An Analysis of Office Market Rents: Parameter Constancy and Unobservable Variables

*John L. Glascock**
*Minbo Kim***
*C. F. Sirmans****

Abstract. **This paper reexamines variations in office building rents using data for a six-year period in a medium-sized city. Previous literature has relied on estimates using OLS estimation of standard fixed-effects models. We test for structural shifts and parameter constancy using random effects and heteroscedastic-autoregressive models and we find that structural shifts occur. Overall, the rent adjustment process does not remain unchanged across different time periods or submarkets.**

Introduction

Empirical evidence on the analysis of rental variations has been primarily at the metropolitan and national levels using standard fixed-effects models (see the *AREUEA Journal,* Winter 1988, for recent efforts). In general there have been two types of research: studies that examine variations in rents across leases and buildings and studies that examine the rental adjustment process.[1] One weakness of the prior research is the lack of testing for parameter stability in different time periods or in different submarkets. This weakness is important from an academic and a practitioner viewpoint. It is important to establish and test models in a rigorous manner and it is important to have results that professionals can have confidence in when making corporate real estate decisions. For example, good forecasts about office space needs depend critically on our ability to understand past and current trends in rents, vacancies and their adjustment process.

Early literature by Blank and Winnick (1953) proposed that different building types should have different adjustment mechanisms. Eubank and Sirmans (1979) confirmed this suggestion. Our concern in this paper is to test the homogeneity of the relationship between rent levels and relevant explanatory variables in different time periods and in various submarkets using covariance analysis. Specifically we offer a detailed reexamination of the previous study by Glascock, Jahanian and Sirmans (GJS) (1990) employing more data and alternative model assumptions. We examine variations in rents over time, across different classes of buildings, geographical submarkets, and level of services provided in the lease contract, using random effects and heteroscedastic-autoregressive models.

*Department of Finance, Louisiana State University, Baton Rouge, Louisiana 70803.
**SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513.
***Department of Finance, University of Connecticut, Storrs, Connecticut 06269.

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The Model

Previous literature (see GJS, 1990) shows that the real rent across buildings in different locations is related to four sets of variables:

$$R_{it}=f(LOC_i,\ MKT_t,\ PHYCHAR_{it},\ SERVE_{it})\ , \tag{1}$$

where R_{it} is the average real rent per square foot for the i^{th} building in the t^{th} year; *LOC* is a vector of location characteristics; *PHYCHAR* incorporates physical characteristics of the building; *MKT* reflects changes in overall market conditions; and *SERVE* represents the kinds of contracted services included in the rent.

The statistical linear model is specified as

$$y_{it}=\boldsymbol{\chi}'_{it}\beta+\mathbf{v}'_i\gamma+\mathbf{w}_t'\delta+\varepsilon_{it},\ i=1,\ldots,N;\ t=1,\ldots,T\ , \tag{2}$$

where y_{it} is real rent level, $\mathbf{v}_i$ the vector of location characteristics, $\mathbf{w}_t$ the vector of market condition variables and $\boldsymbol{\chi}_{it}$ the vector of constant and variables that vary over time periods and across individual buildings.[2] If the disturbance ε_{it} satisfies the assumptions of the linear classical model, the OLS coefficient estimators are efficient and unbiased.

For covariance analysis, we simply write

$$\mathbf{y}_t=X_t\boldsymbol{\beta}+u_t\ , \tag{3}$$

where $\mathbf{y}_t$ is an n×1 vector and $X_t=(x_{1t},\ldots,x_{Nt})'$. To investigate the time-varying effect in the form of different intercepts, annual dummy variables are included:

$$\mathbf{y}=X\boldsymbol{\beta}+W\delta+u\ , \tag{4}$$

where $\mathbf{y}=(\mathbf{y}'_1,\ldots,\mathbf{y}'_T)$ is an NT×1 vector, W is a $NT\times(T-1)$ annual dummy matrix and $X=(X',\ldots,X'_T)$. The usual F-test for H_0: $\delta=0$ is used to investigate the different time effect given the same slope coefficients. In general, the parameter vector $\boldsymbol{\beta}$ is allowed to vary in different time periods:

