11 THE USE AND ABUSE OF RENTAL PROJECT MODELS

Leonard E. Burman, Thomas S. Neubig, and D. Gordon Wilson

I. INTRODUCTION

During consideration of the Tax Reform Act of 1986 (TRA86), housing analysts relied heavily on rental project models to support their arguments for more or less generous tax treatment of residential and commercial rental property. These models derive the rent level that would provide an investor with an assumed required rate of return given a set of assumptions about an investment's economic and tax characteristics. Despite the sophistication of these models, or perhaps because of it, analysts predicted widely varying effects of tax reform proposals.[1] How could analysts using similar models in evaluating a tax reform bill whose characteristics were easy to represent parametrically produce such variant analyses?

The purpose of this paper is threefold. First, we describe what rental project models are and discuss a particularly useful model that has been developed at the Office of Tax Analysis (OTA). Second, we show how these models can be used to gain valuable insights about how tax and non-tax factors affect individual investors, and about the implications for efficiency and equity of various tax policies. Finally, we answer the question posed above. We show that the wide range of results is due to inherent and fatal flaws in rental project models as tools for forecasting market-wide responses to tax policies.

Many other economists have contributed to development of rental project models at OTA. They are, in roughly chronological order, Frank DeLeeuw, Larry Ozanne, Harvey Galper, Eric Toder, Larry Dildine, Steve Sheffrin, Jim Nunns, Joe Cordes, and Hudson Milner. We are grateful to Joe Cordes, Don Fullerton, Tim Goodspeed, Hudson Milner, Jim Nunns, Joel Slemrod, Marty Sullivan, Eric Toder, and Jenny Wahl for helpful comments on earlier drafts and Vicky Conway for assistance in the preparation of the manuscript and tables.

II. WHAT IS A PROJECT MODEL?

A. DEFINITION

A project model simulates the cost and income streams that would be generated by a long-lived investment under a set of assumptions about taxes, the economic environment, and the characteristics of the investor. Early simple models were designed to help investors decide whether a particular investment was worthwhile. More sophisticated variants of this kind of analysis, such as the OTA model, can determine endogenously how long investors should hold properties, break-even rents, and sales price streams. Analysts at OTA have used project models to study the effect of tax changes on investments in real estate, timber, oil drilling, mining, and other assets.

B. KINDS OF RENTAL PROJECT MODELS

This section describes three kinds of rental project models that are used by investors and housing analysts: the spreadsheet model, the "initial investor" model, and a dynamic programming model. While the first two kinds of models are the most widely used, they are not well suited to representing the effects of anticipated future tax laws on the resale value of a property and may thus be misleading. Section III will describe the more sophisticated dynamic model that has been developed by OTA.

1. Spreadsheet Models

Table 11.1 illustrates a simple spreadsheet model for a hypothetical real estate investment. The spreadsheet provides a convenient way to evaluate a project under various assumptions about taxes and economic conditions. The left column lists the assumed parameters that underlie the analysis. It should be noted that, although this list of assumptions is extensive, more complicated models depend on even longer lists of assumptions. The advantage of this kind of model is that it is simple (models like this could be developed in any spreadsheet program on almost any microcomputer), easy to develop, and easy to use.

The simple example in Table 11.1 represents a low-income housing unit under conditions that might have prevailed in 1985 (pre-TRA86). The investor/developer is assumed to hold the project for 15 years, which is the length of the ACRS low-income housing depreciation schedule.[2] The nominal value of the land allocated to the property is assumed to increase at a constant rate (3% per year) over the 15 years. The nominal structure value is constant because inflation in structure values is assumed to just offset economic depreciation. The initial rent is assumed to be 10% of value ($4,100) and initial operating costs are assumed to be 2.5% of the structure value. Both grow at a constant annual rate of 3%.

Table 11.1 Sample Spread Sheet Calculator for ACRS Low-Income Housing

Investment Assumptions	
Purchase	
Land	$5,000
Structure	$30,000
Total Price	$35,000
Rehabilitation	
Percentage	20.0%
Dollar Cost	$6,000
New Basis	$36,000
Total Cost	$41,000
Mortgage	
Interest Rate	11.0%
Term (years)	30
% Borrowed	90.0%
Loan Amount	$36,900
Payment	$4,244
Transaction Costs	
Percentage	3.0%
Dollar Cost	$1,050
Initial Investment	$5,150

Parameters	
Depreciation Rate	3.0%
Operating Cost/Value	2.5%
Initial Rent	$4,100
Rent Inflation	3.0%
Land Inflation	3.0%
Structure Inflation	3.0%
Discount Rate	8.0%
Discount Factor	92.6%
Tax Rate	50.0%
Capital Gains Rate	20.0%

Generated Stream of Income and Deductions for Rental Property

Year	Rent	Operating Costs	Mortgage Principal	Mortgage Interest	Tax Deprec.	Taxable Income	Pre-Tax Cash Flow	Tax Benefit	After-Tax Income
1	$4,100	$900	$36,900	$4,059	$5,100	-$5,959	-$1,044	$2,980	$1,935
2	$4,223	$927	$36,715	$4,039	$4,800	-$5,543	-$948	$2,771	$1,823
3	$4,350	$955	$36,509	$4,016	$4,200	-$4,821	-$850	$2,411	$1,561
4	$4,480	$983	$36,280	$3,991	$3,900	-$4,394	-$748	$2,197	$1,449
5	$4,615	$1,013	$36,027	$3,963	$3,600	-$3,961	-$643	$1,981	$1,338
6	$4,753	$1,043	$35,745	$3,932	$2,100	-$2,322	-$535	$1,161	$626
7	$4,896	$1,075	$35,433	$3,898	$1,800	-$1,877	-$423	$938	$515
8	$5,042	$1,107	$35,086	$3,859	$1,500	-$1,424	-$309	$712	$403
9	$5,194	$1,140	$34,701	$3,817	$1,500	-$1,263	-$191	$632	$441
10	$5,350	$1,174	$34,274	$3,770	$1,500	-$1,095	-$69	$547	$478
11	$5,510	$1,210	$33,800	$3,718	$1,200	-$617	$56	$309	$365
12	$5,675	$1,246	$33,273	$3,660	$1,200	-$430	$185	$215	$400
13	$5,846	$1,283	$32,689	$3,596	$1,200	-$233	$318	$117	$435
14	$6,021	$1,322	$32,040	$3,524	$1,200	-$25	$455	$13	$467
15	$6,202	$1,361	$31,320	$3,445	$1,200	$195	$596	-$98	$498
16			$30,521						
PVs	$41,727	$9,160		$33,188	$24,337	-$24,958	-$3,763	$12,479	$8,716

Computation of Gain or Loss on Sale (Undiscounted)

+ Sale Price	$43,790
- Mortgage Principal	-$30,521
- Transaction Costs	-$1,314
- Capital Gains Tax	-$4,953
= Net Return	$7,003

Present Value of Returns to Investment

Initial Cost	-$5,150	
Income Stream	$8,716	
Gain on Sale	$2,208	
Net Return	$5,774	112.1%
Gross Return	$10,924	212.1%
Coupon Equivalent	$1,087	21.1%

Future values are risky. Rents and operating costs are affected by vacancy rates, how well the tenants care for the units, and actual inflation rates. The project model implicitly assumes that the income and cost streams represent expected values and that risk may be accounted for in the discount rate (or rates[3]) at which the investor discounts future income.

The simple model produces many of the outputs of other more complicated models. It summarizes the investor's cash flows through the assumed life of the project. It computes the present value of benefits, with detail about the value of tax incentives. This spreadsheet reports a variant on the internal rate of return–the "equivalent coupon rate"[4]–which represents for a tax-exempt bond with the same face value, risk, and term as the project, the rate of interest that would generate the same present value. For this hypothetical project, the coupon equivalent is 13.8%.

The model is sensitive to a large number of assumed parameters. Results depend critically on the discount rate and the marginal tax rate of the investor. For example, accelerated depreciation and other tax deductions are most valuable to investors in high tax brackets. In tax-shelter investments, higher leverage (i.e., higher loan-to-value ratio) generates larger interest deductions, which increase the amount of income that can be sheltered from tax. Thus, the initial loan-to-value ratio as well as assumptions about refinancing are important. Finally, with highly leveraged investments, the interest rate is more important than any other parameter.[5]

2. Initial Investor Models

A drawback of the simple model as a policy tool is that it cannot determine the effect of tax policies on how long to hold the rental project.[6] Good tax policy attempts to minimize tax-motivated distortions in taxpayers' decisions to buy or sell assets. But the simple spreadsheet provides no direct information about how investors' selling or holding decisions might respond to tax changes. In a seminal work, DeLeeuw and Ozanne (1979) developed a more complex model that included endogenous determination of the holding period. We call this kind of model the "initial investor" model because it simulates the economic decisions of the first investor to hold a rental project.[7]

An initial investor model is a straightforward extension of the simple model. Given an exogenous stream of sales prices for each year during the life of the project, the model solves for the holding period that maximizes the present value of after-tax cash flows. Initial investor models are especially useful for studying how capital gains taxes, depreciation recapture provisions, marginal tax rates, and inflation affect churning[8] of real estate.

3. Dynamic Models

A shortcoming of initial investor models is that they cannot capture the effect of tax changes on future owners. To accomplish this, OTA has developed a dynamic programming model in which sales prices and holding periods are determined endogenously and simultaneously.[9] An advantage of this kind of model is that it shows how future tax benefits can be capitalized into property values.

III. THE OTA RENTAL HOUSING PROJECT MODEL

The OTA rental housing project model is an extension of the types of models described above. The OTA model can run as either a dynamic model or as an initial-investor model (which allows easy comparison of the alternative methodologies). The model includes as options all of the major features of tax laws and proposals pertaining to rental housing made since the 1981 Tax Act. It allows for accounting peculiarities that help distinguish various tax laws, such as half-year accounting and variable-length construction periods. The appendix describes the mechanics of the model.[10]

A. MEASURES OF RETURN ON INVESTMENT

The model can compute one of three different summary measures of return on investments. By default, the calculator finds the user cost of rental housing capital, defined to be the initial period's rent as a proportion of value that sets the initial investor's net present value equal to zero. This measure is sometimes referred to as "required rent".[11] The OTA model can also determine the internal rate of return on the first investor's equity, holding rates of return for subsequent investors constant. In another mode, the calculator can find the real after-tax rate of return that would drive the net present value for all investors (including the mortgagor) to zero given an exogenous rent level. This measure represents the equilibrium market rate of return given the assumed parameters. Finally, the calculator can simply compute the present value of the project to the initial investor given exogenous rents for the exogenous holding period.

1. User Cost

The user cost measure provides a concise summary of the effects of various tax and non-tax parameters in a single number. The model can thus be used to estimate, for a given tax law, how user costs are distorted among investors with different marginal tax rates and how tax shelter provisions affect user costs. A sequence of model runs can determine how much each of a set of tax provisions affects the cost of rental housing (for a given investor), and how those provisions interact. The model also shows how transaction costs and other non-tax factors affect user costs.

2. Internal Rate of Return

The internal rate of return (IRR) is another useful measure of capital costs for rental housing. Given a fixed rent stream, the IRR indicates how real after-tax rates of return for investments of comparable risk would have to change to make the particular investment attractive (or unattractive). This measure provides interesting insights into how rates of return vary across tax brackets. For example, it appears from the model that tax shelter investors may demand higher rates of return than small-scale landlords.[12] This suggests that the tax shelter investors have higher opportunity costs of capital, perceive more risk in their investments, or have higher operating costs than the smaller investors, or, perhaps, some combination of the three. The IRR is used in the model to compute effective tax rates, as discussed below.

3. Net Present Value

The net present value (NPV) indicates how tax law provisions might be capitalized into the value of the rental property, holding the rent stream and after-tax rates of return constant. This measure is more powerful than might appear at first glance because the model computes sales prices and holding period endogenously. Thus, net present value comparisons not only show the present value of direct tax benefits or costs incurred by the initial investor, but include how taxes are capitalized into the resale value of the property as well as how taxes affect the timing of sale. The initial investor model would ignore this latter component.

The three measures may be used to infer the limits of tax incidence for a particular kind of housing held by a particular kind of investor. The user cost, IRR, and NPV, indicate the effect on renters, capital, or land holders in the case where each of them, respectively, is assumed to bear the entire burden of a tax. If all other prices are constant and there is free entry and exit from the market, then rents for a new building held by the hypothetical type of investor would be driven to the level of the user cost in equilibrium (if the type of investor were participating in the market). Alternatively, if rents, land prices, and the amount of equity capital are fixed, then real after-tax returns on equity would equal the IRR. Finally, if the quantity of land is fixed and all other prices remain constant, then changes in the computed NPV represent changes in land prices (subject to a nonnegativity constraint).

B. EFFECTIVE TAX RATES

1. Measuring Effective Tax Rates

A logical extension of the rental project model is computation of effective tax rates on rental housing investment. The calculator prints three measures of effective tax rate defined by Bradford and Fullerton (1981) based on internal rates of return. The three measures are the effective gross rate

(t_g), the effective net rate (t_n), and the tax wedge (t_w). The gross rate is essentially taxes as a percentage of gross (before-tax) income, the net rate is taxes as a percentage of net (after-tax) income, and the wedge is taxes as a percentage of asset value. They are defined as follows:

$$t_g \equiv \frac{r_b - r_a}{r_b}, \tag{11.1}$$

$$t_n \equiv \frac{r_b - r_a}{r_a}, \text{ and} \tag{11.2}$$

$$t_w \equiv r_b - r_a . \tag{11.3}$$

where r_b and r_a are the before- and after-tax rates of return, respectively.[13b] The property-tax rate is treated as a user charge (a la Tiebout), rather than as a tax, for purposes of computing r_b.

