THE ECONOMICS OF RENTAL HOUSING

KEVIN NEELS

R-2775-HUD

SEPTEMBER 1982

A FINAL REPORT OF THE

HOUSING ASSISTANCE SUPPLY EXPERIMENT

Sponsored by

The Office of Policy Development and Research
U.S. Department of Housing and Urban Development

Rand
SANTA MONICA, CA. 90406

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PREFACE

This report was prepared for the Office of Policy Development and Research, U.S. Department of Housing and Urban Development, under Contract H-1789, Task 2.16.8. It analyzes the economics of rental property operation using data from the Housing Assistance Supply Experiment, conducted by The Rand Corporation under HUD sponsorship. It is one of Rand's final reports to HUD on the results of the experiment.

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SUMMARY

This report examines the economics of owning and operating rental property. Because its viewpoint is that of the landlord, rather than that of the tenant (as is the case with most investigations of the rental housing market), the study affords policymakers with new information: how landlords' costs have changed, whether landlords realize enough income to cover their expenses, and how much landlords make (or lose) on their property investments.

Data come from surveys conducted as part of Rand's Housing Assistance Supply Experiment. Landlords and their tenants in two midwestern areas--Brown County, Wisconsin, and St. Joseph County, Indiana--were interviewed over the years between 1973 and 1977. During that period, energy prices rose dramatically, and inflation and mortgage rates both reached over 10 percent.

From the responses of those interviewed in the surveys, the experiment obtained a complete record of the operation and financial condition of rental dwellings in the two areas, as well as a picture of how landlords reacted to the changing circumstances. Comparing first- and last-year accounts for all rental properties in each county, this report shows how market conditions affect (a) property revenue and expense, (b) the mix of factors of production used to produce housing services, and (c) the returns to the owners of rental property. It also considers the role of energy in producing housing services, as well as how landlords and tenants respond to rising energy prices. Finally, it considers how investment leverage (the ratio of equity to debt financing) and federal

income tax laws affect landlord profits, and how after-tax profits from rental housing compare with returns from other investments.

The study finds that many of the transactions associated with rental property operation do not involve cash. The landlord himself often lives on his property, taking part of his income in the form of housing. Less commonly, he pays his employees by providing them with an apartment. It is also common for landlords to make repairs themselves and to provide much of the labor required for day-to-day operation of their property. Altogether, current cash revenues make up less than two-thirds of total rental property revenues, and current cash expenses make up less than half of total operating costs.

The study also finds that operating expenses paid directly by landlords make up a surprisingly small share of the total. It is more and more common for tenants to pay their own utility bills. The data show that tenants also spend an increasing amount on repairs, and often provide their own appliances.

For every dollar the average Brown County landlord received in 1973, 18 cents went for energy bills. Repairs and other operating expenses absorbed 13 and 11 cents, respectively. Payments for the land and building made up the remaining 57 cents.[1]

By 1976, the situation in Brown County had changed: energy bills now consumed 23 cents of every dollar. The rise in energy prices that took place over the period made this last item a more important component of the landlord's costs. Payments for repairs and other operating expenses accounted for another 14 and 13 cents. The share for the land and building declined to 50 cents.

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[1] The payments do not add to 100 because of rounding.

Between 1973 and 1976, total revenues for the average rental unit in Brown County grew by 29 percent. Payments to energy rose far more rapidly, increasing by a full 61 percent. (Over the same period, the overall consumer price level rose by 29 percent.) In real terms, energy bills became an increasing burden for Brown County landlords and tenants.

The picture in St. Joseph County was similar. Between 1974 and 1977, total revenues for the average rental unit grew by 27 percent. Energy bills rose by 43 percent. Consumer prices over the same period rose by 23 percent.

The study estimates that in both counties, most of the 49 percent increase in energy costs was attributable to rising fuel prices.[2] Adjusting for the effects of changing weather, the quantity of energy used by the average rental unit declined--by 5 percent in Brown County, and by 3 percent in St. Joseph County. Efforts to reduce energy use were not sufficient, however, to keep energy bills from rising dramatically.

The decline in energy use was small relative to the real increase in energy prices. The weakness of the response can be explained by how hard it is to change the type and amount of energy used, and by the short period covered by the data. Over a longer period, after landlords and tenants had had the chance to add insulation and replace appliances with more efficient equipment, further decreases in energy use would have been expected.

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[2] Roughly a quarter of the total rise in energy payments in Brown County can be attributed to increasingly severe winters. The price changes quoted here were computed by adding marginal-price and fixed-charge effects.

In St. Joseph County, most of the reduction in energy use resulted from demolishing old and highly inefficient buildings. The energy used by the remaining buildings changed little over the whole period. In Brown County, most of the reduction in energy use took place within the existing rental stock. Whether the reduction resulted from building improvements or from improved energy-consciousness, the changes were well within what could have been attained through careful property management.

During the period under study, it appears that Brown County landlords were earning after-tax real rates of return 4 to 6 percentage points higher than those offered by alternative investments. Even in the depressed St. Joseph County market, landlords appeared to be earning yields fully comparable with those attainable from government or corporate bonds.[3]

The strong results for St. Joseph County landlords indicate that rates of return are generally independent of market condition. In a depressed market, rents are lower, vacancy losses higher, and current income smaller. However, under those circumstances, property values fall until the rate of return on the reduced base is high enough to make the operation again competitive. Once conditions stabilize, landlords in a depressed market do as well as others.

Eventually, rates of return on rental property converge toward the level set by the financial market; but while the adjustment is taking place, rates of return can diverge widely. In Brown County during the study period, property values were rising as above-normal rates of

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[3] The lack of data on landlord income and tax liability precludes giving precise figures.

return were being capitalized. Landlord profits soared. In St. Joseph County, on the other hand, a low-level equilibrium had been attained before the experiment began. During the market adjustment, many landlords lost their investments.

Among the components of landlord profits, net current income is relatively unimportant. It generally makes up only a quarter of pretax profits (even less in Brown County). Though appreciation constitutes a larger part of pretax landlord income, there is little evidence in either experimental site that landlords tried to cash in their equity gains. Mortgage debt as a fraction of total property value was low in both sites, and declined over time.

Tax benefits, however, are an extremely important component of landlord profits, making the difference between a poor and an attractive investment. Once again, rates of return are determined outside the rental market, and the special provisions of the tax code that enhance the attractiveness of rental property investment are capitalized into purchase prices. Rental property values are thus higher than otherwise.

Tax subsidies allow a property to be economically viable with less expenditure than would otherwise be the case. As a result, marginal properties remain in operation longer, new buildings are erected that would be infeasible without the subsidy, and rent levels are low. The general effect is to expand the supply of rental housing and to lower consumer costs.

Tax benefits have the unfortunate effect, however, of conferring above-average returns to wealthy landlords and below-average returns to poor ones. Other ways of subsidizing rental housing would perhaps avoid that effect. For example, the benefits could be treated as tax credits (making them available to landlords with small total tax liabilities); or income tax writeoffs could be eliminated and property tax liability lowered (making profitability of property ownership independent of income). Either way, rental property would be more attractive to lower and middle income investors.

Subsidies that lower capital or operating costs for all rental properties succeed in treating comparable households similarly. However, they fail to treat all households equitably. They confer the greatest benefits to occupants of new, high-value buildings, who are usually better off than occupants of older, lower value buildings.

Housing allowances provide benefits directly to needy renters. The benefits reach landlords as reduced vacancy losses, fewer bad debts, or in tight markets, higher rent levels. By increasing rates of return in the lower part of the market, housing allowances concentrate growth in supply, where it is needed most. Using housing allowances as a way of subsidizing rental housing could improve the circumstances of low-income renters, and at little or no net cost.

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I. INTRODUCTION

Although over a third of the nation's dwellings are rented rather than owned by the occupants, we have very little systematic data on the financing and operation of rental properties. Consequently, both housing analysts and the general public have been free to generalize about these matters from anecdotes or hypothetical examples. Such generalizations in turn serve as a basis for public policy concerning taxation of landlords, regulation of the rents they may charge, and subsidies enabling them to serve low-income tenants.

This report examines the economics of rental property operation and ownership in two midwestern housing markets between 1973 and 1977. The data are unusual in that they are drawn from marketwide probability samples that cover the full range of rental properties--from large, professionally managed apartment complexes to single-family houses owned and managed by nonprofessionals. They are also unusually comprehensive in that they include both capital and operating expenses, cash and noncash transactions, and landlord and tenant contributions to property upkeep and operation. Finally, the data are especially interesting because they come from a period when property values, rents, operating costs, and interest rates were all changing rapidly, requiring landlords to continually reappraise their plans and policies.

From the data we have compiled comprehensive revenue and expense accounts for various groupings of rental properties, covering four years in each of the two housing markets studied--Brown County, Wisconsin, whose main city is Green Bay, and St. Joseph County, Indiana, whose main city is South Bend. The detailed accounts are presented in a companion volume (Neels, 1982b); here we compare the first- and last-year accounts for all rental properties in each county to show how market conditions affect property revenue and expense, the mix of factors of production used to produce housing services, and the returns to the owners of rental property. Because of current interest in energy conservation, we pay special attention to the role of energy in producing housing services, and to the responses of landlords and tenants to rising energy prices. Finally, we consider how investment leverage (the ratio of equity to debt financing) and federal income tax laws affect landlords' profits, and how after-tax profits from rental housing compare with returns from other investments.

DATA SOURCES

The data used in this report were gathered as part of the Housing Assistance Supply Experiment (HASE), conducted by Rand under contract to the U.S. Department of Housing and Urban Development (HUD). The experiment was designed to measure the housing-market and community response to a full-scale program of housing allowances for low-income families. Ten-year, open-enrollment programs including both renters and homeowners were conducted in Brown County beginning in 1974 and in St. Joseph County beginning in 1975.

To study the market effects of the programs, Rand selected a panel of 2,000 residential properties in each site and interviewed the owners and occupants each year for the first four years of the program. A sample of newly constructed residential properties was added to the panel every year so that it represented the current population of residential properties.

Our report is based on the rental property data collected in the surveys. The sample consisted of about 1,300 rental properties in each site; but not all landlords and tenants responded to the surveys each year, and some who did respond failed to report all the data needed for the study. Our first-year accounts are based on complete survey records for 928 properties in Brown County and 904 in St. Joseph County. Our fourth-year accounts are based on 494 properties in Brown County and 361 in St. Joseph County. As the figures suggest, nonresponse became an increasing problem as interviewers returned each year with more questions--a common experience in longitudinal panel surveys.

To assure that the sample data accurately represented the full population of rental properties, we weighted the cases in our analysis sample so as to correct for differential nonresponse rates, using procedures developed especially for HASE.[1] However, we excluded some kinds of rental properties from the analysis sample because their revenue and expense accounts departed too much from the general pattern for them to be analyzed with the others. The excluded properties are mobile home parks, rooming houses, farms, mixed residential and commercial properties, and public housing projects. The remainder, which we call "regular rental properties," account for 95 percent of all rental dwellings in the two sites.

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[1] See Relles (1978) for the general method and Neels (1982b) for its application to the revenue and expense analysis file.

Landlords provided most of the revenue and expense data for regular rental properties. They were questioned in detail about their receipts and outlays during the calendar year preceding each interview, about repairs and improvements to their properties, and about their own hours of work on the property. In separate interviews, tenants of these same landlords estimated their utility bills for the preceding year and reported repairs or improvements they had made to the properties. They also listed their appliances and who supplied them.

Our revenue and expense accounts draw on several other sources of information. Property tax bills were obtained from public records, which also provided data on building age, floorspace, lot size, and assessed value. Separately from the interviews, survey fieldworkers counted the number of dwellings and buildings on a property and described their condition and the neighborhood environs.

The quality of the financial data obtained from respondents is generally good. After the first year of surveys in Brown County, we tried to contact landlords immediately after the filing date for income tax returns, when their records for the preceding year would be in order. Landlords consulted their records during about half the interviews in Brown County and a third in St. Joseph County; interviewers judged that even those who did not consult records usually had a good grasp of their revenues and expenses.

Inevitably, data quality varies from item to item. The most reliable data relate to regularly occurring payments--rent receipts, mortgage payments, and utility bills--for which systematic records were available. Nonrecurring expenditures--repairs, special tax assessments, occasional expenditures for the services of an accountant or a handyman--were harder to remember as to date and amount unless the landlord maintained a ledger. The least reliable data concern noncash transactions, for which we sought estimates of cash equivalents. Landlords, for example, have no particular reason to keep track of the time they spend working on their property; and unless they have recently hired someone else for similar work, they may not be able to estimate the value of their unpaid labor.

The financial information supplied by tenants, mostly about utility payments, is less reliable. Tenants who had recently moved into a dwelling could not know about the preceding year's utility expenses. Longer term residents often retained their bills and consulted them during the interview, but many respondents relied on their memories. There is some evidence that their estimates are biased upward, possibly by 10 or 15 percent.

The financial data were thoroughly audited in the course of constructing each property's revenue and expense account. Inconsistent or improbable responses were investigated as far as resources permitted and corrected if possible; if not, the data were labeled unusable. Records complete except for a few items of unusable or missing data were completed if possible by imputing the information from data on similar properties. Even so, we had to reject records for about a fourth of the properties for which landlord interviews had been obtained.

CHARACTERISTICS OF RENTAL PROPERTIES

Table 1.1 characterizes the inventory of regular rental properties in the two site counties. The inventories differed in important ways. In Brown County, 30 percent of the properties were single-family houses and 65 percent had between two and four dwellings on them; in St. Joseph County, the proportions were almost exactly reversed. In both counties, less than 5 percent of the properties had five or more dwellings, but those accounted for a considerable share of all rental dwellings--about a fourth in Brown County and a third in St. Joseph County.

Within property-size classes, the dwellings in the two counties were similar with respect to number of rooms and floorspace, but differed sharply as to lot size and age. Those in St. Joseph County, except for a few recently built apartment complexes, were on the smaller lots characteristic of their vintage. Over half the rental buildings in St. Joseph County were built before 1925; in Brown County, only a third were that old.

Nearly all the single-family houses and many of the small multiunit properties began life as owner-occupied homes; they were converted to rental use or subdivided after the original owners died or moved away. About 40 percent of the small multiunit properties in each county provided homes for their owners in addition to one or two rental dwellings.

The larger properties were built specifically for renters. In Brown County, they were rare until after World War II; 70 percent of the

Table 1.1

CHARACTERISTICS OF RENTAL PROPERTIES IN
BROWN COUNTY (1973) AND ST. JOSEPH COUNTY (1974)

Size of Property	Sample Size	Population Characteristics (averages)						
		Number of Properties	Dwellings per Property	Rooms per Dwelling	Floor Space per Dwelling (sq. ft.)	Lot Size per Dwelling (acres)	Age of Building (years)	Market Value ($) per Dwelling[a]
Brown County, 1973								
Single-unit	372	1,912	1.0	5.3	1,004	1.13	45	15,461
2-4 units	452	4,105	2.2	4.4	867	.48	42	11,724
5+ units	104	279	12.2	3.1	684	.71	21	14,061
All sizes	928	6,296	2.3	4.6	900	.68	42	12,732
St. Joseph County, 1974								
Single-unit	478	5,898	1.0	5.1	1,053	.39	53	11,814
2-4 units	372	2,776	2.4	4.1	873	.18	69	6,873
5+ units	54	196	32.9	3.2	644	2.09	52	10,349
All sizes	904	8,870	2.1	4.7	988	.36	58	9,346

SOURCE: Neels (1982b).

[a]Average of estimates by two different methods.

properties with five or more dwellings were built after 1953. In St. Joseph County, most such properties were built between 1895 and 1925, when South Bend was prospering as a manufacturing center. Only about 20 percent of the large properties were built after World War II; but they include some very large suburban garden apartment complexes, which accounts for the large average lot size (over 2 acres per dwelling).[2]

Partly because of their vintage and their skimpy sites, but mostly because of persistently high vacancy rates, rental properties in St. Joseph County had substantially lower market values than their counterparts in Brown County. Standardizing on size of property and age of building, Rydell (1977) estimates that the market values of comparable rental dwellings in St. Joseph and Brown counties differed by a third; and rental properties in central South Bend, the oldest and least attractive area of St. Joseph County, sold for about half the price of comparable (except for neighborhood) properties in Brown County. However, rents for comparable dwellings in the two counties were nearly the same.

Less than 5 percent of all rental properties in either site were owned by corporations. In Brown County, four-fifths of all landlords owned a single property that seldom had more than two or three dwellings on it; a fourth lived on their rental properties. In St. Joseph County, the ownership pattern was similar, except that over half the landlords owned only a single-family house and only 10 percent lived on the rental properties they owned.

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[2] Some of the recently developed complexes were incompletely developed, and the undeveloped acreage was allocated to existing dwellings.

MARKET STRUCTURE AND CONDITIONS

Brown and St. Joseph counties were chosen for HASE to test the allowance program concept under different market structures and conditions. Brown County served as an example of a metropolitan area with a growing urban center and a housing market undivided by racial segregation. St. Joseph County represented an area with a declining urban center and a segregated minority population.

Table 1.2 contrasts population trends and racial composition in the two counties. In Brown County, Green Bay grew rapidly between 1960 and 1970, mostly by annexation; after 1970, growth concentrated in the

Table 1.2

POPULATION CONTRASTS AT BASELINE IN BROWN COUNTY (1974) AND ST. JOSEPH COUNTY (1975)

Area	Number of Persons	Average Annual Growth (%)		Households	
		1960-70	After 1970	Number	Percent Black or Latin
Brown County					
Green Bay	88,500	3.3	.2	28,100	1.9
Rest of county	81,900	1.2	3.0	19,800	.6
Total	170,400	2.4	1.5	47,900	1.4
St. Joseph County					
South Bend	112,500	- .5	-2.2	39,300	18.6
Rest of county	123,000	1.2	.6	36,300	1.3
Total	235,500	.3	- .8	75,600	10.4

SOURCE: U.S. Bureau of the Census (1970a, 1970b); and estimates by HASE staff from weighted records of the baseline surveys of households in each site.

suburban ring. In St. Joseph County, South Bend was losing population before 1970, and the rate of loss accelerated thereafter. By 1975, the entire county was losing population.

Brown County had virtually no racial minorities (blacks, Latins, or orientals) among its population. In St. Joseph County, about 19 percent of South Bend's population was black or Latin; further, those minorities were concentrated in the older parts of the city. Suburban residents were almost all white.

Table 1.3 shows the housing-market consequences of the demographic changes noted above; it covers both rental and homeowner housing because the two submarkets are linked in that households as well as dwellings can change tenure in response to market conditions. Table 1.3 shows that vacancy rates in St. Joseph County were two to three times the corresponding rates in Brown County. Vacancy durations were similarly much longer in St. Joseph County. Clearly, those circumstances are important to rental property revenues in the two sites.

IMPLICATIONS FOR ANALYSIS

We have elsewhere (Neels, 1982b) tabulated rental property accounts by size of property, location, age of building, and type of ownership; this report deals only with countywide averages for all regular rental properties. Moreover, the accounts for individual properties are weighted in the averages to represent the population of properties rather than the population of rental dwellings. Thus, a property with 20 units is weighted equally with a single-family house.

Table 1.3

HOUSING-MARKET CONDITIONS IN BROWN COUNTY (1974)
AND ST. JOSEPH COUNTY (1975)

Market Area	Number of Habitable Units	Average Vacancy Rate (%)	Price Index (Brown County = 100)	
			Gross Rent	Property Value
Rental Housing				
Brown County	14,700	5.1	100	100
St. Joseph County:				
Central South Bend	8,000	12.3	98	56
Rest of county	8,400	8.9	98	76
Homeowner Housing				
Brown County	31,700	.8	(*a*)	100
St. Joseph County:				
Central South Bend	13,600	4.2	(*a*)	48
Rest of county	43,400	1.9	(*a*)	77

SOURCE: Estimated by HASE staff from weighted records of the baseline surveys of residential properties in each site.

NOTE: Price indexes compare average or median market prices for comparable dwellings in each area as of 1974.

[a]Not applicable.