$$\mathbf{y}_t=X_t\boldsymbol{\beta}_t+u_t\ . \tag{5}$$

The simple model (3) is the special case of model (5) when we specify $\beta_1=\beta_2=\ldots=\beta_T=\beta$. The test of homogeneous relationships between the real rent and explanatory variables in different submarkets can also be carried out when we rearrange the data according to types of submarkets.

The unobservable individual component, like landlord's management skill, can also be incorporated into the model (2):

$$\varepsilon_{it}=\xi_i+u_{it}\ .$$

We are assuming that intercept terms vary systematically over time periods while intercepts have random variations in each individual office building. The random effects model is written in matrix notation:

$$\mathbf{y}_i = X_i\boldsymbol{\beta} + \mathbf{v}_i\mathbf{y} + W\delta + \xi_i J_T + \mathbf{u}_i \,,$$

where

$$E(\xi_i) = E(u_{it}) = 0, \ \forall i,t$$

$$\mathrm{Var}(\xi_i J_T + u_i) = \sigma^2_\xi J_T J'_T + \sigma^2_u I_T$$

$$J_T = T \times 1 \ \textit{vector of ones}$$

$$E(\xi_i \mid x_{it}, v_i, w_t) = 0.$$

For estimation, GLS regression will be used. When the unobservable variable ξ_i is correlated with observable independent variables ($E(\xi_i \mid x_{it}, v_i, w_t) = 0$), parameter estimates of OLS and random effects model are biased. The Hausman specification test (Glascock et al., 1990) is used to detect the correlation between the individual random effects and independent variables. The main idea of the Hausman test is that parameter estimates obtained from a random-effects model are not different from those obtained using a fixed-effects model, where the unobservable individual effects ξ_i is assumed to be fixed, under the null hypothesis that random effects model is the appropriate specification. The OLS estimators are not efficient when random effects model is the correct specification.

Finally, we consider a cross-sectionally heteroscedastic and time-wise autoregressive model since we estimate the linear model on pooled cross-section time-series data. Therefore, the assumption of error term of equation (2) is modified:

$$E(\varepsilon^2_{it}) = \sigma^2_i$$

$$\varepsilon_{it} = \rho\varepsilon_{i,t-1} + u_{it}, \ u_{it} \sim (0, \sigma^2_u)$$

$$E(\varepsilon_{it}\varepsilon_{jt}) = 0, \ i \neq j \,.$$

Data

We test the empirical models using data from a sample of office buildings in Baton Rouge, Louisiana. The Baton Rouge SMSA contains a total of approximately a half million people. The data were collected by a telephone survey of leasing agents for various office buildings each year from 1984 to 1989.[3] The basic data contained building name, address, building size, amount of vacant space, the quoted rental rate, and types of services included in rent. We added to this basic data other characteristics, including class of building and geographical location. For location, local leasing agents and real estate appraisers provided location designations and assisted in identifying the relative relationships between locations.

The Baton Rouge office market consists of six basic geographic submarkets. The distinguishing features of some of these submarkets include the following. The downtown [LOC1] area is heavily concentrated with bank and governmental service

Exhibit 1
Summary Characteristics of Office Market by Class of Building and Location Data for 1984–1989

