An Econometric Model of Retail Rents in the United Kingdom

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Abstract. The present study constructs a model of retail rent determination at the aggregate level in the United Kingdom. While recognising the influence of very localised factors in the determination of retail rents, this paper explores the importance of broad economic forces and trends in the retail property market as determinants of retail rental values. A dynamic specification based on GDP, consumer expenditure and past values of retail rents is adopted to explain changes in real retail rents in the U.K. This model provides satisfactory results and it is subsequently used to produce dynamic forecasts four quarters ahead. The forecasts suggested that U.K. retail rents would exhibit a slight recovery in the second half of 1994 terminating the downward trend since the first quarter of 1990. However, a small drop again was forecast for the first half of 1995.

Introduction

Retail rental values in the United Kingdom (U.K.) have displayed a substantially stronger growth rate than both office and industrial rents. They have also outperformed inflation and been considerably less susceptible to the recessions experienced by the property market in the early 1980s and early 1990s. These distinctive patterns of retail rents make their modelling an academically interesting exercise that can provide further insights into the dynamics of retail rents with particular implications for analysts in the property industry. The present study aims to develop an econometric model of retail rent determination suitable for forecasting purposes at the aggregate level in the U.K. The examination of retail rents is an under-researched area and existing studies have pointed out the difficulties in modelling and forecasting retail rents (Hetherington, 1988).

The empirical investigation in the present study is based upon a regression model of retail rent determination. Regression or econometric models are more suitable for longer-term forecasts, although some may argue that these models are better at forecasting the short run than the long run. However, the length of the lag structure of the explanatory variables in regression equations can generate problems in forecasting the dependent variable several periods ahead. This is of particular importance when recent lags are significant in the determination of the dependent variable. Therefore, one must forecast values for the explanatory variables prior to the computation of the dependent variable. For many economic series such forecasts do not exist and this may limit the plausibility of these models for forecasting purposes.

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The present paper also acknowledges that retail rents are sensitive to trends in local markets. A study at the aggregate level does not contradict this fact but it aims to identify the relative importance of national forces in the dynamics of retail property markets and rent behaviour. National economic conditions are expected to influence local retail markets although at different degrees. Aggregate studies provide insights on general trends in the market that will be intensified or become less pronounced in particular localised markets by factors such as the strength of the local economy or location and type of property.

The present study makes use of quarterly data to model retail rents in the U.K. over the period 1977Q2 to 1994Q2. Subsequently, quarterly forecasts were made for a year ahead up to 1995Q2. The discussion is organised as follows: section two reviews relevant studies; section three discusses the model; the fourth section provides the empirical results; section five presents the forecasts; and section six concludes.

Literature Review

Empirical studies on the determination and forecasting of retail rents reflects the limited amount of research devoted to the retail sector. Existing published work on retail property markets has examined several issues including the estimation of sales potential in a trade area (Martin, 1985), identification of retail opportunities (Whaley, 1990), explaining and forecasting retail space development (Benjamin, Jud and Okoruwa, 1993). With respect to retail rents determination, Hillier Parker (1984, 1985, 1987) suggested an equation that specifies retail rents determination as a function of real retail profits in the previous period and real disposable income in the current period. In other versions of this model, Hillier Parker replaced the real disposable income with the volume of retail sales. Hillier Parker cited that the development of a single model of retail rent determination was difficult to establish because rents vary greatly between shopping centers. Moreover, it was argued that rents in high street shops do not seem to respond to economic conditions. This probably implies that location-specific factors are more important in influencing retail rents in high streets.

Hetherington (1988) provides a specification of retail rents that is based upon the volume of retail sales or alternatively, upon real retail profits. This model can be operationalised for forecasting purposes, if the volume of retail sales and real retail profits are predicted. Other findings of this study included the insignificance of supply-side variables and the fact that the effect of retail sales on rents is most significant in small towns.

A cross-sectional study by Sirmans and Guidry (1993) examined the variation in retail rents across shopping centers in the United States. Retail rent variation was modelled on ‘customer drawing power’ (proxied by shopping centre size, age of shopping center and national anchor tenant), architectural design, location, and market conditions. The estimates showed that all these factors were significant in the determination of retail rents, explaining about 85% of the variation in rents when combined together.