Such treatment is appropriate for a study focusing on the typical rental property and its owner. It is important, however, to keep in mind that the typical property has only two dwellings and is owned by a parttime landlord. Nearly all our landlords had other sources of income, and 84 percent in Brown County and 60 percent in St. Joseph County worked at least 30 hours weekly at another job.

In contrast, most of the literature on rental property finance and operation presents actual or hypothetical data for large, professionally managed, newly built rental properties. Our findings, as should be expected, contrast strongly with those data in many respects. For instance, we find that the average owner's equity in St. Joseph County was 79 percent of current market value; whereas the typical hypothetical account in the literature assumes a newly purchased property whose mortgage covers 80 to 90 percent of the purchase price.

We cannot compare the characteristics of rental properties and the pattern of ownership in Brown and St. Joseph counties with those for the nation as a whole because nationwide data are scant. However, from the distribution of occupied rental dwellings by number of dwellings per property in the U.S. Census Bureau's Annual Housing Survey, we can estimate the distribution of properties by size. In 1976, it appeared that about two-thirds of all rental properties in the nation were single-family houses and about 94 percent had less than five dwellings on the property. The corresponding figures for St. Joseph County were 66 and 98 percent; for Brown County, they were 30 and 96 percent. Clearly, large rental properties are nearly as rare in the nation as a whole as in our sites.[3]

We think, therefore, that our data for Brown and St. Joseph counties reasonably approximate the national circumstance of the rental

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[3] However, large properties are more important than their number suggests, accounting for nearly two-fifths of all rental dwellings nationwide--compared with a fourth in Brown County and a third in St. Joseph County.

housing industry, which is also dominated by small properties and almost certainly by nonprofessional, parttime landlords. The two sites differ enough in the physical characteristics of the rental inventory and in current market conditions to demonstrate how local differences affect property revenue and expenses and determines the mix of factors that produce housing services.

One bias (from a nationwide perspective) in our data should be noted: both sites have cold winters and hot summers, leading to high rates of energy consumption for heating and cooling. Rental properties in milder climates would use less energy and their owners would invest less capital in weatherproofing. Another bias concerns the division of responsibility for utility bills between landlord and tenant. Whereas renters in Brown and St. Joseph counties paid utility bills that amounted to about 16 percent of gross rent, the corresponding national figure is about 12 percent.[4] Whether the difference is due to a different division of responsibility for utility bills or to above-average utility expenses in our sites is not clear.

Finally, we note that our report does not nearly exhaust the analytic possibilities of the HASE data on rental properties; it does not, for instance, compare different types of properties or management. We hope therefore that it stimulates further research.[5]

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[4] See Lowry (1982, Table A.1). The figures here are averages for dwellings rather than properties, so should be smaller than the utility component of direct tenant payments given in Sec. II.

[5] As noted, much more detail is presented in Neels (1982b). Persons interested in access to individual property records should contact the Housing Research Data Center, sponsored by HUD and operated by DU-ALabs, Arlington, Virginia.

ORGANIZATION OF REPORT

Section II begins by developing comprehensive measures of operating revenues and expenses that are comparable across all classes of property. The components of the accounts are the conventional categories of rental property accounting, but include noncash transactions, which are usually omitted. We show the composition of revenues and expenses for an average property during 1973 and 1976 for Brown County and during 1974 and 1977 for St. Joseph County. Differencing revenues and expenses, we obtain a measure of the net operating income that accrues to the property owners.

Although we have data for intervening years, we do not present them. Comparing accounts separated by a three-year interval sharpens the contrast between them and focuses on the consequences of background inflation for property management (see Sec. III). Cross-site comparisons are hampered by the year's difference in dates, a difficulty mitigated in Sec. III by a shift to "real" accounts for factor payments. In any case, the inventory differences between the sites imply differences in the pattern of operating expenses, and differences in market condition affect revenues. We show how those factors affect the outcome.

In both sites, operating expenses rose sharply over the three-year interval. In Sec. III, we analyze the causes and consequences of the rise. First, we regroup expenses and net operating income so as to account for all payments to each of five factors of production entailed in operating a rental property--capital, land, energy, repair labor and supplies, and operating labor and supplies.

The regrouping enables us to estimate the "real" quantities of each factor used by the average property during each year covered by our accounts--for example, the number of thermal units of energy consumed. With figures for total payments to each factor and the quantities consumed, we can estimate the change in each factor's unit price during the three-year interval. Assuming that the price changes are exogenous to the firm, we vary the factor mix to examine how landlords responded to uneven price increases.

Up to this point, our focus is on the property as an economic unit, without regard for its ownership. In Sec. IV, we consider rental property ownership from an investor's perspective. We begin by dividing net operating income between the equity owner and the mortgage lenders who provide him with financial capital, then add to the owner's share his paper gains from property value appreciation. The resulting income to the equity owner is called the landlord's "profit," and can be compared with the market value of his equity to estimate a rate of investment return. We compare the rates of return earned by landlords and mortgage lenders, then show how the returns are affected by background inflation and local market conditions. We also show how leveraging (the rate of equity to total property value) and the federal income tax code affect the profitability of rental property investments. Finally, we compare the landlord's after-tax rates of return to those obtainable in the same years from alternate investments.

The analysis of landlord's profits is of special interest because of its empirical foundation. For instance, hypothetical illustrations of the effects of leveraging abound; but here, we begin with actual data on property incomes, equity positions, and mortgage terms. The empirical data do not much resemble the hypothetical, and the consequences of leveraging are not as often represented. Likewise, tax provisions relating to depreciation allowances do not have the consequences often implied by hypothetical analyses.

II. RENTAL PROPERTY REVENUE AND EXPENSES

The operating statement for a rental property reflects its current financial performance and, unless the performance is manifestly aberrant, its longrun value as an asset. The statement totals all the revenue generated by the property during a period (usually a year) and all the expenses incurred during the same period. The difference between revenue and expense is net operating income, which accrues to the owner of the property (although part of it may be obligated to mortgage lenders who hold liens on the property).

In this section we construct operating statements for rental properties in Brown and St. Joseph counties and use them to appraise the marketwide average performance of rental property in each of two years: 1973 and 1976 for Brown County and 1974 and 1977 for St. Joseph County. The operating statement comments on the *property's* financial performance, not the financial performance of the owner's equity investment or the lender's debt investment in the property--matters which are considered in Sec. IV.

Operating statements are commonly used to measure financial performance, including that of rental property businesses. The Institute of Real Estate Management (IREM) compiles and publishes an annual report on the average revenue and expense experience of its members[1], intended as a standard against which a member can assess the performance of his own property. Researchers have also compiled operating statements for

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[1] For an example, see Institute of Real Estate Management (1978).

market analysis bearing on issues of public policy (Sternlieb, 1969, 1972; Stegman, 1972).

The present compilation differs from previous ones in two respects. First, it is based on marketwide probability samples rather than on samples of large, professionally managed properties (IREM), or of other special segments of the market (slum properties, rent-controlled properties). Second, our revenue and expense accounts are more nearly complete and more comparable across properties than any others we have seen. Whereas earlier studies focused on the landlord's cash revenue and expenses, we include payments by tenants and use data from both landlords and tenants to estimate the value of noncash elements of revenue and expense. The result is a nearly comprehensive account of rental property performance in each of two housing markets.

In what follows, we first derive a measure of the operating revenue generated by a rental property, which is fully comparable across all properties and so can be averaged across them without distortion. We examine the level and composition of revenue in both sites for each of two years and draw on background data from our surveys to account for the observed differences. We then derive a similarly comparable measure of operating expense for rental property and consider how and why its level and composition varied between sites and over time. Finally, we deduct expense from revenue to obtain the outcome, net operating income, whose level and trend are important for interpreting market condition and prospects. Later sections show how net operating income is divided between the various actors in the rental market, how it is supplemented by capital gains, and how it is affected by taxation.

REVENUE FROM RENTAL PROPERTY

In principle, the operating revenue from rental property consists of payments by its tenants to the landlord. However, the formal conditions and accidental circumstances of tenancy differ between properties in ways that affect explicit cash payments and complicate cross-property comparisons. For example, some tenants pay directly for heating fuel, while others pay the landlord a contract rent that includes the cost of heat as well as of shelter. To encompass such differences in form of payment, housing analysts customarily compare *gross rents* rather than *contract rents*. Gross rent consists of contract rent (the amount due the landlord) plus direct tenant payments, if any, for specified utility services.

Our concept of *gross operating revenue* is even more comprehensive than gross rent. In effect, it is the amount of revenue the landlord would receive if the property were fully occupied by tenants who paid the full market value for their dwelling, and whose contract rent included all aspects of building maintenance and utility services. Gross operating revenue has four major components: cash rent, direct tenant payments for specified items, waived rent, and rent lost because of vacancies or other reasons. The details are given in Table 2.1 and are discussed below.

Cash rent equals residential rent actually received by landlords plus revenues generated by providing services such as parking or laundry facilities. It is by far the largest of the four components, and it corresponds closely to what is usually thought of as the revenue generated by a property.

Table 2.1

COMPONENTS OF RENTAL PROPERTY REVENUE ACCOUNT

Cash Transaction	Landlord's Receipts (cash/noncash)	Item
		Cash rent:
X	X	Contract rent received
X	X	Fees for services and auxiliary facilities
		Direct tenant payments:
X		Energy[a]
X		Other utility services[b]
		Repairs to structure and equipment:
X		Purchased supplies and paid labor
		Value of unpaid labor
	X	Annual cost of tenant-supplied appliances
		Waived rent:[c]
	X	Dwelling occupied by resident landlord
		Dwelling occupied by employee or relative
		Rent loss:
		Vacancy loss (contract rent)
		Bad debts (contract rent)
		Unpaid tenant utilities[d]
		Total: Gross operating revenue[e]

NOTE: The gross revenue account includes direct tenant payments and noncash items in order to enhance cross-property comparability.

[a]Gas, electricity, fuel oil, other fuels.

[b]Water, sewage, trash disposal.

[c]Estimated market rent for dwelling, less contract rent received.

[d]Estimated amounts tenants would have paid during vacancy intervals.

[e]In effect, the amount of revenue the landlord would receive if the property were fully occupied by tenants who paid full market rents for their dwellings, and whose contract rents included payment for all aspects of building maintenance and all utility services.

Direct tenant payments occur when tenants are responsible for paying bills associated with operating a property; under these circumstances, contract rent is lower than if the landlord was responsible for the bills. Direct tenant payments include payments for utility services, the costs of repairs made by tenants, and an imputation for tenant-supplied appliances. Of the three components, the most important by far is the tenant's utility bill. Tenants usually pay for some utilities, and the trend in recent years has been to expand their responsibilities. Tenant-made repairs are common in the lower end of the rental market. The incidence of tenant-supplied appliances varies regionally. In some markets it is customary for renters to supply their own stoves and refrigerators. In the experimental sites, those appliances were usually supplied by landlords, but tenants of single-family houses often supplied washers and dryers.

Waived rent is an imputation to account for units on a property that are occupied by people paying below-market or no rent. Estimates of waived rent were provided by landlords and covered a number of circumstances. The most common was that the landlord lived rent-free on the property. Rent waivers were often granted to a landlord's employee as part of his pay. Sometimes a landlord's relative occupied a unit and paid less than its full market rent.

Gross revenue includes a measure of rent loss, which has three components. Vacancy loss is the rent not received because units are unoccupied for part of the year. Bad debts include revenues lost because tenants fail to pay their rent. Unpaid tenant utilities bring direct tenant payments up to what they would be if all units on the property were occupied the full year.

Using the sum of those items to measure revenue equalizes the effect on revenue of various special arrangements and circumstances. Including direct tenant payments in the account allows revenues for single-family homes (whose tenants pay directly for most utility services) to be compared with revenues for apartments (whose landlords pay most utility bills). Including waived rent makes it possible to compare properties having resident landlords, employees, or landlord's relatives with those not having them. Finally, including rent loss removes the effect on revenue of variations in vacancies or rent-skipping. All the above conventions require corresponding adjustments to the expense account, discussed later in this section.

Table 2.2 shows the average values (in current dollars) of gross operating revenue and its major components for Brown County (1973 and 1976) and St. Joseph County (1974 and 1977). The figures here (and in all subsequent tables) are annual values per dwelling on the average property; that is, they were compiled by dividing each property's itemized revenue by the number of dwellings on the property, then averaging the result across properties.[2] In consequence, large and small properties have the same weight in the averages, an outcome appropriate for our focus on the typical rental property rather than on the typical rental dwelling.[3]

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[2] The properties in our two samples were weighted to represent the populations of properties in each site.

[3] Readers interested in averages for specific types of property (old or new, large or small, central-city or suburban, etc.) will find the appropriate accounts in Neels (1982b). That report also provides dwelling counts that would enable the reader to compile averages in which all dwellings were equally weighted.

Table 2.2

COMPONENTS OF GROSS OPERATING REVENUE: REGULAR RENTAL PROPERTIES IN BROWN AND ST. JOSEPH COUNTIES, SELECTED YEARS

Revenue Component	Annual Revenue per Dwelling			
	1973 (BC) or 1974 (SJC)		1976 (BC) or 1977 (SJC)	
	Amount ($)	Percent	Amount ($)	Percent
Brown County				
Cash rent	1,193	68	1,444	64
Direct tenant payments	314	18	469	21
Waived rent	179	10	257	11
Rent loss	74	4	93	4
Gross operating revenue	1,760	100	2,263	100
St. Joseph County				
Cash rent	1,012	57	1,203	54
Direct tenant payments	439	25	576	26
Waived rent	143	8	279	12
Rent loss	174	10	177	8
Gross operating revenue	1,768	100	2,235	100

SOURCE: Neels (1982b).

NOTE: Amount per dwelling was computed for each sample property, then averaged across properties. In averaging, properties were weighted to reflect their frequency in the population of properties, not the number of dwellings each represents. Entries are in current dollars, so data for the two counties in adjacent years are not exactly comparable.

During 1973, the typical rental property in Brown County generated revenues of $1,760 per dwelling ($147 per month). Cash rent receipts accounted for about 68 percent of the total; direct tenant payments for about 18 percent; and waived rent for 10 percent. Because of the county's high occupancy rate, rent losses were small--only 4 percent of gross revenue.

A year later (1974), the typical rental property in St. Joseph County generated revenues of $1,768 per dwelling.[4] Although the totals for the two counties are nearly identical, the components differ; cash receipts were only 57 percent of revenue in St. Joseph County and direct tenant payments were 25 percent. Direct tenant payments were higher in St. Joseph County primarily because its rental inventory was heavily weighted with single-family properties (67 percent of all rental properties, as against 30 percent in Brown County). For the same reason, waived rent constituted a smaller share of revenue in St. Joseph County; only 13 percent of all rental properties had resident landlords there, as against 28 percent in Brown County. Finally, rent losses in St. Joseph County amounted to 10 percent of revenue, reflecting much lower occupancy rates than in Brown County.

During the three-year interval covered by our data, gross operating revenue rose by 29 percent in Brown County and 26 percent in St. Joseph County. Although the changes occurred in the same time, they refer to

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[4] Because of the one-year difference in periods of observation, current-dollar revenues for Brown and St. Joseph counties are not exactly comparable. From mid-1973 to mid-1974, the national Consumer Price Index (CPI) rose by 11 percent, so that the purchasing power of revenue was correspondingly lower in St. Joseph County. In 1974, the gross revenue per dwelling in Brown County was $1,886 annually, or nearly 7 percent higher than in St. Joseph County that same year. Comparing revenues for the same year is better, but does not take into account differences in the rental inventories of the two places. Controlling for the quantity of housing services provided, Neels (1981) estimates that in real terms rents in central South Bend were about 6 percent lower than in Brown County, whereas in the rest of St. Joseph County they were 3 percent higher.

different periods during which the general rate of price inflation differed. In constant dollars, gross revenue actually rose faster in St. Joseph County--by 2.9 percent over the three years as against 0.4 percent in Brown County.

The relative importance of the components shifted similarly in the two sites. The share accountable to cash rent decreased and the shares for direct tenant payments and waived rent increased. Part of the increase in direct tenant payments was because those payments are mostly for fuel and electricity, the price of which rose more rapidly than that of other factors used to produce housing services (see Sec. III).

The rent-loss entries are especially interesting. In Brown County, losses were small in both 1973 and 1976, but increased at nearly the same rate as gross revenue--implying little change in the average property's vacancy rate. In St. Joseph County, the dollar amount of rent loss hardly changed from 1974 to 1977, even though rents rose by a fourth--implying a sharp drop in the average property's vacancy rate.[5]

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[5] The rent losses counted in Table 2.2 are contract rents lost because of vacancies or bad debts. The two causes are not sharply distinct, inasmuch as bad debts are usually incurred when a departing or evicted tenant fails to pay all he owes. The trends for vacancy losses alone are similar to those for the sum of vacancy losses and bad debts.

Direct counts of vacancies from our surveys indicate that the rental vacancy rate rose from 4.2 to 6.4 percent in Brown County between 1973 and 1976; and from 11.2 to 13.2 percent in St. Joseph County. But vacancy rates measured at a point in time do not necessarily reflect a full year's experience, and vacancies can shift from expensive to inexpensive dwellings (or the reverse), changing the rent-loss rate without changing the vacancy rate. The discrepancy between the trend in rental vacancy rates and rent-loss rates is not due to the averaging method; when rent losses are recomputed for the average dwelling rather than for the average property, the loss rates are the same (within rounding error) as those shown in Table 2.2.

OPERATING EXPENSE FOR RENTAL PROPERTY

In principle, the operating expense of a rental property consists of all payments for nondurable factors of production used to produce rental housing services. By convention, the purchase of items that have a useful life greater than a year is treated as capital rather than operating expense. As with revenues, we have constructed comprehensive operating expense accounts, comparable across properties.

Table 2.3 details the elements of the expense accounts under six headings: maintenance, taxes and insurance, utility services, management, other operating expense, and rent loss. Except for the last, these are the conventional categories used by property managers. However, most of the major categories in our accounts contain elements missing from other accounts we have reviewed.

We include direct tenant payments for utilities and repairs in the appropriate categories.[6] We also include the estimated value of unpaid labor contributed by both tenants and landlords and the value of rent waivers granted to employees in lieu of wages. Finally, we include contract rent lost because of vacancies or bad debts.[7]

Note that several items--direct tenant payments and tenants' unpaid labor, rent waivers to employees, and vacancy and bad debt losses--directly offset corresponding items in the revenue account. Consequently, if those items were omitted from both accounts (as is usual),

[6] No expense was imputed for tenant-supplier appliances. Instead, the value of such appliances was added to property value.

[7] The third component of rent loss--unpaid tenant utilities--that appeared in our revenue account is omitted because these expenses are reported by the landlord, who normally pays the property's utility bills during vacancies--though the amount of the bills would usually be less in a vacant than in an occupied dwelling.

Table 2.3

COMPONENTS OF RENTAL PROPERTY EXPENSE ACCOUNT

Cash Transaction	Paid by or Imputed to Landlord	Item
		Property maintenance:[a]
X	X	Employees' salaries
	X	Employees' rent waivers
X	X	Service and repair contracts
		Purchased supplies and paid labor:
X	X	Purchased by landlord
X		Purchased by tenants
		Value of unpaid labor:
	X	Provided by landlord
		Provided by tenants
		Property taxes and insurance:
X	X	Property tax
X	X	Special assessments
X	X	Insurance premiums
	X	Self-insurance premium (imputed)
		Utility services:
		Energy:
X	X	Paid by owner
X		Paid by tenants
		Other utility services:
X	X	Paid by owner
X		Paid by tenants
		Property management:
X	X	Employees' salaries
	X	Employees' rent waivers
X	X	Fees to agents and business services
X	X	Office and other business expense
	X	Value of owner's unpaid labor
		Janitorial services[b]
X	X	Salaries
	X	Rent waivers
X	X	Service contracts and fees
X	X	Supplies
X	X	Miscellaneous expenses
	X	Value of owner's unpaid labor
		Rent loss:
	X	Vacancy loss
	X	Bad debts
		Total: Gross operating expense

NOTE: The gross expense account includes direct tenant payments and noncash items in order to enhance cross-property comparability.

[a] Repairs and service to the building and its equipment. Does not include amortizable improvements or replacements.

