

Single Family Housing and Inflation: The Risk-Return Tradeoff

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The purpose of this article is to present and analyze evidence on the actual rates of appreciation and the risk involved in owning a single family house in Lubbock, Texas during the 1970's. Differences in neighborhoods, house, and owner characteristics are identified according to their respective geographic area, and analyzed for differences in risk and appreciation rates. Significant variations were found in the rates of appreciation by geographic area.

In addition, those areas with the highest rates of appreciation and return also realized the greatest amount of risk. Reasons for variations in appreciation rates are discussed.

The decade of the 1970's has been characterized by substantial inflation in the American economy, which has led to the widespread and generally accepted belief that real estate is a good hedge against inflation. The most obvious examples that come to mind are single-family residences, perhaps because readily available statistics document that house prices, on the average, have far out-paced inflation over the last ten years. Owner's rates of return or appreciation based on equity have exceeded even the rate of appreciation of house prices, providing the typical homeowner with excellent, and perhaps the only, protection against inflation.

The concept of risk is certainly not new to people who use real estate as an investment me-

dium. Attempts to measure and/or identify risk have received and continue to receive a great deal of attention. It is generally accepted in real estate that value or price is largely a function of the expected rate of return and the risk associated with that investment. An investment with greater risk would be expected to produce a greater rate of return than an investment with lower risk, *ceteris paribus*. Since housing has appreciated rapidly during the 1970's, a house is now an investment as well as shelter and status to its owner or owners. However, the entire area of housing as an investment, in terms of its risks and returns, has received very little attention from researchers.

The general purpose of this paper is to present evidence on and analyze the actual rates of appreciation of single-family houses for the decade of the 1970's in Lubbock, Texas. More specifically, the rates of appreciation of houses priced for different census tracts within Lubbock will be measured to determine if there are differences between these rates of appreciation and risk. This will indicate whether home owners share equally

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in the inflation protection afforded by their houses or whether certain home owners benefit more than others. If there are different rates of appreciation across census tracts, the second objective will be to identify the neighborhood, house, and owner characteristics which account for or explain those differences.

Review of the Literature

Some of the earlier attempts to move risk and return from a qualitative or descriptive process into one of quantification were the works of Pellatt (1972), Pyhrr (1973), and Montgomery (1976). In those works, value, return, and risk were examined toward the end of being able to quantify the risk element in a real estate investment in order to enhance the decision-making process. That attempt did not end there. The efforts of Friedman (1976), Jackson (1977), Young (1977), and others tend to illustrate the significance in the risk-return problem. Miles (1978), and Wofford (1978) specifically addressed the question of adapting the Capital Asset Pricing Model (CAPM) from finance theory to real estate investments.

Ferri and McGee (1979), used an approach to risk-return not attempted by other authors. They used a standard financial measure of risk (Beta) and identified various housing characteristics which affect price and thus return.¹ Variables including age, size, and number of baths were subdivided into various categories and Beta Values and mean return were computed for each category. They concluded:

According to the study, the house which must be called the more attractive (i.e., the unit with greater size, more facilities, and so on), has more potential for price increases and for price fluctuations than the less well-appointed and smaller houses.

While the Ferri/McGee study is the first empirical research directly related to the risk and return of single-family houses as an investment, their data were selling prices of individual single-family houses. An examination of risk and return, mak-

ing use of the actual rates of appreciation of houses through the use of resale data, may lead to different results and conclusions.

Hypotheses

In analyzing the rates of price appreciation in housing, at least two important questions can be addressed. The first is related to the rate of inflation in house prices vis-a-vis the inflation rate in the economy. It is generally accepted that housing prices have outpaced the general inflation rate during the past decade. The reasons for this might include such factors as strong demand based on the changing age distribution of the population, i.e., increasing numbers of households reaching the traditional house buying age: the rising costs of construction materials and labor: and the availability and cost of mortgage money, which in real terms (the mortgage interest rate less the inflation rate) was quite low or negative during much of the 1970's. Finally, the growth rate of the local economy (and hence the housing market) relative to housing supply might be a factor.

