

UC Berkeley

Fisher Center Working Papers

Title

The Price Adjustment Process for Rental Housing and the Natural Vacancy Rate

Permalink

<https://escholarship.org/uc/item/5284v24v>

Authors

Rosen, Kenneth T.
Smith, Lawrence B.

Publication Date

1982-09-01

Peer reviewed



Institute of
Business and
Economic Research

University of
California,
Berkeley

**CENTER FOR REAL ESTATE
AND URBAN ECONOMICS
WORKING PAPER SERIES**

WORKING PAPER 82-53

THE PRICE ADJUSTMENT PROCESS
FOR RENTAL HOUSING AND
THE NATURAL VACANCY RATE

BY
KENNETH T. ROSEN
LAWRENCE B. SMITH

These papers are preliminary
in nature; their purpose is
to stimulate discussion and
comment. Therefore, they
are not to be cited or quoted
in any publication without
the express permission of
the author.

GRADUATE SCHOOL OF BUSINESS ADMINISTRATION

**CENTER FOR REAL ESTATE AND URBAN ECONOMICS
UNIVERSITY OF CALIFORNIA, BERKELEY**

The Center was established in 1950 to examine in depth a series of major changes and issues involving urban land and real estate markets. The Center is supported by both private contributions from industry sources and by appropriations allocated from the Real Estate Education and Research Fund of the State of California.

**INSTITUTE OF BUSINESS AND ECONOMIC RESEARCH
J. W. Garbarino, Director**

The Institute of Business and Economic Research is a department of the University of California with offices on the Berkeley campus. It exists for the purpose of stimulating and facilitating research into problems of economics and of business with emphasis on problems of particular importance to California and the Pacific Coast, but not to the exclusion of problems of wider import.