[b] Primarily maintenance and gardening service; where applicable, includes elevator and switchboard operation, doormen, security services.

net operating income--the difference between revenue and expense--would be unaffected. However, one unusual item in our revenue account--the rental value of the dwelling occupied by a resident landlord--has no offset in the expense account, so adds to net operating income.

The sum of the items in Table 2.3 is gross operating expense, a measure of the full cost of rental property operation. The amounts per dwelling incurred by the average properties in Brown and St. Joseph counties are shown in Table 2.4, by major component.

The rank order of the expense components is similar across both years and counties. In all cases, the largest single component is utility expense, which includes all expenditures for gas, electricity, and other forms of energy, as well as the cost of water and sewer service and trash collection. Their share of gross operating expense is about a third.

The next most important item is maintenance, accounting for a fifth to a quarter of total expense. It includes the cost of all repairs made to the property, the salaries of all maintenance employees, and an allowance for the value spent by landlord and tenants on maintenance. The share of total expenses devoted to maintenance is somewhat higher in St. Joseph County--25 percent versus 21 percent in Brown County.

The third big expense item is property tax. Its share of the total is quite different in the two counties, accounting for a quarter of gross operating expense in Brown County but only a tenth in St. Joseph County. The reasons for this difference are shown in Table 2.5. First, property value per dwelling was much higher in Brown County. In 1973, market value per dwelling was 36 percent higher in Brown County than in

Table 2.4

COMPONENTS OF GROSS OPERATING EXPENSE: REGULAR RENTAL PROPERTIES IN BROWN AND ST. JOSEPH COUNTIES, SELECTED YEARS

Expense Component	Annual Expense per Dwelling			
	1973 (BC) or 1974 (SJC)		1976 (BC) or 1977 (SJC)	
	Amount ($)	Percent	Amount ($)	Percent
Brown County				
Utility services	352	31	586	37
Maintenance	235	21	319	20
Property tax	274	25	309	20
Management	104	9	147	9
Janitorial services	63	6	71	6
Insurance	35	3	50	3
Rent loss	61	6	82	6
Gross operating expense	1,124	100	1,564	100
St. Joseph County				
Utility services	517	35	695	38
Maintenance	368	25	444	24
Property tax	146	10	170	9
Management	147	10	188	10
Janitorial services	81	6	116	6
Insurance	64	4	84	5
Rent loss	141	10	141	8
Gross operating expense	1,464	100	1,838	100

SOURCE: Neels (1982b).

St. Joseph County a year later, despite the intervening 11 percent rise in the overall level of consumer prices and the higher incidence of single-family rental properties in St. Joseph County. This difference in market value reflects the depressed condition of the St. Joseph County housing market.[8] Second, the gross property tax rate in St. Joseph County was considerably lower than in Brown County. The result of lower taxable value and lower tax rates was that property taxes per dwelling in St. Joseph County were just over half what they were in Brown County.

Table 2.5

CAPITAL VALUES, GROSS TAX RATES, AND PROPERTY TAXES:
REGULAR RENTAL PROPERTIES IN BROWN AND ST. JOSEPH COUNTIES

Item	Brown County (1973)	St. Joseph County (1974)
Capital value per unit ($)	12,732	9,346
Gross property tax rate (%)	2.2	1.6
Property tax per unit ($)	274	146

SOURCE: Neels (1982b)

The expenses associated with management, janitorial service, and insurance each account for a relatively small and stable share of total expenses. Together, they make up roughly a fifth of total expense.

[8] The effect of market condition on capital values is discussed in Rydell (1977).

Over the four years of the experiment, gross operating expense inceased by 39 percent in Brown County and by 26 percent in St. Joseph County. The rate of increase was not the same for all expense categories, however. The share of the total accounted for by maintenance declined slightly in both counties. The share accounted for by property taxes declined slightly in St. Joseph County and substantially in Brown County. In contrast, the share accounted for by utilities rose substantially in both sites.

The last result was to be expected. Utility bills mostly pay for energy, and during the period covered by the data, energy prices rose rapidly--by 66 percent in Brown County (1973-76) and by 46 percent in St. Joseph County (1974-77). The result for Brown County was that utilities as a share of gross operating expense rose from 31 to 37 percent. Because they start a year later, the St. Joseph County data miss a large portion of the initial increase in energy prices. The share of gross operating expense made up of utilities started higher at 35 percent and increased over the next three years to 38 percent.

Tables 2.6 and 2.7 break down gross operating expense by form of payment. The figures emphasize the importance of including noncash expenses. In Brown County, cash expenses composed less than half of total operating costs; in St. Joseph County, less than 40 percent. Direct tenant payments made up about 30 percent, and in both sites their share was increasing over time. The remaining costs consisted of compensation for the landlord's labor, including time spent managing the property, making repairs, and cleaning.

Table 2.6

GROSS OPERATING EXPENSE PER DWELLING, BY FORM OF PAYMENT: REGULAR RENTAL PROPERTIES IN BROWN COUNTY

Item	1973		1976	
	Amount ($)	Percent	Amount ($)	Percent
Direct tenant payments:				
Energy	222	20	353	23
Other utilities	15	1	38	2
Maintenance	30	3	29	2
Appliances	47	4	49	3
Total	314	28	469	30
Unpaid labor:				
Maintenance	82	7	169	11
Management	80	7	123	8
Janitorial services	49	4	46	3
Total	211	18	338	22
Rent loss	61	5	82	5
Cash costs	560	49	675	43
Gross operating expense	1,124	100	1,564	100

SOURCE: Neels (1982b).

NET OPERATING INCOME

Subtracting operating expense from operating revenue gives the net income generated from current operations. This calculation is reported for Brown and St. Joseph counties in Table 2.8. For the average rental

Table 2.7

GROSS OPERATING EXPENSE PER DWELLING, BY FORM OF PAYMENT: REGULAR RENTAL PROPERTIES IN ST. JOSEPH COUNTY

Item	1974 Amount ($)	1974 Percent	1977 Amount ($)	1977 Percent
Direct tenant payments:				
Energy	292	20	428	23
Other utilities	52	4	64	3
Maintenance	53	4	37	2
Appliances	42	3	67	4
Total	439	31	596	32
Unpaid labor:				
Maintenance	130	9	193	11
Management	124	8	166	9
Janitorial services	61	4	70	4
Total	315	21	429	24
Rent loss	141	10	141	8
Cash costs	569	38	672	36
Gross operating expense	1,464	100	1,838	100

SOURCE: Neels (1982b).

property, income per dwelling was twice as great in Brown County (1973) as in St. Joseph County (1974). Although gross operating revenues were about the same in the two sites, St. Joseph County landlords had higher expenses for utilities, maintenance, management, and janitorial services;

Table 2.8

NET INCOME FROM CURRENT OPERATIONS: REGULAR RENTAL PROPERTIES IN BROWN AND ST. JOSEPH COUNTIES, SELECTED YEARS

Item	Income per Dwelling ($)		Percentage Change
	1973 (BC) or 1974 (SJC)	1976 (BC) or 1977 (SJC)	
Brown County			
Gross operating revenue	1,760	2,263	29
Gross operating expense	1,124	1,564	39
Net income	636	699	10
St. Joseph County			
Gross operating revenue	1,768	2,235	26
Gross operating expense	1,124	1,564	26
Net income	304	397	31

SOURCE: Tables 2.2 and 2.4.

NOTE: Amount per dwelling was computed for each sample property, then averaged across properties. In averaging, properties were weighted to reflect their frequency in the population of properties, not the number of dwellings each represents. Entries are in current dollars, so data for the two counties in adjacent years are not exactly comparable.

and they lost more rent because of vacancies and bad debts. Their only operating advantage was low taxes.

Because of intervening inflation, dollar amounts of net operating income for 1973 and 1974 are not precisely comparable, but the same conclusion emerges from a comparison of "operating ratios," a commonly used performance measure that is less sensitive to nominal values of the dollar and to differences in properties. As calculated from Table 2.8, the initial ratio of net operating income to gross operating revenue was .36 in Brown County (1973) and .17 in St. Joseph County (1974).

Trends in net operating income also differed markedly. In Brown County, net income increased by only 10 percent, despite a 29 percent increase in gross revenue. The reason is that expenses increased even more--by 39 percent. In St. Joseph County, revenue and expenses both increased by about 26 percent, but net operating income rose by 31 percent.[9]

Comparing the financial performance of rental properties in the two counties, we find that those in Brown County did better in both 1973 and 1976 than properties in St. Joseph County did in 1974 and 1977. However, the trend was unfavorable in Brown County and favorable in St. Joseph County. The average operating ratio in Brown County fell from .36 to .31, but in St. Joseph County rose from .17 to .18.

The same conclusions emerge from examination of the trend of net income in constant (inflation-adjusted) dollars. From 1973 to 1976, net

[9] Hasty readers may find the rates of change logically inconsistent, but they are readily confirmed from Table 2.8. Gross revenue is larger than gross expense, so that if both increase at the same rate, the difference between them--net income--grows even faster.

income in Brown County rose by 10 percent, while prices in general rose 28 percent. In real terms, net income fell by 18 percent over the period. In contrast, in St. Joseph County net income rose by 31 percent, while prices increased by only 23 percent, leaving a real gain of 8 percent.

The most direct reason for the different trends in the two counties was that operating expense rose very sharply in 1973-74, the first year of the Brown County series, but before the St. Joseph County series began. The increase mainly reflected rising fuel costs, a result of the Arab oil embargo of 1973. However, in 1976, two years later, landlords in Brown County had not yet raised their rents enough to catch up in real terms.[10] In St. Joseph county, revenues more than kept pace with expenses, partly because of rent increases and partly because of higher occupancy rates.[11]

We do not know how St. Joseph County landlords dealt with the exceptionally large expense increase of 1973-74, but they appear to have dealt with subsequent increases to better advantage than their counterparts in Brown County. Although we cannot rule out the possibility of a

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[10] Average gross revenue increased in Brown County by $503 per dwelling from 1973 to 1976, more than enough to cover the utility expense increase of $234; but other factor costs rose by $206, for a total expense increase of $440. Net income increased by $63, or 10 percent, during a period in which the purchasing power of the dollar fell by 28 percent; thus "real" net income fell by 18 percent.

[11] Potential gross rent (the "rent roll") increased by 26.5 percent from 1974 to 1977. In 1974, 9.8 percent of the potential was lost because of vacancies and bad debts; in 1977, only 7.9 percent was lost for those reasons. With the 1974 rent-loss rate, net income in 1977 would have been $357 rather than $399, a decrease of 10.5 percent.

difference in management skills, we think the different performance trends are more likely accountable to a different balance between the supply of rental housing and the effective demand for it.

Our data for Brown County suggest a softening market, in which rent increases were restrained by landlords' perception that faster increases would cause lower occupancy rates and would therefore be unprofitable. During the years in question, about 1,500 more rental units were constructed than were demolished, and the supply of rental housing grew faster than the demand for it.

Our data for St. Joseph County suggest the opposite. In 1974, there was manifestly an excess supply of rental housing in the county; the rental vacancy rate was about 11 percent. Over the next three years, demolitions matched new construction, so even a slight growth in the number of households would cause the occupancy rate to rise and strengthen the hand of landlords seeking catch-up rent increases. However, with so high a vacancy rate, the game had to be played cautiously.[12]

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[12] Reducing the rent-loss rate to Brown County's 4 percent would have increased 1977 net income per dwelling on the average property in St. Joseph County from $399 to $487, or 22 percent.

III. FACTORS AFFECTING OPERATING COST

The preceding section showed that operating costs rose substantially in every category of expense and in both sites during the years covered by the HASE data. This section estimates how much of the cost increase was attributable to changing prices for the factors of production and how much to changes in the quantities of factors used by landlords in the course of rental property operation. When factor prices change unevenly, producers usually find it advantageous to shift from the more expensive to the less expensive factors. We find that the producers of rental housing services in Brown and St. Joseph counties generally responded in that way to the price changes that occurred in the mid-1970s, a period of rapid and uneven inflation.

ALLOCATING EXPENSES TO FACTORS OF PRODUCTION

In Sec. II, we accounted for all the costs of rental property operation, using conventional expense categories. Here, we reorganize the accounts so as to associate expenses with different types of physical inputs to the production process, or "factors of production." Expenditures for the inputs, whether explicit or implicit, we call "factor payments."

To account for all inputs to production, we look beyond the expenditures included in gross operating expense. They cover only operating costs and ignore two of the most important inputs to the production of rental housing services--the building and the land it sits on. Those two factors of production are owned by the landlord, subject to liens held by others from whom the landlord borrows to purchase or improve the property. The "payments" to the factors consist of all revenue not otherwise expended; in other words, the owners of the building and the land are the residual claimants of current income from operations. By including factor payments for capital and land, we can account for all revenue as factor payments. The way in which payments for capital and land are divided between landlords and mortgage lenders is treated in Sec. IV.

Traditionally, production theory distinguishes three factors of production: land, labor, and capital. "Land," however, has been broadly interpreted to mean raw materials brought to the site of production as well as the site itself. The number of factors is arbitrary, though there are logical principles for grouping them according to their role in production. For the production of housing services, we distinguish five factors whose physical inputs can be estimated separately: land (the building site, carrying with it certain locational advantages), capital (structural improvements and durable equipment), repairs (the labor and materials used to maintain the building), operations (the labor and supplies used to operate the building), and energy (a special category of operations--the fuels used for heat, light, and other purposes). Table 3.1 shows with Xs how the groupings relate to the accounting categories used in Sec. II. The reasons for the choices and the allocation methods are discussed below.

The largest expense category for rental properties in the HASE sites was utilities, which includes electricity, natural gas, heating oil, and water, sewer and trash collection services. Here, the nature

Table 3.1

ALLOCATION OF GROSS OPERATING EXPENSE AND NET OPERATING INCOME TO FACTORS OF PRODUCTION

Expense or Income Item	Factor of Production				
	Energy	Repairs	Operations	Capital	Land
Property maintenance		X			
Taxes and insurance:					
Property taxes				X	X
Special assessments				X	X
Insurance premiums				X	
Self-insurance				X	
Utility services:					
Energy	X				
Other utility services			X		
Property management			X		
Janitorial services			X		
Rent loss				X	X
Gross operating expense[a]					
Net operating income			X	X	X
Gross operating revenue[a]					

NOTE: Expense items allocated between capital and land are divided in proportion to the market values of those factors.

[a]Totals are not allocated, but are included to show that factor payments account for all of gross revenue.

of the flows associated with the cash payments is apparent. Because of our interest in energy use, we divide utility payments into two categories: energy and nonenergy. The first category includes electricity, natural gas, and heating oil. By combining those inputs into a single composite good and treating energy as a distinct factor of production, we can show how landlords reacted to the "energy crisis." The second category contains the remaining utility services and is combined with other inputs to form the "operations" factor, as explained below.

Maintenance expenses pay for both the labor of repairmen and the materials and supplies they use. We treat the composite as a single factor of production, because technical constraints cause labor and non-labor maintenance inputs to move together.

Expenditures for management and janitorial services both buy labor, but with different skills. In the first case, the labor is provided largely by landlords and building managers. Small amounts pay the fees of accountants, lawyers, and other providers of business services. In the second case, the labor is provided by janitors, custodians, and again to a large extent, landlords.

We combine the inputs of management, janitorial services, and nonenergy utility expenditures into a third factor of production that we call operations. It is a residual containing all current inputs to rental property operation not counted as either energy or maintenance. As a residual category, it is not wholly satisfactory for analytic purposes; but the alternative of further subdivision would be even less satisfactory, yielding several small categories of inputs, which would complicate analysis without adding much information.

The remaining operating-cost categories are property taxes, insurance, and rent loss. Taxes are a levy on the value of land and improvements, hence should be regarded as a compulsory payment for the use of those factors. Insurance protects against the loss of improvements due to such hazards as fire, hence should be considered a payment for capital but not land. Rent loss is also a risk to which the owners of rental property are subject, hence should be considered an opportunity cost of the use of capital and land. After all the operating costs are accounted for, the residual revenue accrues to the owner of the property, here treated as a factor payment to be divided between capital and land.

Our operating accounts contain enough detail so that we can reorganize them to associate nearly all costs with the appropriate factor of production as defined above. In many instances, the transformations are relatively simple. To compute payments for energy, we take the energy portion of the utility bill. Payments for maintenance services are taken from the maintenance bill for the property. Payments for operations equal the sum of management expenses, janitorial expenses, and the nonenergy portion of the utility bill.

Computing payments for the services of capital and land is more complex. Property taxes, insurance costs, rent loss, and net operating income together comprise a joint payment for the use of capital and land. Insurance premiums can unambiguously be assigned to capital, since they buy protection for only the building. All other expenses, however, are shared between capital and land. We divide property taxes and rent loss in proportion to the fractions of total property value accounted for by capital and land, respectively.[1]

Tables 3.2 for Brown County and 3.3 for St. Joseph County show how the expenses reported by accounting category (Sec. II) map into

[1] For a description of the data sources and procedures used in measuring the current market values of rental properties and dividing them between capital and land, see Neels and Rydell (1981).

Table 3.2

PAYMENTS TO FACTORS OF PRODUCTION USED BY REGULAR RENTAL PROPERTIES IN BROWN COUNTY, 1973 AND 1976

Expense or Income Item	Annual Factor Payment ($ per dwelling)				
	Energy	Repairs	Operations	Capital	Land
1973					
Property maintenance	0	235	0	0	0
Property taxes	0	0	0	203	71
Insurance	0	0	0	35	0
Utility services	319	0	33	0	0
Property management	0	0	104	0	0
Janitorial services	0	0	63	0	0
Rent loss	0	0	0	45	16
Net operating income	0	0	0	472	164
Gross operating revenue	319	235	200	755	251
1976					
Property maintenance	0	319	0	0	0
Property taxes	0	0	0	230	79
Insurance	0	0	0	50	0
Utility services	512	0	74	0	0
Property management	0	0	147	0	0
Janitorial services	0	0	71	0	0
Rent loss	0	0	0	61	21
Net operating income	0	0	0	520	178
Gross operating revenue	512	319	292	862	278

SOURCE: Neels (1982b).

NOTE: Factor payments may be either explicit (cash expense) or implicit (rent loss).

payments to the five factors of production. The tables cover the initial and final years in Brown and St. Joseph counties. The results are summarized in Table 3.4.

Table 3.3

PAYMENTS TO FACTORS OF PRODUCTION USED BY REGULAR RENTAL PROPERTIES IN ST. JOSEPH COUNTY, 1974 AND 1977

Expense or Income Item	Annual Factor Payment ($ per dwelling)				
	Energy	Repairs	Operations	Capital	Land
1974					
Property maintenance	0	368	0	0	0
Property taxes	0	0	0	92	54
Insurance	0	0	0	64	0
Utility services	427	0	90	0	0
Property management	0	0	147	0	0
Janitorial services	0	0	81	0	0
Rent loss	0	0	0	89	52
Net operating income	0	0	0	192	111
Gross operating revenue	427	368	318	437	217
1977					
Property maintenance	0	444	0	0	0
Property taxes	0	0	0	109	61
Insurance	0	0	0	84	0
Utility services	611	0	84	0	0
Property management	0	0	188	0	0
Janitorial services	0	0	115	0	0
Rent loss	0	0	0	90	51
Net operating income	0	0	0	255	144
Gross operating revenue	611	444	387	538	256

SOURCE: Neels (1982b).

NOTE: Factor payments may be either explicit (cash expense) or implicit (rent loss).