More recently, Key, MacGregor, Nanthakumaran and Zarkesh (1994) developed national and regional models of retail rents in the U.K. A reduced-form equation of rent determination is used that reflects demand and supply conditions in the retail property market. The main demand-side variable is consumer spending in real terms. However, Key et al. suggest that retail sales or retail profits can be used as alternative measures of demand for retail space. The supply-side variables that appear in the preferred
specification are the stock of retail space and the level of new construction. In this demand-supply equation rental values lagged one and two periods are included to capture, according to these authors, the cyclical movement in rents. The models produced by Key et al. provide a very good fit to the actual data series at both the national level and the super-regions as defined by these authors (clustering of different geographical regions).

Finally, McGough and Tsolacos (1995) apply short-term forecasting techniques, that is, autoregressive-moving average processes (ARIMA), to predict retail rents. An ARIMA (1,2,0) model provided the best results suggesting that retail rents can be partially predicted in the short run on the basis of movements in their past values.

The Model

Retail rents at the aggregate level are expected to respond to both aggregate demand and supply conditions in the market. Demand for retail space derives from the demand for retail services that is assumed to relate positively to broader economic trends. The supply of retail space comprises both new and existing space coming on the market. The model in the present study is specified as a reduced-form equation of a structural demand-supply model.

In the studies reviewed in the previous section, the main variables that were used to proxy demand for retail space included the volume of retail sales, profitability of retailers, disposable income, and consumer spending. These variables are considered by authors as alternative indicators of demand for retail services and thus retail space. The model in the present paper incorporates two demand-side variables: gross domestic product (GDP) and total consumer expenditure. GDP is used as a measure of general economic conditions affecting all retail markets. Consumer expenditure is expected to provide a more direct estimate of demand for retail services.

On the supply side, there is a lack of suitable variables. In the U.K., some authors (e.g., Key et al., 1994) have utilised data on total retail building stock or retail building output to capture supply-side effects on retail rents. Changes in total stock indicate the new retail space added to the existing stock. The hypothesis tested is that large additions would have a dampening effect on retail rents because demand is likely to be partly satisfied. Similarly, high levels (or large volumes) of retail building output are expected to meet part of the current demand and, therefore, reduce pressures on rents. In the present study, changes in the volume of retail building output are included in the model to allow for supply-side influences on rents. This variable, however, allows only for the effect of new space on retail rents and, therefore, represents a partial measure of the true supply which also comprises preexisting retail units put on the market.

Finally the results of the study by McGough and Tsolacos (1995) are taken into account to produce the complete form of the model. These authors argued that past changes in retail rents convey information about their current and future trends. This contention is explicitly recognised in the present model by incorporating as explanatory variables past values of retail rents.

The dynamic specification that guides our empirical investigation is given by the following equation:

\[
\Delta RENT_i = a_0 + \Sigma \beta_i \Delta GDP_{t-i} + \Sigma \gamma_j \Delta EXP_{t-j} + \Sigma \nu_k \Delta RENT_{t-k} - \Sigma w_m \Delta RBOUT_{t-m} + \epsilon_t
\]

for \( i = 0,1 \ldots N, \quad j = 0,1 \ldots T, \quad k = 1,2 \ldots K, \quad m = 0,1 \ldots M \), \hspace{1cm} (1)
where $\Delta$ is the first lag operator; $RENT$ is real retail rents; $GDP$ is the gross domestic product; $EXP$ is total consumer spending; $RABOUT$ is the volume of retail building output; and $\epsilon_t$ is the current stochastic disturbance term. Full definitions and sources appear in the data appendix.

According to equation (1), changes in real retail rents are affected by the contemporaneous and lagged changes in $GDP$ and consumer spending. This means that current and past changes in these variables determine the demand for retail services and influence the demand for retail property. We cannot determine a priori the length of the lags. We expect, however, that the effect of changing economic trends and consumer spending will be felt in the retail property market within a period of two years. Current changes in retail rents are also explained by their past trends. Finally, current and past changes in the volume of retail space brought onto the market appear as an additional determinant of retail rents capturing supply-side effects.

**Empirical Results**

Equation (1) is estimated using quarterly data over the period 1977Q2 to 1994Q2. The starting date represents the initial observation in the Jones Lang Wootton index of retail rents which is used in the present study. The final date represents the most recent date for which data were available for consumer expenditure and retail building output at the time of conducting the empirical investigation. The results of the estimation of equation (1) are given in Exhibit 1 as equation (2).

