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THE VALUATION OF DEPRECIABLE REAL ESTATE

The Ohio State University

Ph.D. 1984

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THE VALUATION OF DEPRECIABLE REAL ESTATE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

David C. Ling, B.S.D.A., M.B.A.

* * * * *

The Ohio State University

1984

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I wish to thank the members of my reading committee for their support and encouragement. I am especially indebted to Professor Patric Hendershott whose contribution goes far beyond the current project.
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1984).

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Chapter I
INTRODUCTION

1.1 MOTIVATION AND LITERATURE

In a taxless, riskless world with no transactions costs, all investments would earn the same before-tax equilibrium real rate of return. Furthermore, this competitive return would be earned regardless of how long the asset was held or the number of subsequent investors. Sales prices over the economic life of the asset would simply reflect the value of the remaining cash flows discounted at the market rate of return.

In a world characterized by the current federal income tax system, market prices, and hence supply, will reflect the extent to which an asset receives preferential tax treatment. Additionally, prices will no longer be independent of how long the asset is held. Any differential benefits that are expected from trading the asset at the optimal time are capitalized into the current market price.

The importance of tax factors and investment holding periods in the valuation of depreciable real estate is widely recognized. In determining current investment value, the traditional discounted cash flow model explicitly considers the impact of taxes on the expected cash flows from both an-
uual operations and the eventual sale of the property. The user-cost of capital framework for analysis has also been extended to consider the unique tax characteristics of depreciable real estate. Expected holding periods and future sales prices are key variables in both analytical frameworks.

In a competitive market, future sales prices for income property reflect investment value to the marginal investor. The same factors (expected future rents, operating expenses, taxes, etc.) that determine the current market price also determine the price a future investor will pay for the property. Previous researchers have had to assume future sales prices without any reference to these underlying factors because no means were available to endogenize these future prices (and future optimal holding periods).

Exogenous real prices and holding periods are a serious limitation of the traditional methodology when it is used as an asset pricing model. This limitation is especially troublesome when attempting to use discounted cash flow analysis to consider the impact of changes in the tax code or in the rate of inflation on investment values and market equilibrium. Investment values depend upon future prices, but the pattern of future real prices may be altered when the tax code or rate of inflation is changed. Simply changing the depreciation or inflation parameters without simultaneously considering the impact on future prices and holding periods, has been a significant limitation in previous studies.
Because the optimal holding period of the marginal investor is reflected in competitive market prices, any theory of real estate asset prices must contain a theory of optimal holding periods. For well-diversified investors in depreciable real estate, the trading decision may be made with the sole objective of maximizing the value of the property's depreciation tax shelter net of all selling costs. Sales will be timed to achieve the best compromise between postponing capital gain taxes (and sales costs) and the opportunity cost of retaining the old depreciable basis in the face of rising nominal property prices.

The holding period model developed by Brueggeman, Fisher, and Stern (1981) explicitly considers the impact of tax factors and selling costs, but the model assumes that the second owner never sells the property. By assuming that the property is only traded once, the model places a minimum value on the tax depreciation that would result from a sale. Consequently, the initial holding period will tend to be overstated, and the tax shelter value will definitely be understated (unless only one trade is optimal).

Hendershott and Ling (1984) extend the holding period literature by developing a dynamic programming holding period model that reflects the fact that all owners of a property will pursue optimal trading strategies. Endogenizing the trading behavior of all investors over the economic life of the property provides a more accurate estimate of the
first investors' trading behavior and of the tax shelter portion of a property's current market price.

1.2 CHAPTER OVERVIEWS

The initial purpose of the current research is to extend the dynamic programming methodology to allow for the endogenousization of future sales prices (as well as future holding periods). In Chapter 2, the recursive nature of the valuation problem is discussed and the basic valuation equation used within the dynamic programming algorithm is derived. It is argued that the amount of utility (utils) provided by the improvements over time is exogenous. That is, the "want satisfying" ability of the property is not dependent upon tax law, interest rates, or any other variables that are subject to change over time. This ability is determined solely by the physical characteristics of the structure. While a change in tax law will affect the equilibrium level of rents, it will not alter the relative pattern of these rents over the property's economic life. Similarly, changing market conditions will affect the price paid for each util of rental service provided by the improvements, but such changes will not alter the relative pattern of utils (real rents) over time.

Chapter 3 presents a "base-case" application of the dynamic programming methodology for residential property under current tax law where it is assumed that investments are en-
tirely financed with equity capital. The base-case solution includes the price (value) of the property per dollar of initial operating income and the corresponding optimal holding period for each year of the property's economic life. The endogenously determined real price path is then compared with those frequently assumed in previous research. The results indicate that there is not a proportional relationship between the real price path and the underlying pattern of economic depreciation as reflected by the utilities of rental services provided by the improvements. This has significant implications for the interpretation of several previous empirical studies of economic depreciation. Given an observed pattern of used property prices, the rate of inflation, and the corresponding tax code, it is then demonstrated how the model can be used to solve for the underlying pattern of real rents.

Chapter 3 concludes with an analysis of the effects of inflation on real property investment decisions. Although the important factors have been clearly illuminated in the literature, evidence on the net impact of inflation is not conclusive. All researchers agree that inflation affects real prices (values). Yet currently there is not even a consensus on the sign, much less the magnitude, of the change. Simulation results suggest that the net impact of inflation may depend upon much more than tax depreciation rules. The relationship between inflation and market rates
of interest, the mix between debt and equity finance, and the presence (or lack) of capital market constraints all may have a significant impact on the results.

The purpose of Chapter 4 is to analyze the impact of financing decisions (opportunities) on investment values and optimal trading intervals. The basic valuation equation employed within the dynamic programming algorithm is adjusted to incorporate financing variables per the traditional discounted cash flow model. The application is to residential property purchased after the passage of ERISA. Initially, it is assumed that investors are not allowed to refinance their property's, i.e., loan-to-value ratios vary through time. The market price in each year is then decomposed into its rent, depreciation, land, financing, and total selling costs components. The impact of debt financing on real price paths is also discussed. In another set of simulations, it is assumed that investors are allowed to costlessly refinance their property's each year thereby maintaining a more optimal mixture of debt and equity finance. This assumption has a substantial impact on both investment values and trading intervals. The last section of Chapter 4 considers the impact of capital market (borrowing) constraints.

Prior to the passage of the 1981 Tax Act, only the excess of accumulated depreciation over the amount that would have been taken had straight-line depreciation been used was recaptured as ordinary income at the time of sale. These re-
capture rules applied to both residential and nonresidential structures. While the recapture rules for residential property remain unchanged, under post-ERTA tax law all depreciation (up to the initial market value of the improvements) is recaptured as ordinary income if accelerated depreciation is used. If the straight-line option is elected, all depreciation is taxed at the capital gains tax rate. The impact of this differential tax treatment is analyzed in Chapter 5. It is shown to have a significant impact on investment value, trading intervals, and the optimal method of depreciation.

The passage of ERTA in 1981 brought about substantial changes in the federal income tax provisions pertaining to income producing property. Depreciable lives were shortened and the distinctions between new and used properties were eliminated. The primary purpose of Chapter 6 is to analyze the impact of these tax code revisions on residential and nonresidential property markets. Assumptions concerning non-tax parameters (real rent patterns, loan-to-value ratios, etc.) are identical to those made in the corresponding post-ERTA simulations. The income tax variables are then modified to reflect the salient differences in pre-ERTA tax law. Two primary results are then sought: (1) estimates of short run changes in investment values (demand prices) assuming that all the increased tax benefits provided by the new Act were instantaneously capitalized into prices and (2)
estimates of the decline in real rents that would have occurred if investors competed away short-run increases in demand prices by instantaneously increasing the supply of property. These rent reductions are estimates of the long-run decline in rents that would occur as the supply of the affected property adjusts to the rise in demand prices.

Brueggman, Fisher, and Stern (1981) conclude that optimal holding periods for nonresidential property were in excess of 30 years prior to the passage of ERTA. If this is true, then it is possible that the single-trade model understates the number of investors in a property less (if at all) under pre-ERTA tax rules than under the new law. This issue is also addressed in Chapter 6. Pre-ERTA holding period results are shown to be extremely sensitive to financing assumptions.

The final issue addressed in the Chapter is whether or not the passage of ERTA altered the relative pattern, as well as the level, of real property prices over time.
Chapter II
VALUING DEPRECIABLE REAL ESTATE: A NEW METHODOLOGY

2.1 INTRODUCTION

Market prices for income property reflect investment value to the marginal investor. This value is a function of, among other things, the future sales prices at which the investor might reasonably expect to sell the property. The same factors (expected future rents, operating expenses, taxes, expected holding periods, etc.) that determine the current market price also determine the price a future investor will be willing to pay for the property\(^1\). Unfortunately, previous authors assumed arbitrary future price paths without any reference to these underlying factors. This Chapter introduces a methodology for valuing depreciable real estate that does relate future prices to these factors. The methodology employed is Dynamic Programming, a mathematical technique often used in Operations Research to solve similar recursion problems\(^2\).

\(^1\) De Leeuw and Ozanne (1981) recognized this when they suggested that these factors "should affect investors' expectations about the eventual sales price of a structure". They concluded that "it would be possible, though difficult, to use present value analysis to help estimate the appropriate price impact (of these factors) and to modify new investors' price expectations accordingly".
The chapter is structured in the following manner. Section 2 examines the relevant literature and addresses potential shortcomings. Section 3 discusses the recursive nature of the valuation problem and derives the basic valuation equation. Section 4 contains a brief summary and conclusion.

2.2 PREVIOUS RESEARCH

The traditional method of estimating future prices is to assume that the improvements will decline in real value in accordance with some predetermined pattern. In cases where inflation is taken into account, real values are compounded by the appropriate inflation rate factor to determine the nominal value (price) in each year. Improvements decline in real value over time because: (1) older properties have fewer remaining years of economic life, and (2) older properties may be less profitable either because the rental services they provide have less utility or because they require more maintenance than newer properties.

Several patterns of economic depreciation have been assumed for the improvements. Brueggeman, Fisher, and Stern assume that the real value of the improvements follows: a reverse sum of the years depreciation pattern over a 70 year economic life (1981) or a straight-line pattern of economic depreciation.

\(^2\) See, For Example, Bellman and Kalaba (1965) and White (1969).
depreciation over a 70 year economic life (1982). The former assumption is based on Taubman and Rasche (1969), the latter on Hulten and Wykoff (1978). Both of these underlying studies used observed property prices to make their inferences. De Leeuw and Ozanne (1981) assume a constant rate of depreciation equal to 1.4 percent per year. This implies a geometric pattern of real price deterioration.

A potential problem with drawing inferences concerning economic depreciation from used property prices is that such prices reflect federal tax provisions and the interaction of inflation with them. Different tax codes (and inflation rates) would imply different price patterns (and optimal holding periods) even though the utility of the remaining rental services is unchanged. This problem is especially troublesome when attempting to estimate the impact of changes in the tax code on investment values. While such values depend upon future prices, the pattern of future prices is altered when the tax code is changed.

It should be emphasized that the 'utils' of rental services provided by the improvements over time are exogenous. That is, the "want satisfying" ability of the property is not dependent upon tax law, interest rates, or any other va-

---

3 A straight-line pattern means that the real value falls by an equal amount each year. This implies an increasing rate of depreciation through time.

4 For a detailed discussion of the used market price approach to estimating economic depreciation, see Hulten and Wykoff (1982).
riables that are subject to change over time. Such ability is determined solely by the physical characteristics of the structure. While a change in tax law will affect the equilibrium level of rents, it will not alter the relative pattern of these rents over the property's economic life.

Consider, for example, a $1 million apartment building in a rental-housing market at a long-run equilibrium (price equals construction costs). If this $1 million property is expected to produce $200,000 in gross rents and incur $100,000 in operating expense next year, then its operating income is $100,000 (gross rents less operating expense), and its price to (operating) income ratio (PIR) is 10:1. If a change in the tax code favorable to rental-housing investment occurred, the long-run PIR would rise to, say, 15:1 implying that a rental-housing investor would be willing to pay $1 million for the property, even if operating income were only $66,667 next year. Current rental-housing investors would earn extra profits until enough new apartment buildings had been built to compete gross rents down to $166,667 (operating income to $66,667). While the level of operating income would have fallen 33 percent, the relative pattern of operating income would remain unchanged5.

5 The above is obviously a partial equilibrium analysis in that all the possible effects of an alteration in the tax code, such as changes in real interest rates, are not considered.
2.3 Model Development

2.3.1 Dynamic Programming

Consider a property with an expected economic life of 70 years. The expected sales prices of the asset at the end of all 70 years are required as input to the initial investor's optimization process. The dynamic programming algorithm solves for this required vector of prices by starting in year 70, the first "stage" of the Dynamic Programming process, and working backwards through time.

At the end of year 70, the improvements, by assumption, are valueless. The land will be sold to a developer at the prevailing market price. An investor interested in buying the property at the beginning of year 70 has one alternative: to hold the property one year and then sell to a developer. He simply determines the value of one year's worth of operating income, depreciation deductions, interest deductions, and the residual land value to arrive at the price he is willing to bid for the property. This defines the market price in stage 1 of the process. An investor at the beginning of year 69 has two options available to him. He can retain the property for two years and sell to a developer, or he can hold the asset for one year and sell for the price found in stage 1. The wealth-maximizing strategy defines the stage 2 price and optimal holding period. An investor in year 68 has three options to evaluate: hold for one year and sell for the stage 2 price, hold for two years
and sell for the stage 1 price, or hold three years and then sell to a developer. The wealth-maximizing strategy determines the stage 3 price and optimal holding period. This process continues until the market prices for all 70 years have been determined. Note that the investor in year 1 must choose between 70 alternative trading strategies.

2.3.2 Valuation Equation

The basic valuation equation employed within the Dynamic Programming algorithm is the traditional discounted cash flow equation that measures and values cash flow to the equity position after all operating, financial, and tax expenses have been paid. Assume that

1. the property is financed with 100 percent equity capital.

2. the property is expected to be sold after h years at which time a brokerage commission of B percent will be paid, and

3. the all-equity cash flows are discounted at the nominal after-tax return on assets, N\textsubscript{Na}.