DISTRIBUTIVE SHARES OF FACTORS OF PRODUCTION

Table 3.4 shows the distributive share of gross revenue claimed by each factor of production. Although the total revenue to be distributed

Table 3.4

CHANGES IN FACTOR PAYMENTS AND DISTRIBUTIVE SHARES: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973-76) AND ST. JOSEPH COUNTY (1974-77)

Factor of Production	Factor Payment			Distributive Share		
	Amount ($/dwelling/year)			Percent of Total		
	1973 (BC) or 1974 (SJC)	1976 (BC) or 1977 (SJC)	Percentage Change	1973 (BC) or 1974 (SJC)	1976 (BC) or 1977 (SJC)	Percentage Change
Brown County						
Energy	319	512	60.5	18.1	22.6	24.9
Repairs	235	319	35.7	13.4	14.1	5.2
Operations	200	292	46.0	11.4	12.9	13.2
Capital	755	862	14.2	42.8	38.1	-11.0
Land	251	278	10.8	14.3	12.3	-14.0
All factors	1,760	2,262	28.5	100.0	100.0	--
St. Joseph County						
Energy	427	611	43.1	24.2	27.3	12.8
Repairs	368	444	20.7	20.8	19.9	- 4.3
Operations	318	387	21.7	18.0	17.3	- 3.9
Capital	437	538	23.1	24.7	24.1	- 2.4
Land	217	256	18.0	12.3	11.4	- 7.3
All factors	1,767	2,236	26.5	100.0	100.0	--

SOURCE: Tables 3.2 and 3.3

was about the same in the two counties during the initial years of the series (that is, during 1973 for Brown County and 1974 for St. Joseph County), the distributive shares differed sharply. Energy, repairs, and operations all claimed much larger shares in St. Joseph County, and capital's residual share was much smaller. Only the shares allocated to land were similar. Terminal-year accounts for the two counties show a similar but less striking contrast.

Payments for energy were large in St. Joseph County, partly because a larger fraction of its rental stock is single-family houses--in 1974, 31 percent, as contrastd with 13 percent in Brown County in 1973. Single-family houses are larger and more exposed to the elements than are apartments, so require more heating to maintain comfortable indoor temperatures (see Neels, 1982a, for a detailed analysis).

Repair expenditures were also one-half to one-third greater in St. Joseph County. In part this fact reflects the greater age of the housing stock in St. Joseph County, and its correspondingly greater maintenance requirements. It may also reflect some effort on the part of St. Joseph County landlords to upgrade their properties in response to improved market conditions.

Payments for operating inputs were also larger in St. Joseph County than in Brown County. In part, the difference reflects a defect in our accounts. In 1973, few jurisdictions in Brown County charged for either sewage or rubbish disposal; instead, the services were funded out of real property taxes. In 1974, St. Joseph County landlords paid an average of

$48 per dwelling for sewage and rubbish disposal, or 15 percent of the total for operations.

The other major difference between sites concerns the value of the owner's labor reported for management and building services. For properties with from 2 to 4 or 5+ units, the averages for Brown and St. Joseph counties are similar; but for single-unit properties, St. Joseph County landlords claimed 50 percent more unpaid labor (valued at "what it would have cost to get someone else to do this"). Particularly because so many rental properties in St. Joseph County are single-family houses, the difference had a large effect on the total for operations.

Payments for the use of capital and land include taxes, insurance, and the residual of current income after all other claims are satisfied. Because property value and tax rates were lower in St. Joseph County, the tax and insurance payments were smaller there. Because payments to other factors of production were higher in St. Joseph County, the residual income was smaller there. Thus, the total factor payments to land and capital in St. Joseph County were about two-thirds the corresponding amounts in Brown County.

TRENDS IN FACTOR PAYMENTS

When we examine changes in factor payments over time, the most striking is the substantial increase in the amount going to energy. In Brown County, energy payments rose from $319 per unit per year in 1973 to $512 by 1976, an increase of over 60 percent. In St. Joseph County, energy payments rose from $427 per unit per year in 1974 to $611 in

1977, an increase of 43 percent. In both sites, the share of gross revenue allocated to energy also rose dramatically--in Brown County by 25 percent, and in St. Joseph County by almost 13 percent. As noted in Sec. II, the higher rates of increase in Brown County result from the fact that baseline data were collected there in 1973, just before the sharp rise in energy prices triggered by the Arab oil embargo. By the end of the baseline year in St. Joseph County, a substantial rise in energy prices had already taken place, and subsequent price increases were smaller.

Expenditures for repairs rose substantially in both sites--by 36 percent in Brown County and 21 percent in St. Joseph County. However, Brown County started from a lower base--$235 per dwelling as against $368 in St. Joseph County. In the terminal years of our data, St. Joseph County landlords still spent 40 percent more per dwelling than those in Brown County did; and repairs accounted for nearly 20 percent of gross revenue in St. Joseph County, as against 14 percent in Brown County.

Expenditures for operations rose substantially in both sites. In Brown County, payments increased by 46 percent, from $200 per dwellng to $292 in 1976, including a new sewage charge. In St. Joseph County, the increase was more modest; payments rose by only 22 percent, from $318 per dwelling to $387. There was also a difference between the sites in the way the cost share for operations changed. In Brown County, the share of gross rent assigned to operations rose by 13 percent. In St. Joseph County, it fell by 4 percent.

Dollar payments to capital and land increased in both sites. For both capital and land, payments in St. Joseph County rose more than in Brown County, despite the fact that gross revenue was growing faster in Brown County. The net result of the shifts was that even though the distributive shares of capital and land declined in both sites, the rates of decline were much sharper in Brown County.

TRENDS IN FACTOR QUANTITIES AND PRICES

During the years covered by our expense data, factor payments rose--both because the prices of most inputs went up and because landlords adapted to price changes by altering their use of the various inputs. In the following pages, we first estimate the physical quantities of inputs consumed per dwelling on the average property in each site, then use the quantity estimates to derive the price changes that occurred between the initial and terminal years of our accounts. We then consider whether the changes in factor usage are logically related to the changes in factor prices.

Appendix A explains how we estimated physical quantities for the five factors of production. Each factor presented different measurement problems, so the estimating methods also differed. Briefly, we measured the consumption of energy in BTUs (British Thermal Units) by working backward from utility bills and price schedules for individual fuels; we adjusted the result to compensate for variations in weather between sites and over time. Repairs and operations were measured in constant-dollar expenditures, indexing the prices of component expenditures over time and across sites. Land was measured in square feet per dwelling on the property, based on the tax assessor's description of each parcel.

Measuring the quantity of capital and its changes over time was the most complex operation. Using both hedonic index techniques and production functions, we estimated the flow of capital services obtained from each property's structural improvements and equipment. The estimates are physically comparable across sites and over time, but the unit of account is arbitrary. We set 1973 capital service flows per dwelling for the average property in Brown County equal to 1,000 and scaled all other values accordingly.

Table 3.5 summarizes our estimates of factor input quantities per dwelling. Across sites, we see that the average rental property in St. Joseph County used more of every factor except capital than did its counterpart in Brown County. Over time, we see that the changes in both sites were modest except for the sharp decrease of operating inputs in St. Joseph County. We review those results in more detail below.

On comparable dates, rental properties in St. Joseph County used considerably more energy than those in Brown County. One reason has already been mentioned: the greater incidence in St. Joseph County of single-family rental dwellings, which are both larger and less energy-efficient than apartments in multiple dwellings. Another reason, curiously enough, is that winters are milder in St. Joseph County. In milder climates, less heat is required to maintain a given inside temperature, so that the cost of running a furnace is lower relative to the cost of insulating a dwelling. The climatic reasons for skimping on

Table 3.5

INPUT QUANTITIES FOR FACTORS OF PRODUCTION USED BY REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973 AND 1976) AND ST. JOSEPH COUNTY (1974 AND 1977)

Factor of Production	Average Annual Amount per Dwelling		
	1973 (BC) or 1974 (SJC)	1976 (BC) or 1977 (SJC)	Percentage Change
Brown County			
Energy	145	137	- 5.5
Repairs	235	244	3.6
Operations	217	212	- 2.4
Capital	1,000	969	- 3.1
Land	6,539	6,119	- 6.4
St. Joseph County			
Energy	164	159	- 3.1
Repairs	329	318	- 3.4
Operations	306	244	-20.2
Capital	947	962	1.6
Land	6,744	6,807	.9

SOURCE: Estimated from survey data; see Appendix A for estimating methods.

NOTE: Energy is measured in millions of BTUs. Repairs and operations are measured in 1973 Brown County dollars. Capital is measured in arbitrary units such that the average rental dwelling in Brown County in 1973 used 1,000 units. Land is measured in square feet.

energy-saving capital improvements were reinforced by the low cost of energy in the 1950s and 1960s, and also by the depressed condition of the St. Joseph County housing market. When the value of capital seems likely to fall because of market conditions, landlords avoid capital improvements.

In both counties, energy consumption decreased as fuel prices rose. Because the energy consumption entries for both counties have been adjusted to remove the effects of year-to-year variations in weather, the decrease is either a by-product of housing replacement or an operating response to price changes, or both. We return to those issues in the next subsection.

Operating inputs per dwelling were 40 percent greater in St. Joseph County (1974) than in Brown County (1973). As explained earlier, the difference occurs because owners of single-family rental properties in St. Joseph County reported many more hours of unpaid labor spent in caring for those properties. Inputs were reduced slightly in Brown County by 1976 but drastically in St. Joseph County by 1977. The 20 percent drop in operating inputs for St. Joseph County during the period 1974-77 reflects a sharp reduction in the amount of unpaid labor reported by landlords of single-family houses. From the year-to-year pattern, we suspect over-reporting in 1974, the first year of the survey.[2]

In Brown County, real repair inputs rose by 3.6 percent, while in St. Joseph County they fell by 3.4 percent. The difference, however, is far less striking than the disparity in the level of repair activity. At baseline, landlords in St. Joseph County were spending 41 percent more per unit in real terms than their counterparts in Brown County

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[2] After analyzing the first-year data, we redesigned the survey instrument to reduce requirements on the respondent for the mental arithmetic involved in calculating annual averages. We expected thereby to alter unpaid-labor estimates in both sites, but that effect is not clearly evident in Brown County.

were. By year 4, the differential had shrunk, but it still amounted to 28 percent. Clearly, relative to owners in Brown County, St. Joseph County landlords were upgrading their properties more during the period.[3]

We can see the effects of the difference in repair activity on the capital stock. The estimated quantity of capital per dwelling was lower at baseline in St. Joseph County than in Brown County, even though the average rental dwelling in St. Joseph County had more floorspace.[4] The lower ratio of capital to floorspace in St. Joseph County reflects the age and deteriorated condition of the dwellings there. The trends in quantity of capital in the two sites were also sharply different. In Brown County, capital per unit fell by 3.1 percent; in St. Joseph County, it grew by 1.6 percent. Thus, by the end of the period, much of the initial difference between the two sites had been erased.

Some insight into the reasons behind these trends can be gained by examining the factor ratios. At baseline in St. Joseph County, capital inputs per dwelling were considerably lower than in Brown County. Energy inputs per dwelling were considerably higher. The net result was that at baseline, the energy/capital ratio in St. Joseph County was 19 percent greater than in Brown County, even though relative energy prices were higher. Because of the effects of past undermaintenance, rental properties in St. Joseph County were much farther out of tune with

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[3] Real expenditures for capital additions (which are not included in Table 3.5) were somewhat higher in Brown County, but not by enough to offset the difference in maintenance.

[4] The average regular rental unit in Brown County in 1973 contained 900 square feet of floorspace. The comparable figure in St. Joseph County in 1974 was 988.

current factor prices. The higher real maintenance expenditures we see there may represent efforts by the landlords to bring their factor ratios more in line with current prices. They appear to have had some success. Energy/capital ratios declined in both sites, but by more in St. Joseph County. Three years later, the energy/capital ratio in St. Joseph County was only 17 percent higher than in Brown County.

The role played by land differed in the two sites. Lot size per dwelling was slightly higher in St. Joseph County.[5] Trends in land inputs also differed sharply. In St. Joseph County, lot size per dwelling grew by 0.9 percent over the period; in Brown County, it declined by 6.4 percent.

Change in average input level can come about in a number of ways. Part of a shift can be attributed to modification of existing residential structures. A second part reflects the characteristics of units removed from the rental housing stock. Still a third part reflects the characteristics of new rental units.

How the reported changes in average input levels came about has important policy implications. If most of the reduction in energy use occurred because of retrofits that increased the efficiency of existing rental housing, for example, that would suggest bright prospects for further reducing residential energy use in the future. If, however, most of the reduction was brought about by demolishing energy-inefficient buildings, it suggests that the rate at which residential energy use can

[5] Raw averages show that lot size per unit was higher in Brown County, but the averages include much vacant land that has little to do with the operation of the property. Ignoring the excess and considering only the first acre per unit yields a higher average value for St. Joseph County.

be reduced is limited by the rate of replacement of the housing stock. Since replacement occurs very slowly, large, immediate savings would not then be possible.

We can divide the rental housing stock in such a way as to shed light on the issue. To do so, we consider the way in which the composition of the rental stock changes over time. The rental housing stock is in a continuous state of flux: old buildings are demolished, properties are converted to owner-occupancy, new apartment buildings are constructed, and existing homeowner properties are converted to rental use. Comparing housing markets in an area at two points a few years apart will reveal that many properties will have remained in the rental stock throughout the period. The rest of the initial rental stock will, by the end of the period, have been demolished or converted to other uses. Similarly, the rest of the final rental stock will have been added over the period, through either new construction, conversion from owner-occupancy, or conversion from nonresidential use.

If average capital inputs for the properties that remain in the rental housing stock throughout the period decline, it will tend to lower average capital inputs throughout the market. If the structures that are removed from the rental market contain more capital than those that remain, the process of removal will also tend to lower average capital inputs. Finally, if properties that are added to the rental stock during the period contain less capital than those that are carried forward from the start of the period, the new dwellings will also tend to lower average capital inputs.

The relative strengths of the three effects depend on the rates at which old properties are removed from the stock and new ones added. The relationships are complex and difficult to sort out. However, the direction of the different effects can be ascertained from the average input levels for the three groups of properties. They are presented in Tables 3.6 and 3.7. In both sites, the units that were removed from the

Table 3.6

INPUT QUANTITIES FOR FACTORS OF PRODUCTION BY INVENTORY STATUS: REGULAR RENTAL PROPERTIES IN BROWN COUNTY, 1973 AND 1976

Factor of Production	Input Quantity per Dwelling, by Inventory Status and Year of Observation			
	Properties Removed, 1973	Properties Remaining in Inventory		Properties Added, 1976
		1973	1976	
Energy	181	142	131	176
Repairs	354	221	237	283
Operations	275	211	216	186
Capital	1,173	980	956	1,046
Land	11,963	5,909	5,976	7,000
Number of properties	559	5,239	5,239	1,028
Sample size	90	700	700	17

SOURCE: Estimated from survey data; see Appendix A for estimating methods.

NOTE: All properties in the 1973 analysis sample are counted in one of the first two columns; all properties in the 1976 analysis sample are counted in one of the last two columns. Properties in the first column were removed from the rental inventory between 1974 and 1976. Properties in the last column were built between 1974 and 1976.

rental stock over the study period had higher average input levels for all five factors of production than did the properties that remained in the stock. The process of removals tended, therefore, to lower the average input levels in both sites.

Input levels for capital and energy declined for the existing stock in both sites. The declines were much sharper in Brown County. Capital per unit and energy per unit fell by 2.4 percent and 8.0 percent,

Table 3.7

INPUT QUANTITIES FOR FACTORS OF PRODUCTION BY INVENTORY STATUS: REGULAR RENTAL PROPERTIES IN ST. JOSEPH COUNTY, 1974 AND 1977

Factor of Production	Input Quantity per Dwelling, by Inventory Status and Year of Observation			
	Properties Removed, 1974	Properties Remaining in Inventory		Properties Added, 1977
		1974	1977	
Energy	185	159	157	168
Repairs	348	325	327	280
Operations	340	297	248	226
Capital	1,043	924	920	1,138
Land	8,428	6,343	6,299	8,939
Number of properties	1,932	6,441	6,441	1,607
Sample size	180	455	455	25

SOURCE: Estimated from survey data; see Appendix A for estimating methods.

NOTE: All properties in the 1974 analysis sample are counted in the first two columns; all properties in the 1977 analysis sample are counted in the last two columns. Properties in the first column were removed from the rental inventory between 1975 and 1977. Properties in the last column were built between 1975 and 1977.

respectively, compared with 0.4 percent and 1.3 percent in St. Joseph County. It appears that changes in the operation of the existing stock of housing were responsible for much of the decline in average energy use that occurred in Brown County. Within the existing stock of rental housing, the ratio of energy input level to capital input level fell by 5.5 percent in Brown County, but changed very little in St. Joseph County.

Repair inputs increased within the existing stock of both counties. In Brown County, the increase was substantial--7.2 percent over the period. In St. Joseph County, it was negligible, amounting to 0.7 percent. Trends in operations within the existing stock differed, however. In Brown County, operating inputs per unit increased slightly, while in St. Joseph County they declined.

Among properties that remained in the stock throughout the period, the average quantity of land per unit increased in Brown County and decreased in St. Joseph County. The changes were small, as might be expected given the difficulty of altering the lot size of a property. The reported changes may well have come about because of addition or subtraction of units rather than through land acquisition or sale.

In general, the effect of additions to the rental stock in both counties was to increase average input levels. At the end of the study period, input levels for energy, capital, and land were considerably higher for properties newly added to the rental stock than for those that had been in the stock throughout the period. Repairs were higher in Brown County and lower in St. Joseph County. In both sites, however, operation inputs per unit were lower for newly added properties.

The figures in Table 3.6 for energy use per unit in the three portions of the total rental housing stock provide an answer to our question about the change in average energy consumption. In Brown County, most of the decline in energy use came from reductions in the amount of energy used to operate the existing stock. Properties added to the stock used considerably more energy than those already in place, and only slightly less than those removed from the stock. Because Brown County was growing rapidly, additions greatly outnumbered removals.

In St. Joseph County, the reduction in the amount of energy required to operate the existing stock was modest--only 1.3 percent. Properties added to the stock used somewhat more than the properties that remained in the stock throughout the period, and properties deleted from the stock used a great deal more. Because St. Joseph County's rental market was shrinking, removals substantially outnumbered additions. The net effect of additions and removals was to lower average energy use. Most of the reduction in St. Joseph County resulted from removing old, energy-inefficient houses.

DECOMPOSING EXPENDITURE CHANGES

The changes in factor payments that were reported earlier are the net result of changes in factor prices and in the quantities purchased. Having estimated the quantity changes, we can now decompose the payment changes into the portions attributable to changing factor prices on input levels.

The relationship between changes in expenditures (factor payments) and changes in quantity purchased can be demonstrated easily. We begin with the equation defining expenditures:

$$E_1 = P_1 Q_1 \ , \tag{3.1}$$

where E_1 = expenditures in period 1,

P_1 = price per unit in period 1,

Q_1 = number of units purchased in period 1.

A similar definition holds for expenditures at a later time:

$$E_2 = P_2 Q_2 \ . \tag{3.2}$$

Expenditures, prices, and quantities in periods 1 and 2 can be related as follows:

$$\begin{aligned} E_2 &= E_1 + dE \ ; \\ P_2 &= P_1 + dP \ ; \\ Q_2 &= Q_1 + dQ \ ; \end{aligned} \tag{3.3}$$

where dE, dP, and dQ are the changes between periods 1 and 2 in expenditures, prices, and quantities. Substituting Eq. (3.3) into Eq. (3.2) and subtracting Eq. (3.1) gives

$$dE = P_1 \, dQ + Q_1 \, dP + dP \, dQ \ . \tag{3.4}$$

If the changes in prices and quantities are sufficiently small, the last term in Eq. (4) can be ignored. Dropping that term and dividing through by Eq. (1) gives

$$\frac{dE}{E_1} = \frac{P_1 \; dQ + Q_1 \; dP}{P_1 Q_1} , \tag{3.5}$$

or

$$\frac{dE}{E_1} = \frac{dQ}{Q_1} + \frac{dP}{P_1} . \tag{3.6}$$

Equation (3.6) states that the proportional change in expenditures is the sum of the proportional change in quantity and the proportional change in price.

The relationship shown in Eq. (3.6) frees us from the necessity of simultaneously measuring changes in quantity and changes in price. If we have measurements for expenditures and for either price or quantity, we can derive the remaining term as a residual.[6] Table 3.4 shows the expenditure changes and Table 3.5 the quantity changes for each of the five factors of production. We use those data in Table 3.8 to derive the implied price changes.

