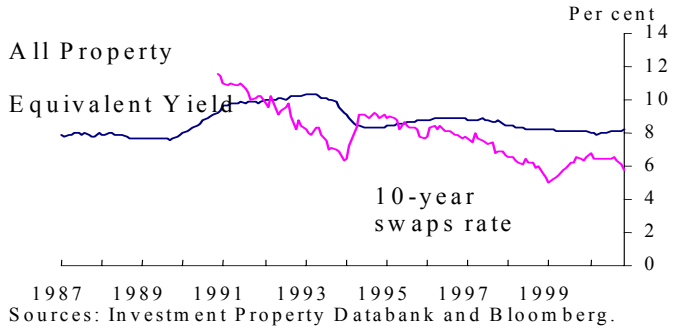
Where M is the margin (profitability of lending), and CAPITAL is a measure of property capital values, designed to capture the role of collateral. In equilibrium

$$L^d = L^s = L \quad \textbf{(6)}$$

where L is actual bank lending to real estate companies.

Chart 3

Property and fixed income yields



Sources: Investment Property Databank and Bloomberg.

However, we do not have a measure of margins. This model therefore relates bank lending to real estate primarily to demand-side variables. The empirical estimates suggest a positive relationship with GDP and with commercial property capital values from demand-side considerations (since an increase in capital values will require more funds to finance the transaction). But the supply side implies that lending may not be perfectly elastic at the going lending rate if the value of collateral declines. Hence the prior expectation on the sign of the capital value variable is ambiguous. The empirical estimates suggest that the demand influence dominates. It also finds evidence for a negative relationship between bank lending and the net asset value discount (the value of property shares relative to assets held), since as shares become relatively undervalued, firms may switch into bank finance instead. The relative cost of borrowing is proxied by the spread between the equivalent yield on property and the risk-free borrowing rate (Chart 3) (assuming that the risk premium remains relatively constant; for sensitivity to other measures see

the discussion below). This is expected to have a positive effect on bank lending to real estate, since a rise in the yield spread reduces the relative cost of borrowing.

The functional form is:

$$\Delta ln\ LENDING = \alpha + \beta * GDPRESID + \gamma * \Delta_4\ ln\ CAPITAL + \delta * NAV + \varepsilon * YIELDGAP + \phi * ln(LENDING/CAPITAL)_{t-1} + \eta_I * DUMMIES$$

where *LENDING* is the Bank's sectoral lending to real estate series, *CAPITAL* is the IPD all property capital values index, *GDPRESID* is the same measure of deviation of GDP from trend as used in the rental equation, *NAV* is the net asset value discount (a measure of the relative attractiveness of equity and bank finance), and YIELDGAP is the difference between the equivalent yield and base rates. The sample period is from 1989 Q1 to 2002 Q1, restricted by the difficulty in getting lending data prior to this date. There are three dummies in the equation for particular periods: *BSR*, *D1995Q4* and *D2000Q4,* representing respectively the reporting change in the lending data in 1997 Q2, and the quarters 1995 Q4 and 2000 Q4, where there were distortions relating to tax/legal changes.

The estimated equations for lending are shown below in Table B. These were derived by testing down from general to specific, eliminating insignificant explanatory variables at successive stages. The model incorporates a long-run unit relationship between lending and capital values to preserve homogeneity in nominal magnitudes.

Equation **(1)** in Table B broadly confirms the theoretical priors. The main difference is the absence of a significant yield gap term over the whole period (not shown). The yield gap term is, however, significant when included from 1999 (equation **(1)**). Alternatively the equation is also improved by the inclusion of a simple shift dummy after 1999 Q3 (equation **(2)**). The coefficient of the lagged level of lending suggests that there is relatively slow adjustment to shocks (the mean lag is 13 quarters).

A key issue is the lack of statistical significance of the yield gap term over the whole sample period. Without this term, however, the equation breaks down after 1999. Chart 3 implies that the risk premium may be quite variable. This is discussed further below. The insignificance of the yield gap over the whole sample period was robust to whether we used the policy rate or the swap

rate, the equivalent yield or the initial yield.[12] In statistical terms, there is little to choose between including the yield gap term after 1999, or simply including a simple shift dummy. The importance of either of these terms is illustrated by the implied dynamic lending path from using the coefficients for the model estimated pre-1999 (equation **(3)**), compared with the actual path of lending (Chart 4).

Table B: Estimation results for bank lending

Dependent variable: Change in log lending; quarterly data

	Sample period 1989Q1 – 2002Q1 (1)	Sample period 1989Q1 – 2002Q1 (2)	Sample period 1989Q1 – 1998Q4 (3)	Sample period 1989Q1 – 2002Q1 (4)	Sample period 1989Q1 – 2002Q1 (5)	Sample period 1989Q1 – 2002Q1 (6)
				Lending adjusted for sale and leaseback	Lending adjusted for sale and leaseback	Lending adjusted for sale and leaseback
Constant	0.44 (3.4)	0.35 (3.1)	0.5252 (3.7)	0.225 (1.6)		0.302 (1.9)
GDP dev from trend lagged 4 qtrs	0.7937 (5.0)	0.87 (5.7)	0.728 (4.3)	0.888 (6.0)	1.026 (7.7)	0.835 (5.3)
Growth in capital values (DLCAPITAL(-4)	0.420 (2.2)	0.46 (2.4)	0.4070 (2.0)	0.1378 (2.9)	0.1977 (5.8)	0.128 (2.6)
Net asset discount	-0.00045 (1.7)	-0.0005 (1.7)	-0.00044 (1.6)	-0.00027 (1.3)	-0.00033 (1.6)	-0.00028 (1.4)
Log (lending/capital) lagged one quarter	-0.0769 (3.3)	-0.06 (3.0)	-0.092 (3.6)	-0.038 (1.5)	0.00237 (3.0)	-0.052 (1.8)
Dummy 1997:2 Banking Statistics Review	0.0895 (4.7)	0.0908 (4.7)	0.088 (4.8)	0.0918 (5.0)	0.0949 (5.2)	0.0907 (5.0)
Dummy 1995:4	-0.056 (3.1)	-0.0550 (3.0)	-0.0566 (3.2)	-0.0508 (2.9)	-0.0472 (2.6)	-0.052 (3.0)
Dummy 2000:4	0.058 (3.2)	0.0477 (2.5)		0.0489 (2.7)	0.0548 (3.1)	0.0564 (3.2)
Dummy 1999:3-2002:1		0.0317 (2.8)		0.0221 (2.0)		
1999 dummy*yieldgap	0.0127 (3.7)					0.00875 (2.2)
R-bar squared	0.804	0.809	0.818	0.813	0.805	0.816
St error (%)	1.78	1.81	1.74	1.72	1.75	1.70
LM (4) (F)	0.78	0.93	0.98	0.66	0.81	0.76
Heteroskedasticity (F)	0.98	0.82	0.83	1.36	1.2	1.2
Forecast test						

T-ratios are shown in brackets.