The investment value of the property at the beginning of year j is:

\[ \text{Investment Value} = \ldots \]

\[ \ldots \]

* If debt financing is used, the mortgage value is added to the discounted value of the equity cash flows to determine total investment value.
\[ V(j,h) = \sum_{i=1}^{h} \frac{(1-To) \cdot I(i)}{(1+NEa)^{**i}} + \sum_{i=1}^{h} \frac{To \cdot DEPF(i) \cdot P(j)}{(1+NEa)^{**i}} + \frac{P(j+h) \cdot (1-B) - Tg \cdot [P(j+h) \cdot (1-B) - P(j) \cdot ACDP(h)]}{(1+NEa)^{**h}} \]

where \( V(j,h) \) = the investment value at the beginning of year \( j \) if held \( h \) years,

\( I(i) \) = net operating income in year \( i \) of the holding period,

\( To \) = marginal ordinary income tax rate,

\( Tg \) = marginal capital gains tax rate,

\( DEPF(i) \) = percentage of the initial tax basis that is written off in year \( i \) of the holding period,

\( P(j) \) = current market price,

\( P(j+h) \) = competitive market price of the property at the end of the holding period, and

\( ACDP(h) \) = percentage of the initial tax basis not written off during the holding period\(^7\).

The two sums are the discounted values, respectively, of the cash flows from annual operations and the depreciation tax savings. The third and fourth terms represent the before-tax cash flow from the sale of the property and the resulting capital gain tax liability.

---

\(^7\) The calculation of the capital gain tax liability in equation 1 assumes that straight-line depreciation is used. In analyses where accelerated depreciation is assumed, the equation is adjusted to reflect the appropriate recapture provisions.
Direct application of this equation requires (assumes) exogenous property prices. The current market (asking) price determines tax depreciation and the adjusted basis at the time of sale. Net proceeds from the reversion depend upon the market price at the time of sale. Because these prices are endogenous, the valuation equation must be altered. Substituting \( V(j,h) \) for \( P(j) \) on the right hand side of equation 1 results in:

\[
 V(j,h) = \sum_{i=1}^{h} \frac{T_o \cdot I(i)}{(1+N_{Ra})^{**i}} + \frac{[(1-T_q) \cdot P(j+h) \cdot (1-B)]}{(1+N_{Ra})^{**h}} \\
\left\{ 1 - \frac{T_q \cdot ACDP(h)}{(1+N_{Ra})^{**h}} - \sum_{i=1}^{h} \frac{T_o \cdot DEPF(i)}{(1+N_{Ra})^{**i}} \right\} .
\]

In equation (4), current investment value is a function of exogenous parameters and the selling price of the property at the end of the holding period (\( h \) years). While this future selling price is an exogenous input to the investor in year \( j \), it is endogenously determined in a prior iteration of the algorithm. The competitive market price in year \( j \), \( P(j) \), is

\[
P(j) = \max_{h \in H} V(j,h),
\]

where the size of the decision set \( H \) equals the number of years of remaining economic life. For example, an investor in year 1 has 70 holding period options to choose from. The holding period \( (h) \) that maximizes \( V(j,h) \) is the optimal
holding period for a buyer in year $j$. The maximum $V(j,h)$ becomes the market price at the beginning of year $j$. It is then used as an input to the investor's optimization problem in years $j-1, j-2, \text{etc.}$.

2.4 SUMMARY AND CONCLUSIONS

The same factors which determine current market prices also determine the price future investors will bid for a property. Unfortunately, previous researchers have been forced to assume price paths without any reference to these underlying factors because no means has been available to endogenize these future prices (and future optimal holding periods). This limitation is especially troublesome when attempting to use discounted cash flow analysis to consider the impact of changes in the tax code on investment values and market equilibrium. Investment values depend upon future prices, but the pattern of future prices may also be altered when the tax code is changed. Simply changing the tax depreciation parameters, without simultaneously considering the impact on future prices, has been a significant limitation in previous studies of tax code alterations.

This perplexing recursion problem occurs in many other forms in Operations Research and is solved by dynamic programming. Using this technique and an exogenous rent-utility path, a model is developed that can jointly determine both a price path and the corresponding optimal holding per-
iods for all owners during the economic life of an income producing property.
Chapter III

BASE CASE SOLUTION: 100 PERCENT EQUITY FINANCING

3.1 INTRODUCTION

This chapter presents a "base-case" application of the Dynamic Programming valuation methodology developed in Chapter 2 where it is assumed that income property investments are entirely financed with equity capital. The solution reported in Section 2 includes the price (value) of the property per dollar of initial operating income and the corresponding optimal holding period for each year of the property's economic life assuming zero inflation.

The impact of inflation on prices and holding periods is analyzed in Section 3. Results suggest that, in the absence of debt financing, market prices are negatively correlated with inflation. The endogenously determined real price path is then compared with those frequently assumed in previous research. The results reported in Section 4 suggest that there is not a proportional relationship between the real price path and the underlying pattern of economic depreciation as reflected by the "utils" of rental services provided by the improvements. This has important implications for the interpretation of several previous empirical studies of economic depreciation.
3.2 **BASE-CASE PARAMETERIZATION**

A 70 year reverse Sum-Of-the-Years-Digit (SYD) pattern of economic depreciation is assumed in the base-case analysis. That is, the utility provided by the improvements and, therefore, gross rents decline at an increasing rate through time. We also assume that operating expenses are proportional to gross rents. Real operating income, therefore, falls $1/x$ in year 2, falls a further $2/x$ in year 3, and continues to fall at a linearly increasing rate until it falls from $70/x$ to 0 in year 71. The denominator, $x$, is the sum of the integers from 1 to 70.

In a world with taxes, transaction costs, and other market imperfections, investment and financing decisions for real property can not be separated. Unless the required after-tax return on equity is equal to the after-tax cost of debt during each year of the expected holding period, financing decisions (opportunities) do affect investor wealth. Because the opportunity cost of equity capital is generally greater than the after-tax cost of mortgage debt, especially for high income individuals, investment value is positively related to changes in financial leverage. Unfortunately, there is no clear consensus concerning the proper way to model the interaction of the financing and investment deci-

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*Brueggeman, Fisher, and Stern (1982) assume that operating expenses, as a percentage of gross rental income, increase slightly each year. Such an assumption decreases the effective economic life of the property because operating income becomes negative before year 70.*
sions. For this reason, 100 percent equity financing will be assumed in the base-case analysis. The impact of financing will be addressed separately in Chapter 4.

It is assumed that land accounts for 20 percent of the property's initial price and that the value of the land remains constant in real terms. The property can be sold at any time for this amount to a developer who would tear down the old building and construct an identical new building.

Because the residual land value is a function of an endogenous variable (i.e., 20% of property price) it is not known a priori. The residual land price is adjusted with a linear search procedure and the simulation rerun until a residual land price is found that is between 19.99% and 20.1% of the initial purchase price.

In some year \( j \), the value of a property to a new investor is less than the price a developer would pay for the land (residual land value) in order to build an identical new apartment building. The owner of the property in year \( j-1 \), therefore, will sell to a developer when he does sell. This condition is incorporated by modifying the dynamic programming procedure to require that the market price in year \( j \) must equal or exceed the residual land value.

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* See Jaffee (1982) for an extensive review of the literature on this topic.

10 It is assumed that the developer always builds the most valuable property allowed by zoning laws. If zoning law changes, the price of the land adjusts. Zoning law uncertainty is another form of risk that this paper does not explicitly consider.
ERTA tax law is assumed, i.e., 80 percent\(^{11}\) of a property's purchase price can be written off for tax purposes using 15 year accelerated depreciation\(^{12}\). We explicitly assume a tax-induced clientele model, where rental-housing investors are in high marginal tax brackets. The marginal rental-housing investor is in a tax bracket (To) where he is indifferent between a rental-housing investment and some alternative, such as stocks\(^{13}\). We assume that To is equal to 45 percent and that the marginal tax rate on capital gain income (Tg) is 18 \((.4\times45)\) percent. We assume that the marginal investor is not affected by minimum tax complications\(^{14}\).

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\(^{11}\) In later years, the building constitutes less than 80% of the property's value. We assume that 80% is always claimed and that IRS argues with investors only when they try to depreciate more than 80% of a property's purchase price.

\(^{12}\) Hendershott and Ling (1983) and Hite and Krasniewski (1982) conclude that, for regular residential property, 175% declining balance depreciation will be preferred over straight-line under post-ERTA tax law. That result holds here as well. Straight-line depreciation will be considered in Chapter 5 which is devoted to the analysis of nonresidential properties. We use the ACRS 15 year tax tables provided under ERTA. If the property is sold within 15 years, depreciation deductions in excess of 15 year straight line are "recaptured" as ordinary income.

\(^{13}\) Investors in tax brackets below To invest in stocks or some alternative investment. Investors in tax brackets above To invest in rental housing and earn economic profits. See Litzenberger and Sosin (1978), Whinihan (1981), and Titman (1982).

\(^{14}\) That is, excess depreciation, which is a tax preference.
Given the above assumptions, a required after-tax return on assets (Ra) of 4 percent, as suggested by Christensen and Jorgenson (1973), 5 percent transaction costs, and a zero percent expected inflation rate, the initial price-to-income ratio (PIR) is 17.3:1. That is, the competitive market price is approximately $17 per dollar of initial operating income. This means that an apartment building that costs $1 million initially and has operating expense of $100,000 per year will have operating income of $57,803 and gross rents of $157,803 initially. The building itself costs $800,000 and the land costs $200,000. The building is rented for 66 years and then torn down, even though it would have positive operating income for 4 more years. The building has five owners during its life: the first four owners each hold the property for 15 years, the fifth owner holds the property for 6 years before selling it to a developer.

3.3 THE IMPACT OF INFLATION

Inflation affects real property investment decisions because of our imperfectly indexed tax system. Three such effects have been isolated in the literature. First, the real tax shield provided by tax depreciation decreases with

item, does not trigger the payment of the alternative minimum tax. As Hite and Sanders (1981) and Sirmans (1980) have noted, this trigger only occurs when tax preferences are large relative to regular taxes paid.

15 A recent summary of the investment literature on this topic is provided by Hochman and Palmon (1983).
inflation because deductions are based upon the historical purchase cost rather than on replacement values. This "depreciation effect" causes investment value to fall with increases in inflation. Second, the real value of interest deductions increases with inflation because investors are allowed to deduct nominal rather than real interest payments. If the rise in interest rates is not sufficient to offset this real increase in the interest tax shield, then total investment value will rise. This is analogous to the familiar result that user costs of capital will decrease with inflation when Fisher interest rates are assumed. This is referred to hereafter as the "interest effect". Of course, this effect is absent when pure equity finance is employed.

The third effect results from the nonneutral way in which capital gain income is taxed. There are two reasons for this nonneutrality. First, capital gains are taxed only upon realization, not as they accrue. The government effectively lends the taxpayer the amount of his accrued tax liability at a zero rate of interest. This is a tax deferral distortion that benefits the taxpayer. Second, the gain that is tax at the time of sale is the nominal rather than the real gain. This tax distortion penalizes the investor.

16 Brinner (1973) offers the following definition of neutrality: "a capital gains tax structure is neutral if for any given gross, real rate of return of a capital asset, the after-tax real wealth position of an investor is invariant with respect to the general inflation experienced by the economy and with respect to the frequency of his gain realizations and reinvestments."
In most studies, this "capital gains effect" has been ignored. It is either assumed that the asset is never traded or that it is held sufficiently long such that the present value of the deferred tax payment is essentially zero.

Although the important factors have been clearly illuminated in the literature, evidence on the net impact of inflation on real property investment is not conclusive. This statement applies to all other depreciable assets as well. Hochman and Palmon (1983), Cordes and Sheffrin (1983), and others argue that the differences in reported results may be attributable to assumptions made with respect to two important parameters: "capital structure", i.e., the mix between debt and equity finance, and the impact of inflation on market rates of interest. Hendershott and Hu (1983) argue that capital market constraints could also be important in the analysis. The purpose of this section is to estimate the impact of inflation on investment value and optimal holding periods assuming 100 percent equity financ-

17 A notable exception is the recent paper by Gandolfi (1982).

18 See, for example, Hendershott and Shilling (1982a), Kief-er (1982), Titman (1982), and Whinihan (1981).

19 For example, Nelson (1976) and Kim (1979) conclude that inflation decreases all forms of capital investment. Cross (1980), in a theoretical analysis, concludes that investment in depreciable assets is positively related to inflation. Gonedes (1981) found empirical evidence that capital investment has not been negatively correlated with inflation.
ing. Trading is not only allowed, it is endogenously determined. The capital gains effect is explicitly incorporated, by the assumption of pure equity finance, there is no interest effect.

For a given 70 year expected inflation rate, nominal operating income and a nominal residual land value are computed for each year by compounding at the expected inflation rate. To determine the nominal required return on assets (NRa), inflation is added to the assumed constant real return on assets (Ra) with Fisher's adjustment:

\[ 1 + NRa = (1 + Ra) \times (1 + Pi) \]

where \( Pi \) is the 70 year expected inflation rate. Simulation results are displayed in Table 1. Investment value monotonically decreases with inflation; from 17.3 at zero percent inflation to 13.5 at 9 percent inflation. The declining PIR's reflect the negative depreciation effect. At low to moderate levels of inflation, the property is sold every 15th year when depreciation deductions are exhausted. At 9 percent inflation, the initial investor retains the property for 66 years. The present value of net taxes is minimized by holding the property for its entire economic life, i.e., the value of deferring the large, inflation induced, capital

\[ \text{Note that the historical cost penalty is nonlinear in inflation and reaches the limiting value of zero. As a result, prices decrease at a decreasing rate.} \]
# TABLE 1

**THE IMPACT OF INFLATION**

**100 PERCENT EQUITY FINANCING**

<table>
<thead>
<tr>
<th>INFLATION</th>
<th>PIR</th>
<th>HOLDING PERIOD BY INVESTOR</th>
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</thead>
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</tr>
<tr>
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<tr>
<td>9</td>
<td>13.5</td>
<td>66</td>
</tr>
</tbody>
</table>
gain is always greater than the value of the incremental depreciation that would result from selling the depreciation tax shield to a new investor.