THE PRICE ADJUSTMENT PROCESS FOR RENTAL HOUSING
AND THE NATURAL VACANCY RATE

by

Kenneth T. Rosen
University of California at Berkeley

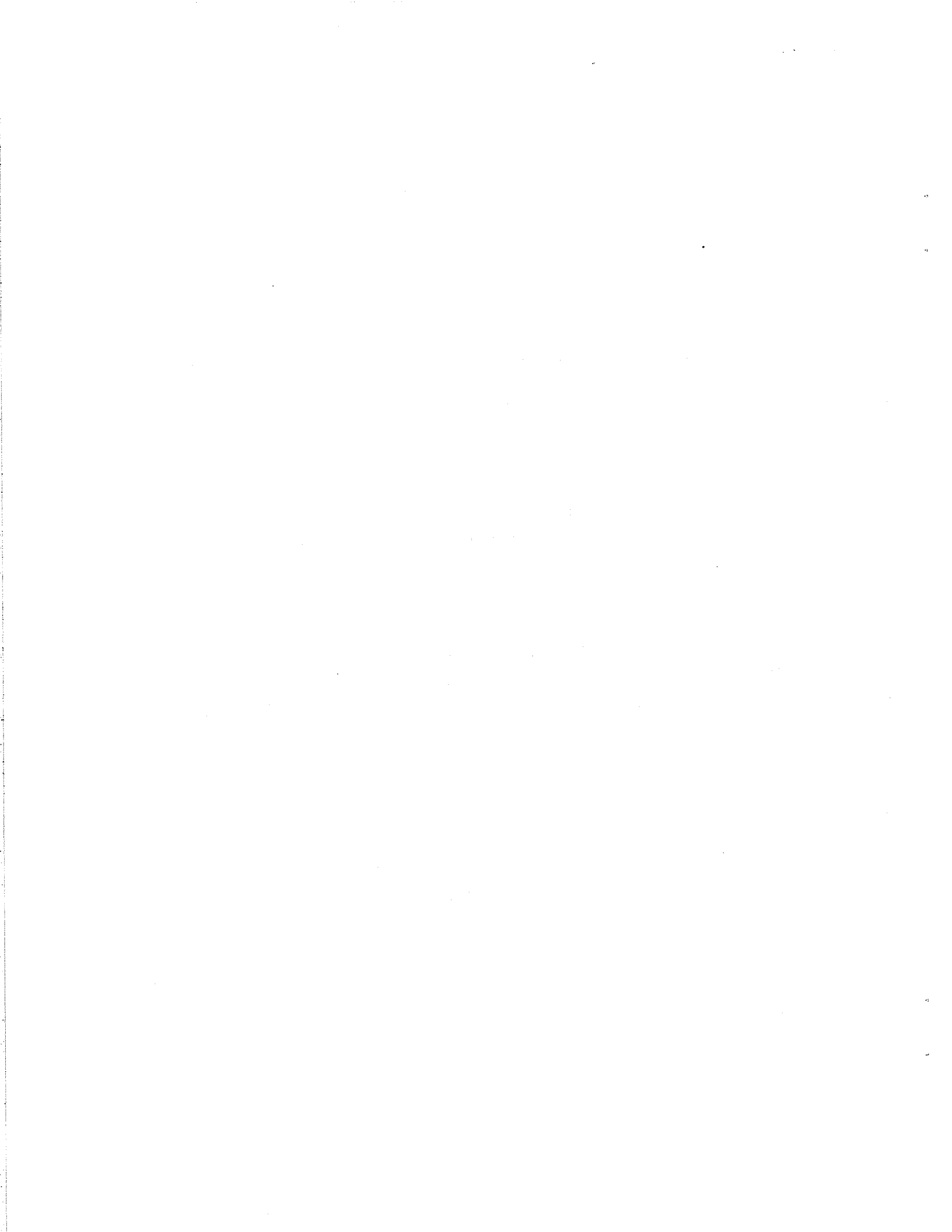
and

Lawrence B. Smith
University of Toronto

Working Paper 82-53

Center for Real Estate
and Urban Economics

September 1982



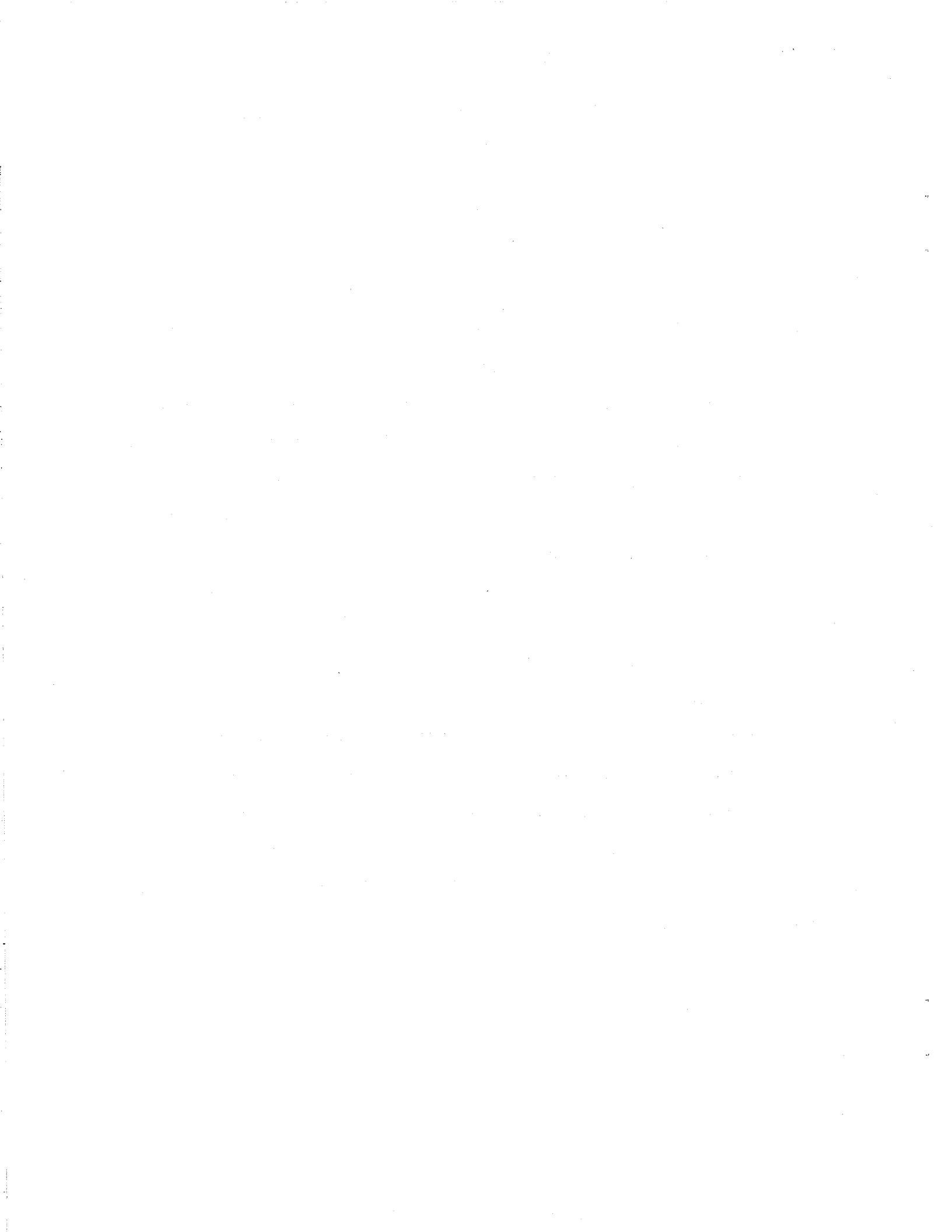
ABSTRACT

THE PRICE ADJUSTMENT PROCESS FOR RENTAL HOUSING
AND THE NATURAL VACANCY RATE

by
Kenneth T. Rosen
and
Lawrence B. Smith

The research supports the traditional view that within some critical zone of occupancy, variations in the vacancy rate around some natural rate of vacancy exert a significant influence on the rate of change of the price of rental housing services. Variations in the actual vacancy rate were shown to be significant in determining the percentage change in rents. The percentage change in operating expenses was also shown to be significant in determining the percentage increase in rent. Estimates of a model of rental price adjustment for 15 U.S. cities demonstrate the crucial role played by vacancies in the price adjustment process. The empirical results are used to generate long run natural or optimal vacancy rates for 14 of the cities examined, and a model is developed to explain these results.

The empirical results were also used to calculate the natural vacancy rate for those cities for which the model applies. The wide but predictable variation confirms the hypothesis that much of the variation in vacancy rates between cities reflects differences in the natural vacancy rates rather than in the degrees of market tightness.



THE PRICE ADJUSTMENT PROCESS FOR RENTAL HOUSING
AND THE NATURAL VACANCY RATE

by

Kenneth T. Rosen

and

Lawrence B. Smith*

Traditional economic and housing market analyses have ascribed a close connection between excess demand, as reflected in the deviation of the actual vacancy rate from some long run normal or optimal vacancy rate, and changes in the price of rental housing services. This process was clearly described by Blank and Winnick (1953) and reiterated by Maisel (1963) and Fair (1972). Despite these analytical formulations, neither this process nor the determinants of the optimal or natural vacancy rate have been empirically demonstrated for the United States.¹ Moreover, the validity of this price adjustment mechanism has been questioned recently in studies by Eubank and Sirmans (1979) and Lowry (1981), and earlier by de Leeuw and Ekanem (1971).