A second question that can be addressed is whether all segments of the housing stock have appreciated at the same rate, i.e., have certain portions provided their owner with a better hedge against inflation than others. A hypothesis that could be tested might be that all segments of the housing stock have exceeded the inflation rate by the same amount. This second question in the one addressed in this paper.

Advancing theoretical propositions to explain differential rates of appreciation is complicated by the fact that each city is unique in its physical development and land use pattern. A theoretical explanation advanced for Lubbock would have considered Lubbock's characteristics, but hopefully factors or variables that are general in nature can be identified and tested so that the results of the analysis can be applied elsewhere. These variables include: the size and age of houses, neighborhood quality and house amenities,

changes in quality over time, characteristics of the owners, location factors, and the length of the holding or investment period. These factors, all of which might be expected to cause houses to appreciate at different rates, will be examined separately.

Age and Size of Houses

Since the improvements (houses) deteriorate over time, it might be expected that the older census tracts would have the lowest observed rates of appreciation, i.e., the rate of appreciation net of inflation should be lowest in the oldest census tracts. However, age also tends to be inversely related to house size, given the rising trend of real incomes in the post-World War II era and the consumption of housing as a luxury good. Thus, houses in older census tracts might also be smaller and therefore more affordable now to a larger segment of the housing market. This means that, during periods of declining purchasing power, the greater demand for smaller, older units should more than offset the depreciation factor. Houses in the oldest census tracts may have the highest rates of appreciation, and age may be positively correlated with the observed rates of appreciation.²

Quality of Neighborhood

It might be assumed that a "good" neighborhood should provide the greatest potential for appreciation. A stable or "good" neighborhood would be characterized, in general, by the houses having the highest selling price per square foot in contrast to a lower quality area with lower average square foot costs. Lower quality neighborhoods offer more possibilities (and risk) for land use or other changes over time such as the conversion of owner-occupied houses to rental property. According to finance theory, the greatest returns or rates of appreciation should be associated with the riskiest areas, as additional compensation to the property owners.³ Hence, the

counter-intuitive conclusion is reached that the "good" neighborhoods should have the lowest rates of appreciation and the "poor" neighborhoods or census tracts should have the highest rates of appreciation, since the return received is partly compensation for risk.

House Amenity Differences

Over time, new housing units have become larger and have more amenities, corresponding to the trend of rising real incomes. Amenities such as built-in kitchens, fireplaces, and central air conditioning are now standard features of new homes. Older homes lacking some or all of these features should be less desirable in the market place. Higher rates of appreciation should result for houses in the new census tracts compared to the less luxurious houses in older census tracts.

Quality Changes

Quality changes in individual houses over time might be apparent in this study since the data cover almost ten years. If the observed rates of appreciation in house prices are greater in older than newer census tracts, one possible reason might be quality changes in some of the houses. If substantial remodeling or renovation has taken place to modernize a house, then it might be expected to appreciate faster than houses in the same tract which have not been improved. The remodeling would have the effect of increasing the overall rate of appreciation of that census tract, reinforcing the earlier statement that houses in older census tracts might have the highest rates of appreciation.

Property Owner Characteristics

Income level, education, and occupation of property owners are all closely correlated and would be expected to differ across census tracts. Better educated households would presumably have better knowledge about the best neighbor-

hoods for investment purposes, and the ability to move to take advantage of those opportunities. Therefore, higher levels of income and education might be expected to be associated with the census tracts showing the highest rates of appreciation.