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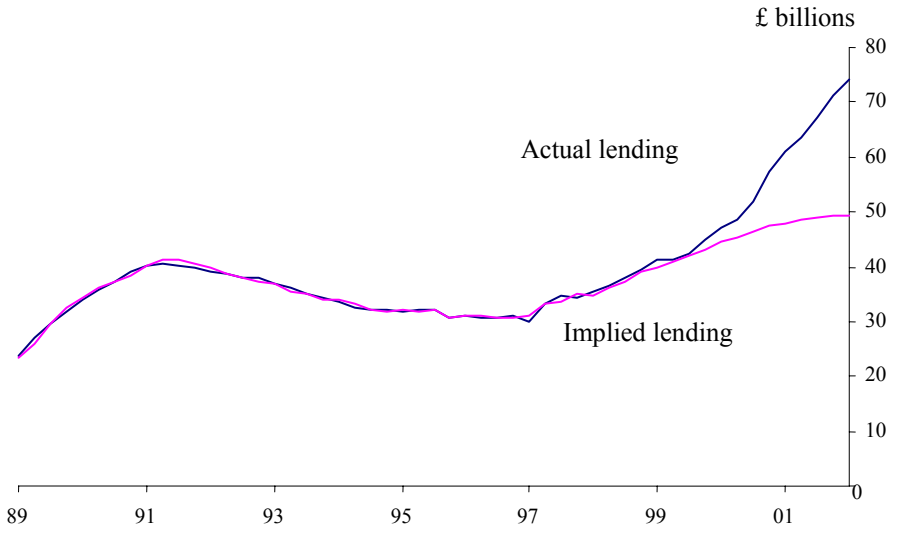
[12]The initial yield is the income received in the current year in relation to the capital value; the equivalent yield is the present value of income in relation to capital value.

There are several possible explanations for the fact that the yield gap term appears to be important only after 1999. For example, it could reflect supply conditions. We accept that a major shortcoming of this lending model is the absence of explicit supply factors (although we consider some specific explanations below). In a reduced-form equation for lending, the coefficient on the relative cost of borrowing could be either negative or positive depending on whether the demand and supply equations are fully identified. In economic terms our results are consistent with property lending being determined primarily by demand conditions after 1999, but with more of a role for supply conditions prior to this. However this is conjecture since we cannot test this with the available data. But the fact that a simple shift dummy 'explains' most of the breakdown thereafter, suggests that there may be other possible explanations.

Chart 4

Lending implied by model estimated up to 1998 Q4



Sources: Investment Property Databank, ONS and Bank calculations.

One is the measurement of the equivalent yield. Not only has the yield gap been persistently negative or positive over long time periods, but also the absolute level of the equivalent yield has been remarkably stable over different inflation periods. As noted above, the implied risk premium is very variable. That might cast some doubt of the yield gap measure. In a relatively illiquid market with a low level of transactions the average yield on all properties can be expected to be a

lagging indicator of the marginal return on property.[13] In addition, the valuation basis of the yield might not capture the underlying rate of return. So measurement error might be present. If this were constant throughout the sample period it would merely be reflected in the constant in the estimated equation, and would not cause systematic error. Given that capital values are measured by reference to the yield we examined whether this breakdown of the equation reflected *changes in the degree* of data mis-measurement by calculating the rise that would have been necessary in capital values to enable the equation fully to track the actual path of lending. Almost a 70% increase in capital values above their present level would be needed, reflecting an average measurement error on the equivalent yield of around -3 percentage points over this period. This difference is large given past volatility of this measure (see Chart 3). So although doubts persist about the measure of the yield gap the error would have to be very large to account for the observed growth in lending since 1999. For further interpretation of the yield gap, see the discussion below.

Although we cannot test directly the hypothesis that the change in the equation post-1999 was the result of changes in supply conditions, we considered whether this might have occurred as a result of changes in the proportion of lending carried out by UK and overseas banks. To test this we included the proportion of lending due to UK banks. In estimation this had a positive coefficient over the whole sample period, suggesting that UK banks were more willing to lend in times of high demand for finance for property. However, this failed to explain a significant amount of the difference between actual and implied lending.

We considered the role of alternative sources of finance through *asset substitution* directly by including a variable for the ratio of commercial property capital values to equity prices, but this variable was insignificant. An indirect measure is already included in the net assets discount measure in the equation.

Possible substitution between *real estate and construction* was considered by including lending to the construction sector to test for possible complementarity between the two. The term was not statistically significant.

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[13]However data on prime yields that are less prone to the averaging of yields also suggest considerable persistence in the yield gap.

There has been a considerable increase in the use of *sale and leasebacks* in the past few years. If financed by bank lending, this will lead to an increase in lending to the property sector (and a corresponding fall in lending to the non-property corporate sector) without necessarily any increase in the property stock or in capital values. Using Reuters, we identified the main sale and leaseback deals since 1997 and then used Loanware to identify the amount of borrowing associated with these deals. We found this to be about £4.5 billion by 2002, accounting for about a quarter of the unexplained level of lending. This suggests that sale and leaseback deals may have a significant role to play in explaining the growth in lending since 1999. Available data cannot reveal the proportion of sale and leaseback deals financed by bank lending in the past. But assuming that the average loan-to-value ratio was 80% on such deals enables a calculation of an upper estimate. We then construct an adjusted lending measure that excludes bank-financed sale and leaseback transactions. The results are shown in Table B (cols 4-5). Although the lending model still breaks down significantly after 1999 when this adjustment is made, the error is reduced by around one-third. That suggests that sales and leaseback might have been a significant but incomplete explanation for the failure of the simple lending model to explain the growth of lending post-1999. The effect of the yield gap on bank lending still remains significant after 1999 when sale and leaseback expenditure is netted off the lending measure (equation **(6)** in Table B). The coefficient implies that a 1 percentage point change in the yield gap increases lending growth by just under 1% in the short run. This equation provides a superior explanation of the data than either of these adjustments alone. So we conclude that both factors may have been important after 1999.