Eubank and Sirmans, based on an examination of the rental adjustment process in four U.S. cities, claimed that "vacancy rates seemed to have an insignificant effect upon rent adjustment," while Lowry, reporting on the HUD housing allowance experiment in two North Central housing markets, claimed "that relative vacancy rates have virtually no effect on market rents." De Leeuw and Ekanem also found no relationship between vacancies and rents in a 35 city cross section study, but hypothesized that

this could be because "much of the variation in vacancy rates among metropolitan areas reflects differences in 'normal' vacancy rates rather than different degrees of housing market tightness."

The purposes of this paper are first to demonstrate empirically the validity of the traditional price adjustment process by examining the relationship between the percentage change in rent and deviations in the actual vacancy rate from its long run normal or optimal level, and second to empirically investigate the determinants of the optimal or natural vacancy rate. In Section I, the paper develops and shows estimates of a model of rental price adjustment for 15 U.S. cities, and demonstrates the crucial role played by vacancies in the price adjustment process. In Section II, our empirical results are used to generate long run natural or optimal vacancy rates for 14 of the cities examined, and a model is developed to explain these rates.

I. The Rental Price Adjustment Process

The price adjustment mechanism and the rental housing market can be viewed as operating in a typical stock flow manner.² At any one time there is stock of rental housing units providing housing services and a demand for these services. If we assume, as is usual,³ that a standardized unit of housing stock yields a unit of housing services during each period of time, then the rent is the price of the flow of services from one standard dwelling unit, and the demand and supply of housing services can be considered as the demand and supply of units

of housing stock. Although the size of the standardized rental housing stock in any period is increased by newly completed or converted rental dwellings and diminished by removals, demolitions and depreciation, the annual change in the stock is relatively small⁴ and hence the stock may be considered as fixed in the short run.

The demand for rental stock is usually assumed to depend upon a variety of variables including demographic variables (such as the number of families, tendency of the population to form non-family households, and age composition of the population),⁵ permanent real disposable income, the price on rental accommodation, the user cost of owner-occupied housing, the price of alternative goods and services, the cost and availability of mortgage credit and consumer preferences.⁶ These demand and supply functions interact to determine the level of rents and the stock of vacant rental units.