3.4 PRICE PATHS AND ECONOMIC DEPRECIATION

It was argued in Chapter 2 that the utilities of rental services provided by improvements over time are exogenous. They are determined solely by the physical characteristics of the structure. The purpose of any study of economic depreciation is to estimate the relative pattern of these rental services over time. Previous researchers have recognized the fact that market prices incorporate information about economic depreciation. Taubman and Rasche (1971) found evidence in used property prices that the decline in real prices can be approximated by the reverse SYD pattern. From this they infer a reverse SYD pattern of economic (real rent) deterioration. Hulten and Wykoff (1978), in a more recent study of used property prices, conclude that real prices decline in a straight-line fashion through time. From this information, they directly infer a straight-line pattern of economic depreciation. While market prices do incorporate patterns of economic depreciation, they also reflect tax law, inflation expectations, and other variables as well. Results indicate that serious errors may arise from directly inferring patterns of economic depreciation from used property prices.
To demonstrate this, the reverse SYD pattern is compared graphically with the price path endogenously determined by the dynamic programming model under the assumption that real rents decline in a reverse SYD pattern over time. If it is possible to directly infer real rent patterns from observed real prices, these two curves should roughly coincide. That is, a reverse SYD pattern of real rents will produce a reverse SYD pattern of real prices.

The results are displayed in Figure 1. The reverse SYD pattern is represented by the graph using the symbol "R". The plot employing the symbol "6" represents the real price path, as a percentage of the initial price, determined by the model assuming 6 percent inflation (the real price is never less than 20 percent of the initial property price because the 20 percent of the property price representing land is assumed to provide a constant flow of services through time). The endogenously determined real prices (the 6's) essentially decline in a straight-line pattern over time. Similarly, it was also found that the price pattern produced when real rents decline in a straight-line fashion closely approximate a geometric pattern of real price deterioration.21

In both cases, real prices fall off much more quickly than real rents. This reflects the finite life of the improvements. These results indicate that there is not a pro-

21 These price path results are invariant with respect to the rate of inflation.
FIGURE 1: ENDOGENOUS PRICE PATH - REVERSE PID REAL RENTS
portional relationship between real price patterns and the underlying pattern of real rental services provided by the property. This has important implications for the interpretation of the previous empirical studies of economic depreciation mentioned above.

The inability to directly infer patterns of economic depreciation from used property prices suggests another application of the dynamic programming methodology. Given an observed pattern of used property prices, the inflation rate, and the corresponding tax code, the model can be used to estimate the underlying pattern of real rental services. For example, it has already been shown that, under post-ERTA tax law, a reverse SYD pattern of real rents produces real property prices that decline in a straight-line (Hulten and Wycoff) pattern over time. If subsequent studies of used property prices suggest a different pattern of real price deterioration, the dynamic programming model can be used to estimate the underlying pattern of economic depreciation.

3.5 'SUMMARY AND CONCLUSIONS

This chapter presents a base-case application of the dynamic programming valuation methodology. Assuming ERTA tax law, 100 percent equity financing, and zero percent inflation, the initial price-to-income ratio is 17.3:1. That is, the market price in year 1 is approximately $17 per dollar of initial operating income. The building has 5 owners
during its economic life: the first four each hold the property for 15 years while the fifth owner holds the property for 6 years before selling to a developer.

The impact of inflation was also explored. In the absence of debt financing, inflation decreases investment value. The price-to-income ratio falls from 17.3, at zero percent inflation, to 13.5 at 9 percent inflation, reflecting the negative depreciation effect. There is no interest effect due to the absence of debt financing. Trading occurs every 15 years at low to moderate levels of inflation. At 9 percent inflation, the initial investor retains the property for 66 years. The value of deferring the large, inflation induced, capital gain is greater than the incremental value of the depreciation deductions that would result from the sale of the property to a new investor.

The results also suggest that serious errors may result from directly inferring patterns of economic depreciation from used property prices. Assuming ERTA tax law and 6 percent inflation (1) a straight-line pattern of real price deterioration is produced with reverse SYD real rents and (2) a geometric pattern of real prices is consistent with a straight-line deterioration in real rents. In both cases, real prices fall off much more quickly than real rents.

Although the exact relationship between rents and prices may vary with changes in tax law and inflation, these results indicate that there is not a proportional relationship
between patterns of real price deterioration and patterns of economic depreciation. The findings of this chapter also demonstrate how the dynamic programming model can be used to estimate patterns of economic depreciation given an observed pattern of real property prices and the corresponding tax law and inflation rate.
4.1 **INTRODUCTION**

The analysis presented in Chapter 3 assumes that investors finance their real property acquisitions with 100 percent equity capital. In a world without taxes, transactions costs, and other market imperfections, such an assumption is innocuous because real investment variables are not affected by the mix between debt and equity finance. When market imperfections are introduced, the necessary condition for capital structure irrelevance is equality between the average, risk adjusted, opportunity cost of equity capital and the after-tax cost of mortgage debt.

The most widely accepted method of modeling the inter-relationship for real property acquisitions is the discounted cash flow technique that measures and values cash flow to the equity position after all operating, tax, and financial expenses have been paid. The mortgage amount is then added to the discounted value of the equity cash flows to determine total investment value.

The purpose of this chapter is to analyze the impact of financing decisions (opportunities) on investment values and
optimal holding periods. In section 2, the basic valuation equation employed within the dynamic programming algorithm is adjusted to incorporate financing variables per the traditional discounted cash flow model. The application is to residential income property purchased after the passage of the Economic Recovery Tax Act (ERTA) of 1981. Section 3 contains a discussion of the financing parameters assumed in the simulations. Section 4 presents investment value and holding period results assuming that investors are not able to refinance their properties. The market price in each year is then decomposed into its rent, depreciation, land, financing, and total selling costs components. The impact of inflation on holding periods and investment values is analyzed and its effect on the various components of market price is deduced. The impact of debt financing on real price paths is also discussed. In Section 5, the prohibitive refinancing assumption is altered. Investors are allowed to costlessly refinance each year. Section 6 estimates the impact of capital market (borrowing) constraints. Two constraints on the interest deductions of investors are analyzed: nominal rents and operating income. A summary and conclusions are provided in Section 7.
4.2 VALUATION EQUATION

Assume that

1. the fraction $x_1$ of the property's purchase price is financed at the mortgage interest rate $NBRd$,

2. the costs associated with refinancing during the holding period are prohibitive,

3. the property is expected to be sold after $h$ years at which time a brokerage commission of $B$ percent will be paid, and

4. the equity cash flows are discounted at the nominal, after-tax, return on equity, $NRe$.

The investment value of the property at the beginning of year $j$ is:

$$V(j,h) = \sum_{i=1}^{h} \frac{(1-To) \cdot I(i)}{(1+NRe)^{i+1}} + \sum_{i=1}^{h} \frac{To \cdot DEFF(i) \cdot P(j)}{(1+NRe)^{i+1}}$$

$$+ \frac{P(j+h) \cdot (1-B) - Tg \cdot [P(j+h) \cdot (1-B) - P(j) \cdot ACDP(h)]}{(1+NRe)^{2h}}$$

$$+ \frac{L(0) - \sum_{i=1}^{h} \frac{PAY(i)}{(1+NRe)^{i+1}}}{(1+NRe)^{2h}}$$

$$+ \sum_{i=1}^{h} \frac{To \cdot NRD \cdot L(i-1) - L(h)}{(1+NRe)^{i+1}}$$

where $V(j,h) =$ the investment value at the beginning of year $j$ if held $h$ years,

$I(i) =$ net operating income in year $i$ of the holding period,

$To =$ marginal ordinary income tax rate,

$DEFF(i) =$ percentage of the initial tax basis that is written off in year $i$ of the holding period,

$P(j) =$ current market price,

$P(j+h) =$ competitive market price of the property at the end of the holding period,

$Tg =$ marginal capital gains tax rate,
ACDP (h) = percentage of the initial tax basis not written off during the holding period\textsuperscript{22},

PAY (i) = the total mortgage payment, and

L (i) = balance of the loan at the end of year i of the holding period.

The first four terms are identical to the all equity case except that the cash flows are discounted at the required return on equity (NR\textsubscript{e}) instead of at the overall return on assets (NR\textsubscript{a}). The remaining four terms capture the cash flow effects of debt financing. L(0) represents the initial value of the mortgage and L(h) the outstanding loan obligation at the end of the holding period. The two sums are the present values of the mortgage payments and of the tax savings from interest deductions, respectively.

When a standard fixed-rate mortgage is used,

\[
PAY (i) = PAY = \frac{(1 + NRd)^{m} \times NRd \times 1 \times P(j)}{(1 + NRd)^{m} - 1} \quad (5)
\]

and

\[
L (i) = \frac{[(1 + NRd)^{m} - (1 + NRd)^{h}] \times 1 \times P(j)}{(1 + NRd)^{m} - 1} \quad (6)
\]

where \( m \) equals the original maturity of the mortgage and NR\textsubscript{d} is the nominal mortgage interest rate. Because \( P(j) \) is an endogenous variable equal, for the marginal investor, to \( V(j, h) \), the reduced-form valuation equation is obtained by

\textsuperscript{22} The calculation of the capital gain tax liability in equation 4 assumes that straight-line depreciation is used. In analyses where accelerated depreciation is assumed, the equation is adjusted to reflect the appropriate recapture provisions.
substituting $V(j,h)$ for $P(j)$ on the right hand side of equation 4 and factoring. The competitive market price in year $j$, $P(j)$, is again

$$P(j) = \max_{h \in H} V(j,h).$$

(7)

4.3 PARAMETERIZATION

For investors in low to medium tax brackets a measure of their opportunity cost of equity capital is the after-tax mortgage interest rate (plus a risk premium) because fully taxable bonds and mortgages are reasonable investment alternatives for such investors. For higher tax bracket individuals, however, tax exempt securities provide a better after-tax rate of return. Because the long-term municipal bond rate has generally been 70 percent of the fully taxable rate, the after-tax rate of return on equity ($N_{Re}$) is assumed to be equal to 70 percent of the nominal mortgage interest rate adjusted by a risk premium ($P_{REM}$).

$$N_{Re} = .7*N_{Rd} + P_{REM}.\quad (8)$$

$P_{REM}$'s of 3 and 5 percent are considered. The former was used by Hendershott and Shilling (1982) and Brueggeman, Fisher, and Stern (1982) who, based on a study by Ibbotson and Singuefield (1976), estimate that the after-tax risk premium on common stocks relative to corporate bonds aver-
aged 3.3 percent during the 1929-1974 period for investors in a 50 percent marginal tax bracket. To the extent that risk differentials between stocks and bonds approximate the risk differentials between equity investments in depreciable real estate and mortgages, the 3 percent assumption is reasonable. However, relatively more leverage is typically used in the purchase of real property. Because equity investors have only a residual claim to cash flow, the riskiness of their position increases with the amount of leverage employed. For this reason, a 5 percent risk premium is also considered.

Two assumptions with respect to the determination of nominal mortgage interest rates are employed. Case one assumes Fisher interest rates. $NRd$ is equal to the product of the assumed constant, real, before-tax rate of return on debt ($Rd$) and the expected inflation rate ($Pi$) or

$$NRd = (1+Rd) \times (1+Pi) - 1.$$  \hspace{1cm} (9)

$Rd$ is set equal to 3 percent which implies that $d(NRd)/d(Pi) = 1.03^{23}$. Because $NRe = 0.7 \times NRd + PREM$, the real after-tax discount rate declines with increases in antici-

---

23 Empirical findings have shown that the Fisher effect is a good approximation of the relationship between inflation and market interest rates [see Kreicher (1981) for a list of references]. The issue, however, continues to be debated. Numerous authors have argued that an increase in expected inflation should result in a more than proportional increase in nominal interest rates because investors (savers) base their decisions on the expected after-tax consequences [see, for example, Darby (1975) and Feldstein (1976)].
pated inflation. Consequently, this specification of \( \text{NRd} \) and \( \text{NRe} \) is labeled the low discount rate case. Case two assumes that nominal mortgage rates respond to changes in inflation in such a way as to keep the real after-tax mortgage rate constant for an investor in the 30 percent marginal tax bracket or

\[
\text{NRd} = \text{Rd} + \frac{\text{Pi}}{.7},
\]

which implies that \( \frac{d(\text{NRd})}{d(\text{Pi})} = 1.43 \). This specification of \( \text{NRd} \) and \( \text{NRe} \) is labeled the high discount rate case.

A leverage constraint is imposed by allowing each investor to borrow no more than 80 percent of the purchase price and by requiring that the loan be amortized over 25 years, or by year 70, whichever is less. Nominal operating income and the nominal residual land value for each year are computed by compounding real values at the expected inflation rate. Other parameter values are identical to those assumed in the all equity finance simulations: a 70 year reverse SYD pattern of real rents; 80 percent of the property's purchase price can be written off for tax purposes using the 15 year accelerated cost recovery option allowed under ERTA tax law; a marginal tax rate on ordinary income and capital gain income equal to 45 and 18 percent respectively; land remains constant in real terms; transactions costs are equal to 5 percent of the sales price.
4.4 PROHIBITIVE REFINANCING

4.4.1 PIR's and Optimal Holding Periods

Table 2 displays simulation results where it is assumed that investors are not allowed to refinance their properties. Expected inflation rates (Pi's) of 0, 3, 6, and 9 percent are considered. Two statistics are reported: (1) the year 1 price per dollar of initial operating income (PIR) and (2) the optimal holding period of each investor in the property. With zero inflation, the PIR in the all-equity finance case was 17.3. The corresponding PIR assuming 80 percent debt financing, a risk premium of 3 percent, and a relatively low discount rate (d(NRd)/d(Pi)=1.03) is 28.4, or roughly 1.5 times as large. The all-equity finance PIR with 6 percent inflation was 14.0. The corresponding PIR with debt financing is 40.9, approximately a 300 percent increase.

Different results obtain when a relatively high discount rate (d(NRd)/d(Pi)=1.43) is assumed. At zero percent inflation, the relative advantage of 80 percent debt financing is unchanged. At 6 percent inflation the relative advantage decreases from 300 percent to 175 percent.

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The value of debt financing is negatively related to the equity risk premium. However, with no inflation, 80 percent debt financing increases PIR's, relative to the all equity case so long as PREM is less than 11 percent. With 6 percent inflation, an equity risk premium of 18 percent is required to completely eliminate the advantages of debt financing. Of course when interest rates respond more than one-for-one with inflation, a smaller equity risk premium is required to negate the benefits of leverage (12 percent with 6 percent inflation).
### TABLE 2

**PROHIBITIVE REFINANCING COSTS**

**OPTIMAL HOLDING PERIODS AND INITIAL PRICE-TO-INCOME RATIOS**

<table>
<thead>
<tr>
<th>d(Nrd)/d(Pi)</th>
<th>PREM</th>
<th>PIR</th>
<th>HOLDING PERIOD BY INVESTOR</th>
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</tbody>
</table>

*Other Assumptions: B=0.05, To=0.45, Tg=0.18, and NBE=.7Nrd*PREM.*
[(24.5/14.0)-1]. In either case, the results suggest that unlevered properties are not able to compete with levered investments.