The effective gross rate, t_g, is the closest analogue to what is typically thought of as a tax rate. However, as Bradford and Fullerton point out, this measure yields peculiar results when the before-tax rate is close to zero or negative. When r_b is zero, t_g is undefined, and when r_b is negative, t_g has the wrong sign and can be very large. So what is, in fact, a large tax subsidy (which is why r_b can be negative) is reported as a large positive effective tax rate.

Since the after-tax rate is usually positive, the effective net tax rate, t_n, may be more appropriate, but care should be taken in its interpretation. Tax rates as a percentage of net income are always larger than gross rates whenever net rates of return are positive. For example, a 50% statutory rate of tax on gross income corresponds to a 100% tax rate relative to net income because tax equals after-tax net income.

The tax wedge, t_w, may be the most robust estimator, in the sense that it is never undefined or ill-defined. But, again, care must be taken in comparing this measure to statutory tax rates.

2. Implementation in the OTA Model

It is both an advantage and a disadvantage of the approach taken here that the internal rate of return is used as a measure of returns to capital investment. The advantage is that the measure is independent of the assumed discount rate of the investors. The disadvantage is the general problem that internal rates of return do not always give consistent rankings of streams of income and expense when the internal rate varies greatly from the actual discount rate.[14] A related problem is that the IRR may be inconsistent with the user cost, sales prices, and holding periods that are derived assuming particular discount rates. Furthermore, some streams of income may have no internal rate of return, or the IRR may not be unique. A possible alternative approach would be to compute effective tax rates using before- and after-tax present values.

The effective tax rates are computed for the equity portion of the investment as well as for all capital invested in the project. The effective rate on the whole investment is useful for analyzing the tax burden on rental housing capital and for comparison with tax rates on other forms of capital. This type of measure would typically be used in analysis of the efficiency aspects of a tax policy change.

The effective tax rate on equity shows the effect of taxes on the equity part of an investment holding taxes on debt constant. This measure might be relevant if equity in rental housing is considered to be a different kind of financial instrument than debt, perhaps because of risk. Of course, in equilibrium, taxes on debt should be reflected in the cost of borrowing and thus affect the rate of return on equity.

Effective tax rates are computed separately for each owner and cumulatively for the project through each successive holding period. The separate computations by owner are helpful in comparing the tax treatment of new and used buildings. The cumulative effective tax rate provides a summary measure of the level of tax or subsidy for the project over its entire economic life.

Finally, we should note that computation of effective tax rates as described above addresses the concerns of Summers (1987) in his recent working paper. He criticized Treasury's published effective tax rates on structures as being too high because they do not account for the capitalization of future tax benefits or the higher leverage that is possible with structures. But the OTA Rental Housing Project Model correctly accounts for both of these features.

3. Effective Tax Rates for a Pre-TRA86 Investment

Table 11.2 illustrates the different effective tax rates computed by the OTA model for a rental housing investment made in 1985. The first section of the table displays internal rates of return for each of three owners of an ACRS rental housing investment assuming that rents are set so that all equity investors earn a 4% real after-tax rate of return. This requires that after-tax returns be positive and well defined, but the large tax incentives in pre-TRA86 law allowed a project with negative before-tax returns on equity to be profitable after taxes. The result is that for all but the last investor, the effective gross tax rate is not meaningful (indicated by NA, not applicable). The effective net tax rate and the tax wedge, however, provide consistent comparisons of the value of tax subsidies in each case.

The table shows that in the case of a depreciating building with moderate inflation (the assumed project turns to dust after 50 years), the value of tax subsidies declines with each owner. The value of depreciation deductions falls as a percentage of each investor's purchase price as the value of land increases relative to structure value. The effective net rates in the table

Table 11.2 **Three Measures of Effective Tax Rates for a Rental Housing Investment in 1985[a]**

	Rates of Return		Effective Tax Rates		
	Pre-Tax	After-Tax	Gross Rate	Net Rate	Tax Wedge
For Each Owner					
Equity Only					
Owner 1	-.0073	.0400	NA[b]	-1.183	-.047
Owner 2	-.0007	.0400	NA	-1.018	-.041
Owner 3	.0115	.0400	-2.482	- .713	-.029
Asset (Debt & Equity)					
Owner 1	.0422	.0400	.052	.055	.002
Owner 2	.0460	.0400	.131	.151	.006
Owner 3	.0593	.0400	.325	.482	.019
Investment to Date					
Equity Only					
Through Owner 1	-.0073	.0400	NA	-1.183	-.047
Through Owner 2	-.0049	.0400	NA	-1.124	-.045
Through Owner 3	-.0041	.0400	NA	-1.103	-.044
Asset					
Through Owner 1	.0422	.0400	.052	.055	.002
Through Owner 2	.0430	.0400	.069	.074	.003
Through Owner 3	.0434	.0400	.079	.086	.003

[a] Non-low-income ACRS housing investment. Rent set so all investors earn zero net present value. Default parameter values (see appendix): e.g., discount rate = 4%, 80% loan-to-value ratio, tax rate = 40%, inflation = 5%, interest rate = 12%. User cost is 9.23%; three owners' holding periods are 19, 19 and 12 years, respectively.
[b] NA = not applicable.

show that tax subsidies amount to 118.3% of the first investor's net return, but only 71.3% of the last owner's. Looked at another way, the tax wedge shows that tax subsidies augmented the rate of return on investment by 4.7% for the first investor, but only 2.9% for the third.

When considering the overall subsidy or tax on rental housing it is appropriate to include debt. The example that generated Table 11.2 was 80% debt-financed for each investor. Including debt, all three measures of effective tax rate are positive. The effective gross tax rates range from 5.2% to 32.5%.

The second section of Table 11.2 presents cumulative effective tax rates. The rates "through owner 3," represent the overall effective tax rates on the project through its entire life. The line in the equity-only portion shows that tax preferences account for more than 100% of the return on equity, even accounting for the smaller subsidy on the last investor. The asset row, however, suggests that the investment as a whole is subject to a small positive effective tax rate on gross income (7.9%).

IV. APPLICATIONS OF RENTAL PROJECT MODEL ANALYSIS

Like many of the tools in an economist's kit, rental project models are most useful for their qualitative results. Since the model represents a possible decision making strategy (based on maximizing expected present value) for a single investor considering a particular project in a hypothetical economic and tax environment, the model's quantitative results do not apply to the economy as a whole. However, it is very useful for tax policy purposes to be able to study how an existing or proposed policy would affect individuals' behavior in isolation from the myriad other factors that tend to confound analysis. Thus the model allows for a kind of controlled experiment.

The model results can be generalized to market-wide phenomena in some cases. Certain qualitative results, such as higher user costs or longer holding periods, might prove to be robust when parameter values are varied between the extremes of their feasible ranges. However, even in these cases, conclusions about the market levels of economic variables (notably rents) cannot be made solely on the basis of rental project model results. Section V expands on the limitations of project model analysis.

Nonetheless, a rental project model is very useful for evaluating tax policies on a micro level. This section illustrates some applications of the OTA Rental Project Model.

A. TAXES AND CHURNING

It would be inefficient and undesirable if the tax system were to encourage investors and landlords to sell rental real estate before they would have in the absence of taxes. A primary economic benefit of having a large and heterogeneous rental market is that it economizes on the very large costs that characterize real estate transactions. Landlords typically hold real estate much longer than the average tenant's occupancy, so individuals who expect a short tenure in a home find it less expensive to rent than to own.

In the absence of taxes, and assuming perfect credit markets (so that investors could borrow against the accumulated value of their real estate), the model predicts that transaction costs would prevent rental property holders from ever selling. Since transaction costs represent real resource costs, this kind of "lock-in" effect is efficient. However, as Tables 11.3A and 11.3B show, before the passage of TRA86, investors would tend to choose shorter holding periods as tax rates increase. This result is qualitatively robust with respect to changes in assumed parameter values.

Churning was profitable under the Economic Recovery Tax Act of 1981

Table 11.3A **Effect of Marginal Tax Rates on Rental Housing Investment (Pre-TRA86 Parameters[a])**

Investor's Tax Rate (%)	User Cost (%)	Percentage of No Tax User Cost	Holding Period (Years)	Number of Owners	Net Effective Tax Rate Equity (%)	Net Effective Tax Rate Investment (%)	Average Debt-Equity (%)
No Taxes[b]	8.79%	100.0%	50	1	0.0%	0.0%	39.1%
0%	10.44%	18.8%	50	1	0.0%	39.8%	41.2%
15%	10.22%	116.3%	50	1	-9.5%	34.4%	41.3%
28%	9.94%	113.1%	19	2	-70.5%	23.7%	62.4%
33%	9.68%	110.1%	19	3	-88.5%	16.9%	62.7%
50%	8.39%	95.4%	19	3	-173.9%	-16.2%	63.9%
70%	5.48%	62.3%	18	3	NC[c]	-99.9%	70.1%

[a] See Table 11.8 for values. Tax rates vary as indicated.
[b] Tax rate on debt is also zero. Interest rate on debt falls to 9% to yield 4% real rate.
[c] NC = not computable. There is not internal rate of return for which the investor's before-tax present value equals zero (i.e. pre-tax income is negative in every year).

Table 11.3B **Effect of Marginal Tax Rates on Rental Housing Investment (TRA86 Parameters[a])**

Investor's Tax Rate (%)	User Cost (%)	Percentage of No Tax User Cost	Holding Period (Years)	Number of Owners	Net Effective Tax Rate Equity (%)	Net Effective Tax Rate Investment (%)	Average Debt-Equity (%)
No Taxes[b]	8.79%	100.0%	50	1	0.0%	0.0%	39.1%
0%	10.02%	113.9%	50	1	0.0%	29.6%	40.7%
15%	10.02%	113.9%	50	1	0.2%	29.7%	40.9%
28%	10.02%	113.9%	50	1	0.4%	29.8%	41.0%
33%	10.02%	113.9%	50	1	0.5%	29.9%	41.1%
50%	10.02%	113.9%	50	1	1.0%	30.1%	41.5%
70%	10.02%	113.9%	50	1	2.2%	30.7%	42.7%

[a] See Table 11.8 for values. Tax rates vary as indicated.
[b] Tax rate on debt is also zero. Interest rate on debt falls to 9% to yield 4% real rate.

(ERTA) and the 1982 and 1984 Tax Acts because of the greatly accelerated depreciation for residential real estate. Rental real estate owners in high tax brackets could earn valuable tax deductions in the early years of a project's life. Thereafter, the project became much more valuable to a new purchaser than to the original owner because each new owner could claim new accelerated depreciation deductions. Moreover, with inflation there would be a "step up in basis" each time the property changed hands. Were it not for recapture penalties.[15] owners would have sold even sooner.

Capital gains taxes tend to distort holding patterns in the opposite direction. Hendershott and Ling (1985) used a project model to explore the effect of inflation and taxes on churning of real estate held as a tax shelter. They reported that capital gains taxes tended to reduce the incentive to sell real estate offsetting somewhat the perverse incentives of accelerated depreciation. As inflation increased (holding real after-tax interest rates constant), Hendershott and Ling found that the lock-in effect intensified, even for high tax bracket investors. This is because the effective tax rate on real capital gains increases with inflation, so investors find deferral of gain more profitable.

In light of these findings, we would expect TRA86 to reduce churning significantly for residential (not low-income[16]) real estate. The Act lengthened the depreciation schedule from 19-year 175% declining-balance to 27.5-year straight-line, reduced tax rates, and repealed the partial exclusion of capital gains income from tax. The first part of Table 11.4A shows that, under one set of reasonable assumptions, rate reduction or repeal of the capital gains exclusion would be expected to end churning, which is optimal in the context of the rental model.

The conclusion that tax reform would result in optimal churning is not robust with respect to changes in parameter values, however. Under a set of assumptions that might be more characteristic of a tax-shelter investor, churning is reduced, but not ended, by the provisions of tax reform. Table 11.4B considers a top-bracket investor who is more highly leveraged and who discounts future income at a higher rate than the hypothetical investor in Table 11.4A. Table 11.4B also assumes somewhat lower interest rates. Under this scenario, tax rate reduction alone would not be sufficient to affect churning among individuals in the top brackets. Lengthening the depreciation schedule actually shortens the holding period for the first investor to fifteen years. However, repealing the exclusion for capital gains would lengthen the optimal holding period for the first investor from 19 to 26 years. The TRA86 provisions, taken as a whole, result in a holding period of 25 years.

These results suggest two conclusions. First, the Tax Reform Act of 1986 should substantially reduce churning for most types of rental real estate.[17] Assuming that refinancing is costly, these results are robust with respect to other assumptions about the characteristics of the taxpayer and the economy. The second important conclusion is that some kinds of results are very sensitive to small changes in parameter assumptions. The sensitivity of model results is discussed in V.B.

B. COMPARATIVE EFFECT OF TAX REFORM PROVISIONS ON RENTAL USER COSTS

Table 11.4A and Figure 11.1 show how the non-low-income residential rental housing tax provisions affect the user cost for a hypothetical investor. They show both the effects of each provision separately as well as the incremental effect of adding one more provision (in a particular order) to the last.