Equation (2) suggests that changes in real retail rents are explained by the demand-side variables we use and previous changes in retail rents. Retail building output is insignificant, taking in most occasions the wrong sign (positive). The effect of $GDP$ changes on retail rents is registered with a lag of five and seven quarters, as the simple moving average of $GDP$ in equation (2) shows. This means that when the economy expands, rents in the retail property market will experience the effects of a buoyant economy with a lag of at least one year. This lag of one to two years suggests by the model, conforms to our expectations. Our estimates also establish a significant effect of consumer expenditure on retail rents with a maximum lag of six quarters (not reported in Exhibit 1). However, the most significant effect is produced by the contemporaneous changes in consumer spending. This finding suggests that current trends in consumer expenditure are considered as an indicator of the contemporary retail market conditions in rent reviews and take up of new leases. We would, of course, expect a high correlation between $GDP$ and expenditure which can lead to multicollinearity problems in the estimation of equation (2). However, the moving average of $GDP$ and contemporaneous expenditure used in equation (2) display a weak correlation (correlation coefficient over the estimation period: .26). Finally, as expected, changes in current retail rents are partly explained by their past trends, in particular, by changes lagged one and two quarters. Equation (2) in Exhibit 1 explains 56% of changes in real rents. This goodness of it is moderate and implies that the unexplained part may be the result of local specific factors affecting retail rents that are not, however, captured by an aggregate model.

In equation (2) lagged values of the dependent variable appear on the right-hand side and, therefore, an investigation of residual serial correlation is required. The use of the Durbin-Watson $h$-statistic is not possible because the regressors include the dependent variable lagged more than one time and thus the $h$-statistic cannot be defined. Therefore
the presence of serial correlation is examined using the procedure suggested by Durbin (1970). The application of this test reveals that residual serial correlation is not a problem in equation (2). The actual and fitted values are shown in Exhibit 2. The model seems to capture the general trend that retail rent changes display but it does not replicate the fluctuations accurately. However, changes in real retail rents, as Exhibit 2 illustrates, are erratic, making the econometric modelling of this time series a difficult task.

The diagnostic tests for functional form and heteroscedasticity do not point to any misspecification problems. On the other hand, the test for normality suggests that the residuals are not normally distributed. This may affect the reliability of the $F$- and $t$-tests as they are based on normal distributions. A possible source of this problem could be the large size of the residuals in certain periods or associated with particular observations. An examination of changes in real retail rents in Exhibit 2 shows that this series takes an exceptionally high value in 1981Q1 which is not captured by the model. The incorporation of a dummy variable to allow for the effect of this particular observation on the performance of equation (2) proves successful, as the normality problem is now corrected. The robustness and adequacy, however, of this specification can be further assessed by examining the cumulative sum of square residuals (CUSUMSQ), a test of

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**Exhibit 1**

**Empirical Estimation of Equation (1)**

\[
\Delta RENT_t = -0.004 + 0.69(\Delta GDP_{t-5} + \Delta GDP_{t-7})/2 + 0.49\Delta EXP_t + 0.28\Delta RENT_{t-1} + 0.25\Delta RENT_{t-2} 
\]

(2.3) (2.8) (3.2) (2.9) (2.4)

Figures in brackets are $t$-ratios
Sample period: 1978Q1–1994Q2*
Estimation method: Unrestricted OLS
Variable definition and sources: see data appendix.

$R$-bar-squared = 0.56  SE = 0.01

Diagnotic Tests for Equation (2)

<table>
<thead>
<tr>
<th>Test</th>
<th>D.F.</th>
<th>Value</th>
<th>$t$-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\xi_1$</td>
<td>1,60</td>
<td>0.38</td>
<td>4.00</td>
</tr>
<tr>
<td>$\xi_2$</td>
<td>1,64</td>
<td>0.30</td>
<td>4.00</td>
</tr>
<tr>
<td>$\zeta_3$</td>
<td>(2)</td>
<td>14.7</td>
<td>5.99</td>
</tr>
</tbody>
</table>

where:

$\xi_1$ is Ramsey’s RESET test for functional form misspecification (F-version);
$\xi_2$ is a test for heteroscedasticity based on the regression of square residuals on square fitted values (F-version);
$\zeta_3$ is the Jarque-Bera test for normality of the residuals, distributed as $\chi^2(2)$ (LM-version).

