

**REAL OPTIONS AND AFFORDABLE ALTERNATIVES:
A CONTINGENT CLAIMS APPROACH TO THE ECONOMICS OF OWNERSHIP**

by

Yaniv Tepper

B.S., Mechanical Engineering
University of California, Berkeley, 1989

Submitted to the Department of Civil and Environmental Engineering
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Civil Engineering

and

Master of Science in Real Estate Development

at the
Massachusetts Institute of Technology
August 1992

© Yaniv Tepper, 1992. All rights reserved.

The author hereby grants to MIT permission to reproduce and to
distribute publicly copies of this thesis document in whole or in part.

Signature of Author _____

Certified by _____

Fred Moavenzadeh
Director, Center for Construction Research and Education
George Macomber Professor of Construction Engineering and Management
Thesis Advisor

Certified by _____

Marc A. Louargand, Lecturer
Department of Urban Studies and Planning
Thesis Advisor

Accepted by _____

Eduardo Kausel
Chairman, Departmental Committee on Graduate Studies

Accepted by _____

Lawrence S. Bacow
Chairman, Interdepartmental Degree Program in Real Estate Development

REAL OPTIONS AND AFFORDABLE ALTERNATIVES: A CONTINGENT CLAIMS APPROACH TO THE ECONOMICS OF OWNERSHIP

by

Yaniv Tepper

Submitted to the Department of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degrees of Master of Science in Civil Engineering and Master of Science in Real Estate Development, Massachusetts Institute of Technology, August 1992

ABSTRACT

The lack of affordable ownership opportunities in the housing markets has been a perennial concern for homebuyers, investors, as well as many housing observers. This thesis presents an "asset-based" approach to affordability using financial options techniques to unbundle certain separable and tradable claims embedded in ownership.

Chapter 1 presents a brief analysis of recent homeownership rates, housing prices, and price volatility in an ownership market. Economic, demographic, business, and political forces which impact these housing variables are discussed. Chapter 2 categorizes past approaches, and recognizes that many are, indirectly, redistributive in nature. It is argued that many of these approaches have lacked permanence and compelling economic logic. Several alternative approaches are explored, including alternative *market mechanisms*, alternative housing *products*, and new *institutional arrangements*.

Next, an "asset-based" approach is introduced, founded on more appealing economic premises - a mutual exchange of value between the homeowner, who gains in affordability, and an investor, who gains a unique investment opportunity. After reviewing some of the recent developments in the financial options literature, an unbundling mechanism is proposed. It is designed to enable homeowners to make direct decisions about the bundles of housing rights and embedded options which they hold. By unbundling certain options implicit in the market price, and selling them to investors, homeowners are able to reduce their carrying costs, and create for themselves new opportunities for ownership. At the same time, more efficient pricing and better allocation of risk from homeowners to investors, make this options approach appealing.

The option-like vehicle proposed exploits the value of housing malleability and related price volatility. The homeowner, in effect, is selling *future* options on physical malleability and functional flexibility, for affordability *today*. Seven fundamental rights of ownership are presented, and segregated by how easily they unbundle and how favorably they may trade. Right of possession, rent, and disposition are identified as most promising for this approach. Three models are used to describe the unbundling option vehicle. A feasibility analysis is then performed on the embedded option to capture appreciation. This approach is different from the new shared appreciation mortgages in its separation of the risk of price volatility from the fiduciary lender to the investor. It is suggested that investors are able to diversify volatility risk across housing markets better than both households and lenders.

Thesis Advisors:

Dr. Fred Moavenzadeh, Director, Center for Construction Research and Education
Dr. Marc A. Louargand, Center for Real Estate

*To my parents,
who have given of themselves
unselfishly, and unconditionally, always*

*Dani, Miri, Bati, Brian, Gili, Dana, and Nina
Lemor, Oren, Adi, Galit, Orië, Tal, Dean, and...*

of course, Nets

For Encouragement and Support,

*Fred Moavenzadeh
Marc A. Louargand
Langley Keyes
William C. Wheaton
Denise DiPasquale
Andy, Matt*

*This thesis is dedicated to Professor Jim Paddock
for his unending inspiration,
academic courage, personal warmth, and unforgettable
energy*

TABLE OF CONTENTS

ABSTRACT	2
ACKNOWLEDGMENTS	3
LIST OF FIGURES	9
LIST OF TABLES	11
INTRODUCTION	12
CHAPTER 1	
OWNERSHIP, PRICES AND HOUSING MARKETS	
OVERVIEW.....	14
I. HOMEOWNERSHIP RATES	
Legacy and Examples.....	15
II. DETERMINANTS OF HOMEOWNERSHIP RATES.....	18
Household Age.....	20
Marital Status	21
Income.....	22
Interest Rates.....	23
Mortgage Qualification Requirements.....	24
Extent and Success of Government Involvement.....	25
Concluding Remarks.....	26
III. PRICE FLUCTUATIONS AND THEIR	
CONSEQUENCES.....	27
Recent History.....	28
Causes of Price Movements.....	34
IV. THE CALIFORNIA EXAMPLE.....	36
Distributional Effects.....	39
Mobility Effects.....	40
Business Effects.....	41
V. MARKET SEGMENTATION	41
Anecdotal Evidence	42
Academic Treatment.....	45
General Comments.....	45
Segmentation and Hedonics.....	46
Several Examples.....	47
VI. POPULAR STRATEGIES.....	50
Relax local land use restrictions	50
Enhance Credit.....	50
Establish Innovative Housing Partnerships.....	51
Increase Government Involvement.....	51
Initiate Housing Entitlements	53
Improve Tax Treatment.....	53

CHAPTER 2

HOUSING STRATEGIES: LESSONS FROM THE PAST

I. OVERVIEW	56
II. SUBSIDY APPROACHES	57
III. ALTERNATIVE APPROACHES	58
Alternative Markets	
Transformations, Conversions, Subdivisions and	
Mergers	60
Measurability.....	63
Alternative Housing Products	
Manufactured/Modular Housing.....	66
Alternative Institutional Arrangements	
Employer Assisted Housing	69
Employers and Developers	
New Opportunities	73
Employers and Housing Agencies	
Community Housing Partnerships	74
IV. ASSET-BASED APPROACHES	75
Sweat Equity Programs.....	76
Mortgage Instruments.....	76
Equity Participation	76

CHAPTER 3

FINANCIAL AND REAL OPTIONS

I. HISTORICAL PERSPECTIVE	80
II. LITERATURE REVIEW	81
Recent Developments	81
III. BLACK-SCHOLES OPTION VALUATION MODEL	84
Motivation.....	84
Discrete Time and Binomial Derivation.....	85
Solution.....	90
Input Parameters.....	92
Comparative Statics.....	93
Current Asset Price.....	93
Volatility.....	94
Interest Rate.....	94
Exercise Price.....	95
Time to Expiration.....	95
Dividends.....	96
General Interpretive Framework.....	97
Assumptions	98
Basic Properties and Observations	100
Distortions.....	103
Investment Strategies	103

CHAPTER 4

HOUSING, OPTIONS, AND THE ECONOMICS OF OWNERSHIP

I. OVERVIEW.....	105
II. CHARACTERISTIC ATTRIBUTES OF HOUSING	
GOODS AND MARKETS.....	107
III. CONSUMER CHOICES IN THE HOUSING MARKET.....	110
Renting vs. Owning.....	112
IV. ECONOMICS OF OWNERSHIP.....	112
The Notion of Bundling.....	112
Identification of the Asset.....	115
Home Ownership	
What Is It?.....	116
Rights of Ownership.....	117
Embedded Options	
Some Examples.....	119
Syndication Analogy.....	121
Securitized Mortgage Pools.....	122
V. OTHER OPTIONS IN REAL ESTATE.....	122
Real Estate Development Rights.....	122
Transferrable Development Rights.....	123
Long Term Leases.....	124
Real Estate Ownership Forms.....	125
Condominiums, Co-ops, Planned Communities.....	125
Real Estate Contracts.....	126
Land-Use Rights and Restrictions.....	127
Historical Districting and Facade Easements.....	127
VI. APPROPRIATENESS OF THE OPTIONS ANALOGY.....	128

CHAPTER 5

PRICING MODELS FOR ASSET-BASED APPROACHES

I. OVERVIEW.....	131
II. THE OPTION CHARACTER OF HOUSING.....	132
The Six Determinants of Option Value.....	132
Current Asset Price.....	132
Volatility.....	134
Interest Rate.....	135
Exercise Price.....	135
Time to Expiration.....	135
Dividends.....	136
Other Option Characters and Considerations.....	136
Investment Timing.....	136
Malleability and Durability.....	137

III. THE ASSET APPROACH.....	138
Standard Option Model	138
The Housing Option Model.....	140
IV. MODELING ALTERNATIVES	143
Zero Coupon Bond.....	144
Homeowner's Perspective	146
Investor's Perspective	150
Combination Call-Put Model.....	152
(A) Premium Paid.....	152
(B) Homeowner Call.....	153
(C) Investor Put	154
European Put Option Model.....	154
V. IMPLICIT ASSUMPTIONS.....	158
VI. SUGGESTIONS FOR FURTHER RESEARCH.....	158
VII. CONCLUSION.....	159
APPENDIX A: QUALITY CHANGES	161
APPENDIX B: AFFORDABILITY MEASURES.....	164
NAR's Affordability Index.....	164
NAHB's Housing Opportunity Index	167
APPENDIX C: COMPONENTS OF HOUSING VALUES.....	169
Literature Review.....	169
Housing Price Indexes.....	171
APPENDIX D: COMPONENTS OF PRICE APPRECIATION.....	173
Hedonic Model of Appreciation	174
An Alternative Model	176
APPENDIX E: RESTRICTIONS AND RECIPROCITIES	178

APPENDIX F: THE HOME IMPROVEMENT DECISION..... 180

APPENDIX G: FEASIBILITY ANALYSIS..... 185

LIST OF REFERENCES 191

LIST OF FIGURES

CHAPTER 1

1.1	Homeownership Rates, 1890-1990	15
1.2	Change in Homeownership Rates by Age Group, 1982-1990.....	17
1.3	Homeownership Rates: Age, Marital Status, and Income	20
1.4	Stock-flow Housing Model	28
1.5	Household Formations, 1940-1990.....	29
1.6	Mortgage Interest Rates, 1968-1988	29
1.7	U.S. New Home Prices	30
1.8	Median Priced New Homes	31
1.9	Median Prices for Existing Homes	32
1.10	Existing Median Prices and Inflation.....	33
1.11	Existing Median Prices and Inflation, 1980-1991	34
1.12	Prices of Existing Homes, California vs. U.S., 1975-1989	37
1.13	Employment Growth, California vs. U.S., 1970-1989	37
1.14	Existing Median Home Price Inflation	43

CHAPTER 2

2.1	Private Single Family Housing Starts by Region	61
2.2	Private Housing Starts	62

CHAPTER 4

4.1	Matrix of Ownership Rights: Unbundling Ability vs. Trading Appeal	119
4.2	Example of Embedded Options.....	120

CHAPTER 5

5.1	Example of Embedded Options	133
5.2	Schematic of Standard Covered Call Option.....	139
5.3	Schematic of Standard Put Option	140
5.4	Schematic of Housing Option	141
5.5	Schematic Between the Homeowner and the Investor.....	142
5.6	Homeowner's Perspective: General Case Cash-flow Diagram.....	146
5.7	Homeowner's Perspective: Case II Cash-flow Diagram	148
5.8	Investor's Perspective: Cash-flow Diagram.....	151
5.9	Schematic of Combination Call-put Model	153
5.10	Schematic of European Put Option Model	155
5.11	Ratio of Shared Appreciation to Premium, $r=18\%$	157
5.12	Ratio of Shared Appreciation to Premium, $\alpha=10\%$	157

APPENDICES

B.1	Affordability Index, 1970-1992.....	165
D.1	Synthetic Implied Price Series from Single Observation	175
F.1	Remodeling Expenditures, 1979-1990.....	183
G.1	Ratio of Shared Appreciation to Premium, $r=18\%$	186
G.2	Ratio of Shared Appreciation to Premium, $r=15\%$	188
G.3	Ratio of Shared Appreciation to Premium, $r=18\%$	189
G.4	Ratio of Shared Appreciation to Premium, $\alpha=10\%$	190

LIST OF TABLES

CHAPTER 1

1.1	Changes in Homeownership Rate by Age, 1982-1990	18
1.2	1983 Homeownership Rates by Household Type, Income, and Age	19
1.3	Age Distribution of the Adult Population	21
1.4	1985 Homeownership Rates by Household Type.....	22
1.5	Tax Break Costs to Federal Government in Fiscal 1991	55

CHAPTER 2

2.1	National Single Family Housing	68
-----	--------------------------------------	----

CHAPTER 3

3.1	Effect of Increasing Input Parameters on Call and Put Option Values	97
-----	---	----

CHAPTER 4

4.1	Characteristics Associated With Renting and Owning	113
-----	--	-----

CHAPTER 5

5.1	Analogy of Standard Option Input Parameters in Housing	136
-----	--	-----

APPENDICES

A.1	Separating Price Inflation on New Homes to Pure Price and Quality Components, 1985-1988	163
-----	--	-----

INTRODUCTION

While there is not always total agreement between academics, investors, households, and other observers, certain issues have characterized contemporary treatments of housing markets:

- Availability
- Affordability
- Quality
- Tenure Security
- Density

Though it is difficult to separate fundamental problems from their symptoms, certain recurring themes can be identified in criticisms of the status quo.

- What are the causes and consequences of fluctuating prices? How do market uncertainties affect the tenure choice? What sort of tools are available to homebuyers to enhance their tenure choice?
- What are the determinants of supply and demand? Can they be measured and predicted?
- What is the proper role of regulation, especially zoning and other land-use restrictions?

- What are financially feasible and politically agreeable solutions to the above housing problems, both in the short and long term?

In light of the above considerations, this thesis looks closely at the issues of *affordability*, specifically in the context of ownership. By applying some of the new work dealing with "real" options, I attempt to identify some new financial strategies for affordable homeownership. Specifically, I investigate the applicability of the option valuation models in the various elements of the housing market. It is believed that through unbundling, tenure choice can be enriched, and homeownership can be made more affordable.

Chapter 1 presents a historical perspective and descriptive framework of homeownership rates, housing prices, and price volatility. Besides looking at the fundamental economic, demographic, business, and political forces which impact these key housing variables, several peripheral issues are addressed - market segmentation, changes in quality (Appendix A), and measures of affordability (Appendix B). It concludes with some popular strategies which have emerged in recent years, such as the relaxation of local land-use restrictions, enhancement of credit, establishment of innovative public/private partnerships, involvement of government, and improvement of the tax environment. Chapter 2 steps back to categorize these approaches, and presents several alternative approaches. It distinguishes the redistributive approaches from the asset-based approaches, through which "value" trades instead of subsidy. For example, a homeowner donates his/her time, or assumes certain risks, or actually "sells" certain embedded options of potential value to others.

Chapter 3 is a background on the techniques and observations of option valuation. Chapter 4 discusses housing in the options context. It also motivates the idea of unbundling the components of ownership. Finally, Chapter 5 presents several alternative models for the application of an option-like vehicle in the housing markets.

CHAPTER 1

OWNERSHIP, PRICES, AND HOUSING MARKETS

OVERVIEW

This Chapter examines some of the important and fundamental elements affecting ownership and prices in the housing markets.

Following a brief history of homeownership, I review some determinants of ownership rates. Then, I examine housing prices and price volatility in greater detail - two principal variables which influence homeownership rates.

The discussion of prices and price volatility is qualified by quality considerations. Since movements in prices are often attributed, to some degree, to changes in quality, Appendix A presents some types and measures of quality.

In Appendix B, I present a discussion of the quality of several affordability measures. I discuss the two most popular and often cited measures - the NAR's Affordability Index and the NAHB's Housing Opportunity Index. Concerns about affordability are often articulated in terms of these measures.

I. HOMEOWNERSHIP RATES: Legacy and Examples

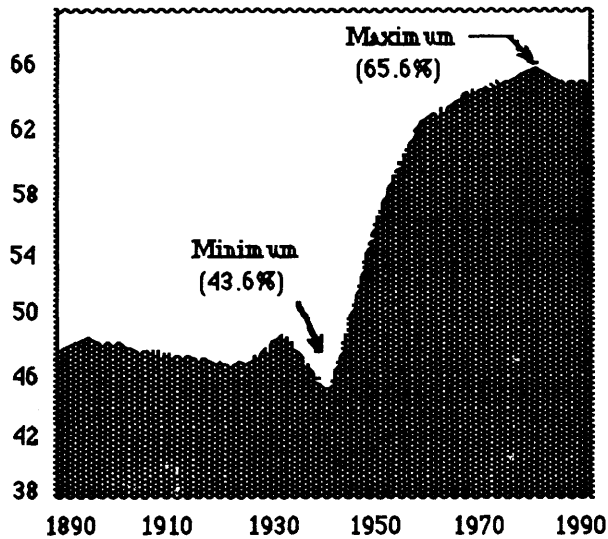


Figure 1.1

Homeownership Rates: 1890-1990

(Source: Michael L. Wilson, *U.S. League of Savings Institutions*, Department of Commerce, Bureau of Census data)

The history of homeownership rates in the U.S. has been greatly shaped by the shocks of war, changing tax policies, shifting demographics and social norms, and finally, evolutions in fundamental economics. Figure 1.1 shows the percentage of households classified as owner-occupants from 1890 to 1990. Though we have recently been enjoying rates of approximately 64%, homeownership was not always this prevalent.

From 1890 to 1930 the "homeownership rate," as defined by the data above,¹ steadily ranged from about 46%-49%. The homeownership aspirations of millions of Americans were temporarily suspended during the Great Depression of the 1930's. The rate plunged sharply to a low of 43.6% just prior to the beginning of the second World War.

Aspirations for ownership have long been associated with improved quality of life, as well as greater social and political participation. In a sense, homeownership represents a stake in the community.

Between the late 1940's and the early 1980's Americans found dramatically

¹ Figure 1.1 represents households, not units. The measurement reflects those households that are owner-occupants, not the percentage of housing units that are owner-occupied.

improved prospects for homeownership. With favorable policy from Washington, economic expansion from the post-war boom, and financing from an increasingly efficient and sophisticated credit system, the United States became a nation of homeowners. Down payment requirements were met using the tremendous savings built up during the war period (Wilson, 1991). From a low of 43.6% in 1940, the rate climbed aggressively and unabated to a high of 65.6% in 1980, as the unprecedented housing demand, arising out of the baby-boom population bulge, was met with new construction methods and innovative deliveries.

However, during the 1980's, nominal interest rates increased and household formations slowed. At the same time, the government's financial support was retreating and the support apparatus for housing in Washington was slowly dismantled. In 1981, this combination of demographic, financial, and political forces resulted in a drop in homeownership rates. Since the 1980 high of 65.6%, the homeownership rate has dropped almost 2 percentage points. Though the drop was small compared to the sharp rise we have seen in the last 45 years, it may have a more significant and visible effect on a local level and on particular groups. Small changes in the national homeownership rate can affect millions of households.

Still, given the dismal economic conditions of the early 1980's, with record high interest rates and perhaps the worst economic outlook since the Great Depression, this downturn in homeownership rates is not surprising.

Gribin (1989) points out some of the losses. Among the youngest homeowners (age 25-29), the rate of ownership fell from 44% in 1979 to less than 36% in 1988. Similarly, for households in the 30-34 age group, the decline during a similar period was from 63% to 53%. Furthermore, of the 61 largest metropolitan areas surveyed by the Bureau of the Census, only 16 showed an increased level of homeownership. Meanwhile, ownership rates actually fell in 9 cities and remained steady in the others.

In terms of falling rates of ownership, younger households are especially affected

Figure 1.1 shows the percentage decline in homeownership rates by age groups. Out of the 12 age groups shown, the youngest 9 groups all experienced declines in ownership rates. The 30-34 age group found its homeownership rate drop by 5.3%, more than any other age group.

Change in Homeownership Rates by Age Group (1982-1990)

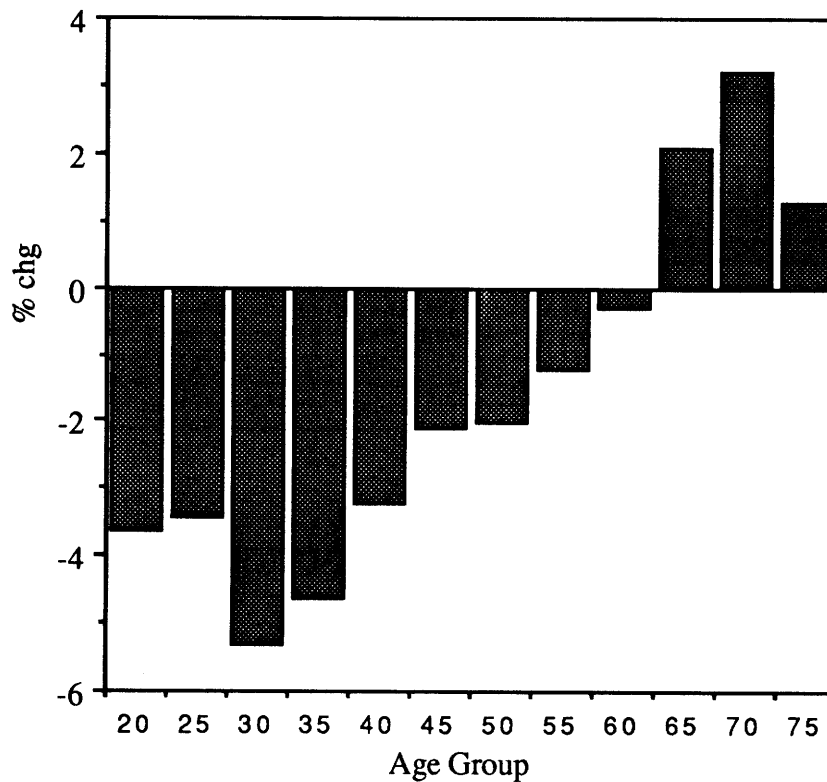


Figure 1.2

(Source: U.S. Bureau of the Census)

Table 1.1 below shows that younger households have posted the lowest homeownership rates and suffered the sharpest declines since 1982. Younger households are not only the most likely first-time buyers, but they are also the least likely to have adequate savings resources to make a down payment.

Age of Household Head	Homeownership Rate	
	1982	1990
25 years and younger	19.3%	15.7%
25-29	38.6	35.2
30-34	57.1	51.8
35-39	67.6	63.0
40-44	73.0	69.8
45-49	76.0	73.9
50-54	78.8	76.8
55-59	80.0	78.8
60-64	80.1	79.8
65-69	77.9	80.0
70-74	75.2	78.4
75 years and older	71.0	72.3
All Households	64.8	63.9

Table 1.1

Changes in the homeownership rate by age between 1982 and 1990.

(Source: U.S. Bureau of the Census)

II. DETERMINANTS OF HOMEOWNERSHIP RATES

There are many conditions driving homeownership rates at any time. These include both micro-economic variables describing the household as well as macro-economic variables which capture the general economic environment, particularly with respect to housing:

1. Income
2. Marital Status
3. Average Household Age (Head)

4. Level of Interest Rates
5. Mortgage Qualification Requirements
6. Extent of Government Involvement
7. Housing Price Levels

With the exception of (7), each of the variables will be briefly discussed below. The effects of prices and price changes (volatility) on homeownership rates will be covered separately and in greater detail in Sections III and IV below.

Income (\$1000's)	Age of household Head			
	under 25	25-29	30-34	35-44
Married Couples				
7-10	17.1	25.9	44.1	50.5
10-15	23.7	37.4	47.8	57.4
15-20	33.8	48.0	59.0	68.1
20-25	38.2	53.1	68.5	79.8
25-35	43.0	60.6	78.9	85.2
35-50	55.0	68.7	80.8	89.2
Singles				
7-10	16.0	15.4	16.9	23.8
10-15	11.6	17.1	22.5	29.4
15-20	19.3	20.3	26.6	27.8
20-25	22.0	24.4	36.3	38.1
25-35	20.0	28.9	35.7	44.1
35-50	00.0	50.8	53.0	55.5
Others				
7-10	7.8	16.3	28.7	32.8
10-15	8.0	14.0	36.4	38.8
15-20	18.4	26.4	38.0	47.2
20-25	26.5	36.9	44.0	58.9
25-35	27.4	39.2	46.4	66.7
35-50	20.7	39.3	66.0	71.2

Table 1.2

1983 Homeownership Rates by Household Type, Income, and Age
(Source: Hendershott, 1988)

The relationships between homeownership rates and age, marital status and income

have been observed for some time. Various explanation have been suggested., and will be summarized below.² Figure 1.3 shows that there is a consistently positive gradient of homeownership with respect to income, age, and marital status. In general, older, wealthier, married households are more likely to own.

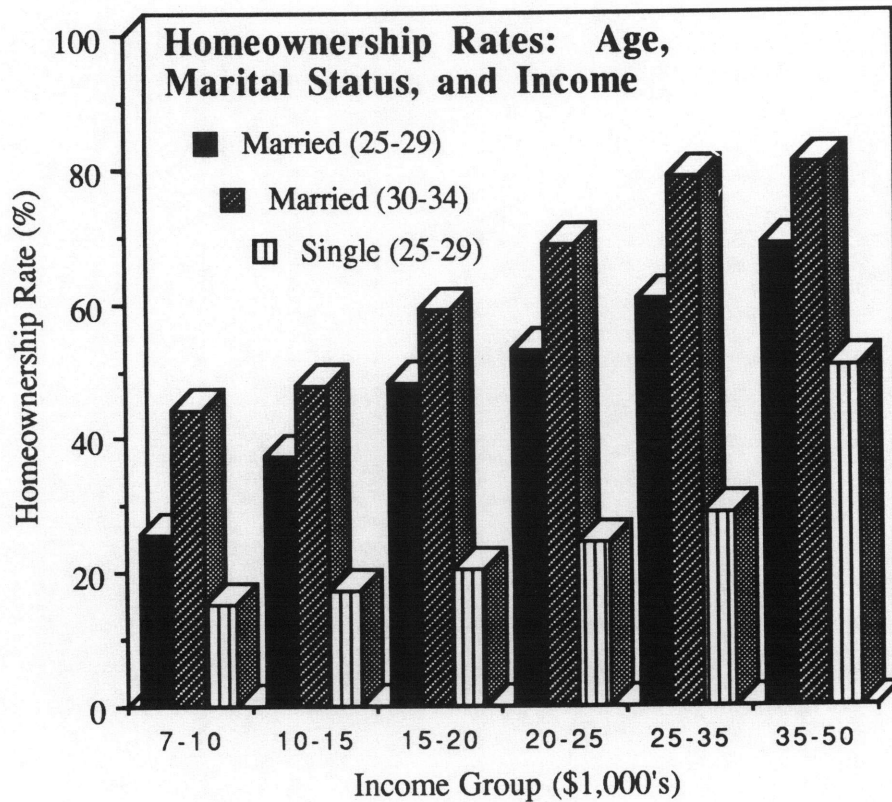


Figure 1.3

(Source: Hendershott, 1988)

Household Age

The trend between age and homeownership rate is less dramatic than that between marital status and homeownership rate.

Older households are more likely to own than younger households for various reasons. One is that not only do older households tend to be wealthier in terms of

² In interpreting these trends, one must be mindful of the correlations between the 3 independent variables themselves. For example, there may be a positive correlation between age and real income, as well as marital status and income. One must separate these relationships from the homeownership rate.

income, but also in terms of capital accumulation to draw upon for down payment. Second, older households may be less mobile, incurring greater "transaction costs" in moving. This makes owning a more attractive tenure choice than renting. Finally, income stability associated with older households makes home owning more appealing, and mortgage qualifying more feasible.

The demographics of age alone placed visible demands on housing as the baby-boomers came of age. (See Table 1.3) The proportion of the adult population under age 30 increased by a dramatic 30% between 1960 and 1980. Hendershott (1980) claims that this younger population bulge alone lowered the aggregate homeownership rate by 1.6 percentage points.

Age	1960	1970	1980	1985	2000
Under 25 Years Old	10%	13%	14%	12%	9%
25-29	10	11	12	13	9
30-44	11	9	11	12	10
35-44	22	19	17	19	23
45-64	33	34	29	27	32
Over 64 Year Old	14	15	16	16	18

Table 1.3

Age Distribution of the Adult Population (over 19)

(Source:Hendershott, 1988)

Marital Status

Anecdotal evidence suggests that married households bring different demand functions to the housing markets. They tend to demand not only more space, but perhaps more privacy as well. In terms of space, married households may be more likely to pay for "extra" space to accommodate their future family plans. Additionally, needing to be closer to ground floor (for carrying such things as groceries and carriages

a shorter vertical distance) as well as wanting access to a basement (for storage) and backyard (for kids to play, adults to supervise) may make married households more likely to own.

In 1985 the ownership rate for married couples was 30% for those under 25 and 80% for those 35-44. Ownership rates for singles also increased with age, though more gradually. Table 1.4 below shows homeownership rates by age and marital status.³

Age of Household Head	Household Type		
	Married	Single	Other
under 25 years old	30%	11%	10%
25-29	53	19	20
30-34	68	29	34
35-44	80	35	51
45-64	87	54	65
over 64 years old	87	61	76

Table 1.4

1985 Homeownership Rates by Household Type

(Source: Hendershott, 1988)

Income

There are several aspects of income profiles which affect homeownership rates: income level, its ability to adjust to inflation, and its distribution. The most obvious relationship is that between income levels and purchasing power. The more income a household has, the more likely that household can afford a local home. Furthermore, since housing is considered a superior good, as household incomes rise, a greater proportion tends to be devoted to housing.

Secondly, income can compel homeownership to the extent that it responds to increases in inflation.

Finally, as long as differential tax rates exist, there is a carrying cost advantage to more affluent households. The reason for this is that higher income households wind

³ Each entry in the table reflects a percentage of households which both fit that description and own a home. Hence, each cell captures a different population. For this reason, sum of all entries in a given row does not add up to 100%.

up with lower after-tax mortgage rates due to their higher marginal tax rates. In other words, higher tax-bracket households save more dollars through deductions, so that ownership makes more financial sense.⁴

As the above determinants (income, marital status, and age) shift, both over time and across regions, homeownership rates can change. For example, as the divorce rate climbs, the percentage of higher aged households which are also married drops. Also, as more young people pursue educational goals, or as the amount of prior education/training increases for certain industries, the marriage decision, and perhaps the tenure decision with it, are delayed. Finally, the distribution of the population with respect to age changes over time. For example, in the early 1980's, the share of the population under 30 declined, boosting the overall homeownership rate as a greater proportion of the households were older, perhaps wealthier, and more likely married. However, the continuing trends toward divorce and postponement of marriage left a greater proportion of the population single. This "singles effect" overwhelmed the "age effect." Hence, these two factors combined to actually reduce the aggregate ownership rate by 0.9 percentage points. (Hendershott, 1988)

Interest Rates

Abraham (1989) and others present the affordability problem more in terms of interest rates and income than changes in quality (described in Appendix A), or changes in demographics (described above). He points out that neither interest rate levels nor income patterns moved in the buyer's direction during the 1980's. After the negative real interest rates of the 1970's, the 1980's brought some of the highest real interest rates in history. These were coupled with low levels of inflation.

Dreier, Schwartz and Greiner (1988) suggest that for every percentage point rise in the national mortgage rates, approximately 450,000 people get priced out of the home-

⁴ Despite the fact that the TRA of 1986 narrowed the gap in tax rates between the income groups, thus reducing some of the carrying cost advantage of more affluent households, differential tax rates still influence the tenure decision. The advantage still exists, but has been seriously reduced.

buying market. So the mere fluctuation of interest rates aggravates the affordability problem.

While high nominal interest rates make it difficult to qualify for a mortgage, high real rates, as we have seen in the 1980's, make it more difficult to reduce the payment burden through income growth.⁵ High real rates also make tangible assets less of a portfolio necessity for inflation protection. Consequently, housing divestment can occur, which places pressure on housing credit markets. Finally, high real rates of interest favor creditors of fixed payment instruments (such as fixed mortgages) at the expense of debtors (homeowners). In essence, debtors are paying with less deflated future real dollars.

While higher real interest rates limit homeownership opportunities, some credit market changes have actually enhanced affordability. For example, the growth of the secondary market and the availability of a multitude of creatively structured mortgage instruments - adjustable rate mortgages (ARM), price level adjusted mortgages (PLAM), shared appreciation mortgages (SAM), and others - have enfranchised buyers. These mortgages structure the payment streams in various ways to reduce the lender's interest rate risks and increase the borrower's principal allowance and chances of qualifying.

Many observers contend that these instruments get little use, both because of the lower interest rates and because of consumer apprehension about complex lending schemes. Still, additional financing choices have helped ease buyers' credit arrangements.

Mortgage Qualification Requirements

Mortgage qualification requirements can influence homeownership rates as well. The logic is that as mortgage qualification requirements tighten, fewer households are

⁵ The assumption here is that incomes tend to increase with inflation while standard fixed-payment mortgages do not. So, for people with variable incomes (as opposed to elderly people often on fixed incomes) and fixed mortgage payments (as opposed to inflation adjusted, or variable rate mortgages), there may be an opportunity to decrease the debt service burden late in the term of the loan. The persistence of high real rates (absence of severe inflation) makes this less possible.

allowed to enter the home buying market. There are many reasons why requirements may become more strict, such as higher perceived risks in housing, and changing standards in both the public and private credit markets. Despite the appeal of this logic, recent research suggests that the impact is not severe.

While housing analysts often cite mortgage qualification requirements as a significant constraint on home-ownership, Zorn (1989) has provided a beginning in modelling and empirically estimating these effects. Using a LOGIT formulation of the probability of owning, he tests to what extent mortgage qualification criteria are binding on households, and constrain their tenure choice.⁶ His study of 1986 data (4,000 households nationally) suggests that mortgage qualification criteria did not provide a large constraint on homeownership. Zorn reports that 61% of the households, were they to move, would be constrained to purchase "less" owner-occupied housing than would maximize their current period utility. Put simply, many households may wind up with "less house" than they would like, but their decision to own is not significantly affected.

Extent and Success of Government Involvement

While traditionally there has been considerable government presence in housing markets, the federal role has recently diminished. Some programs have simply been removed, and those that remain have ranged in effectiveness. For example, the Federal Housing Administration (FHA) mortgage insurance program is limited in its \$101,250 loan cap. However, the median home price in many markets is higher, even double, that limit. For example, in San Francisco, ranked by the NAHB's National Housing Center in March 1992 to be the least affordable metropolitan area in the nation (out of 176 areas included), the median priced house was \$280,000, almost 3 times the FHA cap. 50% of the 40 Western metro areas surveyed, and 72% of the 43 Northeastern

⁶ Zorn makes slightly different qualification assumptions (20% down payment, payment-to income ratio of 28%, 25 year term, fixed rate) as the NAR does on its Affordability Index (See Appendix B).

metro areas surveyed, had median prices which exceeded the FHA cap. For many people in these areas the FHA programs are of little use. (See Hendershott and Thibodeau (1990) for an assessment of this FHA limit.)

The Tax Reform Act of 1986 (TRA) is an example of a policy shift which has had varying impact on different parts of the housing market, and has thereby influenced the tenure choice. On the one hand, the TRA of 86 may have caused a divestment from multi-family housing, which has placed the future of many such projects in question. On the other hand, the TRA of 1986 left owners' tax benefits in tact. In fact, owner-occupied housing remained one of the few assets still yielding tax advantages.

Hendershott (1988) predicts that the TRA of 86 will, in the long-run, improve ownership prospects. He states, "the Act will raise real rents by roughly 10%, but lower the cost of ownership for most households...because the cost of owning will fall and the cost of renting rise, the aggregate homeownership rate will increase."

While not all observers agree on the role of government and public policy in the housing markets, such intervention has proven its effectiveness, if only in terms of its raw scale. Governmental programs, by their nature, operate at a scale and scope that is often much larger than non-governmental efforts can achieve. While the mere *scale* of these programs alone does not justify their use, government involvement has shown to have substantial effects in the housing markets.

Concluding Remarks

Hendershott feels that the decline in homeownership in the early 1980's was not surprising, and should not be considered a crisis. He stresses that, "Less than half of the decline in ownership rates from 1981 to 1985 can be attributed to economic factors. Moreover, the decline only reverses the increase in homeownership rates that occurred during the late 1970's."

Furthermore, Hendershott suggests that much of the decline in homeownership can be attributed to younger households' postponement of owning. He adds that as long as

these declines do not persist or spread to older households, then there is no cause for concern.

It is important to consider all the variables driving homeownership rates, described above, when assessing strategies for affordable ownership. Efforts to increase homeownership rates must focus on affecting household incomes and keeping the interest rate in check. Both the effectiveness of government involvement and the role of mortgage qualification requirements is questionable according to the data presented.

III. PRICE FLUCTUATIONS AND THEIR CONSEQUENCES

Simple economics suggest that housing prices, and their fluctuation over time, should affect ownership rates in a very direct way. If prices drop in a given area, more potential buyers are able to afford the homeownership opportunities there. More households will move in,⁷ or renters may consider owning. These larger pools of bidders, captured by an outward shift in demand, will create upward pressure on prices. Given the typical stock-flow housing models' short term assumption of inelastic supply, an outward shift in demand will cause an increase in price. (Figure 1.4(A) and 1.4(B))

In the long-term, assuming there are no artificial supply constraints, new construction will come on line to capture the higher prices. First, expectations of future prices will start declining, and as new units are completed and the stock is increased, prices can be expected to drop, and settle perhaps above the original price. (Figure 1.4(C)) Such cycles in housing prices have long been observed. (See Case and Shiller, 1988, and Grenadier, 1991)

⁷The extent to which mobility barriers prevent such demand responses is certainly debatable.

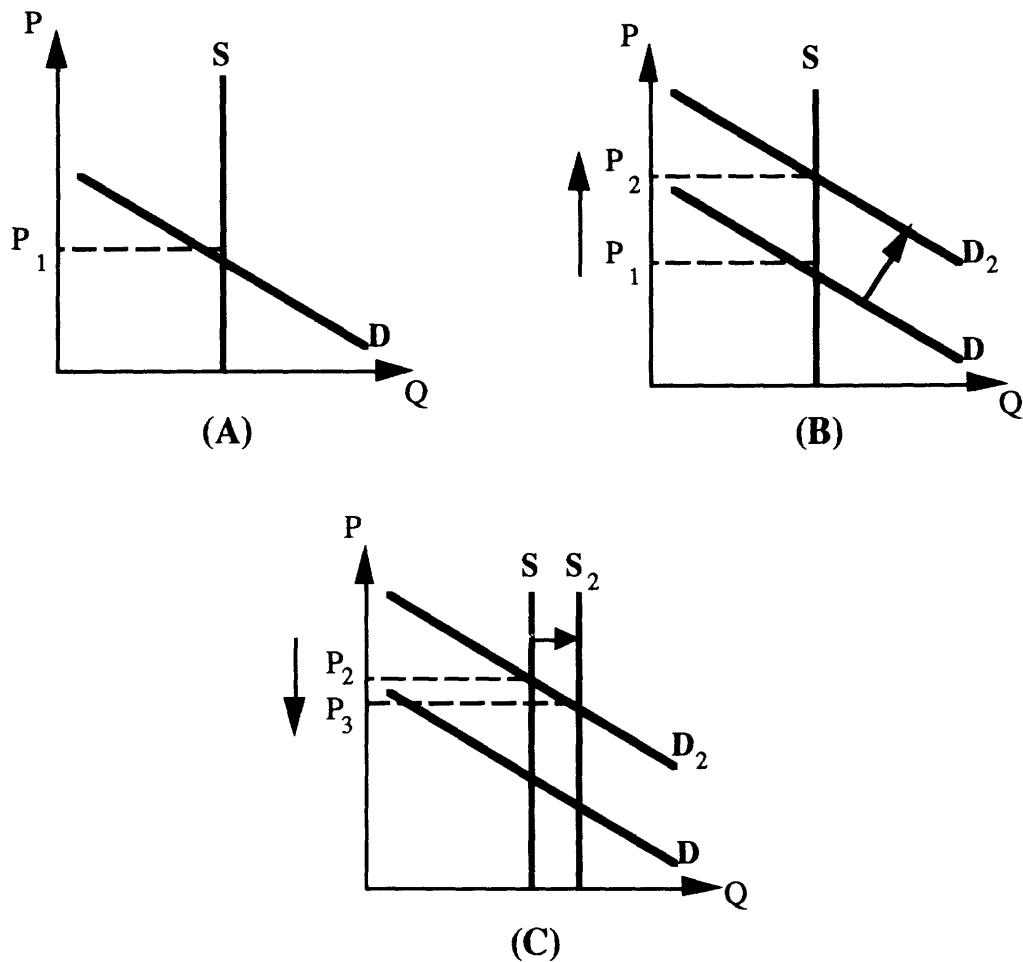


Figure 1.4

Stock-Flow Housing Model

This section shows how such basic economics are manifested in the real world. It explores the historical movement of prices and introduces some potential causes.