Location

The location of a census tract in terms of accessibility to employment, recreation, or shopping might be expected to have a significant effect on rates of appreciation. However, it would be very difficult if not impossible to predict theoretically which factor would be most significant for any specific city, given its unique pattern of development. Also, over ten years a number of different effects may be reflected in a distance variable such as the distance to the Texas Tech campus or the downtown area.⁴ Lubbock grew fairly rapidly during the 1970's and the increasing congestion in the more central areas may have led to greater demand for houses on the periphery. Greater distance from the center of the city might therefore be associated with greater demand for and higher rates of appreciation of houses in the peripheral census tracts. This is based on the assumption that the energy crisis had no appreciable offsetting effect causing households to prefer more central locations. This may be valid for Lubbock and other smaller or middle-sized cities where travel distances and times are still fairly nominal. On the other hand, a central location giving quick and easy access to Texas Tech or the downtown area may be an important consideration to students and others. Greater demand by students for housing around the campus area might lead to higher rates of appreciation associated with centrality rather than a peripheral location.

Holding Period

Finally, the length of ownership or the holding period might significantly affect rates of ap-

preciation. In a census tract of considerable volatility where there is a high rate of turnover, rates of appreciation might be higher than in a more stable area where longer average holding periods would more closely approximate the market average. This would imply that the length of the holding period would be negatively related to the rates of appreciation.

Procedure

In this study, the data on individual rates of price appreciation are aggregated on a census tract basis, essentially segmenting the housing stock geographically. The reason for using census tracts is that by official definition the housing within each census tract is somewhat homogenous, yet significantly different from the housing in other census tracts. The data used in this study were drawn from a larger data base of over 13,000 transactions during the period from quarter IV 1969, through quarter I 1979. All of the houses were in R-1 zoned districts and not adjacent to commercial or multi-family areas. The data were collected from real estate appraisers in Lubbock, Texas. From that base, the 2,635 units involved in multiple transactions were separated out and used in this study. In some cases, more than one resale of the same house is included in the sample. Data included the month and year of each transaction, the original and resale prices, living area, and age of the units at the time of each sale. Additional variables used in the analysis are: the census tract for each house, the mean distance from each census tract to Texas Tech University, percentage of high school graduates in each tract (1970 census), length of the holding period, the change in size of each house over the holding period, and the price per square foot as a measure of housing quality.

The rate of price appreciation of each house in the sample was calculated using the original and resale prices of the houses over the holding period. The annual rate of price appreciation was calculated using a compound interest formula

which was based upon monthly compounding.⁵ The annual rate of appreciation for each unit will be referred to hereafter as the annual holding period return (AHPR).

The individual AHPR's were averaged on a census tract basis yielding a mean AHPR for purposes of comparing rates across tracts. Since the individual AHPR's were averaged, the variance of the individual AHPR's can be used as a measure of the riskiness of that census tract. In a census tract with a high variance (risk), a house

purchaser might realize a very high or a very low (even negative) rate of price appreciation.

Results

The overall mean AHPR calculated from the resale data was 12.39 percent, with a range from 16.84 percent to 10.12 percent (Table 1). There was an even wider range in the variances, from 0.41 percent to 1.24 percent. The mean AHPR's by census tract were analyzed to identify those

TABLE 1. — Annual Holding Period Returns (AHPR) Averaged by Census Tract and the Variance of the AHPR's by Census Tract

Census Tract Number	Observations	Mean of AHPR's	Variance of AHPR's	Duncan's Multiple Range Test*
14.00	73	0.1684	0.0125	A
24.00	77	0.1511	0.0142	A
20.00	75	0.1503	0.0069	A
18.01	154	0.1494	0.0080	A
15.00	72	0.1486	0.0098	A
23.00	73	0.1455	0.0116	A
19.01	79	0.1441	0.0075	A
17.01	149	0.1418	0.0094	
16.02	65	0.1326	0.0059	B
4.03	81	0.1299	0.0050	B
17.03	91	0.1238	0.0047	B
21.00	362	0.1216	0.0046	B
22.00	252	0.1188	0.0056	B
19.02	208	0.1132	0.0052	B
17.02	198	0.1082	0.0047	B
18.02	302	0.1060	0.0041	
4.02	147	0.1029	0.0048	
4.01	177	0.1012	0.0050	
	2,635			

