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THE IMPACT OF DISASTERS ON CONSTRUCTION COSTS

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by

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This study determines the potential for building costs to escalate following a major disaster. Real estate market data was collected from 14 communities which sustained significant damage from either flooding, tornadoes, fire, earthquake, or cyclone. Analysis of the data provided a time path of housing prices from the pre- to the post-disaster period. A dynamic three-equation model of the housing market was tested with price paths developed for Xenia (tornado), Rapid City (flood), and New Orleans (flood). Because the model is able to separate the influence of supply from demand, it provides a more accurate reading of price effects and more sensitive tool with which to assess public policy. Analysis of the resultant time paths suggests that land-use management and improved building techniques are more beneficial than previously thought. They also suggest that Federal aid, under certain circumstances, may simply push prices upward, inflicting additional hardship on those who can least afford it. Lastly, the model indicates that post disaster wage and price controls will prove to be an undesirable method for dealing with the problem. Price stability will be purchased at the expense of an elongated reconstruction period.

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ABSTRACT

The purpose of this study is to determine the potential for building costs to escalate following a major disaster. Real estate market data was collected from 14 communities which sustained significant damage from either flooding, tornadoes, fire, earthquake, or cyclone. Analysis of the data provided a time path of housing prices from the pre- to the post-disaster period. A dynamic three-equation model of the housing market was tested with price paths developed for Xenia (tornado), Rapid City (flood), and New Orleans (flood). Because the model is able to separate the influence of supply from demand, it provides a more accurate reading of price effects and a more sensitive tool with which to assess public policy. Analysis of the resultant time paths showed:

1. A rise in price was detected in 6 out of the 14 sites.
2. For those communities that did sustain inflated prices, the impact never exceeded 25 percent. More often, the range was 10 to 15 percent.
3. New Orleans (Hurricane Betsy, 1965) sustained as much damage as any major disaster occurring during the decade of the 60's. Yet, only a slight shift in housing prices was detected. This was true for the city as a whole, as well as sub-areas within the city.
4. Escalation in price, whenever it occurred, followed a similar pattern. The path of price was initially unchanged by the disaster. After 3 to 6 months, it accelerated then flattened and finally decayed to a path consistent with the pre-disaster trend.
5. Price effects were most severe in communities that sustained damage much in excess of the local construction capacity. This finding indicates that remote communities and communities susceptible to earthquake and storm surge damage may generate inflated building costs.

These results suggest that land-use management and improved building techniques are more beneficial than previously thought. They also suggest that Federal aid, under certain circumstances, may simply push prices upwards, inflicting additional hardship on those who can least afford it. Lastly, the model indicates that post-disaster wage and price controls will prove to be an undesirable method for dealing with the problem. Price stability will be purchased at the expense of an elongated reconstruction period.

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I. INTRODUCTION

In recent years, concern about earthquake induced losses has mounted. As a result, the scientific community has been challenged to first identify types of loss and then to measure their magnitude. Early studies focused on damage to residential structures. These efforts set the stage for loss assessments for commercial buildings and public utilities. Both of the preceding research areas focused on the direct impacts; that is, the destruction of buildings and infrastructure.[1]

An obvious question which grew from these inquiries was, "To what extent will an earthquake affect regional employment?" A number of studies were begun to address that arena of potential loss.[2] Having raised the issue of economic impact, researchers began to ask if earthquakes could cause other market effects as well, such as an escalation in building costs. As it turned out, the potential for increased material and labor costs were not incorporated into initial estimates of property damage. So this area became important in terms of recomputing the risk of damage to homes, businesses, and utilities.

On the surface, this concern over inflated building costs may seem to be of secondary importance. Yet, the occurrence of a large earthquake in San Francisco, such as that modeled NOAA (1972), would require California's entire construction work force to labor for three years in order to repair the damage.

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[1] National Oceanic and Atmospheric Administration (NOAA), 1972.

[2] Wright, et al. (1977).

Although such a statistic in and of itself does not insure price dislocations, it strongly suggests market impacts.

Because so little was known about the potential for increased rebuilding costs, this study was undertaken. If it could be shown that recent disasters have indicated such a potential, then several conclusions could be drawn. First, previous estimates of earthquake losses would prove to be low. Second, the benefits of land use management and improved structural designs would be greater than previously thought. Third, insurance premiums reflecting expected damage may be too low as well. Lastly, the efficiency of hazard mitigation programs may be enhanced. A dollar spent on pre-disaster repair would stretch further than a dollar spent in relief during the post-disaster inflationary period.

In order to put the study on a sound theoretical footing, research reported in the following chapters focused first on the construction of a housing market model layed out in Chapters II and IV. Chapter III reviews the strategy employed to collect data. Results of the study and their application to policy are discussed in Chapters V and VI.

II. FRAMEWORK OF ANALYSIS

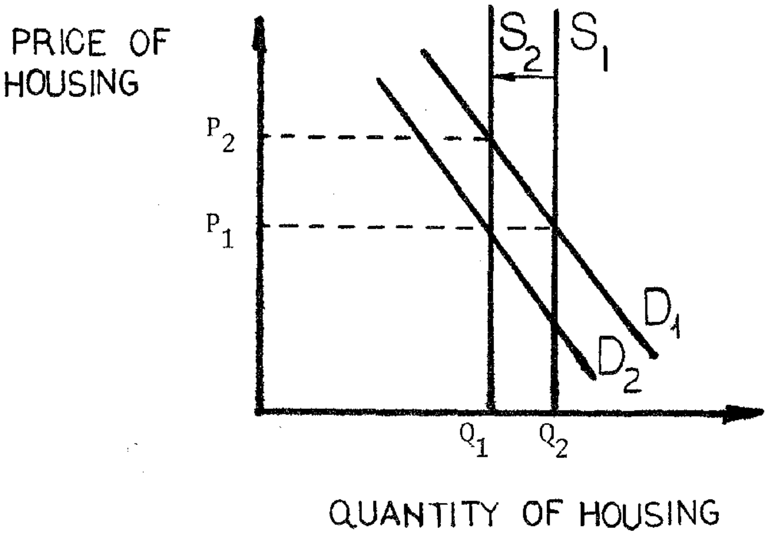
As is often the case, data for testing theories in the social sciences is either unavailable or in an unusable or unreliable form. All of the above proved to be true in this study. As stated in the Introduction, the purpose of the research is to determine the degree to which building costs rise in the wake of disaster. Several reconnaissance trips to cities that sustained damage from natural disasters indicated that reliable information on costs was not likely to be forthcoming. An alternative approach relying upon housing market data was developed to test the hypothesis indirectly. Instead of collecting information on costs, data on sales and housing characteristics were recorded for 15 different cities. It was theorized that if a disaster destroyed a significant proportion of a community's housing, the shortage created would drive the price of the remaining supply upwards. As prices rose, contractors would be induced to expand production of new housing. However, if material and labor shortages were encountered, then builders would be forced to reconsider construction plans. The pace of reconstruction then was thought to hinge upon two dynamically interacting factors: (1) the market for housing which may be influenced by income and wealth effects, as well as the diminished supply of homes, and (2) the degree to which reconstruction pace influences building prices.

A. <u>Housing Market Model</u>

We begin the model with the demand for housing, which is theorized to be a function of the accumulated wealth of households, along with their income.[1] The market price for the pre-disaster stock of homes is determined by the interaction of this demand and the short-run supply (shown in Figure II-1).