However, since numerous frictions and imperfections cause the market to adjust slowly, the rent level determined through this process may not completely clear the market in the sense that actual vacancies equal the normal or optimal vacancies. The natural or optimal vacancy rate, analogous to the natural unemployment rate, is defined by market factors such as the cost of holding inventory, search costs, the variability of demand, and the costs of recontracting. Market frictions such as high transactions and search costs, slow supply responses, credit market imperfections and the existence of long term contracts

may all impede the quick adjustment of rents.⁷ If rents are such that the housing stock demanded exceeds the available supply less the normal level of vacancies, then vacancies will be less than normal and upward pressure will be exerted on rents. This will bring forth new construction and the conversion of existing units, as well as reduce demand from existing renters. Analogously, if rents are such that the housing stock demanded is less than the available supply less the normal level of vacancies, vacancies will be larger than normal, downward pressure will be exerted on rents and new construction will be lower than in the market clearing case. The speed at which the market moves toward equilibrium depends, among other things, upon the supply side response and speed of rental price adjustment. This discussion implies that the rate of change of rents depends upon the vacancy rate, and that variations in the arguments in the demand function or the supply will be reflected initially in the vacancy rate (although they may also exert some direct effect on the rate of change in rents over the long term).

A. The Model

This discussion can be summarized in an empirically testable model as follows. The demand for rental housing services and hence for the rental housing stock, D , may be assumed to be a function of the rent per unit of housing services, R ; the user cost of homeownership, U ; real income per household, Y ; the price level, P ; and demographic variables, Z , as set out in equation (1).

$$D = d(R, U, Y, P, Z) \quad (1)$$

Since the supply of rental units, S , is assumed to be fixed in the short run, the level of vacancies, VL , is the difference between the demand and supply of rental units, as in equation (2)

$$VL = S - D, \quad (2)$$

and the vacancy rate, V , is the ratio of the number of vacant units to the supply of rental units as shown in equation (3).

$$V = \frac{VL}{S} = 1 - \frac{1}{S} d(R, U, Y, P, Z) \quad (3).$$

The rental price adjustment mechanism is set out in equation (4). In this mechanism, the excess demand or supply for rental housing, defined as deviations in the actual vacancy rate from the natural vacancy rate, V^n , determines variations in the real rent within some critical zone of occupancy.⁸ The rate of change of nominal rents, \dot{R} , is thus a function of the excess demand or supply for rental housing and the rate of change of total operating expenses, \dot{E} , where \dot{E} reflects nominal price influences on \dot{R} .

$$\dot{R} = r(\dot{E}, V^n - V) \quad (4)$$

If we assume the natural vacancy rate is constant over our estimation period for any given city, V^n may be incorporated into the intercept, and the estimating model may be written

as in equation (5).

$$\dot{R} = b_0 + b_1\dot{E} - b_2V. \quad (5)$$

Since the market adjustment lag depends upon the supply response and other institutional arrangements which vary between cities,⁹ a variable lag structure was used between cities when estimating equation (5).

B. The Estimated Results

Equation (5) was estimated for each of the 17 cities¹⁰ for which a sufficiently large data sample was available over the period from 1969 to 1980 and the results are presented in Table I.

The data on vacancy rates and expenses were derived from the Institute of Real Estate Management publication Annual Income/Expense Analysis for Apartments.¹¹ Operating expenses were calculated in two stages. First, unweighted averages of the rent per square foot and of the operating expenses per square foot for four apartment building types (elevator buildings, low rise buildings with 12/24 units, low rise buildings with 25+ units and garden type buildings) were calculated annually for each city. Second, the ratio of these operating expenses to rents was then multiplied by the Bureau of Labor Statistics index of apartment rents for each city to generate an index of apartment building operating costs, E, for each city. The vacancy variable, V, for each city was calculated as the annual unweighted average of the percentage of gross potential income not collected for the four apartment building types in the Annual Income/Expense Analysis for Apartments.

Finally, the rental variable, R, was taken directly from the Bureau of Labor Statistics index of apartment rents for each city.

The results of our estimation indicate that vacancies were significant in explaining the percentage change in rents at the 95 percent level in 13 cities (and at the 90 percent level in 15 cities) and were insignificant in only two cities. Given the relatively small size of the sample for each city and the variance in the buildings included in the survey over time, these results are relatively impressive. To further test the validity of our specifications, the city data was pooled and a combined cross section, time series regression was estimated with city dummy variables, $D_1 \dots D_{16}$, introduced for all but one of the cities. This result, excluding the city dummy variables, is shown in the last line of Table I,¹² and strongly supports the appropriateness of our model. Consequently, our results strongly confirm the traditional view that vacancy rates within some critical zone of occupancy are pivotal in explaining the price of housing services.