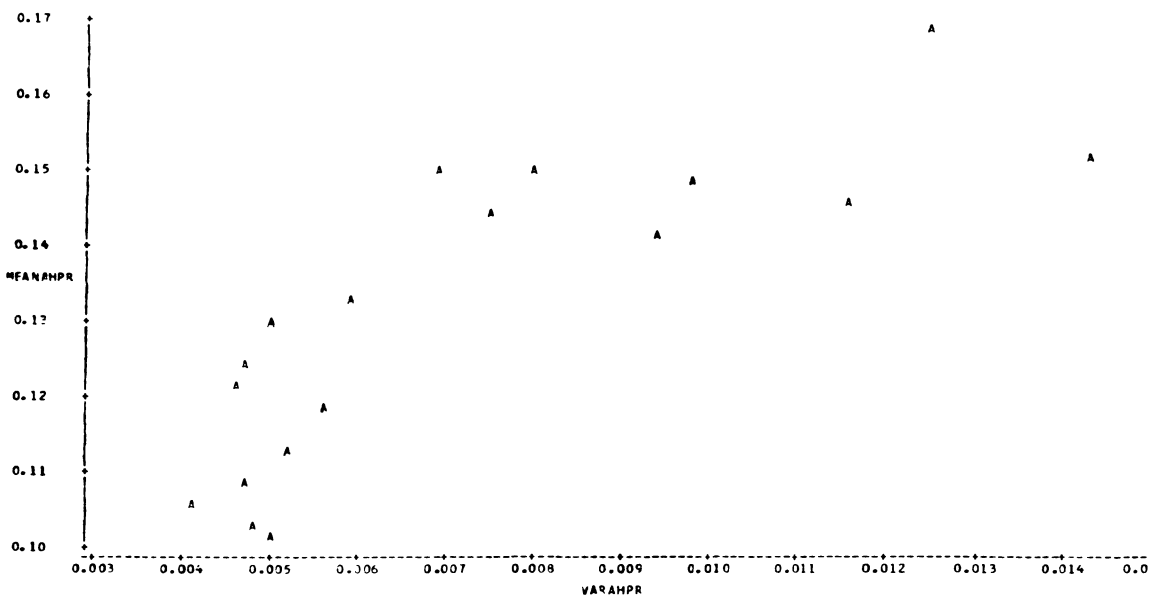
*Means with the same letter are not significantly different. The alpha level used was .05.

whose mean AHPR's were not significantly different. Duncan's Multiple Range Test was applied to the data, and it selected two fairly inclusive but distinctly different groups of census tracts. The higher risk-return census tracts (14.00 through 19.01) comprise one group (A), while the lower risk-return census tracts (16.02 through 17.02) form a second group (B).

The AHPR's and variances for each census tract have been graphed (Figure 1) showing that

higher rates of return were associated with higher levels of risk as would be predicted from finance theory. With the recurring levels of inflation, the typical homeowner has become an investor as well as a consumer in terms of his or her house. It would appear that the same tradeoffs between risk and return that characterize other assets are also associated with housing as an investment, which itself is a significant finding of this research.

FIGURE 1. — The Relationship Between Returns (MEANAHPR) and Risk (VARAHPR) for 18 census tracts in Lubbock, Texas*