Recent History

In the 1970's housing prices far outpaced the rate of inflation, making them an ideal hedge against inflation. According to the Merrill Lynch's Economic & Financial Report on housing in October of 1988, this may be attributable to several circumstances:

Household Formations

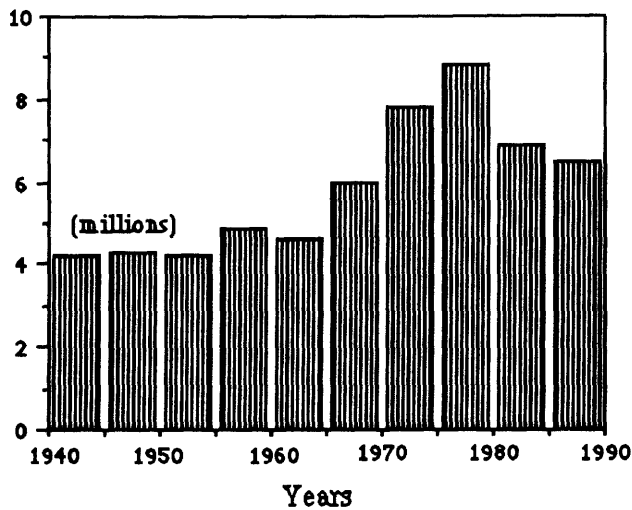


Figure 1.5

(Source: Merrill Lynch, Economic & Financial Special Report, October 4, 1988)

Mortgage Interest Rates

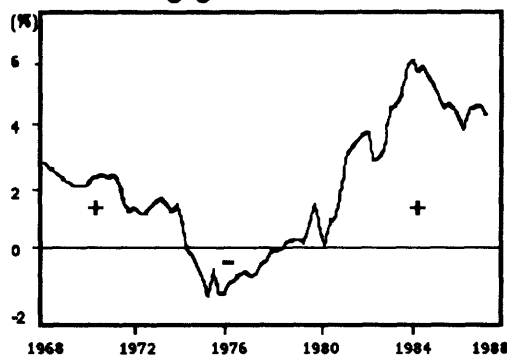


Figure 1.6

(Source: Merrill Lynch, Economic & Financial Special Report, October 4, 1988)

Demographics: (See Figure 1.5)

The demand shock of the baby-boomers' coming of age heated up housing markets. According to the Census Bureau, almost 18 millions new households formed over that decade, an almost 17% increase. The number of households went from about 81 million to 94 million in 10 years, double the formation rate of the 1960's. At the same time, national median prices soared by 156%.

Negative Real Interest Rates:

(See Figure 1.6) As inflation worsened in the 1970's, *real* after tax interest rates ended up negative. Lenders, in effect, were paying borrowers to take out mortgages and convert them into tangible assets to hedge against inflation.

Shift from Financial to Tangible Assets: As inflation eroded real rates of return on financial instruments, tangible assets became a more attractive investment. Hence, capital was diverted from financial to tangible investment, which fuelled housing prices.

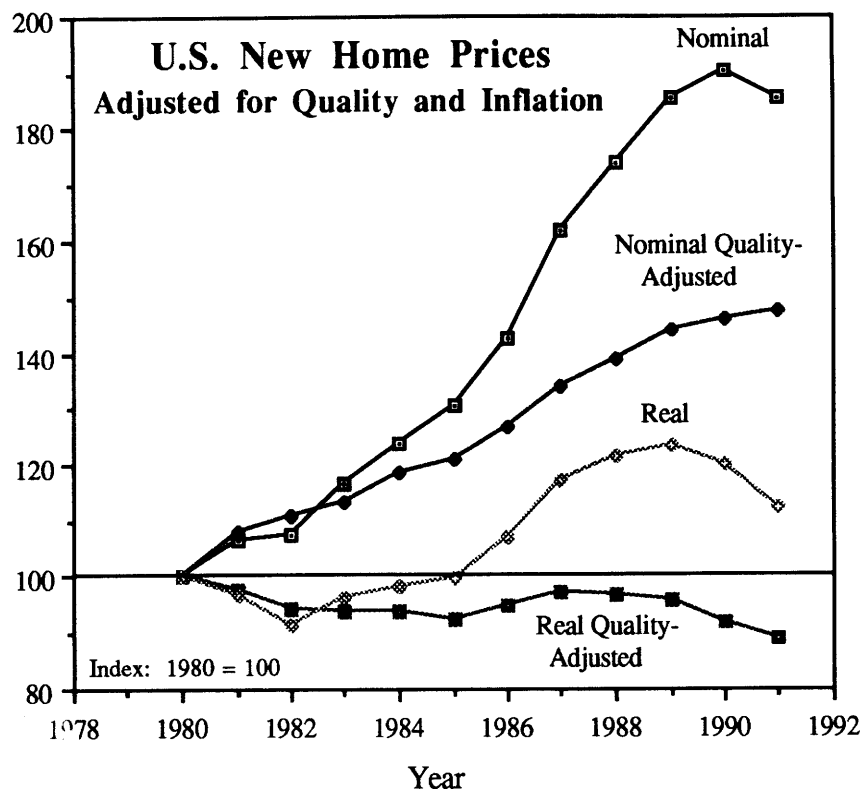


Figure 1.7

(Source: Department of Commerce, from Sahling and McDonough, 1988)

In the 1980's housing prices rose more moderately than in the 1970's and actually failed, on average and on a constant-quality basis, to keep up with inflation. Figure 1.7 shows new home prices in the U.S. in nominal terms, then adjusted for quality, inflation, and both. It shows that once the reported U.S. median new home prices are adjusted for inflation and quality, prices have actually fallen over the last decade. However, the perception of affordability in the market, understandably, is based on prices homebuyers actually face - without inflation and quality adjustments.

On a regional level, the Northeast far outpaced inflation, though the U.S. as a whole did not. Figure 1.8 shows the regional variation of new home prices. In both new (Figure 1.8) and existing (Figure 1.9) home prices, the price differential between regions has grown.

Median Priced New Homes

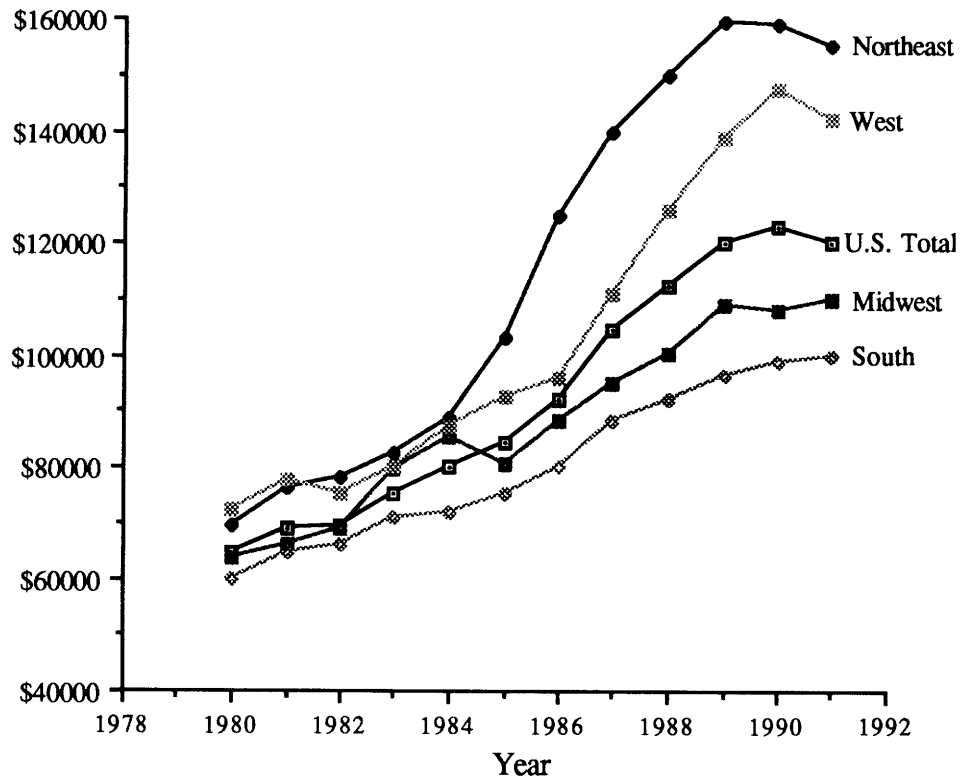


Figure 1.8

(Source: U.S. Bureau of the Census, Construction Reports, Series C-25)

The investment attractiveness of housing diminished for several reasons. For one, as the baby-boom demand bulge passed, household formations slowed, bringing down real housing costs in much of the U.S. Real prices actually fell in the Midwest, South and West (as a whole), though certain booming pockets remained. Secondly, real after-tax interest rates turned decidedly positive as deregulation trends impacted the financial markets. Alternative investment vehicles and markets were competing for the new demand coming from deregulated institutions. At the same time, the growing federal deficit placed heavy demands on U.S. credit markets and boosted real interest rates. Finally, as inflation abated and returns improved on financial assets, investors reallocated their wealth from housing into non-tangible assets again.

By the late 1980's, several additional factors contributed to the decline in real estate

prices. To begin with, government favoritism towards housing was drastically reduced. Secondly, with more financial institutions bankrupt or insolvent, those that remained were tougher with credit. Fewer households were able to find credit with which to bid in the housing markets. Furthermore, the unloading of foreclosed properties from the various insolvent institutions placed downward pressure on prices. Finally, borrowers were using increasingly high levels of leverage in mortgages, making it difficult to pay the monthly debt service.

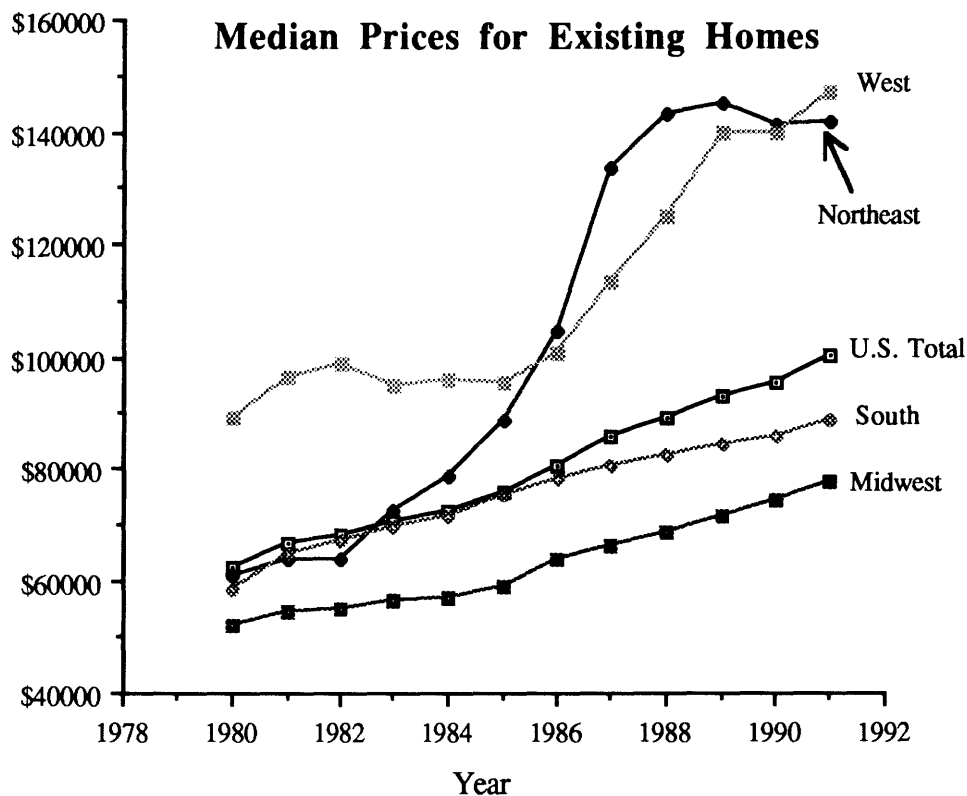


Figure 1.9

(Source: National Association of Realtors, Home Sales)

Figure 1.9 above shows the regional differences in existing home prices. While the California coast, as well as parts of the Northeast, continued rising through much of the 1980's, by 1988 most of these "booming pocket" markets began to turn. Figures 1.10 and Figure 1.11 below show the Northeastern markets skyrocketing above the national

median enough to considerably beat inflation. The U.S. existing median, on the other hand, moved slower than inflation during the 1980's.

Figure 1.10 shows the movement of prices both in the U.S. overall, as well as in the Northeastern market, and compares them to two Consumer Price Indexes: total CPI and CPI on shelter.⁸

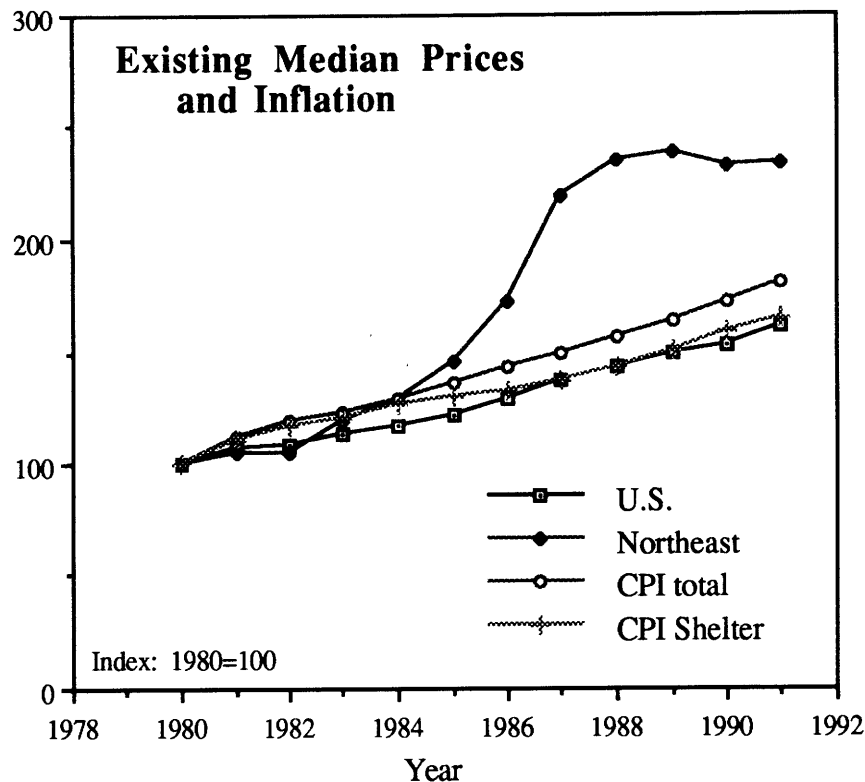


Figure 1.10

(Source: *National Association of Realtors, Home Sales and U.S. Department of Labor, CPI*)

Figure 1.11 takes an observed price of a 1980 existing U.S. median home, and applies to it the yearly spot inflation rate based on the national CPI. The observed prices of median homes failed to keep up with this fictitious "inflated 1980 home" price path.

⁸ In computing the shelter CPI, the Bureau of Labor Statistics includes renters' costs (residential rent, lodging away from home and other renters' costs), homeowners' costs (owners' equivalent rent and household insurance), and maintenance and repairs.

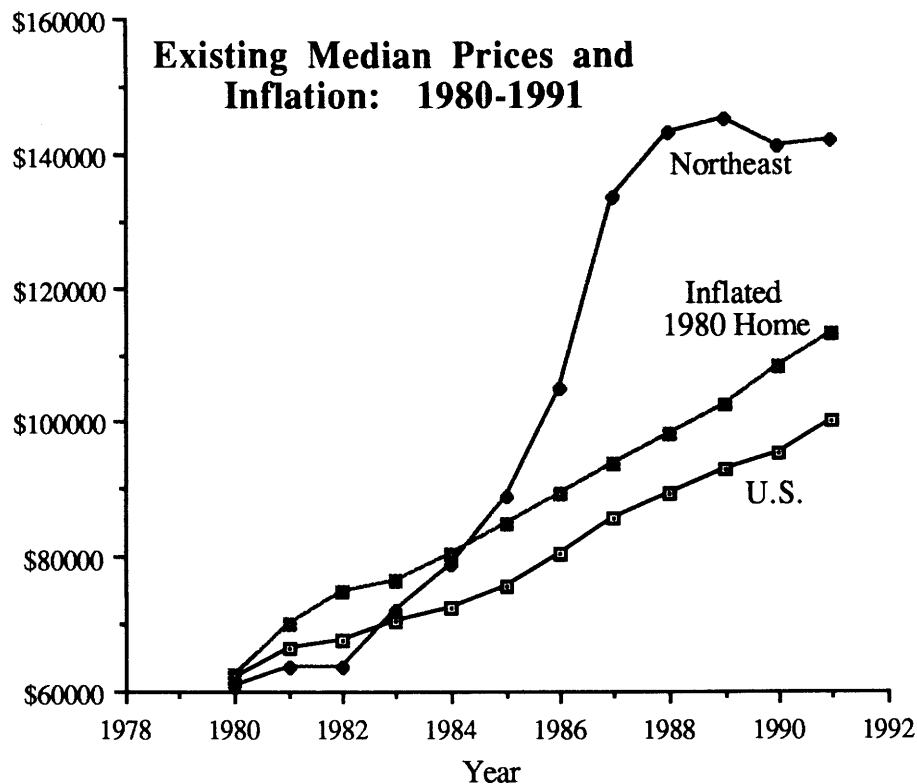


Figure 1.11

(Source: National Association of Realtors, Home Sales and U.S. Department of Labor, CPI)

This suggests that either the quality of the existing pool has improved dramatically in the Northeast, but has fallen in the U.S. Or, more likely, that the pool of observed sales has shifted to higher valued units in the Northeast, and cheaper units overall in the U.S.

Causes of Price Movements

There are various factors which seem to contribute to price fluctuations in housing, including *growth rates* in population, households, employment, and income per household. A recent study (Abraham, 1989) evaluated the relative importance of these variables in the movement of housing prices. A regression was performed with prices as the dependent variable, and the above growth rates as the independent variables in the four U.S. geographic regions. Household growth was found significant in all regions, though its effect was small in the South. Household income growth was very important

only in the Northeast. In short, Abraham concluded that no one mechanism drives home prices nationwide.

While population, employment and income growth were all cited as demand-side contributions to price pressures, there were some markets that underwent relatively low levels of growth yet exhibited rising prices (and vice versa). Some of these anomalies may be explained by supply-side constraints, such as physical barriers to development, restrictive zoning, difficult codes, or anti-growth policies.

For example, in Miami, despite aggressive new development, an over-supply of land has kept the land market from inflating. On the other hand, New Orleans is a low-growth area but yet has seen much land price inflation. The inflationary trends in New Orleans are associated with different type of supply restriction - natural boundaries such as poor soils, swamps, and wetlands. (Treschitta, 1986)

This brings up an important point in the discussion of fluctuating prices. There are many studies which assert that movements in land prices cause direct and proportional movements in housing prices. In fact, much of the discussion of housing prices is really one about land costs.⁹ For example, Case and Cook (1988), in their paper about the distribution effects of housing price booms note from the outset that, "these booms are essentially land price booms." Not booms in the cost of capital, nor construction. Following construction costs, land prices generally account for the second largest development cost associated with new housing. It is thus clear that, as land prices rise, housing costs must follow.

In conclusion, we have seen that homeownership rates and prices have changed historically in response to a complex combination of variables and conditions. I have also shown that regional variations, especially in prices, persist. Substantial market segmentation on a local level undermines the effectiveness of programs at a national

⁹In fact, much work in the urban economics literature describes land values not housing prices per se. Prices of houses are considered a trade off for commuting costs, through the location variable in the monocentric city model. (See W.C. Wheaton, D. Capozza, and others)

level. Section V identifies elements and evidence of market segmentation .

The important point in the options context is that prices fluctuate, at times severely, and with consequence. The fact that there is volatility associated with prices is important. Whether they go up or down in the near future, for the purpose of this thesis, is not.

IV. THE CALIFORNIA EXAMPLE

There are detriments to upward price movements as well as downward ones. California is a prime example of how an area may be impacted by fluctuating prices. Between 1970 and 1990, the median price of a home in California increased 800% (11% per year) or 250% in real terms. (See Figure 1.12) Meanwhile real household income was up only 18%. With the median home price approximately 6 times the median income (versus 3 times nationally) most people who do not already own a home simply cannot afford one.¹⁰ In Los Angeles, San Francisco and San Diego only about 17% of the families qualify for the median priced home versus about 45% who qualify on a national level. (East, 1990) Today, with lower interest rates, that figure may be slightly higher.

¹⁰ Notice that median house price statistics do not measure the same houses each period; they simply measure whatever trades. To the extent that the composition of the current transaction pool is biased. So the median may be skewed towards the most popular area, or the most active buyer type. (see Appendices A and B for a discussion of quality changes and affordability measures.)

Prices of Existing Homes California vs. U.S.

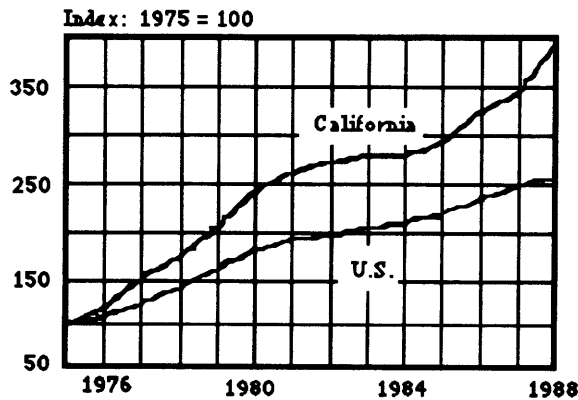


Figure 1.12

(Source: California Association of Realtors, Sahling and McDonough, 1988)

Employment Growth California vs. U.S.

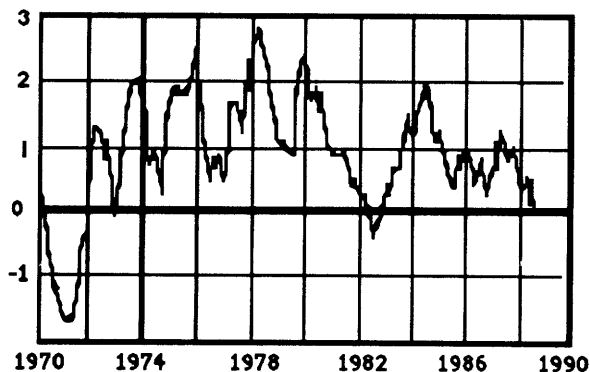


Figure 1.13

(Source: Department of Commerce, Sahling and McDonough, 1988)

On the one hand, these spiralling prices are symptomatic of California's locational popularity. On the other hand, they result in fewer home ownership opportunities, especially for younger households.

Optimism about the future of California real estate has stemmed from often cited regional strengths such as good economic diversity, job growth, presence of Pacific Rim money, quality of life, and stringent land-use restrictions. In the 1980's, the rise in nominal home prices in California was associated with a strong economy and continued growth in employment relative to the U.S. national average. (Figure 1.13 shows year over year employment growth in California over the U.S.)

California's experience was typical of such booming markets, which tend to exhibit a combination of,

- Population growth or "locational popularity"
- Economic strength and growth or "business optimism"
- Availability of credit and capital

- Supply restrictions

Eventually, the market overheats beyond reasonable expectations, and worries of a reversal emerge. Optimism is replaced by concern and investment conservatism. Those less optimistic warn that the unaffordable stock of housing will in turn make firms look towards alternatives in their locational choice. (Rowe, 1990) The high cost of housing can actually become a barrier to productivity and a burden in terms of business costs. Following similar cycles in Dallas, Phoenix, and New England, California approached its own series of unexpected price drops.

The California consumption mentality, typical of other markets with rising expectations, revolved around tapping into home equities - for luxury goods, vacations, investments, and education. Whether unrealistic or just unsustainable, the housing price optimism, caused many households to extend themselves well beyond their financial means.

Declining prices have various effects. To begin with, as prices begin to decline, mortgage holders find themselves in more precarious and exposed positions, and the incidence of default increases. It becomes difficult for present home-owners to sell their homes and trade up. So while on the buy side it is cheaper to purchase a home, on the sell side it is difficult to find an attractive sale price. If the ask-bid spread is wide enough, transactions simply become more infrequent, and rates of sales decline. Meanwhile, equity is eroded, mobility is reduced, and there is a chain reaction depressing prices even further.¹¹ On a municipal level, tax revenues drop, which can impair the level of local services and even transfer the deficit onto businesses.

Though lower prices do not always translate into lower rents (rents are "sticky downward"), renters expect to benefit by way of opportunities to own their first home. A recently released Bureau of the Census study found that 91% of all renters could not

¹¹ First time buyers, or homeowners coming from "other markets," are somewhat immune to these effects.

afford to buy the median-priced home in the region where they lived. And even when the median home price was dropped to the bottom quartile of the region by price, still 86% of all renters were not able to afford it. (Wilson 1991)

Furthermore, raising a down payment is a difficult task which becomes a formidable barrier to homeownership. Sternlieb (1990) claims this "gap" should prompt government agencies and private banks to adopt "bridge mechanisms to help people of lower incomes, who have no inherited wealth, buy that first house so the people who occupy it can trade up." The same study mentioned above showed that over one-third of all renters could not afford any home due to their inability to place a down payment. Difficulties with down payments can keep homeownership rates from rising even when prices fall.

There are other effects of general price movements other than changing homeownership rates: distributional effects, mobility effects, and business effects.

Distributional Effects

Sternlieb (1990) uses the "Hourglass" image to represent the growing disparities in the American housing market between those able to enjoy homeownership and those repeatedly "priced out of the American Dream." In the upper half of the "hourglass" are millions of dual-earning baby boomer households that entered the housing scene during the 1970's and early 1980's. They understood "housing mechanics" - the increasingly crucial financial, legal, and administrative know-how involved with ownership. Having learned from their parents' post-World War II ownership years, these baby-boomers were able to put their professional level salaries to work by moving into the home owning market. In the bottom half of the "hourglass," are the middle and lower-income households who were unable to meet the soaring prices of the last 20 years.

Sternlieb sees the 1990's as "a time of gracious living" for the upper half, trading up to technologically advanced and more consumer sensitive homes. At the same time, the lower half will be facing "ominous" housing prospects. James H. Carr, VP for

Housing Policy research at the Federal National Mortgage Association (Fannie Mae), and John Tuccillo, Chief Economist for the National Association of Realtors agree. They both foresee increasing problems with the lower half achieving their housing needs. (Steinbach, 1990)

Not only have the opportunities to achieve homeownership changed, but the composition of those who get there has changed as well. It is suspected that more middle-income working people, including many minorities, are being squeezed out of the ownership market. However, opportunities to extend housing opportunities to minorities are, ironically, improved during slumping markets.

We've seen that in a reasonably strong housing market racism plays a strong role. But in markets on their belly, racism starts to ebb because you look at the color of money instead of the color of skin. (Steinbach, 1990)

This points to an interesting opportunity to widen the composition of homeowners. In fact, Sternlieb (1990) forecasts that 30-40% of the new homebuyers in the 1990's will be black, Hispanic and other minorities.

During booming markets, Case and Cook (1988) point out some important distributional effects. For example, during the 1980's, when certain land markets were experiencing sharply rising prices, one result was a dramatic change in the distribution of real income and wealth. As prices rise, homeowners experience constantly declining real housing costs (with "cheaper" fixed mortgage payments, in real terms), as well as increases in equity wealth. However, higher prices also pose entry barriers to non-owners. So while homeowners enjoy the boom, renters experience rising real housing costs and diminished probabilities of owning.

Mobility Effects

Price movements can seriously impair household mobility, and in turn perpetuate segmentation. (See Section V) As prices increase, immigration of households is limited,

since they can not afford the housing costs elsewhere. On the other hand, as prices decrease, sales rates decline, and homeowners are less willing to accept the lower prices. They may find difficulty trading up as well as trading out of the market by moving elsewhere. Also, as prices decrease a major source for down payments, equity in existing homes, is being eroded. So even though lower prices can make it attractive to move, families struggle even more with down payment. This too impairs mobility.

Business Effects

There is much anecdotal evidence of the effects of the housing markets on the business environment. For example, in Tokyo, an affordability crisis has increased commuting burdens and reduced business productivity. It has forced firms to subsidize housing costs through higher wages, adding to business costs. The competition for space in Tokyo has driven land prices to an astronomical \$48,000/SF or over \$2 billion per acre! A 1200 square foot home one hour's commute from downtown costs \$504,000. Many young executives are commuting two hours each way to work. This has forced many major firms to provide special housing assistance programs, including low-interest loans or salary premiums, to attract and retain productive personnel. There are many similar examples in U.S. markets. (See Section II of Chapter 2 titled "Employer Assisted Housing")

V. MARKET SEGMENTATION

The 1980's were also marked by significant regional disparities in prices, lending further evidence to the notion of significant localization and segmentation in the housing markets. As a consequence, theories of market segmentation have become both academically popular and empirically sensible. It is important to understand the segmentation in real estate markets to the extent that it limits the market's efficiency.

First, the section below, I describe some anecdotal evidence and explanations for market segmentation. In the next section, I present the academic treatments of segmentation, and approaches to measure its causes.

Anecdotal Evidence

Robert Van Order, chief economist of the Federal Home Loan Mortgage Corporation, comments that the "housing market became much more local and regional in the Eighties than at any other time." (Pare, 1990) He partly bases his observation on the fact that in 1978, the median sales price of existing homes in the U.S. ranged from \$42,000 in the Midwest to \$67,000 in the West. By 1989, that range went from \$71,000 in the Midwest to \$145,000 in the Northeast - a range that was 60% larger than the 1978 range - after adjusting for inflation.

On a local level, the variations are even more acute. In fact, in 1988 the median priced existing home in Orange County, California, was \$226,400, while the national median was \$89,300.

While spectacular gains were observed in the Northeast (50% surge from 1982 to 1987, settling at 70% above the national median), other markets around the U.S. were either stable or declining in *real* terms. Figure 1.14 below shows the relative regional changes in the median price of an existing home (in *nominal* terms).

Besides obvious variations in price, regionally and locally, there are also income variations which can obviate and encourage the segmentation of markets. For example, the 1988 third quarter NAR median home sale price data show that average median ratio of the median home price to the median income was 2.5.¹² But this ratio varied from a high of 7.1 in New York City to a low of 1.69 in Des Moines, Iowa. This points to the

¹² Notice that "median household income" measures all households, including renters, whose income may generally be less than owners. However, "median prices" cover sales only on owner-occupied units. Hence, the ratio is somewhat skewed.

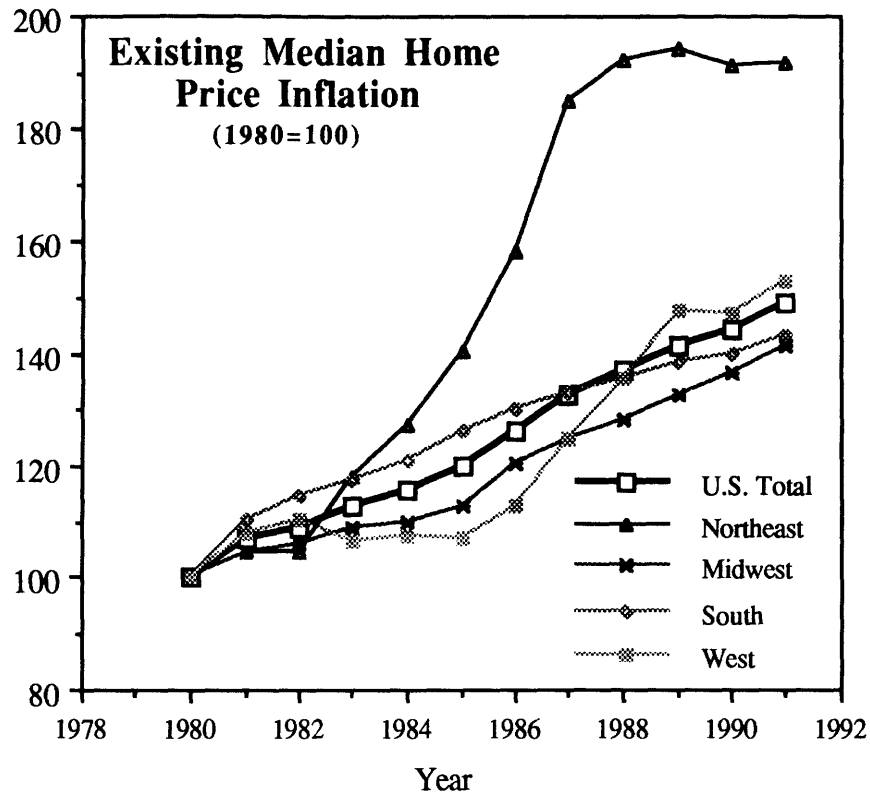


Figure 1.14

(Source: National Association of Realtors, Home Sales and U.S. Department of Labor, CPI)

differing financial burdens homeownership represents in different locations nationwide. Similarly, in Los Angeles, the 1990 median price-per-income ratio was \$218,000/\$34,300 (6.4). In San Francisco this ratio was \$266,000/\$43,300 (6.1), whereas in Houston it was \$69,000/\$43,000 (1.6). Such tremendous regional variations in prices, incomes, and other key housing parameters, frustrate the use of comprehensive macro-level programs which overlook this market segmentation.

Despite the highly segmented nature of the national housing market, conditions in one region still impact another. For example, houses in Boca Raton Florida moved slowly in the late 1980's because of retirees who were struggling to sell their properties in the post-boom Northeast. (Pare, 1990) The point is that despite an endogenous set of localized forces which govern smaller, segmented markets, there is also a set of

systematic market forces that transcend regional boundaries. It is important to understand the nature and extent of segmentation in the housing market in order to identify better indicators of future prices, and put housing in a larger economic context.

Downs (1988) identifies several additional demand-side factors which help explain the wide variations in home prices across the nation: focusing and demographics.

Focusing of demand in key cities: Tokyo exemplifies how intense, localized demand can drive a market through the roof. To discourage excessive concentration of economic strength in a single region, or a "super-city," governments often provide incentives for firms to relocate and regionally diversify. This may be of less significance in a multi-centered U.S. economy. Still, certain industries tend to agglomerate in certain cities: financial services and publishing in New York, insurance and pension planners in Hartford, governmental affairs and global consulting in Washington D.C., entertainment, aerospace and Far Eastern trade in Los Angeles, automotive industry in Detroit, and finally education, R&D/hi-tech firms and financial services in Boston and the San Francisco Bay area. To the extent that local industries may heat up, local housing prices may follow.

Demographics: Demographics receives much attention in the dynamics of housing markets. While I have already discussed the relationship between demographics and prices in Section III above, demographics are also involved in market segmentation. Specifically, the aging of the baby boom is causing demand to shift towards move-up home buying. There are three ways by which demographic shifts will promote market segmentation. First, a change in the composition of demand means a change in tastes, and consequently housing quality. Move-up buyers tend to want larger, more luxurious homes, changing the mixture of units built and sold. This, in turn, increases product heterogeneity and encourages segmentation.

Second, not only can move-up buyers afford more luxurious homes, but they can place larger down payments, allowing them to qualify for even higher price homes. This places yet another and different pressure on the housing stock, increasing the price/income ratio through this leverage.

Finally, the dual-salary households may not only be willing to pay more for the same unit, but may have different tax needs. (i.e. higher tax bracket may enable them to benefit more from interest deductibility) As these dual-salary, move-up homebuyers concentrate in certain market areas, their distinct demand functions can promote segmentation.

Academic Treatment

General Comments

There has also been much academic attention to the issue of explaining market segmentation in real estate. Despite much progress, disagreements remain as to whether academic research has successfully demonstrated that market segmentation occurs, and different prices for otherwise identical goods can be sustained. The reason this is an important point is that it implies a multiple equilibrium condition in real estate markets. The phenomenon of different prices on identical goods as a consequence of buyer characteristics (such as differing tax rates) would imply risk-free arbitrage opportunities. Such opportunities should not persist in a well functioning market. Dale-Johnson (1983) points out that,

The phenomenon would seem to violate the one price rule as one would expect arbitragers to identify the price differential and undertake trades until such time as there existed one market-clearing marginal tax rate.

However, it can be argued that this arbitrage opportunity is not eliminated, and price differentials persist, in the case of segmented housing markets. There is an obvious

nexus between market segmentation and theories of inefficiency in housing markets. (See Case and Shiller, 1989, on the efficiency of the market for single-family homes.)

To explain how a multiple-price condition could persist, one must analyze "rigidities" in the marketplace. An example of rigidities might be "red-lining" practices which prevent certain racial or ethnic groups from entering specific markets. Demand-side examples include differential tax rates which induce homebuyers to pay different prices for the same good, information asymmetries, or mortgage qualification requirements, all of which restrict entry into certain markets. On the supply side, there may be certain differences in builder technologies, or other variable costs of input factors which skew prices between markets. Dale-Johnson (1983) has found that price variations, if they exist, are more likely to arise out of variation in household demand than market supply.¹³

In the sections below, I first describe how the notion of market segmentation fits in the primarily demand-side hedonic approaches. Then, I present an example of one view on the segmentation debate in the housing context; specifically, how household income levels can create separate demand functions in a market, a phenomena known as the "Clientele Effect." (Dale-Johnson, 1983)

Segmentation and Hedonics

By definition, market segmentation arguments assume that buyers have different implicit prices associated with each housing attribute. In other words, the hedonic regression between housing attributes and prices should exhibit non-linearities. Given,

$$(1.1) \quad P_j = P(z_1, z_2, z_3, \dots, z_n)$$

¹³ He suggests two reasons why demand-side factors are more likely to cause market segmentation than supply side factors. One is that in the short run supply can be considered inelastic, or near constant. Second, since most markets are dominated by sales of existing homes, production (supply) costs are less likely to influence short term prices. While this may be reasonable, it implies that in the long-term market segments may shift. The resultant instability in the coefficients is consistent with several studies. (See Mark (1983), "An Empirical Examination of the Stability of Housing Price Equations Over Time")

where P is the sale price of the j^{th} housing unit and Z_i is a vector of n housing attributes, physical characteristics, or service flows associated with the j^{th} unit. The coefficients of the individual attributes are shadow prices which may be constant if the price-characteristics relationship is linear,

$$(1.2) \quad \partial P / \partial z_i = \text{Constant} \quad \text{Linear}$$

or variable if the relationship is non-linear,

$$(1.3) \quad \partial P / \partial z_i = g_i(z_1, z_2, z_3, \dots, z_n; e_D, \text{error}) \quad \text{Non-Linear}$$

$$(1.4) \quad \partial P / \partial z_i = g_i(z_1, z_2, z_3, \dots, z_n; e_S, \text{error})$$

where $\partial P / \partial z_i$ are the coefficients on the attributes for each level of z_i , g_i is some non-linear function, e_D and e_S are vectors of exogenous demand and supply shift variables respectively, and the errors are disturbance terms.

Several Examples

The non-academic treatments of market segmentation presented in the Anecdotal Evidence Section above tend to focus on the relationship between macro-conditions (interest rates, employment growth, demographics, tax policy, etc.) and prices in housing submarkets. There are two possible premises which underpin this relationship. One possibility is that macro-conditions actually vary somewhat from region to region. This is reasonable considering that economic fundamentals such as employment and household growth, as well as availability of capital, can vary from region to region. For example, there is no one single national interest rate which applies to all regions and sub-markets. The second possibility is that different regions may respond to the same macro-conditions differently depending on the regional housing environment. For example, a market with tighter controls or natural land boundaries may have higher rates

of appreciation than a more freely sprawling market under the same set of macro-conditions. (i.e. Boston versus Phoenix). Dale-Johnson (1983) extends these relationships to the micro-level. He suggests that even specific housing attributes can contribute to variations in local response to macro-conditions. For example, houses with larger living spaces may appreciate faster under the same macro-conditions.

In another treatment of market segmentation, Dale-Johnson (1983) looked at another condition that may be causing market segmentation. He examines whether differing household incomes result in a variation in consumers' willingness to pay for a unit of capital gain. In other words, if homebuyers are concerned about after-tax returns, then one would expect higher income buyers to attribute greater value to expected capital gains (or appreciation) since they have more opportunities to shelter them from taxation. Consequently, there are multiple hedonic demand functions, for different income households, which compete for the same stock of housing.

Dale-Johnson proposes a joint null hypothesis that (a) homebuyers are "backward looking¹⁴" in establishing their expectation of future prices, and (b) their willingness to pay for these expectations is varied by their income. This is the "clienteles effect" in housing markets which says that higher-income and lower-income house buyers actually shop in different "submarkets."

Due to the heterogeneity of the housing good, and the lack of repeat sales data, he begins by constructing a synthetic 18-month time series of implicit repeat prices¹⁵ based on one observation of actual sale at period T. (This technique is described in greater detail in Appendix D) From this, a compound growth rate, r_{jt} , is computed on the j^{th}

¹⁴ Unlike consumers with "rational expectations," those that are backward looking naively extrapolate future performance from historical data. This is the trending mentality in price forecasts. More formally, this condition is

$$E(P_j^{T+1} - P_j^T) = E(\sum X_{ij} \beta^T r_i) = P_j^T - P_j^{T-1}$$

The expected increase in price from any period T to T+1 is a function of the observed price difference between T and T-1.

¹⁵ The series is based on 3,743 observed sales in Santa Clara, California, in December 1977 reconstructed for the previous 18 months.

home over the time period $T-t$. Next, a two-stage hedonic pricing model is applied by first regressing price P_j onto housing attributes including expected capital gain (proxied by r_{jt}), and then regressing the implicit price for capital gains ($\partial P_j / \partial r_{jt}$) onto the housing attributes. He concludes by accepting the hypothesis that, "homebuyers naively extrapolate from prior implied price performance to establish future price expectations and that variation in willingness to pay for the expectation is some positive function of income."

However, it is important to note several observations. The study explains very little of the variation in implicit price for capital gains. The highest adjusted R^2 was .187. Secondly, the synthetic repeat sales series is suspect for two reasons. One is that it may be contradictory to use a *linear* function to generate the price series in order to test a *non-linear* pricing hypothesis. Second, as t decreases the price generating function should intuitively give better estimates. However, for small t ($t < 18$), the coefficients generated are unstable. Still, this study of the clientele effect is suggestive of market segmentation which can occur when buyers price capital gains differently. A similar approach could show market segmentation based on differences in buyers' implicit price for other attributes.