II The Natural or Optimal Vacancy Rate

It has been hypothesized by de Leeuw and Ekanem (1971, p. 812) that their failure to obtain a significant relationship between rents and vacancy rates across metropolitan areas could be that the variation in vacancy rates among metropolitan areas reflects differences in the "normal" vacancy rates rather than different degrees of market tightness. To examine the possibility

TABLE I
DETERMINANTS OF THE PERCENTAGE CHANGE IN RENT (R)

	Constant	E-1 (%ΔExpenses (-1))	V (Vacancy Rate)	V-1 (Vacancy Rate (-1))	R ²	DW ¹³	V ⁿ (Natural Vacancy Rate)
Baltimore	8.93 (4.27)	.014 (.28)		-.67 (1.99)	.36	1.22	13.3
Boston	8.75 (9.67)	-.20* (2.74)		-.95 (2.81)	.66	2.25	9.2
Chicago	5.96 (3.78)	.31 (2.44)	-.61 (2.05)		.63	1.58	9.8
Cincinnati	11.76 (3.56)	-.08* (.62)	-1.20 (2.16)		.40	1.30	9.8
Cleveland	10.04 (6.20)	.18 (2.41)		-1.78 (4.05)	.74	1.46	5.6
Dallas	11.37 (3.27)	.16 (1.68)		-.68 (1.81)	.34	.64	16.7
Denver	8.92 (2.33)	.08 (.45)		-.61 (1.10)	.17	.32	14.6
Houston	16.81 (2.95)	.15 (.73)	-1.18 (2.28)		.46	1.57	14.3
Kansas	10.06 (4.49)	-.004* (.12)	-1.14 (2.70)		.51	1.16	8.8
Los Angeles	19.98 (12.37)	.04 (.85)	-1.41 (4.47)	-1.23 (3.62)	.93	1.92	7.6
Milwaukee	5.79 (8.21)	-.03* (.69)		-.25 (1.13)	.17	1.32	23.2
Minneapolis	9.53 (5.33)	.08 (.84)	-.87 (2.95)		.65	1.09	10.9
New York	7.57 (14.99)	.002 (.08)	-.62 (2.12)	-.64 (1.93)	.62	1.75	6.0
Pittsburgh	8.57 (4.29)	.094 (.92)	-1.00 (2.13)		.52	.96	8.6
St. Louis	6.44 (3.58)	.20 (2.43)	-.48 (2.18)		.64	2.14	13.4
17 City Pool ¹²	9.08 (15.9)	.04 (2.58)	-.21 (2.26)	-.28 (3.16)	.24	--	--

* = wrong sign.

Bracket values are the absolute value of the t statistic.

DW is the Durbin-Watson statistic.

Percent of Change in Rent is the dependent variable.

of intercity variations in the natural vacancy rate, we used the empirical results in Table I to calculate a natural vacancy rate for each city and developed a model to explain these rates.

In a manner analogous to the labor market, the housing market requires some normal stock of vacant units to facilitate the search processes of buyers and sellers in the market.¹⁴ These processes and the "unpredictability" of demand fluctuations lead suppliers of rental housing to desire to maintain an inventory of unrented units. The optimal or natural vacancy rate in any market can be defined as that rate at which there is no excess demand nor excess supply and hence the rent is at its long-run equilibrium.¹⁵ This rate is determined by the interaction of optimal search procedures on the part of households searching for dwelling space and landlords searching for tenants,¹⁶ and by tenant turnover and institutional and market characteristics specific to each city.

Landlords face an optimizing problem in which they seek to maximize net rents through setting the gross rent and accepting the level of vacancies that rent implies. The landlord, by setting gross rent, is sampling a probability distribution of potential demanders. Since demand is unpredictable, it pays for the landlord to hold some units vacant to satisfy this fluctuating demand. Since the price structure of competing landlords and set of reservation prices for tenants are not known with precision, landlords often adjust rents on units as they become vacant, and only raise the rents for existing tenants once the new rent levels

have become pre-tested.¹⁷ Since rents for existing tenants can often be raised only on the expiration of their tenancy agreements, a very complex lag structure is built into the pricing behavior of landlords and hence into the relationship between optimal rents and vacancies. Optimal vacancies clearly serve as a buffer stock which prevents the need for continuous rent adjustment in a market with demand fluctuations.