Figure II-1

<u>Market for Housing</u>



The short-run supply is depicted vertically since new housing cannot be constructed instantaneously, even given a dramatic increase in price. The result is a pre-disaster price P_1. How does a disaster disturb such a market? First of all, the supply of housing will be diminished, in some instances dramatically. In Darwin, Australia, for example, Cyclone Tracy <u>destroyed</u> nearly two-thirds of the entire housing stock. In Xenia, Ohio, (tornado, 1974) nearly 15 percent of the city's homes were reduced to rubble, while another 9 percent suffered major damage. In other disasters, the toll has not been so

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[1] This specification oversimplifies the problem; interest rates along with various taxes should influence demand. However, for most of the disaster sites, the time period under investigation was less than three years. So, ignoring these factors should not create much difficulty.

severe. New Orleans (Hurricane Betsy, 1965) lost less than .005 percent of its housing stock, but 6 percent were subjected to major damage.

If the disaster reduced short-run supply only, then the price of structures surviving the event would be bid upward to P_2 in Figure II-1. However, it is possible that disasters influence the income and wealth positions of the survivors. The event may destroy the facilities of a major employer or may drive marginal business from the area.[1] If the economic contraction was sufficiently severe, housing demand could contract, shown as D_2 in Figure II-1, leaving price unaltered.[2] Demand may also shrink because of the disaster victim's loss of assets. Without equity, the victim may be forced to scale down demand for a replacement dwelling. These two factors are, of course, subject to the influence of Federal disaster relief programs and private aid, in addition to the extent of insurance coverage. The important point here is that housing price is influenced by both the demand and supply factors. As a result, cost increase will be subject to the same forces.

The demand side of the model is driven therefore by income, wealth and housing stock. The relationship to be tested is as follows:

$$(1) \qquad P_{(t)} = f\,(W_{(t)}\ I_{(t)}\ Q_{(t)})$$

Where:

$P_{(t)}$ is a price index for housing in the disaster stricken community in time period t. An explanation concerning the derivation of this index is provided below. $P_{(t)}$ is a real price, i.e., it is the price deflated by the cost of other goods.

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[1] The potential for unemployment after disaster has been studied by Wright, et al., (1977). They found in the period 1960 to 1970 that possibly one or two disasters out of the thousands studied caused negative employment impacts.

[2] This would occur either directly (the choice of the prospective buyer) or indirectly due to fewer prospective buyers qualifying for loans.

$I_{(t)}$ is income in time period t.

$Q_{(t)}$ is the housing stock, the number of housing units in place at time t.

$W_{(t)}$ is the measure of the disaster's impact on wealth.

Given that price responds in a way just described, two questions remain to be answered: (1) how quickly will the construction industry respond to a rise in price, and (2) how will building costs change as the pace of reconstruction quickens? A rise in price should be followed by an expansion in new construction. However, expanded use of building materials and labor may induce a rise in their costs. This did, in fact, occur in Darwin, Australia, as is shown in Figure II-2 below. Darwin, a small, remote town on the Northern coast of Australia, lost nearly two-thirds of its housing stock to the winds of Cyclone Tracy (December, 1974). Construction supplies and personnel had to be brought nearly 2,000 miles from Sydney and Melborne before full scale rebuilding could get underway. The graph in Figure II-2 shows that growth in wages for the labor force in Darwin lagged behind that of the rest of Australia until the time of the disaster (December, 1974). For a period of nearly five quarters thereafter (shown by the shaded area), wage rates in the stricken area escalated dramatically. From that period on, the pattern reverted to the pre-disaster trend. The point worth emphasizing here is that expansion of construction activity is observed, at least under certain circumstances, to be accompanied by escalating costs.

Following the concept of supply and demand, any new construction should cause an expansion in stock and a subsequent drop in price.[1]

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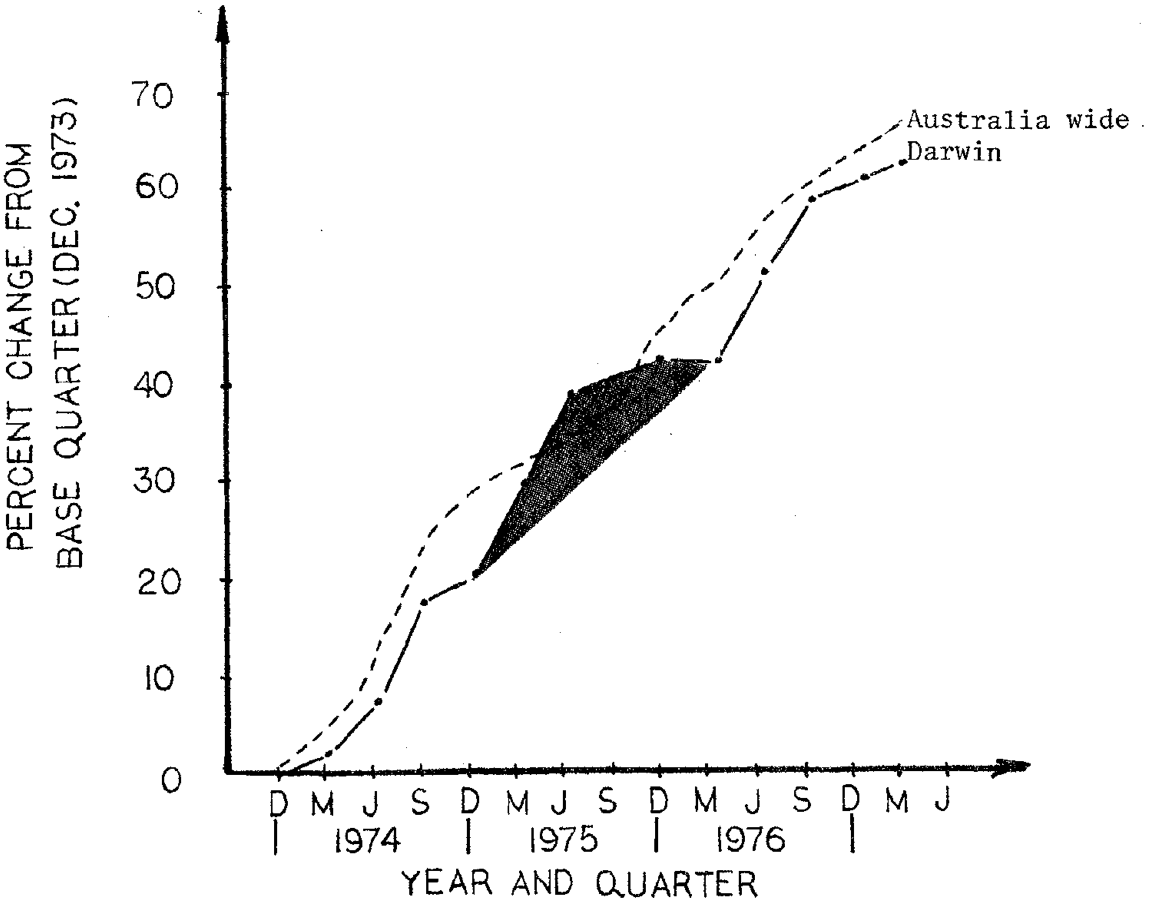
[1] It is unlikely that the absolute price of housing will fall, but the rate of price increase may decline (especially relative to other commodities).