With a relatively low discount rate, PIR is a strictly increasing function of inflation. The capital gain deferral benefit and the interest effect dominate the depreciation effect at all four levels of inflation. That is, the ability to convert heavily taxed ordinary income into lightly taxed, deferred, capital gain income, via the payment of tax deductible interest, more than offsets the penalty associated with the use of historical cost depreciation and the taxation of nominal, rather than real, capital gains. These results support the findings of Titman (1982) and Whinihan (1981) who, assuming Fisher interest rates, also concluded that the net impact of inflation on real property investments is favorable.

Substantially different results obtain when a relatively high discount rate is assumed. PIR's decrease with inflation; from 28.4 at zero percent inflation to 23.3 at 9 percent inflation. The positive interest effect is significantly reduced because the rise in nominal mortgage rates almost completely offsets the increase in the real value of interest deductions that results from deductibility of nomi-
nal, rather than real, interest payments.25 With the positive interest effect substantially reduced, PIR's decrease with inflation because of the negative depreciation effect. This result supports the conclusions of Hochman and Palman (1983) who also argue that the net effect of inflation depends upon the impact of inflation on market interest rates. While Kiefer (1981) concludes that the net impact of inflation on rental property investments is probably favorable, he stressed that this result is extremely sensitive to the assumed relationship between inflation and market rates of return.

The impact of assuming a 5 percent, instead of a 3 percent, risk premium on equity returns depends upon the level of inflation and the discount rate. With a relatively low discount rate and zero inflation, a 5 percent risk premium decreases investment value by 14 percent [(28.3-24.5)/28.4]. The decreases, assuming 3, 6, and 9 percent inflation are 17, 20, and 26 percent, respectively. With a high discount rate, the percentage decline in PIR's is roughly 14 percent at all four levels of inflation.

Analysis of the optimal holding periods reported in Table 2 suggest that trading intervals decrease with inflation. With PREM=.03, d(NRd)/d(Pi)=1.03, and no inflation, the first four owners each hold the property for 15 years.

25 For an investor in the 30 percent marginal tax bracket, the positive interest effect is, by assumption, completely eliminated.
At 3 percent inflation, the first four owners hold the property for 12, 13, 14, and 15 years respectively. With 6 percent inflation, the first five investors retain the property for 10, 11, 11, 12, and 13 years. The corresponding figures assuming 9 percent inflation are 8, 9, 9, 9, and 9 years. These results remain virtually unchanged when the discount rate and risk premium are altered.

In analyzing these holding period results, it is important to remember that they are predicated upon the assumption of prohibitive refinancing costs. Even in the absence of inflation, loan amortization reduces loan-to-value ratios (LTVR's) during the early years of the property's life. Investors who do not sell are forced to accept a progressively less desirable mix of debt and equity finance. With \( \text{PREM} = 0.03 \) and \( \frac{d(NRd)}{d(Pi)} = 1.03 \), the first investor, for example, has a LTVR of only 53 percent at the end of his 15 year holding period. As a result, the interest tax shield associated with the property becomes increasingly more valuable to a potential new owner who can borrow 80 percent of the current purchase price. Such a situation tends to induce more frequent trading. Nonetheless, the first four investors each retain the property for 15 years.

Inflation accelerates the deterioration of LTVR's and, as a result, makes prohibitive refinancing even more onerous. With zero inflation, the first investor's equity investment increases from 20 to 30 percent of market value
after 8 years. The corresponding increase at 6 percent inflation is 20 to 46 percent. Inflation accelerates the use of relatively more equity capital.

Inflation may also induce more frequent trading because it erodes the real value of depreciation deductions. The tax deductions of a potential new owner are based on a higher "stepped-up" basis, and thus the new owner will, in most cases, place a higher value on the remaining stream of depreciation deductions available from the property than will the existing owner.

By trading before the end of the 15 year cost recovery period, investors incur depreciation recapture penalties and increase the present value of the realized capital gain tax liability. However, because inflation increases the relative value of the depreciation and interest tax shields to a potential new owner, this is reflected in the market price received by the current owner at the time of sale. With prohibitive refinancing cost, this latter effect appears to dominate the increased present value of the selling costs at positive levels of inflation. That is, accelerating inflation increases the opportunity costs of keeping the old loan and the initial depreciable basis relatively more than it increases the net cost of selling.

When properties are entirely financed with equity capital, optimal holding periods increase with the rate of inflation (see Table 1). Investors choose to postpone the
recognition of inflated capital gains even though the real value of their depreciation deductions is deteriorating. The fact that inflation induces shorter holding periods when debt financing (with prohibitive refinancing costs) is introduced suggests that the opportunity cost of maintaining the old financing is greater than the opportunity cost of keeping the old depreciable basis.

4.4.2 Debt Financing and Real Price Paths

This section considers the impact of debt financing on real price paths. The real price in all 70 years, assuming an 80 percent LTV, PREM=.03, and \( \frac{d(NRd)}{d(pi)}=1.03 \), was divided by the year 1 price for the 6 percent inflation case. In Figure 2, this with-debt financing price path is represented by the plot using the symbol "Y". The plot employing the symbol "N" depicts the all-equity finance price path, again, assuming 6 percent inflation. Both paths approximate a straight-line pattern of real price deterioration, although the with-debt financing price path falls off more quickly than the all-equity path. This difference, roughly 10 percent in years 20 through 40, reflects the importance of financing in the valuation process. One less year of rent and financing benefits causes prices to fall off more quickly than the loss of one year's worth of rents alone. Nevertheless, while debt financing does significantly increase the level of real property prices, it does not
FIGURE 2: THE IMPACT OF DEBT FINANCING ON REAL PRICE PATHS
materially alter the relative pattern of prices over time. Reverse SYD real rents still implies a straight-line pattern of real price deterioration.

4.4.3 Price Decomposition

Market prices reflect the value of rents, financing, depreciation tax shelter, and net capital gains to the marginal investor. The net capital gain is determined by the price an investor will receive for the property at the time of sale which, in turn, reflects the value to subsequent investors of the components listed above. In this section the capital gain component is decomposed into its various parts so that estimates can be made about the composition of market prices over the economic life of the property. All values depend upon the previously determined optimal holding periods of each investor in the prohibitive refinancing simulations.

The results assuming no inflation, a relatively low discount rate, and a 3 percent risk premium are displayed graphically in Figure 3. The present value of all depreciation deductions over the economic life of the property account for 46 percent of the market price in year 1. The net present value of debt financing \( Vd(j, h) \) in year \( j \) is

\[
Vd(j, h) = L(0) - \sum_{i=1}^{h} \frac{PAY(i)}{(1+NRe)**i} + \sum_{i=1}^{h} \frac{To*NRd*L(i-1)}{(1+NRe)**i} - \frac{L(h)}{(1+NRe)**h} \quad (11)
\]
If the required return on equity is equal to the after-tax cost of mortgage debt \( (N_{Re} = (1 - To) \times NRd) \), it can be shown that \( Vd(j, h) \) equals zero. That is, leverage does not affect investment value. Because we assume that

\[
N_{Re} = .7 \times NRd + PREM > (1 - To) \times NRd ,
\]

debt financing has a positive impact on real property prices. With zero inflation, it constitutes 35 percent of the initial price. The present value of the residual land sale, which occurs at the end of year 63, contributes 1 percent, and rents 28 percent, of the initial price. The present value of all capital gain taxes and transaction costs over the life of the property account for 9 percent of the year 1 price.

The relative importance of each component remains remarkably stable during the first 40 years. The depreciation tax shield, represented by the plot using the symbol "D" continues to account for roughly 40 percent of each year's price. The net value of financing, represented by the symbol "F", and rents, depicted by the symbol "R", each continue to account for approximately 30 percent of the market price during the first 40 years. Beyond year 45, the present value of the residual land sale ("L") exceeds the financing and rent components and, by year 51, it became the largest component of market price. Selling costs and taxes (the "S's") continue to constitute approximately 10 percent of the market price in each year.
The step function using the symbol "B" at the top of Figure 3 plots the loan-to-market-value ratio through time. With no inflation, the negatively sloped portions represent the net impact of loan amortization and decreasing real rents over the investment holding periods. The former reduces LTVR's; the latter, by reducing market prices, increases LTVB's. The slopes over each successive holding period "flatten out" as the relative importance of economic depreciation increases.

To analyze the impact of inflation on the composition of market prices, the real price path determined with 6 percent inflation was similarly decomposed. These results are displayed graphically in Figure 4. Depreciation contributes 43 percent of the year 1 price and, again, continues to account for roughly 40 percent of the market price during the first half of the property's economic life. However, the net value of financing becomes the largest component of market price over the first 45 years (46% in year 1)\textsuperscript{26}. Rents, as before, constitute approximately 30 percent of the total price over the same period. The relative importance of net selling costs more than doubles with 6 percent inflation. This reflects both more (and sooner) trades and the penalty associated with the taxation of nominal, rather than real, capital gains.

\textsuperscript{26} This result is true even in the high discount rate case.
FIGURE 4: PRICE DECOMPOSITION: 6% INFLATION
Inflation significantly increases the slope of the step function plotting LTVR's through time (the E's). Each of the first five investors has increased his equity capital investment to over 50 percent by the end of the holding period, even though they retain the property for only 9 to 11 years. The acceleration in the shift toward greater use of relatively expensive equity capital, and its impact on trading intervals, demonstrates the significance of the prohibitive refinancing assumption.

4.5 COSTLESS REFINANCING

Costless refinancing allows investors to maintain a more optimal mix of debt and equity capital without selling the property. Granting the investor such an option will increase investment value and eliminate an incentive to trade.

Under the assumption that investors will continuously maintain an 80 percent LTVR, the net value of debt financing in year j is

\[
V_d(j,h) = x1*P(j) + \sum_{i=1}^{h} \frac{(1-To)*[x1*P(j+i-1) + NRe]}{(1+NRe)^{i}}
\]

\[
+ \sum_{i=1}^{h} \frac{x1*[P(j+i)-P(j+i-1)]}{(1+NRe)^{i}} - \frac{x1*F(j+h-1)}{(1+NRe)^{h}}
\]

(13)

The first term is the initial loan amount. The last term represents the loan repayment at the end of the holding period (h years). Note that the repayment amount is based on the market price at the beginning of the year of sale. The
first sum is the discounted after-tax cost of annual interest payments where the payment in year i of the holding period is based upon the market price at the beginning of year i. The second sum is the discounted value of the tax-free cash proceeds that result from the annual refinancing. If nominal property prices increase over the holding period, this sum will be positive.

Table 3 presents the results of incorporating equation 13 into the basic valuation equation. At all levels of inflation, and under both discount rate assumptions, costless refinancing implies larger price-to-income ratios with the size of the increase positively related to the inflation rate. With \( d(\text{NRD})/d(\text{Pi}) = 1.03 \) and no inflation, the PIR is 31.2, 10 percent higher than the prohibitive refinancing result. At 3 percent inflation, the corresponding figures are 43.2 and 30 percent. As inflation increases, the dispersion accelerates. 6 and 9 percent inflation produces PIR's of 72.4 and 291.0. These represent respective increases of 78 and 540 percent over the comparable prohibitive refinancing results.

With a relatively low discount rate, accelerating inflation causes the property to become a virtual "money machine." With 9 percent inflation, the initial investor is willing to pay 291 dollars for less than 70 dollars of operating income spread out over 70 years. The price reflects the property's ability to shelter income from other sources.
### TABLE 3

THE IMPACT OF COSTLESS REFINANCING

OPTIMAL HOLDING PERIODS AND INITIAL PRICE-TO-INCOME RATIOS (PIR'S)

<table>
<thead>
<tr>
<th>PI</th>
<th>( d_n / d(P) )</th>
<th>PIR</th>
<th>PIR</th>
<th>HOLDING PERIODS*</th>
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<td>28.4</td>
<td>31.2</td>
<td>15 15 15 15 10</td>
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<td>1.03</td>
<td>33.3</td>
<td>43.2</td>
<td>15 15 15 15 10</td>
</tr>
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<td>1.43</td>
<td>26.1</td>
<td>31.8</td>
<td>15 15 15 15 10</td>
</tr>
<tr>
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<td>1.03</td>
<td>40.9</td>
<td>72.4</td>
<td>15 15 15 25</td>
</tr>
<tr>
<td>6</td>
<td>1.43</td>
<td>24.5</td>
<td>34.2</td>
<td>15 15 15 24</td>
</tr>
<tr>
<td>9</td>
<td>1.03</td>
<td>53.9</td>
<td>211.0</td>
<td>71</td>
</tr>
<tr>
<td>9</td>
<td>1.43</td>
<td>23.3</td>
<td>40.0</td>
<td>71</td>
</tr>
</tbody>
</table>

PREM = 3 percent.

*The holding periods reported correspond to the with-refinancing case. The holding periods for the prohibitive refinancing case are displayed in Table 2.
It should be noted, however, that these results are predicated on the assumption of a constant, marginal, ordinary income tax rate of 45 percent. Eventually, excessive interest deductions would push the investor into successively lower marginal brackets increasing the after-tax cost of mortgage debt and reducing the relative advantage of costless refinancing.

The introduction of costless refinancing produces different results when a relatively high discount rate is assumed. The increases in PIR's for 3, 6, and 9 percent inflation are 22, 40, and 72 percent, respectively; substantially less than in the low discount rate case. The relative advantage of costless refinancing, at a given level of inflation, is decreased.

The results also indicate that costless refinancing reduces the incentive to trade at high levels of inflation. This result is consistent with the findings of Hendershott and Ling (1984). With 6 percent inflation, investors hold the property for 15 years. The comparable result with prohibitive refinancing costs was, depending on the discount rate, approximately 10 years. At inflation rates above 6 percent, the initial owner never sells the property. Exhaustion of his depreciation tax shelter (after 15 years) does not induce the investor to trade if he is allowed to costlessly refinance. The interest tax shield associated with the property remains as valuable to him as it is to a
potential new owner. The incremental gain received from selling the depreciation tax shelter to a new investor is smaller than the two associated costs, recognition of the large, inflation induced, nominal capital gain and the 5 percent transactions cost.