Location[a]	Class A			Class B			Class C			Class D			Total		
	No. of Blding	Square Feet	% of Total	No. of Blding	Square Feet	% of Total	No. of Blding	Square Feet	% of Total	No. of Blding	Square Feet	% of Total	No. of Blding	Square Feet	% of Total
Downtown (LOC1)	3	825,000	21.2	8	196,678	5.1	16	341,645	8.8	—	—	—	27	1,365,323	35.1
Acadian-College (LOC2)	4	338,393	8.7	4	53,450	1.4	20	205,440	5.3	1	24,000	0.6	29	621,283	16.0
Essen-Bluebonnet (LOC3)	2	313,495	8.1	2	40,901	1.0	22	198,647	5.1	—	—	—	26	553,043	14.2
Sherwood Forest (LOC4)	2	149,700	3.8	6	272,416	7.0	14	142,751	3.7	6	75,088	1.9	28	639,955	16.5
Goodwood (LOC5)	—	—	—	—	—	—	19	271,044	7.0	1	5,000	.1	20	276,044	7.1
Wooddale (LOC6)	—	—	—	—	—	—	5	219,956	5.6	10	216,035	5.6	15	435,991	11.2
Total	11	1,626,588	41.8	20	565,445	14.5	96	1,379,483	35.5	18	320,123	8.2	145	3,891,639	100

[a]see text for definition of locations.

buildings. The Essen-Bluebonnet [LOC3] and Goodwood-Jefferson [LOC5] areas are primarily medical services given the location of major hospitals in these areas. The Sherwood Forest [LOC4] area is a mixture of financial and professional services as well as the location of headquarters for several local corporations. It is also the most recently developed area with most of the development having taken place in the last ten years. The Wooddale [LOC6] area is viewed as the worst office location, having primarily older, smaller, one-story buildings.

Physical characteristics are proxied by the size and class of the building. Large buildings are those with more than 50,000 square feet, medium-sized buildings are those with 10,000 to 50,000 square feet and small buildings are below 10,000 square feet. For class, we use the four definitions provided by leasing agents and appraisers, with class A being the best and class D the worst. Class A buildings are high-quality construction. Class D buildings are generally smaller with low-quality construction. We use annual dummy variables to allow for differences in market conditions. These conditions generally deteriorated over time (vacancy rates rose and real rents declined in the market under study).

In the office market a variety of services are provided in the lease contracts. These include such "amenities" as open parking, covered parking, janitorial, utilities (gas and electric), water, lighting, expense stop accounting, security, maintenance, and on site management. The cost of these services should be borne by the tenant in the form of higher rent. Thus, for example, a building that is "full service" would rent for more, holding all else constant, than a building that does not provide any services. We include three different service levels; full, partial and no service.[4]

Exhibit 1 summarizes the distribution of the total sample containing 870 (145 buildings for six years) observations by location and class of building.[5] The high-quality buildings are concentrated in locations 1 and 2 while low-quality buildings are mostly located in locations 5 and 6. The class C buildings are distributed over all geographic areas.

Empirical Results

Overview

We first estimate the OLS fixed-effects model to provide comparisons with previous work. The results show that rents behave in the expected manner: rents are highest in class A offices, in better locations and in buildings with more services. Second, we test for parameter constancy and find that there are differences across markets (i.e., class of buildings) and time. Thus, third, we estimate random effects (RE) and heteroscedastic autoregressive (HAR) models. While the overall estimates are similar to the OLS results, we find some differences in specific parameters.

Fixed-Effects Estimates

Exhibit 2 shows the results of the OLS fixed-effects (OLS) linear and semi-log models. We use five dummies to proxy for changes in market conditions over the

Exhibit 2
Determinants in Real Rents on Office Buildings: 1984–1989[a]