Households face a comparable optimizing problem in which they seek to minimize their shelter costs per unit quality of housing services, where shelter costs consist not only of the rental costs but also the transactions and search costs incurred in obtaining the dwellings. Since housing units are quite heterogeneous in their characteristics and are location specific, potential tenants are forced to devote considerable time to the search process in order to acquire information as to the desired bundle of housing attributes and their appropriate value. This search time increases with the size and complexity of the market, and hence search time and the natural vacancy rate are likely to increase with the size and heterogeneity of the market. The degree of market heterogeneity may be reflected in a variety of indicators including the degree of racial segmentation and the dispersion in rents.

In addition to the effect of landlord and household search behavior, the natural vacancy rate in any market will increase with the mobility or market turnover of tenants, and will be higher in areas of rapid growth where there is relatively more

building ahead of demand than in areas of slow growth.¹⁸

An estimate of the natural vacancy rate for each city can be determined from the empirical results in Table I. If we assume the appropriate estimating specification of equation (4) would exclude an intercept, and that V^n is constant over the estimating period for each city, then the intercept in estimating equation (5) for each city can be interpreted as

$$b_0 = b_2 V^n, \quad 19$$

and the natural vacancy rate for each city is b_0/b_2 . Assuming this specification, the last column in Table I sets out the estimated natural vacancy rate for each city.²⁰

This column shows a large variation in the natural vacancy rate between cities, with Cleveland and New York having the lowest natural vacancy rates at 5.5 percent and 6.0 percent respectively, and Dallas, Denver and Houston having the highest natural vacancy rates at 16.7 percent, 14.6 percent and 14.3 percent respectively.²¹ The median vacancy rate was 9.8 percent. Although these rates appear high, they are reasonable since our measure of vacancies, the difference between the gross potential total income and the actual income received, generates higher vacancy measures than the more common measure of the number of units vacant at any point in time. This happens because our measure includes bad debts, uncollectable rents, rental concessions and frictional rental losses associated with short period

rental losses or rental commissions granted on turnover, while these are rarely reflected in the common measure of vacancies.

The estimated natural vacancy rates in Table I can be used to examine the determinants of the natural vacancy rate on a cross section basis. Since we are focusing on the V^n between cities, we are examining the determinants of the long run natural vacancy rate. This follows since, regardless of the adjustment lag, the fundamental differences between cities, such as zoning constraints, mobility patterns, racial composition, etc. may be assumed to have persisted for years, and hence to have had sufficient time to have affected the market.

The basic estimating model is set out in functional form in equation (6), with the anticipated sign indicated above each variable.²² The expected sign of the R variable is ambiguous because of its opposite influence on landlord and tenant search behavior.

$$\hat{V}^n = v(R, \overset{?}{RDISP}, \overset{+}{S}, \overset{+}{RS}, \overset{+}{M}, \overset{+}{ASH}, \overset{-}{\Delta POP}), \quad (6)$$

where \hat{V}^n is the estimated natural vacancy rate calculated from Table I.²³ The variables in our estimation are as follows: R is the mean level of rents, RDISP is the dispersion in rents defined as the percentage standard deviation of the mean rent, S is the city size in terms of population, RS is the racial segmentation defined as the proportion of black and Spanish-

speaking populations, M is the renter mobility rate for the period from 1975 to 1980, ΔSH is the average annual change in the total housing stock, and ΔPOP is the average annual growth in population. All of these data series were derived from the 1980 Census. The model was empirically tested using OLS estimation and the statistically best results are presented in Table II.

The empirical results support the basic model used to explain the natural vacancy rate. The results indicate that the natural vacancy rate is higher in areas that experience a higher degree of turnover. This is as anticipated since the higher the turnover rate, the higher the proportion of units being vacated and households searching for new shelter space. Consequently, the higher is the vacancy rate required and desired to allow the searching procedures to proceed efficiently.

The greater the dispersion in rents the longer the anticipated search, and hence the higher the natural vacancy rate. The negative coefficient on the rent level indicates that the effect of higher rents on landlord opportunity costs exceeds the effect of higher rents increasing the expected gain for tenants from continuing search.