4.6 **CAPITAL MARKET CONSTRAINTS**

To this point it has been assumed that the maximum mortgage obtainable from a lender is not directly affected by the income producing ability of the property. Borrowers (investors) have been allowed to use income from other sources to satisfy mortgage debt obligations. The importance of this assumption is positively related to the level of expected inflation. For example, with a relatively low discount rate (an equity risk premium of 3 percent), prohibitive refinancing costs, and no inflation, the interest portion of the annual mortgage payment is always less than operating income. At 6 percent inflation, however, the interest portion of the payment in year 1 is 2.8 times greater than operating income. With 9 percent inflation, first year interest is 4.8 times operating income. With a relatively high discount rate, the ratio of interest payments to operating income declines. With 6 percent inflation, the interest payment in year 1 is 1.7 times greater than operating income. With 9 percent inflation, the ratio is 2.0.
Historically, lenders have placed at least some weight on the expected debt-service coverage ratio (NOI/D.S.) in the loan underwriting process. Standard textbook discussions suggest that lenders require the ratio to be, at a minimum, greater than 1.27. The passage of ERTA is expected to decrease the importance of operating income in the valuation process relative to the depreciation and interest tax shields. Furthermore, recent experiences with double-digit inflation and record high mortgage interest rates have made it more difficult for borrowers to qualify under some of the old underwriting rules of thumb. Lenders, as a result, have been forced to reevaluate their loan underwriting process.

The minimum debt-coverage ratio currently required by lenders is an empirical issue. The purpose of this section is to analyze the impact of borrowing limitations assuming two different leverage constraints. Results are displayed in Table 4. Column 3 repeats the price-to-income ratios results for the prohibitive refinancing case. Column 4 reports initial PIR's under the assumption that loan payments are never allowed to exceed gross rents. The PIR's in column 5 assume that mortgage payments are never allowed to exceed net operating income.

---

27 Gettel's (1978) survey, which covered the years 1968 through 1975, found that lender guidelines require a debt-coverage ratio of at least 1.25.
### Table 4

**The Impact of Capital Market Constraints**

<table>
<thead>
<tr>
<th>(1) $d(NH_d)/d(Pi)$</th>
<th>(2) PI</th>
<th>(3) Constraints</th>
<th>(4) PYMTCRENTS</th>
<th>(5) PYMTCO.I. HOLDING PERIODS $a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.03</td>
<td>28.4/1.7</td>
<td>26.4</td>
<td>25.9 15 15 15 15 9</td>
</tr>
<tr>
<td>6</td>
<td>1.43</td>
<td>33.3/1.6</td>
<td>33.1</td>
<td>25.1 12 13 14 15 14</td>
</tr>
<tr>
<td>3</td>
<td>1.03</td>
<td>26.1/1.5</td>
<td>26.1</td>
<td>20.6 13 14 15 15 11</td>
</tr>
<tr>
<td>6</td>
<td>1.43</td>
<td>40.9/2.1</td>
<td>34.2</td>
<td>25.2 10 10 10 12 13</td>
</tr>
<tr>
<td>9</td>
<td>1.03</td>
<td>24.5/2.1</td>
<td>23.6</td>
<td>18.0 10 11 11 12 13 12</td>
</tr>
<tr>
<td>9</td>
<td>1.43</td>
<td>53.9/4.8</td>
<td>34.8</td>
<td>26.4 11 10 10 10 11 15</td>
</tr>
</tbody>
</table>

**PEEX = 3 percent**

*The figures to the right of the slash marks are the ratios of interest payments to operating income in year 1.*

*a-The holding periods reported are for the PYMTCRENTS case.*
With \( \text{PREM}=0.03 \), \( \frac{\text{d} \text{NRd}}{\text{d} (\text{Pi})}=1.03 \), and no inflation, investment value is not affected by the gross rents constraint. With 3 percent inflation, the constrained PIR is slightly lower (33.3 vs. 33.1) than the unconstrained PIR. With 6 and 9 percent inflation, PIR's decrease by 16 and 35 percent respectively. With a relatively high discount rate, the gross rent constraint is not binding at inflation rates of zero and 3 percent. The percentage reductions in PIR's with 6 and 9 percent inflation are 4 \( \left[ (24.5-23.6)/24.5 \right] \) and 11 percent, respectively. The larger percentage decreases at higher levels of inflation result from the way in which the standard, fixed rate, mortgage payment is determined. Inflation tilts the real burden of mortgage payments forward in time. Mortgage payments increase much more than nominal rents\(^2\). 

When loan payments are not allowed to exceed operating income, the negative impact on investment value is increased. With a relatively low discount rate, the percentage reductions in PIR's at 0, 3, 6, and 9 percent inflation are 9, 25, 38, and 51 percent respectively. The percentage reductions are again reduced when a relatively high discount

\(^2\) With no inflation and a 4 percent, before tax, required rate of return, monthly payments on a $50,000 mortgage are $239. With 6 percent inflation, and assuming Fisher interest rates, the monthly payment is $439 per month, an 85 percent increase. Nominal rental income in the first year, however, increases by only 6 percent.
rate is assumed (compare columns 3 and 5 in the d(NRd)/d(Pi)=1.43 rows).

Without capital market constraints, and with a relatively low discount rate, investment value is a strictly increasing function of inflation (see column 3). The positive interest effect dominates the negative depreciation effect if nominal interest rates move one-for-one with inflation. With the operating income constraint (see column 5), investment value is roughly independent of inflation in the low discount rate case because the positive interest effect is truncated. When a relatively high discount rate is assumed, truncation occurs earlier and thus increasing rates of inflation produce lower PIR's with the percentage decreases exceeding those in the unconstrained, high discount rate case (compare the d(NRd)/d(Pi)=1.43 rows in columns 3 and 4).

4.7 SUMMARY AND CONCLUSIONS

In a world without taxes, transactions costs, and other market imperfections, financing and investment decisions can be separated. When market imperfections are introduced, the necessary condition for capital structure irrelevance is equality between the average, risk adjusted, opportunity cost of equity capital and the average after-tax cost of mortgage debt. Because the former is generally greater than the latter, especially for high income indivi-
duals, most researchers agree that investment value is positively related to changes in financial leverage. This chapter analyzes the impact of financing decisions on investment value and optimal holding periods. The basic valuation equation is adjusted to incorporate the interaction of financing per the traditional discounted cash flow model that measures and values cash flow to the equity position after all operating, tax, and financial expenses have been paid. The application is to residential income property purchased after the passage of ERTA.

Several major conclusions follow. First, in all cases, debt financing significantly increases investment value. With prohibitive refinancing costs, a relatively low discount rate (an equity risk premium of 3 percent), and 6 percent inflation, 80 percent debt financing increases investment value by roughly 300 percent over the all equity case. With a relatively high discount rate, the increase is 175 percent. Second, the impact of inflation depends upon the response of market interest rates to changes in inflation. If nominal rates move one-for-one with inflation (the low discount rate case), investment value is a strictly increasing function of inflation. The capital gain deferral benefit and the interest effect dominate the depreciation effect at all four levels of inflation.

With all equity financing, optimal holding periods at low to moderate levels of inflation are 15 years. At 9
percent inflation, the initial investor never sells the property. With 80 percent debt financing and prohibitive refinancing costs, optimal holding periods decrease with inflation. Investors who do not sell are forced to accept a progressively less desirable mix of debt and equity finance. This erosion in the value of the interest tax shield, coupled with the deterioration in the real value of tax depreciation, induces more frequent trading. At 9 percent inflation, for example, the property is traded approximately every 9 years.

With no inflation and a relatively low discount rate, the present value of all depreciation deductions over the life of the property account for 46 percent of the market price in year 1. The net value of debt financing, the residual land sale, rents, and selling costs (including taxes) account for 35, 1, 28, and -9 percent of the year 1 price, respectively. The relative importance of each component remains fairly stable during the first 40 years. With 6 percent inflation, the net value of debt financing becomes the largest component of market price over the first 45 years (46% in year 1). Depreciation and rents constitute, as before, approximately 40 and 30 percent of the market price over the same period. The importance of selling costs more than doubles because of more frequent, earlier trades and the taxation of nominal, rather than real, capital gains.
If investors are costlessly allowed to maintain an 80 percent loan-to-market-value ratio, investment value increases, relative to the all equity case, with the magnitude of the increase positively related to the level of expected inflation. With a relatively low discount rate and no inflation, investment value is 10 percent higher than when prohibitive refinancing costs are assumed. At 9 percent inflation, the comparable figure is 540 percent. The property becomes a virtual money machine in that the initial investor is willing to pay 291 dollars for less than 70 dollars worth of operating income spread out over 70 years. The relative advantage of costless refinancing, at a given level of inflation, is significantly reduced when a relatively high discount rate is assumed because the real, after-tax, cost of obtaining the financing is increased.

The ability to refinance costlessly also decreases the incentive to sell the property because the interest tax shield associated with the property remains as valuable to the current owner as it is to a potential new investor. At inflation rates below 7 percent, the property is held until the end of the 15 year cost recovery period by each of the first four investors. At 7 percent inflation and above, the property is never sold. The opportunity cost of keeping the old depreciable basis in the face of rising nominal property prices does not induce investors to realize inflated capital gains if the value of the interest tax shield is not also increased by the sale.
The final issue addressed was the impact of borrowing constraints on investment values and optimal holding periods. It appears that investment values are frequently affected, even at low levels of inflation. Higher discount rates (and equity risk premiums) lessen the negative impact of borrowing constraints. Optimal holding periods are not materially affected. The results also suggest that, with borrowing constraints, investment value is not a strictly increasing function of inflation even under the low discount rate assumption due to the truncation of the positive interest effect. A net positive impact of inflation thus depends upon the willingness of lenders to allow investors to draw on income from other sources to satisfy mortgage obligations. Such a willingness would represent a fundamental change in the traditional underwriting practices of primary mortgage lenders.
Chapter V
NONRESIDENTIAL PROPERTY

5.1 INTRODUCTION
ERTA tax law offers identical tax depreciation options to investors in conventional residential and nonresidential income properties—175 percent declining balance or straight-line with a 15 year cost recovery period. Tax rules applicable at the time of sale, however, are quite different. If accelerated depreciation is used for nonresidential property, all depreciation (up to the initial market value of the improvements) is recaptured as ordinary income at the time of sale. Thus, investors who choose accelerated depreciation, while able to defer ordinary income, are unable to convert such income into capital gain income via depreciation. This Chapter considers the impact of this differential tax treatment assuming both pure equity and 80 percent debt financing with prohibitive refinancing costs.
5.2 100 PERCENT EQUITY FINANCING

This section reports price-to-income ratios and optimal holding periods for investors in nonresidential property assuming 100 percent equity financing. The use of both straight-line and 175 percent declining balance depreciation are analyzed. The income tax variables used in the Chapter 3 analysis of pure equity residential property are modified to reflect the previously discussed differences in recapture rules. Other parameter values are identical to those assumed in the all equity residential simulations: a 70 year reverse SYD pattern of real rents; 80 percent of the property's purchase price represents depreciable improvements; a marginal tax rate on ordinary income and capital gain income equal to 45 and 18 percent respectively; land remains constant in real terms; transactions costs are equal to 5 percent of the sales price; the nominal required return on assets (Nra) is equal to the product of the assumed constant real return on assets (Ra) and the expected inflation rate (Pi). Ra is set equal to 4 percent.

Results are displayed in Table 5. The first row in each of the four inflation sections repeats the all equity results for residential property reported in Chapter 3. The remaining two rows in each section contain results for nonresidential property assuming accelerated and straight-line depreciation.
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<th>HOLDING PERIODS</th>
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</table>
With zero inflation and straight-line depreciation, the nonresidential PIR is 16.8, 3 percent less than the residential, accelerated depreciation, PIR. In both cases, the first three investors each hold the property for 15 years. By electing the straight-line option, the nonresidential investor is able to convert the same amount of ordinary income into capital gain income as the residential investor. The 3 percent difference reflects the deferral value of the excess depreciation. If the nonresidential investor elected to use accelerated depreciation, the PIR would fall to 15.2 and his optimal holding period would increase to 70 years. The additional deferral benefits would be more than offset by the recapture of all depreciation at the time of sale.

With 3 percent inflation, straight-line is again the optimal method of depreciation for a nonresidential investor. As is the case with residential property, the first three investors sell the property at the end of the cost recovery period. If accelerated depreciation were used, investment value again falls (slightly from 14.6 to 14.5) and the first investor is again the only investor.

With 6 and 9 percent inflation, a nonresidential property is never traded regardless of the method of depreciation that is used. Accelerated is the preferred method
because of its additional deferral benefits. This result agrees with the findings of Hendershott and Ling (1984). With accelerated depreciation, the residential and nonresidential PIRs are equal because the discounted value of the additional recapture penalty on nonresidential property at the end of 66 years is effectively zero.

As with residential property, pure-equity financed nonresidential investment value is negatively correlated with inflation owing to the negative depreciation effect. With straight-line depreciation, the PIR falls from 16.8, with zero inflation, to 13.2, at 9 percent inflation.