Table 11.4A **Effect of Tax Reform Provisions on User Costs Stacked Separately and Together Compared to 1985 Law (Assumptions I)**

	Stacked First Against 1985 law				Stacked Against Previous Provisions			
	User Cost	% Change from Baseline	No. of Owners	Holding Period of First	User Cost	% Change in User Cost	No. of Owners	Holding Period of First
1985 law[a]	9.23%	0.0%	3	19	9.23%	--	3	19
27.5 year straight-line depreciation	10.10%	9.4%	3	19	10.10%	9.4%	3	19
Tax rate reduction[b]	10.08%	9.2%	1	50	10.39%	2.9%	1	50
Non-exclusion of capital gains	9.62%	4.2%	1	50	10.40%	0.1%	1	50
Lower interest rates[c]	8.74%	-5.3%	3	19	9.99%	-3.9%	1	50
Capitalize CPIT	9.26%	0.3%	3	19	10.02%[d]	0.3%	1	50
Passive loss limitation[e]	11.08%	20.0%	2	29	10.36%	3.4%	1	50

[a] Assumes marginal tax rate of 40% for equity investors, 25% on debt, discount rate of 4%, mortgage interest rate of 12%, inflation rate of 5%, 80% leveraged.
[b] Marginal tax rate is 22% for equity investors, 20% on debt.
[c] Interest rate = 11.25% (yields 4% real after-tax return after rate reduction on debt).
[d] TRA86.
[e] Assumes no offsetting passive income so no losses are currently deductible.

Table 11.4B Effect of Tax Reform Provisions on User Costs Stacked Separately and Together Compared to 1985 Law (Assumptions II)

	Stacked First Against 1985 law				Stacked Against Previous Provisions			
	User Cost	% Change from Baseline	No. of Owners	Holding Period of First	User Cost	% Change in User Cost	No. of Owners	Holding Period of First
1985 law[a]	8.79%	0.0%	3	19	8.79%	--	3	19
27.5 year straight-line depreciation	10.56%	20.2%	3	15	10.56%	20.2%	3	15
Tax rate reduction[b]	10.80%	22.9%	3	19	11.60%	9.8%	3	21
Non-exclusion of capital gains	9.42%	7.2%	2	26	11.76%	1.4%	2	28
Lower interest rates[c]	8.04%	-8.5%	3	18	10.97%	-6.7%	2	25
Capitalize CPIT	8.82%	0.3%	3	19	11.01%[d]	0.4%	2	25
Passive loss limitation[e]	12.21%	38.9%	2	26	11.43%	3.8%	2	27

[a] Assumes marginal tax rate of 50% for equity investors, 25% on debt, discount rate of 8%, mortgage interest rate of 10%, inflation rate of 3%, loan-to-value = 90%

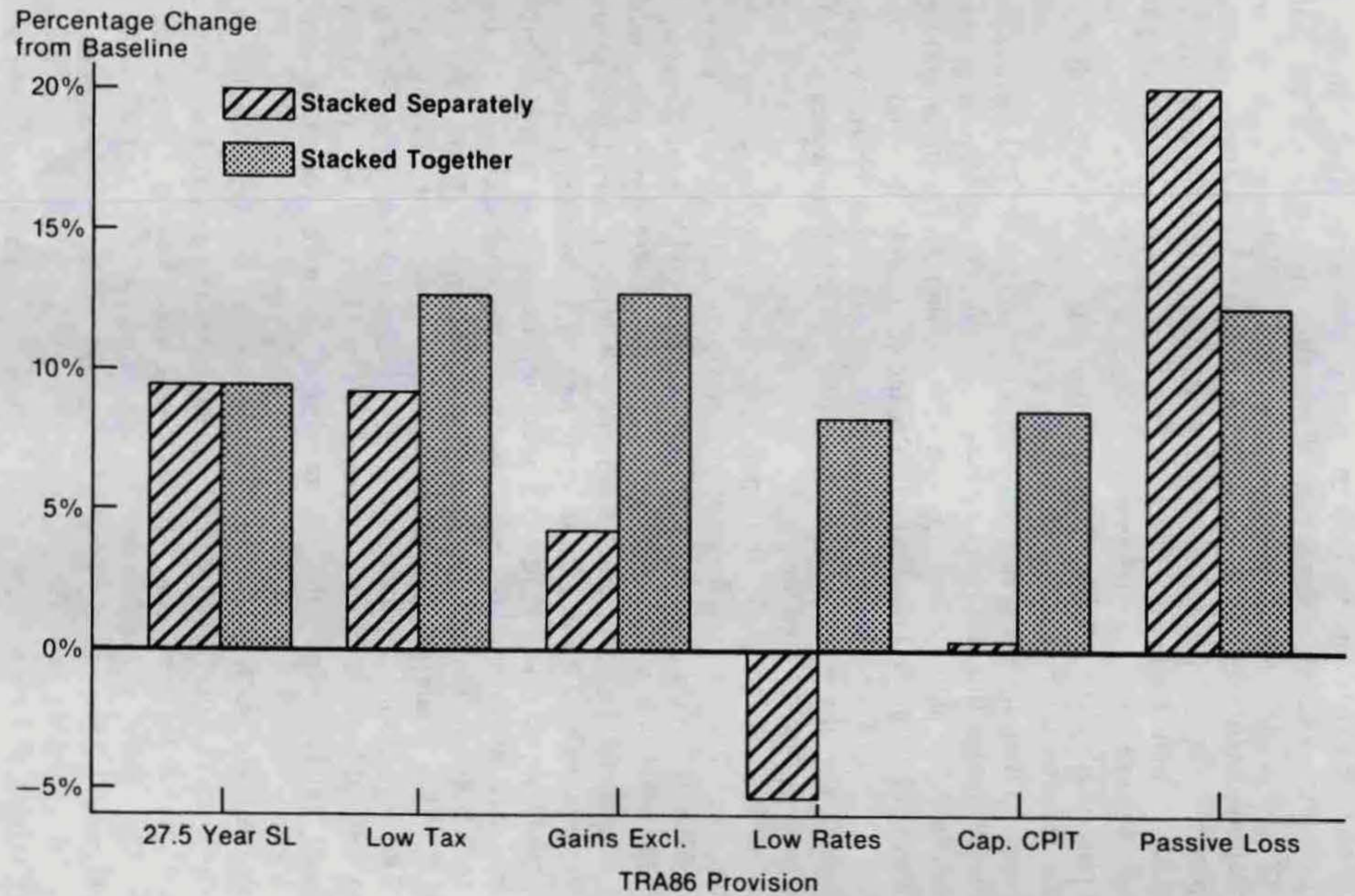
[b] Marginal tax rate is 28% for equity investors, 20% on debt.

[c] Interest rate = 9%

[d] TRA86.

[e] Assumes no offsetting passive income so no losses are currently deductible.

Figure 11.1 **Effect of TRA86 on User Costs**



Aside from the passive loss limitation, which will only affect certain investors, the most important single provision is the lengthening of the depreciation schedule. Were that the only reform, user costs for this hypothetical investor would increase by 9.4%. Reduction of marginal tax rates alone would increase user costs by 9.2% and repealing the exclusion for long-term capital gains would raise user costs by 4.2%.

The total impact is far less than the sum of its parts. After lengthening the depreciation schedule, the decrease in marginal tax rates has a very small effect on user costs, raising them by only 2.9%. With depreciation more closely approximating economic depreciation and with higher rents, there are few "paper losses" to deduct, so the tax rate of the investor diminishes in importance. Similarly, with lower tax rates, repeal of the capital gains exclusion becomes virtually irrelevant. While repealing the exclusion alone would raise user costs by 4.2%, full taxation of capital gains adds only 0.1% to user costs after tax rate reduction.

General equilibrium model analyses generally predict that TRA86 will reduce equilibrium market interest rates. (See e.g., Fullerton, Henderson, and Mackie, 1987). Table 11.4A shows that, in conjunction with other major provisions of TRA86, a 75 basis point decline in interest rates reduces user costs less than it would have under old law. Stacked on top of the other provisions, lower interest rates reduce user costs by 3.9% compared to 5.3% relative to the prior law baseline.

This is an interesting, and perhaps counterintuitive, result that illustrates the subtle interactions of tax revisions in a dynamic context. Because TRA86 curtails churning of rental housing, rental housing investments become far less leveraged on average. As a result, interest becomes a much smaller part of total costs. Thus a reduction in interest rates has a smaller effect on costs under TRA86 than it would have had under prior law.

One might expect that interest rate reduction would have a greater effect on user costs at lower tax rates, because the after-tax cost of debt increases. But user costs reflect before-tax rent levels. At the lower tax rates of TRA86, a one percent reduction in rents costs more after tax than before TRA86. Since lower tax rates raise both after-tax interest expense and after-tax rent, the direct effect of interest rate reduction should not depend on interest rates. Thus, the indirect effect through reduced churning dominates.

Much has been made of the effect of the passive loss limitation on real estate investors. Tables 11.4A and 11.4B show that the passive loss limit has far less impact in the context of TRA86 than it would have if adopted under prior law tax rates, depreciation rules, and interest rates. The separate provision would have raised the 1985 user cost by 20% in the example. However, the passive loss limitation would add only 3.4% when stacked on top of other TRA86 provisions. Under pre-TRA86 law, a passive loss limitation would have nullified the benefits of accelerated depreciation since tax losses would have been deferred until the time of sale. However, the reforms in

TRA86 combined with lower interest rates substantially reduce tax losses, so the passive loss limit has little effect.

C. TAX RATES, TAX REFORM, AND USER COSTS

Both ERTA and TRA86 significantly reduced top marginal tax rates. In 1988, when TRA86 is fully phased in, the top rate will be less than half of the 1980 maximum. With the tax incentives in pre-TRA86 law, investors in high tax brackets faced much lower user costs and effective tax rates for rental housing than investors in lower tax brackets. The Tax Reform Act of 1986, by scaling back the tax incentives and lowering marginal tax rates, removes those disparities. This provides both efficiency and equity gains. With approximately equal effective tax rates, high tax bracket investors will not be earning super-marginal returns. Furthermore, low and high bracket investors will have more equal access to real estate investments. Since accelerated depreciation provides the most valuable tax incentives to households in high tax brackets, tax rate reduction alone would have reduced much of the disparity in rates of return.

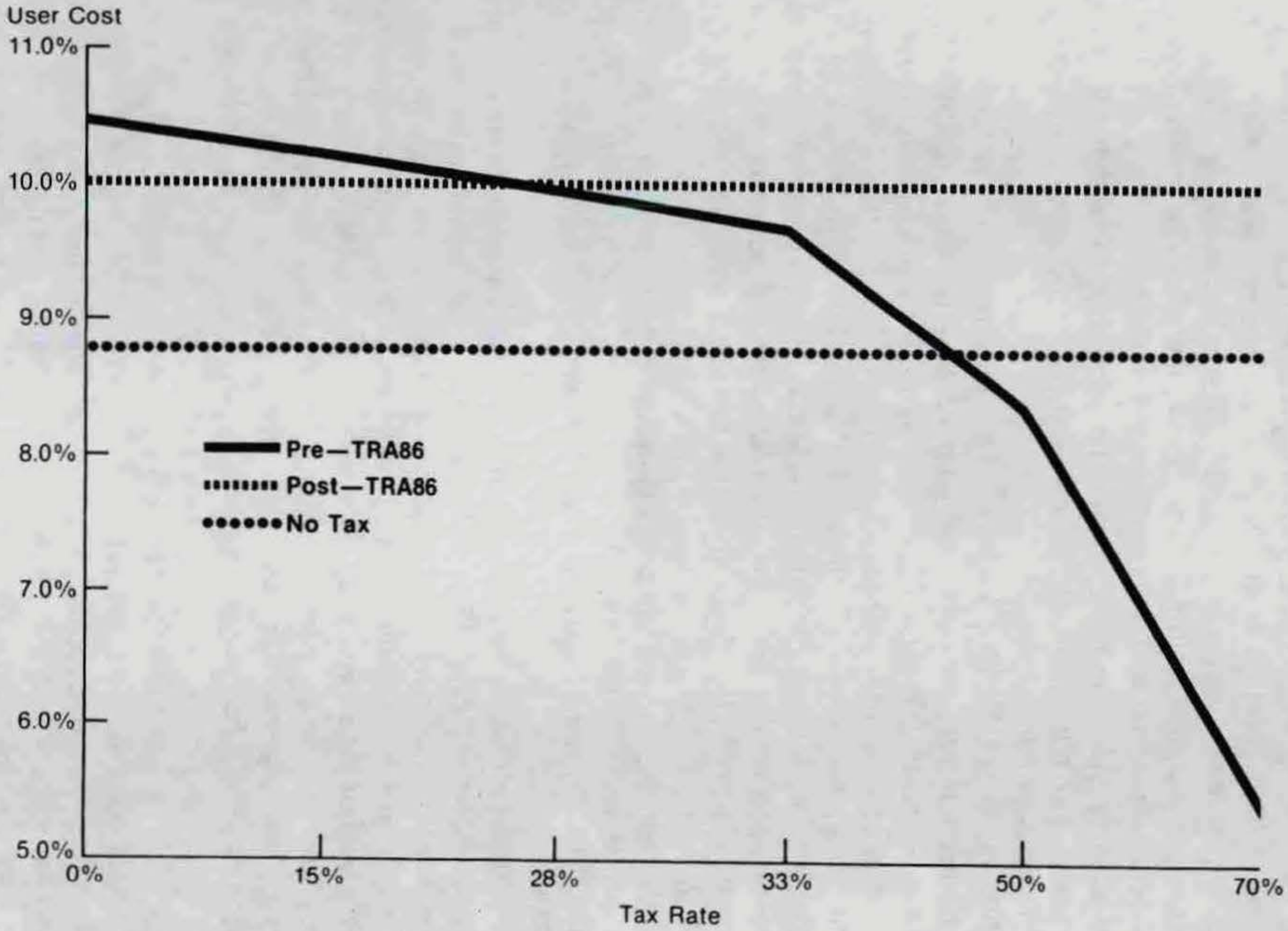
Tables 11.3A and 11.3B show for 1985 law how the cost of capital as well as several other summary indicators vary with marginal tax rates. In 1985 (Table 11.3A), a nontaxable investor faced the highest user cost of capital (10.44%) while the same investor would have a user cost of 8.39% (19.6% lower) if he were in the top tax bracket. If the pre-ERTA top rate of 70% had applied in 1985 the top-bracket investor's user cost would have been approximately half that of the non-taxable investor. Similarly, the net effective tax rate on equity varied from -173.9% for the 50% bracket investor to 0 for the nontaxable investor.