4.5 Capital values

Capital values are measured as the discounted value of future rental income. So we can use a discount model and an assumption about the discount rate to model this series. We use a 25-year discount period and the property equivalent yield as a measure of the discount rate (as in the construction of the data). To do this we need a measure of aggregate rental income. This is not published. Net aggregate rental income from commercial property to the private non-financial sector is around £14 billion. This estimate of rental income only measures net receipts by private non-financial companies from other sectors, and not gross rental receipts by real estate companies within the PNFC sector. We calculate an estimate for gross rental income by using observed data on information about initial yields together with the capital value of property. The initial yield is simply current rental income expressed in relation to the capital value (that is, analogous to the

dividend yield). The estimated value of the property stocks is around £326 billion in 2001.[14] This calculation suggests a figure of £22 billion for aggregate rental income in 2001.

The equivalent yield (used in the lending model) is the present value of projected income (rentals) relative to the capital value. So, for a given discount rate, the two measures of yield are related through assumptions about future rental growth. These calculations suggest that current capital values imply that expected rental values rise at 5% in nominal terms at each (assumed) five-year rent review. This makes it possible to derive a simple relationship (for use in simulations) between current rental values and capital values, given the equivalent yield and an assumption that expected average rental growth is the same as in the past (see Appendix A).[15] However this model can be easily extended to allow for current rental values to have an effect on the growth of rental values in future periods.

4.6 Equivalent yield

The all-property equivalent yield can be defined conceptually in terms of risk-free rates, the risk premium (unobserved) and the expected growth rate of rental incomes. The measure of the yield published by the Investment Property Databank is remarkably stable historically across periods of different inflation (see Chart 3). This stability has also been noted by Ball *et al* (1998). Hetherington (1988) uses institutional investment and bank lending to property in addition to long-dated gilts to try to proxy the risk premium and growth-rate influences. Our empirical estimates shown in Table C suggest that the yield has only a weak relationship with base rates or longer-term interest rates (a 1 percentage point change in risk-free rates leads to a 0.28 percentage point change in property yields according to our estimates). There appears to be no relationship at all over the full sample period, and a significant relationship is found only after 1992. This might be rationalised as being the result of offsetting changes in the risk premium or expected rental growth as interest rates change, although exactly why these should be systematically related is unclear. There are also some practical explanations for the observed stability of the effective yield measure. First, it is measured as an average across a portfolio of property that is of different

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[14] ONS *Blue Book*, net capital stock of commercial buildings, Table 10.5.
[15] However this assumption could be modified if desired.

type and location. Given the low level of property transactions, this average measure might change only slowly in relation to economic conditions. Ongoing (unpublished) work by the Investment Property Databank to examine any biases from valuations in relation to prices of transactions do not suggest a systematic error. Second, the industry practice has been to use yields on comparable properties to estimate the yield directly (see Ball *et al* (1998) for a discussion of this). This creates a problem from a finance perspective. Whatever the reasons, the implications are that the stability of the equivalent yield ensures that capital and rental values will tend to be closely related in the absence of large changes in risk-free rates.

Table C: Estimated yield model

Sample period 1992:1 – 2002:1

Equivalent yield = 6.888 + 0.2767 *RL

(20.4) (5.7)

R bar-squared = 0.443; standard error = 0.51; serial correlation LM (4) F=69.6*

4.7 Probability of default of property companies

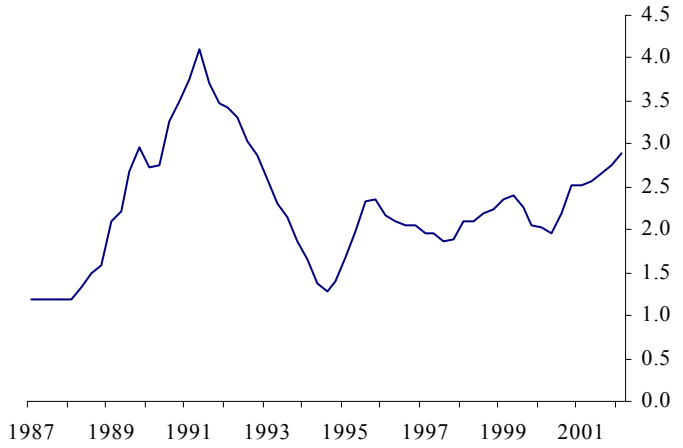
The probability of default of property companies can be determined from their key profitability and balance sheet variables using the structural model of business failures estimated by Bunn and Redwood (2003) on company accounts data for the period 1991-2000. Bunn and Redwood, using a model based on the methodology of Geroski and Gregg (1997), find that the probability of default depends on measures such as income gearing, capital gearing and aggregate GDP. They also find that the probability of default is higher for real estate companies than for other major sectors, for any given level of balance sheet stress. Their estimated model that defines the probability of failure (PD) for real estate companies is:

*PD = -0.851 +0.702*Profit margin (<0)+0.233*Profit margin (>0 and <0.03)+ 0.131*Profit margin (>0.03 and <0.06)-0.012* Interest cover+0.137* Debt to asset ratio+0.129*Profit margin(<0) and debt to assets(>0.35)-0.110*log number of employees –0.094*GDP growth rate plus dummies for subsidiary*

In explaining corporate failure, Bunn and Redwood use a set of nonlinear terms in profitability that imply the probability of default is higher when the profit rate is below 6%, and particularly

when it falls below zero. For most purposes this influence is not triggered for real estate companies, whose estimated profit rates are persistently higher than these thresholds. So the profit terms are excluded from the simulations shown in this paper. The probability of default for the real estate sector implied by the Bunn/Redwood model is then scaled by the average failure rate from 1991-2000 of 2.3%. That rescaled probability of default implies that the failure rate peaked at 4% in 1991 (see Chart 5).

Chart 5
Implied probability of default for real estate companies (%)



Source: Bank of England calculations.

4.8 Connections with the rest of the PNFC sector

The key link between the property model and the rest of the PNFC sector is through implications for the external cost of funds from changes in the value of property as collateral. In this context the main driving variable is capital values. The model can be augmented along the lines of the implicit interest rate premium (Benito and Whitley (2003)). In this model, capital values would enter the equation for the external cost of funds in addition to terms in capital gearing and risk-free interest rates. Although estimates find a role for the change in the value of the stock of commercial property, this term is not statistically significant. Alternatively, this mechanism can be included directly in the equation for aggregate corporate liquidations where, based on an update of the original model of Vlieghe (2001), we find a significant short-run effect from the change in capital values (see Appendix C).