5.3 80 PERCENT DEBT FINANCING WITH PROHIBITIVE REFINANCING COSTS

The first row in each of the four inflation sections of Table 6 repeats the initial price-to-income ratios (PIR's) and optimal holding periods for residential property (R) assuming 80 percent debt financing, prohibitive refinancing costs and a relatively low discount rate. The second row in each section reports the corresponding PIR's and optimal holding periods for nonresidential property (NR) assuming the use of accelerated depreciation by all owners of the property. The nonresidential results in row three of each section assume that the straight-line option is elected by all owners of the property. All other assumptions (the pattern of real rents, the relationship between nominal interest rates and inflation, marginal tax brackets, etc.) are the same as in the residential case.
<table>
<thead>
<tr>
<th>PROPERTY TYPE</th>
<th>d(M+t)/d(Pi)</th>
<th>METHOD OF DEPRECIATION</th>
<th>FTR</th>
<th>HOLDING PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>1.03</td>
<td>ACC</td>
<td>28.4</td>
<td>15 15 15 15 8</td>
</tr>
<tr>
<td>NR</td>
<td>1.03</td>
<td>ACC</td>
<td>19.9</td>
<td>21 22 23</td>
</tr>
<tr>
<td></td>
<td>1.03</td>
<td>SL</td>
<td>26.5</td>
<td>15 15 15 15 8</td>
</tr>
<tr>
<td>R</td>
<td>1.43</td>
<td>ACC</td>
<td>28.4</td>
<td>15 15 15 15 8</td>
</tr>
<tr>
<td>NR</td>
<td>1.43</td>
<td>ACC</td>
<td>19.9</td>
<td>21 22 23</td>
</tr>
<tr>
<td></td>
<td>1.43</td>
<td>SL</td>
<td>26.5</td>
<td>15 15 15 15 8</td>
</tr>
<tr>
<td>R</td>
<td>1.03</td>
<td>ACC</td>
<td>33.3</td>
<td>12 13 14 15 14</td>
</tr>
<tr>
<td>NR</td>
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<td>ACC</td>
<td>24.5</td>
<td>20 21 23</td>
</tr>
<tr>
<td></td>
<td>1.03</td>
<td>SL</td>
<td>30.2</td>
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</tr>
<tr>
<td>R</td>
<td>1.43</td>
<td>ACC</td>
<td>26.1</td>
<td>12 13 15 15 12</td>
</tr>
<tr>
<td>NR</td>
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<td>ACC</td>
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<td>19 21 24</td>
</tr>
<tr>
<td></td>
<td>1.43</td>
<td>SL</td>
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</tr>
<tr>
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<td>ACC</td>
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<td>ACC</td>
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<td>16 17 18 17</td>
</tr>
<tr>
<td></td>
<td>1.03</td>
<td>SL</td>
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<td>10 11 12 12 13</td>
</tr>
<tr>
<td>R</td>
<td>1.43</td>
<td>ACC</td>
<td>28.5</td>
<td>10 11 11 12 13</td>
</tr>
<tr>
<td>NR</td>
<td>1.43</td>
<td>ACC</td>
<td>20.7</td>
<td>17 18 19 13</td>
</tr>
<tr>
<td></td>
<td>1.43</td>
<td>SL</td>
<td>22.3</td>
<td>11 12 13 15 15</td>
</tr>
<tr>
<td>R</td>
<td>1.03</td>
<td>ACC</td>
<td>53.9</td>
<td>8 9 9 9 9 9 9</td>
</tr>
<tr>
<td>NR</td>
<td>1.03</td>
<td>ACC</td>
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<td>9 9 10 10 10 10</td>
</tr>
<tr>
<td>NR</td>
<td>1.43</td>
<td>ACC</td>
<td>20.4</td>
<td>15 16 15 18</td>
</tr>
<tr>
<td></td>
<td>1.43</td>
<td>SL</td>
<td>21.1</td>
<td>9 10 10 11 13 12</td>
</tr>
</tbody>
</table>

Other assumptions: prohibitive refinancing costs, PREM=0.03.
With no inflation, initial investment value falls, relative to residential property, by 30 percent \[ \frac{(28.4-19.9)}{28.4} \] if accelerated depreciation is used. If straight-line depreciation is used, the decline is only 7 percent \[ \frac{(28.4-26.5)}{28.4} \]. With 3 percent inflation and a low discount rate, the initial PIR falls, relative to residential property, by 26 percent if accelerated depreciation is used \[ \frac{(33.3-24.6)}{33.3} \]. Assuming straight-line depreciation, the decline is 9 percent \[ \frac{(33.3-30.3)}{33.3} \]. With 9 percent inflation, the initial nonresidential PIR is 28 percent lower \[ \frac{(53.9-38.9)}{53.9} \] than the corresponding residential value assuming accelerated depreciation; 16 percent lower \[ \frac{(53.9-45.2)}{53.9} \] with straight-line depreciation.

These results indicate that (1) the use of straight-line depreciation maximizes the investment value of nonresidential property at all four levels of expected inflation and that (2) the disadvantage of nonresidential property relative to residential property increases with the rate of inflation. Residential investors, using accelerated depreciation, are able to defer the realization of more income than their nonresidential counterparts. The value of these additional deferral benefits increases with inflation because of the positive relationship between discount rates and inflation.

Trading intervals for nonresidential property under the preferred straight-line option are very similar to those
for residential property. With zero and 3 percent inflation, the first four investors each hold the property for 15 years (row 3 in the 0 and 3% inflation sections). At 6 percent inflation, the holding periods average 11 years while at 9 percent inflation they average 9 years. Note that if accelerated depreciation is (mistakenly) used on nonresidential property (row 2), optimal holding periods are significantly increased. With 3 percent inflation, the initial investor retains the property for 20 years (section 2, row 2). The comparable result for residential property is 12 years (section 2, row 1). With 9 percent inflation, the first owner would hold the property for 16 years. The comparable result for residential property is 8 years. When all depreciation is recaptured as ordinary income, investors have large incentives to defer the realization of gains.

Similar to residential property, nonresidential investment value is an increasing function of inflation when a relatively low discount rate is assumed. The initial PIR increases from 26.5 at zero percent inflation to 45.2 at 9 percent inflation. When a relatively high discount rate is assumed, PIR'S fall substantially, especially at high levels of inflation. However, the use of straight-line depreciation is still preferred²⁹.

²⁹ For residential property, reverse SYD real rents produce real prices that decline in a straight-line pattern over time. This result holds for both the pure equity and the 80 percent debt financing case (see Chapters 3 and 4). This same result was verified for nonresidential property assuming 6 percent inflation, 80 percent debt financing,
5.4 **ANNUAL PRICE DECOMPOSITION**

As discussed in Chapter 4, market prices reflect the value of rents, financing, depreciation tax shelter, and net capital gains to the marginal investor. The net capital gain is determined by the price an investor will receive for the property at the time of sale which, in turn, reflects the value to subsequent investors of the components listed above. In Chapter 4, the capital gain component was decomposed into its various parts so that estimates could be made about the composition of residential property prices over the economic life of the improvements. The year 1 results assuming 6 percent inflation, 80 percent debt financing, and a relatively low discount rate are repeated in column 1 of Table 7. Annual prices over the life of the improvements for nonresidential property were similarly decomposed, again, assuming 6 percent inflation and a low discount rate. The year 1 decomposition is reported in column 2 of Table 7.

Depreciation accounted for 43 percent of the initial residential price; it constitutes 36 percent of the nonresidential price. The use of straight-line depreciation reduces both the initial price and the relative importance of depreciation. Rents and financing, respectively, accounted for 30 and 46 percent of the initial residential price. The

and the use of straight-line depreciation.

\[30\] Decomposition results are not affected by discount rate assumptions.
<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>S.L. Depreciation</th>
<th>Acc. Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation</td>
<td>43%</td>
<td>36%</td>
<td>36%</td>
</tr>
<tr>
<td>Rents</td>
<td>30</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>Financing</td>
<td>46</td>
<td>49</td>
<td>35</td>
</tr>
<tr>
<td>Land</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Selling Costs</td>
<td>-22</td>
<td>-21</td>
<td>-14</td>
</tr>
</tbody>
</table>

Other assumptions: $\pi = 6\%$ and $d(WRd)/d(\pi) = 1.03$
corresponding figures for nonresidential realty are 34 and 49 percent. Selling costs constitute 21 percent of the initial price, slightly less than in the residential case. This result reflects the fact that optimal trading intervals, for both type of properties, averaged roughly 11 years (with 6 percent inflation). The slight decrease in the nonresidential case reflects the absence of any recapture at the time of sale. Similar to residential property, these component percentages remain remarkably stable over the first 40 years after which time the land component begins to increase sharply (see Figure 4).

Annual price decompositions of nonresidential properties assuming the use of accelerated depreciation were also determined. The year 1 price decomposition is reported in column 3 of Table 7. Depreciation, as in the straight-line case, accounts for 36 percent of the year 1 price. Rents and the value of the eventual land sale contribute 40 percent and 3 percent respectively. The contribution of financing falls from 49 percent (in the straight-line case) to 35 percent. Total selling costs also fall as a percentage of the initial price, despite the recapture of all depreciation as ordinary income. This is due to the fact that the property is traded 2 rather than 4 times.
5.5 **Summary**

The recapture rules for residential property remain unchanged under post-ERTA tax law, but all depreciation on nonresidential property (up to the initial market value of the improvements) is now recaptured as ordinary income if accelerated depreciation is used. If the straight-line option is elected, all depreciation is taxed at the capital gains tax rate. These tax code revisions make the choice of depreciation method for nonresidential property somewhat more complicated. If an investor elects to use the accelerated method, he increases the deferral benefits of his depreciation tax shield but he forfeits all conversion benefits.

With zero and 3 percent inflation, straight-line is the preferred method of depreciation for nonresidential investors assuming the use of all equity financing. By electing the straight-line method, the nonresidential investor is able to convert the same amount of ordinary income into capital gain income as the residential investor. Investment values are slightly less (3% at 6 percent inflation) than the residential results because nonresidential investors lose the additional deferral benefits associated with accelerated depreciation. At higher levels of inflation, the nonresidential, all-equity property is never traded, regardless of the method of depreciation. The use of accelerated depreciation is optimal because of its additional deferral benefits.
With 80 percent debt financing and prohibitive refinancing costs, straight-line depreciation is the preferred method at all four levels of inflation under both discount rate assumptions. If straight-line depreciation is used, optimal holding period results are identical to residential property: 15 years at zero and 3 percent inflation, 11 years at 6 percent inflation, and 9 years at 9 percent inflation. If accelerated depreciation is elected, the property is traded much less frequently and never before the end of the 15 year cost recovery period. These holding period results are insensitive to the two discount rate assumptions used in the simulations.
The Chapter is organized in the following manner. Section 2 contains an analysis of both residential and nonresidential properties assuming all equity financing. Section 3 reports the corresponding results assuming 80 percent debt financing with prohibitive refinancing costs. Section 4 considers the impact of ERRA on real price paths.

6.2 ALL-EQUITY FINANCE

To analyze the impact of ERRA on the markets for residential and nonresidential property, the base-case, pure equity finance, models of Chapters 3 (residential) and 5 (nonresidential) are used as the point of departure. That is, it is assumed that: real rents follow a reverse SYD pattern; 80 percent of the property's purchase price represents depreciable improvements; land remains constant in real terms; transactions costs are equal to 5 percent of the sales price; the nominal required return on assets is equal to the product of the assumed constant real return on assets (4%) and the expected inflation rate; nominal operating income and the nominal residual land value for each year are computed by compounding real values at the expected inflation rate. Federal income tax variables are then modified to reflect the tax treatment applicable to the marginal investor prior to the passage of ERRA.

For residential property, a tax (useful) life of 30 years is assumed for the improvements. This assumption was
used by Brueggeman, Fisher, and Stern (1982) and is consistent with various court rulings. With regard to the method of depreciation, the initial investor is assumed to use the 200 percent declining balance method while subsequent investors are limited to the use of the 125 percent declining balance method. These methods provided the most rapid write-offs available under pre-ERTA tax law. The assumed marginal tax rates on ordinary (investment) and capital gain income are increased slightly to 50 and 20 percent, respectively. This reflects the fact that the maximum marginal rate on investment income was 70 percent prior to the passage of ERTA. It is again assumed that the marginal investor is not affected by minimum tax complications.

Residential results are presented in Table 8 for 0, 3, 6, and 9 percent inflation rate scenarios. The first row in each inflation rate section contains pre-ERTA price-to-income ratios (PIR's) and holding period results. The second row in each section repeats the post-ERTA, pure-equity finance results from Chapter 3 where it is assumed that all investors over the life of the property use the 175 percent declining balance method of depreciation available under ERTA with a 15 year cost recovery period. Column 4 contains estimates of the long-run decline in rents that would occur if investors compete away short-run increases in investment values (demand prices) by instantaneously increasing the

---

TABLE 8
RESIDENTIAL PROPERTY: ALL EQUITY FINANCE

THE IMPACT OF ETA ON DEMAND PRICES, RENTS, AND HOLDING PERIODS

<table>
<thead>
<tr>
<th>INFLATION</th>
<th>TAX LAW</th>
<th>PIR</th>
<th>% CHANGE IN RENT</th>
<th>HOLDING PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PRE-ERTA</td>
<td>14.6</td>
<td>-14</td>
<td>30 33</td>
</tr>
<tr>
<td>0</td>
<td>POST-ERTA</td>
<td>17.3</td>
<td>-14</td>
<td>15 15 15 15 15 19</td>
</tr>
<tr>
<td>3</td>
<td>PRE-ERTA</td>
<td>13.6</td>
<td>-11</td>
<td>30 33</td>
</tr>
<tr>
<td>3</td>
<td>POST-ERTA</td>
<td>15.3</td>
<td>-11</td>
<td>15 15 15 19</td>
</tr>
<tr>
<td>6</td>
<td>PRE-ERTA</td>
<td>13.0</td>
<td>-7</td>
<td>66</td>
</tr>
<tr>
<td>6</td>
<td>POST-ERTA</td>
<td>14.0</td>
<td>-7</td>
<td>15 15 15 19</td>
</tr>
<tr>
<td>9</td>
<td>PRE-ERTA</td>
<td>12.7</td>
<td>-6</td>
<td>66</td>
</tr>
<tr>
<td>9</td>
<td>POST-ERTA</td>
<td>13.5</td>
<td>-6</td>
<td>66</td>
</tr>
</tbody>
</table>
supply of residential property.

Several points should be stressed with respect to these results. First, both the short-run increases in demand prices and the long-run decreases in real rents represent maximum changes. To obtain more accurate estimates would require a stock adjustment model. Second, the estimated rent reductions represent a shift in the level, not in the relative pattern, of real rents over time.

With zero inflation, the post-ERTA, all equity finance, PIR is 17.3, 17 percent higher \( [(17.3/14.8) - 1] \) than the pre-ERTA result. This implies a 14 percent reduction in rents. To see this, consider a new apartment complex with construction costs of $1 million. If the market is at a long-run equilibrium, then the selling price of the structure is also $1 million. If the marginal investor can pay up to $14.80 for each dollar of operating income (and still earn his required rate or return), then first year operating income is $67,567 ($1 million/14.8). If the passage of ERTA allows the marginal investor to pay up to $17.30 for each dollar of initial operating income, then the market price of the property will increase in the short run to a maximum of $1.15 million ($67,567*17.3). If construction costs do not change, the supply of apartment buildings will increase until operating income falls to $57,803 ($1 million/17.3), a 14 percent decrease.
Holding period results are also significantly altered. Under pre-ERTA tax law, the property has only 2 owners during its economic life with the first owner holding the property for 30 years, the cost recovery period. The estimated changes in investment value and rents with 3 percent inflation are 13 \[
\frac{15.3}{13.6} - 1 \]
and -11 percent, respectively. The initial owner holds the property for 30 years, the second owner retains the property for the remainder of its economic life (33 years).