The 5% critical values are reported in square brackets.

*The data series on rents covers the period 1977Q2 to 1994Q2. However, the use of first differences and the incorporation of the $\Delta RENT$ variable lagged two quarters results in the loss of three degrees of freedom when Equation (1) is estimated. Thus, Equation (1) is actually estimated over the period 1978Q1 to 1994Q2.*
structural stability proposed by Brown, Durbin and Evans (1975). It is shown in Exhibit 3 that the plot of the CUSUMSQ-statistic does not cross either of the lines, which are drawn at the 5% level of significance and, therefore, the null hypothesis that the regression equation is correctly specified is not rejected at the 5% level of significance.

Finally, we replaced the demand-side variables in equation (2) with alternative proxies that are used in the current literature. The inclusion of the volume of retail sales and disposable income does not result in a better performing specification. Moreover, these variables when combined with those in equation (2) lose their significance. However, a variable that appears significant at the 10% level is changes in outstanding consumer credit lagged three quarters. This variable may become very important at certain times as consumer spending can be driven by the availability of finance.

Forecasts

The presence of the consumer spending variable that is not lagged in equation (1) poses a problem in using this equation for forecasts. Predictions of retail rents four quarters ahead are not possible unless forecasts of consumer spending over the same period are provided. These forecasts were produced by following the theoretical argument that any homogeneous nonstationary time series can be reproduced by both an autoregressive and moving average process, that is an ARIMA process (see Pindyck and Rubinfeld, 1991). Therefore, we adopted the ARIMA methodology to generate quarterly predictions of consumer spending. Our estimates showed that the ARIMA model that best fits the
historical data of changes in consumer spending takes the form of an ARIMA (3,0,1) specification. Using this ARIMA specification we are able to make predictions of consumer spending four quarters ahead. The danger with this methodology is, however, that the forecast error in one period will be transferred to the next period, thus affecting the accuracy of the subsequent forecast. Nevertheless, we hoped that this bias would not affect significantly the forecasts of retail rents four quarters ahead.

Equation (2) is now used to make quarterly forecasts a year ahead. The first step is to examine the forecasting strength of this equation. For this purpose, equation (1) is estimated over the period 1977Q2 to 1993Q2 and dynamic forecasts are produced four quarters ahead, that is 1993Q3 to 1994Q2. Subsequently, comparisons between the actual values of real retail rents and the forecasts produced are made. The second step is to provide forecasts for the period 1994Q3 to 1995Q2 based on equation (2), which is equation (1) estimated over the whole sample period (1977Q2 to 1994Q2).

In estimating equation (1) over the period 1977Q2 to 1993Q2 and then predicting a year ahead, the lags of the regressors are restricted to be similar to those of equation (2). One the other hand, no similar restrictions are imposed on the values of the regressors’ coefficients. The values of the quarterly changes in consumer spending for the period 1993Q3 to 1994Q2, required in equation (1) for the forecasts of retail rents, were predicted using the ARIMA (3,0,1) specification.

Exhibit 4 presents the dynamic forecasts for the period 1993Q3 to 1994Q2. The results are encouraging. Column (2) suggests that real rents would fall throughout the period...
forecasted. Using the forecasted values in the changes of real retail rents, we can derive the predicted values in the index of real retail rents (1992Q2 = 1.00) that appear in column (3). These values can now be compared with those in column (4) that represent the actual values of the index. Actual real rents display a slight drop. The forecasts produced capture this fall in real rents but they overestimate it. However, the forecasting errors in percentage terms suggest that these estimates are very good.

Following this test of forecasting adequacy of equation (1), predictions are now made for the period 1994Q3 to 1995Q2. The predictions are generated based on equation (2). Again the four quarterly values required for changes in consumer expenditure are forecasted using the ARIMA (3,0,1) model. Exhibit 5, which presents the results, suggests that real retail rents will show a very small recovery in the second half of 1994. This recovery will be shortlived as real rents are forecasted to fall in the first half of 1995 and reach a level that is lower than that achieved in 1994Q2. This drop is again very small. We can argue, therefore, that the downward trend of real retail rents has ceased in the U.K. and rents will remain stable until mid-1995. Subsequently, the strength of the demand variables included in this model will determine the direction in retail rents. The predicted trend in the level of real retail rents over the period 1994Q3 to 1995Q2 is illustrated in Exhibit 6. This figure shows that the fall in real retail rents, which began in 1990Q1, ceased at the end of 1993, when rents stabilised. The predictions suggested that no significant changes were anticipated until mid-1995.
Conclusions