Independent Variables[b]	Random Effects Model		OLS		Hetero-AR Model[c]
	Linear	Semi-Log	Linear	Semi-Log	Linear
Intercept	7.086 (18.850)	1.910 (42.362)	6.923 (27.046)	1.878 (65.083)	7.044 (35.751)
Location 1	1.400 (3.169)	.239 (3.972)	1.388 (5.331)	.241 (7.383)	1.065 (4.479)
Location 2	.990 (2.261)	.194 (3.316)	.894 (3.468)	.176 (5.590)	.849 (3.921)
Location 3	1.555 (3.464)	.278 (4.481)	1.486 (5.606)	.268 (7.955)	1.328 (6.022)
Location 4	1.139 (2.865)	.197 (3.701)	1.120 (4.825)	.195 (6.836)	1.044 (5.045)
Location 5	1.236 (2.757)	.227 (3.733)	1.182 (4.498)	.219 (6.689)	1.160 (5.739)
Class A	4.628 (6.608)	.483 (4.619)	4.717 (11.520)	.510 (8.949)	4.641 (11.649)
Class B	2.155 (4.922)	.238 (3.989)	2.226 (8.681)	.255 (7.862)	2.174 (8.315)
Class C	.467 (1.304)	.029 (.675)	.525 (2.502)	.041 (1.719)	.457 (2.281)
Year 1985	−.430 (−3.008)	−.045 (−3.166)	−.429 (−2.313)	−.045 (−2.180)	−.391 (−9.055)

Year 1986	−.923 (−6.457)	−.093 (−6.764)	−.928 (−5.006)	−.094 (−4.732)	−.837 (14.717)
Year 1987	−1.866 (−12.978)	−.188 (−14.256)	−1.880 (−10.129)	−.190 (−10.071)	−1.505 (−22.797)
Year 1988	−2.411 (−16.678)	−.248 (−19.400)	−2.428 (−13.049)	−.251 (−13.745)	−1.980 (−27.589)
Year 1989	−2.777 (−19.210)	−.296 (−23.910)	−2.794 (−15.017)	−.299 (−16.900)	−2.362 (−31.294)
Full Service	.620 (3.147)	.073 (3.300)	.840 (5.401)	.122 (6.555)	.477 (4.342)
Partial Service	.038 (.174)	.009 (.397)	.332 (1.959)	.060 (3.075)	.143 (4.342)
Large Building	1.341 (2.447)	.195 (2.685)	1.245 (3.874)	.176 (4.491)	1.588 (5.223)
Medium-size Building	.589 (2.815)	.080 (3.025)	.546 (4.441)	.072 (5.040)	.372 (3.259)
ρ					.740
SSE[d]	1065.1	10.0	2121.4	26.9	799.3
Sample Size	870	870	870	870	870

[a]The dependent variable is the real rent per square foot adjusted for CPI. t-statistics are in parentheses. In the semi-log estimate the dependent variable is the natural log of the real rent per square foot. All coefficients on the dummy variables in the semi-log estimates have been adjusted using the Kennedy (1981) adjustment process.

[b]See text for a complete definition of the independent variables.

[c]Cross-Sectionally Heteroscedastic and Time Wise Autoregressive Model

[d]Error Sum of Squares

six-year test period. Rents are quoted rents deflated by the national consumer price index. All coefficients are fairly robust and are similar to the results of GJS (GJS used data from 1984 to 1988 while we use data from 1984 through 1989). The base case is a "small" class D building, in the worst location (6), with no services provided, in 1984. This base case rented for $6.92 (the GJS base rent was $7.21). Our conclusions are similar to those of GJS: better buildings in better locations with more services command higher rents, and there is a significant decline in rents over the test period because of the deteriorating general economy in the test city.

Parameter Consistency Tests

Exhibits 3 and 4 contain the results of the parameter constancy tests. The initial null hypothesis is that there is no structural shift given the same slope coefficients. We find that the differences in intercepts in different time periods ($F_{(5,857)}=68.8$) and in different submarkets ($F_{(3,861)}=7.8$) are indicative of structural shifts at the 5% significance level. This is consistent with the evidence from the OLS section. The statistically significant annual dummies indicate structural shift over the test period. Additionally, the test for stable coefficients across individual markets indicates a location effect (the slopes between submarkets are significantly different ($F_{(15,846)}=4.8$)). However, a key issue is whether or not the overall coefficients are stable. If the overall coefficients are not stable, an alternative functional form is indicated.