The relative advantages of ERTA tax law, as reflected in residential investment values, decreases with the rate of inflation. With 6 and 9 percent inflation, the estimated maximum reductions in real rents are 7 and 6 percent, respectively. Additionally, the initial owner holds the property, in both the 6 and 9 percent inflation rate cases, for 66 years. The increase in depreciation tax shelter value that result from a sale in any year is never sufficient to offset the selling costs (tax and realtor fees) that would be incurred because inflated nominal gains, rather than real gains, are taxed at the time of sale. Clearly, inflation-induced taxes, especially in the absence of amortizing debt, may cause investors to be locked-in to properties. The non-trading point is reached at a lower level of inflation under pre-ERTA tax law (6%) because the opportunity cost of retaining the initial depreciable basis in the face of rising nominal property prices is lower.
As is the case with post-ERTA tax law, residential investment value is a monotonically decreasing function of inflation. The PIR falls from 14.8, with no inflation, to 12.7, with 9 percent inflation.

To analyze the impact of ERTA on nonresidential property that is entirely financed with equity capital, federal income tax variables must again be modified to reflect the tax treatment applicable just prior to the passage of ERTA. A tax life of 40 years, which was used by Brueggeman, Fisher, and Stern (1981), is assumed for the improvements. The initial investor is assumed to use the 150 percent declining balance method of depreciation. All subsequent investors are limited to the use of straight-line depreciation. Again, these methods provided the most rapid write-offs allowable under pre-ERTA tax law.

These nonresidential, pure equity, results are displayed in Table 9. The first row in each inflation rate section contains pre-ERTA price-to-income ratios (PIR's) and holding period results. The second row in each section repeats the post-ERTA, pure equity finance, results from Chapter 5. The post-ERTA PIR and holding period figures, at a given level of inflation, represent the optimal method of depreciation.\(^{33}\) Column 4 contains the estimated long-run

\[^{33}\text{Recall that, with 0 and 3 percent inflation, the use of straight-line depreciation is optimal for post-ERTA, nonresidential properties. With 6 and 9 percent inflation, accelerated (175 percent declining balance) depreciation maximizes investment values.}\]
TABLE 9
NONRESIDENTIAL: ALL EQUITY FINANCE

THE IMPACT OF ERTA ON DEMAND PRICES, RENTS, AND HOLDING PERIODS

<table>
<thead>
<tr>
<th>INFLATION</th>
<th>TAX LAW</th>
<th>PIR</th>
<th>% CHANGE IN RENT</th>
<th>HOLDING PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PRE-ERTA 13.0</td>
<td></td>
<td></td>
<td>40 25</td>
</tr>
<tr>
<td>0</td>
<td>POST-ERTA 16.8</td>
<td>-10</td>
<td></td>
<td>15 15 15 18</td>
</tr>
<tr>
<td>3</td>
<td>PRE-ERTA 12.9</td>
<td></td>
<td></td>
<td>40 25</td>
</tr>
<tr>
<td>3</td>
<td>POST-ERTA 14.6</td>
<td>-12</td>
<td></td>
<td>15 15 15 19</td>
</tr>
<tr>
<td>6</td>
<td>PRE-ERTA 12.4</td>
<td></td>
<td></td>
<td>66</td>
</tr>
<tr>
<td>6</td>
<td>POST-ERTA 14.0</td>
<td>-10</td>
<td></td>
<td>66</td>
</tr>
<tr>
<td>9</td>
<td>PRE-ERTA 12.1</td>
<td></td>
<td></td>
<td>66</td>
</tr>
<tr>
<td>9</td>
<td>POST-ERTA 13.5</td>
<td>-10</td>
<td></td>
<td>66</td>
</tr>
</tbody>
</table>
reductions in real rents.

The figures are similar to the residential, all equity finance, results reported above: ERTA tax code changes increase nonresidential investment values with the size of the increase (and hence the reduction in rents) negatively related to the level of inflation; with 0 and 3 percent inflation, the property is only traded once during its economic life with the first investor retaining the property until the end of its tax life (40 years); with 6 and 9 percent inflation, the initial investors hold the property for its entire economic life; investment value is negatively correlated with inflation.

These holding period results are consistent with the findings of Brueggeman, Fisher, and Stern (1981) and imply that, in the absence of amortizing debt, the single-trade model did not systematically overstate optimal holding periods (and understate tax shelter values) under pre-ERTA tax law.

6.3 DEBT FINANCING WITH PROHIBITIVE REFINANCING COSTS

The purpose of this section is to analyze the impact of ERTA on both residential and nonresidential property assuming the use of debt financing. To this end, several assumptions, in addition to those listed in the pure equity analysis above, are required34:

34 These assumptions are discussed in greater detail in Chapter 4, page 39.
1. The after-tax required return on equity is equal to 70 percent of the nominal mortgage interest rate plus a 3 percent risk premium.

2. In the low discount rate cases, nominal mortgage rates are equal to the assumed constant, real, before-tax return on debt (3%) and the expected inflation rate.

3. In the high discount rate cases, nominal rates respond to changes in inflation in such a way as to keep the real after-tax mortgage rate constant for an investor in the 30 percent marginal tax bracket.

4. Investors are allowed to borrow 80 percent of the purchase price with a loan that must be amortized over 25 years, or by year 70, whichever is less.

5. Investors are not allowed to refinance their outstanding loan obligations.

Residential results, assuming 0, 3, 6, and 9 percent inflation are displayed in Table 10 where it is again assumed that the initial investor in pre-ERTA residential property uses 200 percent declining balance depreciation with a 30 year tax life while all subsequent owners are restricted to the use of 125 percent declining balance depreciation. The first and third rows in each inflation rate section report pre-ERTA results for the low and high discount rate cases, respectively. Rows 2 and 4 repeat the corresponding post-ERTA results from Chapter 4 (Table 2). Column 4 contains the estimated, long-run, reductions in real rents.

With zero inflation (and both a high and low discount rate), the post-ERTA investment value is 42 percent \([(28.4/20.0)-1]\) higher than the pre-ERTA result. This im-
**TABLE 10**

**RESIDENTIAL PROPERTY: 80 PERCENT DEBT FINANCING**

**THE IMPACT OF ETA ON DEMAND PRICES, RENTS, AND HOLDING PERIODS**

<table>
<thead>
<tr>
<th>TAX LAW</th>
<th>( \frac{d(\text{Nd})}{d(\Pi)} )</th>
<th>( \Pi )</th>
<th>CHANGE</th>
<th>RENTS</th>
<th>HOLDING PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-ERTA</td>
<td>1.03</td>
<td>20.0</td>
<td>-30</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Post-ERTA</td>
<td>1.03</td>
<td>28.4</td>
<td>-30</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

\( \Pi = 0\% \)

| Pre-ERTA | 1.43 | 20.0 | -30 | 18 | 16 | 16 | 14 | 15 | 15 | 15 | 15 | 15 |
| Post-ERTA | 1.43 | 28.4 | -30 | 15 | 15 | 15 | 15 | 8 |

\( \Pi = 3\% \)

| Pre-ERTA | 1.03 | 23.2 | -28 | 15 | 12 | 14 | 14 | 12 | 12 |
| Post-ERTA | 1.03 | 32.3 | -28 | 12 | 13 | 14 | 15 | 12 |

\( \Pi = 6\% \)

| Pre-ERTA | 1.43 | 19.3 | -26 | 16 | 14 | 16 | 18 |
| Post-ERTA | 1.43 | 26.1 | -26 | 12 | 13 | 15 | 15 | 12 |

\( \Pi = 9\% \)

| Pre-ERTA | 1.03 | 27.6 | -32 | 13 | 10 | 11 | 12 | 12 | 10 |
| Post-ERTA | 1.03 | 40.9 | -32 | 10 | 11 | 11 | 12 | 13 | 12 |

\( \Pi = 12\% \)

| Pre-ERTA | 1.43 | 18.7 | -24 | 14 | 11 | 12 | 14 | 14 |
| Post-ERTA | 1.43 | 24.5 | -24 | 10 | 11 | 11 | 12 | 13 | 10 |

\( \Pi = 15\% \)

| Pre-ERTA | 1.03 | 33.7 | -37 | 12 | 9 | 9 | 10 | 10 | 10 |
| Post-ERTA | 1.03 | 53.9 | -37 | 8 | 9 | 9 | 9 | 9 | 9 |

\( \Pi = 18\% \)

| Pre-ERTA | 1.43 | 18.2 | -22 | 14 | 10 | 11 | 11 | 11 | 9 |
| Post-ERTA | 1.43 | 23.3 | -22 | 9 | 9 | 10 | 10 | 10 | 10 |

Other assumptions: prohibitive refinancing costs, PREM=3.
plies a 30 percent long-run reduction in real rents. With 3 percent inflation and a relatively low discount rate, the PPR and rent changes are $40 \left( \frac{32.3}{23.1} - 1 \right)$ and -28 percent. With 6 and 9 percent inflation, post-ERTA investment values increase by 48 and 60 percent assuming a low discount rate. The corresponding rent reductions are 32 and 37 percent, respectively. With a relatively high discount rate, the percentage increases in investment values are negatively related to inflation (compare rows 3 and 4 in each section).

Several conclusions follow. First, the value of the additional tax benefits conferred by ERTA may be significantly increased by the use of debt financing. Second, the relationship between increases in investment value (and decreases in rents) and the rate of inflation depends upon the discount rate assumption. Specifically, the relative value of ERTA increases (decreases) with inflation when a low (high) discount rate is assumed.

The inclusion of debt financing substantially alters optimal residential pre-ERTA holding periods. With zero inflation, the first investor holds the property for 18 years, much less than the 30 year tax life. Subsequent investors retain the property for 16, 18, and 14 years, respectively. These trading intervals are only slightly longer than the optimal 15 year post-ERTA results.

As is the case with post-ERTA holding periods, optimal pre-ERTA trading intervals decrease with inflation when
amortizing debt is used. With 3 percent inflation and a relatively low discount rate, the first investor retains the property for 15 years. The next four investors hold the property for 12, 13, 14, and 12 years, respectively. These intervals are actually slightly shorter than the corresponding post-ERTA holding periods (compare rows 1 and 2). With a high discount rate and 3 percent inflation, there are 4 owners who hold the property for 16, 14, 16, and 18 years, respectively. These intervals are slightly longer than the 15 year post-ERTA results (compare rows 3 and 4).

Pre-ERTA holding periods continue to decrease with inflation. With 9 percent inflation and a low discount rate, the initial investor retains the property for only 12 years. Subsequent holding periods are approximately equal to the post-ERTA results (roughly 9 years).

These results suggest that optimal holding periods may be more sensitive to financing parameters than to cost recovery periods. The value of maintaining a more optimal mix of debt and equity finance induces investors to sell, and incur capital gain taxes and selling costs, long before the end of the 30 year tax life. Note that, with debt financing and prohibitive refinancing costs, use of the single-trade model significantly understates the number of investors in a pre-ERTA property.

Nonresidential results are reported in Table 11 where it is again assumed that the initial investor uses 150
TABLE 11
NONRESIDENTIAL PROPERTY: 80 PERCENT DEBT FINANCING

THE IMPACT OF ERTA ON DEMAND PRICES, RENTS, AND HOLDING PERIODS

<table>
<thead>
<tr>
<th>TAX LAW</th>
<th>( d(MG)/d(P_i) )</th>
<th>PIR</th>
<th>% CHANGE IN RENTS</th>
<th>HOLDING PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-ERTA</td>
<td>1.03</td>
<td>18.1</td>
<td></td>
<td>15 15 16 19</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.03</td>
<td>26.5</td>
<td>-32</td>
<td>15 15 15 15 8</td>
</tr>
<tr>
<td>PRE-ERTA</td>
<td>1.43</td>
<td>18.1</td>
<td></td>
<td>15 15 16 19</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.43</td>
<td>28.4</td>
<td>-32</td>
<td>15 15 15 15 8</td>
</tr>
<tr>
<td>PRE-ERTA</td>
<td>1.03</td>
<td>21.0</td>
<td></td>
<td>13 12 13 14 14</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.03</td>
<td>30.3</td>
<td>-31</td>
<td>13 14 15 15 11</td>
</tr>
<tr>
<td>PRE-ERTA</td>
<td>1.43</td>
<td>17.6</td>
<td></td>
<td>13 12 13 14 13</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.43</td>
<td>24.0</td>
<td>-26</td>
<td>14 15 15 15 8</td>
</tr>
<tr>
<td>PRE-ERTA</td>
<td>1.03</td>
<td>26.9</td>
<td></td>
<td>12 10 11 11 12 10</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.03</td>
<td>36.1</td>
<td>-31</td>
<td>10 11 12 12 13 12</td>
</tr>
<tr>
<td>PRE-ERTA</td>
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<td>22.3</td>
<td>-23</td>
<td>11 12 13 15 15</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.43</td>
<td>30.1</td>
<td></td>
<td>11 9 10 10 10 10</td>
</tr>
<tr>
<td>PRE-ERTA</td>
<td>1.03</td>
<td>30.1</td>
<td></td>
<td>9 9 10 10 11 11</td>
</tr>
<tr>
<td>POST-ERTA</td>
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<td>45.2</td>
<td>-33</td>
<td>9 10 10 11 13 12</td>
</tr>
<tr>
<td>PRE-ERTA</td>
<td>1.43</td>
<td>16.8</td>
<td></td>
<td>12 10 11 11 11 10</td>
</tr>
<tr>
<td>POST-ERTA</td>
<td>1.43</td>
<td>21.1</td>
<td>-21</td>
<td>9 10 10 11 13 12</td>
</tr>
</tbody>
</table>

Other assumptions: prohibitive refinancing costs, PREM=3.
percent declining balance depreciation over a 40 year tax life. All subsequent investors are restricted to the use of straight-line depreciation.

With zero inflation, the post-ERTA investment value is 46 percent higher than the pre-ERTA result \([(26.5/18.1)-1]\) implying a 32 percent long-run reduction in real rents. Similar to residential property, investment value increases, and real rent decreases, vary with the level of inflation with the direction of the change dependent upon the discount rate. With a low discount rate, the relative value of ERTA increases with inflation. The post-ERTA PIR, with 9 percent inflation, is 50 percent greater \([(45.3/30.1)-1]\) than the pre-ERTA result. With a relatively high discount rate, the advantage of ERTA decreases with inflation. This is reflected in smaller percentage decreases in long-run rents.