Figure II-2

Change in Average Weekly Earnings of Male Workers:

Northern Territory Contrasted with the Rest of Australia

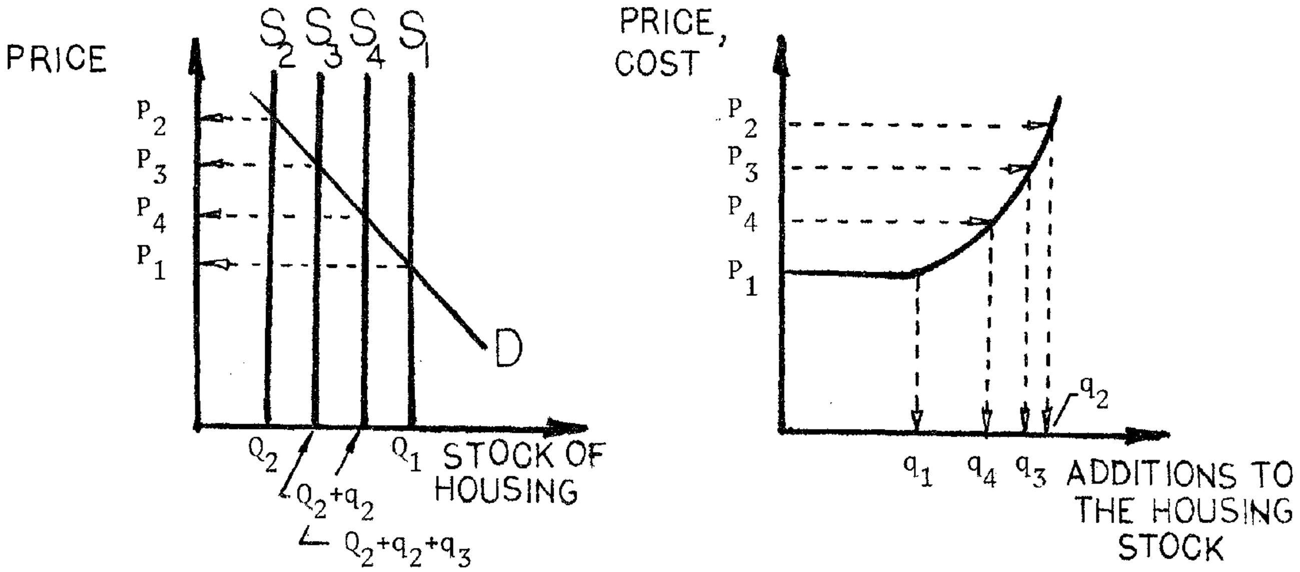


As price falls, fewer contractors will see it in their interest to continue expanding the supply. What will then happen is a gradual reduction in new housing starts; building costs will eventually approach (in real terms) the pre-disaster level; and ultimately, the market will stabilize with the emergence of a new "real" price which should not differ significantly from that prevailing prior to the disturbance.

The dynamic interaction of both sides of the model can be clearly seen in Figure II-3.

Figure II-3

Model of the Housing Market

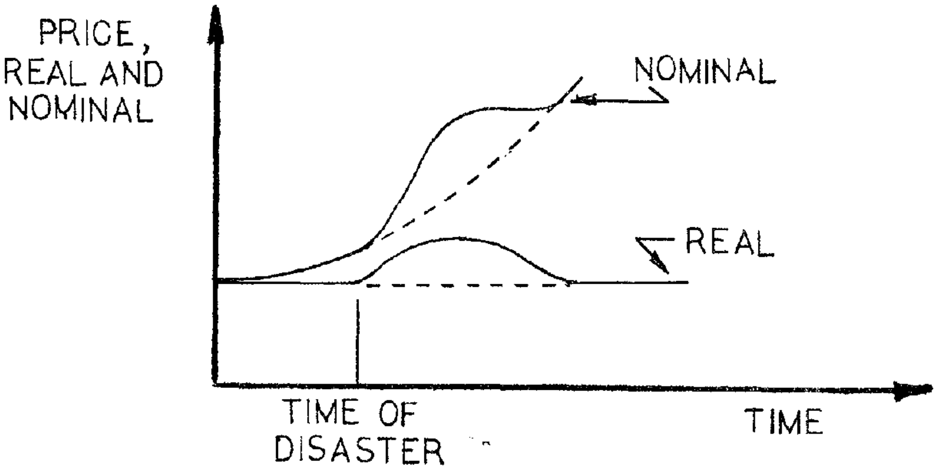


Beginning with the pre-disaster market for housing, P_1 is the price, q_1 is the new and replacement housing one observes every year. Under normal conditions, real costs should not change much within the year. Hence, the cost schedule is shown to be flat up to q_1. This may appear to be an invalid assumption given the observation that the cost of construction has in recent years proceeded to grow at an annual rate of approximately ten percent, however, the costs depicted here are <u>real</u> costs and, therefore, are adjusted by the appropriate price deflator. As indicated above, the disaster creates a shortage of housing (Q_1 to Q_2); unscathed structures command higher prices (P_1 to P_2). Escalating prices induce building contracts to expand operations, possibly at the expense of creating material and labor shortages. The extent to which these builders can afford expanded operations, is governed by the price P_2. Costs will only be covered for an expansion up to the level (q_1 - q_2). Beyond that point, costs will exceed the price individuals in the area are willing to pay; prospective home buyers could just as well purchase a used structure (after making the necessary adjustments for age and deterioration). As q_2 is added to the stock of housing, the more plentiful supply causes price to fall to p_3. A falling price in turn means that contractors can no longer afford the higher wage and material costs, and they respond by cutting the rate of new home construction to q_3. Upon completion of this new batch of homes, price continues to fall, this time to p_4. This process repeats itself until p_1 and housing stock Q_1 are reattained. It should be noted that, for reasons pointed out above, there is no guarantee that these two values will emerge, since the demand may have shifted due to intervening income changes.

Given this model specification, one would expect that price would first increase and then drop back to the pre-disaster path in a manner illustrated in Figure II-4.

Figure II-4

Nominal and Real Price Paths



The upper path shows raw housing prices before applying a price deflator. The lower curve shows "real" housing prices after adjusting for normal rates of inflation. One would not expect that price would respond instantaneously to the housing shortage. Even in Darwin, where 150 mph. winds decimated two-thirds of the town's structures, the real estate market emerged only very slowly; no sales were recorded for the first three months. However, once market signals began to unfold, transactions accelerated and the price path did look very much like that shown in Figure II-4.

In order to round out the model, the supply side must be given a few finishing touches. One factor ignored up to this point is the magnitude of the rebuilding effort in relation to the construction talent available. The shape of the supply equation will be sensitive to the stress the disaster places on local builders and suppliers. For example, at one extreme, Cyclone Tracy (Darwin) created a need to rebuild 8,000 homes given a labor force that normally erects only 1,000 per year. In San Fernando and surrounding areas (San Fernando Earthquake, 1971), the destroyed housing could have been replaced within two weeks by contractors from the Los Angeles-Long Beach Standard Metropolitan Statistical Area.

If it turns out that the construction industry is mobile, then the supply (cost) relationship will prove to have a shallow slope. This means that rebuilding will be undertaken quickly at only slight increases in cost. If the opposite is observed, the rebuilding will be prolonged and costly. The supply relationship developed in subsequent chapters does not explicitly incorporate an argument reflecting damage as a proportion to local construction output. In Chapter V, the impact of this effect is assessed, indirectly, by comparing the supply relationships for several disasters. However, in a generalized model, this factor may be included as is shown in (2) below.

$$(2)\quad q_{(t)} = f\,(P_{(t)}, C_{(t)})$$

Where:

$q_{(t)}$ is the volume of new house construction.

$P_{(t)}$ is the price of housing derived from the demand side.

$C_{(t)}$ is the size of the indigenous construction work force when compared with the requirement to rebuild.