It is interesting to add that Dale-Johnson's hypothesis about the formation of expectations is intuitively popular, and has been mentioned in a non-academic context as well. As East (1990) suggests, "expectations have a lot to do with pricing practices." News of movements in median prices, however inaccurate in terms of market realities, still affect the expectations of market participants. East uses an unreasonable "expectations" argument to illustrate how homeowners irrationally over-priced their own homes in the eighties, until the market was characterized by considerable ask-bid spreads. Unlike others who predict a price collapse, he has predicted that they can only become more "realistic." Pare (1990) adds that if people are backward looking in forming expectations, they may have to look back very far. He has estimated that an

average American homeowner buys and sells on average every 13 years. If that is how homeowners form their expectations, that may be too backward looking.

VI. POPULAR STRATEGIES

A review of the recent non-academic literature on the state of the housing markets reveals many agreements, as well as disagreements, on what is the appropriate immediate and long-term course of action. A brief review of some of the repeatedly mentioned "popular" strategies serves as a background for my current proposal. These are intended to be rather specific prescriptions for the nation's housing ailments. In Chapter 2, I present a more general set of categories, in an effort to identify a historic pattern of what has been attempted to date.

Relax local land use restrictions: When Baer speaks of the phenomena of the Shadow Market, one of his most pointed conclusions is that local zoning and land-use restrictions must be relaxed to allow the Shadow Market to do its work. This identical suggestion comes from varied interest groups - realtors, developers, academics, politicians, even planners. The argument is that less supply restrictions will drive down prices both directly, by reducing development costs, and indirectly, by fueling the alternative or "Shadow" markets. I illustrated in Section IV that in general, supply restrictions can create tremendous upward price pressures in the presence of outward shifting demand curves.

Enhance Credit: There are various suggestions to enhance the availability of credit, and the efficiency of both the public and private credit delivery systems. They range from improving mortgage qualification criteria, using more innovative mortgage instruments, and making better use of the secondary markets.

Establish Innovative Housing Partnerships: Hundreds of corporations, foundations and religious institutions have become involved in low-income housing programs. John Tuccillo, chief economist for the NAR, speaks of a system "whereby local groups identify the housing needs and then seek resources to put good programs into operation. The missing piece of the puzzle is getting resources to them, and that's where the feds have a role." (Steinbach, 1990) While this may be more of a rental assistance system, similar approaches have been advocated for home ownership. It stems from a recognition that while housing problems are seen nationally, creative solutions can be identified and implemented locally, with sufficient federal support. Jonathan L. Kempner¹⁶ adds that not only must the system have a local capacity or connection, but that it must be supported by private industry as well. "I applaud getting non-profits and local government agencies involved, but unless the private sector plays a key role, nothing is going to get done in low-income housing on the scale that we need." (Steinbach, 1990) Others look at this same issue of "scale" and conclude that the only option is to get the government involved.

Increase Government Involvement: Remembering that government involvement in the housing markets was a major part of massive increase in ownership between the 1940's low and the 1980's high (See Figure 1.1), many analysts prescribe a heavier role for government. Advocates claim that only government has the financial capacity and influence to meet housing needs at an appreciable scale, and want to see a shift in federal priorities. Brian P. Smith, Executive Vice President of the U.S. League of Savings Institutions, agrees that housing is simply no longer a top priority on a shifting public policy agenda. He sees education, health care, environmental and infrastructure issues as primary tax policy concerns. Housing affordability concerns have faded.

¹⁶ President of the National Multi-Housing Council, an association of apartment owners and developers.

Meanwhile, opponents take a laissez faire approach with regard to government intervention. They worry about leaks in the system, corruption, sustainability, and prefer the efficiency of the private sector.

The Bush Administration introduced its housing package in November of 1989 entitled, "Home Ownership and Opportunity for People Everywhere" (HOPE). The plan called for a spending increase of \$6.8 billion over the next three years, much of that targeted towards promoting home ownership for low income renters and public housing tenants.

HUD officials have been working with congress to put together a housing package which both the congress and the administration can endorse. There are two major pieces of legislation pending in congress. The Senate's National Affordable Housing Act (introduced by Alan Cranston D-Calif. and Alfonse M. D'Amato R-N.Y.) would authorize an additional \$4 billion annually to address a wide range of housing issues targeting both poor renters and struggling homeowners.

Further provisions in the NAFHA would do the following:

1. Allow first-time buyers to use IRA and 401(d) plans to purchase a home; especially helpful in facilitating down payment.
2. Lower FHA down payment requirements
3. Raise the FHA maximum loan limit (presently \$101,250)
4. Authorize the FHA to insure adjustable-rate mortgages
5. Extend the mortgage revenue bond and mortgage credit certificate programs.

The House has its own package offered by Henry B. Gonzales (D-Texas): the Housing and Community Development Act of 1989. Provisions in the HCDA of 1989 include the establishment of the national Housing Trust, which would help first-time buyers meet certain income requirements by lowering their monthly mortgage payments. The trust would provide a repayable subsidy to reduce the effective interest rate. Furthermore, it calls for an increase of \$8 billions a year over current spending levels.

While housing observers applaud certain elements of all these packages, many are concerned that budgetary constraints and the current fiscal crisis will limit the credibility and effectiveness of any such efforts.

Initiate Housing Entitlements: While the current wisdom may not favor entitlements, Congress and the Administration have received pressures in the past to initiate a housing entitlement program. Under such a program, assistance to the poor would be an entitlement - automatically available to all who qualify by some income measure - much like food stamps or aid to families with dependent children.

Advocates point out that housing is the only major low-income benefit that is not an entitlement, and that a housing entitlement would spur construction of much low-income housing. It is interesting to note that the amount of housing subsidy the government presently provides poor renters is more expensive, on a per household basis, than Medicaid. Medicaid is presently the most expensive low-income entitlement program. However, budgetary constraints make entitlement prospects quite unlikely.

Improve Tax Treatment: Another federal tool is a system of tax incentives to encourage private investment in housing resources. In the past, there has been very little agreement on the role of a tax policy in housing.

Some have suggested making the tax structure more equitable by employing tax credits as opposed to deductions. Presently, the homeownership tax benefits tend to favor more affluent households. As a deduction against taxable income, these benefits favor either high tax-bracket households or similarly households with sufficient income that needs to be tax-sheltered. On the other hand, a tax credit would give taxpayers in all brackets the same benefit per dollar of mortgage interest, shifting the distribution towards less affluent households. (Downs, 1989)

By contrast, a recent position paper written by the staff of the Joint committee on

Taxation altogether questions the role of housing tax benefits as part of a well directed U.S. tax policy. The report notes that,

tax policy can distort the allocation of private investment funds and thereby make less efficient the current level of private investment. For example, tax policy may lead to an inefficiently high level of investment in owner-occupied housing. Owner occupied housing is tax advantaged because the implicit rental income (in the form of housing services) is untaxed to the owner, while the owner may deduct the interest expenses incurred to purchase the home. This creates incentives for taxpayers to over invest in housing...at the expense of other private fixed investment. (Brian P. Smith, 1991)

Instead, the report stresses the urgency of investment in industrial capital equipment, research and development, and education.

As Table 1.5 shows, the deductibility of mortgage interest¹⁷ is the single largest fiscal revenue loss (tax break) for individuals in the tax code.

The problem is not so much in the deductibility of the interest per se, but rather that the flow of "housing services" are not somehow imputed to offset the mortgage payments. In other words, those mortgage payments are not only going to amortize the capital asset (stock) but also will pay for a set of housing services (flows). If only for practical reasons, instead of imputing the dollar value of housing services, tax purists may be inclined to simply do away with the whole deduction.

Lending institutions, as well as other private providers of consumer credit, have also noted that housing gets very preferential tax treatment. Two capital gains items are special to housing. One is the deferral of the capital gains if proceeds are rolled over into another more costly home. The other is the one-time exclusion of up to \$125,000 of capital gains, if the seller is over 55 years of age. Finally, it is interesting to note that equity loan interest represents the only sort of personal debt with a deductibility feature. Smith adds that, "under current tax rules, people need a very good reason *not* to use

¹⁷ Interest on Mortgage indebtedness is deductible on principal up to \$1 million. Home equity interest is subject to a separate ceiling of \$100,000.

(Dollars in millions)

Housing Benefits

General

Mortgage interest deductibility ¹⁸	\$39,575
Property tax deductibility	10,490
Deferral of capital gains on sale	13,265
Exclusion of capital gains (sellers over 55)	3,250

Low Income

Exclusion of Interest on municipal mortgage subsidy bonds	\$1,705
Accelerated depreciation on rental housing	495
low-income housing investment tax credit	40

Health Care Benefits

Exclusion of employer health care premium	\$29,640
Deductibility of medical expenses	3,025
Exclusion of Medicare benefits from recipient income	6,145

Capital Gains Benefits

"Step-up" in asset tax basis on death of owner (to reduce ultimate tax liability to inheritor)	\$24,365
---	----------

Table 1.5

Tax break costs to the federal government in fiscal 1991.

(Source: Budget of the U.S. Government FY1992, Part 3, Table xl-1, from B.P. Smith, 1991)

home equity loans."

This "monetization" of home equity represents an important influence on individual and household portfolio decisions and wealth. For this reason, its tax treatment is an important consideration to both current and prospective owners.

¹⁸ This represents both purchase money and home equity loans.

CHAPTER 2

HOUSING STRATEGIES: LESSONS FROM THE PAST

I. OVERVIEW

The American history in housing is filled with difficult issues and recurring concerns. There have also been many creative solutions, which have achieved varying degrees of success. We have seen innovative financing methods, new delivery strategies, changes in government policy, as well as clever tax incentives. The history of creative strategies for affordable housing is sufficiently long that even the "new" is often just a variant of the old. Perhaps an even greater number of creative and promising approaches have yet to be attempted.

An overview of the United States' rich legacy of affordable housing strategies may serve as a background for new approaches. This chapter reviews past approaches in a generic sense rather than a survey of actual housing policies. I have tried to categorize these approaches to help sort out where we have been as a framework for where we may head next.

First I highlight some conventional, subsidy type approaches which are

characterized by inherently redistributive mechanisms. Then, I present three alternative interpretations of how affordability may be achieved, each by example. The first approach involves looking at "alternative markets" which can generate affordable homes. I describe transformations, conversions, subdivisions and mergers as markets which can encourage affordability.

The second approach involves re-thinking about the housing product, and examining an affordable "alternative product." Manufactured homes are reviewed as an example of how affordability can be achieved by thinking in terms of different housing design forms.

The third approach examines "alternative institutional arrangements." The argument there is that affordability can be achieved by putting together creative partnerships between employers, employees, developers, public agencies, and communities. Finally, I conclude with "asset-based approaches." The fundamental difference between this and previous approaches is the exchange of assets, in a sense. The premise in these asset approaches is that buyers exchange some "asset" for affordability. The buyer may exchange portions of future earnings, future appreciation, or present day labor for affordability. I argue that the underlying economics are more appealing, and the results more sustainable. I pursue the asset-based logic with an application of financial options literature and techniques to housing in Chapter 5.

II. SUBSIDY APPROACHES

Historically, affordable housing approaches have fallen into one, or a combination, of categories:

- **Development Cost Subsidies**
 - Donated or subsidized land acquisition cost
 - Construction subsidies (both hard and soft cost subsidies)

- **Tax Policy Incentives**
 - Syndications
 - Interest deductions
 - Tax-free bonding
- **Other Public Subsidies**
 - Underwriting or insuring risky debt
 - Debt-service subsidies
 - "Silent Seconds"
- **Direct, Demand Side Subsidies**
 - Rental assistance programs
 - Voucher programs

Most historical approaches, whether directly or indirectly, are redistributive in nature. Whether subsidized by the various levels of government, by the taxpayers, or by various self-interested private organizations, there has always been concern about how long these subsidies will last, and whether they are a dependable source for housing assistance programs. Though many subsidy based programs lacked permanence, they were generally believed to be the only tools of sufficient scale to meet the nation's housing needs.

III. ALTERNATIVE APPROACHES

Instead of looking at where funds come from and where they go, as I have done above, housing approaches may be classified in terms of how the lower cost is achieved. This section looks at three specific and alternative perspectives: (a) how the existing segments within the market, or (b) the stages of production, or (c) the participants in the development process may be re-combined creatively to achieve lower costs. The three categories are:

- **Alternative Markets**
 - Renovations, transformations, conversions, subdivisions, mergers

- **Alternative Products and Delivery Systems**
manufactured housing, site & services¹
- **Alternative Institutional Arrangements**
intermediary agencies, support services, partnerships,
syndications, streamlining permitting, expediting approvals

In the first case, the argument is that, in fact, an appreciable portion of affordable housing is produced by the workings of different market mechanisms on the existing stock. Through various processes of what has been termed the "Shadow Market," existing structures are transformed or converted into affordable units. So, the argument is that there is no need for subsidies or creative financing or new partnerships; we must just encourage these alternative markets to do their work. We must remove the restrictions that presently limit the impact of these markets.

In the second case, the approach is to consider a physically different housing product - a manufactured home, or a plot of land with minimal services - which is simply cheaper to produce. The argument here, different from the first case above, is that we must encourage these alternative housing products to penetrate existing or conventional markets.

The third approach deals with forging creative and mutually beneficial arrangements between parties affected, directly or indirectly, by housing markets: employers, employees, communities, and public agencies. In this case we are dealing with the conventional markets, and conventional product, but a new "institutional arrangement."

These three categories are not necessarily exclusive of each other, as actual approaches may combine elements of each. I have presented them here only as a

¹ I mention the "site & service" approach here to represent a series of self-help approaches which basically reconsider "how much home" the formal market really needs to produce. The idea with the site & service approach is to produce a very minimal skeleton for a home and allow the homeowners to add as they financially can or wish. It incorporates public subsidies, sweat equity, technical assistance, and other approaches to create affordable community. While these projects are mostly characteristic of efforts in developing countries, similar ideas have been tested with varying degrees of success in the U.S.

framework from which some further developments and conclusions will be drawn.

Below I present an example of each of the above alternative approaches.

Alternative Markets: Transformations, Conversions, Subdivisions and Mergers

Much of the criticism of subsidy type approaches has been their lack of sustainability and fairness. It can be argued that subsidy arrangements lack the inherent self-sufficiency to be a reliable source of housing relief. Another criticism is a lack of consistency. The production of new housing in the United States has fluctuated considerably over the years. Between 1970 and 1980 the number of housing starts ranged from a high of 2,379,000 in 1972 to a low of 1,171,000 in 1975. (Baer, 1986)

Figures 2.1 and 2.2 show the current private housing production levels by region and the U.S. total. They show considerable regional variation in housing starts.

However, not all of the affordable units come by way of obvious market mechanisms such as new construction. In what has been termed the "Shadow Market,"² many affordable units, both multi-family rentals and single family owned, have been delivered by alternative markets. The U.S. Department of Commerce's statistics on housing expenditures show that in 1980, while developers spent some \$47 billion on new housing, owners of residential property spent another \$46 billion on existing housing for maintenance, additions, and alterations. These numbers reflect the amount of money spent in the U.S. in markets other than new construction, such as the Shadow Market.

These alternative markets consist of processes - such as subdividing, merging, and enlarging - that reconstruct the existing stock of housing or transform nonresidential

² Much of the information I have included about the "Shadow Market" is from Baer, 1986. Others are cited separately.

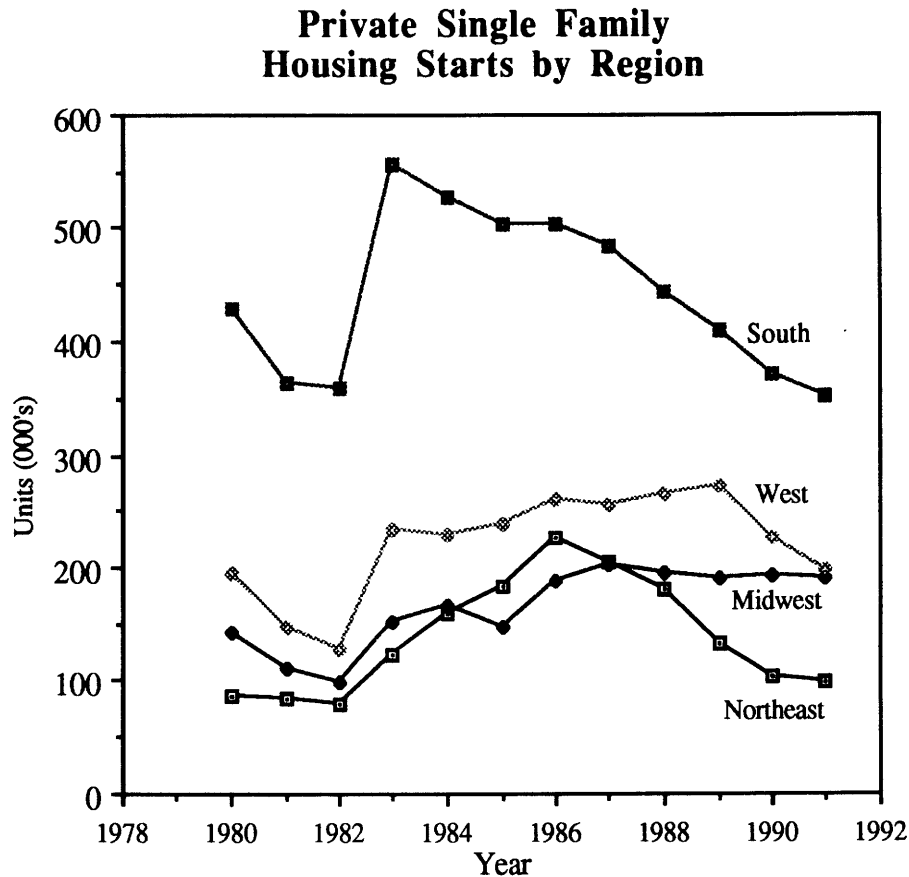


Figure 2.1

(Source: U.S. Bureau of the Census, Construction Reports, Series C-20, NAHB)

structures into housing. Specific examples include:

- Restoration of a previously uninhabitable unit
- Transformation of a nonresidential space into housing³
- Conversion of group quarters into individual housing units⁴.
- Conversion of an X number of units into a Y number of units⁵. (Called "Subdivisions" if $Y > X$ or "Mergers" if $Y < X$.)

³ Transformations can occur at both ends of the housing spectrum. At the low-end they may be transformations of garages, guest houses, stores, barns, schools, libraries, old town halls, or other defunct institutions. On the high-end, there has been much transformation of warehouse type space into luxurious loft condominiums or apartments.

⁴ Examples include quarters where "non-household" people are sheltered, such as prisons, college dormitories, and ex-military barracks.

⁵ Between 1973 and 1980, subdivisions resulted in 2.4 units for every unit converted and accounted for 3.1% of all additions. Mergers, during that same period, removed two units for every unit merged, and hence actually cause the removal of units.

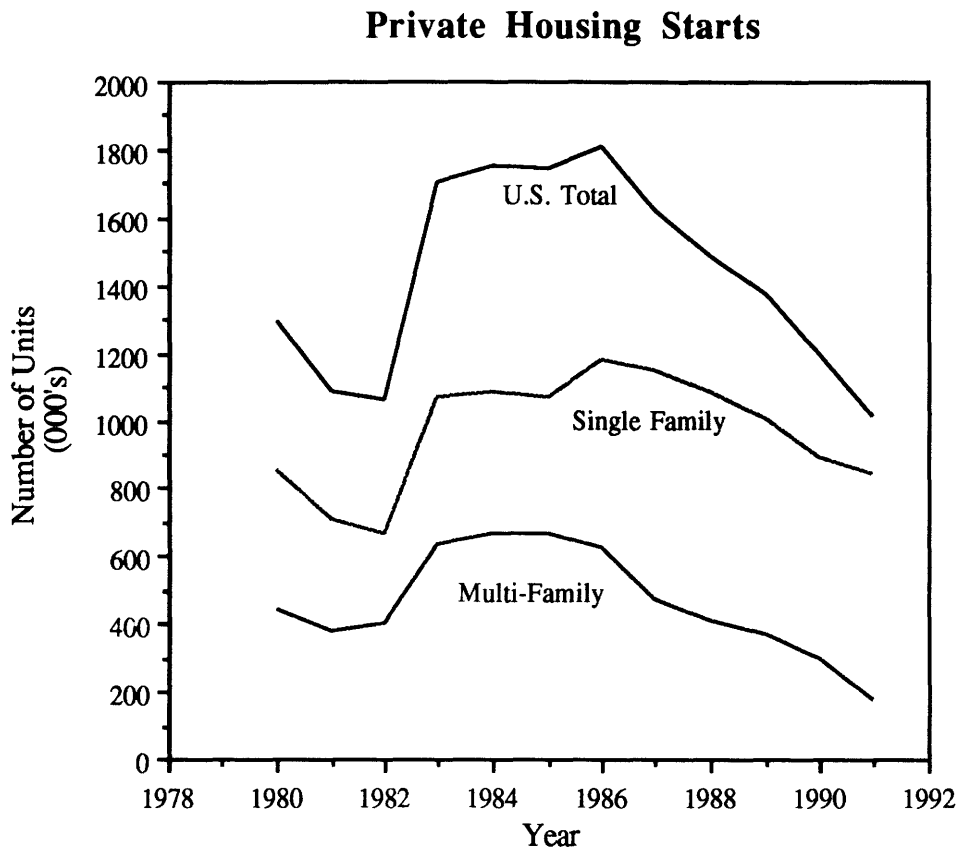


Figure 2.2

(Source: U.S. Bureau of the Census, Construction Reports, Series C-20, NAHB)

Between 1973 and 1980, restorations added only about 1%, transformations added 3.2%, while conversions of group quarters added approximately 1.5% to the existing housing stock. Though not all of these units represent affordable nor owner-occupied units, it is clear that the Shadow Market is of considerable scale.

Despite having grown much in recent decades, this market is less visible and receives little attention. In fact, additions to the housing stock from sources other than new construction have accounted for 21% of the increase in the total stock from October 1973 through September 1980. This figure may be as high as 33% for the low-cost owner-occupied units, or as high as 50% of the renter-occupied units alone. During that same period, 85% of the low-cost rental housing that came from new construction,

rather than through some mechanism of reconstruction, was subsidized. In other words, while taxpayer dollars or other subsidy sources were going towards new construction, the Shadow Market was creating units without any subsidies.

Though new construction remains the primary source for new additions, alternative markets are becoming increasingly important. In the past, new construction accounted for an average of 90% of new additions. But in the 1970's that amount dropped below 80%, averaging 73% between 1973-1980. The alternative markets have been picking up the rest. In 1980, the census of housing revealed one million more units than could be accounted for by new construction. Alternative markets for housing units certainly played a major role. Several characteristics which distinguish the Shadow Market are briefly discussed below.

Measurability

Alternative market mechanisms are often difficult to monitor and measure, and so their importance goes unnoticed. Due to the heterogeneity of the housing product, and the decentralized delivery network for housing services, it is very difficult to account for what happens to existing units under the Shadow Markets. By analogy, the consequences of decentralization and fragmentation are more clear:

Decentralization shows up sharply in a comparison with the automobile, which for most people is second only to housing in size and cost. Only a few manufacturers produce automobiles. In housing, however, the 100 largest developers produce only about 15 % of the annual new construction. The remainder is mostly built by companies of small or medium size or by individuals - all with their own idea of what constitutes a house. Moreover, the builder, unlike the automobile manufacturer, makes no systematic effort to control the quality of maintenance once the product has been sold. Instead the owner must deal with an even more decentralized system of local repair and remodeling service.
(Baer, 1986)

This highly fragmented system of producers and highly decentralized network of after-market service providers (contractors, electricians, carpenters, plumbers, etc.) makes systematic data collection on housing in general quite difficult. It would be

unimaginable to gather reliable data from such a scattered and unstable set of housing service providers and small businesses.

Data on new units, as opposed to existing ones, is generally more available and reliable. There are several reasons for this. For one, new units not only reflect an important indication of current spending and investment, they tell much about short term-employment as well as the need for mortgage credit. Large corporations and lending institutions can use this data frequently. Also, many regard new construction as an indicator of general economic health. So there is an interest, on the part of the government, economists, stock market observers, builders, and many others, to compile new construction data closely. The rather uniform and centralized system of permitting is a valuable tool for achieving this. So, there is both the popular interest and the administrative capability to track new housing units with some accuracy.

On the other hand, good data on the existing stock is more scarce. Since the existing stock is characterized by smaller, incremental changes, these are more difficult to track. Baer points out that, "concealed or visible, done illegally or [not] the actual physical changes to the existing stock are not noted in a national data base when they take place." For this reason, it is difficult to measure the Shadow Market's impact

Baer makes several other important observations about the dynamics of the Shadow Market in its role of adding, removing, and filtering units from the existing stock. To begin with, he finds that rental units were about five times more vulnerable to removal from the stock than were owner-occupied units. Second, this vulnerability was more pronounced with lower quality units.⁶ As an example, the very low category for renters suffered a loss of 4 times as many units as those for the upper category. Finally, additions to the stock exhibit interesting relationships with both tenure (renting vs.

⁶ Baer uses a classification system for value which parallels the typical government standards on household income. That is, value are broken into 5 categories: upper (>120% of median), moderate (between 120-80%) low (between 80-50%) and very low (<50% of median). Value is assumed to be a proxy measure of quality.

owning) as well as cost categories. The following is a summary of these findings:

- There were only two-thirds as many rental additions as there were owner occupied additions.
- The Shadow Market was much more successful in adding to the rental stock than the owner-occupied stock. In fact, there were approximately 4 rental units added for each owner-occupied unit.
- As compared with the number of units added by new construction, the Shadow Market had greater impact with lower cost units. While it provided 3% of the added owner occupied units in general, it accounted for 20% in the low category and 62% in the very low category. This was more dramatic for rentals with 17% of the upper category additions, followed by 65% (low) and dropping to 49% for the very low.⁷

It has long been argued that no matter how efficient or inexpensive, the alternative markets for housing can never reach appreciable scale needed to truly impact the affordability problem. Nevertheless, there are many important lessons which can be learned from the alternative markets. Though these markets are more effective in producing rental units, their ability to produce owner-occupied units has been underrated. Also, the alternative markets are unique in that they are driven by local conditions. Without regard to national housing policies and federal funding priorities, alternative markets are driven by a flexibility in local land-use regulations. Hence, in niches where the traditional market does not perfectly provide, these alternative markets may be more effective. As the federal priorities shift away from housing, and more public treasuries run dry, the alternative markets may become an increasingly important mechanism for the provision of affordable housing opportunities.

⁷ Baer conjectures that this decline in the lowest category was due to the effect of government subsidies encouraging activity in this category, thus diminishing the apparent role of the Shadow Market.

Alternative Housing Products: Manufactured/Modular Housing

Various construction industry advocates and technologists have long claimed that the affordable housing problems can be met with appropriate construction technologies. There have been various proposals to drastically cut construction costs and schedules and hence provide lower cost shelter. Examples include the use of cheaper materials, advanced scheduling methods, more cost effective management techniques and contracting methods, increased energy efficient building systems, and construction automation.

Manufactured housing can be seen as a new construction technique which actually changes what the ultimate "housing product" is: from an on-site stick-built custom designed structure to a prefabricated, standardized, even mass produced versatile form. The manufactured housing industry has long struggled to make its product indistinguishable from a conventionally built home. But the manufactured home is undeniably different. It is a different way of thinking about housing design and production.

The manufactured housing industry is large and growing. As of 1990, there were 4.7 million manufactured homes, representing 5.6% of the nation's stock of year-round housing units. With 120 companies building manufactured homes in nearly 300 factories throughout the United States, and between 7,000 to 7,500 retailers, the industry has considerable manufacturing capacity. In 1987, manufactured home sales exceeded \$5 billion.

In terms of this manufacturing capacity and retail network, one thing that distinguishes the manufactured home industry from the site-built industry is the separation of production from installation. When new construction is used to "kick-start" a lagging economy, this separation allows the economic fuel to be spread. With

site-built delivery, the bulk of economic activity that is generated by new construction is local - creating jobs, purchasing material, renting equipment, etc. Jobs tend to aggregate where there is new construction. Eventually, this revitalization may reach raw material suppliers and manufacturers further away.

On the other hand, with a manufactured home, new construction in California may be immediately on the production line in Texas or Pennsylvania. When the stages of production are separated, physically and economically, the economic fruits of new construction can be spread. In a sense, the separation of production from installation adds another value-added layer. So when new construction is started locally, the economic effects can more quickly be felt regionally, or even nationally. Furthermore, regions that may not be the beneficiaries of the "new construction" directly, can still benefit indirectly by getting new jobs on the housing production line. Hence, with the manufactured process "new construction" can be a more effective tool in economic policy.

Through increased production efficiency and aggressive cost control, the manufactured home industry has been relatively successful in keeping home prices from escalating wildly. While the median price of new site-built homes has increased 7.7% since 1980, the prices of manufactured homes increased by only 3.8%.⁸ (Battle, 1990)⁹ Table 2.1 shows the ranges in sales volume and median prices of both manufactured and site-built homes.

Indeed, with lower construction cost, through more efficient production and a shorter development cycle, the final housing product is cheaper.¹⁰ According to the Manufactured Housing Institute in Arlington, Virginia, the cost of a manufactured home

⁸ These figures are not quality adjusted.

⁹ Though Battle does not specifically qualify this statistic, I assume this is the price of new homes, and is probably not quality adjusted.

¹⁰ It is difficult to truly compare manufactured housing costs to site-built, since the former may not always include the price of the land. Either pure construction costs must be compared, or all-in costs, but one must be careful that statistics do not mix the two.

National Single Family Housing						
year	Sales Volume (000's)			Median Price		
	Existing Single Family	New Single Family	Manufactured shipments	Existing Single Family	New Single Family	Manufactured Housing
1984	2,868	639	295	\$72,400	\$79,900	\$21,500
1985	3,214	688	284	\$75,500	\$84,300	\$21,800
1986	3,565	750	245	\$80,300	\$92,000	\$22,400
1987	3,526	671	233	\$85,600	\$104,500	\$23,700
1988	3,594	677	218	\$89,300	\$112,500	N/A

Table 2.1

(Source: National Manufactured Housing Federation and National Association of Realtors (Maddock, 1989))

in 1987 was averaging \$20.61 per square foot, a 60% reduction from the site-built average of \$53.28 per square foot. Costs are reduced not only through efficient production but through fast installation.

Though the market itself has grown, the percentage of new housing starts that are manufactured has been consistently 13% since 1980. This rather small share has frustrated an industry which feels its product is indistinguishable from the site-built competition but yet has struggled to break an image of inferiority.

Skeptical consumers have avoided the manufactured image. Manufactured homes have also been associated with a primarily elderly and low income clientele. However, a nationwide survey of nearly 24,000 manufactured home residents showed a different story. Battle reports that 70% of new buyers are under 60 years old (averaging 47) with median household incomes of \$17,500. Many mentioned low maintenance, affordability and the efficient use of space as advantages.

Despite a 1974 HUD Code for standard of safety and durability, and other legislative successes at gaining recognition, sales have not dramatically improved. In fact, in 1988, 218,429 manufactured homes were shipped, 6.1% less than in the previous year.

In that same year, the median price of an existing home increased by 4.3%. As Table 2.1 above shows, despite the fact that new single family median home prices increased between 1984-1988, and manufactured housing costs were consistently and significantly lower, their yearly shipments declined. Apparently, the HUD code has neither dispelled the industry's poor reputation nor compelled many communities to accept manufactured homes. Only 18 states have passed laws which prevent "discrimination" against the manufactured home. Fearing that the presence of manufactured homes will depress adjacent housing values, many communities have resisted manufactured home shipments to neighboring lots. Only 40% of the homes are shipped to residential communities and private lots.

To reverse some of these trends, the *customized* manufactured home has emerged in the mid 1980's. Amenities may be added, fixtures and materials custom selected, and floor space may be custom configured, all to match buyers' tastes. Enlarged spaces, larger spans, wet bars, jacuzzies, and built-in oak furniture have all become available. While sizes average 1,800 square feet, they can exceed 4,000 square feet.

Hence, despite advances in gaining legislative acceptance, improvements in production technologies, success in cost control, and increasingly customized designs, the manufactured home has struggled to break its poor image and fully penetrate the market as a viable alternative "housing product."

Alternative Institutional Arrangements: Employer Assisted Housing

Amongst all of the uncertainties in the causes and implications of spiralling housing prices, one relationship is increasingly clear. There is growing evidence of the impact of a housing shortage on the availability and productivity of labor, and on the subsequent cost to firms. In many areas, including Boston, New York, and parts of California,

where housing costs grossly outpaced wages, firms found it difficult to attract and retain employees. Cities, in turn, faced an emigration of firms that was threatening the economic vitality as well as the municipal treasury.

Housing price disparities between economic regions can also impair the efficient movement of labor, and in turn the overall job growth rates. This affects the availability of labor on all levels of the wage scale - from executives to support staff to manual labor. Firms are finding it difficult to convince management level employees to relocate and incur the higher housing costs. In fact, many are forced into costly but prudent housing assistance programs to achieve more mobility and flexibility in their personnel.

There is an ironic set of forces operating in these areas. Often, it is the boom areas that are hardest hit with the housing problems. Those with the healthiest economies have the largest number of available jobs, but housing prices partially prevent those jobs from being filled. Wage earners from other more depressed cities who would like to move to booming areas find the financial barriers to relocation simply insurmountable. (Drier, Schwartz, and Greiner, 1988) In many places where wage levels comfortably exceed the national average¹¹, labor shortages persist since housing prices are so high.

In Boston, for example, where in 1987 the average wage level exceeded the national average by 12%, the median price of an existing home exceeded the national average by 110%.¹² As for renters, during the 1980's the percentage of renters paying more than half their income for housing doubled. As Boston firms were forced to pay for some of this increase through wages, they learned how uncontrollable housing prices can hinder otherwise healthy economy. A Boston Redevelopment Authority study shows that to attract workers, 75% of area employers had raised wages or benefits beyond inflation adjustments. Eventually, the Boston Hotel and Restaurant Workers Union demanded

¹¹ Examples include 12% above the national average in Boston, 26% in San Francisco, and 32% in New York.

¹² In April of 1987 the national median-price of an existing home was \$84,500. (Kamath 1988) Meanwhile in Boston the same home was \$177,200, the third highest in the country behind Honolulu and New York. (Dreier, Schwartz, and Greiner)

that their wages be indexed to the cost of housing instead of the Consumer Price Index. Human resource managers in the Boston area, familiar with the effect of local housing costs and the business costs of relocation, estimated a loss of 20-30% of potential employees to areas of the country where housing costs are lower. (Dreier, Schwartz, and Greiner, 1988)

The metropolitan New York area is perhaps an even more striking example of how soaring housing costs cripple the business environment to the point that firms simply pick up and move. Between 1982 to 1987, as housing prices doubled and wages rose only 27%, an exodus of businesses emerged - from New York to New Jersey and Connecticut. (Dreier, Schwartz, and Greiner, 1988) While it was not the spiralling costs of housing alone that caused this migration, many firms cited housing as a major business concern.

The role of firms has traditionally been to provide adequate wages to afford their employees consumption choices. However, in terms of housing this demand-side approach has increasingly failed. Instead, firms are finding it cheaper to participate directly in the provision of housing than to increase wages, or pay indirectly in terms of poor productivity, absenteeism, high rates of turnover, and relocation costs. In fact, in 1988 U.S. corporations were spending an estimated \$20 billion in housing assistance for their employees.¹³ (Schwartz and Hoffman, 1989)

More recently, the programs have not only become more creative and complex, but they have reached deeper down the payroll to assist both non-relocating and non-management personnel. Examples of actual programs in place include (Schwartz and Hoffman, 1989):

¹³ The United States is certainly not the only country where businesses have been learning about the adverse affects of scarcity of affordable housing choices. In Japan, housing assistance has long been an intimate part of many business interests. For example in Tokyo, many young executives have been commuting to work 2 hours each way. This has forced many major firms to provide special housing assistance programs, including low-interest loans or salary premiums, to attract and retain productive personnel.

- Colgate-Palmolive - offer closing points discount programs
- Mutual Benefit Life Insurance Company - provide discounted rate mortgages
- PC Connection - purchase land for employee subdivisions, sold at cost
- Rock of Ages Corporation - donated land to a non-profit for employee housing
- Hartz Mountain Industries - discounted prices of new homes
- EBON Corporation - develop subsidized rental property for employees
- Dwight and Church - provide down payment loans in designated condominium complexes; loans are forgiven after 5 years of employment
- University of Pennsylvania - extend a 100% mortgage guarantee for single-family homes
- Coastal Housing Partnership - group of firms struck bilateral agreement with local lender: reduced rate down payment loans in exchange for various banking agreements; debt service payments optionally made directly out of payroll.

The above examples highlight some of the ways employers have structured their participation in the housing markets. Employers have provided credit, direct assistance, or a market guarantee by way of: (Schwartz and Hoffman, 1989)

1. Group mortgage origination discount plans
2. Mortgage interest rate buydown plans
3. Down payment loan plans
4. Mortgage guarantee and insurance plans
5. Discounted or donated housing sites
6. Facilitating rental properties through ownership, construction subsidies, or master lease arrangements
7. Purchaser of last resort for new construction projects
8. Cash donation plans and housing grants
9. Construction financing and/or assistance.

Several more arrangements may just now be emerging such as:

- **Housing Revenue Bonds** whereby employers purchase reduced rate taxable bonds as a business investment with the funds dedicated towards employee housing;
- **State Tax Credit Programs** for employers which provide housing benefits
- **State Demonstration Programs** whereby state will match employer-assisted housing contributions with low-interest loans and grants;
- **Group Mortgage Insurance Programs** in the private sector.

As employer-assisted housing programs advance and become more widely accepted, two new partnerships may arise: one between the employers and developers, the other between employers and public or private-non-profit housing agencies.

Employers and Developers: New Opportunities

As rapid and structural changes reshape the real estate market, developers find themselves seeking meaningful new roles. One of the interesting opportunities which may arise involves a new direct partnership between developers and employers.

Developers may bring a human and informational component to the deal: financial expertise, familiarity with the delivery of facilities, the local codes and authorities.

Employers, on the other hand, may offer:

- Direct financing or assistance
- Captive demand through their employees, master lease agreement, or acting as purchasers of last resort
- Land
- Construction financing
- Mortgage insurance and guarantee programs

This "alternative arrangement" between employers and developers has a high degree of mutual benefit. It can be a unique opportunity to provide affordable housing choices.

Employers and Housing Agencies: Community Housing Partnerships

Another "institutional arrangement" which has emerged with some success combines the resources of employers with the commitment and know-how of various housing agencies. There has recently been an emergence of "Community Housing Partnerships."

With the Federal government both trimming down expenditures and shifting priorities away from housing, the nearly 50 year legacy of federal assistance in private housing markets seems to be ending. That assistance has been slashed by 75% between 1980 and 1988. As a partial response, states and localities began their own efforts at dealing with the housing problem, by setting up housing finance agencies, local community development corporations (CDC's). As the government's role in the housing sector diminishes, and businesses find their share of the burden growing, a natural partnership has evolved between businesses and these more traditional housing advocates.

To make these new alliances work, local government has had to seek new sources of revenue. Using their recent lessons from similar downtown redevelopment partnerships, cities have become creative and resourceful. Revenues have come from tax incremental financing techniques, special housing bonds, linkage fees from commercial developments, and others. However, as the capacity of local government falls far short of replacing withdrawn federal funds, businesses are increasingly encouraged to chip in.

In San Francisco, for example, the Bridge Housing Corporation has forged partnerships with local companies to create a development fund. In five years it produced 3,043 units of housing valued at more than \$238 million, 40% of which were below-market or "affordable" units. Executives from various local firms, including

Chevron, Levi Strauss, and Wells Fargo, contributed to these community housing partnership efforts. (Dreier, Schwartz, and Greiner, 1988)

In Boston, the Boston Housing Partnership (BHP) has been able to ally some of the region's leading banks and other businesses with local and state government officials and neighborhood-based non-profit CDC's. The BHP has offered technical assistance, corporate and foundation philanthropy, loans from a state financing agency at tax-exempt rates, city grants, and private financing from the member banks. These arrangements have proven effective in dealing with the region's housing needs.

Private, corporate-sponsored foundations have also contributed to the success of these housing partnerships, including the Ford Foundation's Local Initiatives Support Corporation (LISC), James Rouse's Enterprise Foundations, and the congressionally chartered Neighborhood Reinvestment Corporation.

IV. ASSET-BASED APPROACHES

On the premise that "there is no such thing as a free lunch," asset-based approaches revolve around the homeowners giving up something of future value in return for an effectively lower price today. They are distinguished from other approaches through their bilateral nature. That is, between the homeowner and the method of assistance, there is a flow of value in both directions.

There are a limited number of "assets" of sufficient value to others that the homeowner may offer in exchange for assistance. One is his/her opportunity cost of time in an economic sense, which has paved the way for various types of "sweat equity" programs. Second is his/her prospectively rising income stream, which has been the basis for various mortgage instruments which basically shift payout burdens back to coincide with optimistic income horizons. Third is his/her right to the home equity,

captured in various forms from equity participation programs to shared appreciation mortgages (SAM's).

The interesting point in these asset-based approaches is their compelling and fundamental economic appeal. I briefly review several such programs below.