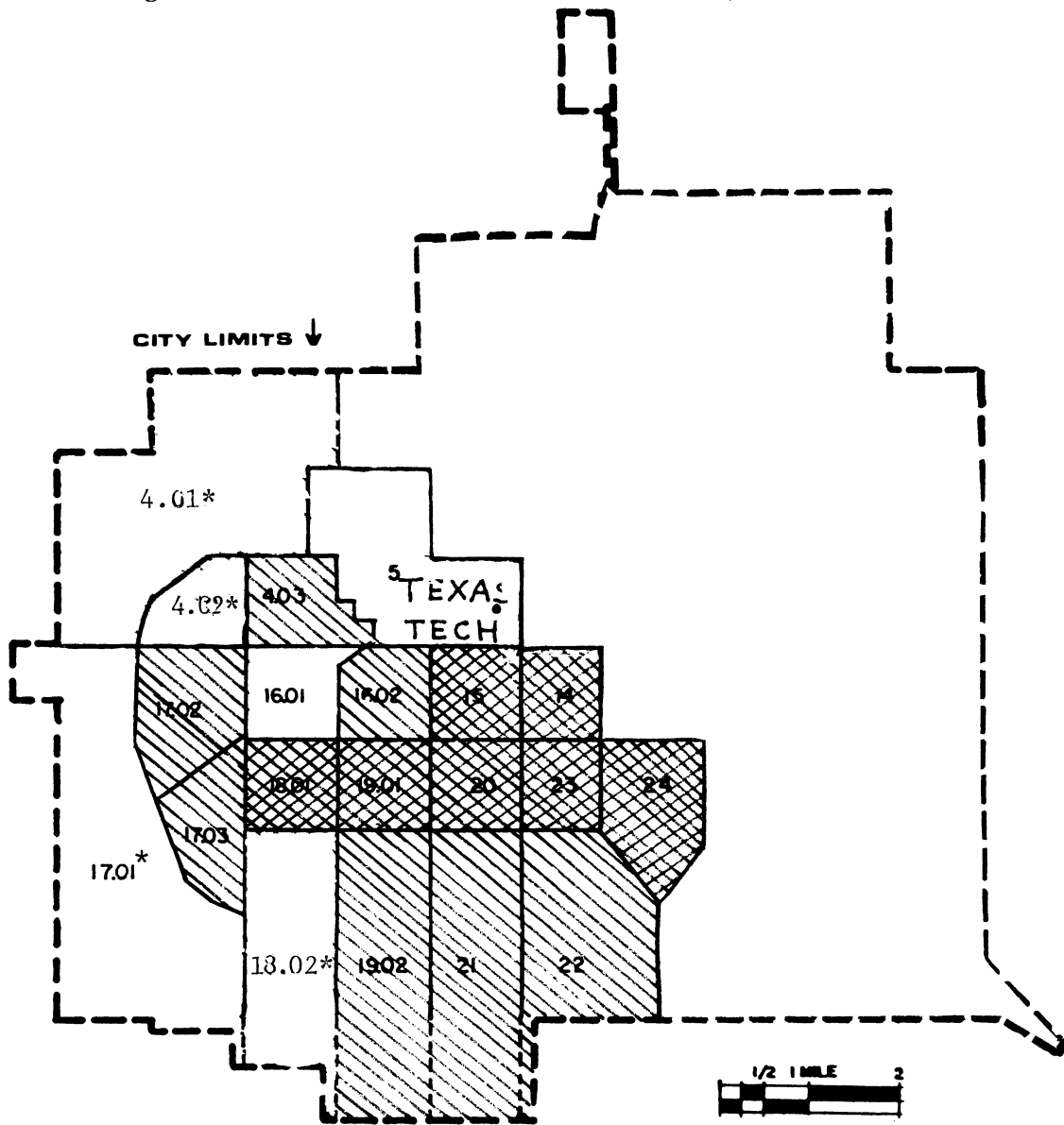


*Each "A" represents a census tract

The two groups identified by the Duncan test were marked off on a map to see if an identifiable geographic pattern existed (Figure 2). The unshaded areas represent commercial/industrial areas or residential areas where insufficient resale data were available to be included in the analysis.⁶ It can be seen that the high risk-return census tracts were generally the older, more centrally located areas of the city. The university campus is approximately one mile from the downtown area,

and those tracts provide relatively easy, fast access to both places. As a group, they are considerably different from the newer, peripheral census tracts, which have lower risks and returns. Some of these differences are highlighted in Table 2. The higher return census tracts are distinctly older and have somewhat smaller houses than in the lower return districts. The higher return areas appear to be lower quality since their average prices per square foot are lower, and the level of