If equations (1) and (2) could be estimated with data from previous disasters, then a dynamic model of the housing market could be assembled. To show how the model would work, assume that estimates for (1) and (2) have already been obtained. Expressions (1) and (2) incorporate a common term, that is, $P_{(t)}$. $P_{(t)}$ is derived from demand and short-run supply (1) and enters into (2) as a determinant of new construction. The housing model is therefore recursive with (1) and (2) feeding back and forth.

$$(3)\quad \begin{aligned} P_t &= f[Q_t, W_t, I_t] \\ q_t &= f[P_t, C_t] \\ Q_t &= Q_o - \text{Stock Destroyed} + q_t \end{aligned}$$

The last equation shown in the system is just an accounting relationship; the housing stock Q at any point in time equals the preceding period's stock less current period losses plus additions. Beginning with P_t, q_t is determined; q_t augments Q_t which causes P_t to drop, and so on in a manner already described above. Equation set (3) is no more than an algebraic representation of the process portrayed diagramatically in II-3. By postulating the interaction in this manner, it is possible to determine how government policies have or could have influenced housing costs. For example, one could ask under what conditions would government aid heighten the inflationary impact of disaster? Or, under what conditions would it be preferable to provide material and labor aid? To illustrate, the provision of disaster aid in the form of money will shift the demand curve outward thereby increasing prices and cost of repair. If subsequent analysis showed that the cost function was very steep, then this form of aid would not benefit the disaster victim. It may be better, under such circumstances, to provide temporary housing or material aid.

The indispensable ingredient in equation set (3) is P, the price of housing. The choice of an index for P had to meet several requirements. First, data had to be available on a monthly or at least quarterly basis. It was not known how long post-disaster price dislocations would last, but evidence from Darwin suggested that the effects may, even in most severe cases, disappear within three years. Annual data would, therefore, not be acceptable. Second, many of the more recent disasters have occurred in small towns, e.g., Rapid City, Xenia, Buffalo Creek, etc.; it is difficult to collect meaningful secondary price data for such communities. In order to resolve these problems, a Hedonic Price Index was created from real estate market data. A discussion of this most important part of the research follows.

B. Construction of a Hedonic Price Index for Housing

A critical component of the model just described is the index of housing price. One could have gone to different disaster sites and collected information on housing sales, specifically the price, and simply averaged them period by period. However, the quality of housing could well have changed over time. The strategy of averaging sales would have confused quality changes with changes stemming from scarcity. This problem was tackled by developing a Hedonic Price Index for each of the communities in the study. A Hedonic Index has been used by economists to capture the influence of products' characteristics on selling price. In the case of housing, one would be interested in, for example, how much a square foot of living area or lot area contributed to selling price, or, how much an attached garage is valued. The use of Hedonic Price Indexes in housing studies is not new, and as the following review indicates, there is a fairly well-developed body of literature concerning the determinants of price.

1. Milgram (1967)--Change in accessibility, land improvement, and intensity of land use were sufficient to explain five percent growth in Philadelphia's land prices.

2. Maisel (1963)--A cross-sectional analysis of 86 SMSA's showed that the level of agriculture land prices was significant in explaining the level of building site prices.

3. Ridker and Henning (1970)--Found a negative relationship between levels of pollution and property values in the St. Louis area.

4. Czamanski (1966)--Land that was zoned for twin housing had a price almost double that of land zoned for single-family housing.
land uses lowered the market value of single-family homes.

5. Ball and Kirwan (1977)--The data confirmed a general tendency for unit housing prices to decline with distance from the city center.

6. Brigham (1965)--Hypothesized that land value is a function of accessibility, amenity level, topography and a historic factor. Brigham concludes that the former three are significant, but more importantly,

> the coefficient of the topographic dummy is negative and highly significant, indicating that single-family land values are relatively low in very hilly areas. Since all properties included in the sample are developed sites, it is likely that the negative relationship is caused by the inclusion of undeveloped land in hill area lots.

7. Correll, et al., (1978)--Sales price was hypothesized to be a function of walking distance to the greenbelt, the age of the house, number of rooms, finished square footage, lot size, distance to city center. All factors were found to be significant except age. Distance from the greenbelt turned out to be an important ingredient in the sales price model. If a residence was thirty feet from the greenbelt, the property increased to 3,200 feet, the sales price fell to an average of $41 thousand. The importance of this finding lies in the possibility that park values are capitalized into the selling price of homes; and, therefore, the cost of greenbelts may be captured through property tax collections.

8. Brown, et al., (1977)--Sales price was hypothesized to be related to the characteristics of the house; e.g., existence of a fireplace, area, basement, etc. In addition, distance to the water front and set-back from the shoreline were included. The set-back variable proved to be significantly positive. The greater the greenbelt between home and shoreline, the greater the sales price.

9. Witte (1977)--The responsiveness of average price per square foot was shown to be related to: (1) the value of agricultural land; (2) population density; (3) income; and (4) population growth; and (5) average size of a residential site. Witte concludes that housing demand was also found to be inelastic with respect to price. It paid speculators to withhold supply.

10. Hushak (1975)--Price of land was hypothesized to be a function of: (1) size of parcel; (2) distance to city center; (3) distance from major highway; (4) zoning of the parcel; and (5) the property tax rate. The results indicate that the most important factors were zoning for commercial activities (increasing land values by five-fold over agricultural uses), the tax rate, the distance from a major metropolitan area, and the size of the parcel.

11. Muth and Wetzler (1976)--Price of new homes was hypothesized to be related to house characteristics plus union restrictions, monopoly in building supplies, scale of the home builder, and restrictive building codes. The results show that local codes add no more than two percent to housing prices, while the impact of union wages increase costs by another four percent.

12. Poon (1978)--The price of housing was related to housing characteristics in a way similar to that already described by Correll (1978). To measure the impact of noise and air pollution due to a rail line, Poon included distance from the tracks in the regression equation. The results indicate a significant relationship; the price of a house will rise by $2 thousand if the distance from the rail line increases from 50 to 850 feet.

13. Richardson, et al., (1977)--All the traditional factors were included in this model; i.e., housing characteristics, general spatial variables, accessibility and environmental quality.

14. Grether and Mieszkowski (1974)--A House's value was established with a rather exhaustive list of physical characteristics and a set of factors which capture the social amenities of a neighborhood; e.g., school quality, etc.

The studies selected above by no means represent an exhaustive review of the literature. For the most part, they point to the importance of parcel size, physical characteristics of the structure and locational factors in determining price. Table II-1 summarizes the detailed factors found to be important in one or more of the studies surveyed.

Table II-1

Demand Characteristics

Housing Characteristics

1. Dimensions of the house
2. Number of baths
3. Number of stories
4. Age (depreciation)
5. Exterior
6. Type of heat
7. Fireplaces
8. Basement, etc.

Locational Land Factors

1. Distance to city center
2. Distance to main transportation; access to highway; bus route
3. Proximity of recreational facilities
4. Proximity to polluted environments (non-residential land uses)
5. Proximity to shopping facilities
6. Zoning

Social Factors

1. Racial mix
2. Crime rate

Financial Considerations

1. Income (permanent or current)
2. Housing expenses (interest, insurance, utilities, and property tax rate)
3. Price of other commodities
4. Value of raw land in agricultural production

With the above factors as a guide, real estate sales data were collected for a number of previous disasters. The subject of data collection will be treated in more detail in Chapter III. After some experimentation with the data, it was found that for most of the disaster sites, at least 65 percent of the variation in housing price could be explained with knowledge of the following:

1. Square feet of living area;
2. Square feet of property (lot area)
3. The condition or age of the house at the time of sale;
4. The number of bedrooms and baths; and
5. Quality of the structure.

The first three characteristics proved to explain much of the variation in price and, therefore, for the sake of simplicity, factors 4 and 5[1] were omitted from the model.

In the case of New Orleans, additional explanatory variables were available. These included:

1. Type of construction (frame, brick, etc.), and
2. Type of structure (ranch, two-story, etc.).

Again, not much additional explanatory power was afforded by knowledge of construction or structure type (even though they proved to be statistically significant).