It is apparent from the figures shown in Table 3.8 that virtually all the changes in factor payments in the two sites are attributable to rising factor prices. In Brown County, input levels for every factor of production except repairs declined slightly, even though factor payments increased anywhere from 10 to 60 percent. In St. Joseph County, capital and land input levels grew slightly, but their rate of increase was dwarfed by the rise in payments made for them. Payments for energy,

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[6] The method is both useful and perilous. If we have overestimated the value of one variable, we will underestimate the value of another, and the reverse.

Table 3.8

DECOMPOSITION OF FACTOR-PAYMENT CHANGES INTO QUANTITY AND PRICE CHANGES: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973-76) AND ST. JOSEPH COUNTY (1974-77)

Factor of Production	Percentage Change in: Payment	Quantity	Price
Brown County			
Energy	60.5	- 5.5	66.0
Repairs	35.7	3.6	32.1
Operations	46.0	- 2.4	48.4
Capital	14.2	- 3.1	17.3
Land	10.8	- 6.4	17.2
St. Joseph County			
Energy	43.1	- 3.1	46.2
Repairs	20.7	- 3.4	24.1
Operations	21.7	-20.2	41.9
Capital	23.1	1.6	21.5
Land	18.0	.9	17.1

SOURCE: Computed from entries in Tables 3.2, 3.4, 3.6, and 3.7.

NOTE: Decomposition is approximate because it neglects a second-order term in the decomposition algorithm.

repairs, and operations rose substantially even though the purchased quantities declined.

In both sites, energy was subject to the most rapid price inflation, with operations not far behind. Repairs occupied third place, while capital and land prices changed least of all.

Additional Decomposition of Energy Expenditure

The estimates of changing energy prices presented in Table 3.8 are somewhat misleading. The decomposition of expenditure changes shown in Eq. (3.6) is based on the assumption that the good in question is sold at a constant price per unit. For energy, that is manifestly not the case. Both electricity and natural gas are sold through complex rate structures involving fixed fees, special surcharges, and marginal prices that vary with the consumption level. Furthermore, for the purposes of this analysis, we have defined quantity of energy as what a property would have used had it experienced the weather prevailing in Brown County in 1973. In fact, the severity of winters varied by site and year, causing variation in actual energy use and in energy expenditures.

A more realistic model of energy expenditures would expand Eq. (3.1) as follows:

$$E_1 = F_1 + P_1 W_1 Q_1 \ , \qquad (3.7)$$

where E_1 = energy expenditures in year 1,

F_1 = fixed charge associated with energy use in year 1 (includes hookup fees and inframarginal consumption in the lower blocks of the declining block rate structure)

P_1 = marginal price of energy in year 1,

W_1 = weather effect in year 1 (multiplication of constant-weather quantities by this term gives the actual quantity of energy used),

Q_1 = constant-weather quantity of energy used in year 1.

Energy expenditures can change because of variations in the fixed charge, the marginal prices, the weather, or in the constant-weather quantity of energy used. A full decomposition of changes in energy expenditures would have to include all four terms. To do that, we first define expenditures in period 2:

$$E_2 = F_2 + P_2 W_2 Q_2 \ ; \tag{3.8}$$

then define the relationships between period 1 and period 2 values:

$$\begin{aligned} E_2 &= E_1 + dE \ ; \\ F_2 &= F_1 + dF \ ; \\ P_2 &= P_1 + dP \ ; \\ W_2 &= W_1 + dW \ ; \\ Q_2 &= Q_1 + dQ \ . \end{aligned} \tag{3.9}$$

Substituting Eq. (3.9) into Eq. (3.8), subtracting Eq. (3.7), dividing through by E_1, and dropping all second-order change terms gives the following decomposition of the percentage change in payments to energy:

$$\frac{dE}{E_1} = \frac{P_1 Q_1 \ dW}{E_1} + \frac{W_1 Q_1 \ dP}{E_1} + \frac{P_1 W_1 \ dQ}{E_1} + \frac{dF}{E_1} \ . \tag{3.10}$$

The first term on the right side of Eq. (3.10) gives the portion of the percentage change in payments to energy attributable to climatic variation. The second term gives the change in expenditures associated with changes in marginal energy prices. The third term captures the effects of variation in the amount of energy used after adjustment for weather effects. The last term gives the change in expenditures caused by changes in fixed charges.

The processes by which we measured energy expenditures and quantity of energy are described in Appendix A. Part involved measuring climate-related variations in energy use. The only remaining pieces of information needed for decomposing energy expenditures as in Eq. (3.10) consisted of marginal energy prices.

In actuality, the marginal price of energy for any given landlord depends on which energy sources he uses, which functions he uses them for, and how much of each type of energy he consumes. The factors vary from one property to another. The survey data collected as part of HASE allow us to measure marginal energy prices at the individual property level, but the information is not very useful for analyzing marketwide changes. We therefore measured marginal energy prices through a process designed to capture average market behavior.

We specified a model from which a set of weights could be derived for constructing indexes of marginal energy prices. The weights gave the fractions of energy consumed at the margin attributable to the various energy sources. They also gave the fractions of total marginal natural gas consumption that fell in different portions of the declining block rate structure. The parameters of the model were estimated using data on energy expenditures, individual fuel prices, and total quantity of energy consumed for all four years of data in both sites (the model itself is described in Appendix B).

Results of the expanded decomposition of energy expenditures are shown in Table 3.9. In both counties, the marginal price effect was estimated to be considerably smaller than the price effect shown in Table 3.8. In Brown County, the combination of an unusually mild winter in 1973 and a severe winter in 1976 created a large weather-related increase in energy expenditures, which accounted for roughly a quarter of the county's total rise in energy expenditures. St. Joseph County saw a substantial increase in the fixed charges associated with energy use. The change had a larger effect on total energy expenditures than

Table 3.9

CAUSES OF ENERGY PAYMENT CHANGE: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973-76) AND ST. JOSEPH COUNTY (1974-77)

Cause of Change	Payment Change (%) Brown County (1973-76)	Payment Change (%) St. Joseph County (1974-77)
Normal-year quantity used[a]	- 4.6	- 2.7
Weather in specific years[b]	16.6	- 3.1
Change in fixed charge	- 1.4	27.7
Change in marginal price	49.9	21.3
All causes	60.5	43.1

SOURCE: Computed from survey data; see Appendix B for details.

[a]Quantity that would have been purchased at current prices if degree-days of heating had been the same in both sites and both years.

[b]Quantity purchased to compensate for unusual weather.

did the rise in marginal energy prices. In contrast to Brown County, winters in St. Joseph County became somewhat milder, causing a slight reduction in energy expenditures.

Additional Decomposition of Payments to Capital and Land

Payments to capital and land in our factor accounts include not only the net operating income that accrues to the owner, but also external payments, explicit and implicit, for the use of capital: property taxes, insurance premiums, and rent losses. We can go beyond the decomposition reported in Table 3.8 to show how each element changed.

We begin with a definition of the payments per dwelling that are attributed to capital in our account:[7]

$$E = Y + T + L + I \ , \qquad (3.11)$$

where E = expenditure for capital services,

Y = net operating income,

T = property tax attributable to capital improvements,

L = rent loss attributable to capital improvements,

I = insurance premium on capital improvements.

Each term on the right side of Eq. (3.11) can also be written as the product of the market value of the dwelling (exclusive of land) and a rate of payment, as follows:

$$Y = Vr \ ,$$

[7] The treatment of payments for land is analogous except that the term for insurance premiums is omitted.

$$T = Vt \ ,$$

$$L = Vl \ ,$$

and

$$I = Vi \ , \tag{3.12}$$

where V = market value of the dwelling,

r = rate of net operating income,

t = property tax rate,

l = rent-loss rate,

i = insurance rate.

We note that the value of the building is given by

$$V = QP \ , \tag{3.13}$$

where Q = quantity of physical capital per dwelling,

P = stock price of capital.

Putting all together gives

$$E = QP(r + t + l + i) \ . \tag{3.14}$$

Any of the foregoing parameters can change over time, thereby influencing the trend in capital expenditures. Adding, as before, subscripts to indicate time period, we write

$$E_2 = E_1 + dE \ ;$$

$$Q_2 = Q_1 + dQ \ ;$$

$$P_2 = P_1 + dP \ ;$$

$$r_2 = r_1 + dr \ ;$$

$$t_2 = t_1 + dt \ ;$$

$$l_2 = l_1 + dl \ ;$$

$$i_2 = i_1 + di \ . \qquad (3.15)$$

Those various relationships yield the following decomposition of capital expenditure change:

$$\frac{dE}{E_1} = \frac{Q_1P_1\ dt}{E_1} + \frac{Q_1P_1\ dl}{E_1} + \frac{Q_1P_1\ di}{E_1}$$

$$+ \frac{Q_1\ dP(r_1 + t_1 + l_1 + i_1)}{E_1} + \frac{Q_1P_1\ dr}{E_1}$$

$$+ \frac{dQP_1(r_1 + t_1 + l_1 + i_1)}{E_1} \ . \qquad (3.16)$$

The first three terms in Eq. (3.16) give the effect of rate changes for taxes, rent losses, and insurance on the change in payments for capital. The next two terms give the effect of the residual shift in net operating income. We divide the effect into two parts: one due to a change in the market value of capital, the other due to a change in the rate of return received by the owners of that capital. The last term in Eq. (3.16) gives the change in factor payments attributable to shifts in the quantity of capital.

Equation (3.16) can be applied to changes in expenditures for land as readily as to those for capital. Because there are no insurance payments for land, terms containing i drop out of the equation. We will treat Eq. (3.16) as an accounting identity--a relationship that is true by construction. It clarifies events in the two markets under consideration and helps determine the factors most influential in changing payments to capital and land. In that spirit, we derive our measures of changes in the market value and rate of return from the observed outcomes in the two markets, sidestepping the questions whether the markets are in long-run equilibrium and whether payments fully cover the long-run costs.

The results obtained by applying Eq. (3.16) are shown in Table 3.10. As in Table 3.9, the quantity effects are small relative to the total expenditure change. The effects on external payments are also

Table 3.10

CAUSES OF CAPITAL PAYMENTS CHANGE: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973-76) AND ST. JOSEPH COUNTY (1974-77)

Cause of Change	Payment Change (%)	
	Brown County (1973-76)	St. Joseph County (1974-77)
Quantity of capital service used	- 3.0	- 1.6
External payments:		
Property taxes	- 3.3	- .9
Insurance premiums	.5	1.1
Rent loss	.3	- 3.7
Total	- 2.5	- 3.5
Change in capital price:		
Market value	33.8	19.5
Rate of return	-14.1	5.5
Total	19.7	25.0
All causes	14.2	23.1

SOURCE: Computed from survey data.

small; in both sites, they reduced the total change in expenditures for capital. In Brown County, the reduction resulted from a drop in effective property tax rates. In St. Joseph County, it resulted jointly from a small drop in property tax rates and a larger drop in the rent-loss rate.

Price changes still dominated the shift in expenditures for capital. In both sites, the market value of residential capital increased, but the increase was much greater in Brown County. In contrast, the rate of return to capital fell sharply in Brown County but rose in St. Joseph County. The increased rate of return in St. Joseph County offset the modest gain in market value there, so that the combined effect on the price of capital services was larger than in Brown County.

Such contrasts in price behavior make sense in the light of differences between the sites in rates of return at the start of the experiment. In 1973, rental property capital in Brown County earned 5.0 percent, whereas in St. Joseph County, capital earned only 3.3 percent. The former rate was above the long-run rate of return on residential capital, while the latter was below it.[8] Over the next several years, the higher rate of return in Brown County became capitalized into higher sales prices, and the rate of return fell. In St. Joseph County, building values rose more slowly, and the rate of return increased. Overall, rates of return in the two sites appeared to converge.

Table 3.11 presents the results of the expanded decomposition of factor payments to land. In general, the pattern is similar to that

[8] Neels and Rydell (1981) estimate that the long-run real rate of return on residential capital is 4.0 percent.

Table 3.11

CAUSES OF LAND PAYMENTS CHANGE: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973-76) AND ST. JOSEPH COUNTY (1974-77)

Cause of Change	Payment Change (%)	
	Brown County (1973-76)	St. Joseph County (1974-77)
Quantity of capital service used	-6.4	.9
External payments:		
Property taxes	-3.1	-1.1
Rent loss	.3	-4.2
Total	-2.8	-3.1
Changes in capital price:		
Market value	33.5	22.1
Rate of return	-13.5	.3
Total	20.0	22.4
All causes	10.8	18.0

SOURCE: Computed from survey data.

shown for capital. Both quantity and external payment effects are small, while price effects are large. Once again, the rate of return fell in Brown County and rose in St. Joseph County.

Real Changes in Factor Prices

Table 3.12 subtracts background inflation from the estimates of factor price changes to compute real changes in factor prices. In both sites, the real price of operating inputs increased by a fifth. In Brown County, the real price of energy rose by 31 percent from 1973 to

Table 3.12

NOMINAL AND REAL CHANGES IN FACTOR PRICES: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973-76) AND ST. JOSEPH COUNTY (1974-77)

Factor of Production	Percentage Change in:		
	Nominal Factor Price	All Consumer Prices[a]	Real Factor Price[b]
	Brown County, 1973-76		
Energy[c]	59.5	28.1	31.4
Repairs	32.1	28.1	4.0
Operations	48.4	28.1	20.3
Capital	17.3	28.1	-10.8
Land	17.2	28.1	-10.9
	St. Joseph County, 1974-77		
Energy[c]	23.9	22.9	1.0
Repairs	24.1	22.9	1.2
Operations	41.9	22.9	19.0
Capital	21.5	22.9	- 1.4
Land	18.9	22.9	- 4.0

SOURCE: Tables 3.8 and B.1.

[a]Nation Consumer Price Index (CPI), mid-year to mid-year.

[b]The "real" factor price change is the nominal price change minus the CPI change.

[c]Based on marginal energy prices only; excludes flat-rate changes.

1976; the St. Joseph County data for 1974 to 1977 miss the sharp climb of energy prices in 1973-74. In both sites, the real prices of capital and land declined--sharply in Brown County, only slightly in St. Joseph County.

FINDINGS

In Sec. II we saw that over the course of HASE there were substantial increases in payments to all the factors of production used by landlords to produce housing services. This section has analyzed the forces behind the changes in factor payments. The most dramatic changes occurred in connection with energy. Both sites saw substantial increases in the price of energy. In Brown County, most of the increase was due to higher marginal prices. In St. Joseph County, the price increases were primarily in the form of higher fixed charges. Nonetheless, energy use declined in both counties.

Energy use declined by different mechanisms. In Brown County, most of the decline came about through reductions in the amount of energy used by the existing stock of rental housing. In St. Joseph County, the amount of energy used by the existing stock declined only slightly; most of the overall reduction in average energy use was achieved by removing old, energy-inefficient buildings from the rental inventory--a mode of change appropriate for an area where the inventory was shrinking.

The real price of repair inputs rose in both the experimental sites. In neither case was the increase very large, however.

The price of operation inputs rose sharply in real terms. The size of the increases was similar in both counties, but the reactions of landlords were sharply different. In response to a real price increase of about 20 percent over the period, landlords in Brown County reduced labor inputs by slightly over 2 percent, while landlords in St. Joseph County brought about a reduction of over 20 percent. However, there is reason to suspect that we overestimated their initial-year labor inputs, and so overestimated the reduction.

The prices of capital and land fell in real terms in both counties. Although the declines were greater in Brown County, input levels for capital and land declined there, while in St. Joseph County they rose slightly.

The period covered by HASE was one of rapid and uneven price inflation. The incentives facing landlords changed drastically. Their responses were complex, but we have seen that efforts were made to reduce their reliance on the factors of production subject to the worst inflation. The following section considers how successful landlords were and what effect their responses had on the profitability of their operations.

IV. PROFITS FROM RENTAL REAL ESTATE INVESTMENTS

Rental real estate investment yields are usually treated from the perspective of a wealthy investor contemplating the construction or purchase of a large building. For such investors, leverage (the ratio of equity investment to purchase price), depreciation allowances for tax purposes, and property value appreciation are extremely important, and may have more bearing on investment yields than the net operating income of the property.

In Brown and St. Joseph counties, over 95 percent of all rental properties have fewer than five dwellings, and the average building age is over 40 years (in St. Joseph County, it is 58 years). The owners usually have only one or two small properties, and often live on the property themselves. Most are parttime landlords who derive the best part of their income from other employment. Some inherit their rental properties, some convert their former houses to rental use, some add rental units to the family homestead, and some purchase rental properties strictly as investments. Both the properties and the owners in the experimental sites are so different from the textbook examples that there are real questions whether the textbook assumptions and calculations apply.

There are no nationwide data on landlords' personal and financial characteristics, but the scant data on the composition of the rental inventory indicate that in the nation as a whole, as in our sites, it is dominated by small properties and old buildings. We are reasonably sure that few owners of those properties are wealthy professional investors.

The data from Brown and St. Joseph counties therefore tell us more about the general profitability of investments in rental real estate than do the textbook examples.

In this section, we estimate the rates of return obtained by the average landlord in Brown and St. Joseph counties, two markets that differ sharply as to structure and condition. We show how the rates of return were affected by differences in net operating income, property value appreciation, background inflation, debt financing, and depreciation allowances for tax purposes.

Briefly, we conclude that the owners of rental property in the tight market of Brown County earned a real rate of return on equity of 4 to 5 percent after taxes in a period when most financial investments (such as bonds and treasury notes) had negative real yields. In the loose market of St. Joseph County, the average real return on equity was negative (about minus 4 percent), but no worse than most alternate financial investments. By using their depreciation allowances to shelter other income, wealthy landlords in both sites could increase their real returns by about 4 percentage points.

MEASURING EQUITY RETURN

In Sec. II, we estimated the net operating income from rental properties; in Sec. III, we estimated factor payments to the capital and land invested in the production of rental housing services. Neither estimate correctly describes the financial benefits accruing to the owner of a rental property, nor does the value of the capital and land that he owns correctly describe his equity in the property. Below, we explain how we calculated annual equity income and the value of the owner's equity. Dividing the former by the latter gives the current rate of return on an owner's equity, a measure of current investment performance. To simplify exposition, we call the equity owner the "landlord" and his income from the property "equity income."

Equity Income

The annual financial benefit to the landlord has two parts: his share of net operating income, and his share of future gains to be realized from the sale of the property. As defined in Sec. II, net operating income is mostly cash, but may include the cash value of a rent-free dwelling occupied by the landlord. It is the revenue remaining after current operating expenses, including property taxes and insurance, have been paid. But it usually must be divided between several parties who have ownership claims on the property: the landlord, the mortgage lenders(s), and in our accounts, the tenants who supply appliances.

Most rental property is mortgaged during part of its life. The landlord may borrow to build, buy, repair, or improve the property, or simply because he needs cash for some other purpose and can offer the property as security. Under certain circumstances, discussed later, he may see financial advantages in reducing his own investment in the property by borrowing against his equity. Whatever his motive for borrowing, the landlord contracts to pay interest on the loan. The interest payments do not depend on the current amount of operating income from the property, but only on the amount of the loan outstanding and the agreed rate of interest. However, it is an accounting convenience to think of mortgage interest as a share of net operating income, with the proviso that the share could be greater than 100 percent.

We include tenant-supplied appliances in our revenue and expense accounts to improve the cross-property comparability of the accounts. Sometimes landlords supply the appliances, sometimes tenants do. Whoever supplies them, the appliances represent a capital investment and therefore a claim on income from the property. From our survey data, we estimate that on the average property in our sites, the tenants supplied appliances--refrigerators, cooking ranges, washers, dryers, and air conditioners--worth about $500. Our revenue account includes the annualized cost of these appliances as a tenant payment for the services they yielded; likewise, our factor-payment accounts include annual tenant expenses for appliances as part of the payment to capital.

A third item to be deducted from net operating income is the amount that tenants would have paid for utilities during vacancies. The quantity, usually quite small, was added to the revenue account to make gross operating revenue more nearly comparable across properties with different vacancy experience. Our expense account includes the utility bills actually paid by landlords during vacancies--which only partly offsets the revenue item, however.

The landlord's share of net operating income is therefore the amount remaining after deducting mortgage interest payments, tenant expenses for appliances, and the hypothetical tenant payments for utilities during vacancies. The landlord's residual share is usually positive; but it could be negative.