5. Model performance and simulation results

5.1 Dynamic forecasts

The performance of the overall model is a product of the individual equations. The estimated equations for the property sector are those for rental values, bank lending, and the equivalent yield. One obvious question is how well this model would have predicted property prices and defaults in the early 1990s, given actual developments in the macroeconomy. In order to answer this we perform a dynamic simulation of the model starting in 1990. To do this we set the adjustments on the three main property equations (taking bank lending equation **(1)** from Table B) at a constant value based on their average 1989 level. The results are summarised in Charts 6-8. Rental growth was tracked quite closely (Chart 6) but, at face value, the simulated model suggests that the large cycles in capital values are not captured by the model. Capital values fell by around 7%-8% during 1992 in contrast to a small simulated rise (Chart 7). During 1994 they grew at an annual rate of around 15% whereas the simulated model predicted a fall of around 5%. However, between 1995 and 1999 simulated capital values have tracked actual growth quite closely, although the post-1999 slowdown in capital values is not predicted. Similarly, the simulated growth of bank lending failed to pick up all of the swings in actual growth during 1991-95, although the post-1995 trading performance is good (Chart 8).

From the chart it can be seen that the decline in capital values during 1990-92 preceded the fall in rental value growth. When capital values rose sharply during 1994-95 rental values were still declining. The simulated values of rental growth broadly match the patterns of the actual growth observed, so the rental equation does not seem to be the source of these differences (Chart 6). As a matter of arithmetic this implies that it was the failure of the yield equation to pick up the rise in the equivalent yield of around 1-1.5 percentage points during 1990-92, and the subsequent reversal of this in 1994, that explains the large unexplained fluctuations in capital values. This is confirmed by rerunning the counterfactual experiment, assuming that the equivalent yield was at its actual level. Simulated capital value growth then tracks actual growth quite closely. The temporary increase in the equivalent yield that is not picked up by the model might reflect an increase in the risk premium associated with property (the risk premium is assumed constant in the property model).

Chart 6

Actual and simulated rental growth

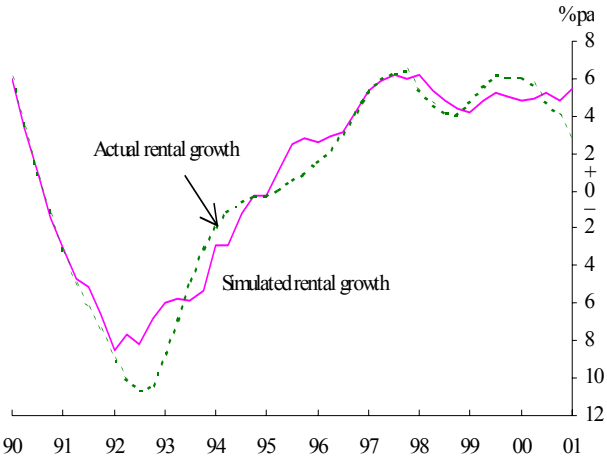


Chart 7

Actual and simulated capital value growth

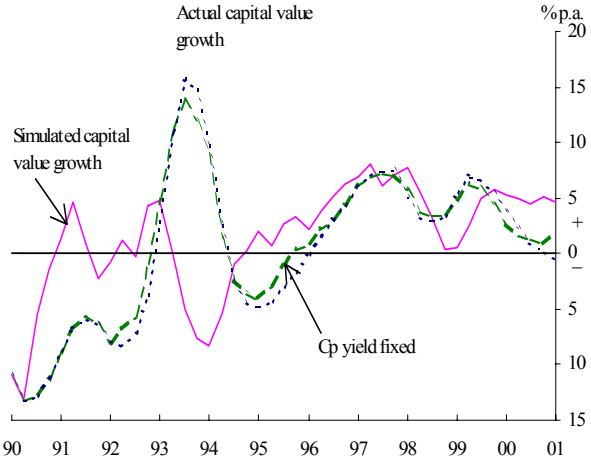
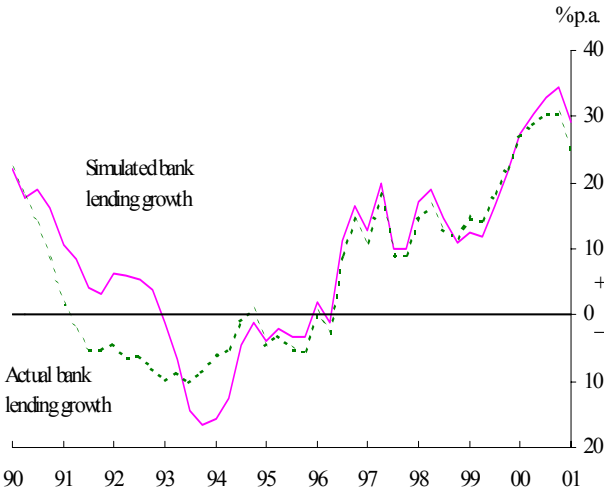


Chart 8

Actual and simulated bank lending growth (annual growth)



5.2 Simulation properties

The discussion above has shown that the model has some problems in tracking history fully over the 1990s but that these largely derive from the failure of the model of the equivalent yield (discount rate). We now illustrate some of the marginal properties of the model by shocking it relative to a benchmark projection (since the model is broadly linear the exact nature of this base is not an issue). We show three shocks, which are all computed using the Bank's

macroeconometric model (MTMM) to ensure a consistent set of inputs for the property model. But, although the property model contains a link between capital values and aggregate corporate liquidations, there are no feedbacks to other macro variables.

The first shock is an unanticipated rise in nominal interest rates of 1 percentage point for four years. The second is an unanticipated fall in both residential and commercial property values of 12%, corresponding to a shift in sentiment/expectations about future prospects in these markets. The third simulation involves a fall in world and UK equity prices of around 35%, corresponding to a change in expectations about future real earnings (not necessarily reflected in actual performance). All these shocks are applied to the full macro model with an assumption that, for the second and third simulations, monetary policy will adjust to any change in the level of output and inflation according to a Taylor rule.[16] The simulation results describe the changes relative to a baseline scenario over the period 2002 Q1-2005 Q4.

A rise in interest rates[17]

Following a rise in interest rates, GDP falls as domestic demand is reduced. This lowers the level of overall corporate profitability relative to the base path. The overall level of income gearing of the non-financial corporate sector rises because of higher interest rates and the fall in income. This rise in income gearing, together with the fall in profitability, implies a rise in corporate liquidations. If the link between the property model and aggregate liquidations is cut, liquidations increase by 15% after four years. But the inclusion of the link through property values increases this to around 25% (Chart 9). Property capital values fall as higher interest rates raise property yields. Lending growth, which also depends on capital values, falls. But rental income rises-higher interest rates raise the user cost which reduce the supply of property and raises rents. The probability of default for real estate companies rises by around 7%, reflecting the fact that the rise in interest rates offsets the effect of lower lending growth on the income gearing of property companies.