A number of other tests were performed with the data, the results of which are reported in Chapter IV. For the purposes here, it is sufficient to indicate the general nature of the Hedonic Index under development. Table II-2 shows

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[1] Another reason for omitting number of bedrooms and baths was that it turned out that these variables were highly correlated with each other, and with living area. To avoid multicollinearity, these two factors were excluded from the regressions.

the type of results obtained for each of fourteen sites. The left-most column indicates the period prior to or after Hurricane Betsy. Sales price is the price of the "average" house sold in New Orleans within the indicated four-month intervals. The average house is defined differently for each site. For New Orleans, it represents a 1,450 square foot home located on a 5,500 square foot lot, 21 years old, in "average" condition. The coefficients shown below each independent variable indicate how much each housing factor contributes to the selling price. For example, using the first period, for each year of age housing price declines by $140. Each unit on the condition scale[1] added $11 hundred to the selling price. Lot and living area contributed $.61 and $8.10 per square foot, respectively. The sample size is quite good for each period as are the R^2's and F's. The entire sample for New Orleans was 4,300 sales. The prices shown in Table II-2 represent a path from the pre- to the post-disaster period. However, it only tells us the price of an "average" house, where the type of structure is maintained constant throughout the entire span of time. It does not indicate why the price is changing. An explanation of the "why" must embody the housing model developed earlier, and is further developed in Chapter V. However, the price path shown was an essential first step; without it, it would have been impossible to carry the analysis any further. Hedonic indexes were developed for each of the disaster sites (see Appendix A). Analysis and discussion of the resultant price paths is the subject of Chapter IV.

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[1] The scale from 1 to 7; 1 indicating poor and 7 new. The best way to tackle such a scale is to establish a set of dummy variables. This was done and it was found that each unit on the scale carried approximately the same marginal value. Hence, it was possible to adopt simpler methods of including condition as a continuous variable.

Table II-2

New Orleans Time Profile of Housing Prices

PERIOD

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT						
	SALES PRICE ($/1000)[a/]	AGE[b/]	COND[c/]	LOTAR[d/]	SQ.FT.[e/]	SAMPLE SIZE	R^2	F STATISTIC
-28 to -32	17.7	-1.40	11.01	.0061	.081	248	.82	2190
-24 to -28	17.6	-1.16	12.83	.0074	.066	336	.74	2713
-20 to -16	16.7	-1.10	13.20	.0074	.058	267	.75	2315
-12 to -16	18.0	-1.22	13.38	.0052	.076	361	.83	3545
-12 to -8	18.5	-1.25	16.88	.0051	.068	354	.74	2338
-8 to -4	18.3	-1.19	13.95	.0064	.071	250	.72	1574
-4 to 0	18.4	-1.28	14.02	.0067	.072	324	.76	2366
0 to +4	18.6	-1.13	14.71	.0069	.068	200	.77	1966
+4 to +8	18.5	-1.08	16.31	.0047	.069	289	.71	1803
+8 to +12	19.0	-1.39	15.35	.0018	.092	362	.70	2088
+12 to +16	18.7	-1.46	13.72	--	.103	271	.75	2184
+16 to +20	18.7	-1.07	14.65	.0043	.078	289	.83	2978
+20 to +24	18.9	-1.11	18.26	.0007	.081	286	.82	2782
+24 to +28	19.4	-1.14	12.49	.0069	.081	195	.82	1817

a/ SALES PRICE of the "average" house, given the regression equations shown for each period. The "average" house was defined as 21 years old, 1450 square feet of living area, on a 5500 square foot lot in average condition.

b/ AGE is measured in years.

c/ CONDITION is a 7 point scale ranging from poor (1) to new (7). 5 is average.

d/ LOTAR is lot area in square feet

e/ SQ.FT. is square feet of living area.

f/ All variables shown have t values in excess of 2.

III. DATA COLLECTION

Collection of data turned out to be less of a problem than first anticipated. An initial visit to Darwin, Australia (Cyclone Tracy), yielded very fruitful results. The Chief Assessor for Western Australia made available real estate records for the time period beginning with the date of the disaster (December, 1974) through June of 1977. Buoyed by this success, site visits were made to Rapid City, South Dakota, and Wilkes Barre, Pennsylvania, in order to obtain comparable sales information. Again, cooperation with local assessors insured an adequate sample in both instances. One obvious problem with this strategy was cost; given a limited travel budget, the number of site visits would have had to be limited to less than six. Fortunately, at this point, we became aware of a computerized data bank originated by the Society for Real Estate Appraisers (SREA). The chief advantage offered by the service was that it kept records of sales and home descriptions throughout much of the United States. In order to be sure that specific disaster sites would be covered by the SREA Market Data Center, the National Red Cross disaster records were reviewed and a list made of the most destructive events.[1] The list of disaster stricken communities was then merged with those cities available through SREA. The result was seven additional sites.

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[1] Rossi, et al., (1978), in their exhaustive study of post-disaster employment effects found that Red Cross records were as accurate, if not more so, than any other source. This was sufficient justification for use of the NRC disaster summaries.

Beside site visits to those communities mentioned above, trips to a number of other disaster stricken communities were made. A breakdown of those records obtained through the SREA Data Center and those obtained via site visits is given in Table III-1. In some instances, it was possible to record whether the property was in a hazardous location, specifically the flood plain. In such instances, a map of the city along with the specific location of the real estate sample is provided (see Appendix B). The absence of a map reveals that a sample of the entire city was taken.

The sampling procedure used was not sophisticated. At each site, the assessor was asked to provide the entire record of residential sales for representative areas of study. A sample of at least forty sales per year for each of four years was recorded. In those cities where neighborhood effects could have yielded erroneous results, sampling was conducted for a number of neighborhoods. This insured that different years were not dominated by varying neighborhoods. Although not a sophisticated approach, it appears adequate especially given the time and budget constraints under which the project operated.

One last point about sampling. Unlike the Wright, et al. study, this project was not designed to look at the average event. We, therefore, were not interested in sampling events. Instead, the strategy was to focus on the most destructive disasters. In so doing, the possibility isolating inflationary impacts was enhanced. This was especially important in that the purpose of the research was to suggest what would happen to cost in the wake of a large earthquake.

Table III-1

Disaster Sites

Disaster Site	Disaster	Sample
Rapid City, SD	Flash Flood (1972)	139
Darwin, Australia	Cyclone (1974)	211
Wilkes Barre, PA	Flood (1972)	72
Johnstown, PA	Flash Flood (1977)	116
Harrisburg, PA	Flood (1972)	403
Elmira, NY	Flood (1972)	165
Corning, NY	Flood (1972)	175
New Orleans, LA	Hurricane Betsy (1965)	4,300
*Xenia, OH	Tornado (1974)	209
*San Fernando, CA	Earthquake (1971)	200
*San Diego, CA	Fires (1970)	315
*Atlanta, GA	Tornadoes (1973, 1975)	376
*Madison County, MS	Tornado (1976)	233
*Rockdale County, GA	Tornado (1973)	163
*Loveland, CO	Flash Flood (1976)	249

*Indicates that the data was provided by the SREA Data Center.

IV. PATH OF HOUSING PRICES IN DISASTER STRICKEN COMMUNITIES

Hedonic Price Indexes were constructed for 14[1] different communities; where the sample size was large enough, the analysis was extended to neighborhoods, specifically the flooded and non-flooded areas. This was done in order to test the sensitivity of the index to neighborhood effects. In addition, a number of short studies were undertaken to probe the impact of income, racial mix, degree of damage, and age of housing on prices.