Simply reducing the top tax rate would substantially reduce this disparity. At a top rate of 33%, the disparity in user costs is cut by nearly two-thirds to 7.3%. The lowest effective tax rate is increased in absolute value terms to -88.5%.

Table 11.3B shows that the combination of residential real estate measures in the Tax Reform Act of 1986 obliterates the wide discrepancies between high-tax and low-tax investors. Effective tax rates become slightly positive for investors in every taxable income class. Because of longer depreciation and the repeal of the capital gains exclusion, the nontaxable investor becomes the least-cost investor by a small margin. If we were to further assume that the top-bracket investor were subject to the passive loss limitation, his or her user cost would become significantly greater than the untaxed investor's cost.

These data are illustrated in Figure 11.2. Before TRA86, user costs fell precipitously with marginal tax rates. But after TRA86, the relationship is virtually flat. (For comparison, the user cost that would apply in equilibrium if both lenders and real estate investors were exempt from tax is also shown.) At least for the baseline set of parameters, tax reform seems to have

Figure 11.2 **Effect of Tax Rates on User Cost**



succeeded dramatically in "leveling the playing field" among the various income classes of investors in rental housing.

It is important to point out that the quantitative conclusions are dependent on parameter assumptions. At lower discount rates or higher inflation rates, for example, the effective tax rates and user costs would be different. However, the qualitative results about the disparity in user costs and rates of return are robust with respect to different parameter assumptions. It is clear that tax reform will tend to place investors in different tax brackets on a much more even footing than under pre-1986 law.[18]

D. THE VALUE OF LOW-INCOME HOUSING TAX INCENTIVES

Table 11.5 compares the value of tax incentives for low-income rental housing before and after enactment of the Tax Reform Act of 1986. The table includes the value of tax-exempt bonds and the more generous ACRS depreciation schedule and expensing of construction period interest and taxes available in 1985. After tax reform, a credit of 4% per annum for ten years is available for low-income housing purchases and 9% per annum for ten years for new investment. A certain percentage[19] of units must be devoted to low-income tenants and abide by rent restrictions for a period of fifteen years. Rents are restrained to be no greater than 30% of "qualifying" income.

For the 1985 law rows, the rent stream is that which would allow the particular investor to break even without special tax preferences. The first two columns are based on the dynamic model; the third and fourth are based on the initial investor model. A comparison of columns shows how initial investor models tend to underestimate the capitalized value of tax incentives for subsequent investors since sale price is set exogenously. For the TRA86 columns, rents with the low-income housing credit are assumed to be limited to 30% of qualifying income, adjusted annually by the rate of inflation. For the credit for existing housing (4%), it is assumed that rents and all parameters for the initial investor are the same as in the low-income housing base case in row 2. The subsequent investors face limited rents and the same tax provisions as in TRA86.

Table 11.5 shows that before the Tax Reform Act of 1986, tax-exempt bonds were a very valuable subsidy.[20] While greatly accelerated depreciation would have been worth \$3,267 over the life of the project under the assumed parameters, tax-exempt bonds would have been worth more than twice as much (\$7,632) assuming that each owner received new tax-exempt bond financing.[21] If the unit qualified for low-income accelerated depreciation, the present value of tax benefits and appreciation in property value increased to \$12,672. With the lower interest rates, the optimizing investor would have found it worthwhile to sell after only 10 years, despite recapture penalties, to another investor who could claim the interest rate subsidy on the inflated value of the property. If the low-income units had to be rented at below-market rents, some or all of the value of the tax subsidy would be lost to the investor.

Table 11.5 **Present Value of Low-Income Housing Tax Incentives Relative to 1985 Law**

	Dynamic Model		Initial Investor Model	
	Present Value	Holding Period	Present Value	Holding Period
1985 Law				
1. Baseline	$0	19	$0	19
2. Special depreciation	$3,267	13	$2,167	15
3. (2) + bonds	$12,672	10	$6,327	18
4. (1) + bonds	$7,632	14	$4,499	19
Tax Reform Act of 1986				
5. 4% credit	$15,558	15	--	--
6. 9% credit				
a. 20% low-income	$9,968	15	$8,508	15
b. 40% low-income	$15,790	15	$14,721	50
7. 4% credit + bonds				
a. 20% low-income	$1,129	15	$1,100	15
b. 40% low-income	$7,699	15	$7,422	50

Assumptions:

1. $50,000 unit, newly constructed: all owners subject to 19-year ACRS: no tax-exempt bond financing. Rent stream is the same for (1) to (4). See Table 11.8 for parameter list.
2. Same unit as in (1). All owners subject to 15-year ACRS. Original owner expenses contruction period interest and taxes.
3. Same as (2), but all owners receive tax-exempt bond financing at interest rate 20% below rate in (1) and (2).
4. Same as (1), but all owners receive tax-exempt bond financing.
5. Same as (3) for first owner, but subsequent owners receive the 4% per annum low-income housing credit and are subject to TRA86 depreciation rules. Rent for second and subsequent owners is constrained to be not greater than $3,600 (approximately 30% of 50% of 1986 median income) in 1986 dollars.
6. First owner receives 9% per annum low-income housing credit: subsequent owners receive 4% credit. All investors in (6) and (7) are subject to TRA86 depreciation rules. In (a), at least 20% of units have tenants with incomes not greater than 50% of area median income: rent is constrained to be not greater than $3,600 per year in 1986 dollars. In (b), at least 40% of units have tenants with incomes not greater than 60% of area median income: rent is constrained to be not greater than $4,320 per year in 1986 dollars.
7. First owner receives 4% per annum low-income housing credit and tax-exempt bond financing: subsequent owners receive 4% credit, but not bond financing. Otherwise, this is the same as (6).

This probably explains why most units financed with tax-exempt bonds were not claiming low-income depreciation, which had far tighter restrictions on tenants' incomes.

The difference between the "dynamic" columns and the "initial investor" columns represents the extent to which future tax subsidies might be capitalized into the value of the property. In rows 2 to 4, the present value of tax subsidies is increased by at least half because future owners would bid more based on anticipated tax benefits.

Rows 5 to 7 in Table 11.5 represent the values of some of the tax subsidies for low-income housing in the Tax Reform Act of 1986. Row 5 shows the value of the 4% per annum credit for existing low-income housing applied to the ACRS low-income project in row 3.[22] The present value of $15,558 indicates that the 4% credit is more generous to the hypothetical investor than prior law.

The other rows show the two credits available for newly constructed low-income rental housing. Row 6 shows that the 9% per annum credit (for 10 years) could be worth between $9,968 and $15,790 to an investor in present value terms. In other words, the credits are equal to or more valuable than any tax preferences under pre-TRA86 law. From the table, it seems clear that the investor would be far better off using the higher qualifying percentage (40% low-income tenants) because that would allow him to charge 20% higher rents. However, this analysis does not account for possibly higher costs caused by having a larger percentage of low-income tenants.

Finally, the last rows illustrate the value of tax-exempt bond financing plus the 4% credit. After TRA86, units financed with tax-exempt bonds will be subject to meaningful restrictions on tenants' incomes combined with limits on rents. This will tend to reduce the value of the bond-credit combination as a subsidy for new construction–to $7,699 assuming a qualifying percentage of low-income occupants of 40%. Nonetheless, this is still comparable in value to the most popular tax-exempt financing option before TRA86.

V. LIMITATIONS OF PROJECT MODEL ANALYSIS

The basic limitation of project model analysis is that the results apply specifically to a single project. Sometimes a particular kind of result seems to occur even when assumed parameters are altered over a range of values, as in the first two examples in the last section. In this case, it may be safe to generalize the qualitative result as a market-wide phenomenon. But project models are not models of markets. Great caution must be exercised in trying to infer anything specific about prices and quantities of rental housing in either the short or the long run based on project model analysis alone.

A particular problem arises in using rental project models to predict changes in market rents. This interpretation of model results is, even under the best of circumstances, totally dependent on a set of assumptions that are guaranteed to be false. There is an obvious problem that complicated rental project models are dependent on a large number of parameters. The results shown in Table 11.3[23] amply demonstrate that quantitative model results are very sensitive to reasonable changes in parameter values. However, more fundamentally, the assumptions that would be necessary to allow generalization of the optimal investment decisions for one representative investor to the rental housing market could simply not hold in practice, no matter how good the parameter values were.

An analogy may be drawn with the corporate income tax. Arnold Harberger's (1962) analysis showed that, in general equilibrium, the incidence of the corporate income tax may fall in whole or in part on any of the input factors as well as on consumers. In the last decade, a number of economists have reconsidered the incidence of the corporate tax in a variety of general equilibrium models. The general conclusion of these models is that the corporate tax is a tax on capital. (See Shoven and Whalley, 1984.) And yet, those who use rental project models to predict market rent responses are implicitly assuming that the entire incidence of taxes on rental housing capital falls on consumers, at least in the long run. This incidence assumption is no more credible in the rental market than it would be for corporations.

To be sure, other kinds of analyses depend heavily on implicit assumptions. Bradford and Fullerton (1981) pointed out that effective tax rate calculations are sensitive to the assumed relationship between nominal interest rates and inflation (typically Fisher's Law or some variant). Hendershott and Ling's (1984) conclusion that high inflation reduces churning depends heavily on their assumptions that real after-tax interest rates are constant (what Bradford and Fullerton refer to as "modified Fisher's Law") and that refinancing is costless. If, on the other hand, pre-tax interest rates are sticky and refinancing is costly, high inflation will reduce real interest rates. However, with high refinancing costs investors' debt-equity ratios will increase even as the cost of debt falls. In this case, inflation would tend to <u>increase</u> churning because the property is worth more to a purchaser at a high loan-to-value ratio and a low interest rate than to the seller if he holds. Thus, user costs could move in the opposite direction to that predicted by Hendershott and Ling assuming constant real interest rates.

A. USING RENTAL PROJECT MODELS TO PREDICT RENT CHANGES

Perhaps the most common use to which rental project model analysis has been applied is the prediction of the effect of tax policy changes on market rents. While a plausible argument can be made that the user cost estimate could represent long-run equilibrium rents in a simple microeconomic model, we believe that in practice this insight is likely to be of little relevance to estimating quantitative changes in rents. Generalizing rental project model results to infer the response of market rents requires a number of assumptions that have not been critically appraised in the literature. This section explores the implications of each of these assumptions.

1. A Model in Which User Costs are Long-Run Equilibrium Market Rents

To see which assumptions are important, we can construct a hypothetical economy in which user costs would be good predictors of long-run required rents. This economy consists of a large number of identical investors. There are no barriers to entry or exit from the rental housing market, so when rents exceed their break-even levels, new rental housing is constructed which drives rents down to the level of user costs. Similarly, when rents are too low, the quantity of rental housing declines until rents cover costs. In other words, the market for rental housing is perfectly competitive.

The model treats all input prices as exogenous. This is equivalent to assuming that the supply of inputs, such as land, is perfectly elastic in the long run. Furthermore, rental housing services are produced under conditions of constant returns to scale.

Analysts typically compare "equilibrium" states in which a particular tax policy is assumed to hold for the life of the project. So in our hypothetical economy, the tax policy and economic environment that is assumed to be the baseline has been in place or predictable for long enough that investors could adjust. The new tax policy is a permanent change in the tax system, or investors will believe that it is permanent for long enough that the market will achieve the new equilibrium.

Finally, there is an issue of how investors would discount future returns. In the simple world hypothesized here, prices are either constant or evolve in such a way that investors can rationally plan for the future. Predictability is necessary for the market to converge to an equilibrium.[24] This means that real discount rates should be equal to the investors' real after-tax cost of funds. If future prices, costs, and taxes are random and investors are risk-averse, then we assume that investors discount future streams at the interest rate that would be charged in the market on an investment of comparable risk.

2. Critical Assumptions

Of course, the real world is different from the stylized model presented above. But it is not obvious that these deviations are more problematic than those required to generalize the results of other kinds of simulation models. However, we will show that the following implicit assumptions underlying project model analysis tend to bias rent predictions, generally in the direction of overstatement of market rent changes.

- Either all investors are the same, or there is one class of investor that is the marginal investor, or there exists an average or representative investor whose behavior approximates that of the market. Under the marginal or representative investor model, the marginal investor before the parameter change will remain the marginal investor after the change.

- Either the supply for rental housing is perfectly elastic or demand is perfectly inelastic in the long run.
- The market is in long-run equilibrium before the change that is being considered is undertaken.
- Investors are myopic with respect to future policy or structural changes.
- The parameter values chosen are correct for the representative investor.

3. Is There a Marginal or Representative Investor?

Housing analysts often assume that a particular kind of investor (such as the tax shelter syndicate) is the marginal investor. Under this assumption, for small changes, considering the behavior of the marginal investor would be sufficient to determine what will happen to the market.