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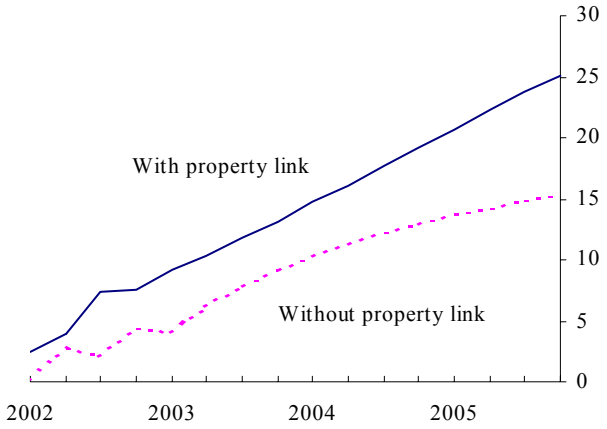
[16]See Taylor (1993) for further information.
[17]See Bank of England (2000) for a general discussion of the simulation properties of the MTMM.

Chart 9

Effect on corporate liquidations rate from an interest rate shock (a)(b)



Source: Bank of England calculations.

(a) Interest rate shock of 1 percentage point for four years.

(b) Shown as the percentage change in the liquidation rate from base, both with and without the property link in the model.

A fall in property values

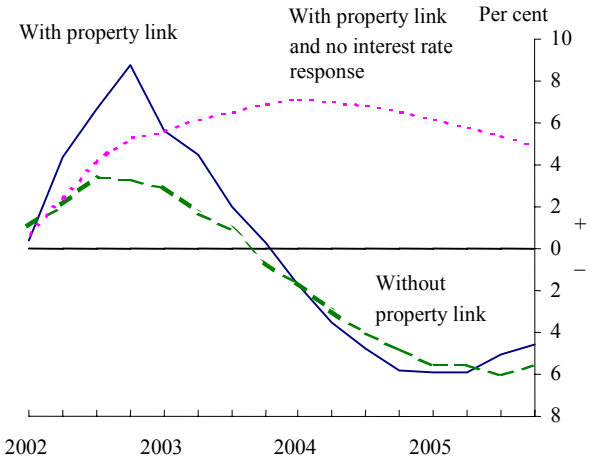
The macroeconomic effects on output, demand and inflation from a fall in property prices all arise from the decline in residential house prices. This causes private consumer spending, and hence aggregate demand and output to fall. The assumed monetary policy response implied by the Taylor rule is a cut in interest rates relative to their previous level in order to maintain inflation on target. Lower GDP leads to an initial rise in the level of overall corporate liquidations. But liquidations subsequently fall because of the decline in nominal interest rates. The alternative simulation shown in Chart 10 illustrates the effect on liquidations with the property link but without any monetary policy adjustment. Without the reduction in interest rates, liquidations continue higher after the fall in property prices.

The cyclical response of aggregate liquidations is accentuated by the role of capital values in the equation. But this simulation only produces a temporary effect on overall corporate liquidations since there is only a one-off change in the growth rate of capital values (Chart 10). Rental incomes are lowered because of the initial weakening in aggregate activity, and the fall in residential property prices. The equivalent yield only partially adjusts to lower policy interest rates, but the effect of a rise in the yield gap in boosting bank lending is offset by the fall in capital values, which acts to reduce bank lending. The probability of default of real estate

companies increases initially, peaking at a rate of 8% relative to the baseline path by the end of the first year. This initial rise is driven by lower GDP, but this is subsequently offset by lower income gearing of these companies when policy rates adjust to lower aggregate demand and inflation. The difference in the effects with and without the monetary policy adjustment demonstrates the sensitivity of the simulation results to the Taylor rule.

Chart 10

Effect on corporate liquidations rate from a property shock(a)(b)



Source: Bank of England calculations.

(a) Residential and commercial property capital value shock of an unanticipated fall of 12%.

(b) Shown as the percentage change in the liquidation rate from base.

A fall in world equity prices

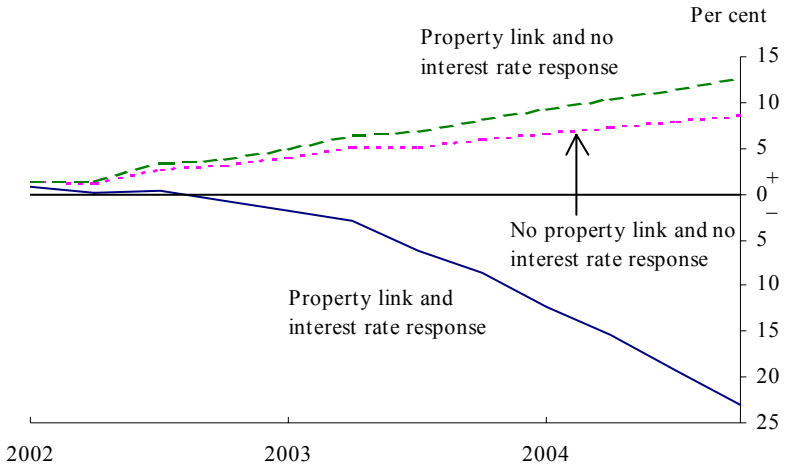
The assumed fall (of 35%) in the level of world and UK equity prices, relative to the baseline path, leads to a weakening of household balance sheets, in much the same way as a fall in residential property values. The macroeconometric model assumes that households respond by cutting spending. So the result is a fall in aggregate demand both in the United Kingdom and globally, and hence a fall in the inflation rate. A reduction in interest rates follows, given the assumed monetary policy reaction function. The property model implies that rental values fall at an increasing rate relative to the base, as a result of weaker aggregate demand. The fall in rental income from property raises the probability of default of real estate companies initially, before lower income gearing reduces default rates thereafter. Despite a small fall in the discount rate, capital values also continue to fall at an increasing rate. This implies a smaller fall in overall

corporate liquidations that would otherwise be implied by lower overall income gearing. The importance of the interest rate response is shown by comparing the effect on corporate liquidations with the property link and with and without any change in interest rates. The importance of the property link is demonstrated inasmuch as its inclusion raises liquidations by more than if the link between capital values and corporate liquidations were absent.