FIGURE 2. — High and Low Risk-Return Census Tracts for Lubbock, Texas



 High Risk-Return Census Tracts

 Low Risk-Return Census Tracts

*Census Tracts 4.01, 4.02, 17.01 and 18.02 did not fall into either group.

amenities is less as reflected in the percent of units with fireplaces. The higher return areas are more centrally located (Tech distance) and the residents, on the average, appear to be somewhat less well-educated. Many of these differences were discussed earlier, and may serve as a basis for specifying a multiple regression equation to explain the variations in returns across census tracts.

census tracts do provide their owners with higher rates of return (appreciation) as compensation for the greater risk. However, it would also be interesting to attempt to identify which, if any, of the theoretically postulated variables can explain the observed variation in the mean AHPR's. The following regression equation was therefore estimated on data for 17 census tracts (deleting 17.01) using those variables.

Characteristics Explaining Variation

The results to this point show that there are substantial variations in the rates of price appreciation by census tract, and that the riskiest

$$REALMHPR_i = a + B_1MEANAGE_i + B_3HOUSAMEN_i + B_2NEIGQUAL_i + B_4CHNGSIZE_i + B_5\%HSEDUC_i + B_6TECHDIST_i + B_7HOLDPERI_i$$

where,

TABLE 2. — Characteristics of the Census Tracts for Lubbock, Texas

Census Tract	Mean Age (Years) ¹	Mean Price Per Square Foot (1975) ¹	Percent Wood Burning Fireplaces ¹	Mean Living Area ¹ (Square Feet)	Percent High School Graduates ²	Mean Texas Tech Distance (Miles) ¹
14.00	31.76	\$12.94	16.43	1381	62.8	1.25
24.00	16.15	13.10	3.96	1182	33.9	2.88
20.00	19.56	14.19	10.66	1371	62.1	2.00
18.01	17.25	15.35	9.09	1254	64.3	3.00
15.00	25.92	15.55	19.44	1481	73.8	1.07
23.00	18.47	14.93	4.10	1188	63.1	2.19
19.01	17.49	16.52	37.97	1766	80.2	2.38
16.02	18.36	14.28	10.77	1224	65.9	1.69
4.03	9.13	18.42	38.27	1728	75.4	2.19
17.03	9.19	17.04	47.25	1462	76.5	3.94
21.00	6.16	17.25	62.98	1665	87.3	3.50
22.00	10.33	17.00	47.22	1559	79.1	3.63
19.02	6.93	18.45	87.50	2054	86.0	3.69
17.02	6.55	18.34	50.50	1464	79.7	3.31
18.02	3.39	19.41	77.81	1654	86.9	3.88
4.02	8.61	18.03	63.94	1642	81.1	3.19
4.01	3.00	21.15	78.53	1417	24.7	3.06

1. Calculated from the data
2. From the 1970 Census

- REALMHPR_i = the mean of annual holding period returns (mean AHPR's) for the *i*th census tract less the annual rate of change of the CPI — Housing index for the period 1969IV to 1979I,
- MEANAGE_i = the average age of houses at the time of resale for the *i*th census tract,
- NEIGQUAL_i = the mean price per square foot for 1975 of the houses in the *i*th census tract, (measure of neighborhood quality)
- HOUSAMEN_i = the proportion of the houses in the *i*th census tract that have a fireplace (a proxy for all house amenities),
- CHNGSIZE_i = the average change in the square footage of houses in the census tract (change in quality over time),
- %HSEDUC_i = the proportion of the residents in the *i*th census tract with a high school education (1970 census data),
- TECHDIST_i = the estimated average distance from the center of the Texas Tech University campus, in miles, and
- HOLDPERI_i = the average length of the holding period in the *i*th census tract.