There are a number of reasons why this assumption is inappropriate. The real shortcoming of generalizing based on the "representative" investor is that there is no such animal, not even as an approximation. Refer again to Table 11.3, which compares investors in different marginal tax brackets. Residential rental real estate, with the possible exception of high-end units, is owned by significant numbers of individuals in each tax bracket, as well as by corporations and by government. See Gravelle, 1985.

As Table 11.3 indicates, variation in marginal tax rates differentiates investors' costs and optimal behavior in every significant respect. Thus we cannot assume that investors are identical.

An alternative rationale is that there is a class of investors who are or who represent the marginal investor; that is, the source of new investment in real estate. There are three problems with this interpretation. First, economic theory suggests that all investors are "marginal" investors in the sense that they balance their portfolios so that, on a risk-adjusted basis, the expected marginal opportunity cost of additional investment in real estate just equals the expected additional revenue.[25] Since all investors are on the margin, a change in prices should affect investors in all classes. It is possible that because of credit constraints and transaction costs, most investors would not adjust their portfolios in response to small changes in prices. However, this should hold for investors in all classes.

Second, analysts often model the marginal investor as an individual or syndicate that is using real estate as a tax shelter. Tax shelter syndicates only represent a minority of investors in the residential real estate market. Furthermore, this application of "marginal" is somewhat peculiar in that the tax shelters seem to be the least-cost, rather than the highest-cost, investors in the market. Tax deductions are most valuable to high-bracket investors. But traditional economic analysis would identify the highest-cost investor as the marginal investor.

Alternatively, analysts could assume that there is some average or representative investor whose behavior accurately reflects the behavior of the market. A logical choice would be to use an investor with the weighted average characteristics of all investors. However, Table 11.3A makes it clear that an average investor would not match the "market average" response of high and low tax investors to a policy or structural change.

For example, suppose that 44% of the investors are non-taxable and 56% are in the 50% tax bracket. The average tax rate is 28%. Based on Table 11.4A, the average user cost would be 9.29%, the average holding period would be 32.6 years, the average debt-equity ratio would be 0.54, and the average effective net tax rate on the investment would be 8.3%. But looking at the "average" investor with a tax rate of 28%, the user cost is 9.94%[26], the holding period is 19 years, the debt-equity ratio is 0.62, and the effective net tax rate is 24%. The debt-equity ratio and the holding period are not even continuous functions of the tax rate. It is clear that the "typical" investor would not match market aggregates very closely at all.

The third criticism of this approach is that tax policy changes rarely represent marginal change, even approximately. Every tax bill since 1978 has made significant changes in the way real estate was taxed. The Economic Recovery Tax Act of 1981 expanded opportunities for real estate tax shelters, and the composition of the market changed in response. The Tax Reform Act of 1986 generally discourages tax shelters. It would be naive to assume that there would not be a structural change in the market.

Comparing Tables 11.3A and 11.3B, the user costs for investors in different tax brackets flip-flop based on the assumed parameterization of the effect of tax reform. High tax bracket investors are the low-cost investors in the pre-1986 environment, and costs increase as the marginal tax rate falls. But after tax reform, low tax-bracket investors face the lowest costs and high tax-bracket investors become the high-cost investors, although by a small margin. As Tables 11.4A and 11.4B showed, investors subject to the passive loss limitation will face much higher costs than other investors after TRA86. The result should be a shift in rental investment away from tax-shelter partnerships in favor of tax-exempt institutions and other lightly-taxed investors.

We conclude that any analysis based on a representative investor is likely to exaggerate predicted rent changes, even if all of the other assumptions underlying rental project model analysis were correct. Actual market responses depend on the market dynamics, as investors in different classes become more or less important. While rental project model analysis might be a useful first stage in such an analysis, dynamic market analysis with many classes of investors is beyond the scope of available project models.

4. Problems With a Static Competitive Model Assuming Regressive Expectations

a. Is Supply Perfectly Elastic or Demand Perfectly Inelastic?

Rental project model estimates of market rents require, at a minimum, that either long-run supply be perfectly elastic or that long-run demand be perfectly inelastic. Figures 11.3A and 11.3B show these cases. Suppose, for example, that the initial equilibrium rent or user cost is P_o and that the equilibrium market quantity of rental housing is Q_o. Then a tax policy change raises the after-tax user cost to P_1 given the same input prices.

If input prices do not depend on the quantity of rental housing, then the long-run supply will be perfectly elastic as in Figure 11.3A. If demand is not perfectly inelastic, the equilibrium quantity of rental housing will fall until market rents rise by the full amount of the increase in user costs. However, it does not seem reasonable to assume that input prices are fixed in the long run. Since land of a given quality and location is fixed, even in the long run, land prices will depend on the quantity of rental housing. As individuals respond to higher rents by renting smaller homes, the demand for the complementary good, land, will also decline. Even for those who switch tenure modes to owner-occupancy, their housing costs will increase and they will tend to consume less housing. Furthermore, zoning laws may limit the convertibility of land between uses. Thus, overall demand for residential land will decline, which will drive its price down. The result is that the long run supply of rental housing can not be totally elastic.

However, if the demand for rental housing is perfectly inelastic, rents would also increase by the change in user costs, as Figure 11.3B shows. In this case, the quantity of rental housing remains fixed.

While empirical evidence suggests that demand for rental housing is inelastic (see Mayo, 1981), there is no statistical evidence that the demand elasticity is zero. In the long run, market demand reflects changes in tenure choice as the relative price of rental housing increases relative to owner-occupied housing as well as a decrease in average quantity of housing services consumed by those who continue to rent. Furthermore, long-run demand elasticities will be greater than in the short run when housing choices are limited by transaction costs of moving.

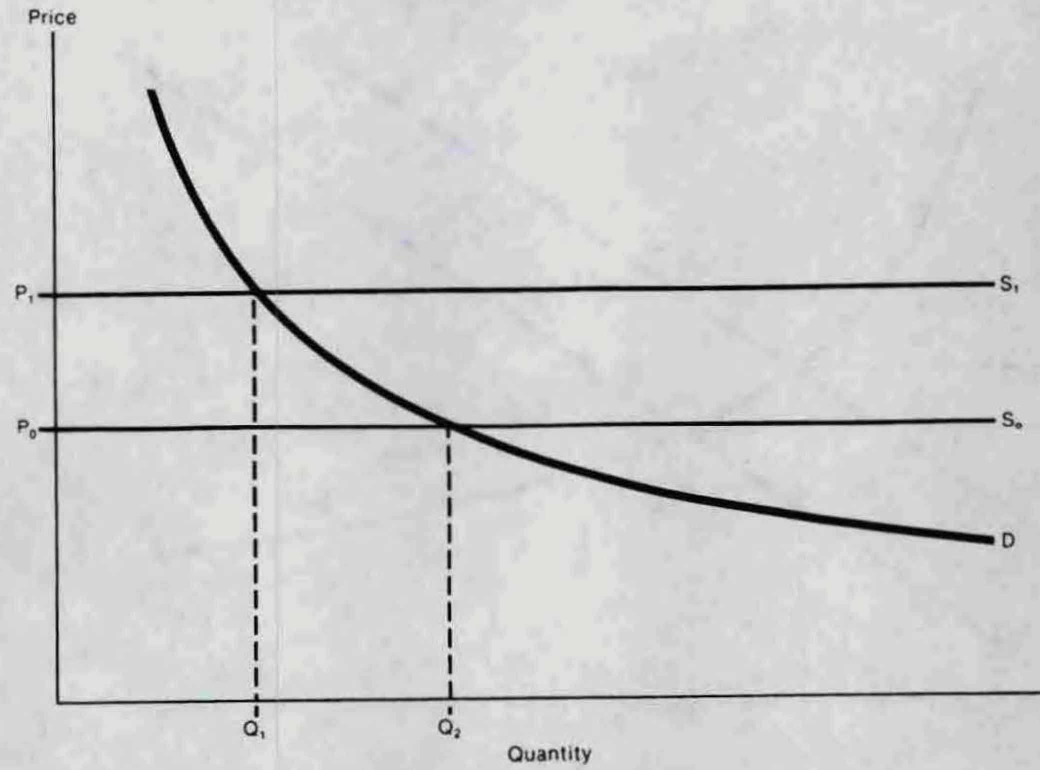
Figure 11.3C shows the equilibrium in the case where long-run supply and demand both have constant elasticities of 0.5. The graph shows that a parallel shift in the supply curve would increase equilibrium prices by less than half of the predicted change in the extreme models. While the actual level of price increase depends on long-run elasticities, it is unlikely that the long-run change in market equilibrium rents will be as great as the change in user costs.

b. The Relevance of Static Analysis

Even if one of the extreme models of long run supply and demand were accurate, that would not mean that the change in long run equilibrium rents would be a good predictor of how actual market rents would change, either in the short or the long run. If the user cost were an accurate measure of long-run rents, it would generally not represent rents in the short run. The high

Figure 11.3 **Long-Run Supply and Demand**

A. **Assuming Perfectly Elastic Supply**



B. **Assuming Perfectly Inelastic Demand**

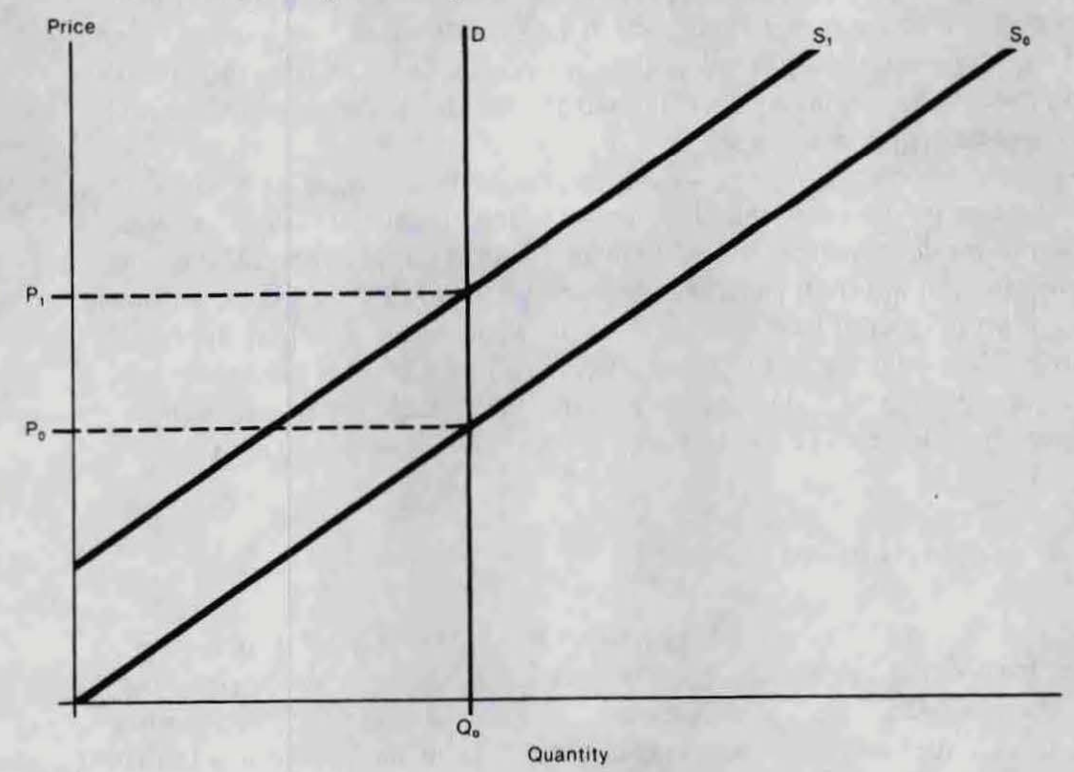
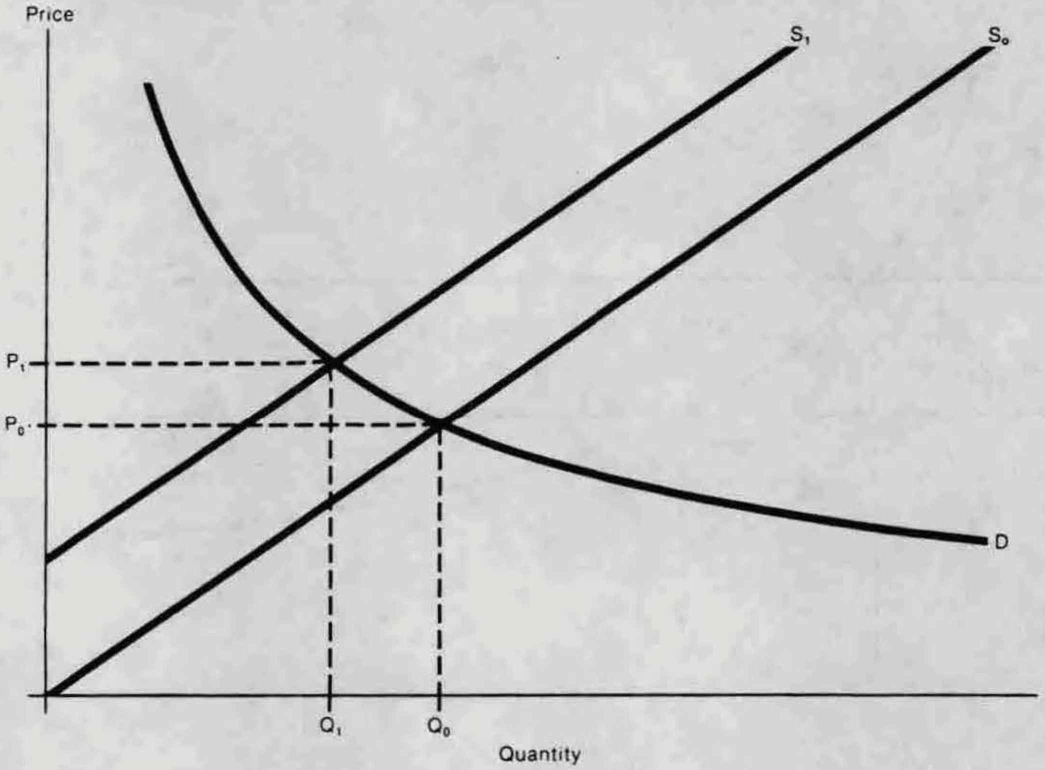


Figure 11.3 **(continued)**

C. **Assuming Constant Elasticity Supply and Demand**



transaction costs of buying and selling rental housing, the lengthy construction period for new housing, and local rent controls mean that market rents would be very slow to adjust toward their long-run levels. This also means that in a dynamic environment where tax and non-tax shocks are common, current rents are not at equilibrium levels.