The other component of equity income is the net gain due to appreciation in the market value of a property, which ordinarily accrues to the equity owner when the property is sold. Because a mortgage lender's claim on assets is usually a fixed dollar amount, any change in property value implies a corresponding change in the landlord's equity. Considered annually, such changes are a kind of income, even though they can be realized in cash only by selling the property or by borrowing against the increased equity.

The market value of rental properties often changes because of external conditions--increased demand for a particular type of housing, anticipated redevelopment of the site, or even a change in the yield of alternative investments. Often, however, changes in market value reflect some change in the property itself. It may deteriorate because of undermaintenance, or it may be improved by major capital expenditures. Clearly, if a landlord spends $1,000 on a new roof, thereby increasing market value by $1,000, his income is unaffected even though the form in which he holds his assets has changed. The share of value appreciation to be counted as equity income should therefore be net of the cost of major capital improvements. (It should also be net of repair expenses, but those were subtracted along with other expenses from gross operating revenue to obtain net operating income.)

Finally, we note that a landlord can increase his equity by amortizing a loan; he can decrease his equity by borrowing against the value of the property, or by selling the property. Those transactions do not create equity income. They only change the form in which the landlord holds his assets.

To summarize, equity income can be represented in our accounts by the following equation:

Equity income = Net operating income
- Mortgage interest payments
- Tenant payments for appliances
- Unpaid tenant utilities
+ Appreciation in property value
- Cost of capital improvements. (4.1)

Value of Owner's Equity

To decide whether equity income is gratifyingly large or disappointingly small, the landlord must compare it with some benchmark. An unsophisticated investor might choose as a benchmark the amount he paid for the property, or perhaps the purchase price minus the amount he borrowed to make the purchase. Neither is a reasonable measure of the current value of his equity in the property, so neither serves as a proper benchmark for the current performance of his investment.

If at the beginning of an accounting year a landlord sold his property and paid off all outstanding mortgages, the residual proceeds would be available to him for investment. That hypothetical amount is his equity in the property at the beginning of the year, and constitutes his current investment in the property, whatever the initial purchase price or earlier loan balances. Over the course of the year, his equity may change because of changes in market conditions, because of loan amortization or new loans, or because of property improvement or deterioration. We take the estimated mid-year value of equity as the appropriate benchmark for appraising the full year's equity income.

To estimate the value of the landlord's equity, we therefore need first to estimate the market value of the property, then to deduct the shares "owned" by others. Market value is an abstraction that becomes a reality only when a property is sold. We asked the owners of rental properties in our sample to estimate what their properties would bring if offered for sale in the current market; we also estimated market values from tax assessments. Because tax assessors do not appraise properties each year, we gave preference to the owners' estimates, but used adjusted assessment data when the owner declined to estimate.[1] Where relevant, we added the value of tenant-owned appliances.

To arrive at the landlord's share of property value, we deducted the outstanding balance of all loans for which the property constituted security, as well as the value of tenant-owned appliances. Thus, in our accounts, the landlord's mid-year equity position can be represented by the following equation:

$$\begin{aligned}\text{Equity value} = {} & \text{Current market value of property} \\ & - \text{Current balance of mortgage loans} \\ & - \text{Value of tenant-supplied appliances.}\end{aligned} \tag{4.2}$$

Equity Return

Given our definitions of equity income and equity value, the rate of return on equity is easily computed:

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[1] For details, see Neels and Rydell (1981).

$$\text{Equity return (\%)} = 100 \times \frac{\text{Equity income}}{\text{Equity value}} \tag{4.3}$$

This quantity is a useful measure of investment performance because it is comparable across properties whatever the ratio of equity to property value. However, it may not be comparable over time because the rate of general price inflation may differ, and price inflation erodes the real value of equity income--what goods and services it will buy. And it may not be comparable across landlords because their income tax liabilities on equity income will differ.

To deal with the first problem, we will deduct the current inflation rate from equity return. To deal with the second, we will show estimates of after-tax equity return for landlords with varying incomes. But first, we use the accounts presented in Sec. II together with other data from our surveys to show the amounts and trends of equity income, equity value, and equity return for landlords in Brown and St. Joseph counties.

EQUITY RETURN FOR LANDLORDS

Using the formulas presented above, Table 4.1 computes landlord equity income, equity value, and equity return. As noted in Sec. II, the effects of market condition on current income are readily apparent. Lower rents and higher rent losses combined to lower current income in St. Joseph County to roughly half what it was in Brown County.

Brown and St. Joseph county landlords differed in their use of mortgages. Brown County landlords were more highly leveraged, with outstanding mortgage balances that were anywhere from two to three times

Table 4.1

EQUITY RETURNS TO OWNERS OF REGULAR RENTAL PROPERTIES: BROWN COUNTY (1973 AND 1976) AND ST. JOSEPH COUNTY (1974 AND 1977)

Item	Brown County 1973	Brown County 1976	St. Joseph County 1974	St. Joseph County 1977
Annual Amount ($ per Dwelling)				
Net operating income	636	699	304	397
Less: Mortgage interest payments	342	455	143	147
Less: Tenant expense for appliances	47	49	42	67
Less: Unpaid tenant utilities	13	11	33	36
Plus: Property value appreciation	919	1,129	512	488
Less: Cost of capital improvements	69	36	67	28
Equals: Equity income	1,084	1,277	531	607
Mid-Year Value ($ per Dwelling)				
Market value of property	12,732	16,356	9,346	11,410
Less: Balance of mortgage loan	3,790	3,846	1,831	1,248
Less: Value of tenant-owned appliances	512	534	458	730
Equals: Equity value	8,430	11,976	7,057	9,432
Rate of Return (%)				
Equity return[a]	12.9	10.7	7.5	6.4

SOURCE: Neels (1982b).

[a] $100 \times \frac{\text{Equity income}}{\text{Equity value}}$.

higher than in St. Joseph County. Mortgage interest payments were also correspondingly higher in Brown County.

Total appreciation in property values was much higher in Brown County. The difference reflects the difference in market condition between the two sites. In the prosperous Brown County market, where housing was very much in demand, property values rose briskly. In the stagnant St. Joseph County market, they remained depressed. The size of the difference was dramatic. Landlord gains through appreciation in Brown County were more than double what they were in St. Joseph County.

Adding current income to appreciation in property values and subtracting payments to tenants for appliances, mortgage interest payments, and expenditures for capital additions gives net equity income. In Brown County, it rose from $1,084 to $1,277 over the study period, an increase of 17.8 percent. Inflation in consumer prices over the same period amounted to 28.1 percent. In real terms, therefore, total landlord equity income in Brown County fell by 10.3 percent. In St. Joseph County, the picture was somewhat different. Total landlord equity income started much lower, at $531 per unit. It also rose more slowly. In the final period, total equity income per unit stood at $607, an increase of 14.3 percent. By contrast, the inflation rate over the same period was only 22.9 percent, and the decline in real landlord income was only 8.6 percent. In absolute terms, St. Joseph County landlords were much worse off. However, trends were somewhat more favorable for them than for their counterparts in Brown County.

Property values per unit in both years were higher in Brown County than in St. Joseph County. Remaining mortgage debt per unit was also considerably higher. The net result in Brown County was that landlord equity was higher in absolute terms but lower as a percentage of total property value. Brown County landlords were more highly leveraged. In both sites the ratio of landlord equity to total property value rose substantially over the period.

The ratio of equity income to equity value for landlords was dramatically higher in Brown County. The rate of equity return there at the start of the period was 12.9 percent, in comparison with 7.5 percent in St. Joseph County. The effects of the depressed condition of the St. Joseph County housing market are clearly visible. Current equity income there was much lower. Appreciation was lower. Landlord equity was a higher percentage of total property value. The net effect of all those factors was to drive down the rate of return on landlord equity.

Equity return in Brown County declined significantly over the period, falling from 12.9 to 10.7 percent. The decline was the net result of several factors, including an erosion of current income and a sharp increase in landlord equity traceable to rising property values. Rising interest and energy expenses ate into the earnings of Brown County landlords, and they lost some of the benefits of leveraging. Equity return in St. Joseph County also declined somewhat, dropping from 7.5 to 6.4 percent.

REAL EQUITY RETURN FOR MORTGAGE LENDERS AND LANDLORDS

In a period of inflation, a landlord's apparent equity income expands in ways that can be misleading. When prices are rising rapidly, the value of a rental property must grow substantially simply to hold the asset's value constant in real terms. Much of the appreciation shown in Table 4.1 can thus be traced directly to the rise in consumer prices that took place over the course of HASE.

Similar problems arise in evaluating the rates of return earned by lenders on their outstanding mortgages. When inflation is high, lenders must demand high interest rates on loans to compensate for the declining real value of their loan balances. The mechanisms through which landlords and mortgage lenders hedge against inflation are quite different. Landlords enjoy appreciation in property values, which increases their equity. If the rate of inflation suddenly rises, property values tend to keep pace, offering landlords automatic protection.[2] Lenders, in contrast, must estimate the rate of inflation in advance. When they make a loan, they must set the interest rate high enough to compensate for the effects of inflation. Under the traditional fixed-interest rate, level-payment mortgage banks have no protection if they underestimate the inflation rate.

This section compares the rates of return earned by landlords and mortgage lenders to see how well they did relative to each other and to inflation. Landlord equity returns, taken from Table 4.1 to compute returns for lenders, divide landlords' interest payments by the average outstanding loan amount. The results are given in Table 4.2. We subtract the inflation rate during the year to arrive at a measure of real equity return.

Landlords in Brown County were doing quite well. Their real equity return rose from 4.1 percent to 5.9 percent over the period. Both figures were above 4.0 percent--the long-run real rate of return to residential real estate.[3]

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[2] The protection against inflation afforded by rising property values may well be less than complete. During the inflation of the late 1970s, operating costs rose in real terms, while rents generally lagged behind consumer prices. As a result, current income declined in real terms.

[3] See Neels and Rydell (1981) for an analysis of the long-run real rate of return on residential capital.

Table 4.2

REAL PRETAX RATE OF RETURN FOR LANDLORDS AND MORTGAGE LENDERS: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973 AND 1976) AND ST. JOSEPH COUNTY (1974 AND 1977)

Item	Brown County		St. Joseph County	
	1973	1976	1974	1977
Landlords				
Equity return	12.9	10.7	7.5	6.4
Inflation[a]	8.8	4.8	12.2	6.8
Real return[b]	4.1	5.9	- 4.7	- .4
Mortgage Lenders				
Mortgage return	9.0	11.8	7.9	11.8
Inflation[a]	8.8	4.8	12.2	6.8
Real return[b]	.2	7.0	- 4.3	5.0

SOURCE: Table 4.1.

[a]Measured by the December-to-December change in the CPI.

[b]Computed by subtracting the inflation rate from nominal return.

In contrast, mortgage lenders in Brown County initially did very poorly. The interest rate they earned on their existing portfolio of loans was only 9.0 percent. Inflation in 1973 was 8.8 percent, and as a result their real return on equity was only 0.2 percent. Their poor showing, however, appears to have been a passing phenomenon caused by the sudden and unanticipated rise in the inflation rate. By 1976, lenders had substantially raised the interest rate on their loan portfolios. The inflation rate had subsided, and in that final year they were doing better than landlords, enjoying a 7.0 percent real rate of return.

In 1974 in St. Joseph County, both landlords and mortgage lenders were losing money. Because of double-digit inflation in that year, they suffered from negative real returns. By 1977, lenders had recovered. As in Brown County, they had been able to increase the interest earned on their portfolio of loans. Inflation had subsided, and they earned a respectable 5.0 percent in real terms. By 1977, St. Joseph County landlords had succeeded in cutting their losses but were still not doing very well. Real equity return for landlords was near zero.

Whether mortgage lenders fare well or poorly is strongly influenced by the lag in the use of fixed-rate mortgages. While inflation accelerates, they suffer losses on low-interest-rate mortgages carried over from the past. While inflation decelerates, they enjoy windfall gains on recent high-interest loans. The erratic path of the inflation rate in recent years explains much of the recent drive toward variable-interest-rate mortgages. These more flexible instruments would smooth out the "boom-and-bust" cycle and allow banks to enjoy a steadier real rate of return.

Landlords' fortunes are governed by the risks inherent in real estate investment. When the market is healthy, they prosper. When it is depressed, they suffer losses. We see the former in Brown County and the latter in St. Joseph County.

EFFECTS OF LEVERAGING ON EQUITY RETURN FOR LANDLORDS

Landlords in both Brown County and St. Joseph County come surprisingly close to owning their properties free and clear.[4] This fact runs counter to a well-known principle of real estate investment that one of the easiest ways to increase one's equity return is to take advantage of leveraging. A highly leveraged property is one that is heavily mortgaged so that the landlord's equity is very small. Under such circumstances, heavy debt service reduces the landlord's current equity income. However, he retains rights to all income generated by appreciation. When a landlord takes out a new mortgage, total profits may therefore go up or down depending on the values of the interest rate and the appreciation rate. His equity will decline, which will tend to push up equity return.

In Table 4.3, we examine the effect of leveraging on the equity return earned by landlords. The figures were computed in one of two ways, depending on whether the indicated equity ratio was above or below the actual value for the year in question. If the equity ratio was below the actual, we assumed that in the year indicated the landlord took out a new 20-year mortgage that was large enough to reduce his equity to the listed value. The interest rate for the new loan was set one percentage point above the current rate for conventional home

[4] There are a number of reasons for the low equity ratios in the experimental sites. A surprising number of landlords acquired their property by inheritance and hence owned it free and clear. When the property had been originally purchased with the help of a mortgage, the owner's equity ratio tended to decline rapidly, because of rising property values and slow repayment of the loan. To maintain a highly leveraged position under those circumstances would have required frequent refinancing. There were apparently few landlords willing or able to manage their holdings that aggressively.

Table 4.3

EFFECT OF LEVERAGING ON RETURN ON LANDLORD EQUITY: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973 AND 1976) AND ST. JOSEPH COUNTY (1974 AND 1977)

	Equity Return (%)			
	Brown County		St. Joseph County	
Equity Ratio[a]	1973	1976	1974	1977
.10	31.2	16.8	-12.7	-20.3
.20	20.4	13.2	- 1.0	- 5.1
.30	16.8	12.1	2.8	- 0.0
.40	15.0	11.5	4.8	2.5
.50	13.9	11.1	6.0	4.0
.60	13.2	10.9	6.7	5.0
.70	12.7	10.7	7.3	5.8
.80	12.2	10.8	7.5	6.3
.90	11.8	10.9	7.6	6.9
Actual equity ratio	.66	.73	.76	.83
Actual equity return	12.9	10.7	7.5	6.4

SOURCE: Table 4.1

[a]Landlord equity divided by total property value.

mortgages.[5] His current equity income was reduced by the amount of the first year's interest payments on the new loan.

If the equity ratio was above the actual, we assumed that in the year indicated the landlord made a lump sum payment sufficient to increase his equity to the listed value. We assumed that this payment

[5] The one-point difference covers the premium lenders usually charge to cover the riskiness of rental properties relative to homeowner properties. The mortgage interest rates used reflect actual lending practices in the sites; they were taken from Noland (1981, 1982).

triggered no prepayment penalties and therefore that its sole effect was to alter the division of the landlord's normal monthly mortgage payments between interest and amortization. The amount by which interest payments were reduced was added to the landlord's current equity income.

We can see from Table 4.3 that in Brown County in 1973, leveraging worked to the landlord's benefit. The lower the equity ratio, the higher the rate of return on equity. Landlords possessed an incentive to sell their equity to the lenders by taking on a new debt.

By 1976, the situation in Brown County had changed in some curious ways. Landlords would still have benefitted by increasing their indebtedness, although the incentives to do so appeared to have weakened. However, landlords would also have benefitted by retiring their old debt. They appear to have chosen the worst possible position.

Landlords' apparently anomalous behavior resulted from changes in the nature of the loans they took out. By 1976, the inflation rate had begun to decline after remaining for several years at unprecedented levels, pushed by high inflation rates. Because of normal market turnover, some old loans were retired during the period, and some new ones were taken out. The net effect was to significantly increase the average interest rate on loans held by landlords.

By 1976, that average interest rate was above the property rate of return (defined as equity return for an equity ratio of 100 percent). This relationship placed landlords in a position to benefit by paying off old loans and increasing their ownership of their rental properties. The fact that the property rate of return was higher than the rate charged in the market for new loans meant that landlords could also benefit by incurring new debt and cashing in their equity. If the property rate of return had not fallen between the current market rate and the rate on old loans, one of the two effects would have dominated. The differences between the various interest rates, and hence also the benefits to be derived from changes in the equity ratio, were quite small unless the landlord's equity was substantially reduced. Equity ratios of 0.2 or 0.3 were needed before equity return was greatly affected.

St. Joseph County reveals a third pattern. In both 1974 and 1977, landlords faced a strong incentive to pay off their mortgages and become free-and-clear owners of their property. Conditions were ripe for reverse leveraging. The property rate of return was below both the current market interest rate and the interest rates on existing loans in both years. Landlords essentially had to rob themselves to pay the bank. They were better off to retire their loans. That fact explains the high equity ratio in St. Joseph County and its upward trend over time.

AFTER-TAX RATES OF RETURN FOR LANDLORDS

Equity return provides only an imperfect measure of landlord profitability. It ignores the effect of rental property ownership on a landlord's income tax liability. For some, the primary reason for investing in rental housing is the opportunity it provides for sheltering income from taxation. The federal government has long sought to encourage investment in housing by providing generous tax writeoffs for apartment buildings. Landlords have taken advantage of and benefitted from those provisions, and no discussion of landlord profits would be complete without some mention of the role of tax savings.

The advantage of owning rental property is that depreciation in excess of the actual loss of value through obsolescence can be claimed as an expense. During the period of HASE, the Internal Revenue Service (IRS) held that for tax purposes, apartment buildings had a useful life of 40 years.[6] They assumed therefore that buildings wear out with use and allowed landlords each year to claim as a deductible expense 2.5 percent of the original purchase price of the property net of the value of the land. In actuality, however, apartment buildings often last longer than 40 years. During recent periods of inflation, many rental properties have actually risen in nominal value. That, in fact, is what happened in both Brown and St. Joseph counties over the course of HASE. Provisions in the tax code for deducting depreciation make it possible for the landlord to enjoy positive income while posting a tax loss. The loss can be used to offset his regular income.

He will, of course, eventually have to pay tax on that income. When he sells the property, he will report as income the difference between the new sales price and the sum of the original land value plus the remaining undepreciated value of the building. However, that income will be taxed at the lower rates applicable to capital gains. Furthermore, he will have deferred his tax liabilities and in the meantime had the money available to be invested and to earn interest.

The normal method of computing depreciation for tax purposes is to divide the purchase price of a building by its assumed lifetime. Land

[6] The Economic Recovery Act of 1981 reduced depreciable lifetimes for apartment buildings to 15 years. Later, we examine the effects of this change on landlord profits.

is assumed to have an infinite lifetime and is therefore not depreciable. That method of treating apartment buildings allows landlords to claim 2.5 percent of the original purchase price of the building each year as an expense. If the building is held for more than 40 years, its book value declines to zero, and its owner is not allowed to claim further deductions. This method is referred to as the straight-line depreciation method.

The IRS also permitted landlords to use accelerated depreciation methods that allowed them to claim expenses at a rate initially in excess of that allowed by the straight-line method. The attraction of the accelerated methods is that they permit landlords to defer even more of their tax liabilities. Some of the accelerated methods can be used only in special situations. The one most relevant to our examination of existing rental housing is the 125 percent declining balance method. Under that method, the allowable depreciation expense is 125 percent of the percentage allowed under the straight-line method, but is computed on the declining balance rather than on the original purchase price (it was the only accelerated depreciation method applicable to existing rental housing).[7]

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[7] Landlords who purchase existing apartment buildings also have the option of depreciating them by the component method. Under that method, each of the building's subsystems is assigned its own lifetime. The component of building value associated with the subsystem is then depreciated by the straight-line method. The approach can lead to more rapid depreciation than that allowed by the 125 percent declining balance method, but at the cost of much more bookkeeping. The effect of using the component method depends strongly on the details of a particular case, making general statements difficult. We ignore this option in the discussion that follows.