With no inflation, the initial investor holds the property for 15 years under either tax regime. With 3 percent inflation and a low discount rate, the initial holding period is 13 years under either tax law. Note, however, that subsequent investors actually average slightly shorter holding periods (13.0 vs. 13.8 years) than their post-ERTA counterparts. At higher levels of inflation (6 and 9 percent), the initial pre-ERTA investor retains the property for 12 years, 2 years longer than post-ERTA investors do. Subsequent holding periods, however, are approximately equal to post-ERTA trading intervals.
6.4 THE IMPACT OF ERTA ON REAL PRICE PATHS

Given an exogenous rent-utility path, the results reported above suggest that the passage of ERTA will significantly alter the level of real rents. The final issue considered in this Chapter is the impact of ERTA on the pattern of real prices over time.

Under post-ERTA tax law, reverse SYD real rents produce real prices that decline in a straight-line pattern over time. This result holds for both the pure equity and 80 percent debt financing cases (see Figure 2). The real pre-ERTA price path, assuming 6 percent inflation and 80 percent debt financing, is displayed in Figure 5. The plot using the symbol "R" is a depiction of straight-line price (or rent) deterioration. The plot employing the symbol "6" is the endogenously determined real price path assuming a reverse SYD pattern of real rents. This pre-ERTA real price path closely approximates a straight-line pattern of real price deterioration. The corresponding, pre-ERTA, nonresidential path is not displayed because it virtually plots on top of the residential path. These results are identical to the corresponding post-ERTA result and suggest that ERTA did not alter the pattern of real price deterioration over time.

This result has significant implications for the interpretation of previous studies of economic depreciation. Hulten and Wycoff (1978) found evidence, under pre-ERTA tax law, that real prices decline in a straight-line pattern.
Figure 5: The impact of ETA on real price paths.
over time. If their findings are correct, and if real price paths are invariant with respect to changes in tax law, as the above results suggest, then it appears that the economic depreciation of income properties follows a reverse SYD pattern.

6.5 SUMMARY AND CONCLUSIONS

Prior to the passage of ERTA, cost recovery periods for depreciable real estate ranged from 30 to 50 years and allowable methods of depreciation varied from 200 percent declining balance to straight-line. Recovery periods and allowable methods depended upon whether or not the property was new or used, residential or nonresidential.

ERTA significantly revised the tax treatment of depreciable real estate. Identical tax depreciation options are now offered to investors in conventional residential and nonresidential properties -- 175 percent declining balance or straight-line with a 15 year cost recovery period. These options are available on used, as well as new, properties.

The primary results reported in this Chapter are (1) estimates of short-run changes in investment values that occur if all the increased tax benefits provided by ERTA are immediately reflected in market prices and (2) estimates of the long-run reductions in real rents that will occur as the supply of property adjusts to the increased demand prices. Residential and nonresidential properties are considered assuming both pure equity and 80 percent debt financing.
With 6 percent inflation and pure equity financing, ERTA increases residential investment value by 8 percent which implies a 7 percent long-run reduction in real rents. Nonresidential investment value increase by 13 percent, implying a 11 percent reduction in rents. The differences reflect the fact that, while tax depreciation options are now identical for both types of property, residential property received relatively more preferential tax treatment prior to the passage of ERTA. Optimal pre-ERTA holding periods for the initial investors are equal to the respective tax lives with little (3%) or no inflation. Neither type of property is traded when inflation is at the 6 or 9 percent level.

With 80 percent debt financing, a relatively low discount rate, and 6 percent inflation, ERTA increases residential investment values by 48 percent. The associated rent reduction is 32 percent. The corresponding figures for nonresidential property are 44 and 31 percent, respectively. In either case, the availability of debt financing amplifies the value of ERTA to income property investors.

The availability of amortizing debt significantly shortens optimal holding periods. With 6 percent inflation and a low discount rate, the initial pre-ERTA, residential, investor holds the property for 13 years, 3 years longer than his post-ERTA counterpart. The average holding period for the remaining investors, however, is actually slightly shorter than the post-ERTA average (11.0 vs. 11.8 years).
These results suggest that, in the presence of debt financing, the single-trade model significantly understates the number of investors in a property.

Finally, it appears that ERTA will not alter the pattern of real prices over time. Reverse SYD real rents still produce a straight-line pattern of price deterioration. This means that, if real prices decline in a straight-line fashion over time, then the economic depreciation of income properties follows a reverse SYD pattern.
Chapter VII

SUMMARY AND CONCLUSIONS

The same factors which determine current market prices also determine the price future investors will bid for a property. Previous authors have assumed price paths without any reference to these underlying factors because no means has been available to endogenize these future prices (and future optimal holding periods). This limitation in the use of both discounted cash flow analysis and the user-cost of capital framework is of critical importance when these methodologies are used as asset pricing models. Analyzing the impact of a change in the tax code or in the rate of inflation on current market prices, without simultaneously considering the impact of such changes on future prices, has been a significant limitation in a variety of previous studies.

Dynamic programming is used to solve this perplexing recursion problem. With this optimization technique and an exogenous rent-utility path, a simulation model is developed in Chapter 2 that can jointly determine both a price path and the corresponding optimal holding period for all owners during the economic life of an income producing property.
The base-case application of the model in Chapter 3 is to a residential property purchased after the passage of the Economic Recovery Tax Act (ERTA) that is entirely financed with equity capital. Assuming no inflation and a reverse sum-of-years-digits (SYD) pattern of economic depreciation, the initial price-to-income ratio is 17.3. That is, the first investor is willing to pay approximately 17.3 dollars for each dollar of operating income in year 1.

The effect of inflation on the base-case solution is then explored. In the absence of debt financing, investment value decreases with inflation. The price-to-income ratio falls from 17.3, with no inflation, to 13.5, at 9 percent inflation. The decrease reflects the negative depreciation effect that results from the fact that depreciation deductions depend upon historical purchase costs rather than on replacement values. Although the real value of interest deductions typically increase with inflation because investors are allowed to deduct nominal, rather than real, interest payments, this positive effect is precluded by the assumption of pure equity financing.

Trading occurs every 15 years at low to moderate levels of inflation. With 9 percent inflation, however, the initial investor retains the property for its entire economic life. The value of deferring the large, inflation induced, capital gain is always greater than the incremental value of the depreciation deductions that would result from
the sale of the property to a new investor. In the absence of debt financing, this eliminates trading.

Chapter 3 also presents evidence that there is not a proportional relationship between patterns of real price deterioration and patterns of economic (real rent) depreciation. Assuming ERTA tax law and 6 percent inflation, a straight-line pattern of real price deterioration is produced with reverse SYD real rents, and a geometric pattern of real prices is consistent with straight-line deterioration in real rents. In both cases, real prices fall off much more quickly than real rents, reflecting the finite economic life of the improvements. This result has important ramifications for the interpretation of several previous studies where patterns of economic depreciation are directly inferred from used property prices.

Chapter 4 analyzes the impact of financing decisions and opportunities on investment values and optimal holding periods. The basic valuation equation used within the dynamic programming algorithm is adjusted to incorporate the interaction of financing and investment value. The application is to residential income property purchased after the passage of ERTA. In all cases, use of debt financing significantly increases investment value. With prohibitive refinancing costs, a relatively low discount rate, and 6 percent inflation, the ability of all investors to finance 80 percent of the purchase price with debt increases the initial
investment value by roughly 300 percent. With a relatively high discount rate, the increase is 175 percent.

The impact of inflation on investment values, in the presence of 80 percent debt financing, depends upon the response of market interest rates to changes in inflation. If nominal rates move one-for-one with inflation, investment value is a strictly increasing function of inflation. The capital gain deferral benefit and the interest effect dominate the depreciation effect at all four levels of inflation. This result supports the findings of Titman (1982) and Whinihan (1981), among others, who, assuming Fisher interest rates, also concluded that the net impact of inflation on real property investments is favorable. However, when after-tax nominal mortgage rates, for 30 percent marginal tax bracket investors, rise one-for-one with inflation, investment value is a strictly decreasing function of inflation. This is due to the fact that the positive interest effect is greatly reduced for high tax bracket individuals. This result supports the analysis of Hochman and Palman (1983) who also conclude that the net effect of inflation depends upon the impact of inflation on market rates of interest.

In contrast to the pure equity results, optimal holding periods decrease with inflation when 80 percent debt and prohibitive refinancing costs are assumed. Investors who do not sell are forced to accept a progressively less
desirable mix of debt and equity finance. This erosion in the value of the interest tax shield, coupled with the deterioration in the real value of tax depreciation, induces more frequent trading. At 9 percent inflation, for example, the property is traded approximately every 9 years.

With no inflation and a relatively low discount rate, the present value of all depreciation deductions over the life of the property account for 46 percent of the market price in year 1. The net value of debt financing, the residual land sale, rents, and selling costs account for 35, 1, 20, and -9 percent of the year 1 price, respectively. The relative importance of each component remains fairly stable during the first 40 years. With 6 percent inflation, the net value of debt financing becomes the largest component of market price over the first 45 years (46% in year 1). Depreciation and rents constitute, as before, approximately 40 and 30 percent of the market price over the same period. The importance of selling costs more than doubles because of the taxation of nominal, rather than real, capital gains and earlier, more frequent trading.

Chapter 4 also considers the impact of allowing investors to costlessly maintain an 80 percent loan-to-market-value ratio. In all simulations, investment value increases, relative to the prohibitive refinancing case, with the magnitude of the increase positively related to the level of inflation. With a relatively low discount rate and no in-
flation, investment value is 10 percent higher than when prohibitive refinancing costs are assumed. At 9 percent inflation, the comparable figure is 540 percent. The property becomes a virtual money machine in that the initial investor is willing to pay 291 dollars for less than 70 dollars worth of operating income spread out over 70 years. The relative advantage of costless refinancing, at a given level of inflation, is significantly reduced when a relatively high discount rate is assumed because the real, after-tax, cost of obtaining the financing is increased.

The ability to costlessly refinance also decreases the incentives to sell the property because the interest tax shield associated with the property remains as valuable to the current owner as it is to a potential new investor. At inflation rates below 7 percent, the property is held until the end of the 15 year cost recovery period by each of the first four investors. At 7 percent inflation and above, the property is never sold. The opportunity cost of keeping the old depreciable basis in the face of rising nominal property prices does not induce investors to realize inflated capital gains if the value of the interest tax shield is not also increased by the sale.

The final issue addressed in Chapter 4 is the impact of borrowing constraints on investment values and optimal holding periods. Historically, lenders have placed some importance on the ability of a property to generate enough in-
come to cover mortgage debt obligations. That is, expected operating income is an important consideration in the loan underwriting process, regardless of the borrower's ability to use income from other sources to service mortgage debt. While important to lenders, the passage of ERTA is expected to decrease the importance of operating income in the investment valuation process relative to the depreciation and interest tax shields. Furthermore, recent experiences with double-digit inflation and record high mortgage interest rates have made it more difficult for borrowers to qualify under some of the old underwriting rules of thumb because inflation tilts the real burden of mortgage payments forward in time. Lenders, as a result, have been forced to reevaluate their loan underwriting process.

Two borrowing constraints are considered. In the first case, loan payments are never allowed to exceed gross rents. With 6 percent inflation and a relatively low discount rate, this assumption reduces investment value by 16 percent relative to the unconstrained case. Case 2 assumes that loan payments are not allowed to exceed operating income. This assumption, coupled with 6 percent inflation and a low discount rate, decreases investment value by 38 percent. Under both constraints, percentage reductions in investment values are positively related to inflation. This reflects the way in which the standard, fixed-rate, mortgage payment is determined. Such payments increase, in per-
percentage terms, much more than nominal rents in response to an increase in inflation. Thus, the net impact of inflation depends upon the willingness of lenders to allow investors to draw on income from other sources to satisfy mortgage obligations.

ERTA tax law offers identical tax depreciation options to investors in conventional residential and nonresidential income properties—175 percent declining balance or straight-line with a 15 year cost recovery period. Tax rules applicable at the time of sale, however, are quite different. If accelerated depreciation is used for nonresidential property, all depreciation (up to the initial market value of the improvements) is recaptured as ordinary income at the time of sale. Thus, investors who choose accelerated depreciation, while able to defer ordinary income, are unable to convert such income into capital gain income via depreciation. Chapter 6 considers the impact of this differential tax treatment assuming both pure equity and 80 percent debt financing.

With zero and 3 percent inflation, straight-line is the preferred method of depreciation for nonresidential investors assuming the use of all equity financing. By electing the straight-line method, the nonresidential investor is able to convert the same amount of ordinary income into capital gain income as the residential investor. Investment values are slightly less (3% at 6 percent inflation) than
the residential results because nonresidential investors lose the additional deferral benefits associated with accelerated depreciation. At higher levels of inflation, the all equity financed nonresidential property is never traded, regardless of the method of depreciation. The use of accelerated depreciation is therefore optimal because of its additional deferral benefits.

With 80 percent debt financing and prohibitive refinancing costs, straight-line depreciation is the preferred method at all four levels of inflation under both discount rate assumptions. If straight-line depreciation is used, optimal holding period results are strikingly similar to residential property: 15 years at zero and 3 percent inflation, 11 years at 6 percent inflation, and 9 years at 9 percent inflation. If accelerated depreciation is elected, the property is traded much less frequently and never before the end of the 15 year cost recovery period. These holding period results are insensitive to the two discount rate assumptions used in the simulations.

Chapter 6 analyzes the impact of ERTA on income property investments. Residential and nonresidential properties are considered assuming both pure equity and 80 percent debt financing. With 6 percent inflation and pure equity financing, ERTA increases residential investment value by 8 percent which implies a 7 percent long-run reduction in real rents. Nonresidential investment value in-
crease by 13 percent, implying a 11 percent reduction in rents. The differences reflect the fact that, while tax depreciation options are now identical for both types of property, residential property received relatively more preferential tax treatment prior to the passage of ERTA. Optimal pre-ERTA holding periods for the initial investors are equal to the respective tax lives with little (3%) or no inflation. Neither type of property is traded when inflation is at the 6 or 9 percent level.

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Finally, it appears that ERTA will not alter the pattern of real prices over time. Reverse SYD real rents still produce a straight-line pattern of price deterioration. This means that, if real prices decline in a straight-line fashion over time [as per Hulten and Wycoff (1978)], then the economic depreciation of income properties follows a reverse SYD pattern.
BIBLIOGRAPHY