Thus, the percentage change in long-run equilibrium rents as a result of adopting some policy could overstate or understate the actual change in rents, even if the model were perfectly specified. For example, several analysts predicted that equilibrium rents would increase from 1985 levels as a result of tax reform. But if rents in 1985 were above their equilibrium levels because of slow adjustment to the tax incentives in ERTA and the precipitous drop in interest rates of the past few years, the actual increase in equilibrium rents from their 1985 levels would be much less than predicted (or even negative).

c. Are Investors Really Myopic?

The assumption of myopia is also troublesome in trying to infer market rent changes from rental project models. Tax laws have changed about every two years over the last decade, and every new law has changed the depreciation treatment of rental housing. Rational investors would have to conclude that special tax incentives for rental housing are risky. Since tax benefits are capitalized into property values, investors should also be able to figure out that the resale values for their properties are also risky.

With pre-TRA86 depreciation deductions greatly in excess of economic depreciation, investors might have perceived more downside risk in resale prices than on the upside. The result would be that pre-TRA86 prices would not be as low as would be predicted by a model assuming perfect certainty. Thus, post-1986 price increases would be overstated by the model. This would be exacerbated if current investors expected that future tax bills would have a high probability of restoring tax shelter benefits, as has been suggested by some press reports. Finally, as Hendershott, Ling, and Follain (1986) pointed out, investors would have anticipated, at least in part, the effect of TRA86 on rental real estate, and prices would have begun to adjust long before the bill became law.

While it is common to account for risk through higher or lower discount rates, a model of how particular kinds of risk are reflected in market risk premia is really needed. This is a notable shortcoming of rental project models.

B. SENSITIVITY OF MODEL RESULTS TO PARAMETER CHANGES

Every model is dependent on assumed parameters. A useful feature of sophisticated rental project models is the large range of parameters that may be selected and varied. However, model results are very sensitive to the assumed parameter values. Thus, even if all of the other assumptions used to justify generalizing model results were valid, model predictions would be very imprecise.

1. Some Alternative Assumptions

Table 11.6 shows user costs based on tax parameters representing pre-TRA86 law and TRA86 for a particular investor under a range of assumptions. The discount rate is probably the most commonly varied assumption, and it is very important. Raising the real after-tax discount rate from 4% to 12% exaggerates the effect of tax reform on user costs. The user cost increase (what some call a rent increase) as a result of TRA86 is 49.4% greater at the high discount rate than at the lower one. Furthermore, while tax reform would still reduce churning at the higher discount rate, it would no longer be expected to end churning altogether.

Hendershott and Ling (1985) showed how inflation can affect investor behavior and user costs. Higher inflation (holding real rates of return constant) lengthens optimal holding periods and raises user costs, as is shown in row 3 of Table 11.6. If we assume that Fisher's law does not hold with respect to real after-tax interest rates, however, so that real rates of return decline as inflation increases, the results change substantially. Investors then would find it profitable to churn more often under pre-1986

Table 11.6 User Cost Estimates Under a Range of Parameter Values

	Pre-1986 User Cost	Pre-1986 Holding Period	TRA86 User Cost	TRA86 Holding Period	% Change in User Cost
1. Baseline	9.23%	19	10.02%	50	8.3%
2. High Discount Rate	12.23%	12	13.41%	18	9.8%
3. High Inflation w/ const. real interest rate	9.79%	14	10.54%	50	7.1%
4. High Inflation w/ lower real interest rate	6.52%	14	7.35%	50	13.8%
5. Constant Refinancing	8.91%	50	9.95%	50	11.8%
6. Retired Landlord (X)	10.27%	50	9.68%	50	-5.8%
7. Pure Tax Shelter (Y)	10.37%	4	16.40%	25	58.1%

Assumptions:

1. See Table 11.8.
2. Discount rate = 12%
3. Inflation rates for land, operating costs, and rent are 10%. Real after-tax interest rates are the same as in (1), 4%.
4. Same as (3), except real after-tax interest rates fall by half of the increase in inflation (2.5%).
5. Mortgages are costlessly refinanced each year to keep the loan-to-value ratio at 80%.
6. Discount rate = 2%, inflation rate = 3%, tax rate = 15%, interest rate falls from 12% before to 10.5% after TRA86, no capital gains tax (property is held until death).
7. Discount rate = 12%, inflation rate = 10%, tax rates at maximum level, interest rate = 18.57% with no reduction after TRA86, 10% syndication fee, passive loss limitation is binding after TRA86.

law. The real cost of debt falls and the debt-equity ratio declines rapidly with high inflation, so investors sell to others who can leverage the property. As a result, user costs are much lower than they would be in the absence of inflation. While the level of increase in user costs is only slightly greater than in the base case, the predicted percentage increase rises substantially, as shown on row 4.

The churning result with inflation and a decrease in real rates depends heavily on another assumption, that refinancing is prohibitively expensive. If refinancing is allowed continuously, as Hendershott and Ling assumed, then there is no incentive to churn under this scenario. With constant refinancing, user costs are lower under each tax law, and the expected increase in user costs rises by 32%.

Table 11.3 showed that the results are sensitive with respect to tax rates. Other assumptions are also important. The cautionary tale is that predicted user cost increases and behavioral responses depend heavily on assumptions, upon which reputable analysts may have wide disagreements.

2. Two Views of TRA86

Rows 6 and 7 of Table 11.6 show two views of the effect of tax reform on rents. Row 6 shows an investor, X, who will be pleased with tax reform. Her required rent, as indicated by the user cost, falls by 5.8% from pre-1986 law as a result of tax reform provisions. In contrast, row 7 shows an unhappy person, Y, who would require higher rents after 1986 than he would have in 1985 to earn the same after-tax rate of return. Were the market made up entirely of investors like Y, both before and after tax-reform, rents might rise as predicted by some housing industry analysts.

Individual X might be representative of a number of current owners of rental real estate. For example, a large number of small units are owned by individuals in low tax brackets (for example, retired persons). It might also be assumed that low tax bracket investors have a low opportunity cost of funds and thus a low real discount rate. These individuals got negligible benefit from accelerated depreciation and other front-loaded tax incentives under pre-1986 law. Since we assume in Table 11.6 that tax reform will reduce interest rates by 0.75 percentage points, the benefit to X of lower interest rates exceeds the value of her lost tax benefits.

For Y, on the other hand, tax preferences were very valuable under pre-1986 law. Y might represent a typical partner in a tax-shelter syndicate. By making a highly leveraged investment and taking advantage of accelerated depreciation, he could generate tax losses that were very valuable at a tax rate of 50%. The front-loading of tax benefits was especially important to this investor because he has a high discount rate. Longer depreciation schedules, lower tax rates, a higher tax rate on capital gains, and the passive loss limitation combine to raise his user cost by 58.1%.

These views of the effect of tax reform on rents are completely contradictory and, of course, completely wrong, except as they pertain to particular kinds of individuals. The user cost changes could not both represent average rent changes. The only information about rents that might be gleaned from these polar cases is that the actual long-run rent change would probably be no greater than Y's user cost increase and no less than X's. This is not terribly useful given the range.

However, the comparison is informative if we forget about market rents and think about the individuals. The example for X suggests that low-taxed and untaxed investors similar to X should become more important in the rental housing market after tax reform than they have been recently. Y's experience suggests that rental housing tax shelters will probably not be as viable after tax reform unless they change their structure. This, of course, was the point of the anti-tax shelter provisions.

C. THE TRACK RECORD OF RENTAL PROJECT MODELS

The previous section argued that the assumptions necessary to justify inferring market rents from rental project models are unlikely to be satisfied in practice. With the exception of the assumption that parameter values are accurate, the practical effect of the assumptions is that predicted rent swings tend to exaggerate actual market responses. There is no guarantee that the predicted change would have the right sign, even if parameters were right on average.

Table 11.7 shows how user cost estimates, adjusted for changes in construction costs, tracked market rents as measured by the consumer price index for rents over the 1975-1985 period. Figure 11.4 illustrates the relationship graphically. The figure suggests that predicted rent changes bear only a weak relationship, If any, to short-term rent changes.[27]

Compared to actual rents there are large swings in the adjusted user cost variable. Actual rents increased steadily between 1975 and 1985, but never by more than 9% or by less than 5% in a year. User costs, on the other hand, decreased in four out of ten years. The absolute magnitude of the annual changes was greater than 9% in five out of ten years.[28] Finally, the predicted increase in rents over the eleven years was more than double the actual increase.

This does not demonstrate that rental project models cannot predict rents in the long-run. It may be that actual rents can be explained by a distributed lag on predicted user costs or that a different set of baseline assumptions would produce a stronger correlation. But the data suggest that, if there is a relationship between user cost estimates and actual rents, it may be too subtle to be useful.

Figure 11.4 **Predicted versus Actual Rents, 1975 - 1985**

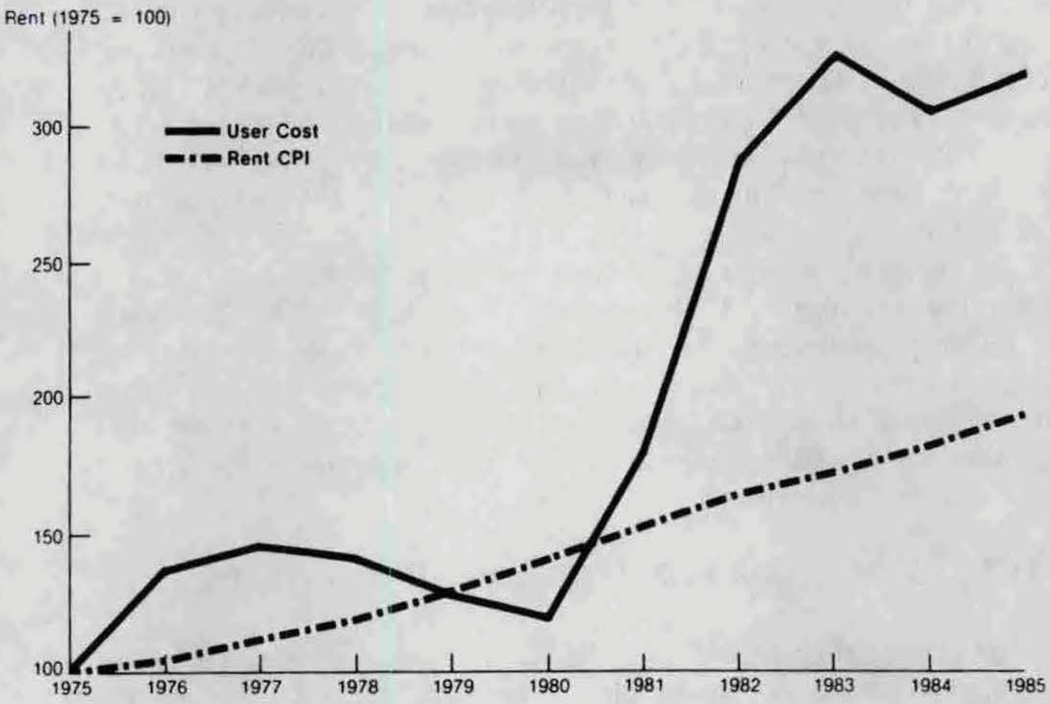


Table 11.7 **Project Model Estimates of Break-Even Rent Compared to the CPI for Urban Rents Using Historical Values - 1975 to 1985[a]**

Year[b]	Inflation Rate[c]	Mortgage Rate[d]	Construction Cost[e]	Break-Even Rent[f] Level	Break-Even Rent[f] % Change	CPI[g] Level	CPI[g] % Change	Holding Period
1975[1]	9.1%	9.00%	89	100	--	100	--	9
1976[1]	5.8	9.00	92	137	37%	105	5%	16
1977[1]	6.5	9.02	100	146	7	112	6	14
1978[2]	7.7	9.56	113	141	-3	119	7	9
1979[2]	11.3	10.78	129	127	-10	128	7	5
1980[2]	13.5	12.66	143	120	-6	140	9	4
1981[3]	10.4	14.70	152	178	48	152	9	7
1982[3]	6.1	15.14	154	287	61	163	8	15
1983[3]	3.2	12.57	157	326	14	173	6	50
1984[4]	4.3	12.38	164	307	-6	182	5	18
1985[5]	3.6	11.50[p]	169	320	4	193	6	19

[a] For non-low-income residential rental property.