Sweat Equity Programs

Sweat equity programs are "asset-based" in that the prospective recipient of the below market unit is participating in the production process. These programs generally involve prospective owners donating their time and skills to help reduce construction costs. In exchange, they receive equity in their units. While their popularity has mostly passed, they remain, at least in principle, an effort in the right direction. One obvious reason for their obsolescence is that land prices and soft construction costs have increased more rapidly than hard construction costs. Hence, the savings achieved through the sweat of prospective owners lost its impact on the bottom line.

Mortgage Instruments

Growing sophistication in mortgage design has enabled borrowers to achieve a greater degree of affordability, and a better chance of qualifying, by choosing an appropriate mortgage contract. Price level adjusted mortgages, shared appreciation mortgages, adjustable rate mortgages, and many others have enhanced the borrower's credit choices. These instruments shift risks (interest rates, inflation) away from the lenders and onto borrowers. I have called these asset-based approaches to the extent that affordability comes at the price of added risk. Borrowers are allowed to trade flexibility, future income, or assume additional risks, in exchange for these new credit mechanisms.

Equity Participation

Equity Participation is a program which partitions the cash-outlays, risks, and responsibilities of homeownership between two counter-parties: the equity investor and

the occupant investor. Specifically, one party (equity investor or equity owner) makes all or most of the initial down payment and takes half the title, while the other party (occupant investor or resident owner) makes all the monthly payments and takes possession. The former must meet the heavy up-front cash burdens, while the latter takes the monthly payment and maintenance burdens. The two parties then share, in some negotiated proportion (often 50-50), the subsequent appreciation.¹⁴

This arrangement benefits an investor who wants to invest in housing without the risks associated with being landlord: negative cash flow, collection efforts, maintenance and repair, management and leasing issues. By assuming some credit risk (i.e. that the occupant investor will meet his/her end of the deal), the equity investor is able to shift these other risks to the occupant investor. The more credit risk the occupant owner represents, the greater the proportion of appreciation the equity investor may demand. Should the occupant investor fail to meet his/her obligations, he/she forfeits partial ownership status and its benefits and immediately becomes a tenant.

The equity participation arrangement also benefits homeowners who do not otherwise have adequate funds for down payment, or could not qualify for a conventional loan. Without having to make a down payment, the occupant investor becomes a homeowner.

Like any other financial arrangements, it is important to understand the nature of the agreement, and the contractual allocation of risks and rewards. The contract typically takes on the form of a cotenancy agreements and lease, between the equity investor and the occupant investor, with five major parts: the duration, the value of the property, the investor's contribution, the title, and the conditional requirements. The duration may vary greatly (3-15 years), with possibilities for renewal used as well. Of course, since

¹⁴ As the parties split the equity appreciation, they also split income-tax deductions for depreciation and interest payments, property taxes, insurance and improvements. While the splits tend to be proportionate, there is no reason why one could not take more of any one benefit or liability as they negotiate. For example, the equity investor often takes all the depreciation benefits, while the occupant investor takes all the interest deductions.

the relationship revolves to a certain extent around the appreciation, the duration must be long enough for considerable appreciation to occur.¹⁵

Assessment of value is a pivotal and difficult element with the contract. Value estimates must be established both at the beginning and end of the contract term. The beginning value is generally, but not necessarily, the purchase price. Certain circumstances, such as below market (assumed) financing, may complicate the valuation both up front and at the back end (refinancing, disposition, or contract termination).

One interpretation of this arrangement, is that it is a combination of secured lending, and leasing with an option to purchase. The equity investor is lending the down payment, in exchange for several benefits: tax deductions with a good deal of certainty, and a return on the investment (resembling a zero-coupon bond) with much uncertainty. Should the house appreciate, the equity investor is betting on refinancing or sale. Either the occupant investor will "buy him out" at the contract expiration, or the house will be sold, two rather risky alternatives. At worst, the equity investor may wind up with title to a property whose value is less than that required to salvage the investment. This is more of a short-term risk. As the occupant investor performs on the monthly payments, the principal portions go towards the build-up of equity. In the case of default, the equity investor will capture at least that amount.¹⁶ The primary risks in the short term are poor initial valuation (paid too much for the house), excessive loan-to-value ratios (over-encumbered the house), or general price collapse.

The dynamics of this vehicle are rather involved in terms of flows of benefits, incentives to perform on the contract, incalculable risks¹⁷, and realizable remedies in the

¹⁵ In Chapter 3, this "duration of the exposure to volatility" is shown to have positive value in an options context.

¹⁶ The equity investor's remedies in the case of default are rather limited. He/she may terminate the lease and repossess the property, to gain full title and try to liquidate to recover the investments. Alternatively, the equity investor may file suite for all past due payments, future monthly payments for the duration of the lease and perhaps an additional amount for the inconvenience. (Wright) I question the strength of this latter remedy since in essence there has been a breach of contract, and any judgements against the occupant investor may be worthless.

¹⁷ One examples is the equity investor's exposure to various claims of innocent third parties, such as mechanic's liens.

case of default. However, the success of this arrangement depends heavily on the tax treatment of home owning and the rate of equity appreciation. This appreciation, in turn, depends on the volatility of local market prices and the amount of time the contract is "exposed" to that volatility. Prices, volatility, and time of exposure are well modelled by the financial options framework presented in Chapter 3 and applied in Chapter 5.

Wright concludes that, "Even with the new and less favorable tax laws, both parties can benefit if there is a small amount of appreciation. The equity investor can gain with a zero-appreciation rate, but the occupant investor must have an annual appreciation rate of nearly 1 percent before equity participation is more advantageous than renting."

Another way to think about the above asset-based arrangements is that the homeowner is effectively giving up rights or favorable conditions in the future in some limited way - the opportunity cost of time, the enjoyment of rising income in the future, the expectations of changes in equity wealth - in order to enjoy more affordable homeownership today. Thinking about approaches to affordability in these terms, there may be other rights or opportunities that homeowners may be willing to give up, which may be of value to others. This is the main motivation for the asset-based housing option vehicle discussed in Chapters 4 and 5.

CHAPTER 3

FINANCIAL AND REAL OPTIONS

I. HISTORICAL PERSPECTIVE

Option-like instruments have been trading in both formal and informal dealer-markets for many years. There is much anecdotal evidence of options-like instruments since perhaps the time of the Greeks, Phoenicians and Romans. Even earlier civilizations at least found the intuition of contingent claims appealing and perhaps profitable.

The proliferation of warrant¹ valuation models in the 1960's, including Sprenkle (1961), Ayres (1963), Boness (1964), Samuelson (1965), Baumo, Mallkiel, and Quandt (1966), and Chen (1970) underpinned the modern era of equilibrium based option valuation models. Having been inspired by this rich legacy of valuation work on

¹ In their simplest form, warrant are analytically similar to options, and in a sense were their predecessors. A warrant is an option to purchase securities at a given price and time, or even a series of prices and times, depending on the specific agreement. The fundamental differences are that warrants are (a) longer term securities, sufficiently long to expect substantial changes in the volatility measure; (b) they are issued by the entity (such as a corporation) whose stock is underlying the security as opposed to a clearinghouse; (c) when exercised a warrant increases the number of shares outstanding, whereas options are issued on existing shares; (d) their exercise price is usually not adjusted for dividends; and (e) their values are heavily affected by mergers and acquisitions.

warrants and other convertible securities, in 1973 Fischer Black and Myron Scholes made a historical addition to the academic literature and an unprecedented contribution to the industry's understanding of derivative securities.² The options framework was formalized with the introduction of Option instruments into the American Capital markets.

Also in 1973, the Chicago Board Options Exchange opened. Other exchanges including the American Options Exchange, the Philadelphia, Baltimore, and Washington Options Exchanges, as well as the Options Clearance Corporation, all provide valuable data and a working forum on options markets.

II. LITERATURE REVIEW

Recent Developments

The recent and rapid development of the theoretical framework for contingent claims³ can be traced to the seminal work of Fischer Black and Myron Scholes in 1973. In that ground-breaking piece, they provide the first explicit general equilibrium solution for the option-pricing problem. In addition, they made what some regard as the single most useful and profound contribution to the field of finance in recent decades. Arguing that the position of a firm's stockholders is equivalent to the purchase of a call option (so the position of the bondholders is that of the call writer), Black and Scholes fueled

² "Derivative Securities" is a term used to describe a family of instruments whose value is some function of another security, equity stock, debt bonds, or various currencies and indices. Often used both as hedging tools (or "insurance") as well as speculative vehicles, many such creative derivative securities emerged in the 70's and 80's as investors were seeking ways to deal with an increasingly volatile stock market environment.

³ Assets whose value is a non-proportional function of the value of another asset. This definition has been expanded to include those assets whose value is "contingent" upon not only other assets but other events and conditions which have inherent and changing value. Note that the volatility on the underlying asset is what creates the value of the contingent claim. Were the underlying asset's value known with certainty, a contingent claim on it would be a trivial instrument.

academic efforts at valuing corporate assets and liabilities and modeling investment decisions. In other words, they suggested that stockholders hold the right to buy the firm back from the bondholders by the election to repay the debt.

Implications of the work of Black and Scholes has permeated the literature of corporate finance. Merton (1974) described how riskiness of the corporation affected its debt, followed by many others including Galai and Masulis (1976) who examined the effect of mergers, acquisitions, expansions and the debt and equity claims of a firm.

Subsequent work found the model quite robust with respect to realizations of any of the basic assumptions. Important modifications include Thorpe's (1973) relaxation of the no short-sales assumption; the Merton (1973) Proportional Dividend Model which relaxes the no-dividends assumption; the Ingersoll (1976) Differential Tax Model which relaxes the no-taxes assumption; the Merton (1973) Variable Interest Rate Model which relaxes the interest rate constancy assumption; and the Cox and Ross (1976) which relaxes the continuous price movements assumption.

In the 1970's there was a host of other works which examined other option-like financial transactions. These include exchanging one risky asset for another (Magrabe, Stulz in 1978), and compound options (Geske in 1979). Hence, in the last 20 years, there has been considerable advances in our understanding in option valuation theory.

Most of the literature tends to fall into three categories: (1) modification of the original assumptions on either probabilistic processes governing price movements and interest rates or on boundary conditions, (2) alternative derivations and empirical tests, and (3) applications of options valuation theory.

As mentioned before, modification of the basic assumption have insignificant effects on the equilibrium solution. Examples of statistical assumptions on the evolution of stock price over time have included both geometric and arithmetic Brownian Motions, the Poisson or Jump Process, as well as other random walks. Various stochastic process assumptions have been applied to the movement of interest rates, and stock

price movements.

There have been several important alternative derivations. One, which yielded very similar results, was performed by Merton (1973). He essentially presents an exhaustive set of equilibrium restrictions instead of making distributional assumption. In other words, instead of assuming some statistical process which generates the stock price⁴, he describes the set of restrictions which would yield that same price distribution in equilibrium. Another alternative derivation was presented by Cox, Ross and Rubinstein (1978). They offer a discrete-time approach, generalized using the binomial formula, as opposed to Black-Scholes' continuous time approach.

Beside simplified derivations, there have also been numerous extensions and applications of the option valuation theory. An important extension of the literature occurred as real options were being distinguished from financial options. The major difference involves the existence and efficiency of the market for the underlying asset, and the appropriate statistical assumptions on price movements. The literature on real options and their application tends to focus more on explanatory power of the model in describing price movements, rather than the propositions that indeed such a "real option market" should or does exist. There have been many examples of real options applications, the earliest by Paddock, Siegel and Smith (1987) in their valuation of offshore-petroleum oil leases. They describe the price paid for potentially oil-rich land as a call option, with the strike price being the exploration and extraction costs, and the value of oil as the underlying (quite literally) asset. Later works ranged from treatment of conversion timing decisions (Majd and Pindyck, 1987), general descriptions of the real estate market (Williams, 1991) and the development process (Capozza and Sick, 1991) to the particular option characters in mortgage contracts (Murphy, Chinloy), and long-term land leases (Capozza, 1991). Most recently, Capozza and Amin (1991) as

⁴ There are various statistical processes in the literature for which formulation exists and an explicit non-normal price distribution can be found.

well as Grenadier (1992) have attempted to explain the nature of real estate cycles especially with regard to the explanation of over-building and extended time-lags in incorporating new market information. Emmanuel Bar-Or has looked at the application of option valuation theory to construction decisions.

III. BLACK-SCHOLES OPTION VALUATION MODEL

Motivation

Most of the models developed prior to the seminal work of Fischer Black and Myron Scholes in 1973 were analytical and graphical representations of empirical evidence. Relying heavily on curve-fitting and formalized rules-of-thumb, they generally missed equilibrium constraints. Furthermore, as Black and Scholes note, they "were not complete, since they all involved one or more arbitrary parameters." (Black and Scholes, 1973) Hence, the approach taken by Black and Scholes was distinguished not only in its simplicity of use, empirical accuracy, and almost immediate practical popularity, but most importantly for a single penetrating insight whose profundity and usefulness has yet to be exhausted. By recognizing the position of stockholders as equivalent to holding call options on the assets of the firm, their option pricing theory became relevant to many different areas of finance.

While Thorp and Kassouf recognized in 1967 that a hedged position can be achieved by taking a long and levered position in the asset and shorting the option, "what they failed to pursue is the fact that in equilibrium, the expected return on such a hedged position must be equal to the return on a riskless asset." (Black and Scholes, 1973) If such a hedged position is continuously maintained (often referred to as a "dynamic hedging strategy"), the the return on the hedged position is completely independent of the change in the stock price, and dependent only on time and the values of several

known constants. In fact, as Robert Merton pointed out, "the return on the hedged position becomes certain." (Black and Scholes, 1973) This idea will be elaborated using a discrete time approach below.

Discrete Time and Binomial Derivation⁵

Equilibrium-based option price models are derived from arbitrage arguments. That is, in an efficient market with negligible transactions costs, part of a tax-free world, securities must be priced as to eliminate any systematic pure arbitrage profits. A simple two-state discrete time setting can be used to develop an option-pricing formula which meets this no-arbitrage condition in a simplified world.⁶ This formula can then be expanded using binomial methods, and then generalized into the continuous-time Black-Scholes approach.

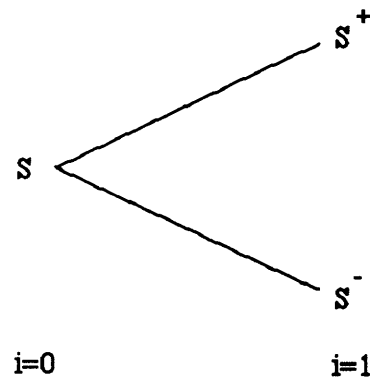
The insight mentioned above, which will be motivated through the discrete time approach, is that it is possible to replicate the payoff to a call (put) option position using a very specific combination of borrowing (lending) and going long (short) in the asset.⁷ In other words, there exists a portfolio of stocks and borrowing that after one period will have the same value as the call option, regardless of the interim stock price movement. We are interested in identifying that portfolio to help us price the call.

Assuming the stock price is S at $i=0$, and we allow the stock to proceed to either S^+ or S^- at $i=1$, we have,

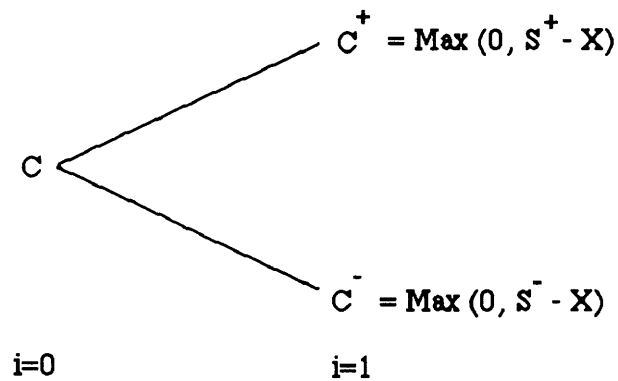
⁵ This discrete time approach was originated by Sharpe (1978) and developed by Cox, Ross, and Rubinstein in, *Option Pricing: A Simplified Approach*, 1979. This is the classic exposition of the binomial model for an option-pricing framework. This section is partially a review of that work.

⁶ Assumptions include no dividends, no taxes, no transactions costs, and no margin requirements.

⁷ Unless otherwise noted, I will discuss the derivation of a call option only since a direct analogy applies to puts.

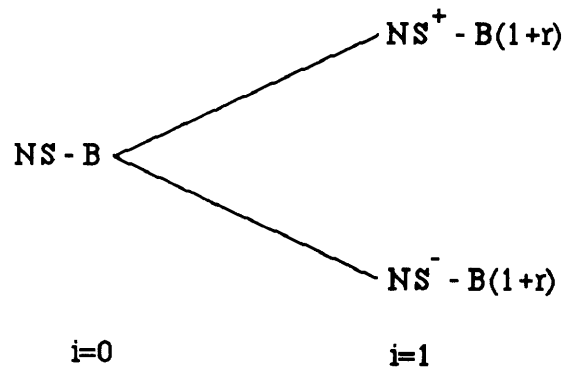


The price of a one-period call option written on this stock ("underlying asset") with an exercise price X at $i=1$ would move as follows,



The value of the call position at $i=1$ reflects the fact that an option is a "right but not an obligation." Since it will not be exercised unless it is valuable, C will always be non-negative. In fact, C_i will be the maximum of either zero or the difference between the stock price at period i (S_i) and the strike price X .

To find the portfolio which contains N number of shares long, partially financed through B dollars of borrowing at the interest rate of r , we follow the cost of such a position in the same way we did for stock price and call value above. Namely,



In order to perfectly replicate the payoff to the call option holder, we set the end of period values of the call option equal to the end of period values of the replicating portfolio in order to solve for N and B. Hence, we have,

$$3.1 \text{ (a)} \quad NS^+ - B(1+r) = C^+$$

$$3.1 \text{ (b)} \quad NS^- - B(1+r) = C^-$$

Solving these two equations simultaneously yields,

$$3.2 \text{ (a)}^8 \quad N = \frac{(C^+ - C^-)}{(S^+ - S^-)}$$

$$3.2 \text{ (b)} \quad B = \frac{(S^-C^+ - S^+C^-)}{(S^+ - S^-)(1+r)}$$

So, a portfolio containing N shares of the asset and B dollars of borrowings will exactly replicate the payoff to the call option. To satisfy the Black and Scholes no-arbitrage condition, it must be true that the call option at $i=0$ is equal to the stock-borrowing

⁸ Notice that this is equal to the end-of-period security (call option) value range divided by the asset (stock) value range.

portfolio at $i=0$. Algebraically,

$$3.3 \quad C = NS - B$$

Plugging in the values of N and B found above, we have found the value of the call option at $i=0$. Again, this must be true to prevent the existence of riskless arbitrage profits.⁹ By periodically adjusting the replicating portfolio according to equations 3.2 as the periodic stock prices become available it is possible to construct a "synthetic call option."

There are several important observations at this point. To begin with, the replicating portfolio position is self-financing. That is, once the original portfolio of N shares of the stock and B dollars of borrowing is established, no new monies are required by the periodic adjustments. For example, if at some future i , N increases (must buy additional shares of stock) this purchase would be paid for by borrowing. And if N decreases, some shares are liquidated, and those funds are used to pay off part of the loans. Second, a very analogous procedure can be employed to arrive at put option values. While a call option is replicated by a long stock plus borrowing portfolio, the put option is replicated by a short stock plus lending portfolio. Finally, by increasing i we can allow for more end of period asset prices, to more closely represent actual (or observed) asset price distributions.¹⁰

One adjustment must be made to the above formulation. Originally, we assumed that stock prices moved up and down in an incremental additive fashion. That is, we just had the condition that $S_i^+ > S_{i-1}$ and $S_i^- < S_{i-1}$. However, this could eventually lead

⁹ Riskless arbitrage profits would exist if investors could find two identical securities (or portfolios) with different market prices. To exploit the mispricing opportunity investors could short the over-priced security and use those proceeds to take a long position in the under-priced one. The difference in price would be risk-free profits. An efficient market would necessarily move to eliminate such opportunities. For a numerical example of how this would work see HBS 9-286-112.

¹⁰ In fact, we are not increasing time but decreasing the trading interval. We are essentially allowing the stock prices to move more often, until in the limiting case they are continuous.

to negative asset (stock) prices, which can not occur. In order to assure non-negative stock prices ($S_i \geq 0$), we require,

$$3.4 \text{ (a)} \quad S_i^+ = u(S_{i-1})$$

$$3.4 \text{ (b)} \quad S_i^- = d(S_{i-1})$$

where $u = 1 + \% \text{ increase}$, and where $d = 1 + \% \text{ decrease}$.¹¹ Instead of using an additive process governing prices from period to period, we now are using a multiplicative one. For example, if prices increased or decreased by 20% in a given interval, then $u=1.20$ and $d=.80$. The values of u and d are restricted by,¹²

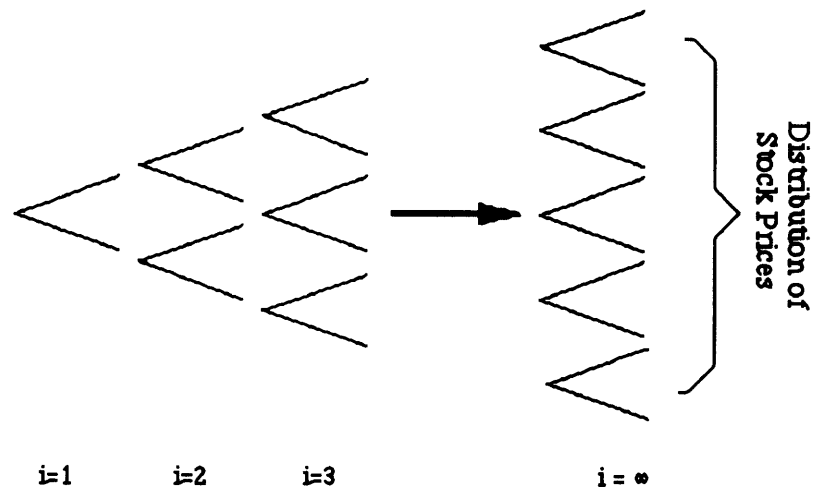
$$3.5 \quad d < 1 + r < u$$

where r is the riskless interest rate.

The two-state model can be expanded into the more generalized binomial form. As i increases (or alternatively as the trading intervals get shorter) the above equation become a binomial expansion. Graphically, we have,

¹¹ u and d are the continuously compounded or logarithmic rates of return.

¹² Cox, Ross, and Rubinstein (1979) point out that if these inequalities do not hold, there would be opportunities for risk-free arbitrage profits.



In order to get C (the call option value at $i=0$) we need only know the family of end of period stock prices (S_i), the risk-free

In general, for a i -period model, there will be 2^i number of potential stock prices in the last period, which together represent some distribution, which approaches the lognormal as i approaches infinity (or the trading intervals get infinitely small). It is this distribution that the various equilibrium models, such as the Black-Scholes, implicitly generate by making a certain stochastic assumption on stock prices movements. That is, these models make a standard statistical assumption about what the stock price distribution (family of values S_i) will look like at any point in time. They use a stochastic process to generate and describe the end of period price distribution.

Notice, that in the simple two-state example above we avoided mathematical complications by explicitly solving out each period's stock and call option prices. However, we have also made an implicit distributional assumption by employing the u and d factors at each period.

Solution

The Black-Scholes option valuation model is a continuous time analogy of the discrete time developments above. As the trading intervals become infinitely small, the number of periods i approach infinity, the multiplicative binomial process (using u and d) approximates the lognormal distribution with or "smooth" diffusion Wiener process, and continuous trading is approximated. Cox, Ross and Rubinstein (1979) show that indeed the binomial formula converges to the continuous-time Black-Scholes solution, given as,

$$3.6^{13} \quad C = SN(d_1) - Xe^{-r(t^* - t_0)}N(d_2)$$

where,

$$3.7 \quad d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{1}{2}v^2\right)(t^* - t_0)}{v\sqrt{t^* - t_0}}$$

$$3.8 \quad d_2 = \frac{\ln\left(\frac{S}{X}\right) + \left(r - \frac{1}{2}v^2\right)(t^* - t_0)}{v\sqrt{t^* - t_0}}$$

and, t_0 = contract starting date

t_* = contract strike date

$T = t_* - t_0$, which is the time to maturity

Analogous to previous interpretation, the first term in Equation (3.6) $N(d_1)$ represents N , the number of shares of the stock held in the replicating portfolio, and the second term represents B , the dollars borrowed.

¹³ It is interesting to note that the solution to the partial differential equation that Black-Scholes used to value the option in their 1973 paper was actually solved by Churchill, in his book 10 years earlier. It was a solution to a mechanical engineering (heat-transfer) problem.

Input Parameters

The Black-Scholes formula's advances of theory and significance to academics are well balanced by its popularity in practice and ease of use. The model is remarkable in both what it does - and does not - require as inputs.

The Black-Scholes closed-form solution for the option value (see Solution section above) depends on only 5 variables:

1. The current stock price (S) or underlying asset price.
2. The variance (v^2) or "volatility" on the stock price.
3. The exercise price (X), or strike price.
4. The time to maturity (T) or expiration of the option contract.
5. The short-term or risk free interest rate (r).

The tremendous appeal of the Black-Scholes quantitative development is its simplicity. All of the variables, except the variance, are readily observable given active and theoretically efficient markets. Variance is usually derived through observations of historical time-series data.

Most notably, this model does not depend on the expected rate of return to the stock or investors' attitudes towards risk. The expected rate of return is certainly one variable investors have a difficult time agreeing on, in fact it is partially this same disagreement over return expectations that partially creates investment opportunities. Instead, the Black-Scholes model, and other option valuation models as well, depend on the stock price volatility. While volatility is still an illusive and unobservable variable, it is a more "agreeable" variable for several reasons. First of all, satisfactory proxies exist. For example, it is possible to get a volatility measure from historical stock price data. Secondly, historical volatility measures are better ex ante basis for ex poste decisions than historical return data. Volatility may not only be a more consistent variable over time than expected returns, but is less cumbersome and controversial. Put in another

way, it is intuitively more appealing to expect past volatility to reflect future volatility, than past returns to reflect future returns. In effect, I am suggesting that volatility measures are less volatile than expected return measures. Secondly, most investors may be more confident and capable in describing the volatility of a stock than expected returns. You live with volatility, and follow prices daily. You measure returns only once.

These two omissions offer the options valuation methods tremendous advantage over present value (NPV) or other time-adjusted cash flow approaches. In any discounted cash-flow analysis there are many more implicit assumptions that must be made, especially with regards to the risk adjusted discount rate. These assumptions can be suspect, and render the analysis less meaningful.

Comparative Statics

The call option value moves in a rather predictable and intuitively appealing fashion with changes in any of the input parameters. First, these comparative statics results are presented below. We are interested in how an increase in each one of the input parameters affect the value of calls and puts. Then, a general interpretive framework for how the option model works is presented.

Current Asset Price

Holding all other parameters constant, a higher current asset price increases the value of a call option, but decreases the value of a put option. In the case of a call option on an underlying stock, for example, the higher the current stock price the more likely it is that the stock price will exceed the exercise price at the expiration date. Since the call option holder is positioned to own the underlying stock, the higher its price the more valuable the call option. However, in the case of a put option on an underlying stock,

the opposite is true. The put option holder is betting on prices falling below the exercise price. So, unlike the case of a call, the higher the current stock price, the less likely it is that it will drop below the exercise price, and hence the less valuable the put option. Hence, for increasing current asset price, the call value **increases** while the put value **decreases**.

Volatility

An increase in volatility, reflected by an increase in v^2 , increases the rate at which the asset price changes for a given period of time. The more volatile the underlying asset price, the more likely it is to move beyond the exercise price - above it for calls, below it for puts. For this reason, a very distinguishing characteristic of options is that their values increase with greater volatility. This is especially true since the option contract is inherently and positively skewed - allowing the investor to capture gains while avoiding losses. This asymmetry in the nature of the contract allows the holder to actually benefit from increased uncertainty.

Volatility is not directional - it does not measure up or down movement, but rather movement in either direction. Hence, it would be reasonable to expect that volatility effects puts and calls in the same way. So, for increasing levels of volatility, the call value **increases** and the put value **increases** as well.

Interest Rate

Algebraically, the primary role of the interest rate r is to discount the exercise price. As the rate of interest increases, the "effective" (present value) exercise price decreases. Of course, downward movements of the exercise price affect calls and puts in different ways. For call options, effectively decreasing the exercise price makes it more likely that future stock prices will be higher than the exercise rate. Exercising the option is hence more likely, and call option value is enhanced. On the other hand, for put options higher interest rates and lower "effective" exercise price makes chances of exercising

less likely, and hence put option value is diminished. So, for increasing interest rates, the call value **increases** while the put value **decreases**.

Exercise Price

Since calls are in essence bets that the future stock price will be higher than the exercise price, and puts are bets that it will be lower, as the exercise price increases, calls and puts exhibit opposite effects. For call options, a higher exercise price becomes a more difficult hurdle for future stock prices to beat. Another interpretation is that higher exercise price means a bigger price tag on possible future gains, measured by the gap between stock price and exercise price at some period i in the future ($S_i^+ - X$). Put differently, as the exercise price increases, the potential profits from exercise of the call option decrease. As these potential profits are eroded, the call option value diminishes.

For put options, a higher exercise price becomes an easier target - it leaves a larger target range of stock prices below the exercise price that puts can bet on. It is a better bet, with better probabilities, and hence a more valuable option contract.

So, as the exercise price increases, holding all else equal, call value **decreases** while put value **increases**.

Time to Expiration

The time parameter has several mechanisms of influencing value - a discounting effect, and an uncertainty effect. The net effect of the time parameter on the value of an option depends both on the type of option and on the nature of the underlying security.

The discounting effect involves changing the amount of time through which the exercise price must be discounted. The longer the time, the more the exercise price must be discounted. As we have seen above (see Exercise Price Section), this has opposite effects depending on the type of option contract. As the exercise price decreases, holding all else equal, call value **increases** while put value **decreases**.

The uncertainty effect involves changing the possible dispersion of values at

termination, since a certain volatility rate is applied for a longer amount of time. The more uncertainty (i.e. volatility) the greater the ultimate price dispersion, and the more likely the exercise price will be exceeded. So, for call options, the discounting effect and the uncertainty effect reinforce each other, and the value of the call option unambiguously **increases**.

Since an *American* put option cannot logically decrease in value with an increased time to maturity¹⁴, the uncertainty effect must overwhelm the discounting effect, and the put value **increases**. However, for a European put option, the net effect of the two effect is less clear. With an increase in the time to maturity on a *European* put option, the two forces are opposed. On the one hand, the discounting effect **decreases** value but the uncertainty effect **increases** it. Hence, a static comparison is not conclusive.

The effect of the time parameter also depends on the nature of the underlying asset or security. There is stochastic premise underlying the uncertainty effect applied above that does not hold for all securities. That is, it is not always the case "the more time to maturity, the greater the uncertainty." For securities where the distribution of potential prices is actually a negative function of time, or varies with time, there is no clear role for increased time in enhancing option value. The uncertainty effect disappears.

For example, if the underlying security were a risk-free bond, the effect of an increase in time is not clear. It has been observed that the volatility associated with such a bond tends to increase at first, then decrease over its life. As the bond approaches maturity, its price horizon is known with greater certainty. In other words, the partial derivative of the variance function with respect to time changes signs. It is not clear how a European option written on this bond would react under a longer time to maturity.

¹⁴ An American option can not possibly decrease in value with increased time to expiration for the simple logic that an American option with term $T_1 > 0$ can be thought of as including any European or American option with term $T_2 < T_1$. Hence, it must be worth more.

Dividends

Since option holders do not receive cash dividends, but share holders do, any cash disbursements made during the term of the option should reduce option value.

Increasing Input Parameters	Effect on	
	Call	Put
1. Current Stock Price	↑	↓
2. Volatility	↑	↑
3. Interest Rate	↑	↓
4. Exercise Price	↓	↑
5. Time to Expiration	↑	↑
6. Dividends	↓	↑

Table 3.1

Effect of increasing input parameters on
call and put option values

General Interpretive Framework

The model takes the current stock price as a sort of "reference point," and applies a rate of change (volatility) for a certain amount of time (term of the contract) to reason a current option value. The three parameters mentioned - current price, volatility, and term to maturity - can be thought of as one set of operators on value, capturing the sort of "likelihood and size" of the upside potential that the option holder has bought. This is the "benefit side" of the equation. On the other hand there is another set of operators on value - exercise price, interest rate, and term to maturity. These represent the present value of the required outlay. This is the "cost side" of the equation.

Notice that there is a time measure included in both "sides" of the equation. On the benefit side, the longer the term to maturity, the more time the volatility has to act to possibly drive up stock prices in the case of a call (or drive them down in the case of a put). In other words, the investor is betting on a severe one-directional stock price movement. The time, in this context, works to the investor's favor. The longer he/she

waits, the more likely he/she is to see, at some point, the price radically change. On the cost side, the time also works to the investor's favor.¹⁵ The longer the time, the lower the present cost of exercising. In other words, the same exercise price either delayed further into the future (term increases) or discounted more severely (interest rate increases) translates into lower overall cost, and hence a more valuable option opportunity. Hence, time operates on the one hand to gauge how long the stock price is exposed to volatility, and on the other hand to discount the exercise price. In fact, by looking at Equation (3.6), the $(t_* - t_0)$ term appears only multiplied by the interest rate r or the variance rate v^2 . Algebraically, an increase in the term to maturity has the same effect on the value of the option as an equal percentage increase in both r and v^2 . (Black and Scholes, 1973) This is an algebraic representation of what I have described above as the benefit side (through v^2) and the cost side (through r) of the call option value equation.

Assumptions

In their original paper, Black and Scholes (1973) assume various "ideal conditions" in the market for the stock as well as the option (Black and Scholes (1973) and Black (1988)):

1. **Interest Rates:** The short term interest rate is known and is constant through time.

¹⁵ Again, this is in the case of a call. In general, the opposite applies to a put.

2. **Stock Price Distribution and Volatility:** The stock price follows a random walk in continuous time with a variance rate proportional to the square of the stock price. There are no price "jumps." The end of period distribution of prices is hence lognormal. The variance rate of the return on the stock is constant.
3. **Dividends:** The stock pays no dividends or other distributions during the option term.
4. **Contract Type:** The option can not be exercised prior to maturity ("European" contract).
5. **Borrowing and Lending:** It is possible to borrow without restrictions at the (risk-free) short-term interest rate.
6. **Transaction Costs:** There are no transaction or trading costs in buying or selling the stock or the option.
7. **Short Sales:** There are no penalties for engaging in short selling, such as margin requirements. That is, an investor who sells a stock or option short will have full use of the proceeds and will receive any returns from investing these proceeds.
8. **Taxes:** There are no differential taxes. Investors do not have differing tax considerations.
9. **Information:** All investors have access to equal information. There are no inherent and permanent information asymmetries.
10. **Divisibility:** All shares of all securities are infinitely divisible.
11. **Early Termination:** There are no events, such as takeovers, which may prematurely terminate an option.

Some of the above assumptions, specifically (6) - (10), may be grouped under the assumption of general efficiency or "frictionless markets." (Trigeorgis, 1986) They essentially imply that there are many traders capable of trading as frequently as prices change at virtually zero marginal cost and without differential restrictions. The market is efficient and operates continuously.

The assumptions of smooth price movements with constant variance (volatility) in (2) implies a lognormal price distribution. The lognormal distribution is characterized by the asymmetric truncation of values at zero, capturing the limited liability associated with securities. That is, the lognormal distribution assigns a zero probability to negative

stock values. While the lognormal distribution does not capture the observed variation of stock volatility over time, it is a distribution often associated with stock price movements.

Basic Properties and Observations

There are some basic properties which option contracts, option markets, and even prices on underlying assets exhibit. These properties are quite helpful in identifying analogous markets or situations where applying options valuation methods and logic may be appropriate.

Options can not have a negative value to their holders ($C_i \geq 0$).

Representing a right but not an obligation, options will only be exercised when their value is a benefit, not detriment, to the holder. The fact that an option's value is "truncated at zero" is a fundamental character of options, and give rise to much of their value as hedging or insurance vehicles.

Options will be priced so that immediate arbitrage profits do not exist.

That is, options will not be priced in a way which would allow simple profits through immediate exercise. For example, an American call option on a \$100 non-dividend paying stock, with an exercise price of 90\$, must be sold for at least \$10 (i.e. if $S=\$100$, $X=\$90$, then $C_0 \geq \$10$). In other words, the value of American calls and puts can not be less than their in-the-money value. Of course, this property would not hold for a European option contract since the holder can not exercise immediately and capture these simple profits; European options can only be exercised at maturity.

Given otherwise identical put options, an American option must be worth at least as much as a European one.

The intuition is that an American option can be thought of as a European option *plus* the right to early exercise. This right (but not the obligation) to early exercise must have some non-negative value, making the American contract at least as valuable as a European one.

Merton (1973) showed that the above is true for a put option contract, where early exercise may have a significant positive value. For example, if the stock price falls almost to zero, and the probability that it will rebound above the exercise price is negligible, Then it may be advantageous to exercise early so that the exercise price will be received sooner rather than later, earning the investor the interim interest.

Merton (1973) also showed that the value of an American call option is always greater than the value it would have if exercised immediately. In other words, American call options are always worth more alive than dead. The reasoning is that as long as you hold the option, you can always capture the upsides, should the stock boom, but you are protected from the downside. Hence, as long as no dividends are paid, the call option holder should wait, in effect to allow the action of volatility to work on the asset longer, and be positioned to capture gains while being protected from the losses. Thus, a rational investor would wait till maturity to exercise, when the value of an American call option is the same as a European call option.

A fundamental relationship between calls and puts must hold as follows:

$$3.9 \quad C = S - \frac{X}{(1+r)^t} + P$$

Put-Call Parity (for European Options)¹⁶

¹⁶ The relation between the value of a call and put option was first noted by Hans R. Stoll, in "The Relationship Between Put and Call Option Prices," 1969.

This relationship arises out of an interesting constraint on put-call prices which Black and Scholes (1973) point out. They show that buying a call and selling a put yields the same return profile as buying the stock on margin, borrowing $Ce^{r(t-t^*)}$ toward the price of the stock. This can be shown by adding the payoff and profit diagrams of a call holder and a put writer. The resultant line represents a leveraged long position in the stock.

The option value does not depend on the expected return to the stock.

As described before, this is one of the tremendous strengths of the options approach to valuation. Two investors need not agree about the future expected return on the stock. Instead, the required parameter is a measure of stock price volatility.

Common stock is at least equivalent to a perpetual call ($T = \infty$) with an exercise price of zero ($X=0$).

Merton (1973) and later Cox, Ross, Rubinstein (1979) identified this condition solely on dominance arguments. In fact, Merton set forth the most exhaustive set of equilibrium restrictions on call option pricing without making any distributional assumptions about stock prices and movements. He appeals to dominance arguments alone.¹⁷

By noticing that essentially the hold on equity though common stock is at least equivalent to holding a fictitious call with perpetual term and no exercise price, the above observation then is quite intuitive. It is also interesting to note that a call option with the above terms, $T=\infty$ and $X=0$, has to be more valuable than any other call on that stock

¹⁷ Dominance arguments formalize the intuition that (1) more is better than less, and (2) now is better than later. Given two portfolios, A and B, with returns R_A and R_B respectively. Portfolio A would be dominant over B if over some given time interval $R_A \geq R_B$ for all states of the world, and $R_A > R_B$ for at least one state of the world. In equilibrium, no dominant nor dominated security could exist. If a dominant portfolio existed, investors' demand would create such a pressure on it as to drive price up to the point that the dominance disappeared.

since it has the maximum T and minimum X a call option could have. Hence, one can further observe that,

$$3.10 \quad S \geq C(T=\infty, X=0; S) \geq C(T, X; S)$$

That is, the stock price must be greater than any the price of any call option on that stock.

Distortions

When tested against market data, the Black-Scholes model performs quite well. However, the model has several patterned differences to market prices.¹⁸ The model tends to overprice (1) options on highly volatile stocks, (2) long term option contracts, and (3) marginally "in-the-money" options.

On the other hand, the model tends to under price (1) options on very stable, low volatility stocks, (2) short term option contracts, and (3) both deep "in-the-money" and deep "out-of-the-money" options. (Harvard Business School Note, 1986)

Investment Strategies

Options, and other derivative instruments, have become invaluable tools for sophisticated portfolio management. Still, there has been much hesitance by many investors to include options as part of their investment strategy. One reason for this may

¹⁸ See Extensions section for a review of some of the distortions, such as presence of dividends or investment timing delays, that were analytically corrected for with some success.

be the aura of complexity which surrounds the options market, and the fact that highly leveraged options have yet to be accepted into the same risk-reward hierarchy as corporate bonds or common stocks. They are frequently dismissed as highly speculative and unsuitable for any conservatively managed account.

However, the sale of a “fairly priced” call option will simply move the risk-return position of a portfolio along the securities market line. By contrast, the purchase of a call option will increase the variability of the portfolio and increase the expected return accordingly. So the investor is accepting greater volatility (and hence risk) in exchange for higher expected return on the portfolio. In this way, it is possible to adjust the position of a portfolio to reflect the investor/manager’s risk preference.

As compared to positions in the underlying assets themselves (i.e. stocks and bonds), positions in options offer the investor various opportunities. These include:¹⁹

- New and highly flexible patterns of returns
- Tax advantages
- Lower transaction costs to hedging a portfolio
- Opportunities to take advantage of certain information
- Ability to hedge against unanticipated changes in stock volatility
- Ability to hedge against unexpected changes in dividend policy
- Increased leverage in positions in underlying assets.