The significant positive coefficient on the growth of the housing stock variable supports the de Leeuw and Ekanem hypothesis that natural vacancy rates will be higher in areas of rapid construction. The negative but insignificant sign on the population growth variable suggests that more rapid population growth reduces the natural vacancy rate once the higher rate

TABLE II

DETERMINANTS OF THE NATURAL VACANCY RATE (V^n)

	Regression	
	(1)	(2)
Mobility Rate (1975-1980)	.214 (1.81)	.306 (1.95)
Rent Dispersion	.241 (1.97)	.265 (2.10)
Average Rent (1980)	-.139 (2.23)	-.150 (2.33)
Change in Housing Stock (1970-1980)	9.38E-06 (2.52)	1.56E-05 (1.99)
Change in Population (1970-1980)	---	-4.8E-06 (-.91)
Constant	15.04 (2.17)	13.41 (1.86)
\bar{R}^2	.547	.55
n	14	14

Bracketed values are the absolute values of the t statistic.
The Natural Vacancy Rate is the dependent variable.

of construction is taken into account.

Various variable specifications were attempted to capture a racial segmentation effect, including the proportion of black to white households and blacks and hispanic to white households, but the variable was always insignificant. This suggests that segmenting the market may not affect search time, possibly because the time required to search a given portion of the available market is reduced as a result of segmentation restricting the available universe, which offsets the effect of segmentation on restricting choice. Similarly, various measures of city size (population, total housing stock, rental housing stock) were also insignificant in determining the natural vacancy rate, suggesting that city size exerted neither economies or diseconomies in the search procedure.

III. Summary

The preceding analysis supports the traditional view that within some critical zone of occupancy, variations in the vacancy rate around some natural rate of vacancy exert a significant influence on the rate of change of the price of rental housing services. Variations in the actual vacancy rate were shown to be significant in determining the percentage change in rents at the 95 percent level in 13 out of 17 cities examined (and at the 90 percent level in 15 out of 17 cities), and in the pooled cross section, times series regression over all 17 cities. The

percentage change in operating expenses was also shown to be significant in determining the percentage increase in rent in most cities and in the pooled regression.

The empirical results were also used to calculate the natural vacancy rate for those cities for which the model applies. These percentage rates showed a large variation ranging from lows of 5.5 and 6.0 for Cleveland and New York respectively, to highs of 16.7, 14.6 and 14.3 for Dallas, Denver and Houston respectively. The variation in the natural vacancy rate across cities was explained by a search model, interacting the search behavior of landlords for tenants and tenants for dwelling space, and by the turnover and growth rates specific to each city. The wide but predictable variation in the natural vacancy rate confirms the hypothesis that much of the variation in vacancy rates between cities reflects differences in the natural vacancy rates rather than in the degrees of market tightness, and that variations in the actual vacancy rate from its long run normal is the appropriate variable for explaining the price adjustment mechanism for rental housing markets.

FOOTNOTES

- * The authors are respectively Professor of Economic Analysis and Policy, University of California, Berkeley, and Professor of Economics, University of Toronto, and are listed in alphabetical order. This research was conducted at the Center of Real Estate and Urban Economics, University of California, Berkeley, and was funded by the Center and by the Social Sciences and Humanities Research Council of Canada, Research Award 451-81-2999 to the second author.
1. Smith (1974) demonstrated a similar relationship between the percentage change in rents and the vacancy rate for Canada.
 2. Much of the next three paragraphs is based on Fair (1972) and Smith (1974).
 3. See, for example, Muth (1960) and Olsen (1969).
 4. Approximately 1.5 - 2.0 percent a year.
 5. For a discussion of the impact of demographic variables, see Gordon (1956) and Jaffee and Rosen (1979).
 6. For a discussion of rental demand and tenure choice, see Diamond (1978); Hendershott and Schilling (1981); and Rosen and Rosen (1980).
 7. For a discussion of some of these frictions, see de Leeuw and Ekanem (1973), Fair (1972) and Maisel (1963).
 8. See Blank and Winnick (1953). The specification holds only within the normal or critical zone of vacancies since the model collapses as vacancies approach zero.
 9. These differences arise from a variety of factors including differing zoning regulations, planning procedures and other land use controls.
 10. Baltimore, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Houston, Kansas, Los Angeles, Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis and Washington.
 11. Data for 1974 was estimated by interpolation since the data were not available for that year.
 12. The coefficients on the city dummy variables in alphabetical order, excluding Washington, were: -1.54, -3.05, -2.60, -1.72, -3.09, .56, -1.20, 1.07, -2.82, -.68, -3.43, -1.77, -2.85, -2.59, -2.15, -2.00.