The means, standard deviations, and a correlation matrix of the variables used in the regression equation are presented in Table 3. While the theoretical relationship between each independent variable and the dependent in a regres-

sion equation may be clear, the empirical estimation of the equation is usually not as straightforward. For example, the variables for age, neighborhood quality, and house amenities, not surprisingly, are highly correlated. Houses in the older census tracts often have fewer amenities, and these neighborhoods are perceived to be of lower quality, i.e., houses sell for less per square foot. Distance and age are also highly correlated since the newer census tracts are at the periphery of the city, i.e., growth occurs outwardly. The correlation which exists between some variables may preclude the interpretation of the magnitude of the regression coefficients. However, this study attempted only to identify factors which may affect the rates of appreciation of house prices in different sections of the city, not make quantitative estimates of their magnitude. Therefore the correlation, while significant, is not seen as critical to the empirical results.

The estimated equation and *t* ratios are as follows:

$$\begin{aligned} \text{REALMHPR}_i = & 0.1108 + 0.00169 \text{ MEANAGE}_i - 0.00129 \text{ NEIGQUAL}_i \\ & (-1.74) \quad (2.19) \quad \quad \quad (-0.50) \\ & -0.040 \text{ HOUSAMEN}_i + 0.0000608 \text{ CHNGSIZE}_i + \\ & (-1.98) \quad \quad \quad (0.58) \\ & 0.0052\% \text{ HYSEDUC}_i \\ & (0.39) \\ & + 0.0045 \text{ TECHDIST}_i - 0.00165 \text{ HOLDPERI}_i \\ & (0.93) \quad \quad \quad (-1.96) \end{aligned}$$

$$R^2 = .924$$

The MEANAGE, HOUSAMEN, and HOLDPERI variables are significant at the .10 level. The MEANAGE variable has the anticipated negative sign, indicating that as discussed earlier, the greater demand for older, smaller, and more affordable housing is a significant factor in the high rates of appreciation for these units. The HOLDPERI variable is also statistically significant and has the anticipated negative sign. The high risk-return areas of older, smaller houses do exhibit higher turnover rates, which partly accounts for the higher rates of appreciation of houses in those census tracts.

The HOUSAMEN variable for housing amenity variations across census tracts was stat-

TABLE 3. — Mean, Standard Deviation & Correlation Coefficients for Variables Used in the Regression Analysis

Variable	Mean	Standard Deviation					
MEANAGE	13.42	8.05					
NEIGQUAL	16.58	2.28					
%HSEDUC	0.69	0.17					
TECHDIST	2.89	1.06					
HOUSAMEN	0.41	0.29					
HOLDPERI	30.69	3.36					
CHNGSIZE	15.41	20.32					

	MEANAGE	NEIQUAL	%HSEDUC	TECHDIST	HOUSAMEN	HOLDPERI	CHNGSIZE
MEANAGE	1.00000 0.0000						
NEIGQUAL	-0.85430 0.0001	1.00000 0.0000					
%HSEDUC	-0.17415 0.5038	0.19761 0.4471	1.00000 0.0000				
TECHDIST	-0.84662 0.0001	0.60430 0.0102	0.25509 0.3231	1.00000 0.0000			
HOUSAMEN	-0.80006 0.0001	0.88394 0.0001	0.33763 0.1851	0.74097 0.0004	1.00000 0.0000		
HOLDPERI	0.52982 0.0287	-0.66485 0.0036	-0.00920 0.9720	-0.37871 0.1339	-0.68847 0.0022	1.00000 0.0000	
CHNGSIZE	-0.07888 0.7635	0.17543 0.5006	-0.10027 0.7018	0.01349 0.9590	0.27645 0.2828	-0.14922 0.5676	1.00000 0.0000

istically significant, but carries a negative sign. If this variable is a proxy for amenity or quality features such as central air conditioning, fireplaces, or wall-to-wall carpeting, then these results indicate that such amenities are inversely related to rates of appreciation during periods of

inflation. The older, smaller houses satisfying basic shelter needs provide a greater return than the larger, more luxurious houses that have been constructed more recently. This is not to say that the newer houses do not provide good inflation protection for their owners: only that many of the

amenities in these houses apparently are not fully valued by the market compared to their replacement costs. In summary, the age and housing amenity variables that are statistically significant indicate that housing characteristics are the most important factors in explaining the observed rates of price appreciation. This is in contrast to factors such as neighborhood quality, changes in house quality, occupants' education levels, or the location (centrality) of the house.