A. Contrasting the Paths Between Communities

The paths shown in Figures IV-1 through IV-10 were developed by regressing sales price against the housing characteristics discussed in Chapter II. The results of nearly 250 separate regressions are provided in Appendix A. In a few of the diagrams, a sharp rise in price following the disaster can be observed, e.g., Rapid City, Darwin, Xenia, and Madison County. In other cases, New Orleans, Loveland and San Diego, the trend in price appears to be uninterrupted. Surprisingly in some instances, notably San Fernando and Elmira, the occurrence of disaster appears to have had a depressing effect on the housing market. One possible explanation for this behavior was that risk of future damage was recognized and capitalized into housing values. This statement is highly speculative since income changes in the community could just as well have been responsible for the observed path. However, the path shown for San Fernando (IV-7) is flatter than that displayed for San Diego during the same period. Although not attempted, it would be straight forward to apply the housing model

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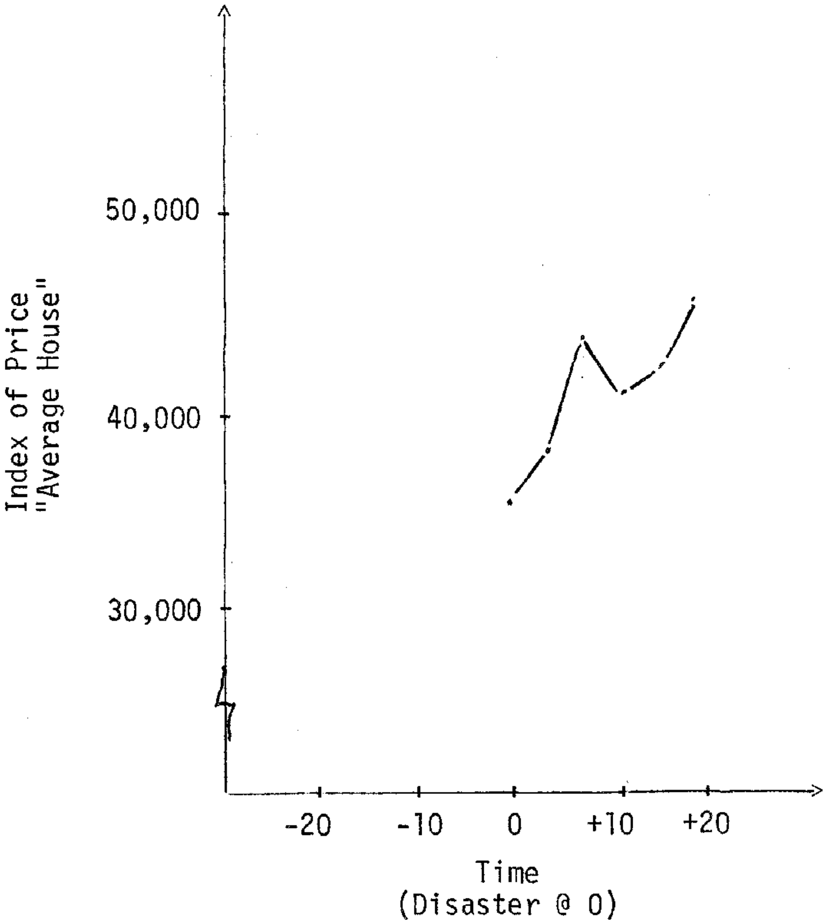
[1] Table III-1 shows 15 sites. Data collected in Wilkes-Barre, although, tending to support the theory, was not in a form comparable to the other sites. Hence, it was omitted from the material presented in Chapter IV.

Figure IV-1

DARWIN, AUSTRALIA

CYCLONE (1974)

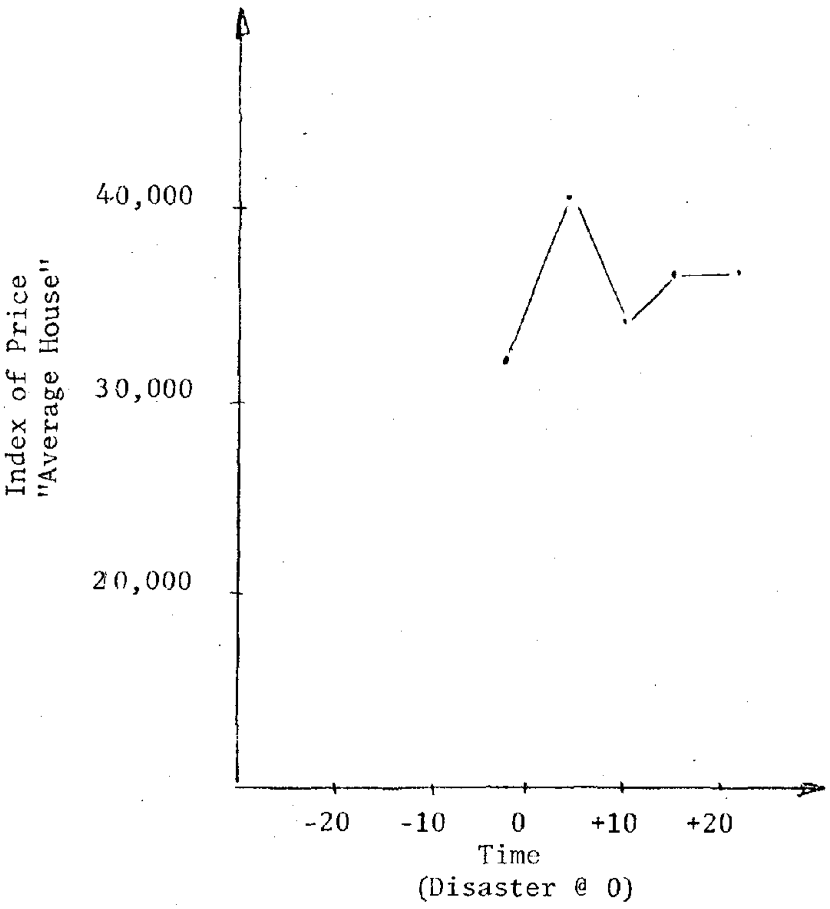


Sales price of the "average" house, given the regression equations shown for each period (Appendix A). The "average" house was defined as a $35,000 home, partially damaged.