[b] Tax law assumes marginal tax bracket of twice median income investor and:

[1] 175% declining balance (DB) depreciation new property, 125% on used property with useful life over 20 years, 50% capital gain exclusion, 10-year amortization of construction period interest and taxes.

[2] Same as a, except 60% capital gains exclusion.

[3] Same as b, except ACRS (175% DB), 15 year life on new and used property.

[4] Same as b, except ACRS, 18 year life.

[5] Same as b, except ACRS, 19 year life.

[c] Consumer price index for all items.

[d] New home mortgage yields (p = preliminary).

[e] Department of Commerce composite construction cost (1977 = 100).

[f] Product of user cost and construction cost index normalized so 1975 = 100.

[g] Normalized so 1975 = 100.

VI. CONCLUSION

This paper has described the state of the art of rental housing project models. We have found that rental project model analysis is useful–almost essential–in studying the behavioral responses of individual investors to complicated tax policy changes that may affect current or future investors in rental housing. Rental project models can be used to study how special tax preferences are capitalized into land and property values as well as the direct effects of those policies on the costs and returns to investors. The OTA rental project model provides estimates of effective tax rates that take account of the special characteristics of the rental investment, especially leveraging and the effects of tax benefits on future investors when there is churning.

However, rental project models cannot by themselves produce reliable estimates of changes in market rents as a result of tax policy changes. Virtually all of the assumptions necessary to generalize the results of rental project models to the market as a whole tend to predict grossly exaggerated market responses. No credible market analysis can rely solely on the predictions of rental project models.

We have used the OTA model to look at the effects of the Tax Reform Act of 1986 on the behavior of residential rental real estate investors. It was found that tax reform succeeds in greatly reducing the distortions in investor behavior that were prevalent under prior law.[29] TRA86 diminishes the incentive to churn real estate for tax reasons. It reduces the disparity in the costs and returns to real estate investment among different investors. As a result, residential real estate will no longer provide large tax shelters for high-income investors (except for low-income housing). Investors in all tax brackets will have to evaluate real estate investment based on the economic, rather than the tax, consequences. Further, we found that the most significant anti-tax shelter provisions in TRA86 were lengthening depreciation schedules and lowering marginal tax rates, not the passive loss limitation, even though the latter was the only explicitly tax shelter-oriented provision.

This paper has focused on using the OTA model as a residential rental housing project model, but the scope of such analysis is much broader. OTA analysts have used the model to study the effects of tax provisions and proposals on commercial real estate. The model could also be used to study the effects of taxes on other capital assets, especially long-lived assets for which resale markets are reasonably well developed.[30] Farm machinery and equipment, for example, would provide logical applications.

Several extensions of rental project model analysis would be worthwhile. The model presented here does not allow for rehabilitation, although tax laws are important in certain kinds of rehabilitation projects. A better developed model of the role of uncertainty in rental housing investment decisions is clearly called for. While Hendershott and Ling's approach of discounting future streams of income and expense at different rates is an interesting extension, a full treatment of risk would have to explicitly account for the nature of the random disturbances that could affect future income. A model that assumed that investors maximize expected utility under some degree of risk aversion might provide results very different from the essentially perfect certainty model presented here.

Finally, the question of how tax policy affects market rents is important, even if present models are not well suited to answering the question. A general equilibrium market model that incorporated the level of detail about tax policies in the OTA model would be a valuable tool. Such a model should include a variety of classes of investors and should integrate the various kinds of real estate: residential rental, commercial rental, and owner-occupied housing. Investors should choose between real estate and other kinds of capital investment. Consumers should choose between rental and owner-occupied housing as well as other consumer goods. However, whether such a model is or will be technically feasible is an open question.

APPENDIX

A. INTRODUCTION

The OTA Rental Housing Project Model program was developed by the Treasury Department to simulate the effects of tax law changes on returns to rental housing investment. The model simulates the costs, returns, and tax consequences of a hypothetical real estate investment. The model includes tax provisions for housing under current and recent Federal statutes, as well as several reform proposals made over the past few years.

An extensive set of data parameter assumptions is necessary to generate user costs, sales prices, and before and after tax returns for a hypothetical investment in a rental unit. The model requires specification of tax law parameters, the building's useful life, the mix of the original investment between land, structure, and construction period costs, interest rates and inflation rates, operating costs, competitive real rates of return and the marginal tax rates of current and potential future investors, and the economic rate of depreciation for the structure. All of these parameters may be changed by the model user.

The program output may include (depending on print parameter settings) detailed information about the initial investment and period-by-period before and after tax returns for the original and subsequent investors. By default, the calculator computes the present value and internal rate of return, both before and after tax, earned by the original investor. The program can also be set to find the initial rent-to-value ratio that would give the initial investor an after tax present value of zero or compute the internal rate of return that would make all investors break even in present value terms.

Table 11.8 lists the parameters used to simulate a rental housing investment both before and after enactment of the Tax Reform Act of 1986. The full list of possible parameters is much longer. Documentation is available upon request. For reference, Table 11.9 briefly summarizes the key rental housing provisions in the Tax Reform Act of 1986.

B. HOW THE CALCULATOR WORKS

The flowchart in Figure 11.5 illustrates how the model computes before and after tax returns for all investors in a rental project over its useful life. The calculator inputs parameter values from a FORTRAN NAMELIST.

The calculator can operate in several modes. In its basic mode, the calculator may be thought of as planning the optimal investment for a well-informed hypothetical investor. This investor would want to know how much the investment will cost (see 2 on Figure 11.5), the expected stream of rents and operating costs (3), the tax benefits that would accrue while the property is held (5), and sales prices and tax costs of sale at various dates (4 and 5). The investor could then find the holding period that maximized the present

Table 11.8 **Input Parameters and Baseline Values**

	1985 Law	TRA86
A. Economic Characteristics		
1. initial operating cost to value ratio	.0250	.0250
2. true depreciation rate	.0300	.0300
3. growth rate of prices		
a) land	.050	.050
b) structure	.050	.050
c) CPI.050	.050	
d) operating costs	.050	.050
4. length of construction period	1	1
5. amount spent on structure	44000.	44000.
6. value of land when building placed in service	6000.	6000.
7. fraction of expenditures on structure by year		
a) year 1	1.000	1.000
B. Financing Characteristics		
1. initial mortgage/value ratio	.800	.800
2. mortgage rate	.1200	.1125
3. initial mortgage term (years)	30	30
4. frequency of refinancing (years)		
a) original owner	NA	NA
b) subsequent owner	NA	NA
5. construction loan/value ratio	.800	.800
6. construction loan rate	.1200	.1125
C. Tax Characteristics		
1. income tax bracket of owner		
a) original owner	.40	.22
b) subsequent owner	.40	.22
2. tax bracket of lender	.25	.20
3. property tax rate	.018	.018
4. capital gains treatment		
a) structure		
1) inclusion rate	.40	1.00
2) if indexed	No	No
b) land		
1) inclusion rate	.40	1.00
2) if indexed	No	No
5. depreciation treatment		
a) schedule, ACRS		
1) if declining balance	No	No
2) useful life	19	27
3) whether indexed	No	No
4) type of recapture	Excess	None
6. CPIT treatment		
a) fraction expensed	.10	.00
b) fraction 10 year amortization	.90	.00
c) fraction capitalized	.00	1.00
d) if indexed	No	No
7. minimum tax		
a) rate	.00	.00
b) fraction of excess depreciation subject	.00	.00
c) fraction of excluded gains subject	1.00	1.00
8. tax-exempt financing		
a) whether tax-exempt financing	No	No
b) percent reduction from conventional rate	20.	20.

NA = Not applicable.

Table 11.9 **COMPARISON OF REAL ESTATE TAX PROVISIONS BEFORE AND AFTER ENACTMENT OF THE TAX REFORM ACT OF 1986 (TRA86)**

Item	1985 Law	TRA86
Depreciation		
Low Income*	15-year real property; 200% DB	27.5-year SL
Other	19-year real property; 175% DB	Residential: 27.5-year SL Commercial: 31.5-year SL
Recapture		
Low-income*	Excess over SL; phased-out: 1% per month after 100 months	Not relevant because there is no exclusion of capital gains
Other	Excess over SL	
Construction Period Interest and Taxes		
Low Income*	Expensed	Capitalized
Other Housing	10-year amortization	Capitalized
Rehabilitation Credit		
Historic Structures Reduction	25% tax credit; 1/2 reduces basis	20% tax credit; full basis reduction
Nonhistoric Structures (nonresidental)	15% credit for 30-year old, 20% credit for 40-year old; full basis reduction	10% credit for buildings placed in service before 1936.
Rapid Amortization		
Low Income* Rehabilitation	60-month amortization; $20,000 or $40,000 limit per unit	Provision allowed to expire 12/31/86
Low Income Housing Credits	No provision	
Credit Level		
Non-Federally Subsidized Units		Credits with present value of 70% of basis over 10 years for new construction and qualified rehabilitation expenditures
Federally Subsidized (e.g., tax-exempt bonds)		Credits with present value of 30% of basis over 10 years
Certain Existing Housing (HUD resyndications)		Same as Federally subsidized
Additional Low Income Units		Units added above the contracted level may receive credits at 2/3 the annual rate of base credits over the remaining years in the compliance period
Income Requirement		
General		Same as for tax-exempt bonds
Existing Housing		At least 50% of units are very low income*

Table 11.9 **COMPARISON OF REAL ESTATE TAX PROVISIONS (continued)**

Item	1985 Law	TRA86
Rent Limitation		Rent can be no greater than 30% of qualifying income (either 50% or 60% of area median)
Compliance Period		Income requirement and rent limitation must be met for 15 years
State Volume Cap		
Non-Federally Subsidized		New annual authority of $1.25 per resident per year, admin. by state housing authority
Federally Subsidized		Not subject to credit cap (although tax-exempt bond cap may apply)
Compliance Penalty		Accelerated portion of credit (relative to a 15 year credit) is recaptured with interest
Expiration Date		December 31, 1989
At-Risk Rules		
Deductibility of Losses	No limit for real estate	Repeal real estate exception, except 3rd-party non-recourse debt secured by real estate is considered at risk
Tax Exempt Bonds		
Multi-Family Rental	Unlimited tax-exempt bond authority	Bond authority subject to private-purpose bond state volume cap
Income Requirement	20% of households (15% in targeted areas) have incomes <80% of area median or 25% of households have incomes <70% of area median	Either 20% of units are very low income* or 40% are low income*
Qualified Project Period	Max {10 years, 50% of loan term, period of Section 8 Assistance}	Minimum period is 12 years
Compliance Penalty	Bonds retroactively taxable	Bonds retroactively taxable; interest not deductible
Loss Limitation	No provision	Rental losses may not be used to offset active income; $25,000 exception for active rental losses by indiv., phase-out at high incomes

*Definitions
Low Income
1985 Law - 85% of households have incomes ≤ 50% of area median, adjusted for family size
TR86 - Incomes ≤ 60% of area median, adjusted for family size
Very Low Income
TRA86 - Incomes ≤ 50% of area median, adjusted for family size

Figure 11.5 **Flow Chart of Treasury Rental Investment Calculator**

1. Input Data
   NAMELIST input parameters override default values.

2. Initial Investment (period 0)
   Net cash flow = - down payment
   - closing costs
   + initial tax benefit from CPIT

3. Generate Flows
   Determined by initial values of land and structure, rent-to-value and operating cost-to-value ratios, and rates of inflation.

4. Generate Sales Prices and Holding Periods
   For a given year:
   1. Find the sales price for each possible holding period that gives a typical investor a competitive rate of return.
   2. The optimal holding period and sales price give maximum sales price in (1).

5. Compute the Consequences of Optimal Holding Pattern
   The optimal holding period for the orignal owner is computed as above, except that the purchase price is fixed and the tax benefits of CPIT are included and the original owner's tax rate is used.

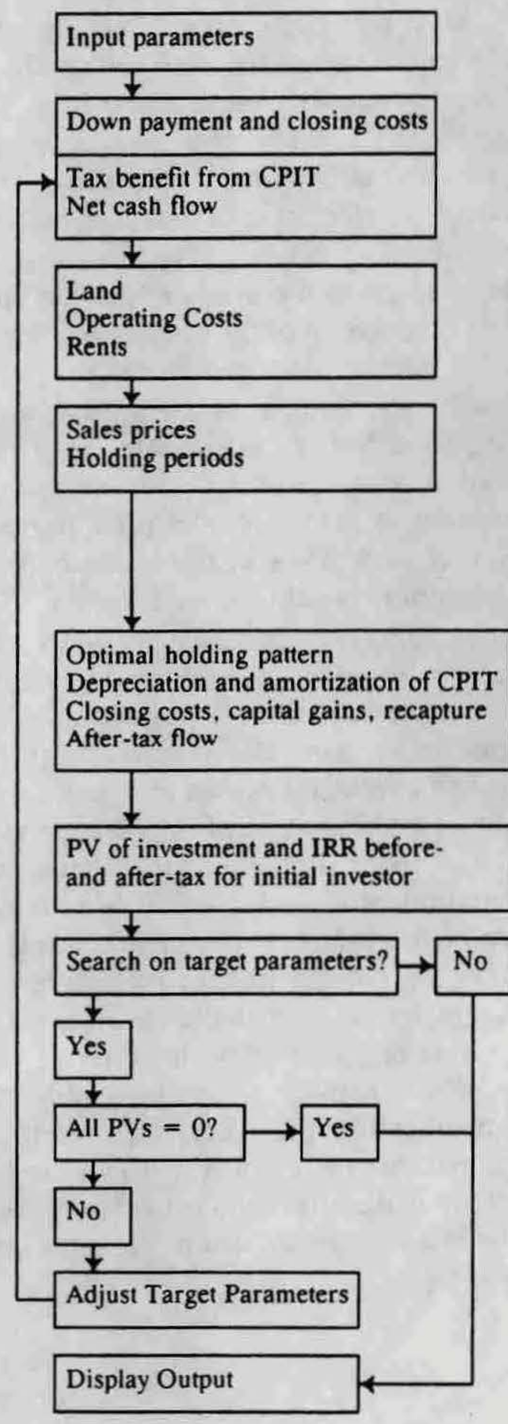
6. Analysis of Investment (initial investor)
   Present value is based on initial cost, and taxes. IRR is found iteratively.