Our tests for constancy of overall coefficients also show that rent levels are not determined homogeneously in different submarkets ($F_{(18,846)}=5.3$) and time periods ($F_{(40,822)}=9.3$). Thus, there are different functional relationships between rent levels and explanatory variables corresponding to various time periods and market characteristics. To estimate the coefficients in a non-fixed-effects framework, we use random effects (RE) and heteroscedastic autoregressive (HAR) models. Therefore, we are able to allow for variations in intercept terms which vary systematically in different time periods and randomly for different office buildings.

As indicated earlier, the OLS estimation results of equation (2) are basically the same as the previous GJS results.[6] However, both the RE model and the HAR model provide lower variance estimates, linear SSEs of 1065.1 and 2121.4 respectively.[7]

The base case building, that is of small size and class D in location 6 in 1984 with "no service," rents on average for $6.90 per square foot in OLS model, for $7.10 when estimated by RE model, and $7.0 in HAR model. The highest rent for better buildings (large class A buildings in location 3) in 1984 is $15 for all models. The changes in rent levels of better buildings (18% decrease in RE and OLS; and 16% decrease in HAR) seem to be small compared to the large rent decrease between 1984 and 1989 in base buildings (43% in RE, 40% in OLS and 34% in HAR) and in all buildings (30% in RE ($t=-23.9$) and OLS ($t=-16.9$), 29% in HAR ($t=-31.3$); see semi-log column in Exhibit 4).[8]

Parameter Estimation Robustness

In our sample, class A and B buildings are concentrated in downtown, Acadian-College and Essen-Bluebonnet while only class C and D buildings are located in Goodwood and Wooddale areas. Therefore, possible correlation between location and

Exhibit 3
Analysis of Covariance for Parameter Constancy over Time Periods

Source	SSE[b]	df[c]	MSE	Test Statistics[d]
$\mathbf{x}_{it}$	3113.7 (S_1)	862 (df_1)	3.6	$F_1 = 68.8$ (0.0001)
$\mathbf{x}_{it}, \omega_t$	2220.0 (S_2)	857 (df_2)	2.6	$F_2 = .8$ (0.7549)
Z^a	2146.6 (S_3)	822 (df_3)	2.6	$F_3 = 9.3$ (0.0001)

[a] $Z = \text{diag}(X_1, \ldots, X_T)$
$X_t = (\mathbf{x}_{1t}, \ldots, \mathbf{x}_{Nt})', \; t = 1, \ldots, T(=6)$

[b] $S_l = \hat{e}'_l \hat{e}_l, \; l = 1,2,3$
where
$\hat{\mathbf{e}}_1 = \mathbf{y} - X\hat{\beta}$
$\hat{\mathbf{e}}_2 = \mathbf{y} - X\hat{\beta} - W\hat{\beta}$
$\hat{\mathbf{e}}_3 = \mathbf{y} - \hat{\mathbf{y}}$
$\hat{\mathbf{y}} = (\hat{\beta}'_1 X'_1, \hat{\beta}_2 X'_2, \ldots, \hat{\beta}'_T X'_T)'$

[c] $df_1 = NT - K, \; df_2 = NT - T - K + 1, \; df_3 = NT - TK$

[d] P values are in parentheses (0.0001 if P value ≤ 0.0001)

test for different intercepts: $F_1 = \dfrac{(S_1 - S_2)/(T-1)}{S_2/(NT-T-K+1)}$

test for different slopes: $F_2 = \dfrac{(S_2 - S_3)/(TK - T - K + 1)}{S_3/T(N-K)}$

test for coefficient homogeneity: $F_3 = \dfrac{(S_1 - S_3)/K(T-1)}{S_3/T(N-K)}$

class variables may distort the parameter estimates. We use the sample of class C buildings, which are distributed in all submarkets, to check the robustness of our empirical results.