Chart 12 shows the change in the real estate sector's probability of default under each of these three scenarios. It shows the probability of default rising initially under all three, before falling for both the equity price and the property price shocks, although it remains higher throughout for the interest rate shock. This difference again demonstrates the importance of the monetary policy reaction in lowering interest rates in the second and third scenarios. All three simulations illustrate the role that commercial property may play in accentuating the response of the corporate sector's probability of default as a whole, and hence the financial system, to shocks.

Chart 11

Effect on corporate liquidations rate from an equity price shock(a)(b)(c)

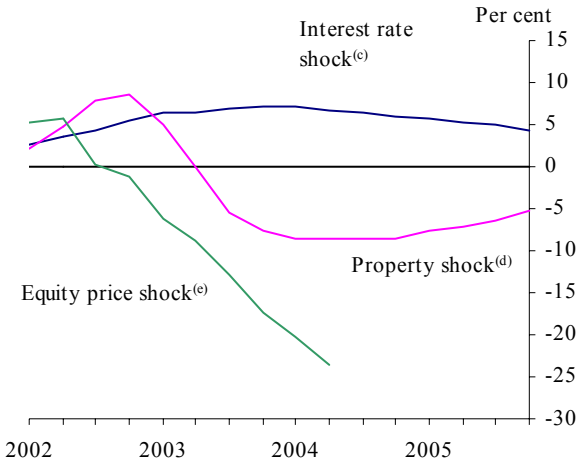


Source: Bank of England calculations.

(a) World and UK equity prices fall by around 35%, corresponding to a change in expectations about future real growth.

(b) Shown as the percentage change in the liquidation rate from base.

Chart 12
Probability of default in the real estate sector under different shocks(a)(b)



Source: Bank of England calculations.
(a) Shown as the percentage change in the corporate probability of default from base.
(b) Equity price shock only modelled up until 2004 Q2.
(c) Unanticipated rise in nominal interest rates of 1 percentage point for four years.
(d) Unanticipated fall in residential and commercial property capital values of 12%.
(e) Shock to world and UK equity prices of around 35%, corresponding to a change in expectations about future real growth.

6. Conclusions

In this paper we have developed a quantitative model of the real estate sector to analyse commercial property and shown how it might have implications for the probability of default for the non-financial corporate sector as a whole. The real estate model is based on an econometric analysis of rental values and bank lending, and supplemented by a calibrated model of the financial accounts of real estate companies. This calibration is based on data for private and public real estate companies. Using related work on company failure models we are able to extend the analysis to provide an equation for the probability of default of real estate companies. The bank lending equation is probably the weakest part of the system. In the absence of supply variables it depends almost exclusively on demand-side variables. The yield gap only enters with the expected sign after 1999, suggesting perhaps a difference in supply conditions before and after 1999: without this term the equation shows evidence of systematic failure. Other potential factors are also considered as explanations for this breakdown. Increased levels of sale and leasebacks might provide a further reason for the unexplained recent growth in lending. Further development of the bank lending model is a priority for further work. In the context of the present model the role of this equation is to link to the default probabilities of real estate companies. It is not, however, an important link between the property sector and the rest of the corporate sector.

A dynamic simulation of the property model starting in 1990 illustrates the overall performance of the model. Although the model appears to fail to capture all the cyclicality of capital values and bank lending since 1990, particularly between 1990-94, almost all of this failure can be attributed to the unexpected changes in the discount rate used to determine capital values from prospective rental growth. In turn this may reflect a temporary shift in the risk premium - a factor that has been highlighted in some of the theoretical literature and in historical accounts of the period. Future work might usefully examine the role of alternative expectations mechanisms and their relationship to this risk premium.

As well as its potential usefulness in the analysis of real estate companies and the determination of property values, simulations with the model show the importance of any link from property prices for the probability of default of other non-financial companies. These simulations illustrate the role that commercial property may play in accentuating the response of corporate sector default as a whole, and hence the financial system, to shocks.

Appendix A

Determination of capital values

The model of capital values follows from a simple discounted flow of rental receipts as follows:

$$Capital \quad = \quad \frac{r_{t+1}}{(1+E)} + \frac{r_{t+2}}{(1+E)^2} + \frac{r_{t+3}}{(1+E)^3} + \ldots + \frac{r_{t+n}}{(1+E)^n}$$

where E is the equivalent yield and r is the rental receipt.

From the calibrations r is assumed to be constant so this reduces to:

$$Capital \quad = \quad \left[\frac{1}{E} - \frac{1}{E(1+E)^n} \right] . r$$

This can be simply extended to allow for changes in the future growth rate of dividends by defining E as the equivalent yield less the growth rate of rental incomes.

Appendix B

Property sector model

Gross operating surplus	=	0.44* *rent*
Interest payments	=	(*bank rate* + π) . lending where π is an annual premium
Tax paid	=	0.14* *profits after interest*
Dividends paid	=	0.8* *post-tax profits*
Change in assets	=	*Change in capital values . lagged asset values*
Capital gearing	=	*Lending*/*assets*
Income gearing	=	*Interest payments/gross income*
Equivalent yield	=	6.89 + (0.27*20-year gilts)
Bank lending		See equation **(2)** Table B
Rental values		See equation on p.x
Probability of default	=	1 + (3.56 ((0.094 Δ ln *GDP*) – (0.12 *income gearing) + (0.137 capital gearing*)))
Real estate debt at risk	=	(*Probability of default . lending*)/*GDP at current prices*

Appendix C

Corporate liquidations model

The corporate liquidations model based on an update of Vlieghe (2001) is presented below:

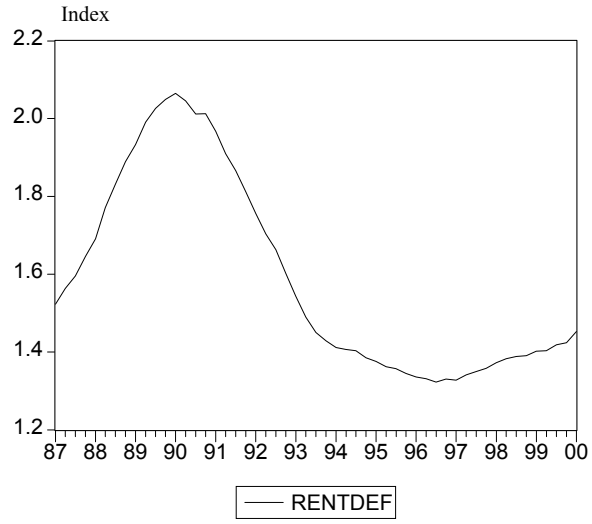
	ln *lqr*
Constant	-0.525 (-2.87)
$(\ln lqr)_{-1}$	-0.093 (-2.02)
$\Delta(\ln lqr)_{-1}$	-0.401 (-3.20)
$\Delta(gdpresid)$	-3.81 (-1.69)
$(\ln ig)_{-1}$	0.144 (2.77)
$\Delta(\ln ig)_{-2}$	0.148 (0.878)
$\Delta(\ln property)_{-1}$	-0.844 (-2.15)
$\Delta(r)_{-1}$	0.0236 (2.36)
$\Delta(\ln debtgdp)_{-1}$	-0.0695 (-0.508)
Adj R^2	0.61
S.E.	0.047
F	8.90 [0.00]
Serial correlation LM(4)	6.20 [0.18]
Serial correlation LM(1)	1.09 [0.30]
Jarque-Bera	2.92 [0.23]
White test for heteroskedasticity	14.16 [p=0.59]
RESET(1)	1.34 [p=0.25]