¹⁹ This list has been partially adapted from class notes from John Cox's Options and Futures course, MIT, 1991.

CHAPTER 4

HOUSING, OPTIONS, AND THE ECONOMICS OF OWNERSHIP

I. OVERVIEW

In Chapter 1, I looked at homeownership rates first from a historical perspective, trying to rationalize how ownership rates have shifted. I also looked at the causes of fluctuating prices and implications to affordability in the housing markets. Finally, I addressed some of the issues which complicate the discussion of price movements - market segmentation, quality changes (Appendix A), and affordability measures (Appendix B). Based on the history of homeownership rates and the fluctuating and segmented state of the market, certain popular strategies were presented

In Chapter 2, I placed these popular strategies into a more general framework. I categorized the *types* of approaches which have been pursued in the housing markets in the past. Questions of the sustainability fairness of redistributive policies were raised. Then some alternative approaches were presented, concluding with some examples of so-called asset-based approaches. These approaches, which have a more fundamental

economic appeal, necessarily involve the trading of housing assets or goods for affordability.

These next two chapters combine the lessons and insights from the first two chapters, with the techniques and option-based observations from the third chapter, to arrive at a new asset-based approach. This approach considers the "unbundling of ownership" in ways which can achieve lower homebuyer costs.

The aim of this chapter is to qualify and understand the mechanisms which would drive the pricing of these unbundling vehicles. It begins with an examination of some of the basic physical, financial, and economic attributes which distinguish the housing good from others in the market portfolio. Next, I examine a set of considerations which every housing consumer must face, part of which is what has been termed the "tenure decision." Specifically, I review the economics of ownership - choices about "bundles" of housing attributes, which bear on the tenure decision. This leads to the question of how can we allow each consumer to make those choices more efficiently using asset-based, unbundling vehicles. So while this Chapter motivates the general unbundling approach, Chapter 5 looks at how specific vehicles may be priced.

In Section V, I give some examples of how the options framework has been applied, and unbundling has occurred, in other real estate settings. In section VI, I discuss how appropriate the options analogy is, with its implicit assumptions, in the real estate arena in general, and housing markets in particular.

Several topics related to the developments in this chapter appear in the Appendices. In Appendix C, I review some of the findings from the hedonic literature on housing values, in order to understand the analytical components of prices and price changes. Analysis of the process of price appreciation, and the related home improvement decision.- two major elements underpinning the valuation of options in housing - appear in Appendix D and F respectively.

II. CHARACTERISTIC ATTRIBUTES OF HOUSING GOODS AND MARKETS

Housing goods and markets have some distinguishing attributes, which can complicate the application of many financial models in housing:

Durability and Depreciation: The housing good is more durable than most other goods. Lasting easily over 50 even 100 years, it must survive shifting functional standards, changing consumer demands, evolving technologies and tastes. There is a certain perpetuity associated with the housing good, partly from durability, and partly from the high transactions costs of moving. This bears heavily on both the production and consumption/investment parts of the market.

Depreciation is partly a fictitious creation of a tax system and partly a measure of physical and functional obsolescence.

Spatial Fixity: There is a unique locational choice that is embedded in a housing good, that may in fact have little to do with the unit itself, but the land it sits on or its environment. "Housing services" are a function of this locational choice. Most of the locational value is reflected in the land price.

Adaptability/Malleability: To a great degree, a house's attributes can be retrofitted and changed over its life. Malleability is partly a tool to reverse the depreciation. But also, it allows the housing good to be improved. Malleability may be thought of as allowing physical value enhancement. This is fundamental to its "option-like" character. This character also mitigates the depreciating element since the commodity can somewhat grow and change, and be improved. In fact, part of the value of this life-time flexibility is reflected in the up-front price.

Investor/Consumer duality: Housing is a compound good. Every household is both investing in the housing market and consuming services from it at once. Likewise, every housing unit is both a consumption good as well as an investment vehicle.

On the one hand, houses yield service flows to the consumer with respect to shelter, living space, public services, and a sense of community. At the same time, housing can play a significant role in an individual's portfolio of investments. In a changing economy, the role of housing can shift from a durable good yielding a flow of services to an investment vehicle yielding a flow of returns.

In fact, between 1970 and 1980, the investment value of the single-family home became more evident to both the housing consumer and the investing public. Data from the Federal Reserve (from Balance Sheets of the U.S. Economy: 1945-1982, 1983) shows that investment in owner-occupied housing as a percentage of total household assets increased from 14.9% to 18.9% from 1970 to 1980. (Dale-Johnson, 1983) This shows that as the real price of housing increases, returns on housing assets outpace inflation. At that point, housing has not only consumption value as shelter but investment value as well. For the most part, the "investment" value of housing is not incorporated into hedonic models. (See Appendix C)

Capital Intensive: Housing is perhaps the single most consequential consumer decision. Housing costs have historically accounted for 25-50% of household consumption budgets. It also comprises an appreciable portion of households' investment portfolios.

Centrality in the Economy: Housing is a major claim on wealth not only in the context of household portfolios, but in terms of the dominant role housing has in the market portfolio. Housing may reflect as much as 40% of the market portfolio.

Local Role: Housing contributes in a profound way to neighborhood security, community identity and well-being, and urban stability. It is in an entire neighborhood social and physical context, that is of utmost importance. The "local" nature of housing also gives rise to informational asymmetries. That is, local investors may have an informational advantage.

Universality: One way or another, everyone consumes housing goods or participates in the housing markets - by renting, owning, even squatting.

Regulations: There are various regulating elements in the housing markets - formal, informal, public, and private. For one, there is a heavy presence of government in housing markets. Other regulatory mechanisms include zoning and other land-use regulations, building codes and standards, union involvement, environmental restrictions, tort laws, rental laws, etc. Persistent public intervention has long kept housing from being a pure free market .

Taxation: Housing is a major financier of municipal agendas - schools, social services, police and fire - via its tax status. It both enjoys a unique tax treatment, and heavily impacts fiscal treasuries.

Limits and Biases in the Data: Housing data is susceptible to biases in measurement as well as interpretations. (appraisal bias, etc.) Often data is either scarce, very localized, or otherwise questionable.

Hedonic methods have been used to deal with both the general lack of repeat sales data and problems with "aggregation." Pricing indexes and synthetic sales series have been constructed using hedonic methods. (See Appendix C)

Heterogeneity: Unlike financial assets which tend to be standardized and homogeneous, real assets tend to be non-homogeneous. Each building is both physically and financially different from the next. In housing studies, heterogeneity is usually either assumed away or dealt with by segmenting the market and disaggregating the data.

III. CONSUMER CHOICES IN THE HOUSING MARKET

There is a set of *choices* which a *consumer* in the housing market must face - choosing between housing prototypes, legal forms, and contractual arrangements. These choices are made under conditions of personal, financial, and informational *uncertainty*.

I see the housing good as a *bundle* of rights along with a sense of place where households settle. *Households* are the basic consumer in the market for housing goods. They seek a *claim* to shelter, land, and community by bidding under conditions of uncertainty and both consumption and investment intentions.

In fact, there is an entire continuum of claims bundles together in physical and legal forms. Over the years, a variety of physical prototypes have evolved, along with creative legal forms and contractual arrangements, to expand consumer choices in the housing markets. The *tenure decision* is a choice between various claims.

These claims can be classified according to the criteria listed below:

- Title
- Possession
- Time frame
- Maintenance Responsibility
- Taxes, Insurance and Transaction Costs
- Extent of Financial Liability

- Allocation of Tax Benefits
- Right to Appreciation
- Right to Positive Cash Flows
- Control in Immediate and Extended Community
- Access to Community Services
- Degree of privacy
- Claim on Common Property
- Responsibility for Dues, Fees

In its most general form, I think of the the tenure decision as one which describes both a legal and financial "relationship" as well as a physical "place." Examples of the "relationship" are squatting, renting, leasing, time-sharing, or owning. Examples of the "place" are apartments, dormitories, condominiums, co-ops, town-houses, planned communities, assisted living quarters, as well as single family attached or detached houses.

This list of claims on housing is by no means complete. As consumer needs and trends periodically shift, various imaginative combinations and obscure sub-categories of claims on housing emerge. Hence, these are just part of a greater continuum of claims on shelter, land, and community.

What distinguishes the various claims can be interpreted in financial, legal, or economic terms. In a financial sense, housing may be though of as a bundle of *assets and liabilities*. Financially, housing is an investment good where prices reflect a valuation of an opportunity for present/future and positive/negative cash flows. In a legal sense, one may think of a bundle of housing *rights and responsibilities*. In an economic sense, housing may be thought of as a bundle of *goods and services* . Economically, housing is a consumption good where prices represent a valuation on a package of physicalities and amenities.

In all these interpretations - financial, legal, or economic - housing is a "packaging" of attributes with, individually, both negative and positive value. Different packages of attributes constitute different valued claims. The market price, to some degree, is an embodiment of this packaging.

Renting vs. Owning

Two more specific bundles have been traditionally termed "renting" and "owning." In the context of the discussion above, no two owners and no two renters are holding the same bundle of goods. Still, Table 4.1 on the next page highlights some of the characteristics traditionally associated with each:

IV. ECONOMICS OF OWNERSHIP

As discussed above, claims on housing - shelter, land, and community - can take many forms. One of the most elusive and critical questions which arises from this is, how do we distinguish ownership from other claims on housing? What is the unique bundle of rights called "ownership?" In this section, I approach the fundamental question of which rights constitute "ownership," and then motivate the idea of unbundling them. Then, I classify various embedded options based on whether they unbundle easily and trade favorably.

The Notion of Bundling

In economic terms, markets for heterogeneous goods are often thought of in terms of consumer preferences and budgets, and the availability of choices. When consumers,

Owning	Renting
<u>Positive</u> Can Capture Appreciation	<u>Positive:</u> Fixed/Known Costs of Housing
Use of Tax Benefits Interest Deductions Property Tax Deductions Depreciation	Low Entry Cost Save Down Payment
Security in Tenure	Lower Maintenance Costs
Use of Leverage	No Taxes, Insurance, Transactions costs
	Flexibility in Moving Low Exit Costs
<u>Negative:</u> Exposed to Real Depreciation	<u>Negative:</u> Lack of Security in Tenure
Down Payment Requirement High Entry Costs	Less Control with Neighbors and Community
Variable Housing Costs	No "Wealth" Gains
Transaction Costs (points, processing fees, title insurance, etc.)	
Less Mobility High Exit Costs	
Additional Expenses Property Taxes Maintenance Insurance	

Table 4.1

Characteristics associated with renting and owning.

facing their individual budgetary constraints, are given "baskets" of goods to choose from, they act by maximizing their utility within their constraints. Their constraints are at least budgetary, but other constraints may exist as well.

For example, if the market inherently required that good A could only be purchased together with good B, that would be a further constraint on consumers. This would leave consumers with fewer choices, or less flexibility. Whereas there were N baskets

to choose from before, there would now be $N-1$ baskets since good A and B are effectively one basket. One degree of freedom has been removed. Bundling constraints hence do not allow the consumer to reveal preferences on individual attributes. That is, by bundling the goods, consumers' choices are reduced, and their ability to maximize utility is limited. In this way, bundling limits the efficiency of the market.

Bundling of goods in the housing market may have some undesirable effects. Home buyers are paying for *more* than they really want. That is, there are certain embedded rights included in the pricing and packaging of a home, which were bought more because of market bundling than consumer choice. These embedded rights, or "options," result in premiums, embodied in the market price, which the consumer can not separate at the point of purchase or thereafter.

For example, the market price on a particular house may reflect the potential to put in a pool, because of the site size, layout, and local popularity of pools. This house may be worth more than the identical house next door which, for whatever reason, does not have the potential for a pool. Consumers must pay for this flexibility. The owner of the first house has an embedded choice, whether to put in a pool, a choice which the neighbor does not have. The market implicitly prices for this added flexibility on the first home. Whether or not the purchaser of this home plans to put in a pool or not, he/she will pay a premium for the *flexibility to chose*.

In some cases, these premiums may, unintentionally, be keeping the marginal home buyer from purchasing his/her marginal home. If consumers could somehow "detach" these embedded options and sell them separately, housing packages and costs may be better controlled. That is, homebuyers can better chose their housing claim by selling off those embedded housing options they do not want. This would also effectively reduce their cost of carry.

In the production end of housing, the manufactured housing sector has already recognized the possibilities of unbundling consumer choices. (See Alternative Housing

Products Section, Chapter 2) Consumers are given various "options" at the production stage to allow them to custom construct their ideal home. Since 1985, we have witnessed the dramatically increased popularity of the custom manufactured home. (Maddock, 1989) Buyers are given various choices of floor plans, materials, spatial dimensions, and other built-in optional features. In other words, we have given the consumer "options" on the production portion of the process through the custom-designed, mass-produced, modular home.

Why couldn't we provide financial back-end options to allow the homebuyer to decompose the existing unit, post-production, into those elements he/she wants. This would complete the unbundling capacity of the housing markets - physical options at the production stage, and financial options thereafter.

Hence , in this section I have interpreted the affordability issue as a structural problem in the way homes are "packaged." A study of actual cost/price time series data versus the implicit hedonic variables (such as these rights or "embedded options") may reveal the possibility of a new strategy to make ownership more affordable. Options Valuation Theories may be used to price these rights, and to quantify the market inefficiencies caused by bundling.

Identification of the Asset

One issue is to identify what it is, exactly, that home buyers are wanting to buy. Are they buying a consumption good or an investment opportunity? In other words, are they in the market for a package of attributes to consume - bedrooms, bathrooms, location, quality, historical worth, public services? There has been much work in the hedonic literature which takes this more physical approach to the pricing of homes. (See Appendix C) Or are they in the market for an opportunity to invest in appreciation, or

achieve equity returns? (For example, see Alberts and Kerr (1981), Case and Shiller (1990), Hendershott and Hu (1981), and Dale-Johnson (1983, 1984)) And finally, are there efficient mechanisms which can allow consumers to make these choices themselves? Can consumers somehow be enabled to package their own housing "bundles?" This is what I examine further in this and the following chapter.

Home Ownership: What Is It?

One way to decompose the idea of home-ownership involves breaking down the home into physical amenities, some of which are standard or minimal, while others are optional or luxuries. This is essentially what much of the hedonic literature has done. (See Appendix C)

The hedonic literature typically prices homes in terms of implicit prices on micro-attributes, most of which are physical in nature - bedrooms, bathrooms, fireplace, type of materials, fireplaces, landscaping, etc. Some of the hedonic attributes involve the neighborhood character - historical prestige, proximity to a desired node, presence and quality of public services, etc. Depending on the specification and functional choice of the model, and the coherence of the underlying data, hedonic studies can explain anywhere from 70% to 90% of the variations in observed prices. The hedonic literature, for the most part, does not explicitly treat the presence of embedded options.¹

Suppose we assume that homes are not only the aggregate sum of physical

¹ The hedonic literature may have *implicitly* captured the option component to housing prices. That is, if one could identify those physical attributes which most capture the option character, a hedonic regression should reveal higher coefficients on these variables in housing settings that are rich in options. (This was pointed out to me by William C. Wheaton.) For example, in communities which neighbor large urban universities, students may often rent as "boarders" in single family homes. Suppose a hedonic regression were performed with "the presence of a second kitchen" as a dummy variable, which captures the "option to convert to boarding house." One would expect that the coefficient on the second kitchen variable would be higher in these communities than others, in which there is no potential for boarders. So the coefficient on the second kitchen variable in the university community may reflect both the inherent value of having a second kitchen plus the option to rent which it represents. So the option character may be captured in the hedonic regression.

amenities, but rather physical amenities plus embedded options². These options, which may add calculable increments of value to the home, have been inseparable from the housing “package” thus far - they are included in the market price. If these rights can be identified, valued, and separated from the home itself, homes may be made more affordable. Homeowners may be allowed to purchase these options only when they plan to use them, not sooner. In other words, it may be that home-buyers may have been denied an opportunity to choose which options they want, how much they value them, and when they wish to exercise them.

Rights of Ownership

The ownership of real estate may be embodied by seven basic rights:³

- **Possession:** Right to use and modify
- **Access:** Right to enter and exit
- **Disposition:** Right to sell
- **Encumbrance:** Right to encumber or give away
- **Rent:** Right to receive rents
- **Privacy:** Right to privacy or "quiet enjoyment"
- **Do Nothing:** Right to do none of the above

The various legal, contractual, and physical forms of ownership grant different degrees and combinations of these basic rights. For example, in the planned community form of ownership, there is often a community association which, to some degree, changes the level of both **access**, and perhaps **do nothing**. The planned community may have a private network of access roads, walkways, and easements which the community controls more so than the individual homeowners. There may also be a gated, secured entrance, which can limit **access** but enhance **enjoyment**.

In a condominium form of ownership, some of the responsibilities of **possession** are shifted from individuals onto the condominium association. Common area maintenance and capital replacements (water heater, roof) are generally paid by the

² Some of these may in fact be an option to buy a physical amenity in the future.

³ This listing of ownership rights was suggested to me by Marc Louargand. They were used as part of a study of housing opportunities in Poland.

association through the collection of fees.

In a cooperative, **disposition** may be limited as well. A cooperative association can control new entrants into the co-op, which on the one hand can enhance **privacy**, by excluding "undesirables. On the other hand it can hamper **disposition**, by denying potential sales. The fact that the condominium form has been more popularly received and more widely employed than the cooperative form suggests the high value many owners place on their **disposition** rights.

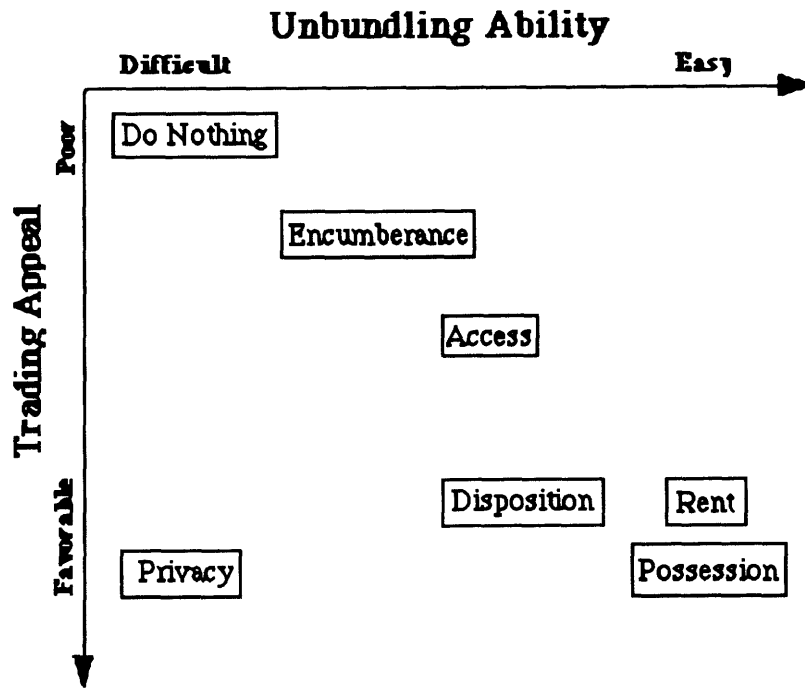
In historically zoned districts, there are both positive and negative forces on the owners' right of **possession**. Individual owners may be heavily restricted in the improvements that are permitted (colors, materials, etc.). At the same time, owners benefit from an added sense of predictability in knowing the neighbors are restricted in the exact same way. This tension between the positive and negative externalities of historical zoning has been termed "reciprocity."

Figure 4.1 sorts out these rights associated with ownership by how feasible it is to unbundle and trade them. For example, the right of **privacy** has considerable trading appeal - people go through much effort, and pay generously, to secure their "quiet enjoyment." For many, the ideal of privacy may constitute much of the appeal of ownership. However, there are obvious limitations to unbundling privacy. Rights of **access** are somewhat tradeable, and somewhat easy to unbundle, in the case of easements, private roadways, walkways, etc. Most notably, the rights of **rent**, **disposition**, and various rights associated with **possession**, lend themselves most to unbundling and trading.

The seven basic rights presented in Figure 4.1 can be broken down further to reveal many embedded options. Actually, each one of the seven rights - possession, access, disposition, encumbrance, rent, privacy, and do nothing - may actually represent a whole range of embedded options. The following section explores some of the possible embedded options.

Figure 4.1

Matrix of Ownership Rights: Unbundling Ability vs. Trading Appeal



Embedded Options: Some Examples

A question which remains is *what* ownership options to sell, and to *whom*?

Possible examples of these “embedded options” are:

- The option to increase the home’s square footage by a certain amount.
- The option to remodel (to some measurable extent).
- The option to convert the garage into an office, a studio apartment, etc.
- The option to add a second, or third, floor.
- The option to build on top of the garage, for example, a guest house.
- The option to put in a swimming pool.
- The option to rent, or sublet, a certain portion of the home, or the entire home.
- The option to the oil reserves beneath the land known as “oil rights.”
- The option to subdivide a lot, or otherwise sell a portion of it.

While many embedded options exist, the question is whether they may be unbundled and traded. Figure 4.2 classifies various options according to how feasible it is to unbundle them and how appealing it is to trade them. Most of these embedded options are on the right of **possession**. (See Section on "Rights of Ownership" above). Embedded options on the rights of **rent** and **disposition** are included as well.

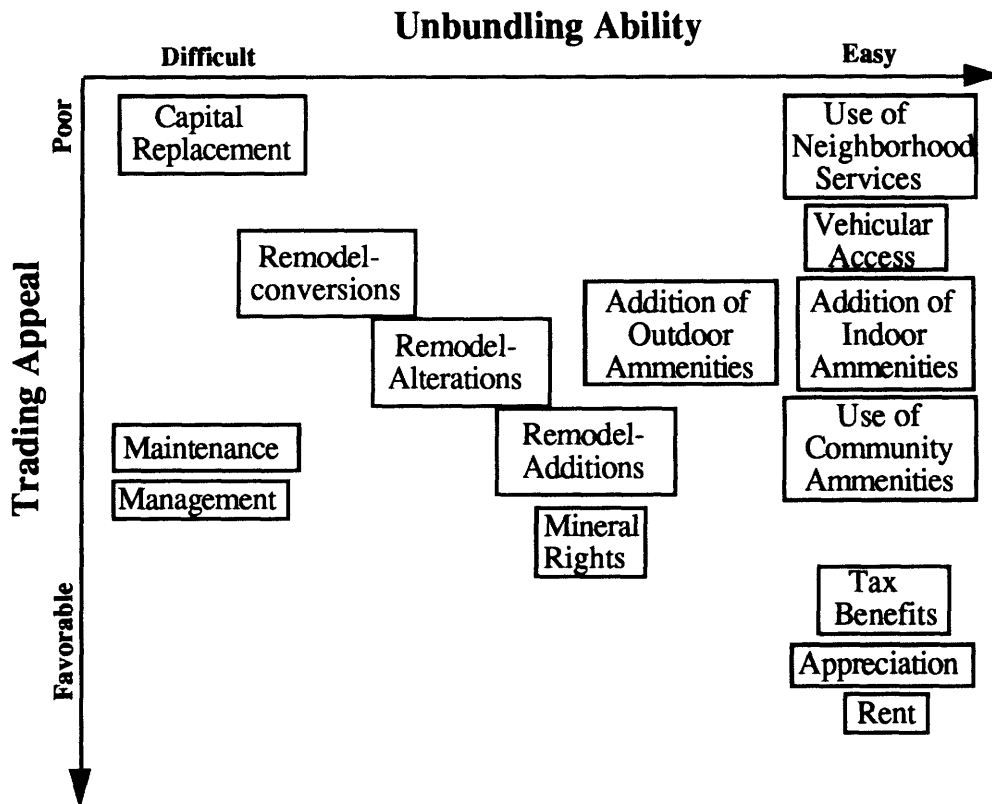


Figure 4.2

Examples of Embedded Options.

From this Figure it is evident that the option to receive tax benefits, appreciation, or rent, are most likely to underlie an options instrument based on their ability to be unbundled and traded.

Syndication Analogy

This unbundling reasoning may be reminiscent of the syndication movement in the 1970's and 1980's, whereby certain tax incentives were partitioned and sold, making otherwise marginal deals more attractive. These arrangements created value simply by "disaggregating and packaging" portions of a deal.

Actually, there are several fundamental differences between unbundling embedded housing options and unbundling tax benefits. One fundamental difference is the true arbitrage character of capital markets which is absent in the sale of tax benefits. Tax benefits are mostly defined at the outset of a project, at least to the extent that pro-formas hold and tax rules do not change. Whether the benefits involve interest deductions, or depreciation, the "value" is not subject to severe fluctuations. On the other hand, as I have shown, prices in the housing markets exhibit considerable volatility.

There are various reasons why tax benefits have not had a surviving popularity. Though they may be easily unbundled, as the syndication experience proved, they may not always have trading appeal. One reason for this is that tax benefits can be swiftly lost by changes in legislation (i.e. Tax Reform Act of 1986), tax code interpretations, or changes in accounting standards. An asset whose value can be so randomly terminal has poor market trading appeal. The motivations for the syndication movement were more idiosyncratic than economic in nature. It was an idea driven more by a set of rules than fundamental economic elements.

The only similarity between syndications and these proposed home-options is in the basic premise: If you have no use for something, it makes economic sense to sell it to someone who does. Unbundling allows consumers to do so.

Securitized Mortgage Pools

More recently, unbundling approaches have been used with much success in the secondary mortgage market. The unbundling of mortgages has taken place on several levels. On the one hand, portions of the mortgage delivery *process* - origination, underwriting, and servicing - have been unbundled. Also, the mortgage payment streams themselves have been unbundled, to allocate the risks and returns associated with the mortgage pools more efficiently. Not only have the interest payments been separated from the principal payments, but different "tranches" of the mortgage term have been separated as well. So, using what has been called collateralized mortgage obligations (CMO's) investors may, for example, buy only the principal payment in the last 5 years of a 30 year mortgage pool. These instruments have allowed the income profiles to be unbundled and traded in various creative and efficient ways.

V. OTHER OPTIONS IN REAL ESTATE

The notion of "selling the right to make a future decision" may be one of the fundamental building blocks in real estate. Hence, there are many examples of situations where the option valuation techniques and logic may be useful in a real estate context. In most of these cases, other market mechanisms have been used to price these "options." In some, as with mortgage pricing, options have already begun to be used. Some examples follow.

Real Estate Development Rights

There are several situations in real estate in which development rights, or "the option

to develop," is being priced. One is in the case of transferrable development rights. The other is in the case of a long term lease, which several observers have compared to a fee simple ownership in land less the development rights.

Transferrable Development Rights:

Transferrable development rights (TDR's) are really land-use options where the spatial fixity associated with land has been relaxed. In other words, the option to redevelop is bought from one parcel and sold to another. This technique has been used as a planning tool as well as a way to generate yet control development.

Purchased development rights (PDR's) have been used as an alternative planning tool where other efforts have been frustrated. They have been employed as an alternative to other, more traditional, attempts to maintain lands in agricultural use. Tax incentives have failed largely because developers are able to "outbid" the IRS's small tax break gestures. Legislative approaches, primarily through zoning, have been frustrated by political pressures to re-zone on the one hand, and legal challenges from the private sector on the other. Also, farmers have not been receptive to agricultural zoning, in that it restricts their use of land without compensation. (Daniels, 1991) PDR's are a way to deliver that compensation.

PDR programs are particularly popular around Northeastern urban fringes, to deal with intense land conversion pressures.⁴ Under these programs, development rights of agricultural lands are bought in order to to maintain public control of the use of agricultural land. The farmer voluntarily sells the development rights (or "conservation easement") and receives compensation consistent with the restrictions placed on the land. Technically, the farmer retains title and possession, can sell or otherwise mortgage the land, but the use is restricted to farming and open space. All other

⁴ Also see Capozza and Sick (1991). They combine a capital asset pricing model with spatial urban land pricing model to describe land conversion pressures.

"options" have been effectively sold.⁵

Obviously, valuation of such instruments has been very difficult. Appraisals of fair value must evaluate the probability that the zoning ordinance will allow certain non-farm uses, since zoning severely limits development potential and governs option value. Development rights may cost as much as 85% of the fee simple value, which may exceed the value under its present agricultural use. Most cases are eventually valued by a combination of appraisals and negotiations.

Two strengths mentioned about PDR programs, which are likely to contribute to their proliferation in other states, are their fairness to farm owners, and their permanence to the public as far as the preservation of space is concerned. As planning programs to preserve agricultural land spread to Georgia, Oregon, Hawaii, Wisconsin and Florida, there may be an opportunity to employ options valuation methods to price these development options.

In the PDR context, Daniels (1991) points out elements quite coincident with the options framework: "A landowner's property rights are often compared to a bundle of sticks, with each stick in the bundle representing a separate right. Each right may be used or disposed of separately. For example, the bundle of rights includes mineral rights; the right to sell, lease, or mortgage; surface rights; air rights; and development rights."⁶

Long Term Leases: Another example where the option pricing character of development rights appears is in the valuation of long term leases. It has been suggested that the long-term leaseholder's interest is like fee-simple ownership less the option to develop. (See Capozza (1991) and Capozza and Sick (1991) for a contingent claims

⁵ Notice that PDR's are slightly different from TDR's mentioned above in that the rights do not become transferrable and sold. They are generally retained by the state or local public authority.

⁶ Also quite similar to the present housing proposal, Pennsylvania allows farmers to buy back their rights to develop, if after 25 years the farm is no longer viable due to neighboring non-farm uses. The landowner can buy back the development rights at the original price plus appreciation.

analysis and compare to Jones and Roach (1989) which is a present value approach)

Real Estate Ownership Forms:

There are many legal, contractual, and physical forms of housing ownership, and different bundles of rights associated with each. One way to distinguish between these forms is to look at an implicit exchange of options.

Condominiums, Co-ops, Planned Communities: For example in both the condominium and the co-op forms, certain "rights to decide" are transferred from the individual owners to a collective body, an association of owners.

Essentially, individual owners have sold certain rights or "options" to the community association. Though it has not been empirically proven, it is suspected that otherwise identical units should sell for lower prices in the cases where options have, in theory, traded hands. So, two physically identical units, in the same location, held under different forms of ownership, should exhibit a difference in price to reflect the implicit exchange of options.

The existence of externalities complicates an empirical test of this proposition. On the one hand the placement of restrictions should reduce value consistent with the sale of future "options." On the other hand since the restrictions apply to neighbors as well, overall value may be enhanced. In a sense, the individual gives up in personal freedom what he/she gains in control over the neighbor. These two competing effects would be tricky to separate empirically.

By positing that, holding all other determinants of value constant, a home in a restricted community should be cheaper than one in an unrestricted community, I have implied that the loss in value due to the disposition of options exceeds the gain through

reciprocity⁷.

There seems to be no clear agreement in the housing and urban economics literature regarding this point. (See Appendix E) For example, in the case of historical districting, which place substantial restrictions on land-use, opinions in the literature have changed over the years.

Real Estate Contracts

There are several examples of real estate contracts which embody an options character. Mortgage instruments are one such example where the application of option valuation methods has already begun. (See French and Haney (1984), and Murphy) The option to prepay is one portion of the mortgage contract which has received much attention. (Hall, 1985) Additional options in the mortgage contract include the option to default, and the option to refinance.

Certain aspects of a retail leasehold contract have also been analyzed in an options framework. Both straight leases and percentage leases have been examined with, for example, the option to receive a percentage of sales. (See Chiang, Lai, and Ling, 1986) That is, the underlying asset in that model, upon which the lease value is contingent, is the volume of tenant sales.

Asset leasing contracts have an obvious options element - the "option to purchase." In these contracts, an explicit price (option premium) is paid to the asset owner for the right to purchase the property at a fixed price by some future date. A direct analogy to the stock call option model can be drawn. (see Brown and Achour, 1984) Another study looked at the option to purchase contract in the case of condominiums, and found

⁷ By the term "reciprocity" I refer to the fact that restrictions on self are reciprocated by restrictions on neighbor. So freedom on an individual level is exchanged for predictability on a community level. (See Appendix D)

that pricing behavior roughly conformed to that predicted by an options model. (See Shilling, Benjamin, and Sirmans, 1985)

Finally, master leases can be viewed in an options framework given the implicit right to sublet.⁸ Through a master lease arrangement, a landowner has hedged himself against some future uncertainties, similar to the options type hedge. He/she has given up upside potential in rents and leasing flexibility in exchange for more certainty with respect to the vacancy and revenues.

Land-Use Rights and Restrictions

In the case of land use laws or zoning ordinances, one may think of home-owners having “sold” certain rights to the city, and “buying” these rights back by paying permitting fees and special taxes. Moreover, home-owners are not at all guaranteed to be able to buy these rights back. The fact that land-use permits are often denied raises questions about the value of the “underlying asset.”

The difference in value between unimproved land, and land with all the necessary plans and permits should partially reflect the value of this option.

Historical Districting and Facade Easements⁹: Historic districting, a specialized form of land-use zoning, has the same economic rationale as zoning itself - to create positive externalities by separating uses and minimizing negative impacts through thoughtful planning. The designation of a historic district in residential neighborhoods, as a planning tool for preservation and revitalization, has grown in popularity. There are 1,200 historic districts scattered nationally, varying in size, effectiveness, and legislative strength and content.

Opinions vary widely as to the possible effects. Concerns include escalating

⁸ This was specifically suggested by Marc A. Louargand.

⁹ This was suggested by William C. Wheaton.

property value, increased tax liabilities, higher rents, and consequent displacement of low-income and elderly (i.e. fixed income) households. On the other hand, historic districting is not necessarily value-enhancing. Historic district, by their very nature, are negative restrictions on development rights. They require special design requirements, lengthy approvals, and meticulous permits. Developers often argue that the zoning imposes a serious amount of functional and physical disutility (Asabere and Huffman, 1991), and increases business risks. The result is a general tension between the positive planning type externalities and the negative development restrictions. (See Appendix E)

Asabere and Huffman found that in Philadelphia, where the historic districting ordinance can be considered relatively mild, non-residential parcels exhibited no significant price differences. That would suggest that the option value removed by the imposition of zoning restrictions was not substantial, or was overwhelmed by the value of the positive externalities.

Considering the vacillation of opinions in the literature on this subject (See Gale 1991 for a non-technical review of this literature), the options methodology may help shed light on the dynamics in this market. While the data on historic districting is troubled by the presence of externalities, historical designation of stand-alone buildings, such as with facade easements, may be free of such interferences. The difference in observed prices between a historically designated building and comparables should reflect the absent "option" to redevelop the facade.

VI. APPROPRIATENESS OF THE OPTIONS ANALOGY TO REAL ESTATE

It is important to evaluate how appropriate both an arbitrage approach or an equilibrium based approach are to the real estate industry, and the housing sector in particular. To some degree, neither is perfectly appropriate.

The arbitrage approach revolves around insights about where arbitrage opportunities exist (riskless profits) and assumes, through dominance arguments and market efficiency arguments to a lesser extent, that such opportunities can not persist. This is how the B-S model, and most options models, are developed. To simplify the analysis, arbitrage approaches assume frictionless markets (i.e. no transactions costs, perfect symmetric information, unrestricted lending/borrowing and short selling). Arbitrage approaches make no references to individual preferences or "utility functions." On the other hand, equilibrium models depend on supply-demand equality, market clearance mechanisms, individual utility functions and budgetary constraints to capture investor preferences. These models are different in both their motivation and assumptions. They are motivated by economic fundamentals and aggregated individual preferences. We must ask: are real estate markets efficient.¹⁰ Is there short selling in real estate? Is there "closure" in the market? Are there asymmetries? How serious are these effects?

Two of the prime elements often pointed to in the housing markets in discussions of inefficiency are the notions of segmentation and immobility. In discussing *immobility* in housing markets, this applies at different levels in the market.

On the consumption (demand) level, there is an immobility in terms of household locational preferences, connectedness to labor markets (wage levels and locational distribution of firms) as well as other transaction costs which households must bear. This makes households less than perfectly mobile.

On the production (supply) level, there is a physical immobility of housing units themselves. Not only is there this "spatial fixity," but there are also zoning and other land-use constraints, not to mention a scarcity developable sites. So, even if units were physically mobile, our present system would resist supply mobility on the premise that the public would lose too much planning control.

Admittedly, the existence of market segmentation, immobility at various levels,

¹⁰ See Case and Shiller (1989) for a discussion of efficiency in the market for single-family homes

heterogeneity of the product, and other causes of "friction" in the housing markets may limit how strictly the options analogy applies.

CHAPTER 5

PRICING MODELS FOR ASSET-BASED APPROACHES

I. OVERVIEW

In Chapter 2 it was argued that most of the approaches to affordable ownership proposed to-date have proven, at least anecdotally, inadequate. Approaches have included a host of public and private programs many of which, one way or another, are redistributive in nature. Examples include reduced rate mortgage programs, linkage fees for land developers, tax credits, construction cost subsidies, and the use of various cost-cutting technologies in construction materials or methods. I presented the manufactured home industry as an example of off-site production as a cost cutting method.

Recently, additions to this pool of approaches have become increasingly "institutional" in nature, whereby the institutional arrangements are examined more attractive "partnerships" are formed. In Section III of Chapter 2 several such examples were give.

With ongoing concern about the long-term prospects for ownership opportunities,

and the sustainability of many proposed programs, new directions must constantly be considered. In this chapter, I present an asset-based approach to unbundling the rights and reallocating the risks associated with homeownership.

II. THE OPTION CHARACTER OF HOUSING

The Six Determinants of Option Value

In order to apply the options methods onto the housing markets, the six parameters which govern option value must be discussed. Finding meaningful analogies to the financial option parameters in the housing setting is particularly challenging. The underlying asset is more complex, movements in "stock prices" and "dividends" are less understood, and meaningful market data is more rare. Also, there is the investment/consumption problem which has been discussed earlier. (See Chapter 4, Section II). Peek and Wilcox (1991) point out that "judgments about the trend, volatility, and determinants of house prices...depend crucially on which price series is used"

Current Asset Price

In the housing context, the underlying asset may be modeled as an option itself. That is, the underlying asset is an American call option on an investment/consumption decision. As I have shown in Section IV of Chapter 4, it may be an embedded option on the right of possession, disposition, or the right to receive rents. The particular options I am interested in are those which are both easy to unbundle and attractive to trade. Figure 5.1 below focuses on those embedded options which fit this criteria.

The "current asset price" is the value of this embedded option at any point in time. This value is in turn reflected by expectations on two components - appreciation and imputed rent.

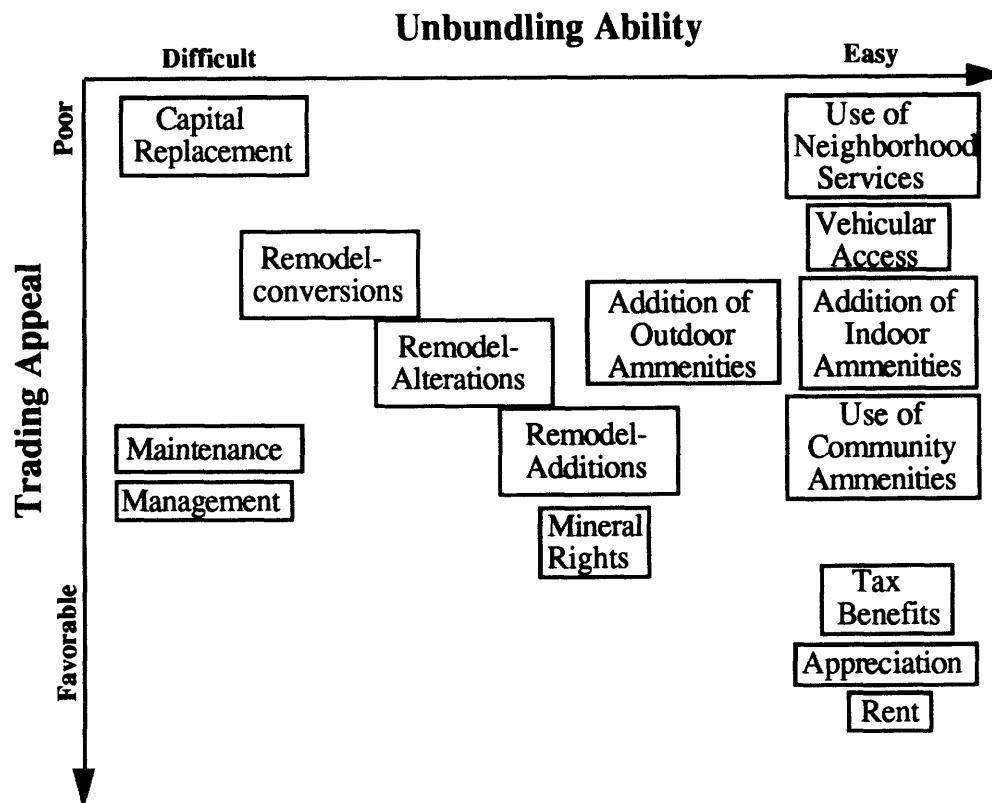


Figure 5.1

Examples of Embedded Options.

The appreciation portion is the incremental increase in market price (ΔV_t) which would be observed were the home to be sold the day the embedded option is exercised, and an investment $X_1 = I_t$ is put in place.

The imputed rent portion, ΔR_t , is a stream of increased housing services. These are additional housing services that the option holder does not receive until the embedded option is exercised. They can continue as long as the ownership does.

The value of the embedded option does not equal the discounted cash flows which are contingent upon exercising since they are not deterministic variables. Technically, the investment amount I_t , the appreciation ΔV_t , and the imputed rent ΔR_t are all stochastic variables. Furthermore, there is some unknown probability function which

describes how likely any of these cash-flows may occur at any point in time.