For the subsample of C buildings, we find results similar to the overall sample. The RE and HAR models provide better fit (i.e., lower variance). The error variance of the HAR model is the smallest (526.9) and RE has lower variance than OLS. The random-effects model is the correct specification on the basis of Hausman test ($\chi^2_7 = 2.37$). Both the RE and the HAR models tend to find lower coefficient estimates, but with higher significance levels on the annual dummies. One difference is that rent levels for location 2 (Acadian-College) are higher than for location 5 (Goodwood) in these models, whereas previous study (GJS) and the estimates based on an entire data set (see Exhibit 2) show lower rent levels in location 2 than in location 5. Thus, the estimation model makes a difference in both the precision level and the interpretation of the results.

This difference in results fits well with local perception and causal empirical evidence. Local realtors perceive that Acadian-College is a growth area, while Goodwood is a declining commercial area. Post-event evidence confirms this with new hotel, office, and retail space development in the Acadian-College area. However, no

Exhibit 4
Analysis of Covariance for Parameter Constancy over Submarkets

Source	SSE[b]	df[c]	MSE	Test Statistics[d]
x_{it}	3370.4 (S_1)	864 (df_1)	3.9	$F_1=7.8$ (0.0001)
x_{it}, v_i	3281.7 (S_2)	861 (df_2)	3.8	$F_2=4.8$ (0.0001)
Z^a	3026.3 (S_3)	846 (df_3)	3.6	$F_3=5.3$ (0.0001)

[a] $Z=\text{diag}(X_1, \ldots, X_M)$
$X_i=(x_{it}, \ldots, x_{iT})'$, $i=1, \ldots, M(=4)$

[b] $S_l=\hat{e}'_l\hat{e}_l$, $l=1,2,3$
where
$\hat{e}_1=y-X\hat{\beta}$
$\hat{e}_2=y-X\hat{\beta}-V\hat{\gamma}$
$\hat{e}_3=y-\hat{y}$
$\hat{y}=(\hat{\beta}'_1X'_1, \hat{\beta}'_2X'_2, \ldots, \hat{\beta}'_MX'_M)'$

[c] $df_1=NT-K$, $df_2=NT-M-K+1$, $df_3=NT-MK$

[d] P values are in parentheses (0.0001 if P value<0.0001)

test for different intercepts; $F_1=\dfrac{(S_1-S_2)/(M-1)}{S_2/(NT-M-K+1)}$

test for different slopes: $F_2=\dfrac{(S_2-S_3)/(MK-M-K+1)}{S_3/NT-MK)}$

test for coefficient homogeneity: $F_3=\dfrac{(S_1-S_3)/K(M-1)}{S_3/(NT-MK)}$

new development has occurred in the Goodwood area. Thus, more precise estimation of the model provides results that agree with local professional opinion.

Additionally the estimated coefficients of "partial service" and "big building" indicator variables are statistically insignificant (see Exhibit 5). This result supports a very small magnitude of "partial service" coefficient estimate of the random-effects model on all office buildings. We also find an insignificant effect of building size on rent levels in large class C buildings, but the coefficient estimates of medium-sized buildings are significant ($t=3.1$ in RE, $t=4.8$ in OLS, $t=3.7$ in HAR).

Summary and Conclusions

We analyze the constancy of rent variations and robustness of coefficient estimates under different model assumptions in the office market at the building level, using a six-year data set in a medium-sized city. While previous literature used the standard fixed-effects OLS model, we use random effects and heteroscedastic autoregressive models. Our results indicate, as suggested by Blank and Winnick for rental housing and supported by Eubank and Sirmans, that the rent process is different across time and building classes.