The TECHDIST variable was not statistically significant. It may well be that the previously noted conflicting forces relative to location may be why this variable was not significant.

The lack of statistical significance for the NEIGQUAL variable would seem to indicate that the quality of a neighborhood does not provide a basis for predicting its investment potential in terms of price appreciation. However, some of the lowest income areas of Lubbock were not included in the analysis because of insufficient data. If the entire city could be analyzed, neighborhood quality may be a significant factor in rates of appreciation. Also, the high correlation between this variable and the housing amenity variable makes it difficult to interpret the results.

The CHNGSIZE (changes in house quality) variable was also statistically insignificant. It is possible that this variable, measured by the change in square footage in each house, does not accurately reflect quality changes such as internal remodeling and decorating. Quality change over a long period of time, either via improvement or deterioration, may still be a significant factor if accurately measured. The %HSEDUC (educational level) variable was also insignificant. This may simply reflect the fact that it is more the physical factors associated with a house which determine its rate of appreciation rather than the characteristics of its owners or occupants.

Conclusions

This paper is the first to investigate the rates of appreciation of house prices for different geographic areas within an urban housing market. The results from the first part of the study revealed significant variations in the rates of appreciation across census tract. These findings have important implications for consumers because they indicate that not all houses or portions of the housing stock provide equally strong protection against inflation. Today's home buyers are investors in a major asset as well as consumers seeking shelter. The reasons for these variations in rates of appreciation would therefore be important for consumers to understand when making this investment/consumption decision.

A second finding of this research was that housing, as an investment, exhibits the characteristics of other financial investments in terms of the tradeoffs between risk and return. The census tracts with the highest rates of appreciation also had the greatest variation of returns. While on the average, the returns were greatest in those census tracts, and the risk of purchasing a house and realizing a low rate of appreciation was also the greatest. This finding ties housing as an investment in with other types of assets and should open this area of housing research to the theories and methodologies of finance.

The final major area of investigation reported here involves an explanation of the variations in the rates of appreciation across census tracts. Because of correlation problems between certain variables, the results must be interpreted carefully and conclusions reached tentatively. It appears that house characteristics such as age and amenities are the most important factors explaining the variations in rates of appreciation. These characteristics seem to be inversely associated with the rates of appreciation, indicating that the older houses possessing fewer amenities represent the best investments. Other attributes such as neighborhood quality, the characteristics of the property occupants, and distance or location considerations appear to be less important.

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Notes

- The specific function is:
 $R_i = a + bR_m$ where,
 R_i = total return for asset i
 R_m = total average return for the investment market
 a = return on asset i where $R_m = 0$
 b = slope of the regression, called beta
- The older census tracts have a higher proportion of rental houses which could conceivably cloud the findings of this research. However, a variable on the percent owner occupied by census tract, which was included in the model explained later, proved to be statistically insignificant.
- The risk-return relationship postulated by finance theory will be discussed in more detail in a later section of this paper.
- The Texas Tech University campus and the downtown business district are both centrally located in Lubbock. Location variables are unique to each city, given its geography and pattern of growth. The presence of a major university in a city might cause the results of this research to be somewhat specific. Hopefully, the results, except for the distance variable, are more general in nature.
- $P_2 = P_1 (1 + i + q)^n$ where,
 P_2 = the resale or second selling price
 P_1 = the original selling price
 i = the annual holding period return (AHPR)
 q = 12, since the compounding is monthly
 n = the number of years (and/or fraction of a year) the house was owned between P_1 and P_2 , (holding period).
- The Lubbock SMSA has 35 census tracts. In 12 of these tracts the data were so inadequate (as to make the AHPR's unusable). Five other census tracts were predominately nonresidential in character.