Figure IV-2

MADISON COUNTY, MISSISSIPPI

TORNADO, MARCH 29, 1976

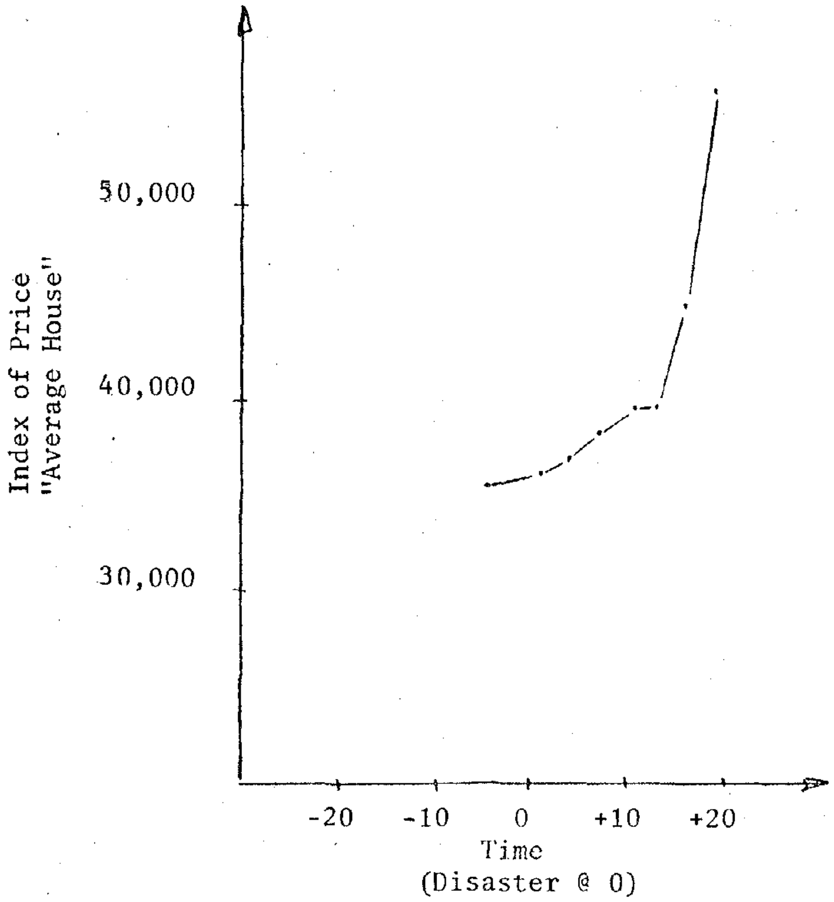


Sales price of the "average" house, given the regerssion equations shown for each period. The "average" house was defined as 10 years old, 1,450 square feet of living area on a 25,000 square foot lot with a 1.5 car garage, 1.75 baths and 6 rooms.

Figure IV-3

LOVELAND, COLORADO

BIG THOMPSON FLASH FLOOD, JULY 31, 1975

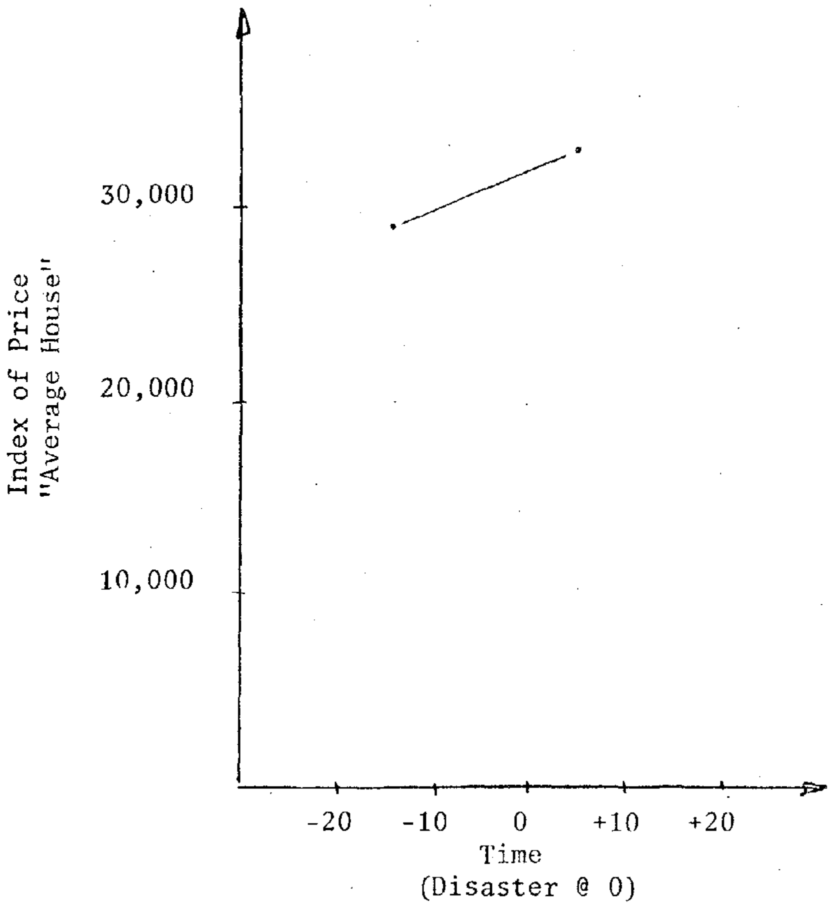


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 1,265.1 square feet of living area on a 10,861.5 square foot lot with a 1.5 car garage.

Figure IV-4

JOHNSTOWN, PENNSYLVANIA

FLASH FLOOD, JULY, 1977

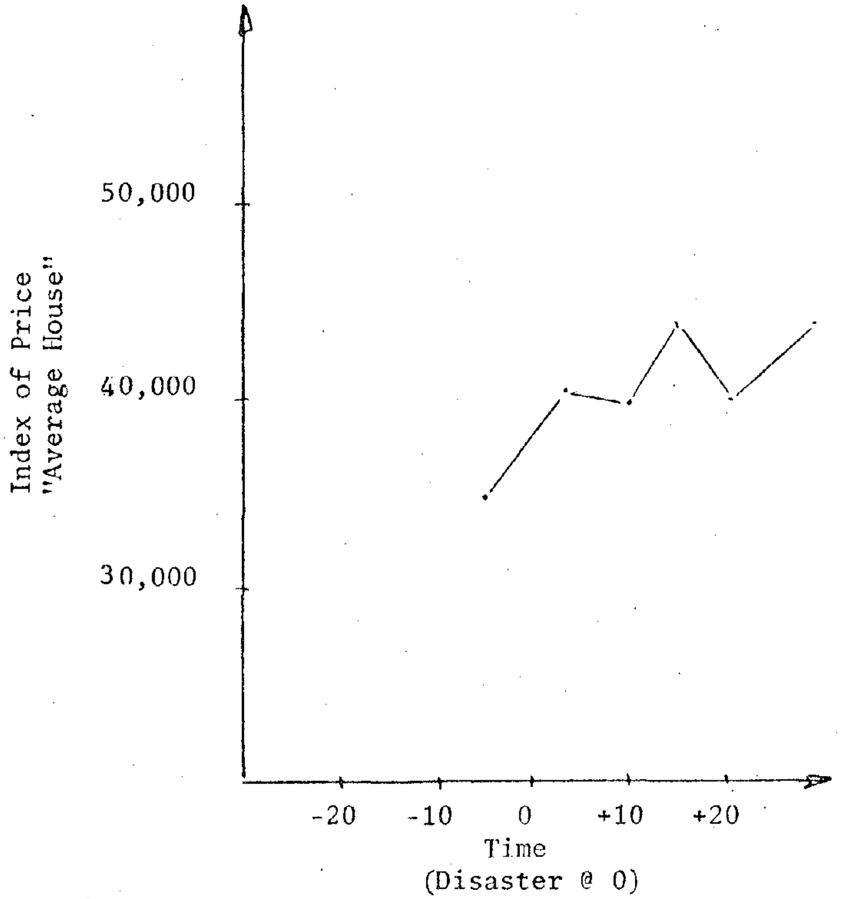


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 20 years old, 915 square feet of living area with a full basement.