Exhibit 5
Determinants in Real Rents on Office Buildings: Class C Building

Independent Variables	Random Effects Model Linear	OLS Linear	Hetero-AR Model Linear
Intercept	7.011 (12.464)	6.867 (18.960)	7.123 (28.261)
Location 1	1.752 (3.062)	1.734 (5.058)	1.026 (3.906)
Location 2	1.803 (3.073)	1.633 (4.611)	1.237 (4.776)
Location 3	2.329 (3.977)	2.249 (6.367)	1.748 (6.834)
Location 4	1.753 (2.931)	1.717 (4.812)	1.401 (4.285)
Location 5	1.704 (2.963)	1.618 (4.693)	1.372 (6.175)
Year 1985	−.496 (−2.769)	−.492 (−2.152)	−.376 (−8.457)
Year 1986	−.952 (−5.300)	−.953 (−4.173)	−.787 (−13.265)
Year 1987	−1.714 (−9.492)	−1.745 (−7.629)	−1.410 (−20.106)
Year 1988	−2.258 (−12.383)	−2.309 (−10.057)	−1.865 (−24.100)
Year 1989	−2.590 (−14.203)	−2.641 (−11.502)	−2.216 (−27.015)
Full Service	.342 (1.489)	.735 (4.102)	.413 (3.165)
Partial Service	−.148 (−.600)	.164 (.847)	.130 (1.006)
Large Building	1.126 (1.325)	.948 (1.860)	.473 (.927)
Medium-size Building	.766 (3.111)	.707 (4.797)	.532 (3.692)
$\hat{\rho}$			.786
SSE	732.6	1403.6	526.9
Sample Size	576	576	576

Overall, there are three key results. First, the assumption of parameter constancy is not supported. The Hausman test indicates that the random-effects model is the correct specification. Second, while the practical differences in most of the coefficients are small, the estimated error variance can be reduced substantially when the random-effects (or heteroscedastic autoregressive) model is used. Finally the results from the subsample of class C buildings indicates that the effect of locational difference on rent levels is incorrectly estimated because of correlation between location and class of buildings. Thus, this evidence adds support for considering non-fixed-effects models when analyzing office rents.

Notes

[1]Research on variations in rents at the individual lease level within an office building or set of buildings include Benjamin, Shilling and Sirmans (1989), Colwell and Cannaday (1988), and Bennan, Cannaday and Colwell (1984). Research efforts on the relationship between vacancy and rents include Smith (1974), Hekman (1985), Rosen (1984), Shilling, Sirmans and Corgel (1987), Wheaton and Torto (1988) and Voith and Crone (1988). Glascock, Jahanian and Sirmans (1990) provide a comprehensive time-series cross-sectional analysis of rental variations and adjustment-mechanisms. Recently Clapp, Pollakowski and Lynford (1990) analyze office market growth and location in a cross-sectional framework using dynamic variables.

[2]For a general discussion of the statistical techniques, see Judge et al. (1990).

[3]Telephone surveys were conducted by the *Baton Rouge Business Report*, which publishes an annual office guide. Data were collected in various years in conjunction with the Baton Rouge Chamber of Commerce and the Commercial Investment Division of the Baton Rouge Board of Realtors.

[4]Full service is defined as either the provision of one-half or more of the potential services or the designation of full service by the building manager, verified by the leasing agent.

[5]Because the data was provided by an external source, we verified the data by two procedures. First, we selected a random sample for confirmation (and found only minor differences in the data from that provided by the *Baton Rouge Business Reports*). Second, we checked all data where the rent was substantially different from the normal rent in an area and class. In those cases where we could not verify the outlier value, it was deleted from the data set. Our data set contains more observations than GJS because we use more years and are able to also verify more data points within the years.

[6]In general, the RE and HAR models provide smaller annual dummy coefficients which are statistically more significant.

[7]The estimated coefficients do not show any systematic differences between different model assumptions. The Hausman specification test result is $\chi^2_7 = 1.24$, which indicates that there is no correlation between individual random effect and explanatory variables.

[8]Rents decline by 31%–38% in slightly better (class C) buildings than in the base case building. We also observe fairly low rent decrease (19%–22%) in one grade lower buildings (class B) than the highest rent buildings.

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