7. Optional Search
   Vary initial rent-to-value ratio or target internal rate of return until all PVs = 0 (i.e., everyone gets competitive rate of return).

   Done search?

   Marginal tax rates

8. Output
   For each investor:
   Initial costs (including CPIT for first)
   Pre-tax cash flow
   Cash-flow tax benefits
   After-tax cash flow
   Closing costs, capital gain taxes, recapture
   Either after-tax PV and IRR for first investor or IRR for all investors or user cost.



value of the investment. The property would be purchased if the net present value of the investment were at least zero.

Most real estate project models treat the sales price in each period as an exogenous stream (Hendershott and Ling, 1984, is the notable exception). The Treasury model computes the sales price in each period that would give a subsequent investor who behaves optimally the same rate of return as his/her best alternative investment (i.e., net present value equals zero). The calculator iterates over possible holding periods and finds the bid price for each holding period. The sales price in any period is equal to the highest bid price, which corresponds to the optimal holding period.

Computation of the optimal holding period requires knowledge of all future sales prices. At the terminal period (N), the structure is assumed to have totally deteriorated, so sales price would be equal to the value of the land. At period N-1, all future sales prices are known. The decision is whether to hold for one period or to sell the property for its land value. If the property is held, the sales price in period N-1 is the present value in period N-1 of cash flows in the last two periods. Working backwards, all future sales prices are thus always known. The calculator computes the sales price and holding period in each period by computing the optimal holding period for some sales price, then raising or lowering the sales price depending on whether the present value is positive or negative, and repeating the computation until the present value is driven to zero.

The alternative modes of operation, which are set by parameter, provide a way of altering some of the inherent assumptions in the basic mode computation. Using option 1, the initial rent-to-value ratio is varied until the initial investor's net present value is driven to zero. This provides a measure of the user cost of rental housing. In the second option, the calculator finds the change in the internal rate of return for all investors (i.e., the rate of return such that all earn a net present value of zero). This gives a measure of how changes in policy or other parameters would affect the return on capital assuming that the supply of capital is fixed and all other prices remain constant. After a tax increase, for example, the change in the internal rate of return would indicate how much interest rates would have to fall to make the hypothetical investor just as well off as before the tax. The internal rate of return also allows measurement of effective tax rates.

FOOTNOTES

[1] For example, some analysts predicted that residential rents would increase by more than twenty percent, while others predicted long-run rent increases of less than ten percent. For low-income housing, the disparity in estimates was much wider.

[2] This is arbitrary. In fact, because of the weak recapture provisions on low-income housing, investors would often find it profitable to sell before 15 years. See Table 11.5 for examples.

[3] Hendershott and Ling (1985) argue that different income and expense streams should have different discount rates depending on their relative certainty. Nonetheless, there is no empirical evidence showing some future streams to be more certain than others. Summers (1986) argues that business planners do not discount relatively sure streams of tax deductions at a lower rate than other riskier expenses and income.

[4] Unlike the internal rate of return, which may only be calculated iteratively, the equivalent coupon rate can be computed based on a simple formula.

The equivalent coupon rate is the value i that solves the equation,

$$\Sigma_{t=1}^{N} \; iY(1+\gamma)^{-t} + Y(1+\gamma)^{-N} = X ,$$

where N is the holding period of the investment (15 years in the example), Y is the initial investment ($5,150), γ is the discount rate (8%), and X is the gross present value of returns to the investment ($7,693). The equation simply requires that the "equivalent" bond, which pays rate i, pay annual interest (the first part of the equation) and repay the principal at the end of year N (the second part) with present value equal to the present value of returns to the rental investment (X).

[5] For example, the five percentage point drop in mortgage interest rates since 1981 almost certainly has had more effect on rents and returns to investors than any of the tax-shelter provision in the Tax Reform Act of 1986 will have, even under the most extreme assumptions about other parameter values.

[6] The holding period is also important in determining the rate of return to the investor, which will generally depend on when the project is sold.

[7] Endogenous determination of holding periods is the essential feature of timber, oil, and other resource models. In this kind of model, the analyst is interested in how long an investor will hold a tree (or oil well) before cutting (or drilling).

[8] The term churning refers to the frequent sale of an asset in order to maximize the value of tax benefits. The primary tax benefit to churning, at least before TRA86, was that new investors would get a "step-up in basis," while the seller would not be fully taxed on the gain due to weak recapture rules. In other words, each new purchaser would be able to take new accelerated depreciation deductions based on the purchase price of the asset, rather than the old depreciated basis.

[9] Hendershott and Ling (1985) independently developed a model similar to the one described here.

[10] Technical documentation and FORTRAN 77 source code for the model is available upon request.

[11] The user cost is the most common, and most commonly misinterpreted, output of rental project models. Section V discusses the misinterpretation of user costs in detail.

[12] Holding other parameters constant, model simulations indicate that pre-TRA86 investors in high tax brackets earned far higher rates of return than investors in low brackets.

[13] The model uses computed internal rates of return for r_a and r_b.

[14] See Musgrave and Musgrave, 1983, pp. 185-186.

[15] Recapture provisions penalized sale of the property before the end of the depreciation period (19 years in 1985) by subjecting capital gain which corresponded to deductions in excess of straight-line depreciation to taxation at ordinary rates rather than the lower capital gains rates.

[16] Table 11.9 compares the rental housing provisions in the Tax Reform Act of 1986 with those of pre-1986 law. TRA86 includes a new tax credit for low income housing, which may encourage churning if it is extended beyond its planned expiration date.

[17] The low-income housing credit provides a credit-equivalent of greatly accelerated depreciation with a harsh recapture provision during the first fifteen years after the credit begins. This credit will encourage churning of qualifying low-income properties every fifteen years. However, since the credit provision is temporary, the incentive to churn low-income housing will be sharply reduced if the credit is allowed to expire as scheduled in 1989.

[18] TRA86 may make effective tax rates quite different for individuals in the same tax bracket. For example, a high-income investor with sources of passive income will find investing in

loss-producing real estate more advantageous than a similar investor with portfolio and labor income only. Since investors with incomes below $200,000 will only be able to currently claim low-income housing credits equal to their marginal tax rate times $25,000, individuals in the top bracket (33%) will be able to claim the most credits.

[19] To qualify for the low-income housing credit, either 20% of rental units must be rented to households with incomes not greater than 50% of area median income or 40% of units must be rented to tenants with incomes not greater than 60% of area median income.

[20] The value of tax-exempt bond financing includes a possibility for leveraging the value of the subsidy. In the case of elderly housing, for example, the non-low-income units might well be rented to tenants who can pay market rents. The result is that with a 20% low-income occupancy requirement, the value of tax-exempt bond financing is leveraged by as much as four to one. In other words, since the bond financing is for the whole project, four non-low-income units are subsidized for every one low-income unit. However, in other cases, rents might be depressed or risk might be higher for the entire housing project, which would mean that the leveraging argument would be less valid. The table assumes no leveraging.

[21] To qualify for bond financing, subsequent owners would have to substantially rehabilitate the property, which was not reflected in the model runs. To the extent that rent increases would not cover the cost of rehabilitation, the value of future subsidies may be exaggerated.

[22] The low-income housing credit is scheduled to expire after 1989, many years before any ACRS low-income housing would become eligible (since a project has to have been in service for at least 15 years to qualify for the credit). The low-income housing credit examples in Table 11.5 answer the question: "how would investors value a property under TRA86 if they expected the low-income housing credit to be extended permanently?"

Note that there is no initial investor column in row (5) because the credit only applies to second and subsequent investors.

[23] See also Table 11.7, which is discussed in section C.

[24] Note that "predictability" does not mean that there can be no random shocks. A rational expectations equilibrium could exist if the optimizing behavior of economic agents conditional on their expectations produces market prices whose means are equal to those expectations. However, the rental project model would only produce user costs that represent market rents if investors were risk neutral and the investors' optimization problem satisfied the conditions for "certainty equivalence" (Sargent, 1987). Proof of certainty equivalence is beyond the scope of this paper.

[25] This issue is reminiscent of Miller's (1977) model of the effect of taxes on ownership of debt and equity and subsequent analyses. In Miller's model, there is some marginal tax rate at which an investor is indifferent between holding debt and equity. Investors with higher marginal tax rates hold only equity, and investors in lower tax brackets hold debt. In this framework, the marginal investor determines the relative cost of debt and equity in equilibrium.

Of course, as Miller noted, equity is held by non-taxable institutions and debt is held by high tax bracket investors. Subsequent general equilibrium models of portfolio choice under risk with many classes of investors have shown that portfolio diversification between debt and equity is rational. (See Slemrod, 1985, or Galper, Lucke, and Toder, 1987.) In a model with risk, every investor is a marginal investor, buying assets until marginal risk-adjusted after-tax rates of return are equalized. Thus, the simple device of considering a single investor or class of investor as the marginal actor is inappropriate.

[26] The average user cost would always be less than the user cost of the "average" investor, at least for the assumed pre-TRA86 parameters. Figure 11.2 shows that user costs were a concave function of marginal tax rates, which implies this result.

[27] The hypothesis of no relationship between adjusted user cost and rents is not rejected at the 5% level. The estimated regression equation is

$$\text{CPI Rent} = \underset{(38.8)}{0.819} + \underset{(15.2)}{0.0867}\ \text{Time} + \underset{(2.1)}{0.0432}\ \text{User Cost.}$$

T-ratios are in parentheses. The adjusted R^2 with eight degrees of freedom is 0.993. However, if user cost is excluded, the adjusted R^2 is 0.990. Note that the small sample size and obvious collinearity between user cost and the trend variable make this a dubious statistical test. It suggests, however, that if user cost has any contemporaneous effect on rents, it is likely to be dwarfed in importance by other factors.

[28] To keep things in perspective, one should note that non-tax factors contributed significantly to predicted changes.

[29] This is not true in the case of low-income housing. However, presumably low-income housing tax preferences are designed to distort behavior.

[30] Note that a rental market is not absolutely necessary. The project model's "rents" are really imputed rents or the opportunity cost of capital.

REFERENCES

Bradford, David F. and Don Fullerton (1981), "Pitfalls in the Construction and Use of Effective Tax Rates," in C.R. Hulten, ed., *Depreciation, Inflation, and the Taxation of Income From Capital*, Washington, DC: The Urban Institute Press.

DeLeeuw, Frank and Larry Ozanne (1979), "The Impacts of the Federal Income Tax on Investment in Housing," *Survey of Current Business*. 59, December, 50-61.

Fullerton, Don, Yolanda Henderson, and James Mackie (1987), "Investment Allocation and Growth Under the Tax Reform Act of 1986." Chapter 6 in this volume.

Galper, Harvey, Robert Lucke, and Eric Toder (1987), "General Equilibrium Model of Differential Asset Taxation," mimeo.

Gravelle, Jane G. (1985), "U.S. Tax Policy and Rental Housing," Congressional Research Service Report No. 85-208E.

Gordon, Roger H., James R. Hines, Jr., and Lawrence H. Summers (1986), "Notes on the Tax Treatment of Structures," NBER Working Paper No. 1896.

Harberger, Arnold C. (1962), "The Incidence of the Corporation Income Tax," *Journal of Political Economy*. 70, 215-240.

Hendershott, Patric H., James R. Follain, and David C. Ling (1986), "Real Estate and the Tax Reform Act of 1986," NBER Working Paper No. 2098.

Hendershott, Patric H. and David C. Ling (1984), "Trading and the Tax Shelter Value of Depreciable Real Estate," *National Tax Journal*. 37, 213-223.

Mayo, Stephen K. (1981), "Theory and Estimation in the Economics of Housing Demand," *Journal of Urban Economics*. 10, 95-116.

Miller, Merton H. (1977), "Debt and Taxes," *The Journal of Finance*. 32, 261-275.

Musgrave, Richard A. and Peggy B. Musgrave (1984), *Public Finance in Theory and Practice*, New York: McGraw-Hill Book Company.

Sargent, Thomas J. (1987), *Dynamic Macroeconomic Theory*, Cambridge: Harvard University Press.

Shoven, John B., and John Whalley (1984), "Applied General-Equilibrium Models of Taxation and International Trade," *Journal of Economic Literature*. 22, 1007-1051.

Slemrod, Joel (1983), "A General Equilibrium Model of Taxation With Endogenous Financial Behavior," in Martin Feldstein, ed., *Behavioral Simulation Methods in Tax Policy Analysis*, Chicago: University of Chicago Press.

Summers, Lawrence H. (1986), "Investment Incentives and the Discounting of Depreciation Allowances," NBER Working Paper No. 1941.

Summers, Lawrence H. (1987), "Should Tax Reform Level the Playing Field?", NBER Working Paper No. 2132.

☆ U.S. GOVERNMENT PRINTING OFFICE:1987-181-903:64713