Volatility

The options approach has been uniquely able to remove return considerations, and hence investor preferences, from the valuation analysis. Unlike present value approaches, it does not require "expected return" as an input parameter. However, it does require a measure of volatility. As I argued in Chapter 3, volatility is a more reliable, stable, and observable parameter, and a better predictor of expected "value."

Volatility in the housing context may be measured by *the variance, over time, of a cross-sectional series of observed changes in prices.*

Ideally, it would be based on a price series on an identical unit (perhaps a repeat price series.) Alternatively, it may be based on the movement of a quality adjusted price index. (See Appendix A for a discussion of quality changes, and Appendix C on price indexes.)

Of course, the volatility is a function of (a) which index is used, (b) what time period is observed, and (c) whether the deviation is with or without regard to "trend." There are several proxies for historical volatility available for the underlying housing asset. Historical volatility on housing prices has been 2-10%. (See Peek and Wilcox (1991) for a discussion of price deviations) For instance, Peek and Wilcox (1991) found that the real growth rates implied by price indices fall into two groups - those that account for quality and those that do not. Those that do account for quality grow significantly more slowly, and their percentage standard deviation of price are about one-half of those implied by quality-unadjusted price series.

As a refinement, O'Keefe and Van Order (1990) suggest using the implicit volatility from historical mortgage prices rather than historical volatility. That is, one can use the options model to solve for volatility, and see what historical volatility would have created those observed prices, rather than calculating historical volatility directly. The use of implied volatility measures instead of historical ones should be applied to the

housing option as well. However, such an empirical effort is beyond the scope of this thesis.

Interest Rate

The interest rate should reflect the opportunity cost (or benefit) of waiting to receive (or pay) the exercise price. It should have a term length similar to that of the option contract, T . As a check, it should be higher than the return on equity, over a similar term, from investments in single-family homes. As an example, Case (1990) predicts that an upper-middle-class homeowner carrying an 80% mortgage might easily enjoy an annual return that is fully 5 percentage points above the T-bill rate.

Exercise Price

There are various exercise prices which are being modeled. The first is the exercise price on the embedded option, which is I_t . In most of the embedded options on "rights of possession," it is the investment required to achieve the ΔV_t and the ΔR_t . In other cases, such as option on the "right to receive rents," it may be zero.¹ In the case of the option on the "rights of disposition" (i.e. receive appreciation) it may also be zero. (See Chapter 4 for a review of these basic "housing rights.")

Time to Expiration

For the most part, embedded options naturally do not expire. Except where they are susceptible to changes in local land-use policy, tax policy, or some form of housing regulation, embedded options are an interminable part of ownership. However, once these options begin to be unbundled and traded, some time boundaries must be introduced.

The time to expiration is purely a contractual parameter, which may vary greatly.

¹ Notice that an option with $X=0$ is worth the market price of the underlying asset. Hence, in the case of options on appreciation, which have the characteristic $X=0$, the expected appreciation stream is the underlying asset, not an embedded American option.

Dividends

The housing option is on an underlying asset that is continuously yielding "dividends" in the form of imputed rents. In the housing context, "dividends" paid on the "underlying asset" are the incremental increases in housing services (ΔR_I) gained by capital improvement (I_t).

Dividends are also included since they may induce an option holder to exercise early. Clearly, foregone ΔR_I can affect the optimal timing decision in the housing setting. For example, in the "option to build a swimming pool" example, the imputed rent may be higher during the summer. In the case of an option on the "right to receive rents," the value may vary with the prevailing rent levels.

Standard Option Input Parameters	Housing Option Input Parameters
1. Current Stock Price	Value of an Embedded American Call Option
2. Volatility	Variance of Price Changes
3. Interest Rate	Interest Rate
4. Exercise Price	Investment
5. Time to Expiration	Time to Expiration
6. Dividends	Imputed Rent Series

Table 5.1

Analogy of standard option input parameters in housing.

Other Option Characters and Considerations

Investment Timing

Options embedded in housing prices have some of the optimal investment timing issues identified in the literature. (See Majd and Pindyck, 1987; and McDonald and Siegel (1986) Also, especially with the options on the rights of possession, there is a

limit to the rate at which the exercise price I_t can be put in place. There are also some irreversibilities associated with the investment decision which limit flexibility, and affect timing.

Finally, there are strategic decisions involved which are often disregarded in standard option models (See Trigeorgis, 1986). The changing nature of information, and the role of new information in future decisions, has some impact on the behavior of homeowners under these options contracts.

Malleability and Durability

Different goods exhibit a different degree of *malleability*. Economists often use the putty-clay image to explain this term. In economics, there is the notion of the "flexibility of capital." In finance, a similar term is the "reversibility of an investment decision." These are different terms to describe the degree of malleability.

For example, in the computer industry, malleability is achieved via the "upgrade path" - whereby certain after-market pieces of hardware may be added to a base machine, without having to purchase a new one every time technologies change. In the automobile industry, malleability may be measured by the availability of automotive "accessories."

Consumers must pay for these economic flexibilities. There are certain up front costs associated with the opportunities to enhance value down the line. The housing good provides a case in point. The malleability inherent in housing is one of the reasons values change, prices fluctuate, and hence the application of options makes sense. There is a great deal of retrofit that can take place down the line. In other words, market prices embody both future flexibility as well as present day utility. One way to think about this present proposal is the sale of options on malleability.

III. THE ASSET APPROACH

In this section, I describe the mechanics of how this Housing-Option market could work, identifying the transactors, and reasoning through their respective investment motivations. For this purpose, I first re-introduce the standard option model, for which much analytical literature exists (See Chapter 3), and then consider ways in which the Housing Option model may be similar or different. Indeed, there are sufficient differences that the standard Option model does not easily apply. In the next section I propose several alternative models for this Housing Option unbundling vehicle. Finally, I price one under some simplifying assumptions.

Standard Option Model

Below is a graphical representation of the standard scenarios involving financial options. These are concepts that were introduced in Chapter 3, but are briefly summarized here in a way to motivate the Housing Option case.

There are two types of option instruments. A "Call Option" is the right to *buy*, and a "Put Option" is the right to *sell*. Figure 5.2 represents a covered² Call Option, whereby the option-holder purchases the right, but not the obligation, to *buy* an asset at some point in the future. It is important to note that the option-holder does not presently own the asset in question, but is paying for the right to buy it for some price (X), by some time (T)³. The price paid for the option today, the "premium," is C_0 . This is the

² A covered position merely reflects that the options writer currently holds the underlying asset in his/her portfolio. An uncovered writer may have to purchase the asset for delivery to the holder on the expiration date, in what is called an "off-setting transaction."

³It is important to note here that the option-holder is paying the premium *for the right to make a decision*. Furthermore, the reason that right is worth anything at all is that it would not otherwise be available. In other words, the option-holder has created a situation which does not easily exist in the market. The option contract fixes a price and a time. The open market does not. The dynamic between

amount that Option Valuation Models, such as the Black-Scholes Model, calculate explicitly.

Figure 5.3 represents a Put Option, whereby the option-holder purchases the right, but not the obligation, to *sell* an asset. There are several important points to note:

- The option-holder is always paying C_0 (or P_0 in the case of a put) for the Option to make a decision in the future. The option-holder is *always the one to make the decision*. The Option-seller must accept that decision.⁴
- The decision by the Option-holder must be made *on or before* time T .⁵ Otherwise, the option expires the asset does not exchange hands.

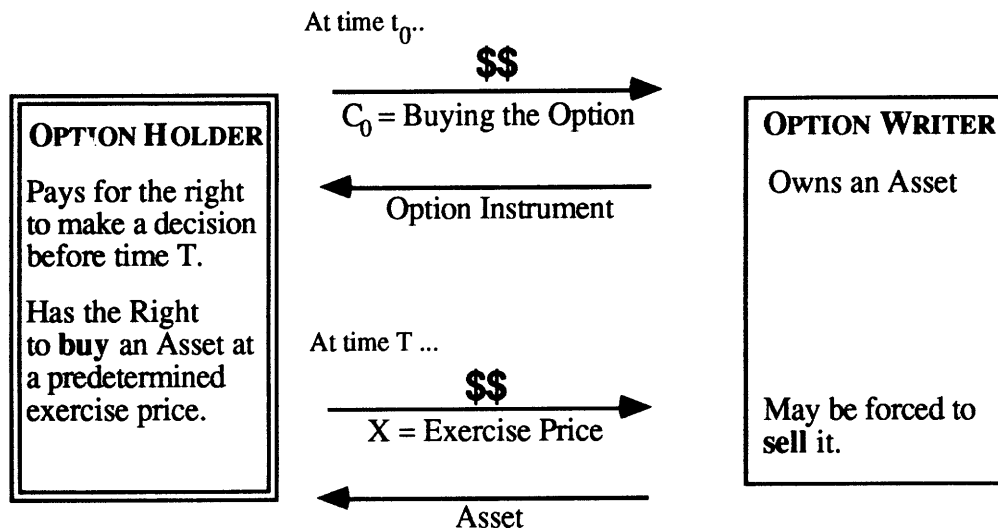


Figure 5.2

Schematic of the standard covered call option.

the fixed option strike price (X) and the current market price (S) is a "barometer" of option value. In a sense, everyone has the trivial call option on goods at the market price.

⁴ In the diagrams which follow, it is important to note who is holding the power to decide (i.e. option-holder, denoted by a double box), for how long is that decision available (T), and is the price fixed (X).

⁵This is the case with an American Option. There is also a European Option which can only be exercised at time T , not earlier.

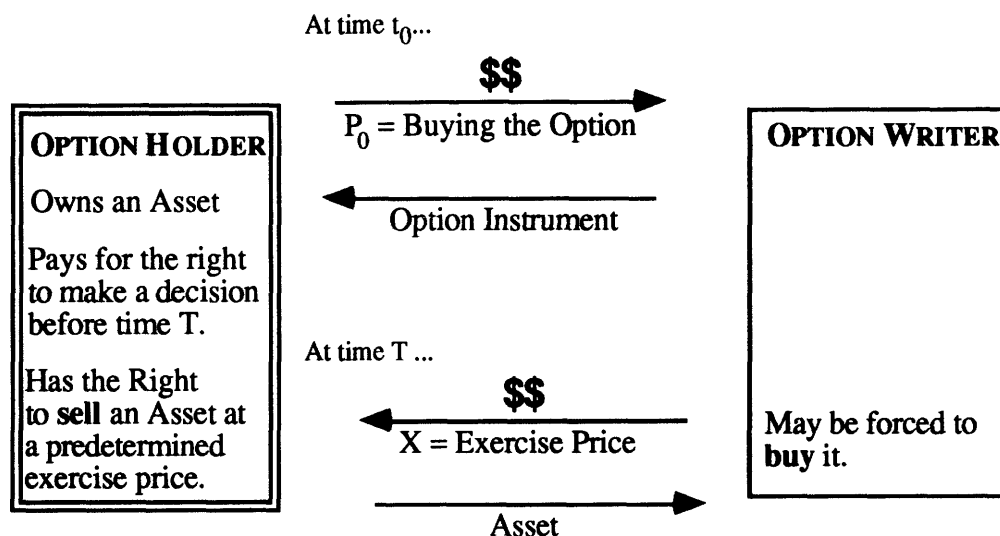


Figure 5.3

Schematic of the standard put option.

The Housing Option Model

There may be several ways of modeling the Housing Option scenario. Using the standard options models as a framework, I present several alternative pricing approaches below.

Figure 5.4 shows how the housing option could be used at the point of purchase to reduce the homebuyer's effective price. Though this scheme seems to have some similarities to the standard call option, there are some serious analytical differences. An isolated view of the Homeowner-Investor portion from Figure 5.4 is shown in Figure 5.5, and reveals some of these differences, which are described below.

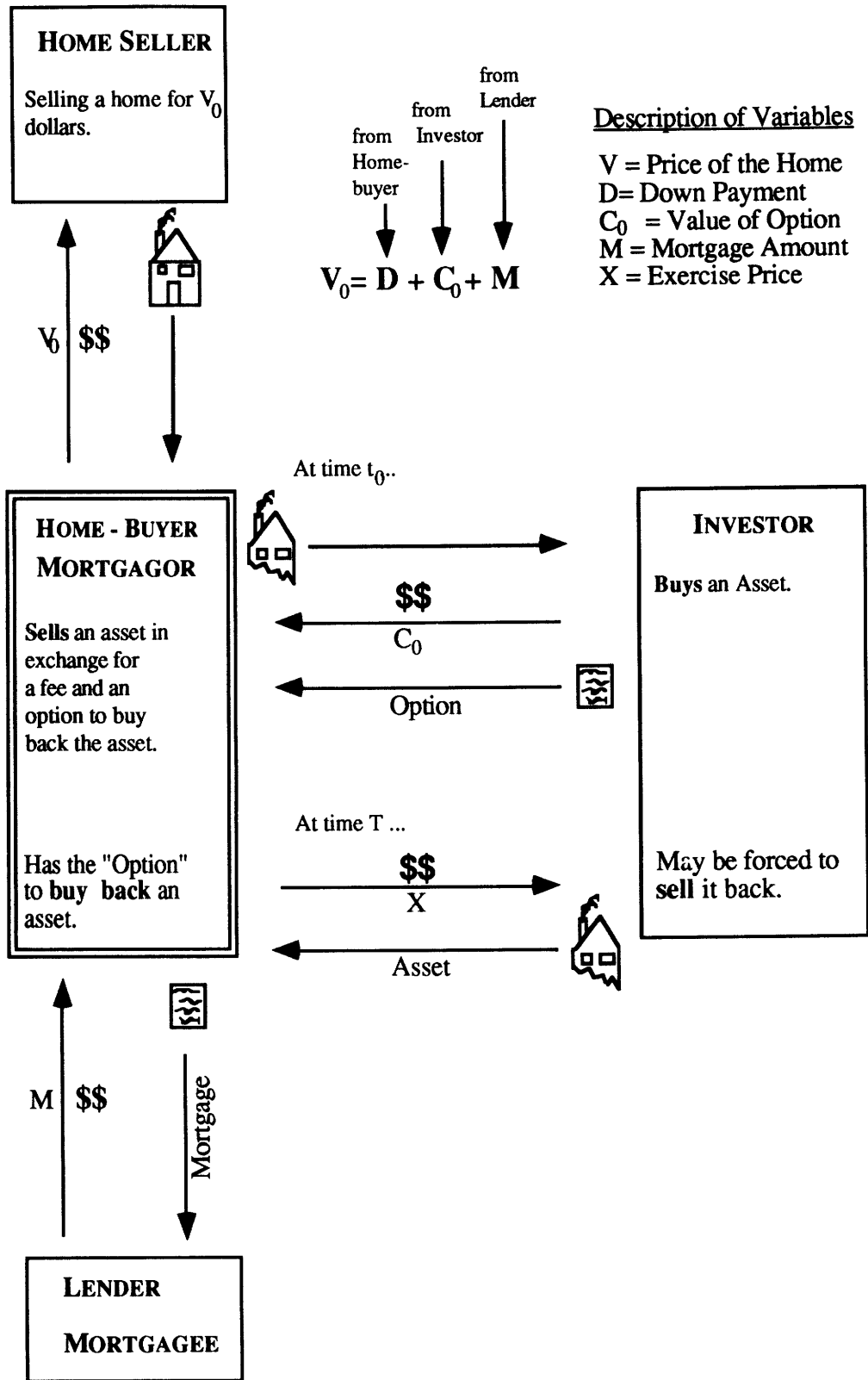
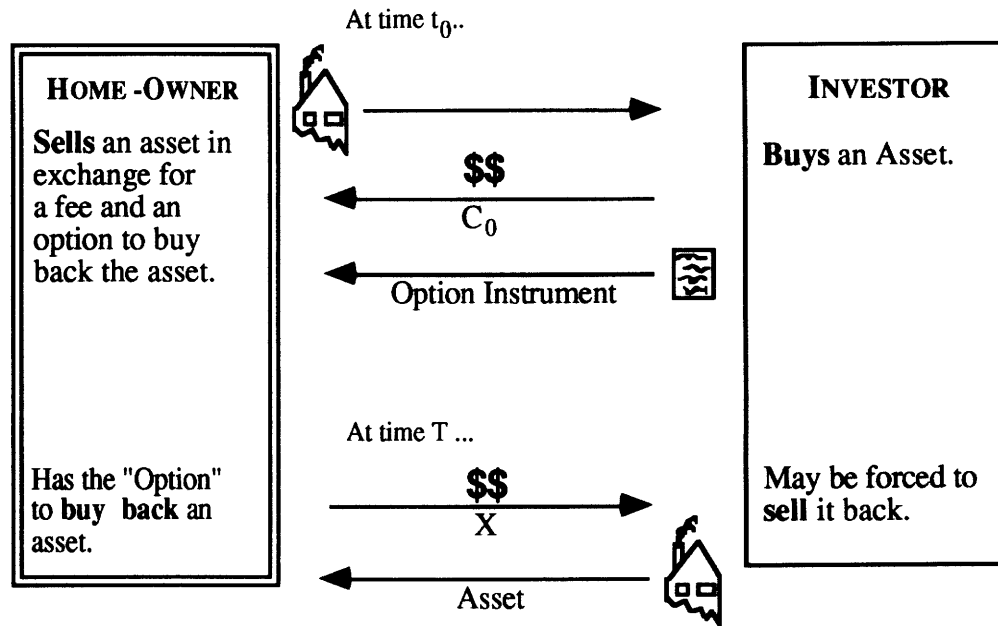


Figure 5.4

A schematic of the Housing Option.



A schematic between the home-owner and the investor.

Reversal of the direction of C_0 at time t_0 : Unlike in the standard Call Option where the option holder must *pay* C_0 for the right to decide, here the option holder *receives* C_0 and gets the option as well.

The additional transfer of an asset occurring at t_0 : At time t_0 , an additional exchange takes place - the homeowner is in effect selling an asset, an embedded option, for a premium *and* the option to buy these rights back someday.⁶ In fact, the homeowner is selling some flexibility from tomorrow for affordability today.

Different factors which affect the decision to exercise: In the standard model, the decision to exercise is a trivial comparison between exercise price and current market value. In the Housing Option, the decision rule is not quite so clear. It may depend on idiosyncratic sets of individual needs and resources.. Considerations about

⁶In the standard Call Option Model, the two transactors do not exchange the asset until time T.

expectations of future income, expectations of changes in the family size, job movement, current construction costs, availability of financing, and commitment to neighborhood all influence the decision. The decision is neither a pure investment decision, nor a pure consumption one. Hence it is a difficult one to model.

Homogeneity/Heterogeneity: With a standard American call option, either all option holders will exercise, or none. Part of this is due to the homogeneity of the underlying asset. One stock of IBM is no different from another. Also, given the good market price information, and assuming near perfect liquidity, there is a homogeneous set of decision parameters. The Housing Option, on the other hand, is on a heterogeneous good. No two underlying assets are identical, in that no two homeowners value their rights alike.

Perfect Markets: Stock options depend on the existence of an efficient, active, open market, with relatively low transaction costs and information asymmetries. In the stock options market, the option-holder has the ability to exercise, obtain the underlying asset, and liquidate on the open market to realize his/her gains. In fact, in many cases the asset never actually changes hands but instead an offsetting transaction is placed. Either way, near perfect liquidity and minimal transaction costs make this "cashing out" strategy realistic. The housing option is quite different. There is very little liquidity and no open market exists.

IV. MODELING ALTERNATIVES

The Housing Option instrument is designed to enable homeowners to make direct decisions about the bundles housing opportunities they hold. By unbundling certain

options embedded in the market price of their home, and selling them off to interested investors, homeowners are able to reduce their carrying costs.

There are many possible interpretations of the proposed Housing Option instrument. Various models can be constructed depending on assumptions on the exercise prices (fixed, variable, or market valued) and the time period (indefinite/definite, American/European). However, any model must result in a substantial premium to the homeowner, to offer him/her ownership opportunities which would otherwise be out of reach, and at the same time make a sensible investment opportunity.

The purpose of this sections is to develop both a qualitative and quantitative understanding of this financial arrangement by modeling it as a combination of more familiar instruments. Ultimately, the objective is to both obtain a dynamic theoretical pricing equation, as well as some significant and practical static results.

The three alternative models are (a) a zero coupon bond with an uncertain and unsecured payoff, or (b) a combination call-put instrument, and (c) a simple put.

Zero Coupon Bond

There is an interesting similarity between an American call option, and a zero-coupon bond. In fact, an American call option is really a zero-coupon bond with probabilistic assumptions on the repayment. The probabilistic quality is captured by the relationships between the option parameters - current asset value, exercise price, volatility, interest rates, and time.

Hence, one model of the Housing Option involves the use of zero-coupon bond pricing methods. The Housing Option is like a zero coupon bond for the amount of the "option value" with substantial and explicit default risk, and no marketable security. This investment is characterized by no debt service payments, and a one-time and risky balloon payment . It could trade and be valued like a zero coupon bond.

A critical assumption which limits this analogy is that the embedded option, which the investor has bought by paying C_0 , is not transferable. In other words, the investor can not turn to another homeowner who wishes to use the embedded option on a different parcel. Likewise, the holder of a zero-coupon bond can always sell his/her position, but must always wait for maturity to receive (or not receive) full repayment.

Also like the zero-coupon case, the investor is holding the embedded option as security for C_0 . However, the only value inherent in the security is the resale value. It has quite a different "inherent" value to the homeowner than the "resale" value to another investor. The owner's value is based on a combination of utility (ΔR_I) and expectations (ΔV_I). The investor's value is based purely on expectations.

Once the transferability of the embedded option is allowed, the investor is now holding a marketable security with potential value to other land owners. Suddenly, there is a larger pool of bidders for this instrument - other homeowners who may want to exercise the embedded option on their own parcels.

In the case of market driven exercise price, the assumption of constant X made in most standard option models is violated. This starts resembling the case of transferable development rights. Rather than being contractually set, the "exercise" price would become a market determined variable. Hence, a fundamental relationship which characterizes true options - the relationship between a fixed exercise price and a dynamic current asset price on which the option-holder is betting - is lost. As I have mentioned before, there is no value to a call option with the market price as the exercise price.

Homeowner's Perspective

In the most general case, the scenario is as follows:

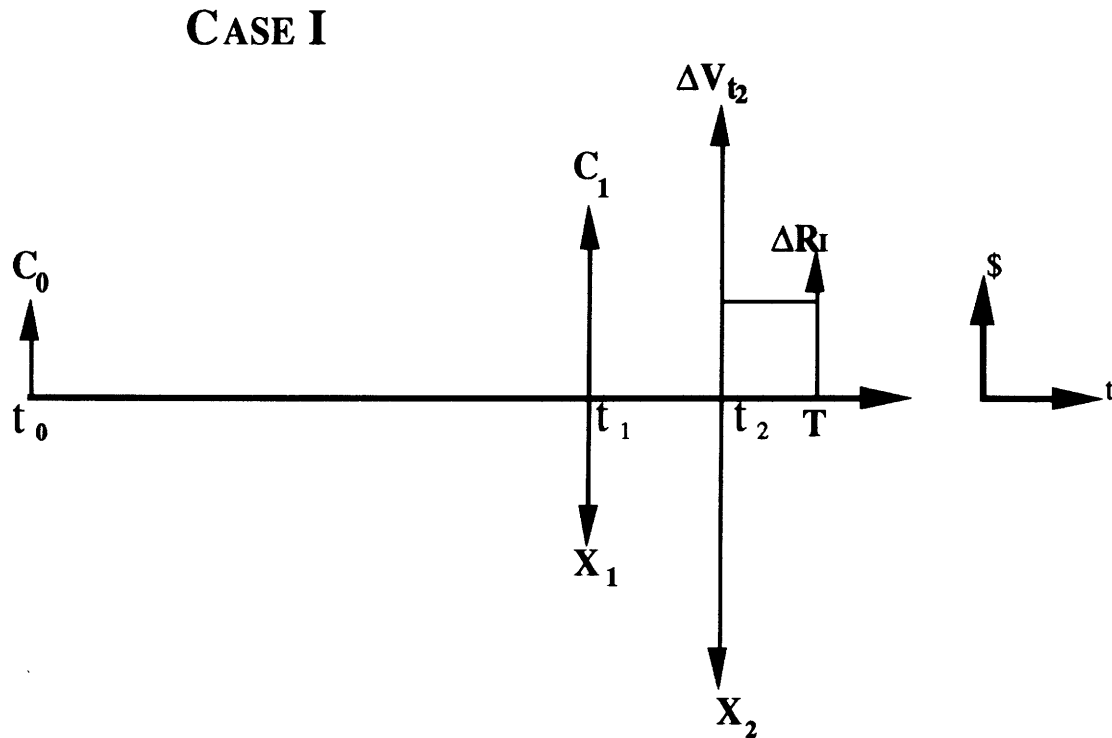


Figure 5.6

Homeowner's Perspective: Cash-Flow Diagram of General Case

- where,
- C_0 = Payment homeowner receives (at $t=0$) giving up an embedded option
 - X_1 = Price homeowner must pay to recover the embedded option (at $t=1$)
 - C_1 = "Value" of having recovered the "right" (at $t=1$)
 - X_2 = Investment in house (at $t=2$)
 - ΔV_{t_2} = Change of value of house attributable to investment (at $t=2$)
 - ΔR_I = Change in imputed rent

From the homeowner's perspective, there is an opportunity to receive housing assistance today of C_0 , in exchange for giving up some embedded option. At some time

in the future between t_0 and $t_1 < T$, the homeowner can pay $X_1 = C_*$ to "buy back the right," which in itself is an option. Once the homeowner spends $X_1 = C_*$ dollars at t_1 , he/she has regained the right to spend $X_2 = I_{t_2}$ at some point $t_2 > t_1$ to achieve a change in value (equity) of ΔV_{t_2} and a higher utility in the form of ΔR_I . So that, one may think of C_1 , X_2 , ΔV_{t_2} , and ΔR_I all being contingent upon the occurrence of X_1 . By paying X_1 the homeowner recovers his/her original embedded option.

In order to "exercise" on the first option by paying $X_1 = C_*$, the homeowner would require,

$$5.1 \quad X_1 \leq C_1$$

where, C_1 is the value of the call option with a time variant exercise price of I_t , and an underlying asset of,

$$5.2 \quad C_1 = \frac{\Delta V_{t_2}}{(1+r)^{t_2-t_1}} + \sum_{i=t_2}^{\infty} \frac{\Delta R_I}{(1+r)^i} - \frac{X_2}{(1+r)^{t_2-t_1}}$$

This is the discrete form "decision rule" for Case I. In continuous form,

$$5.3 \quad C_1 = \frac{\Delta V_{t_2}}{(1+r)^{t_2-t_1}} + \int_{t_2}^{\infty} \Delta R_I e^{-rt} dt - \frac{X_2}{(1+r)^{t_2-t_1}}$$

Investment Timing

The termination date of the underlying call option with I_t as an exercise price can be randomly cut short by land-use restrictions. There must be an underlying assumption that land-use restrictions are known and constant at the outset.

It is important to note that the investor does not gain anything by spending X before I_t , because he/she gains nothing in the interim that he couldn't have had by holding the option instead, and delaying the decision to exercise. You would never exercise early

on an American option that pays no dividends. However, this may not be true in the case of an American call option with a non-constant, stochastic exercise price, that trends upward. Homeowner may exercise early to take advantage of expectations of future increases in I_t .

An investor will always delay the decision to exercise, as the value of it is being discounted further, and the option holder retains all the rights that the holder of the underlying asset does, less the down side and the dividends. (In this case, we have assumed thus far that the underlying asset pays no dividends. See the section below on Dividends) So, spending X_1 at t_1 and investing I_2 at $t_2 > t_1$ would not be a prudent investment strategy. Since nothing is being "gained" by the homeowner in the interim $t_2 - t_1$ by owning the asset instead of the option, it makes sense to further simplify this general case.

Hence, the general case can be collapsed into a more simple case by assuming that $t_2 = t_1 = t_*$. This scenario can be represented by:

CASE II

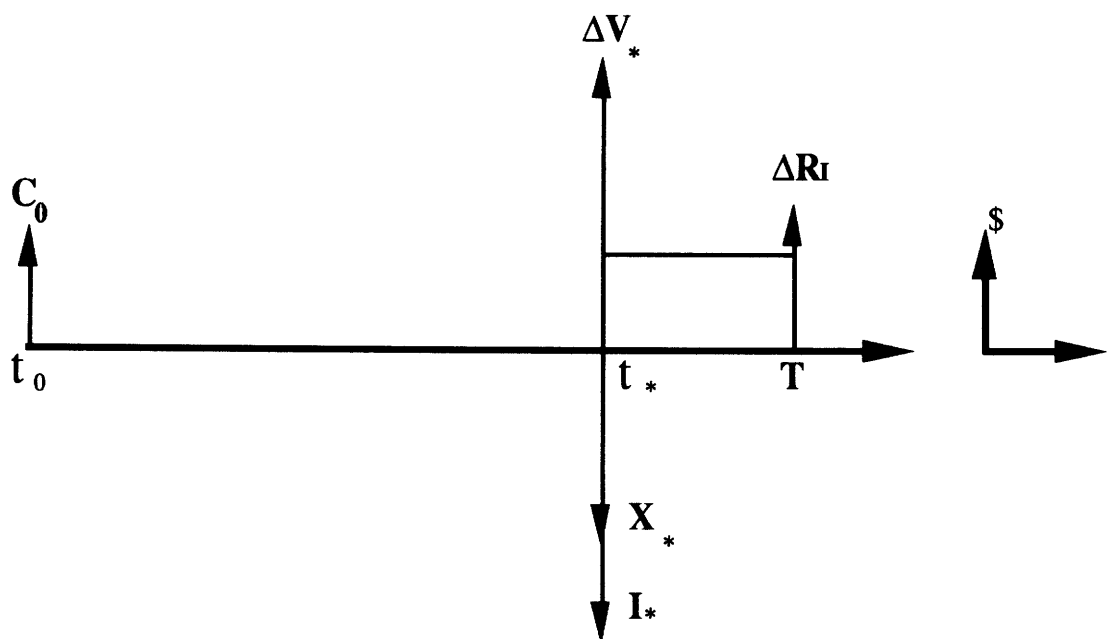


Figure 5.7

Homeowner's Perspective: Cash-Flow Diagram for Case II.

That is, the homeowner will only spend X if he/she plans to immediately go ahead with the investment I_t . That is I_t and X fall at the same point in time t_* .

In Case II, the homeowner's investment decision rule will be based on.

$$5.4 \quad X_* + I_* = V_* + \int_{t_*}^{\infty} \Delta R_I e^{-rt} dt$$

Determinants of the Exercise Price

In the standard model X is contractually set at time t_0 when the option is first sold. In fact, X is one of the dependent variables which go into the Black-Scholes formulation, so it must be fixed. In the Housing Option Model, X is much more elusive. It may be a formula, as a function of time, which determines the return on V_0 , the original investment amount. This would be like a zero-coupon bond purchased at V_0 and yielding X after $T - t_0$ years. X may also be a market valued parameter.

Market Valuation of the Exercise Price

It would be more interesting to allow X to become time variant. In fact, to allow X to be the market's valuation on what the "underlying asset" is worth at any point in time. Since the underlying asset is a call option, the function $X_t = X(t)$ would be the market value of a call option. So, whenever the homeowner wanted to recover the right originally "sold" for C_0 , he/she would pay whatever the market presently appraises that value to be. The homeowner's decision rule on whether or not to re-purchase his/her right would be to look at the market value, subtract from it the homeowner's costs, and see if the residual exceeds the "consumption" value of the right. That is, at any time t , the strike price would be X_* , the investment price would be I_t , the market price would be X_t , and the consumption value would be the infinite series (perpetuity) ΔR_I .⁷ Hence,

⁷ I have assumed that all the variables are time dependent. Some vary deterministically, and others

there is the dynamic decision rule,

$$5.5 \quad X_t + I_t \leq \sum_{i=t^*}^{\infty} \frac{\Delta R_i}{(1+r)^i}$$

Relationship between X_t and I_t

If the homeowner were able to afford the house price at t_0 , he/she would have paid V_0 for the house, retaining all embedded rights and options. However, by selling the option homeowner has been able to afford the home. By bring in an outside "investor", in a sense, the homeowner has reduced his/her portion of the purchase price from V_0 to $V_0 - C_0$. This "assistance" of C_0 dollars may have made a dramatic difference in the tenure choice.

However, when the homeowner finally chooses to exercise on the embedded option, he/she must now pay for whatever was saved before. Having saved C_0 at the point of purchase t_0 , the homeowner must now pay the contract price to recover the right, in addition to I_t cost of putting the investment in place. Another way to interpret this dynamic is, the homeowner is now facing a higher exercise price on the embedded option than he would if he never entered the agreement. His "exercise price" has increased from I_{t^*} to $X_{t^*} + I_{t^*}$. That is an increase of X_{t^*}/I_{t^*} percent.

As X_{t^*} increases, the likelihood of exercising would be expected to diminish. However, as I have noted before, in some cases I_{t^*} may be near zero, as may be the case with a right-to-use instead of on a right-to-improve. The right to mow the front lawn, would be an example.

Investor's Perspective

The cash flows in Figure 5.8 below represent the investor's perspective.

stochastically, with time.

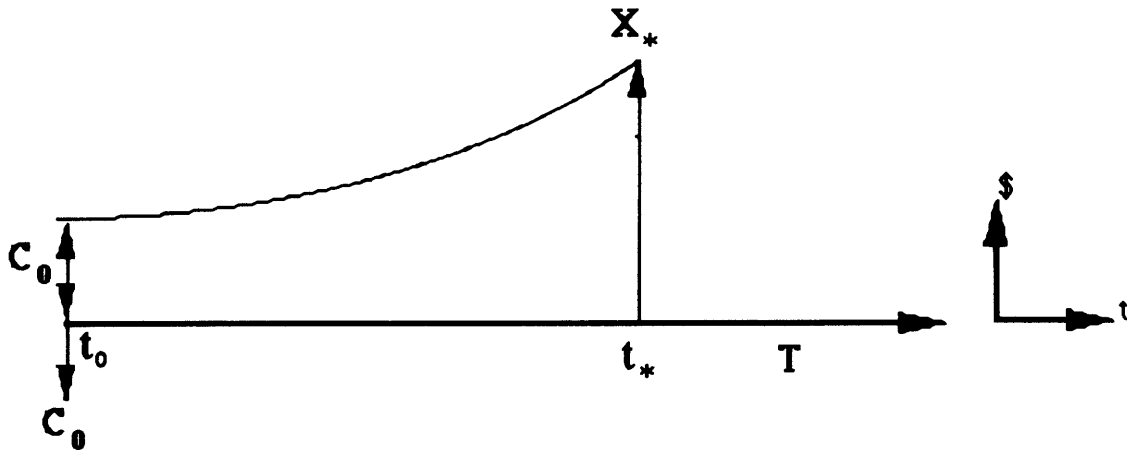


Figure 5.8

Investor's Perspective: Cash-Flow Diagram

In Figure 5.8 above we have,

$$5.6 \quad X = C_0 (1 + r)^{t_*}$$

or,

$$5.7 \quad C_0 = \frac{X}{(1+r)^{t_*}}$$

where C_0 is the premium paid at time t_0 (may be P_0) and X is the exercise price, or payoff yielding a return of r .

To the extent that the arrangement depicted in Figure 5.8 resembles a zero-coupon loan, one must question nature of the investor-homeowner relationship. It looks like debt in that a principal sum C_0 has been loaned, and there is an expected repayment by T . However, there is an equity component in that the exercise price may be a share in the appreciation. Part of what distinguishes debt from equity is the nature of the returns - how they are specified and prioritized. By definition, a debt position has priority over equity. However, this is necessary but not sufficient. Debt has contractually set returns commensurate with the level of risk the owner represents. When there is significant upside potential, the distinction between equity and debt is

blurred.

This is an important distinction in terms of legal rights and obligations as well as tax treatment. If the investor is construed as an equity partner, he/she may also be entitled to some proportionate share of the depreciation and other tax benefits of ownership. (See Chapter 2, Section IV on Equity Participation).

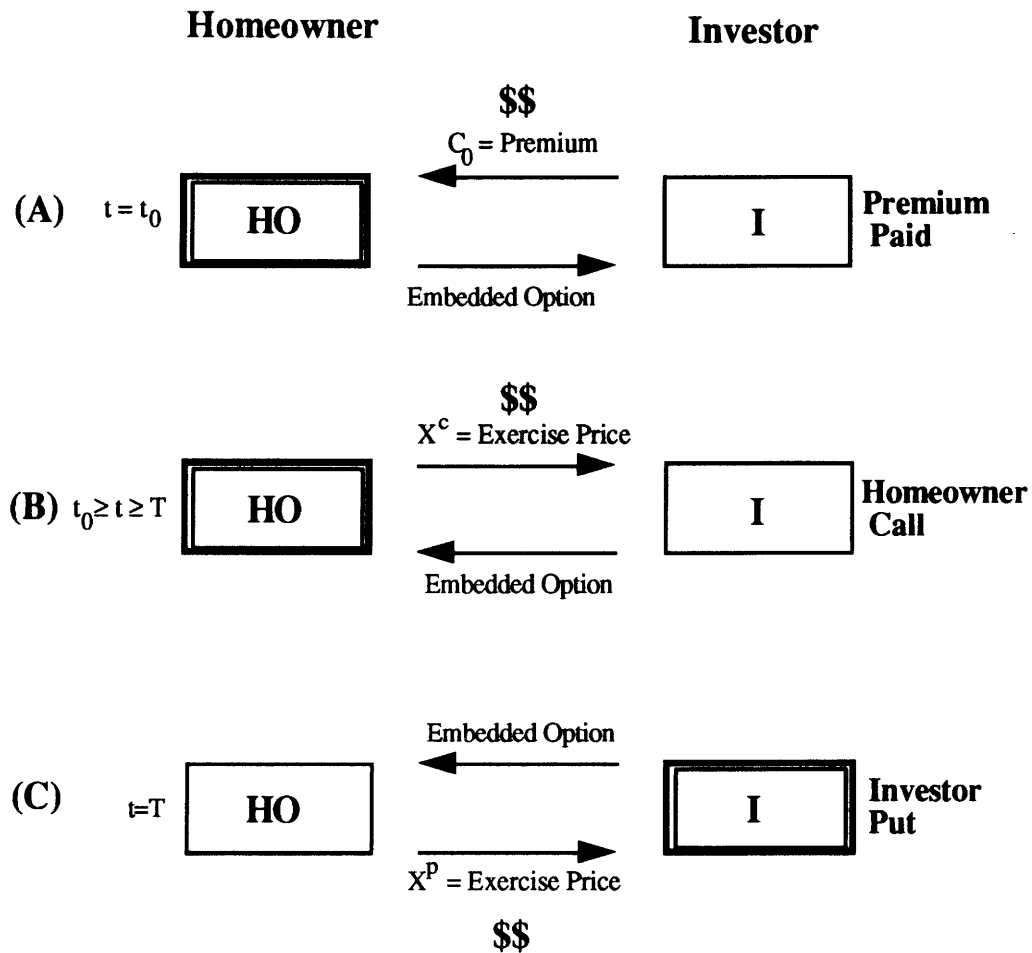
Combination Call-Put Model

Figure 5.9 shows a combination call-put model to describe this housing option unbundling mechanism.

(A) Premium Paid: At time $t=t_0$, the homeowner "sells" an embedded option on a right of ownership in exchange for a premium C_0 . The homeowner has achieved an effective price reduction of C_0/V_0 , where V_0 is the market price or "value" of the house at time t_0 . This value may be expected to be between 5% - 20% to make the vehicle feasible. Preliminary calculations show that this is achievable.

In the homeowner's possession, this underlying asset is an American call option. Embedded in the market price, it allows the homeowner to make a future decision about his/her home - place an investment I_t , rent out the house, etc. (See Figure 5.1 for examples of such "embedded options.")

Having sold the embedded American call option to the investor, the homeowner must first settle with the investor before exercising on this embedded option. It has been unbundled from his rights of ownership. In effect, the homeowner has sold flexibility in exchange for affordability. This is the foundation of the asset-based approach - a bilateral exchange of things of value between the homeowner, who has gained affordability, and the investor, who has entered an investment opportunity.

Figure 5.9⁸

Schematic of Combination Call-Put Model

(B) Homeowner Call: Between t_0 and T , the expiration date, the homeowner retains the right to "call" back his embedded option. If the homeowner wants to perfect his title and regain his embedded option, he must buy it back for X^c dollars.

Hence, the "underlying asset" of this call option is an American call option embedded in the house's market price. It may be thought of as the net present value of a

⁸ In Figure 5.9, HO denotes "Homeowner," I denotes "Investor," and T is the time to expiration. The darkened boxes represent who is holding "the right to make a decision." It is important that this right shifts.

cash flow diagram consisting of an investment I_t , a change in value ΔV_t and an imputed rent series ΔR_t from t to infinity. Each one of these variables is stochastic. It has a certain characteristic distribution at any point in time. Only *expected* values are known; no values are known with certainty. Each variable has a certain probabilistic distribution of expected values.

When,

$$5.8 \quad E_t(I) \leq E_t(\Delta V) + \sum_{t=t^*}^{\infty} \frac{E_t(\Delta R_t)}{(1+i)^t}$$

the homeowner would be expected to exercise. An options valuation implicitly accounts for the distribution of expected values.

Notice that if the spatial fixity on the embedded option is relaxed, it becomes like a transferable development right. The investor would be holding a "security" of significant value to other homeowners. In this case, there would be no need for (C), the put portion of the deal. The only reason the put exists is that otherwise the investor would be holding a security of value only to the homeowner from whom the option was bought.