13. A Cochran-Orcutt transformation was used for those equations exhibiting serial correlation. Since these transformed equations made the calculation of a natural vacancy rate difficult, the untransformed equations are reported in Table I.
14. See, for example, Alchian (1970) for a discussion of this process in the labor market.
15. Smith (1974), p. 481.
16. For a discussion of this process in the resale housing market, see Chinloy (1980).
17. This implies that tenancy discounts will exist according to length of tenure. For evidence of this, see Clark and Heskin (1982).
18. This point was suggested by de Leeuw and Ekanem (1971, p. 812).
19. Alternatively, if we assume the appropriate specification has an intercept, but that the intercept is proportional to b_2 across cities, then b_0/b_2 measures the natural vacancy rate plus a given constant for each city. In the empirical work that follows, this constant would be absorbed in the intercept and the independent variables would explain the variance in V^n between cities.
20. The V^n could not be determined for Philadelphia and Washington, since the model did not hold for these cities.
21. Milwaukee is excluded in this summary because the calculated natural vacancy rate seemed unreasonably high.
22. Since this is a cross-sectional model, the rate of interest was not included as an explanatory variable. However, the interest rate could have a significant influence on the cost of vacancies, and hence the natural vacancy rate, over time.
23. Philadelphia, Milwaukee and Washington were excluded since a reasonable natural vacancy rate could not be calculated.

REFERENCES

1. Armen A. Alchian, "Information Costs, Pricing and Resource Unemployment" in Ed Phelps *Microeconomic Foundations of Employment and Inflation Theory* (New York: W.W. Norton & Co., 1970), pp. 27-52.
2. David M. Blank and Louis Winnick, "The Structure of the Housing Market," *Quarterly Journal of Economics* 67 (May 1953), pp. 181-203.
3. Peter T. Chinloy, "An Empirical Model of the Market for Resale Homes," *Journal of Urban Economics* 7 (May 1980), pp. 279-92.
4. W.A.V. Clark and Allan D. Heskin, "The Impact of Rent Controls on Tenure Discounts and Residential Mobility," *Land Economics* 58 (Feb. 1982), pp. 109-117.
5. Frank de Leeuw and Nkanta F. Ekanem, "The Supply of Rental Housing," *American Economic Review* 61 (Dec. 1971), pp. 806-17.
6. Frank de Leeuw and Nkanta F. Ekanem, "Time Lags in the Rental Housing Market," *Urban Studies* 10 (Feb. 1973), pp. 39-68.
7. Douglas B. Diamond, Jr., "A Note on Inflation and Relative Tenure Prices," *Journal of the American Real Estate and Urban Economics Association* 6 (Winter 1978), pp. 438-50.
8. Arthur A. Eubank, Jr. and C.F. Sirmans, "The Price Adjustment Mechanism for Rental Housing in the United States," *Quarterly Journal of Economics* 93 (Feb. 1979), pp. 163-38.
9. Ray C. Fair, "Disequilibrium in Housing Models," *Journal of Finance* 27 (May 1972), pp. 207-21.
10. Robert A. Gordon, "Population Growth, Housing and the Capital Coefficient," *American Economic Review* 46 (June 1956), pp. 307-22.
11. Patric H. Hendershott and James D. Schilling, "The Economics of Tenure Choice" in C.F. Sirmans (ed), *Research in Real Estate* (Greenwich: JAI Press, 1981).
12. Institute of Real Estate Management, *Annual Income/Expense Analysis for Apartments* (Chicago: National Association of Realtors, various years).
13. Dwight Jaffee and Kenneth T. Rosen, "Mortgage Credit Availability and Residential Construction," *Brookings Papers on Economic Activity* 2 (1979), pp. 333-76.

14. Ira S. Lowry, "Rental Housing in the 1970s: Searching for the Crisis" in John C. Weicher, Kevin E. Villani and Elizabeth A. Roistacker (eds), *Rental Housing: Is There a Crisis* (Washington D.C.: The Urban Institute Press, 1981), pp. 23-38.
15. Sherman T. Maisel, "A Theory of Fluctuations in Residential Construction Starts," *American Economic Review* 53 (June 1963), pp. 359-83.
16. Richard F. Muth, "The Demand for Non-Family Housing" in Arnold C. Harberger (ed), *The Demand for Durable Goods* (Chicago: University of Chicago Press, 1960), pp. 29-96.
17. Edgar O. Olsen, "A Competitive Theory of the Housing Market," *American Economic Review* 59 (Sept., 1969), pp.612-21.
18. Harvey S. Rosen and Kenneth T. Rosen, "Federal Taxes and Homeownership: Evidence from Time Series," *Journal of Political Economy* 88 (Feb. 1980), pp. 59-75.
19. Lawrence B. Smith, "A Note on the Price Adjustment Mechanism for Rental Housing," *American Economic Review* 64 (June 1974), pp. 478-81.