where *lqr* is the liquidations rate, *gdpresid* is the deviation in GDP from a simple time trend, *ig* is corporate income gearing, *property* is property capital values, *r* is the policy rate, and *debtgdp* is the debt to GDP ratio.

Appendix D

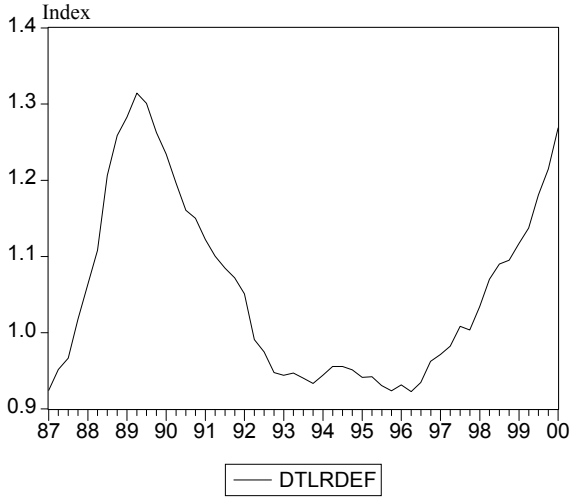
The data

Chart D1
Real commercial property rental values



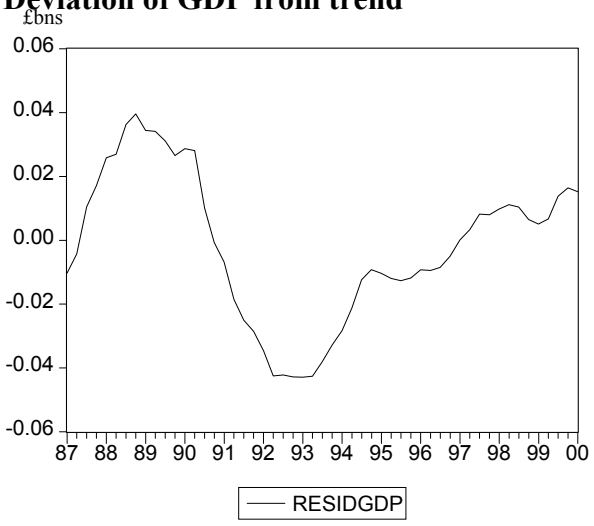
Sources: Investment Property Databank, ONS.

Chart D2
Real house prices



Source: DTLR.

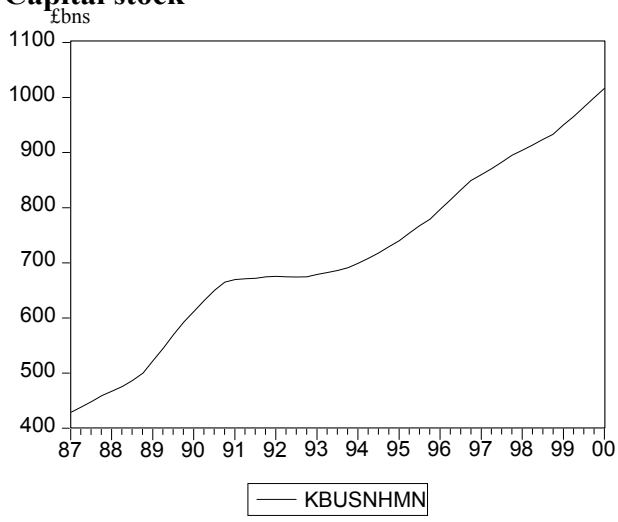
Chart D3
Deviation of GDP from trend[(a)]



(a) Residuals from regressing GDP at constant market prices agaiRnst a constant and a time trend.

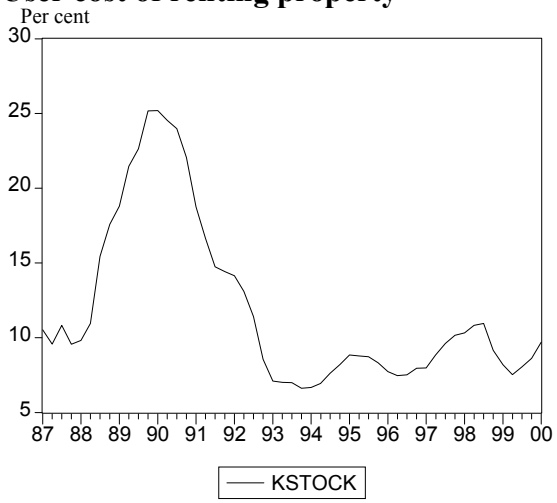
Source: ONS.

Chart D4
Capital stock



Source: Bank of England.

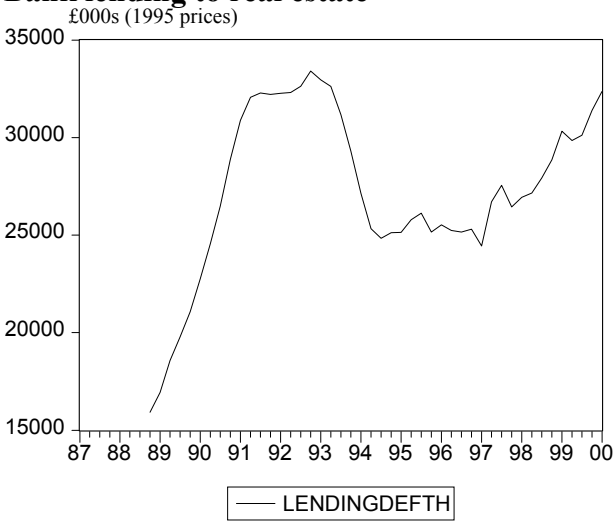
Chart D5
User cost of renting property[(a)]



(a) Calculated as the base rate multiplied by commercial property capital values and the capital stock, all divided by GDP at current market prices.