(C) Investor Put: At the time of expiration T , the investor can "put" the embedded option to the homeowner and collect X^P dollars. So, once the homeowner abandons the American call option, it converts to a put, with the investor now deciding to exercise. X^P may be a contractually set share of appreciation. The homeowner may settle on the put by either selling, or more likely, refinancing.

European Put Option Model

Figure 5.10 below presents a simple European put model to represent the Housing Option.

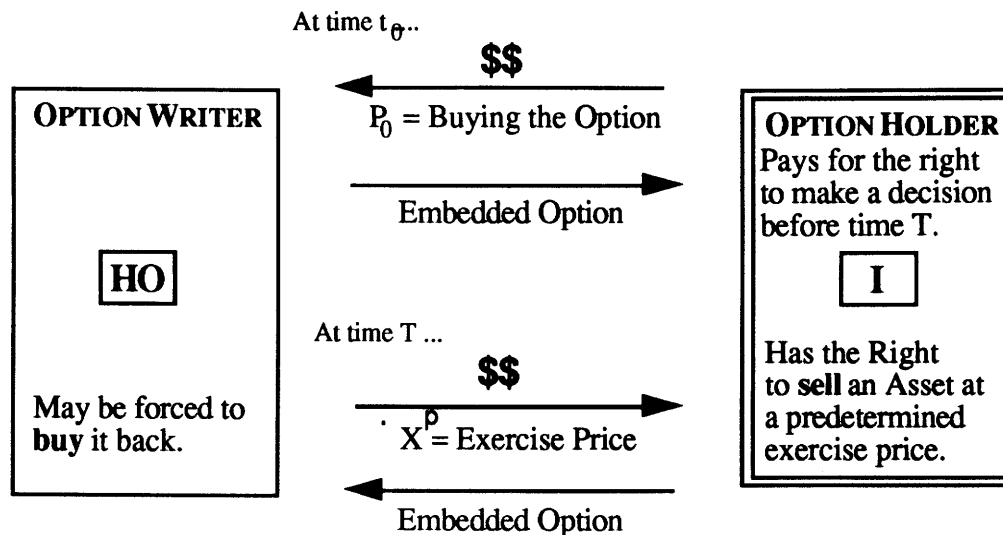


Figure 5.10

The simple put model is just the second half of the combination call-put model described above. The investor pays a premium P_0 to the homeowner, and in exchange has the right to put the embedded call option back to the homeowner at time T .⁹ It is a European version of a put option contract. Notice that the investor is the decision maker (denoted by the double-line box) for the entire term.

The assumption is that the embedded call option is transferable, so that market value exists. That is, the investor, at any point in time, would measure the exercise price from the homeowner against the price in the market. Of course, with the homeowner having the ability to purchase the embedded option out in the market as well, a single market price would emerge.

If the embedded call option were not transferable, then the investor would always exercise at T , and the pricing problem is significantly simplified. We have two choices - fix X^P or allow it to be a percentage of appreciation. In the former case, where X^P is

⁹ Note that the premium paid in the simple *covered* put model must reflect two things: the purchase of the embedded option, and the value of a put option on it. In effect, the investor purchases the embedded option (which can be valued as a call option from the homeowner's perspective), and then buys a put on it. So, premium = $P_0 + C_0$.

held constant, we have a simple European put option. In the latter case, with X^P being a function of the appreciation, then the put model in fact becomes a shared appreciation mortgage.¹⁰

In Appendix G, I price such an instrument using some simplifying assumptions. The results from that analysis showed that indeed the arrangement is feasible. One may think of this simple put option, with the exercise price being a function of the appreciation, as a shared appreciation mortgage (SAM) whereby instead of getting interest rate reduction, the homeowner is getting an up front premium. This premium may be equal to the net present value of all the debt service savings under a SAM, discounted to t_0 .

This is a very important point which distinguishes the options contract from the shared appreciation mortgage. The housing option prices the appreciation risk to an equity type investor, explicitly through the option value. This mechanism takes the appreciation risk out of the realm of the lender and places it with an individual investor. From the perspective of risk allocation, this shifts the appreciation risk from the lender to an investor, who is more able to take the risk, and be paid for it. The investor is in a more appropriate risk strata than the fiduciary lender to be exposed to the risks of price volatility.

Appendix G has shown that these shared appreciation type put instruments have substantial interest rate sensitivity. For higher interest rates, the contract feasibility, measured by a low A/ρ , is more sensitive to the annual appreciation rate α_1 . As the interest rate increases, the "family" of feasibility curves shift up substantially. That is, it would take a much higher A/ρ (share of appreciation (%) to premium (%) ratio) to satisfy investor returns. Consequently, a higher annual appreciation α_1 would be

¹⁰ One may think of a shared appreciation mortgage as a European put contract, with the termination date of the contract equal to the date of title transfer or sale, and the exercise price equal to some percentage share of the appreciation.

required in the housing market.

Figures 5.11 and 5.12 below show these relationships graphically. See Appendix G for detail.

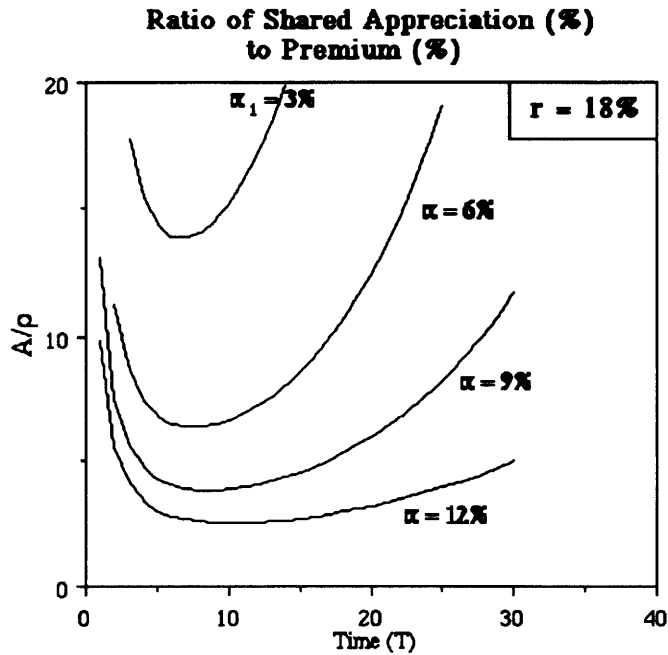


Figure 5.11

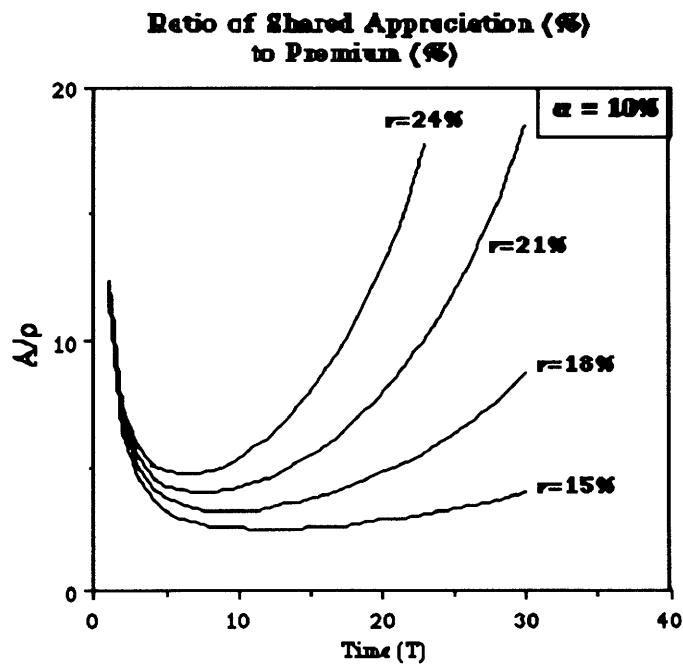


Figure 5.12

V. IMPLICIT ASSUMPTIONS

There are several key assumptions, implicit in the above analysis, which are important to note:¹¹

- Units of housing price appreciation are tradable, and their price is distributed log-normally.
- The exercise price required on the embedded option is equal to an investment amount I_t . It is known and has a joint relationship with the expected appreciation and imputed rent. That is, there is some relationship between the amount of investment in the house, and its immediate price appreciation as well as the added utility the household would enjoy.
- Units of housing price appreciation are homogenous, despite the fact that housing units are heterogeneous.
- The decision to exercise on the embedded option results in instantaneous discontinuity in the house price path, and immediate "enjoyment." That is, the investment I_t is instantaneous, and results in an instantaneous change in utility.
- Land use restrictions do not change to render an embedded option useless.

VI. SUGGESTIONS FOR FURTHER RESEARCH

There are various issues of considerable interest which underpin the options approach to affordable ownership. Some of these issues deserve some further work.

- **Quality:** Optioning improvement rights may inhibit improvements and threaten the quality of the housing stock.
- **Regulations:** What sort of security do participants in this vehicle have that all parties will perform?

¹¹ I am following a note titled, "Observed Problems Motivating Research in Corporate Lease Bid Valuation," by James Paddock, written for class use. (MIT, 1992) It discusses the valuation problem of the oil leases, modelled as an option on reserves.

- **Portfolio Considerations:** Analysis must be done to see how pooling these instruments would affect their value. Portfolios would combine options with different variability to enhance likelihood of exercising. In fact, the superior ability of investors, over households, to diversify the risk of price volatility is one of the option's more attractive features.
- **"Mortgageability":** Would the existence of such encumbrances increase mortgage risks, or affect the lender's security in any way? Would they affect further transfers or encumbrances of title?

VII. CONCLUSION

We have seen that ownership rates have, historically, been much lower, and regional variations in both homeownership rates and prices persist. Housing prices and price volatility can vary not only regionally, but even with the micro-economic characters of the household or neighborhood attributes. While the hedonics literature explains some of these variations, it has been largely limited to physical, and observable attributes. Furthermore, it ignores both the investment character of housing, and, to some degree, a perhaps valuable set of embedded options. These are two critical considerations in the valuation of housing.

The set of economic, demographic, business, and political forces which can impact these critical housing variables are both unpredictable and complex. In addition, fluctuations in prices, in either directions, can have considerable and unfavorable effects. Financial options instruments have been suggested as an appropriate tool for better risk allocation and at the same time greater opportunities for affordable ownership. The new patterns of risk-return relationships that the option instrument brings is promising in the housing markets.

Hopefully, what this proposed unbundling mechanism would achieve is substantially reduced effective housing prices (or "carrying costs"), without decreasing the overall value of the housing stock. It may also encourage a more efficient market for

homes which would separate some of the more volatile portions of market prices, and shift the associated risks onto investors, who are in a superior position to diversify from the unsystematic portion. Finally, it would enhance the tenure choice by allowing homebuyers to choose not only a physical housing form, or a legal and contractual form, but an explicit and specific set of embedded options.

One of the important observations is that the unbundling mechanism allows the risks associated with the equity position to be allocated more efficiently. The investor is better equipped to take on this mostly unsystematic risk, which can be diversified away by holding a prudent portfolio of such securities. The investor can hold many such "options" on various homes, which the homeowner obviously could not do.

In a practical sense, the homeowner would sell whatever embedded option he does not intend to use. He/she may not value that right as part of the bundle of rights called "homeownership." By unbundling those rights, the homeowner has been allowed to choose which rights he/she values more than others, and which rights others value more than him. In a financial sense, by selling the embedded options, the owner has unbundled the rights associated with homeownership and sold those to someone who has differing expectations, different ability to pay, or better capacity to wait.

I have presented a framework with which to ownership rights, and the embedded options associated with them, can be categorized by the ease with which they may be unbundled and traded. With numerous and analogous examples of the power of unbundling, this approach to affordable ownership seems promising. Initial models and simple feasibility calculations show the same.

The options pricing logic and valuation methods may be applied in the housing markets not only as a financing tool, but also as a powerful and insightful descriptive tool - to describe market pricing mechanisms, consumer/producer behavior, and to strengthen and justify price forecasts. Advances in that direction would be a considerable contribution to our understanding of housing markets.

APPENDIX A

QUALITY CHANGES

Whenever price changes are observed, the question of "changing quality" should immediately emerge. In most cases, the first goal of a rationalization of a change in prices is to separate that portion due to changes in quality. For example, a typical house erected in 1989 was 22% larger than its 1983 counterpart. A substantial share of the increase in median price often reflects, as in this case, a change in "quality." In other words, part of the higher 1989 home price is simply due to its larger size.

When discussing the "quality of housing stock," it is important to distinguish between various effects and measurements. For example, quality may change because higher quality units are being added at the margin (as new construction), hence raising the average quality level of the stock as a whole. These can be termed "marginal" quality improvements. This is the type of quality change most often referred to and measured through hedonic price indices. These indexes measure how much housing values have appreciated on a "quality adjusted basis." That is, the effects of new *and better* quality housing has been removed.

Quality may also change due to what is happening to the existing stock. Physical deterioration and depreciation decrease quality (or value), while improvements and repair increase quality. These changes in "current quality" are much more difficult to measure.¹ Increases in current quality may be thought of in a financial sense as equity appreciation, or in an economic sense as a higher level of homeowner utility and hence higher imputed rent for housing services. These notions will be elaborated in Chapters

¹ In the options approach presented in Chapter 5, it is these changes in current quality that I shall focus on. The question is, to what extent people exercise improvement rights (a sub-set of land-use rights granted by title) in order to capture increased quality.

4 and 5.

U.S. Bureau of the Census uses hedonic regression technique to distinguish between pure price movements and those due to quality change. To do this, the Bureau's survey records 10 characteristics for each home: lot size, house size, number of stories, number of bathrooms, geographic location, inside/outside SMSA, and the presence/absence of central air, fire place, garage, and foundation. By regressing the observed market prices onto individual attributes, the marginal contribution (or implicit price) of each is attained. An R-squared of 66% is typical. Given the incidence of each attribute in new homes at any point in time, new home prices are then weighted by the proportion of like-quality homes in the existing stock. This way, the Census uses hedonic methods to remove, to some extent, the distortions of quality changes.

It is important to realize the limits of this technique. 34% of the variation in price is simply unaccounted for. Indeed, there may be numerous attributes which the survey omits for various reasons. At the same time, the survey does capture certain trends, such as cluster housing, which may lower values and bias the price measure downward. Finally, to the extent that the regressions ignore home improvements over time, the price inflation would be biased upward. Hence, there are shortcomings and biases to quality adjustments using hedonic techniques.

Over the last 25 years, U.S. quality-adjusted home prices have risen half a percentage point per year faster than overall consumer prices. However, this national long-term measure conceals some very important regional differences. Not only has new home quality improved over time, heavily affecting overall price changes, but the quality-price relationship is one with serious regional variation. As Table A.1 below shows, the strong price appreciation in the Northeast in the mid-eighties reflected mostly price inflation, not quality improvement. In contrast, price increases in the South and West stemmed almost entirely from quality improvements.

Price Inflation on New Homes due to...			
Region	Pure Price	Quality	Total
Northeast	39.9%	8.2%	48.1%
South	0.0	28.7	28.7
Midwest	13.3	15.5	28.8
West	3.8	35.7	39.5
United States	6.4%	30.7%	37.1%

Table A.1

Separating price inflation on new homes to pure price and quality components (1985-1988)

(Source: U.S. Department of Commerce, Bureau of the Census from Abraham, 1989)

Americans seem to want "more house," with more space and amenities. Looking at the significant improvement in quality, it seems that builders and construction techniques have been able to deliver. For instance, new home size increased by only 70 square feet between 1982 and 1985, but jumped by 200 square feet between 1985 and 1988. (Abraham, 1989) This partially reflects rising standards due to the predominance of move-up buyers in the market.

APPENDIX B

AFFORDABILITY MEASURES

In the previous sections, I have tried to critically present the various perspectives and complex issues underlying key housing variables. This section reflects the increasing sophistication with which one housing indicator - affordability - is measured.

NAR's Affordability Index²

In light of the concern about the state of "affordability" in the U.S. housing markets, there have been many attempts to quantify this elusive measure. The NAR's affordability Index (AI) is one such attempt to capture some of the elements which affect affordability. The index is computed by dividing the median family income by the income needed to qualify for a mortgage on a median-priced, existing single family home. So whenever an area's median family income is just sufficient to qualify for the median priced existing home the AI is equal to 100 percent. The higher the index, the more "affordable" the market.

B.1 $AI = \text{Median Family Income} / \text{Qualifying Income}^3 \times 100$

Figure B.1 below shows the affordability index from 1970 to 1992.⁴

² See Ravi Kamath (1988) for a thorough critique of the NAR's index.

³ In computing the denominator (Qualifying Income), the NAR chose an income multiplier of 4. To avoid having to characterize individual institutional standards, the NAR looked at "conforming loans," which meet Fannie Mae's guidelines for sale on the secondary market. Generally, these require housing costs cannot exceed 28-30 percent of the purchaser's gross income. To avoid the problem of real estate taxes as well, NAR dropped to a 25% limit, or an income multiplier of 4. This is consistent with a 1-1.5% effective property tax rate.

⁴ The 1992 value is just the average of the first 5 months reported thus far.

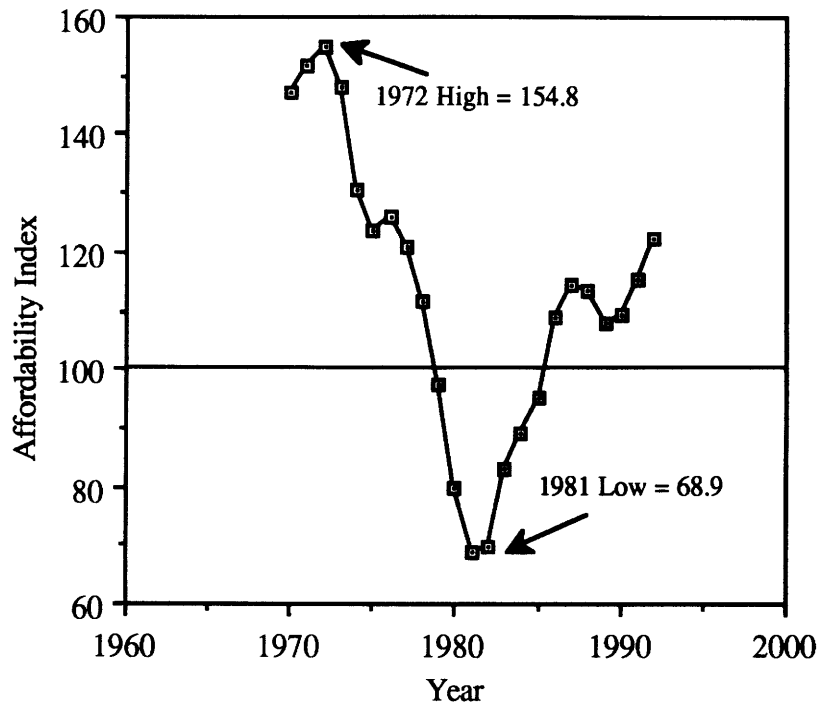


Figure B.1

Affordability Index from 1970 to 1992.

(Source: National Association of Realtors, Research Division, Washington D.C.)

Many variables contribute to fluctuations in affordability, including:

1. Buyer's net income
2. Home price
3. Availability of down payment
4. Points, closing costs, and other buyer subsidized transactions costs
5. Mortgage terms: rate of interest, duration
6. Instrument type: FRM, ARM, SAM, PLAM, etc.
7. Lender qualifying criteria
8. Non-mortgage housing expenses: insurance, real estate taxes, assessments, private mortgage insurance

With great regional disparities in prices, differences in household incomes and

preferences, and in many cases limited national data, the NAR attempted to somehow represent all the above factors into one intuitively appealing and measurable index.

A product of many implicit assumptions, the AI is unavoidably limited in its application. The Affordability Index assumes that:

1. The homebuyer's gross income is indeed equal to the median family income in the United States.
2. A median-income family is actually interested in purchasing a median-priced, existing single family home.
3. The buyer's down payment is 20% of the home price.
4. The remainder is mortgaged at a fixed interest rate equal to the effective rate on existing homes (closed in a given month) as per the Federal Home Loan Bank Board, for a 30-year term.
5. By using the effective rather than nominal interest rate, the AI ignores the the initial cash burdens of loan closing costs. Furthermore, despite the fact that mortgage markets have become nationalized and more complete, variations in mortgage rates have still been observed between areas. As the AI assumes national rates, it overlooks these regional variations thereby limiting its credibility and local applicability.
6. The lending requirements of the Federal National Mortgage Association are used as qualifying criteria. As such, the AI ignores real estate taxes, insurance (hazard and private mortgage insurance), and other assessments.

A sensitivity analysis quickly illustrates that the interest rate variable often becomes the most pivotal parameter in the AI formulation. (Kamath, 1988) Assuming that median family income and median price on existing homes move somewhat in concert over the long-term, small shifts in the interest rate can create significant movements in the index.

The NAR has recently developed a separate affordability index appropriate for first-time homebuyers. The original AI was deficient for this group for several reasons:

- they buy non-median homes (typically smaller, less expensive);
- they can not meet the 20% down payment assumption;
- they are often not families;

- they earn less than the median-family income.

The first-time-buyer index makes a different set of assumptions. Instead of using the median priced home, it assumes the first-time buyer purchases a starter home at 85% of the median existing price. Then, it assumes a smaller down payment of 10% instead of 20%. Finally, it uses the median-family income of those in their 20's to 40's who are currently renters, to represent the typical first-time buyers.

The AI is most appealing for its compactness and simplicity. However, while it can quickly and adequately represent general national environments in the housing markets, it is of little use to individual homebuyers in their local consumption decisions.

NAHB's Housing Opportunity Index⁵

The National Association of Home Builders has constructed a different measure of affordability. The Housing Opportunity Index (HOI) measures the ability of a typical family to purchase a home in its own market. The HOI, which has only been compiled since the first quarter of 1991, measures the percentage of both new and existing homes sold during a particular quarter in a local market which could have been purchased at prevailing mortgage rates by a household earning that area's median income.⁶ The higher the percentage, the more "affordable" the area. In other words, a median-income household could have afforded a higher percentage of the observed sales.

For example, data from the fourth quarter of 1991⁷ shows that the Boston HOI was 48.6%, with a median sales price of \$148,000 and a median household income of \$50,200. That is, the median income household could have "afforded" 48.6% of the

⁵ Data in this section was provided by the Economics and Housing Policy Department of the National Association of Home Builders.

⁶ Sales data are obtained from court records, and median-income data are obtained from the U.S. Department of Housing & Urban Development.

⁷ Fourth quarter 1991 tabulations were based on 367,000 sales of new and existing homes in 176 markets.

homes sold during that quarter in the Boston area. Boston was ranked 31st in the Northeast (Nashua, NH was first with an HOI of 86.0%) and 139th in the nation. San Francisco had an HOI of 9.9% (median sales of \$280,000 and median income of \$49,900) ranking last in the nation. The index showed that housing tended to be most affordable in smaller market throughout the Midwest and South, and least affordable in the larger, more urbanized market of the West and Northeast. Not surprisingly, of the 25 most affordable markets, 18 were located in the Midwest, 4 in the South, and 3 in the Northeast.

In the last quarter of 1991, households earning the national median income were able to afford 37.9% of the homes offered for sale nationwide, up from 34.8% from the previous year.

The Housing Opportunity Index makes many of the same assumptions as the NAR's Affordability Index. The main difference is that while the AI looks at the whole pool of homes (it looks at the median-priced existing single family home), the HOI looks at a subset of that - only those homes which actually sold during the quarter. In that sense, the AI may reflect the affordability of homes which are not for sale. The HOI instead only measures affordability against homes which have just closed. Hence, while the HOI is more sensible, it may also be more erratic, depending heavily on current transactions.

APPENDIX C

COMPONENTS OF HOUSING VALUES: HEDONICS IN THE HOUSING MARKETS

"Hedonics" can be thought of as a way to quantify how people value relative consumption "pleasures" (from "hedonism"). A hedonic price model refers to the procedure of regressing the price of differentiated goods on quantities of attributes or physical characteristics associated with that good. The regression coefficients represent implicit marginal prices the consumer places on each attribute. There is a large literature describing how to specify these hedonic models (which attributes to include and exclude), different functional forms (linear or non-linear), and methods to "test" the significance of the results. A brief review follows.

Literature Review

The hedonic framework for the analysis of consumer's implicit marginal prices for attributes of differentiated products was presented in the Market Segmentation Section of Chapter 1. A very rich and extensive literature began with Sherwin Rosen's 1974 ground-breaking work which formalized the equilibrium pricing of differentiated goods.⁸ The hedonic technique is used extensively in housing to construct general price indices (for example, see Case and Shiller, 1987) as well as focus on particular value components.

⁸ See Grether and Mieszkowski (1974) for a review of some of the work that preceded Rosen in the hedonic tradition. They studied the effects of zoning codes, traffic, and city services to describe neighborhood character as well as an exhaustive list of physical attributes of the house itself. To account for supply, they only included construction costs.

Knowledge about the components to value in the housing markets can be captured by the categories listed below.⁹ A sampling from the literature on each is included:

Physical Characteristics of the House (Micro-Variables)

Price Indexes	Case and Shiller, 1987 Haurin and Hendershott, 1991 Case, Pollakowski, and Wachter, 1991 Abraham and Schauman, 1991
Architecture	Asabere, Hachey and Grubaugh, 1989

Locational Characteristics of the Property (Locational Variables)

Distance from Fixed Amenities	Gill and Haurin, 1991
-------------------------------	-----------------------

Environmental Characteristics of the Neighborhood (Spatial Variables)

Effects of zoning	Jud, 1980
Land Regulation	Landis, 1986
State Land-Use Controls	Shilling, Sirmans, and Guidry, 1990
Urban Design	Vandell and Lane, 1989
Historic Zoning	Asabere, Hachey and Grubaugh, 1989 Gale, 1991 Asaber and Huffman, 1991

Public Services within the local Jurisdiction (Service Variables)

Traffic, Education, Fire Protection	Grether and Pieszkowski, 1974
Schools	Jud, 1985

General Conditions in the Economy (Macro-Variables)

Mortgage Rates	Ferris and Kumar, 1988
Real Interest Rates	Harris, 1989
Demographics	Mankiw and Weil, 1991
Inflation, Tax Rates (User Costs)	Gill and Haurin, 1991

Subjective, Perceptual, Consumer Character (Perceptual Variables)

Consumer Preferences and Personalities	Nelson and Rabianski, 1988
--	----------------------------

⁹ I have borrowed these in part from Nelson and Rabianski, 1988. The macro-variables category has been added.

Objective Consumer Character (Individual Variables)

Individual Income and Tax Rates

Dale-Johnson, 1984

In the hedonic pricing models, the relationship between the price and the attributes of a good is a product of the actions of both consumers and producers. The hedonic price at each level of consumption or production is generated by the tangency of two curves - the consumer's bid price schedule and the producer's offer price schedule. The consumer's schedule captures the price a consumer would be willing to pay for different combinations and levels of attributes, as well as factors which describe the household (income, size, etc.). Meanwhile, the producer's schedule is a function of attribute levels, as well as factors which describe the production or input costs (state of technology, labor rates, etc.). Under ideal conditions there would exist a unique point of tangency of these two schedules which determine the market price. In the case of a segmented market, non-linearities in the schedules result in multiple tangencies and hence multiple prices.

Housing Price Indexes

One of the most extensive uses of hedonic methods is found in the development of housing indexes.¹⁰ The literature on price indexes for home prices is quite rich and there is much work remaining before our understanding, and our ability to measure, price changes is consistent. "Though it is common to hear references to 'house prices' ...none of the currently available series adequately measures what we presume is meant by the term." (Peek and Wilcox, 1991)

There is variation both in the interpretation of past prices as well as in the forecasting of future ones. For example, estimates of the increase in real house prices over the past two decades range from 10-90%. This wide variation can be attributed to whether sales

¹⁰ See Haurin and Hendersott (1991), Case, Pollakowski and Wachter (1991), Abraham and Schauman (1991), and Peek and Wilcox (1991) for the most recent examples.

data or appraisal data or homebuyer reported data is used, whether quality is properly accounted for, whether new, rehabilitated, or strictly existing houses are measured (or a combination), whether land value is included (the Bureau of Economic Analysis' implicit deflator for residential investment excludes land, yet some studies use it to deflate total prices), whether adjustments were made for regional and local segmentation, whether exogenous conditions varied considerably over the observed term, or whether some other biases have crept into the data pool ("good data is scarce"). The bottom line is that housing price indexes must be closely interpreted.¹¹

¹¹ See Peek and Wilcox (1991) for an examination of various price series including the FHA, the NAR, the U.S. Bureau of the Census (both median and constant quality series), the Mortgage Interest Rate Survey of the FHLB, the BEA, and Freddie Mac's new weighted repeat sales series.

APPENDIX D

COMPONENTS OF PRICE APPRECIATION

Most of the formal attempts to model the rates of change in housing prices tend to focus on macro-determinants of prices. The assumption is that macroeconomic factors unrelated to the home itself govern price movements, and affect all houses equally. Such factors include demographic shifts, changing tax policy, real rates of return on tangible versus financial assets (and hence inflation), employment growth, household formations, and more. (See Chapter 1).

The possibility of cross-sectional variation in rates of appreciation on housing units are generally ignored by both hedonic treatments as well as other price forecasts. By and large, it is assumed that there are macro-factors which systematically affect rates of change of housing prices over time, but not across a sample. Most discussions of cross-sectional variation in rates of appreciation is in the market segmentation context. (See Market Segmentation Section in Chapter 1)

However, cross sectional variation in appreciation rates have been observed. Put simply, certain types of houses appreciate at different rates than others. For example, one would expect a solar heated home to appreciate more rapidly during periods of high energy costs than an identical oil heated home. Similarly, a house that has rentable space (proxied by second kitchen or separate entrance) may appreciate faster than an identical house without this "option to rent" during periods of higher rents. While it is unlikely that such "differential appreciation" could be sustainable in the long-run, it could result in a one-time, short-term capital gain for the owners.

The presence of differential appreciation rates is especially important in an options context. Differential appreciation rates imply a cross-sectional variation in price volatility on different houses. This volatility may even be a function of hedonic

attributes.

Hedonic Model of Appreciation

Dale-Johnson and Phillips (1984) attempted to model this phenomena by regressing individual housing attributes on an imputed time-series of price changes. Their aim was to identify those attributes that have a significant positive relationship with capital gains. However, since price changes *on identical units* can not be readily observed, they had to compile a "synthetic" series.

Since the housing market is one consisting of heterogenous goods, which trade infrequently, and repeated sales are not common, it was necessary to construct a "synthetic" time series of price data using hedonic methods. Basically, the method of doing so involves looking at an actual pool of observed sales, and reconstructing a historical path of implied prices. Pools of sales data from previous periods are used to impute the historical price of a unit based on its vector of housing attributes. So, even though a given unit did not sell during those previous periods, its implied price can be derived. Dale-Johnson and Phillips use such a technique on 3,473 housing units that sold in the fourth quarter of 1977. They impute 18 previous months of prices.

Figure D.1 depicts such a price path, where P_j^{T-t} is the selling price of housing unit j in period $T-t$. "*" denotes the actual (observed) sales price, while the other terms are imputed prices. Note that for any period, the imputed price is based on transactions that actually occurred in that period.

Their model looks like a standard hedonic equation with an added appreciation component.

$$(D.1) \quad P_j^T = \sum_i X_{ij} \beta_i^T + Z_j b + [\text{error}]_j^T$$

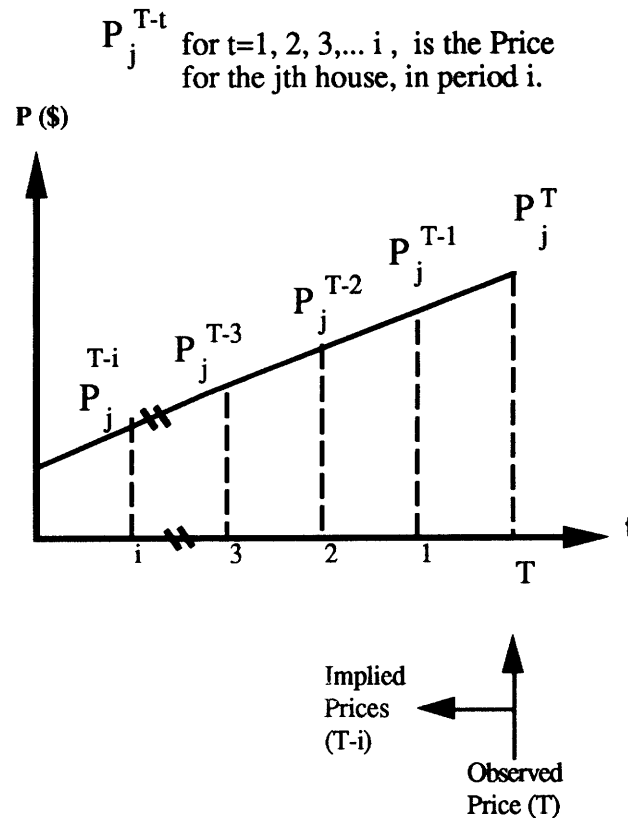


Figure D.1

(Source: Adapted from Dale-Johnson and Phillips, 1984)

Equation (D.1) says that the price of housing unit j at time T is a function of the amount of each i^{th} attribute (X_i) plus an appreciation on each attribute (vector Z_j) and an error term. X_{ij} is the quantity of the i^{th} attribute on the j^{th} house, and β_i^T is the implicit price of the i^{th} attribute (coefficient). Finally, Z_j is the purchaser's expectation of appreciation, or future price changes, with b as its coefficient. More formally,

$$(D.2) \quad Z_j = E(P_j^{T+1} - P_j^T)$$

Their model assumes market efficiency and backward looking consumers in housing. Namely, they have

$$(D.3) \quad E(P_j^{T+1} - P_j^T) = E(\sum X_{ij}\beta_i^T r_i) = P_j^T - P_j^{T-1}$$

That is, the expectation on future price changes is based on historical price changes.

Using Equation (D.3) the future price P_j^{T+1} can be written as follows:

$$(D.4) \quad P_j^{T+1} = \sum X_{ij}\beta_i^T(1+r_i) + Z_j b + [\text{error}]^{T+1}$$

By subtracting P_j^T from P_j^{T+1} one can obtain an expression for the price difference.

$$(D.5) \quad P_j^{T+1} - P_j^T = \sum X_{ij}\beta_i^T r_i + [\text{error}]$$

Finally it is possible to regress attributes (X_{ij}) onto price differences $P_j^{T+1} - P_j^T$ to see which attributes affect appreciation most significantly.

An Alternative Model

Let the value of the house equal V_0 at time $t=0$, or t_0 . This may represent the purchase price at that point, or an appraised value, but it is the base price from which our discussion of "appreciation" begins. Spatial differences in median sales prices, changes in quality, real incomes, regional differences in the growth of income and employment, contribute to a difference between what many call median home price and what economists call the asset price of housing. Hence, my discussion of housing appreciation starts with the "asset price of housing."

Appreciation is assumed to have several components, which in practice may not be distinguishable from each other. For the purpose of discussion, we assume that appreciation has components of inflation, price level, and interest rates. The inflation portion reflects the popular notion that housing prices are positively correlated with

inflation. In other words, houses are tangible assets which provide a good inflation hedge. Housing prices have been noted to both outpace as well as lag inflation, but nevertheless it is reasonable to assume that there is some positive correlation. This can be considered the systematic portion of housing appreciation - all houses are exposed to the same amount of inflation.

There is also some evidence that different houses appreciate at different rates. (See, for example, Delaney and Seward, (1991)) To capture this element, we assume rate of appreciation is also a function of price level. More expensive homes may exhibit greater price volatility than cheaper ones. This may be considered the unsystematic portion of appreciation. It is the specific attributes of the home, reflected in its price, which for some reason affect its tendency to appreciate (or depreciate). (See Dale-Johnson, 1983, and Dale-Johnson and Phillips, 1984)

Finally, there is an interest rate component to appreciation.(See Harris, 1989) This is included to represent the notion that divestment from housing occurs as real interest rates rise. Similarly, as (nominal) interest rates rise, housing becomes more difficult to qualify for, demand for housing drops, and prices may drop as well. However, this may be competing with the tax structure effects. As interest rates rise, there are greater deductions to be had. At the same time, there is a relationship between the inflation portion of nominal rates and the shift of capital from financial assets (bonds, stocks, debt holdings) to tangible assets such as housing (jewelry, antiques, art, etc.).

These three components are actually not independent of each other. Admittedly, there is a complex set of causalities between inflation, interest rates, housing prices, and rates of appreciation, but for the sake of simplicity some assumptions must be made.

Hence, we have appreciation as a function of inflation, interest rate, and price.

APPENDIX E

RESTRICTIONS AND RECIPROCITIES Effects of Historical Districting on Property Values

Assessing the effects of historical districting on land values is not a trivial problem, due to the competing effects of *restrictions* and *reciprocities* inherent in the policy. The *restriction* is the negative effect associated with constraints on property rights. The *reciprocity* is the positive externality associated with the prestige, stability and predictability owners within the district enjoy. The restriction reduces value. The reciprocity enhances value.

Both academic and popular opinions about the net effect of districting have changed. The early hedonic literature (on Richmond, VA, Washington D.C., Chicago, Savannah, GA, and others) tends to be statistically inconclusive and flawed. Still, the belief was that property values within historic districts rose faster than those not under such designation. However, Gale (1991) points out these studies, like several more recent ones, failed to show direct causality. As experience with historic designation spread, more recent studies (on Boston, MA, Brooklyn, NY, and Washinton, D.C.) failed to show, conclusively, that either property values rose faster after designation than before, or that they rose faster than non-designated neighborhoods. Some of the studies remain biased. For example, the Washington D.C. study relied on property tax assessment data rather than sales data. (Gale, 1991) Gale concludes that , "there is little support for the belief that designation, per se, significantly affects the economic value of real estate.

Yet, there is concurrence that the intricate processes of rapid property turnover, speculation, arbitrage, rehabilitation, and reinvestment associated with revitalizing neighborhoods and historic preservation movements do indeed inflate property values. "

In

fact, he points out that in many cases, designation often follows, rather than precedes, many of these speculative elements and redevelopment efforts.

Asabere and Huffman (1991) find different results. They examined the effect of historic districting, as defined and protected by the National Trust for Historical Preservation. Their study area was Philadelphia, whose historic district ordinance is less restrictive, in terms of public powers and specific design criteria, than similar ordinances in other cities (i.e. New York, New Orleans, Washington D.C.) Using standard hedonic pricing methods, they show that historic districting has tremendous positive impacts on residential land, but insignificant impacts on other-than residential land. Though the effects of zoning ordinances can vary regionally, where restrictions are not "severe" (Philadelphia serving as example) the positive externalities can be expected to overwhelm the negative restrictions. For example, residential parcels in Philadelphia attracted a 131% price premium.

APPENDIX F

THE HOME IMPROVEMENT DECISION

Given the various models of price appreciation covered in Appendix D, and the ability of households to control, to some degree, their house appreciation, we focus in this Appendix on the question of how housing improvement decisions are made. Clearly, decision to undertake home improvements affect the observed house price path.

The question is, do households undertake improvements in order to recapture their investment in appreciation? Or, do household have different motivations for deciding to improve their homes?¹² This necessarily involves dealing with the difficult housing investment-consumption duality.

As was pointed out in Chapter 4 housing can be considered a compound good. When a homeowner decides to spend I dollars at a point in time t , in a house valued at $V_t = V(t)$, the decision is at once an investment decision and a consumption decision. The homeowner considers whether the investment today will result in both immediate price appreciation ("stock") and an incremental rise in utility or housing service ("flow").

As an investment decision, the homeowner considers the added market value associated with the investment of I_t . There is a relationship between the investment I_t and the market value of that investment. The former is a "cost," while the latter is a "value." The relationship between the two is reflected by the amount the house appreciates, due directly to the investment. This is represented by the change in value ΔV_t , at a point in time t , namely,

¹² This discussion excludes maintenance decisions. While improvements may be considered value enhancing, maintenance is more an attempt to reverse natural depreciation. I think a different set of parameters govern the improvement decision versus the maintenance decision.

$$(F.1) \quad \Delta V_t = V_{t+1} - V_t$$

Assuming ΔV_t is directly attributable to the placement of I_t dollars in the house, we can assume a relationship between the two,

$$(F.2) \quad \frac{I_t}{V_t} = P_I$$

where P_I represents the percentage investment placed in the house. It is the ratio of dollars of investment to dollars of value at any given point. Furthermore, we assume,

$$(F.3) \quad \Delta V_t = V_{t+1} - V_t = pV_t$$

and

$$(F.4) \quad V_{t+1} = V_t (1+p)$$

If $p < P_I$, the appreciation was proportionately less than the investment. If $p > P_I$, the appreciation exceeded the investment. Finally, if $p = P_I$, the investment was recovered through capital appreciation.

Note that even if $p < P_I$, homeowners may still put the investment in place since the decision is not entirely an investment decision. There is also an increase in utility reflected by a stream of higher imputed rents. For example, a pool which costs $I_t = \$10,000$ to put into a \$100,000 house ($P_I = 10\%$) may only result in immediate price appreciation of $\Delta V_t = \$5,000$, only a $p = 5\%$ increase in value. The fact that $p < P_I$ in the case of most pool investments does not stop most homeowners from putting one in. They get more than the \$5,000 in appreciation, they also get the added utility from swimming daily. Were they to rent a house with a pool, they would pay ΔR_I ("imputed rent") more than they would for an identical house without a pool. Furthermore, even if

both the higher imputed rent and appreciation together still do not exceed I_t , homeowners may still decide to invest. There are decisions which affect real options which are not explicitly accounted for in the formulations - such as strategic considerations and positive externalities. (See Trigeorgis, 1986) In our pool example, if the family were aware of an ordinance being debated which would halt swimming pool construction (perhaps due to a severe drought), the improvement decision may become strategic. They may not recover the cost through appreciation, nor get swimming enjoyment from the pool, but make a strategic decision to build a pool while the local zoning still allows it.