Owners of newly constructed rental properties could take advantage of several more-generous depreciation methods. The 150 percent and 200 percent declining balance methods are like the 125 percent method except that they allow the landlord to claim 150 or 200 percent of the percentage allowed under the straight-line method.

The sum-of-the-years'-digits method works somewhat differently. The proportion of the original building value that can be claimed as depreciation in a given year is equal to the number of useful years remaining in the life of a building divided by the sum of all the years' digits in the useful life. Thus, for example, in the first year the appropriate fraction would be 40 (the remaining useful life) divided by the sum 40 + 39 + ... + 2 + 1 = 820, or 4.9 percent. Note that the fraction is considerably larger than the 2.5 percent that would be allowed under the straight-line method.

The appropriate indicator for measuring the effects of liberalized depreciation provisions on landlord profits is after-tax equity return, which is computed by dividing the landlord's after-tax equity income by his equity in the property. After-tax equity income is the sum of three components: after-tax net current income, the portion of regular income sheltered by the depreciation deduction, and after-tax capital gain.

Since our measure of landlord net current income is identical to current taxable income, we compute after-tax current equity income by simply multiplying by the difference between 1 and his marginal tax rate. Thus, we write

$$Y_c = C(1 - t_n) \,, \tag{4.4}$$

where Y_c = after-tax net current income ,

C = pretax net current income ,

t_n = landlord's marginal tax rate.

The portion of the landlord's regular income sheltered by the depreciation deduction equals his marginal tax rate multiplied by his allowable depreciation expense:

$$Y_s = (D_n + D_a)t_n , \tag{4.5}$$

where Y_s = portion of landlord's regular income sheltered by the depreciation deduction,

D_n = normal (straight-line) depreciation deduction,

D_a = additional depreciation claimed by an accelerated depreciation method.

After-tax capital gains equal net appreciation (total appreciation less capital additions) less relevant taxes. In computing taxes on capital gains, two factors must be taken into account: the amounts subject to capital gains tax as opposed to regular tax, and the time at which the taxes will be paid. Under the accelerated methods, the landlord can defer tax liability on an amount of income equal to his full depreciation deduction. However, he can convert normal income to capital gains taxable at a lower rate only for the amount of depreciation allowable under the straight-line method. The "excess depreciation" he claims over and above that allowed under the straight-line method is taxable as normal income in the year in which the property is sold. Because of these excess depreciation recapture provisions, the only advantage of the accelerated methods is that they allow the landlord to postpone paying his taxes.

To place some value on the postponement, we assume that the capital gains taxes and deferred normal taxes will be paid ten years from the time the property is sold. For each dollar of future tax liability, we subtract \$0.39 from current income, the present value at 10 percent interest of a dollar ten years hence. The formula for after-tax capital gains is

$$Y_g = A - F((A + D_n)t_g + D_a t_n) , \tag{4.6}$$

where A = net appreciation,

F = present value of a dollar ten years hence,

t_g = tax rate on capital gains.

The HASE data are not particularly well suited to the study of income taxes and their effect on landlord profits. The survey administered to landlords was designed to maximize the amount of information obtained about the operation of their properties. It asked them nothing about their personal finances. The designers of the survey felt that this was simply too sensitive an area to probe. They feared that after a long series of extremely detailed questions about the financial condition of his property, further questions about his personal income might cause a landlord to break off the interview.

Lacking exact data on landlords' income tax position, we base our analysis on illustrative cases. We consider three hypothetical landlords, whose incomes and tax status are summarized as follows:

Annual Landlord Income ($)		Marginal Tax Rate (%)
15,000	...	18
30,000	...	28
45,000	...	42

Income is in current dollars; tax rate is based on 1980 rates and itemized deductions computed from returns filed in 1977 by persons who had comparable real income and who itemized. We assume that the hypothetical landlords bought their properties ten years ago--very near the average length of ownership in the two sites. We also assume that they plan to hold their properties for another ten years--probably longer than most landlords intend to hold their properties. We assume a long period of ownership to emphasize the advantages of deferring tax liability.

Our measure of profitability is the landlord's after-tax real rate of return on equity. Results for 1973 in Brown County and for 1974 in St. Joseph County are shown in Table 4.4. For comparison, we also show after-tax real rates of return for several alternate investments that were available to landlords in those years.

At baseline in Brown County, landlords were doing extremely well. The tax shelter offered by rental property ownership effectively wiped out any liability landlords might have had on their pretax equity income. That fact, combined with high pretax rates of equity return and relatively modest inflation, meant that Brown County landlords were earning a 4 to 5 percent real after-tax return on their equity. None of the other investments offered a rate of return that even approached what

Table 4.4

REAL AFTER-TAX RATE OF RETURN ON INVESTMENTS IN BROWN COUNTY (1973) AND ST. JOSEPH COUNTY (1974)

Type of Investment	Real Rate of Return (%) by Annual Landlord Income		
	$15,000	$30,000	$45,000
Brown County			
20-year treasury bonds	-3.0	-3.7	-4.7
High-grade municipal bonds	-3.6	-3.6	-3.6
Public utility bonds	-2.4	-3.2	-4.3
Large-denomination certificates of deposit	-1.9	-2.7	-3.9
Brown County rental property	4.4	4.6	4.8
St. Joseph County			
20-year treasury bonds	-5.6	-6.4	-7.5
High-grade municipal bonds	-6.1	-6.1	-6.1
Public utility bonds	-4.6	-5.5	-6.8
Large-denomination certificates of deposit	-3.8	-4.8	-6.3
St. Joseph county rental property	-4.3	-4.1	-3.9

SOURCE: Table 4.1 and hypothetical landlord data.

could be earned through rental property ownership. The best alternative for a low-income landlord would have been a large-denomination certificate of deposit. If a low-income landlord could have afforded such an instrument, he would have lost money at the rate of 2 percent per year. A high-income landlord would have done best with a high-grade municipal bond, losing money at the rate of about 3.5 percent a year. By comparison, rental property in Brown County offered an enormously attractive yield.

Baseline in St. Joseph County was a year of high inflation.[8] None of the investments offered a positive after-tax rate of return. However, apart from large certificates of deposit for low-income landlords (an unlikely combination), rental property offered the highest after-tax yield, even in the depressed St. Joseph County market. The difference between St. Joseph County rental property and competing investments was not nearly as large as that in Brown County. Between 20-year treasury bonds and St. Joseph County rental property, the difference in after-tax yields was about 2 percent, reasonable in view of the difference in risk. We therefore conclude that even in St. Joseph County, landlords were earning acceptable rates of return.

The after-tax rate of return on rental property differs substantially from what could be earned on alternate investments only when the market is reacting to a shift in either the financial markets or the housing market.[9] In St. Joseph County, that shift occurred in the 1960s and very early 1970s. During that period, property values fell sharply in real terms, and great numbers of landlords lost money. In Brown County in 1973, we see the opposite. Property values were rising to capitalize above-normal yields, and landlords were profiting handsomely. We would not expect such extremely high rates of return to last, and as we saw earlier, by 1976 they seem to have declined.

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[8] In 1974, largely because of the increase in energy prices, consumer prices rose by 12.2 percent.

[9] The shift will usually occur in the housing market because of changes in demand such as those that occurred during the 1960s in St. Joseph County.

It has been suggested that laws regarding depreciation of rental property be liberalized to stimulate investment in rental housing. Proposals for liberalizing the depreciation methods available to landlords have taken one of two directions. The first would allow the owners of existing rental housing to use the accelerated depreciation methods now available only to owners of newly constructed buildings. The second, which was actually implemented in the Economic Recovery Act of 1981, would shorten the assumed useful lifespan of apartment buildings. Both have the effect of raising allowable depreciation deductions for landlords.

The effects of liberalized depreciation provisions on real after-tax equity return for our three hypothetical landlords are shown in Tables 4.5 and 4.6. Table 4.5 is based on average rental property income and equity for Brown County landlords in 1973. Table 4.6 repeats the calculations using averages for St. Joseph County landlords in 1974. Calculations based on 1976 Brown County and 1977 St. Joseph County figures would produce similar results.

The tables show that the faster depreciation methods have only a minor effect on equity return. The fastest methods add at most a half-percentage point to after-tax equity return under the straight-line method. The most dramatic changes in after-tax equity return occur when the useful building life is reduced from 40 to 15 years. In Brown County, this change added as much as a percent-and-a-half to real after-tax equity return.

The main conclusion to be drawn from Tables 4.5 and 4.6 is that the tax writeoff provisions would not have made much of a difference to

Table 4.5

REAL AFTER-TAX RATE OF RETURN ON LANDLORD EQUITY:
REGULAR RENTAL PROPERTIES IN BROWN COUNTY, 1973

Annual Landlord Income ($)	Real Equity Return (%)				
	Straight-Line Depreciation	Accelerated Depreciation			Sum-of-Years'-Digits Depreciation
		125 Percent	150 Percent	200 Percent	
40-Year Building Life					
15,000	4.2	4.2	4.3	4.4	4.5
30,000	4.3	4.3	4.4	4.5	4.7
45,000	4.5	4.4	4.5	4.8	5.0
15-Year Building Life					
15,000	4.9	4.9	4.8	4.5	4.6
30,000	5.4	5.3	5.1	4.7	4.9
45,000	6.0	5.9	5.7	5.1	5.3

SOURCE: Table 4.1 and hypothetical landlord data.
NOTE: See accompanying text for description of various depreciation methods.

landlords in Brown and St. Joseph counties. The most generous depreciation allowances shown--sum-of-the-years'-digits--raise after-tax equity return for a landlord with an annual income of $15,000 by only three-tenths of a percentage point relative to the return provided by straight-line depreciation. For landlords with an annual income of $45,000, the difference rises to half a percentage point in Brown County and four-tenths of a point in St. Joseph County. An increase of half a point in a landlord's after-tax equity return is undoubtedly welcome,

Table 4.6

REAL AFTER-TAX RATE OF RETURN ON LANDLORD EQUITY:
REGULAR RENTAL PROPERTIES IN ST. JOSEPH COUNTY, 1974

Annual Landlord Income ($)	Real Equity Return (%)				
	Straight-Line Depreciation	Accelerated Depreciation			Sum-of-Years'-Digits Depreciation
		125 Percent	150 Percent	200 Percent	
40-Year Building Life					
15,000	-4.4	-4.4	-4.4	-4.4	-4.3
30,000	-4.3	-4.3	-4.3	-4.2	-4.1
45,000	-4.1	-4.2	-4.1	-3.9	-3.7
15-Year Building Life					
15,000	-4.0	-4.0	-4.1	-4.3	-4.2
30,000	-3.6	-3.6	-3.8	-4.1	-3.9
45,000	-3.1	-3.1	-3.3	-3.7	-3.6

SOURCE: Table 4.1 and hypothetical landlord data.
NOTE: See accompanying text for description of various depreciation methods.

but it is small compared with year-to-year fluctuations in rate of return and with the differences in return between rental property and other investments. Moreover, the subsidy is available only to landlords with comparatively high incomes. The information available on landlord incomes is fragmentary at best, but it suggests that only a very few landlords are wealthy enough to derive substantial benefits from tax writeoff provisions for rental housing. Accelerated depreciation allowances appear to be a poor way of encouraging investment in rental markets such as those in the HASE sites.

The effects of shortening depreciable lifetimes for apartment buildings are more favorable. For a landlord with an annual income of $15,000, shortening the assumed lifetime increases real after-tax equity return by seven-tenths of a percentage point in Brown County and by four-tenths of a point in St. Joseph Count. For a landlord with an annual income of $45,000, the comparable figures are one-and-a-half percentage points and one full point. Even here, however, the changes in return are small compared with the difference in yield between rental property ownership and other investments.

Tables 4.5 and 4.6 show that with shortened depreciable lifetimes, it is advantageous for landlords to use straight-line depreciation rather than any of the accelerated methods. That incentive exists because with a 15-year depreciable lifetime, all of the accelerated methods exhaust their benefits well before the tenth year of ownership.

We note that Tables 4.5 and 4.6 overstate the benefits to landlords of the Economic Recovery Act of 1981. By cutting marginal tax rates, the act greatly reduced the value of rental property as a tax shelter. A full analysis of the implications would have to consider the effects both of changes in tax rates and of changes in depreciation schedules.

Circumstances could arise in which the benefits of using rental property as a tax shelter would be highly significant. Under the accelerated depreciation methods, tax savings are higher in the initial years. If we considered a new owner rather than one who, like the average owner in Brown and St. Joseph counties, had held the property for ten years, there would be more difference in after-tax equity return between the straight-line and the accelerated methods. In all cases, the absolute size of the tax savings is related to the value of the building rather than to the owner's equity. The savings would have a much greater effect on after-tax equity return for a landlord who was highly leveraged than for one who, like landlords in the two counties, held a mortgage that was small relative to the market value of his property. Finally, tax savings are directly proportional to the landlord's marginal tax rate. Extremely wealthy landlords who fell into a very high tax bracket would reap correspondingly greater benefits.

To illustrate what effect liberalized income tax provisions can have on real after-tax equity return under the above circumstances, we construct what for Brown and St. Joseph counties is an extreme case. We assume that the average rental property at baseline was purchased one year ago by an individual whose marginal tax rate was 50 percent. It is difficult to say precisely what income that rate implies, since tax status tends to become considerably more complex at high levels of income. We can say confidently, however, that the hypothetical landlord would be quite well off. His income would be in the $150,000 to $200,000 range. We assume also that he is more highly leveraged than average, with an equity ratio of only 50 percent. Calculating his after-tax equity return using the same formulas shown above yields the results shown in Table 4.7.

The first point to note about Table 4.7 is that the rates of return are much higher than before. Under the least generous depreciation schedule, the high-income landlord would earn a 7.8 percent real after-tax return in Brown County and a slightly negative return in St. Joseph County. The returns compare favorably with those available on most

Table 4.7

REAL AFTER-TAX RATE OF RETURN ON HIGH-INCOME LANDLORD EQUITY: REGULAR RENTAL PROPERTIES IN BROWN COUNTY (1973) AND ST. JOSEPH COUNTY (1974)

	Real Equity Return (%)	
Depreciation Method	Brown County (1973)	St. Joseph County (1974)
40-Year Building Life		
Straight-line	7.8	-2.1
Accelerated:		
125 percent	8.4	-1.7
150 percent	8.9	-1.2
200 percent	10.0	- .3
Sum-of-years'-digits	10.1	- .3
15-Year Building Life		
Straight-line	11.2	.7
Accelerated:		
125 percent	12.2	1.4
150 percent	13.5	2.5
200 percent	15.9	4.5
Sum-of-years'-digits	16.1	4.6

SOURCE: Table 4.1 and hypothetical landlord data.

NOTE: Landlord is assumed to have a marginal tax rate of 50 percent, to have purchased the property the previous year, and to have a 50 percent equity ratio.

alternate investments and are well above what we showed earlier for the income brackets we judge typical of landlords in the experimental sites. Clearly, the richer you are, the more attractive rental properties are as investments.

For our atypical landlord, liberalized tax provisions make much more of a difference than before. Moving from straight-line to sum-of-the-years'-digits adds almost two-and-a-half percentage points to the real after-tax rate of return, with building life set at 40 years.

Shortening the assumed building life to 15 years adds anywhere from 3 to 6 percentage points to after-tax rate of return, depending on which depreciation schedule is used. For individuals in the select, very-high-income group, the tax benefits associated with rental property make it an extremely attractive investment. Even in the depressed St. Joseph County market, we see the possibility of earning a healthy 15 percent after taxes.

The question that remains is whether there are enough very-high-income investors active in the rental property market to have a significant effect on it. We are confident that in the experimental sites such individuals are rare; "mom and pop" landlords are the rule . We have no information about whether the same ownership pattern holds generally. Our lack of information is unfortunate, because the level of activity of high-income investors determines whether generous tax writeoffs are a stimulus to rental housing production or merely a subsidy for rich households.

FINDINGS

The portion of gross rent that landlords receive for owning a property constitutes a relatively small fraction of their equity income. Landlords in both sites made most of their money through appreciation in property values.

Data on landlord equity returns in the two experimental sites paint contrasting pictures. In Brown County, landlords appeared to be doing extremely well, earning rates of return well in excess of those offered on a number of other common, alternate investments. The rate of return declined over time, however, in large part because of capitalization of initial above-normal returns. In St. Joseph County, the after-tax equity return for rental property was more closely in line with alternate returns available in the financial markets. The trends over time, however, were more favorable to landlords in St. Joseph County than to those in Brown County.

In the literature on real estate investment, much has been made of leveraging as a way for a landlord to increase the rate of return he earns on his equity. An examination of actual landlord financial data from the two experimental sites indicates that Brown County landlords were in a position to benefit from the use of leveraging. In both the initial and the final years, they could have increased their rate of return by taking out new mortgages and selling equity to the lenders. They did not do so, however, and equity ratios increased over time. In St. Joseph County, the same actions would have reduced a landlord's rate of return. In that depressed market, conditions were ripe for reverse leveraging. Landlords faced an incentive to increase their equity, and in fact did do so over the course of the experiment.

Provisions of the tax code that allow accelerated depreciation of rental structures increase landlords'after-tax equity return by allowing them to postpone paying their taxes and to shelter part of their regular income from taxation. Tax benefits currently play an important role in maintaining the attractiveness of rental property as an investment. However, we found little evidence that more liberal depreciation rules would add greatly to after-tax landlord rates of return. Calculations for three hypothetical landlords suggest that for the types of rental operations found in Brown and St. Joseph counties, even major increases in the rate at which landlords can depreciate their buildings would have only a modest effect on after-tax equity return. It is clear, however, that high-income individuals who have recently purchased their properties and are highly leveraged could derive substantial benefits from liberalized depreciation rules. Shortening the legal lifetime and allowing landlords to use accelerated methods would allow those investors to earn generous rates of return, even in the depressed St. Joseph County market.

Tax benefits have an undesirable effect, however. A wealthy landlord will earn above-average rates of return; a poor one will earn below-average returns. Tax writeoffs thus confer greater benefits to wealthier landlords.

Other ways of delivering rental housing subsidies would perhaps avoid that effect. For example, treating the benefits as tax credits would make them available to landlords whose total tax liability was small. Alternatively, income tax writeoffs could be eliminated, and the proceeds used to lower landlords' property tax liability; the profitability of rental property ownership would be independent of landlord income. Either way, the attractiveness of rental property ownership to lower and middle income investors would increase.

Any subsidy that lowers capital or operating costs for all rental properties raises questions of equity. Such subsidies treat comparable households similarly.[10] However, benefits are not concentrated where they are most needed. The poorest tenants live in buildings whose values, depreciable bases, and hence tax subsidies are small. Tax

[10] In this respect, tax benefits to landlords stand in contrast to other rental housing subsidies, such as the public housing or Section 8 programs, which provide benefits to only a minority of eligible households.

writeoffs thus provide the greatest benefits to occupants of new, high-value buildings, who tend to be much better off.

Housing allowances, on the other hand, provide benefits directly to needy renters. The benefits reach landlords as reduced vacancy losses and fewer bad debts and, when the market is tight, as a rise in the general rent level. By increasing the rates of return in the lower part of the market, housing allowances concentrate growth in supply, where it is needed most. Shifting from tax writeoffs to housing allowances as a way of subsidizing rental housing might greatly improve the circumstances of low-income renters, and at little or no net cost.

Appendix A

DEVELOPING QUANTITY MEASURES FOR FACTORS OF PRODUCTION

To analyze changes over time in the production strategies of landlords, we developed quantity measures for all factors of production. This appendix describes our procedure.

ENERGY

For measuring energy inputs to the production of housing services, we used estimates of average utility bills provided by tenants and landlords in the HASE surveys. Separate estimates were obtained from each group for electricity, gas, fuel oil, and coal.

To convert dollar expenditures for energy to estimates of physical quantity required data on energy prices and utility rates. Conversion was easy for fuel oil because it sold at a constant price per gallon. Dividing reported fuel oil expenditure by the price yielded an estimate of number of gallons used.