This paper discusses a model of retail rent determination that can be used to forecast broad trends in retail rents. The main objective of the paper is to advance further the limited literature on modelling and forecasting retail rents. A single-equation regression model is used to explain and forecast changes in retail rents quarterly a year ahead. Our estimates demonstrate the importance of demand-side variables, in particular GDP and consumer spending. The effect of changes in GDP on retail rents is established with a lag of one to two years. On the other hand, contemporary consumer spending has the most important effect on current retail rents. We rationalise this finding by arguing that consumer spending provides evidence about conditions in the retail sector which, in turn, are taken into account by agents when rents are negotiated. Past values of retail rents also appear to be significant, suggesting that these values provide partial information about current and future directions in retail rents, which is consistent with other recent literature.

Testing for the forecasting ability of the preferred specification, dynamic forecasts were produced for the period 1993Q3 to 1994Q2 and compared with the actual values of the retail rent index the present study uses. The results were considered satisfactory as very small forecasting errors were obtained. Further forecasts to 1995Q2 suggested that the downward trend in retail real rents since 1990Q1 has come to an end in the U.K. with rents bottoming out. The direction of retail rents at the national level in the second half of 1995 and beyond will be dictated by the strength of national economic activity and
consumer spending. Analysts should, therefore, monitor trends in GDP and total consumer spending in order to predict the general direction in retail rents. Furthermore, trends in outstanding consumer credit can provide further insights on the direction of retail rents six to nine months ahead.

Finally, caution needs to be exercised with respect to the importance of supply-side influences on retail rents. The present study suggests that they are unimportant, but this could be the result of examining their significance at the aggregate level. An understanding of the forces that underpin broad trends in retail rents is important to property market analysts, but further demand and supply analysis to capture local specific factors is critical in the study of retail rents.

Appendix

\[
\text{RENT: Retail rent index (deflated by the implied GDP deflator), 1990Q2=100; index calculated from rents achievable on rent review. Source: Jones Lang Wootton.}
\]

\[
\text{EXP: Total consumer spending, real terms, 1990Q2=100. Source: Datastream.}
\]

\[
\text{GDP: Gross domestic product, output measure, volume, 1990Q2=100. Source: Datastream.}
\]

\[
\text{RBOU: Retail building output, real terms, 1990Q2=100. Source: Housing and Construction Statistics, Department of the Environment, London: HMSO Publications.}
\]

Notes

1Durbin (1970) suggested a procedure that can be used for tests of residual serial correlation if the dependent variable appears among the explanatory variables lagged by more than one single period. The application of this procedure in the context of the present paper initially requires an OLS estimation of equation (2) to obtain the residual \( e_t \)’s. Subsequently, we estimate the following OLS regression:

\[
e_t \text{ on } e_{t-1}, [(\Delta GDP_{t-5} + \Delta GDP_{t-7})/2], \Delta EXP, \Delta \text{RENT}_{t-1}, \Delta \text{RENT}_{t-2}.
\]

If the coefficient of \( e_{t-1} \) is significantly differently from zero then we reject the null hypothesis of no first-order residual autocorrelation. In our computations this coefficient took the value of .2 which we consider as a number not significantly different from zero. Therefore, we do not reject the null hypothesis.

2An ARIMA (3,0,1) specification implies that quarterly movements in consumer expenditure in the U.K. relate to their own values in the past three quarters and a current random disturbance as well as a random disturbance going back one quarter.

3Equation (1) estimated for the period 1978Q1 to 1993Q2 is given below so that we can see how the coefficients change compared with equation (2). The only coefficient the value of which differs in the two equations is that of \( \Delta EXP \). This is an indication of the structural stability of equation (1).

\[
\Delta \text{RENT}_t = -.004 + .69[(\Delta GDP_{t-5} + \Delta GDP_{t-7})/2] + .5 \Delta EXP_t +
\]

\[
.28 \Delta \text{RENT}_{t-1} + .25 \Delta \text{RENT}_{t-2}.
\]
References