Remember that I_t reflects a "cost" while ΔV_t reflects a "value." Cost is a supply-side attribute, associated with the inputs to production. The value is a demand-side attribute, associated with consumers' willingness to pay. This in turn is a function of their utility maximizing behavior under budgetary constraints.

As a consumption decision, a homeowner considers the added personal value associated with the investment of I_t . When the homeowner spends I_t dollars in improvements, the consumption part of the decision is based on the incremental housing services obtained for that money. This is measured as a change in the "imputed rent," ΔR_I . As illustrated through the pool example above, the imputed rent is a sort of "shadow rent" series which the homeowner would be willing to pay for the housing services received were he/she renting instead of owning. While there is no necessary functional relationship between the investment and the change in imputed rent, one can think of a "flow" ΔR_I associated with a "stock" I_t .

There is no obvious functional relationship between I_t and ΔR_I . However, in an ideal market, where (a) there are no excess profits, (b) all goods clear the market, and (c) the market price is equal to the inputs to the lowest cost producer, one may expect that the investment I_t would be equal to the sum of the discounted future imputed rent series. Housing investment costs would be approximated by the coupon on a perpetuity with I_t

as the face value: $I_t = \Delta R_I / r$. The "flow" of enjoyment or utility gained by the investment is that which it would take to capitalize the investment over its lifetime (which would be infinite).

There has been an increase in home improvements in recent years. Figure F.1 below shows the remodelling expenditures observed between 1979-1990. It shows how overall expenditures have increased by 250% since 1979 alone. Additions and alterations, which is of particular interest in the context of home improvements and price appreciation, have increased over 100%.

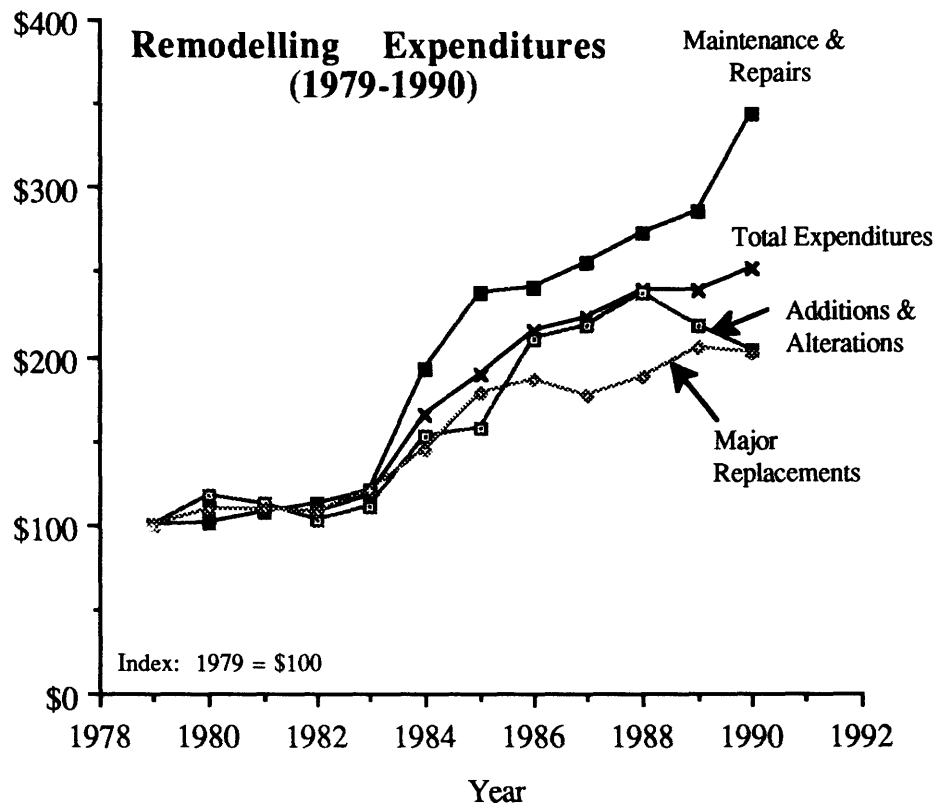


Figure F.1

(Source: U.S. Bureau of the Census, Construction Reports Series C-25, NAHB)

The topic of a recent article by Publishers Weekly was the boom in home improvement spending by the American homeowner. (Robert Dahlin, June 22, 1992) The article centers around a substantial increase in interest, felt by publishers, for a category of how-to books catering to an "indefatigable corps of American homeowners" who have

apparently spent more than two and a half times as much for tools and materials to improve their places of residence than nine years earlier.

The most common explanation offered for the much-increased energy and funds spent on refurbishments is that in a tight economy, nervous consumers don't easily chase after new houses; rather, they alter and fix what they've got - the better to live in or the better to sell (Robert Dahlin, June 22, 1992)

Dahlin points out that part of what makes consumers "nervous" is "economic uncertainty and fluctuating real estate values." Indeed, there has been much price fluctuation in the single-family market. Consumer Reports Books executive editor Sarah Uman reports that 83% of the subscribers are single-family homeowners. Perhaps owners of smaller, older homes have greater potential gains through improvement. (See also Mendelsohn (1977) and Myers (1984))

APPENDIX G

FEASIBILITY ANALYSIS

This Appendix establishes the general feasibility of the financial vehicle proposed using a very simplified numerical example.

Let us assume that the price of the house at time $t=0$ is equal to \$100,000. (The national existing median home price in 1991 was \$100,300.) Furthermore, let us define the following variables,

T = Term to maturity = 10 years
 r = discount rate = 18%
 C_0 = premium received at t_0 = \$5,000

Assuming a zero-coupon bond which is "sold by the homeowner" for a premium C_0 at time t_0 , the amount due at maturity would be

$$(G.1) \quad \$5,000 * (1.18)^{10} = \$26,169.17$$

Over the term of 10 years, the house would have to appreciate by \$26,269.17, or 26.2% (or 2.35% annually) in order for the bond holder's positions to be secured by the equity in the house. Of course, this would be the case if the bond holder were given 100% of the appreciation.

Assuming the bond holder wanted 50% of the appreciation to cover the payment at maturity, we would require,

$$(G.2) \quad (V_{10} - V_0) * 0.5 = \$26,169$$

or $V_{10} = \$152,338$. That is a 52.34% appreciation over the 10 years (or 4.3% annually). Quite simply, when the share of the appreciation is cut in half, it would take twice the total appreciation rate to cover the bond holder under the same terms.

Figure G.1 on the following page represents a family of curves, each with a different annual appreciation. Each curve represents a set of possible ratios of share of appreciation (%) to premium (%), or A/ρ , which would meet the lender's discount rate for a given amount of time under a "zero-coupon shared appreciation mortgage."

In general, we have,

$$(G.3) \quad \alpha_T = \frac{C_0(1+r)^T}{(A)(V_0)}$$

where,

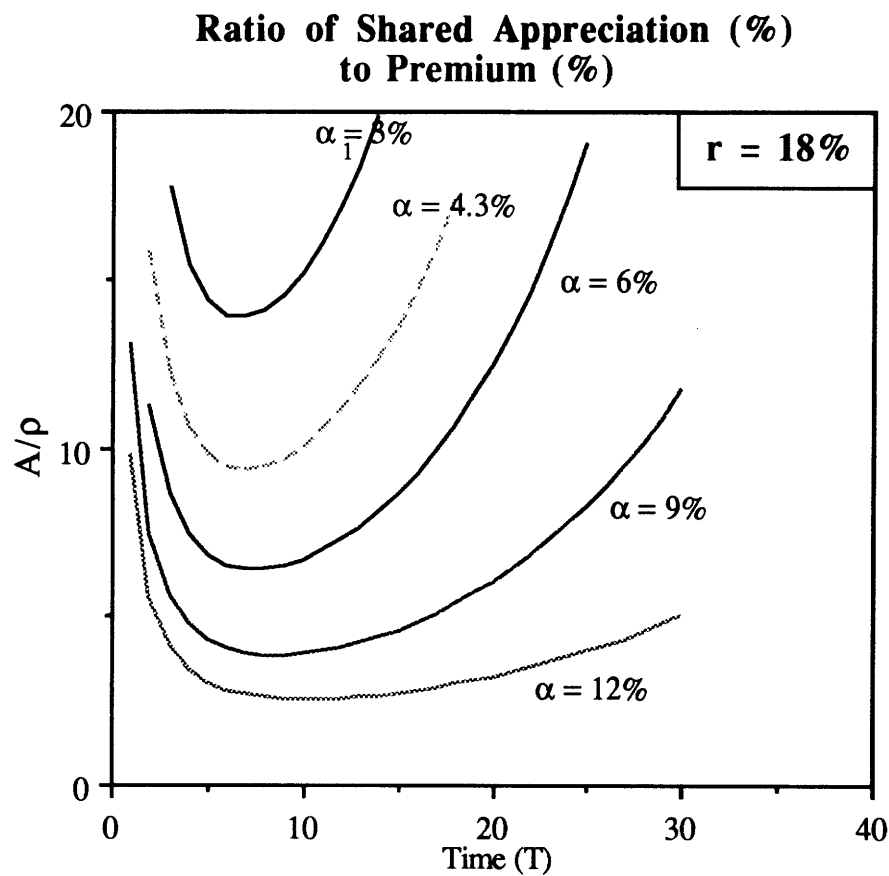
α_T = appreciation rate over the term T
 A = share of the appreciation (%)
 V_0 = Value of the home at t_0

By substituting,

$$(G.4) \quad \rho = \frac{C_0}{V_0}$$

where ρ is the premium as a percent of the original value, Equation (G.3) can be simplified to,

$$(G.5) \quad \alpha_T = \frac{\rho(1+r)^T}{(A)}$$



From the relationship,

$$(G.6a) \quad (1+\alpha_1)^T = 1+\alpha_T$$

we have the interest rate conversion equations,

$$(G.6b) \quad \alpha_T = (1 + \alpha_1)^T - 1$$

$$(G.6c) \quad \alpha_1 = (1 + \alpha_T)^{1/T} - 1$$

which convert from the total appreciation rate, α_T to the annual appreciation rate, α_1 . By substituting (G.6b) into (G.5) and rearranging, we obtain the following relationship:

$$(G.7) \quad \frac{A}{\rho} = \frac{(1+r)^T}{[(1+\alpha_1)^T - 1]}$$

The term on the left hand side of Equation (G.7) is the ratio of the share of appreciation to the premium as a percent of value. So, in the example above, where there was a 50% share of appreciation and a 5% premium, the A/ ρ ratio would be 5.

A feasible contract would be one with,

- Share of Appreciation: $10\% < A \leq 100\%$
- Premium as a % of Value: $5\% < \rho < 20\%$
- Discount Rate:¹³ $13\% < r < 24\%$
- Annual Housing Appreciation:¹⁴ $3\% < \alpha_1 < 12\%$
- Term to Maturity: $5 \text{ years} < T < 30 \text{ years}$

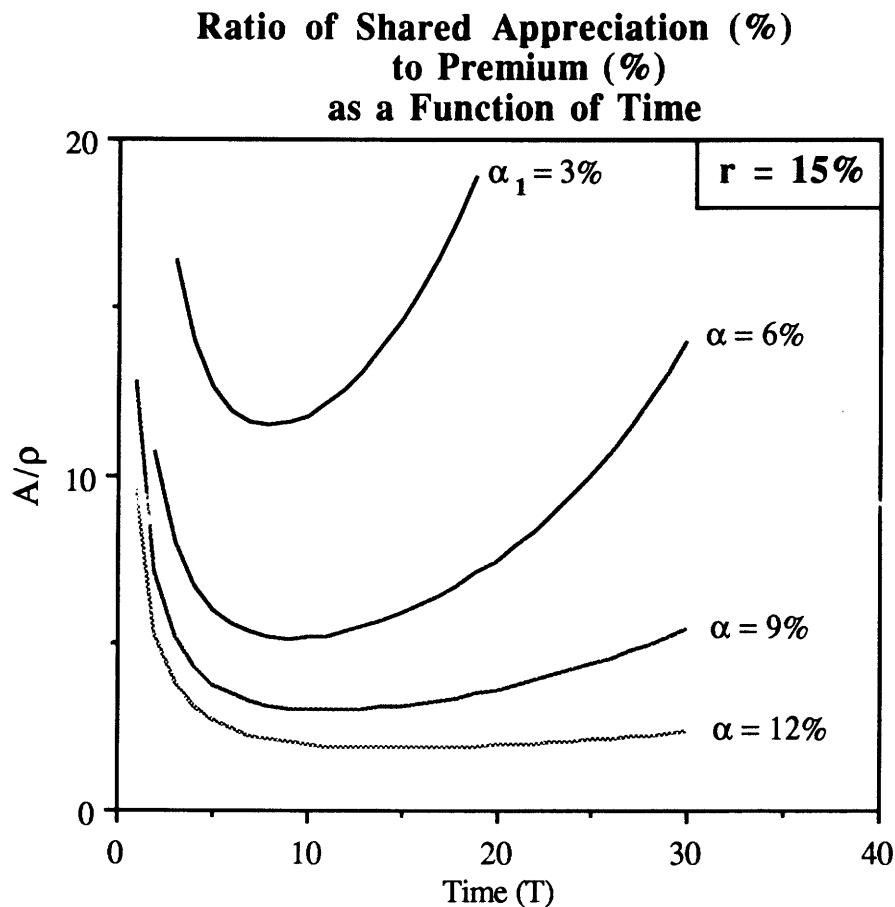
Comparative Statics

Equation (G.7) is a deterministic relationship between the share of appreciation required, the percentage premium paid, the bond holder's discount rate, the term to maturity, and the annual appreciation rate on housing. That is, all the variables are specified, rather than allowed to vary stochastically. Uncertainty is considered only through the discount rate, rather than through assuming probabilistic distributions on separate variables in a contingent claims type framework.

¹³ This rate must be higher than the levered, nominal rates of return observed on owner-occupied housing, to reflect the greater risk of debt, and especially higher due to the zero-coupon element. Levered returns on equity can, like other housing measures, vary significantly. Estimates of 10-15% are reasonable. (See Hendershott and Hu, 1981)

¹⁴ Annual existing median price appreciation rates can vary considerably, depending on the index employed, the time period observed, the region, and the submarket. For example, between 1970-1990, California median prices rose 800% in total, or 11% per year (in nominal terms). (See Sahling and McDonough, 1988) By contrast, the U.S. existing median increased by 61.25% between 1980-1991, or 4.4% annually. (See NAHB Home Sales Data) In a more extreme example, between 1983-1986, the Northeast corridor posted price increases approaching 40% per year. (See Case and Cook, 1988) Still another measure, Pollakowski, Stegman and Rohe (1991) looked at annual rates of appreciation for the 1974-1983 period through local, disaggregated hedonic price indexes. Their preliminary results showed no significant difference in appreciation rates between lower valued homes (lowest 20% of local distribution) and the highest 60% homes. Their reported appreciation rates ranged from 8.7% (high valued homes in Washington D.C.) to 12.6% (lowest valued homes in Baltimore).

As Equation (G.7) shows, for a given percentage premium, additional share of the appreciation would be required as the discount rate increases, or as the expected annual housing appreciation decreases. The ratio varies parabolically with time. These relationships are captured in the Figures below.



Figures G.2 and G.3 show a set of A/p curves for $r=15\%$ and $r=18\%$ respectively. They illustrate that for higher interest rates, the feasibility of the contract, measured by a low A/p , is more sensitive to the annual appreciation rate α_1 . As the interest rate increases, the family of feasibility curves shift up substantially. That is it would take a much higher A/p to satisfy investor returns, so that a higher annual appreciation α_1 would be required.

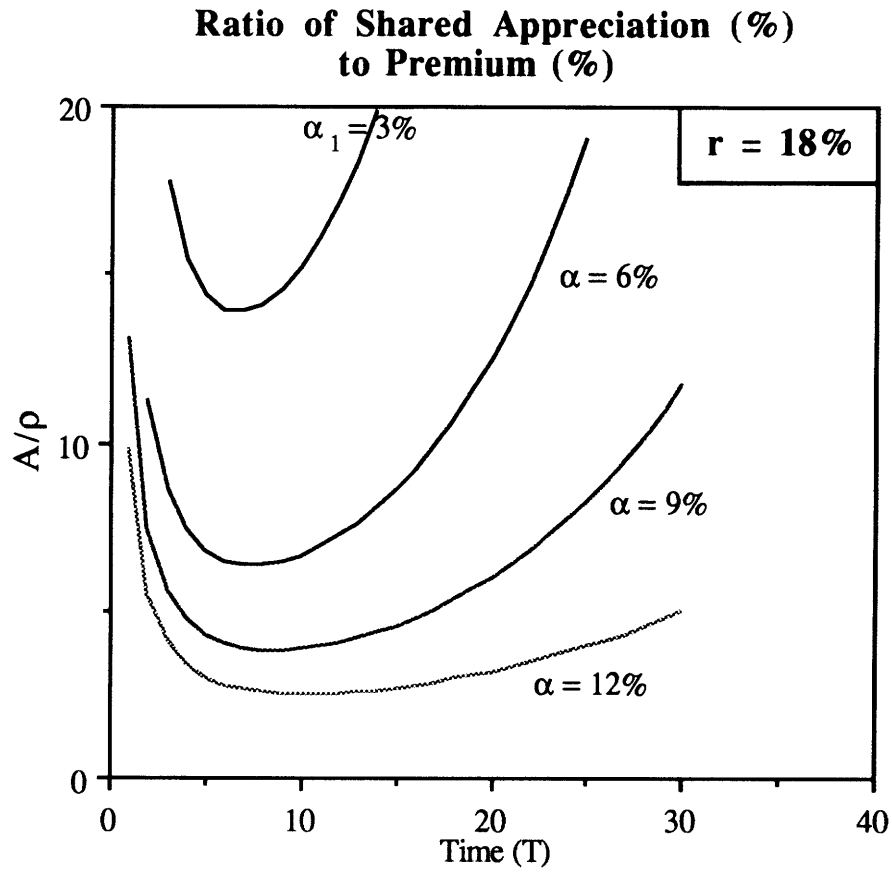


Figure G.3

Figure G.4 below shows a set of A/p curves for a given annual appreciation rate of 10% and varying discount rates.

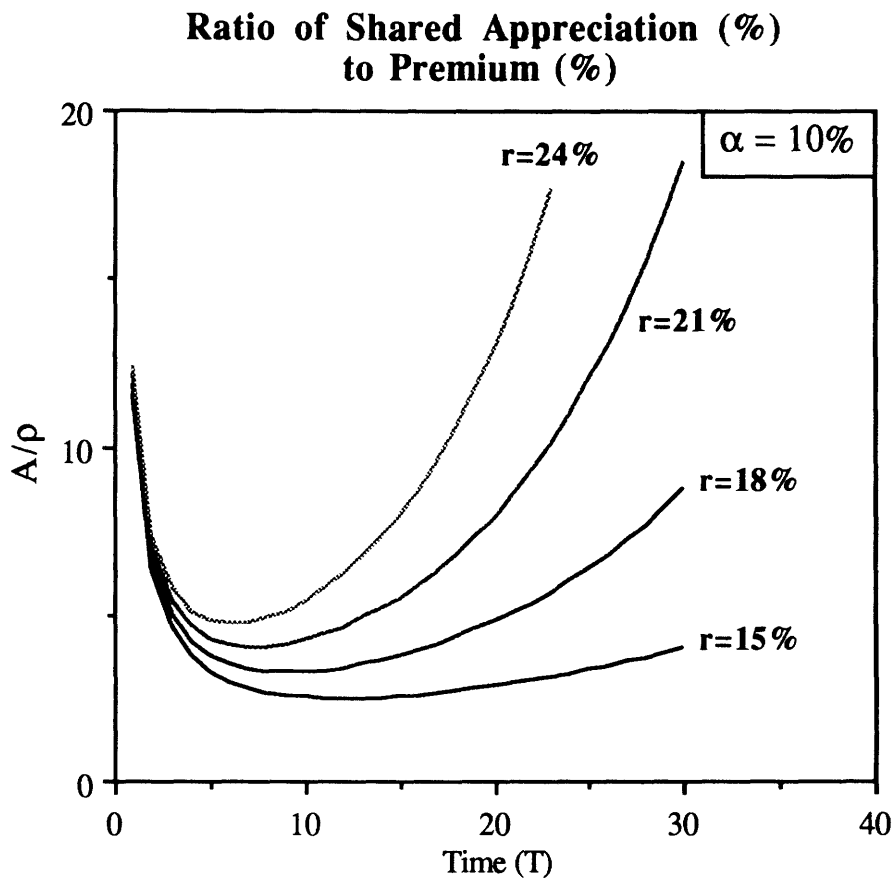


Figure G.4

LIST OF REFERENCES

- Henry Aaron, Shelter and Subsidies, Brookings Institution, Washington D.C., 1972.
- Jesse M. Abraham, "Are Home Prices Too High?" **Secondary Mortgage Markets**, Fall 1989.
- Jesse M. Abraham and William S. Schauman, "New Evidence on Home Prices from Freddie Mac Repeat Sales," **AREUEA Journal**, Vol 19, No 3, pp 333-352, 1991.
- E.P. Achtenberg and P. Marcuse, "The Causes of the Housing Problem," from Bratt *et al.* (eds.) Critical Perspectives on Housing, pp 4-11, Temple Press, Philadelphia, 1987.
- William W. Alberts and Halbert S. Kerr, "The Rate of Return from Investing in Single-Family Housing," **Land Economics**, Vol 57, No 2, pp 230-242, May 1981.
- William C. Apgar Jr., "The Nation's Housing: A review of Past Trends and Future Prospects for Housing in America," MIT Housing Policy Project , 1987-88, HP#1.
- P.K. Asabere, G. Hachey, S. Grubaugh, "Architecture, Historic Zoning, and the Value of Homes," **Journal of Real Estate Finance and Economics**, Vol 2, pp 181-195, 1989.
- Paul K. Asabere, and Forrest E. Huffman, "Historic Districts and Land Values," **The Journal of Real Estate Research**, Vol 6, No 1, Spring 1991.
- William C. Baer, "The Shadow Market in Housing," **Scientific American**, Vol 255, No 5, pp 29-35, November, 1986.
- Vladimir Bajic, "Urban Housing Market Modelling: Short-Run Equilibrium Implications," **AREUEA Journal**, Vol 11, No 3, pp 416-438, 1983.
- Emanuel Bar-Or, "The Use of Options in Construction," MIT Masters Thesis, 1984.
- Timothy J. Bartik, "Measuring the Benefits of Amenity Improvements in Hedonic Price Models," **Land Economics**, Vol 64, No 2, May, 1988.
- Stafford L. Battle, "Manufactured Homes," An Affordable Alternative?" **Journal of Housing**, December 1990.
- Charles Colby Bent II, "The Manufactured Home as an Affordable Housing Option," MIT Master's Thesis, Center for Real Estate Development, 1989.
- Fischer Black and Myron Scholes, "The Pricing of Options and Corporate Liabilities," **Journal of Political Economy**, Vol 81, pp 637-659, 1973.
- Fischer Black, "How to Use The Holes in Black-Scholes," from The Handbook of Financial Engineering (Clifford W. Smith Jr., ed.) pp 304-315, 1990.

-
- H. Parket Blount and C. F. Sirmans, "Lease to Own: A Marketing Strategy for Single-Family Homes," **Real Estate Review**.
- Richard M. Bookstaber, Option Pricing and Investment Strategy, 3rd edition, Probus Publishing, Chicago, 1991.
- Richard A. Brealey, Stewart C. Myers, Principles of Corporate Finance, 3rd edition, McGraw Hill, New York, 1988.
- Robert L. Brown and Dominique Achour, "The Pricing of Land Options," **Urban Studies**, vol 21, pp 317-323, 1984.
- William B. Brueggeman, Jeffrey D. Fischer, Leo D. Stone, Real Estate Finance, 8th edition, Irwin Publishers, Boston, 1989.
- James F. Burgess Jr. and Oskar R. Harmon, "Specification Tests in Hedonic Models," **Journal of Real Estate Finance and Economics**, Vol 4, No 4, 1991.
- Phillip Cagan, "Measuring Quality Changes and the Purchasing Power of Money," in **Price Indexes and Quality Change**, Harvard University Press, Cambridge, 1971.
- Tim S. Campbell, Financial Institutions, Markets, and Economic Activity, McGraw Hill, New York, 1982.
- Dennis R. Capozza and Gregory M. Scwann, "The Asset Approach to Pricing Urban Land: Empirical Evidence," (with comments by Karl E. Case) **AREUEA Journal**, Vol 17, No 2, pp 161-174, 1989.
- Dennis R. Capozza, "The Value of Long-Term Leased Property," Working Paper, September 1991.
- Dennis R. Capozza and Kaushik Amin, "Seemingly Irrational Construction," Working Paper, June 1991.
- Dennis R. Capozza and Gordon A. Sick, "Pricing Risky Land: The Option to Redevelop," **Journal of Real Estate Finance and Economics**, Vol 4, No 2, June, 1991.
- Bradford Case, Henry O. Pollakowski, and Susan M. Wachter, "On Choosing Among Housing Price Index Methodologies," **AREUEA Journal**, Vol 19, No 3, pp 286-307, 1991.
- Karl E. Case and Robert J. Shiller, "Forecasting Prices and Excess Return in the Housing Market," **AREUEA Journal**, Vol 18 No 3, 1990.
- Karl E. Case and Robert J. Shiller, "The Efficiency of the Market for Single Family Homes," **The American Economic Review**, Vol 79, No. 1, pp 125-137, 1989.
- Karl E. Case and Robert J. Shiller, "The Distributional Effects of Housing Price Booms: Winners and Losers in Boston, 1980-88," **New England Economic Review**, pp 3-12, June, 1989.

-
- Karl E. Case and Robert J. Shiller, "The Behavior of Home Buyers in Boom and Post-Boom Markets," **New England Economic Review**, pp 29-46, December, 1988.
- Karl E. Case and Robert J. Shiller, "Prices of Single-Family Homes Since 1970: New Indices for Four Cities," **New England Economic Review**, pp 45-56, October 1987.
- R. Chiang, T.Y. Lai, and D.C. Ling, "Retail Leasehold Interests: A Contingent Claims Analysis," **AREUEA Journal**, Vol 14, No 2, pp 216-229, 1986.
- Peter Chinloy, "The Option Structure of a Mortgage Contract," **Journal of Housing Research**, Vol 2, No 1, pp 21-38.
- David E. Clark and James R. Kahn, "The Social Benefits of Urban Cultural Amenities," **Journal of Regional Science**, Vol 28, No 3, 1988.
- David E. Clark and James C. Cosgrove, "Hedonic Prices, Identification, and the Demand for Public Safety," **Journal of Regional Science**, Vol 30, No 1, 1990.
- John C. Cox, and S.A. Ross, "The Valuation of Options for Alternative Stochastic Processes," **Journal of Financial Economics**, No 3, 145-166, 1976.
- John C. Cox, Stephen A. Ross, and Mark Rubinstein, "Option Pricing: A Simplified Approach," from **The Handbook of Financial Engineering** (Clifford W. Smith Jr., ed.) pp 316-347, 1990 (originally in **Journal of Financial Economics**, Vol 7, pp 229-263, 1979).
- Glenn Crellin, "Housing Affordability Index - What It Is and Isn't," **Real Estate Issues**, Fall/Winter 1988.
- Robert Dahlin, "Home is Where the Sales Are," **Publishers Weekly**, pp 34-41, June 22, 1992.
- David Dale-Johnson, "Clientele Effects on the Demand for Housing Price Appreciation," **AREUEA Journal**, Vol 11, No 3, pp 382-396, 1983.
- David Dale-Johnson and G. Michael Phillips, "Housing Attributes Associated with Capital Gain," **AREUEA Journal**, Vol 12, No 2, pp 162-175, 1984.
- David Dale-Johnson, M.C. Findlay, A.L. Schwartz, Jr, and S.D. Kapplin, "Valuation and Efficiency in the Market for Creatively Financed Houses," **AREUEA Journal**, Vol 13, No 4, 1985.
- Charles J. Delaney and Allen J. Seward, "An Analysis of the Relationship Between Price and Variance for Homogeneous Housing Stock," **The Journal of Real Estate Research**, Vol 6, No 1, Spring, 1991.
- Phoebus F. Dhrymes, "Price and Quality Changes in Consumer Capital Goods: An Empirical Study," in **Price indexes and Quality Change**, Harvard University Press, Cambridge, 1971.

-
- Denise DiPasquale, "First-Time Homebuyers: Issues and Policy Options," HP #7.
- Anthony Downs, "High Housing Prices: A Worldwide Problem," **National Real Estate Investor**, pp. 40, December, 1988.
- Anthony Downs, "Low-Income Housing Problem is Too Big to Ignore," **National Real Estate Investor**, pp. 30, June, 1989.
- Peter Dreier, David C. Schwartz, and Ann Greiner, "What Every Business Can Do About Housing," **Harvard Business Review**, pp 52-61, October 1988.
- Borland East, "Paradise Lost: California House Prices Are Slumping," **Barron's**, July 23, 1990.
- R.C. Ellickson, Tarlock, A.D., Land-Use Controls, Little, Brown &Co., Boston, 1981.
- Stephen P. Ferris and Raman Kumar, "Mortgage Rates and the Pricing of Residential Housing," **Review of Business and Economic Research**, Vol 23, No 2, pp 63-68, 1988.
- Dan W. French and Richard L. Haney, Jr., "Pricing the Shared-Appreciation Mortgage in a Stochastic Environment," **Housing Finance Review**, Vol 3, No 4, pp 431-443, October, 1984.
- Dennis E. Gale, "The Impacts of Historic District Designation," **American Planning Association Journal**, Vol 57, No 3, Summer 1991.
- David Geltner, "Real Estate Risks and Returns: Some Fundamental Relationships," MIT Doctoral Dissertation, 1989.
- David Geltner, "On the Use of the Financial Option Price Model to Value and Explain Vacant Urban Land," (with comments by W.C. Wheaton) **AREUEA Journal**, Vol 17, No 2, pp 142-158, 1989.
- Robert Geske, "The Valuation of Compound Options," **Journal of Financial Economics**, No. 7, pp 63-81, 1979.
- H. Leroy Gill and Donald R. Haurin, "User cost and the Demand for Housing Attributes," **AREUEA Journal**, Vol 19, no 3, pp 383-395, 1991.
- Steven Grenadier, "The Persistence of Real Estate Cycles," working paper, Harvard Business School, 1991.
- D.M. Grether and P. Mieszkowski, "Determinants of Real Estate Values", **Journal of Urban Economics**, Vol 1, pp 127-146, 1974.
- Ira Gribin, "Promoting Home Ownership for First-Time Buyers," **The Real Estate Finance Journal**, pp 82-83, Fall 1989.
- William G. Grigsby, Housing Markets and Public Policy, pp 30-83, University of Pennsylvania Press, Philadelphia, 1968.

-
- Zvi Griliches, editor, Price Indexes and Quality Change: Studies in New Methods of Measurement, Harvard University press, Cambridge, 1971.
- Arden R. Hall, "Valuing the Mortgage Borrower's Prepayment Option," **AREUEA Journal**, Vol 13, no 3, 1985.
- Jack C. Harris, "The Effect of Real Rate of Interest on Housing Prices," **Journal of Real Estate Finance and Economics**, Vol 2, pp 47-60, 1989.
- Harvard Business School, "Option Pricing," No 9-286-112, 1986 (revised February, 1989).
- Patric H. Hendershott and S.C. Hu, "Inflation and Extraordinary Returns on Owner Occupied Housing: Some Implications for Capital Allocation and Productivity Growth," **Journal of Macroeconomics**, Vol 4, pp 177-203, 1981.
- Patric H. Hendershott and James D. Shilling, "The Economics of Tenure Choice, 1955-1979," **Research in Real Estate**, Volume 1, pp 105-133, 1982.
- Patric H. Hendershott, "Choices of a New Generation," **Secondary Mortgage Markets**, Winter 1987/88.
- Patric H. Hendershott and Thomas G. Thibodeau, "The Relationship between Median and Constant Quality House Prices: Implications for Setting FHA Loan Limits," **AREUEA Journal**, Vol 18, No 3, 1990.
- J. Ingersoll, "A Theoretical and Empirical Investigation of the Dual Purpose Funds: An Application of contingent Claims Analysis," **Journal of Financial Economics**, No 3, 1976.
- Werner Jammerneegg, Sequential Binary Investment Decisions, Springer-Verlag, Berlin, 1988.
- Lawrence D. Jones, "Current Wealth and Tenure Choice," **AREUEA Journal**, Vol 17, No 1, pp 17-40, 1989.
- Robert N. Jones and Stephen D. Roach, "Valuation of Long Term Leases," **The Appraisal Journal**, pp 451-459, October, 1989.
- G. Donald Jud, "The Effects of Zoning on Single-Family Residential Property Values: Charlotte, North Carolina," **Land Economics**, Vol 56, No 2, pp 142-154, May 1980.
- G. Donald Jud, "A Further Note on Schools and Housing Values," **AREUEA Journal**, Vol 13, No 4, pp 452-562, 1985.
- Ravi Kamath, "The NAR's Housing Affordability Index," **Real Estate Review**.
- Ravi Kamath, "The Measurement of Housing Affordability," **Real Estate Issues**, pp 23-33, Fall/Winter 1988.
- Langley C. Keyes, Denise DiPasquale, "Housing Policy for the 1990's," HP #0.
- John D. Landis, "Land Regulation and the Price of New Housing," **American**
-

-
- Planning Association Journal**, pp 9-21, Winter 1986.
- Michael Lea, "Housing and the Capital Markets," HP #8.
- James, H. Leigh, "Homeowner Satisfaction and Preferences: A Survey," **The Journal of Real Estate Development**, Vol 1, No 4, pp 43-49, Spring 1986.
- Donald L. Lerman and William J. Reeder, "The Affordability of Adequate Housing," **AREUEA Journal**, Vol 15, No 4, pp 389-404, 1987.
- Mingche M. Li, and H. James Brown, "Micro-Neighborhood Externalities and Hedonic Housing Prices," **Land Economics**, Vol 56, No 2, pp 125-141, May, 1980.
- David T. Maddock, "Meeting the Market with Manufactured Housing," **The Journal of Real Estate Development**, Vol 5, No 1, pp 34-37, Summer 1989.
- Saman Majd, Robert S. Pindyck, "Time to Build, Option Value, and Investment Decisions," **Journal of Financial Economics**, No 19, pp 7-27, 1987.
- Paul B. Manchester, "In the 1990's, Real Home Prices Aren't Likely to Decline," **Savings Institutions**, November 1989.
- Thomas C. Marcin and John Kokus Jr., "Economic and Demographic Factors Affecting Housing Demand into the 1980's and 1990's," **AREUEA Journal**, Winter 1975.
- William Margrabe, "The Value of an Option to Exchange One Asset for Another," **The Journal of Finance**, Volume 33, No 1, pp 177-186, March 1978.
- Jonathan H. Mark, "An Empirical Examination of the Stability of Housing Price Equations Over Time," **AREUEA Journal**, Vol 11, No 3, 1983.
- Robert McDonald and Daniel Siegel, "The Value of Waiting to Invest," **Quarterly Journal of Economics**, November 1986.
- Robert Mendelsohn, "Empirical Evidence on Home Improvements," **Journal of Urban Economics**, Vol 4, pp 459-468, 1977.
- William Mendenhall, James E. Reinmuth, **Statistics for Management and Economics**, 2nd edition, Duxbury Press, Massachusetts, 1974.
- Norman G. Miller, "Residential Property Hedonic Pricing Models: A Review," in **Research in Real Estate**, JAI Press, 1982.
- Robert C. Merton, "Theory of Rational Option Pricing," **Bell Journal of Economics and Management Science**, Vol 4, No 1, pp. 141-183, 1973.
- Dowell Myers, "Turnover and Filtering of Postwar Single Family Houses," **APA Journal**, pp 352-358, Summer 1984.
- Robert C. Merton, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," **Journal of Finance**, No 29, pp 449-470, 1974.

-
- Dowell Myers, "Housing Allowances, Submarket Relationships, and the Filtering Process," **Urban Affairs Quarterly**, Vol 11, No 2, pp 215-240, December, 1975.
- National Housing Task Force, **A Decent Place to Live**, Washington D.C., 1988.
- Dowell Myers, "Extended Forecasts of Housing Demand in Metropolitan Areas: The Coming Downturn," **The Appraisal Journal**, Vol 55, No 2, pp 268-278, April, 1987.
- T.R. Nelson and J. Rabianski, "Consumer Preferences in Housing Market Analysis: An Application of Multi-dimensional Scaling Techniques," **AREUEA Journal**, Vol 16, No 2, pp 138-159, 1988.
- Terence P.Pare, "Does It Still Pay to Own a House?" **Fortune**, July 30, 1990.
- Joe Peek and James A. Wilcox, "The Measurement and Determinants of Single-Family House Prices," **AREUEA Journal**, Vol 19 No 3, pp 353-382, 1991.
- Constance Perin, **Everything in its Place: Social Order and Land Use in America**, Princeton University Press, New Jersey, 1977.
- H.O. Pollakowski, M. A. Stegman, W. Rohe, "Rates of Return on Housing of Low- and Moderate-Income Owners," **AREUEA Journal**, Vol 19, No 3, 1991.
- Sherwin Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," **Journal of Political Economy**, Vol 82, pp 34-55, 1974.
- Frederick E. Rowe, "We've Heard That Song Before," **Forbes**, February 19, 1990.
- Leonard Sahling and Catherine McDonough, "Home Sweet Home," **Economic & Financial Special Report**, Merrill Lynch, October 1988.
- David C. Schwartz and Daniel Hoffman, "Employers Help with Housing," **The Journal of Real Estate Development**, Vol 5, No 1, pp 18-22, Summer 1989.
- Seymour I. Schwartz, David E. Hansen, and Richard Green, "The Effect of Growth Control on the Production of Moderate-Priced Housing," **Land Economics**, Vol 60, No 1, February 1984.
- A. G. Shilling, "Home Not-So-Sweet Home," **Forbes**, February 19, 1990.
- J.D. Shilling, J.D. Benjamin, and C.F. Sirmans, "Contracts as Options: Some Evidence from Condominium Developments," **AREUEA Journal**, Vol 13, No 2, 1985.
- J.D. Shilling, C.F. Sirmans, and K.A. Guidry, "The Impact of State Land-Use Controls on Residential Land Values," **Journal of Regional Science**, Vol 31, No 1, pp 83-91, 1991.
- Daniel R. Siegel, James L. Smith, James L. Paddock, "Valuing Offshore Oil Properties with Option Pricing Models," **Midland Corporate Finance Journal**, Volume 5, No. 1, Spring 1987.
-

-
- Daniel R. Siegel, James L. Smith, James L. Paddock, "Option Valuation of Claims on Real Assets: The Case Of Offshore Petroleum Leases," **The Quarterly Journal of Economics**, August 1988.
- Brian P. Smith, "Housing is Eyed as Tax-Advantaged and Due for a Cutback," **Savings Institutions**, pp. 34, August, 1991.
- Clifford W. Smith, Jr, "Option Pricing: A Review," from The Handbook of Financial Engineering (Clifford W. Smith Jr., ed.) pp 255-299, 1990.
- Clifford W. Smith and Charles W. Smithson, Handbook of Financial Engineering, Harper & Row, New York, 1990.
- L.B. Smith, K.T. Rosen, G. Fallis, "Recent Developments in Economic Models of Housing Markets," **Journal of Economic Literature**, Vol 26, pp. 29-64, March, 1988.
- Carol Steinbach, "The Hourglass Market," **The National Journal**, pp 568-572, October, 1990.
- Rene M. Stulz, "Options on the Minimum or the Maximum of Two Risky Assets," **Journal of Financial Economics**, Vol 10, pp 161-185, 1982.
- Ron Treschitta, "Residential Land Price Inflation," **Urban Land**, pp 6-9, March, 1986.
- Lenos Georgiou Trigeorgis, Valuing Real Investment Opportunities: An Options Approach to Strategic Capital Budgeting, PhD Dissertation, Harvard University, 1986.
- Kerry D. Vandell and Jonathan S. Lane, "The Economics of Architecture and Urban Design: Some Preliminary Findings," (comments by John F. Kain), **AREUEA Journal**, Vol 17, No 2, pp 235-260, 1989.
- William C. Wheaton, "A Bid Rent Approach to Housing Demand," **Journal of Urban Economics**, no 4, 1977.
- Joseph T. Williams, "Real Estate Development as an Option," **Journal of Real Estate Finance and Economics**, Vol 4, No 2, pp 191-208, 1991.
- Michael L. Wilson, "Vigorous Responses Can Crack the Slump in Homeownership," **Savings Institutions**, October, 1991.
- Arthur L. Wright, "Equity Participation: Sharing Homeownership," **Real Estate Center Journal**.
- F.C. Zinkhan, "Option Pricing and Timberland's Land-Use Conversion Option," **Land Economics**, Vol 67, No 3, pp 317-325, August, 1991.
- Peter M. Zorn, "Mobility-Tenure Decisions and Financial Credit: Do Mortgage Qualification Requirements Constrain Homeownership?" **AREUEA Journal**, Vol 17, No 1, pp 1-15, 1989.