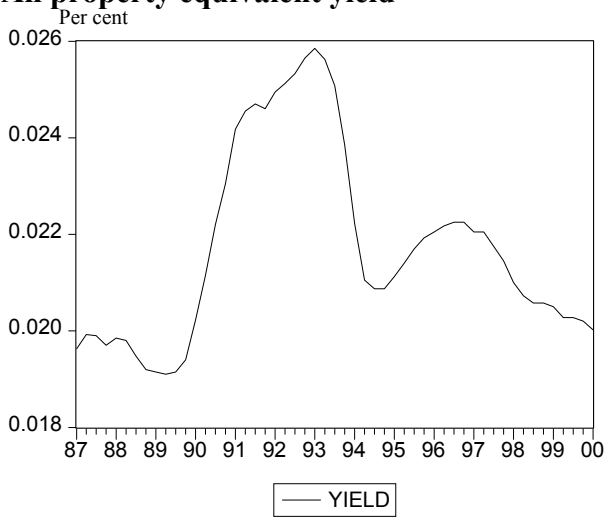
Sources: Bank of England, Investment Property Databank, ONS.

Chart D6
Bank lending to real estate



Sources: Bank of England, ONS.

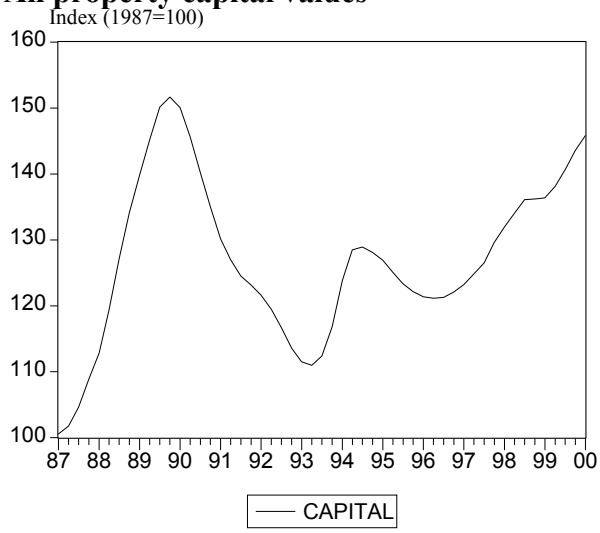
Chart D7
All property equivalent yield[(a)]



(a) Quarterly rate.

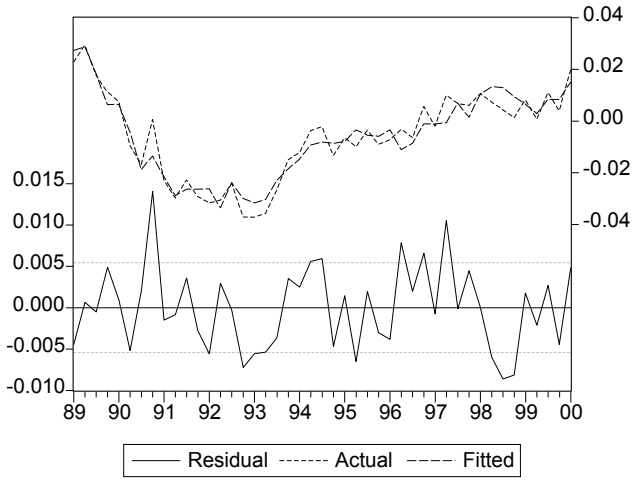
Source: Investment Property Databank.

Chart D8
All property capital values



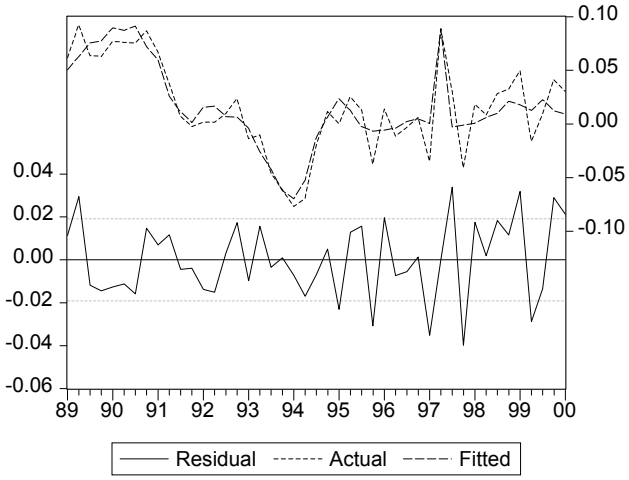
Source: Investment Property Databank.

Chart D9
Actual/fitted/residual values of rental values model[(a)]



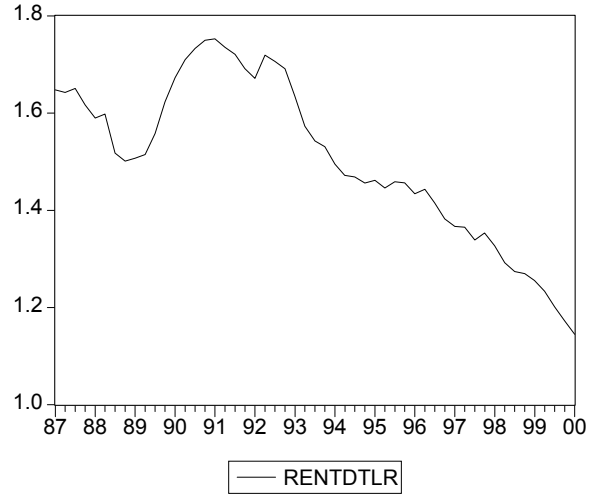
[(a)]Sources: Bank of England, Investment Property Databank, ONS.

Chart D10
Actual/fitted/residual values of bank lending model



Sources: Bank of England, ONS.

Chart D11: Ratio of commercial property rental values to house prices



Sources: Bank of England, Investment Property Databank, ODPM.

Sources:

Bank lending: Lending to real estate companies (Bank of England)

Rental and capital values (Investment Property Databank)

Equivalent property yield (Investment Property Databank)

Real estate balance sheet (Bank estimates using company accounts from Thomson Financial Datastream)

Risk-free interest rates: London clearing banks' base rate (ONS); yield on long-dated government securities (ONS)

GDP: GDP at constant 1995 market prices (ONS)

Probability of default of real estate companies: Bank estimates (see Bunn and Redwood, Bank of England, forthcoming)

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