Electricity and natural gas, in contrast, had a complex, declining block rate structure involving fixed fees, special surcharges, and prices that varied by location and level of use. To convert expenditures for those sources to physical quantities, we first assumed that energy use per month was constant throughout the year. After computing the average rates in effect during the year, we then worked average monthly expenditures back through the average rate structure to arrive at estimates of average monthly energy use.

We converted all forms of energy to a common unit of measure based on their heat potential and how efficiently it is used. When electricity is a source of power, virtually its entire energy potential can be used.[1] When fuel oil or natural gas is burned, much of the potential heat is vented through exhaust gases. To reduce the fuels to a comparable basis, we assumed that electricity is used with 100 percent efficiency, and that fuel oil and gas burn at 70 percent efficiency.[2]

Weather was taken into account in measuring the quantity of energy. When winters are hard, it requires more energy to maintain a given temperature inside a building than otherwise. Winters differed in severity from site to site, and within each site from one year to the next. Because the variations in actual energy use were substantial, they hid the responses of landlords to the economic incentive of rising energy prices. To highlight the responses, we converted all quantities of energy into what they would have been had the property in question experienced a winter identical to that in Brown County in 1973. We relied on data on heating degree days by year and the estimated elasticity of total energy use with respect to heating degree days reported in Neels (1982a).

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[1] We ignored the energy loss that occurs when electricity is transmitted from the generating station to a dwelling. All quantities of energy were measured as they entered a property.

[2] This aggregation procedure is the same as that in Baughman and Joskow (1978), who used efficiency factors of 50 percent, but found their results insensitive to the choice of values over the range from 30 to 80 percent. The value of 70 percent used here fits the Brown and St. Joseph County data better and is consistent with the value used in analyzing energy demand in the two counties (Neels, 1982a).

REPAIRS

Payments for repairs included a variety of expenditures for labor and materials. We assumed that they were all used efficiently, and hence that the contribution to production was the same for a dollar spent on any of them. We could therefore measure total repair inputs by simply adding the amounts spent. To allow comparison between sites and years, however, we first deflated all repair expenditures to 1973 Brown County dollars.[3]

OPERATIONS

In measuring operation inputs, we followed a procedure similar to that used for repairs. Each expense item was deflated to 1973 Brown County dollars using indexes measuring longitudinal and cross-sectional price variation. The deflated amounts were then summed, giving a measure of real operation inputs.

The input measure was expanded to include imputations for properties that received free water or sewer service. The amount added was computed from the average charge per unit for all properties that reported some water or sewer expenses. It was deflated to 1973 Brown County dollars and then added to deflated labor expenses for all properties reporting a connection to a public water or sewer system but reporting no charges.

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[3] Expenditures were deflated using price indexes that take into account both the rise in prices over time and any cross-sectional price differences between the sites.

CAPITAL

To measure the quantity of capital, we had to overcome two types of problems. The first was that we had to examine and control for the flow of capital services, rather than being able to simply use market value as a measure of capital. We also had to control for expectations regarding future capital service flows, housing prices, and operating costs before market value was usable as a measure of the quantity of capital. The second problem was that to examine longitudinal changes in the quantity of capital, we had to design instruments sensitive to temporal changes in the overall condition of a structure.

In unraveling the theoretical relationship between building value and current period capital service flows, we drew on the results of an earlier study (Neels and Rydell, 1981). That study specified a model of building value that took into account deterioration, maintenance and repair costs, property taxes, and insurance expenses. By mathematically manipulating the model, the authors derived an equation giving current capital service flows as a function of building value, building age, and the combined tax and insurance rate prevailing in the jurisdiction where the building was located.

Parameters for the model were estimated using baseline data from Brown County. The choice was motivated by the fact that market conditions in Brown County had long been stable and the market was not highly segmented. It was therefore reasonable that maintenance policies would be uniform and that private expectations would reflect actual conditions.

Because market conditions were so strikingly different in St. Joseph County, we would not expect to find the same relationship between building value and current capital service flow. It was therefore difficult to develop a measure that would be comparable between the two sites. To overcome the problem, Neels and Rydell used baseline data from Brown County and regressed their measure of current capital service flows on a vector of variables for building attributes. The results are shown in Table A.1.

The variables for rooms per unit and floorspace per room--both basic measures of unit size--dominate the regression. Measures for the cost of replacing appliances, number of bathrooms, overall structural condition, and size of building also contribute strongly to the explanatory power of the model. Coefficients for all variables have the correct signs and are significantly different from zero. The strong intuitive and statistical validity of the results indicate that the assumptions incorporated in the model, though restrictive, did not greatly distort the underlying factors.

The attribute measures that served as independent variables in the regression were easily observed. Using them together with the estimated coefficients, we constructed a measure of the quantity of capital that was comparable across the sites and from year to year. The measure was theoretically correct in that it measured current capital service flows. It was also free of distortions caused by variations in market condition.

The physical attribute measures, however, were not sensitive to changes over time on individual properties. Some, such as those for

Table A.1

REGRESSION RESULTS FOR CAPITAL SERVICES INDEX

Variable	Coefficient	*t*-statistic
Rooms per unit (ln)	.7124	30.02
Floorspace per room (ln)	.5585	31.02
Replacement cost of appliances in unit	.00021	9.82
Log of (1 + number of bathrooms per unit)	.4199	8.48
Presence of central heating	.1160	5.98
Presence of garage	.0609	4.18
Presence of thermostat	.0663	2.84
Structural quality	.1917	9.87
Presence of wood or composition siding	-.0853	-6.73
Presence of lobby	.0938	3.40
Presence of basement	.0794	4.06
Number of stories	-.1274	-9.93
Presence of public water or sewer service	-.1038	-4.20
Constant	3.0919	14.87

SOURCE: Regression analysis of 1,557 cases drawn from the baseline surveys of landlords, tenants, homeowners, and residential buildings, and from public records in Brown County; reported in Neels and Rydell (1981).

NOTE: The dependent variable is the log of current capital service flows per dwelling: $R^2 = 0.75$, $F = 352.5$.

room size or number of stories, change only rarely. But the qualitative attributes most likely to reflect a landlord's maintenance policies are inherently difficult to measure. Moreover, certain measures of building condition, such as state of electrical and mechanical systems, had to be omitted from the model because of lack of data. We therefore hesitated to use the index to measure changes in capital service flows over the course of the experiment.

The search for a way of measuring changes in the quantity of capital led to two variables--the rent roll for the property and the value of the building. Although neither by itself was a perfect measure of the quantity of capital, both were likely to be sensitive to small changes in building condition. The problem was to take advantage of that sensitivity without sacrificing the theoretical virtues of the capital index.

To derive a measure of the quantity of capital from the rent roll for the property, we took into account the production function for housing services. We began by specifying the following model:[4]

$$H = f(K_I, E, O, L) , \qquad \text{(A.1)}$$

where H = quantity of housing services,

K_I = current period capital service flows, as measured by capital index,

E = quantity of energy,

O = quantity of operation inputs,

L = quantity of land.

The basic rent identity is

$$R = P_H \times H , \qquad \text{(A.2)}$$

where R = rent roll,

P_H = price of housing services.

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[4] We omit repairs from this model under the assumption that they affect output of housing services only indirectly, through their influence on the quantity of capital.

Substituting Eq. (A.1) into Eq. (A.2) gives the result

$$R = g(P_H, K_I, E, O, L) \ . \tag{A.3}$$

To estimate Eq. (A.3), we specified a price model in which a set of dummy variables measure differences between sites and over time in general price levels, and in which a set of location variables capture intrasite price variations associated with differences in accessibility and neighborhood quality. For the technical portion of the model, we used a four-factor translog production function. The final estimating equation is similar to that described in Neels (1981). However, in contrast to the earlier study, which used only baseline data for the two sites, we used information from all four years of the experiment. The regression results obtained are reported in Table A.2.

Table A.2 provides us with the means for using the rent roll to measure the quantity of capital. Algebraic rearrangement of Eq. (A.3) gives

$$K_R = h(R, P_H, E, O, L) \ , \tag{A.4}$$

where K_R = quantity of capital as measured by the rent roll for the property.

This rearrangement deflates the rent roll by the price of housing services to arrive at a measure of the total quantity of output. It then subtracts the contributions of energy, operations, and land to arrive at the contribution of capital as a residual. Thus, if the rent roll grows more rapidly than housing service prices in general, while input levels for energy, labor, and land remain unchanged, we infer that the flow of capital services has increased.

Table A.2

REGRESSION RESULTS FOR PRODUCTION FUNCTION

Variable	Coefficient	t-Statistic
Site 1 location variables:		
Neighborhood quality	.297	6.17
Distance to central business district	-.00665	-3.47
Presence of stores on block	-.0193	-1.56
Presence of vacant land on block	-.0124	-1.01
Site 2 location variables:		
Neighborhood quality	.216	5.54
Distance to central business district	-.00991	-4.68
Presence of stores on block	-.0371	-2.63
Presence of vacant land on block	-.0078	-0.58
Price level dummies:		
Brown County		
1974	.103	11.46
1975	.208	22.07
1976	.257	26.68
Central South Bend		
1974	.402	2.13
1975	.479	2.53
1976	.549	2.90
1977	.582	3.07
Rest of St. Joseph County		
1974	.450	2.34
1975	.543	2.82
1976	.580	3.01
1977	.648	3.36
Input-level variables:		
K	.291	1.03
E	.165	1.27
O	.186	1.78
L	.364	2.75
K x K	.0356	1.68
K x E	-.0455	-2.71
K x O	-.0190	-1.43
K x L	-.0329	-2.11
E x E	.0195	13.63
E x O	.00623	1.09
E x L	.0283	4.18
O x O	-.00306	-0.92
O x L	.00240	0.41
L x L	-.00936	-2.4

SOURCE: Regression analysis of 5,317 cases drawn from surveys of landlords, tenants, residential buildings, public records, and neighborhoods in Brown and St. Joseph counties.

NOTE: K = log of capital per unit; E = log of energy per unit; O = log of operating inputs per unit; L = log of land per unit. $R^2 = 0.43$, F = 118.8.

Although the measure of capital service flows derived in this way is highly correlated with the hedonic index estimate, nonlinearities in the estimation procedure cause the two measures to have somewhat different means. To guarantee comparability, we pooled all four years of data from both sites to form one grand cross-section and then regressed the index estimate on the measure derived from rent. We used the resulting equation to center the rent-derived measure on the index value.

Building value is clearly related to the flow of capital services. As pointed out above, however, the exact relationship depends in a complex way on the age of the building, property tax rates, and expectations regarding future trends in prices and market conditions. The earlier study by Neels and Rydell (1981) analyzed those relationships for one point in time in the stable Brown County market. To derive a measure of capital service flows from building value data, we had to perform a similar analysis that would allow us to deal with the striking differences between the sites in market condition.

Drawing on the theoretical work of Neels and Rydell (1981), we specified a list of variables affecting the relationship between capital service flows and building values. We included our measure for the level of housing service prices derived from the regression results shown in Table A.2. To capture the effects of property taxes, we included the effective property tax rate. To capture the effect of expected maintenance requirements, we included the age of the building. Finally, to capture the effects of expectations about the future, we included a variable having a value of 1 for properties in Brown County and 2 for properties in St. Joseph County.[5]

Because of the difficulty of specifying the effects of differences in expectations, theory provided little guidance as to the exact form of the relationship between capital service flows, building value, and the above variables. Moreover, although it might have been possible with highly restrictive assumptions to derive a closed-form model, it is likely that the result would have been nonlinear and difficult to estimate. Instead, we specified a translog equation in which the dependent variable is the log of current period capital service flows, as measured by the hedonic index, and the independent variables are products of the logs of building value, age, property tax rates, housing service price level, and the site variable. The translog functional form can be regarded as a second-order approximation in logs to an arbitrary function. It allowed us to derive an empirical approximation to the underlying unknown nonlinear function relating the variables.

We estimated the parameters of the model using a set of data constructed by pooling all four years of data from both sites. The regression results are shown in Table A.3. We estimated the flow of capital services from building value data using the coefficients and control variables shown in the table. Although the method of fitting the model guaranteed that the building value and hedonic index estimates had the same geometric means, their arithmetic means differed because of the nonlinearity of the model. To center the estimate for building value on the hedonic index measure, we regressed the hedonic index measure on the

[5] This variable was in effect a dummy variable.

Table A.3

REGRESSION RESULTS FOR VALUE INDEX

Variable	Coefficient	t-Statistic
V	-1.08	-7.63
A	-.0958	-0.71
S	8.97	7.20
T	-2.30	-3.15
P	-7.25	-4.72
V x V	.0675	14.33
V x A	-.0129	-1.80
V x S	-.225	-3.27
V x T	-.109	-3.49
V x P	.209	2.55
A x A	.00855	2.41
A x S	.138	2.47
A x T	-.0441	-1.36
A x P	-.00832	-0.13
S x S	*(a)*	--
S x T	1.25	3.91
S x P	-9.07	-9.36
T x T	-.494	-5.37
T x P	-1.35	-3.61
P x P	5.89	10.92
Constant	6.92	4.01

SOURCE: Regression analysis of 11,318 cases drawn from surveys of landlords, tenants, homeowners, residential buildings, public records, and neighborhoods in Brown and St. Joseph counties.

NOTE: V = log of building value per unit; A = log of building age; S = log of site variable; T = log of sum of effective tax and insurance rates; P = log of price of rental housing services. $R^2 = 0.51$.

[a] Constrained to equal zero to avoid perfect collinearity among the independent variables.

building value estimate and used the resulting equation to transform the estimate.

This set of analyses provided us with three measures of current capital service flow, all in comparable units of measure. The measure derived from rent best reflects variation in landlord maintenance policies. However, because it required the most data, we were often unable to compute it. To avoid an undue loss of sample, we used the building value and hedonic index measures to fill in missing values. Where the rent measure was unavailable, we filled in the building value measure. Where neither the rent nor the building value measure was available, we used the hedonic index measure. The resulting pooled measure provided the basis for the analysis reported in Sec. III of this report.

LAND

The terrain in the two experimental sites was similar enough that the main feature distinguishing lots in the both places was size.[6] Accordingly, the quantity of land was measured by the size of the lot (in square feet). A number of properties in outlying areas consisted of large plots of land that had only a few rental units. It appeared that the land was being held speculatively and had little to do with the operation of the rental units. Accordingly, we chose to ignore land amounting to over one acre per rental unit.

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[6] Lots also varied by location. Housing located in desirable areas would rent for more than housing in less-desirable locations. Location rents were treated as price rather than quantity differentials. We assumed that they were reflected in both the price of output and in the price of land, but not in the quantity of either.

Appendix B

MEASURING MARGINAL ENERGY PRICES

Most goods are sold at a constant price per unit. As a result, expenditures are directly proportional to quantity purchased. Energy is a notable contrast, however. Electric utility companies often levy a fixed charge on their customers, who are thus billed even if they consume no electricity. Moreover, the amount charged at the margin for an additional kilowatt-hour of electricity generally depends on the amount consumed. Electricity is often priced through declining block rate structures in which the price per unit falls as the amount consumed increases. Natural gas may also be sold in this way (as it is in the HASE sites). Thus, for natural gas, as for electricity, expenditures and quantities are not always directly proportional.

Combining electricity, natural gas, and fuel oil into a single composite measure of total energy use introduces further complications into the relationship between expenditures and quantity. The increase in expenditures resulting from incremental growth in energy use depends on the mix of energy sources that make up the increment. The mix at the margin may be quite different from the overall mix. As an example, electricity is the most expensive of all the forms of energy used in Brown and St. Joseph counties. However, it performs functions that cannot be performed otherwise. We can imagine a situation in which every household uses a fixed quantity of electricity for lighting and for operating essential appliances. All variation in energy use arises because of differences in the thermostat settings that affect the consumption of natural gas. In that situation, the marginal price of energy is equal to the marginal price of natural gas. Electricity costs are the same for all households and can be regarded as part of the overall fixed charge. Because gas is sold on a declining block rate structure, its price would vary depending on the level of consumption. The average price would be a combination of gas and electricity prices.

We sought to measure the marginal price of energy in the two experimental sites. In effect, we asked how much energy expenditures would increase as a result of incremental growth in energy consumption. To answer the question, we had to discover what mix of energy sources the typical consumer was using at the margin. In addition, for gas and electricity, we had to discover what fractions of marginal consumption fell into the various blocks of the rate structures.[1]

We assume that the mix of energy sources being used at the margin is constant. We can thus represent the marginal price of energy as

$$P_M = w_1P_1 + \dots w_nP_n \;, \qquad \text{(B.1)}$$

where P_M is the marginal price of energy and $P_1, \dots, P_n$ are published prices per million BTUs of energy. This vector of prices decribes the energy rate structure for a given location and time. The index i is defined across energy sources, and for gas and electricity, across consumption levels. The weights $w_1, \dots, w_n$ sum to 1. Thus,

[1] For any consumer, marginal consumption must by definition fall into a particular rate block. Marketwide averages, however, must take into account the fact that different consumers use different amounts of gas and electricity and face different marginal rates. The effect on average expenditures of an overall increase in energy use thus depends on the distribution of consumption levels within the population.

for example, if P_3 is the price per million BTUs of natural gas at a consumption level of 20 therms, w_3 gives the fraction of marginal energy consumption that falls into the block defined by that price.

We define a fixed charge F such that the following identity holds:

$$E = F + P_m Q \, , \qquad \text{(B.2)}$$

where E gives energy expenditures per household and Q gives per-household energy consumption. The fixed charge includes not only hookup fees but also the costs associated with gas and electricity consumption in the initial rate blocks. We assume that this fixed charge varied between sites and across years, but otherwise was the same for all properties.

The surveys provided us with measurements of energy expenditures. By contacting utility companies and fuel oil dealers, we were able to assemble complete data on the vector of energy prices. However, we could directly measure neither the weights needed to combine detailed prices into an overall marginal price, nor the levels of the fixed charges. Instead, we estimated the weights and the fixed charges econometrically. The sample was created by pooling data from both experimental sites and all four years. The equation was created by substituting Eq. (B.1) into Eq. (B.2):

$$E = a_{11}D_{11} + a_{12}D_{12} + a_{13}D_{13} + a_{14}D_{14} + a_{21}D_{21} + a_{22}D_{22}$$

$$+ a_{23}D_{23} + a_{24}D_{24} + w_1P_1 + \ldots + w_nP_n \, , \qquad \text{(B.3)}$$

where D_{ij} is a dummy variable identifying cases in year j of the site i data. The coefficients a_{ij} provide estimates of the magnitudes of the fixed charges defined by Eq. (B.2). The coefficients w_k provide estimates of the fractions of marginal energy consumption corresponding to the indicated prices. In estimating Eq. (B.3), the weights w_k were constrained to sum to 1. The results are reported in Table B.1.

The regression model coefficients indicate that electricity, natural gas, and fuel oil are all used at the margin. Most of the

Table B.1

REGRESSION RESULTS FOR MARGINAL ENERGY PRICE MODEL

Variable	Coefficient	Standard Error
Energy prices:[a]		
Electricity at 1,000 kwh consumption level[b]	.075	.009
Gas at 25 therm consumption level[b]	.325	.058
Gas at 100 therm consumption level[b]	.461	.036
Fuel oil	.139	*(c)*
Brown County dummy variables:[d]		
Year 1	85.91	9.76
Year 2	84.76	7.07
Year 3	129.78	7.77
Year 4	35.08	9.05
St. Joseph County dummy variables:[d]		
Year 1	103.26	8.46
Year 2	143.31	7.35
Year 3	163.97	7.48
Year 4	197.03	6.97

[a]Prices are per million BTUs.

[b]Stated consumption levels are per month.

[c]Standard error cannot be computed. Energy price weights were constrained to sum to one.

[d]Dummy variable coefficients give annual fixed charges.

increment in consumption involves burning natural gas, although a sizeable amount of fuel oil is also used. The relative sizes of the gas and fuel oil coefficients correspond roughly to the relative proportions of properties in the two sites that use those fuels for space heating. Electricity accounts for only a fraction of marginal energy use.

The pattern of fixed charges in the two sites differs considerably. In St. Joseph County, the charges increase over time, while in Brown County they show no regular pattern. In general, the fixed charges are higher in St. Joseph County.

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