Figure IV-5

ROCKDALE COUNTY, GEORGIA

TORNADOES, MARCH 31, 1973

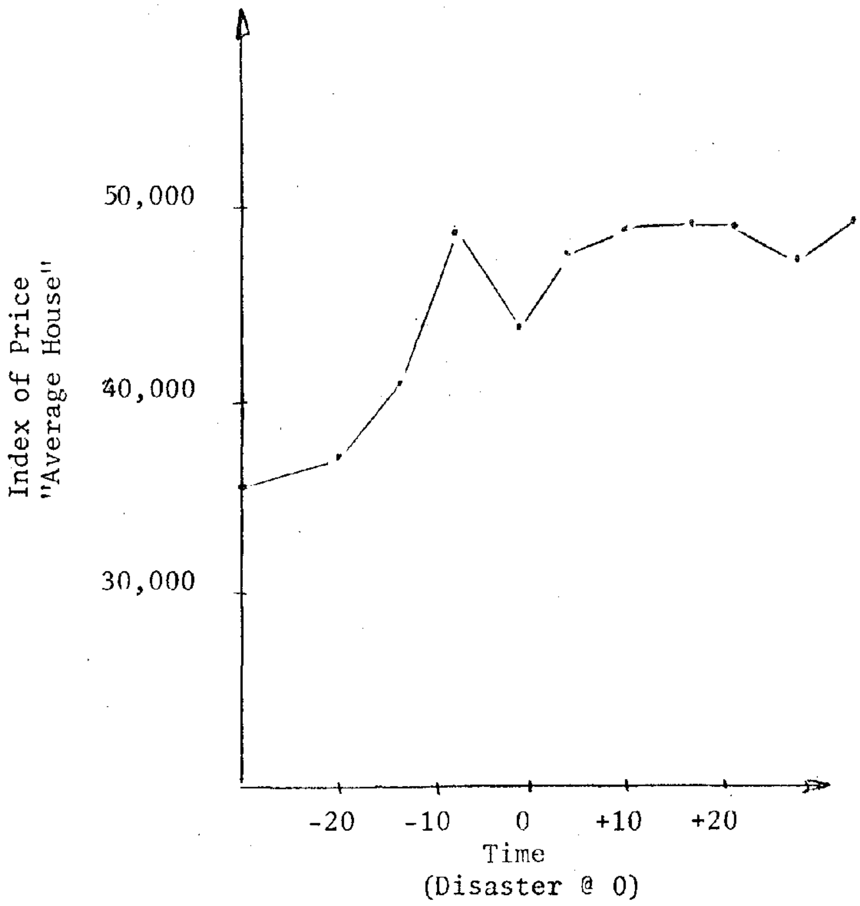


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 9 years old, 1,750 square feet of living area, on a 19,000 square foot lot.

Figure IV-6

ATLANTA, GEORGIA

TORNADOES, MARCH 31, 1973 and MARCH 24, 1975

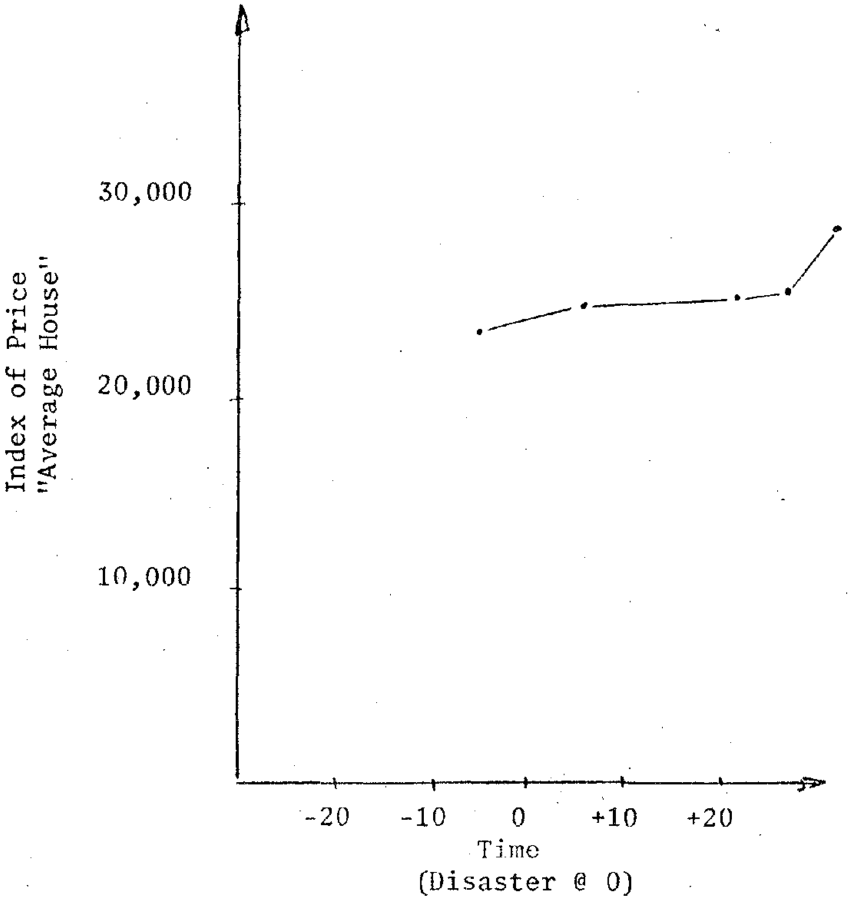


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 21.3 years old, 1,617.1 square feet of living area, on a 18,033.7 square foot lot, with a 1.2 car garage.

Figure IV-7

SAN DIEGO, CALIFORNIA

FIRES, SEPTEMBER 20, 1970

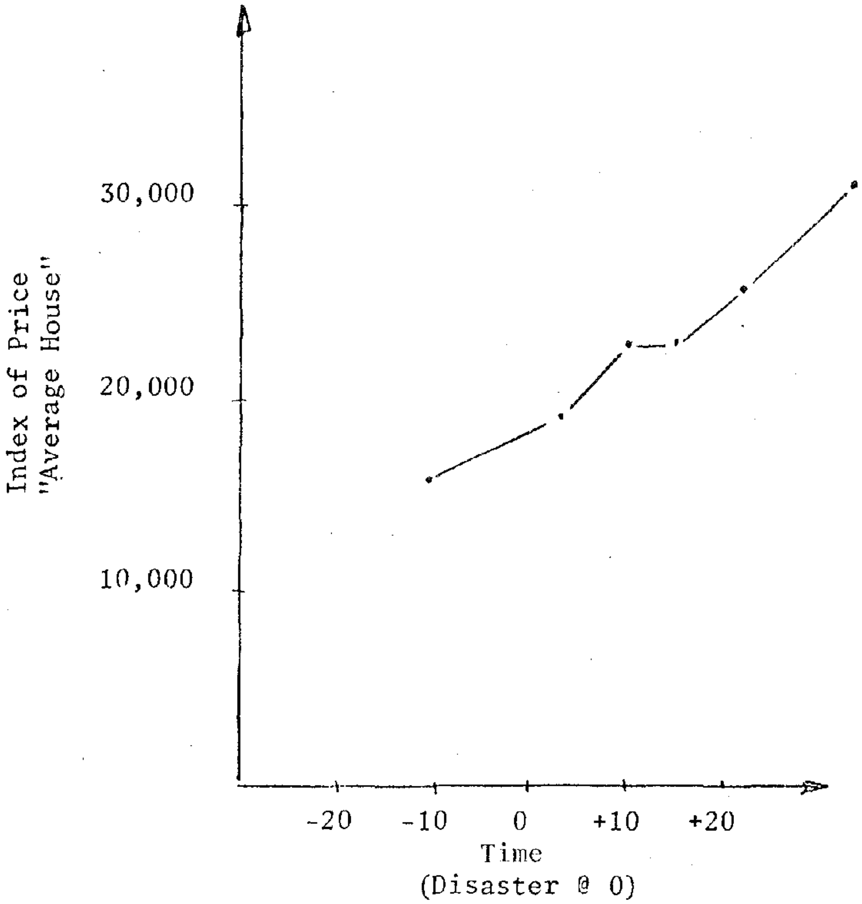


Sales price of the "average" house, given the regression equations for each period. The "average" house was defined as 15 years old, 1,190 square feet of living area, on a 7,650 square foot lot with a 1.5 car garage.

Figure IV-8

RAPID CITY, SOUTH DAKOTA

FLASH FLOOD, JUNE, 1972

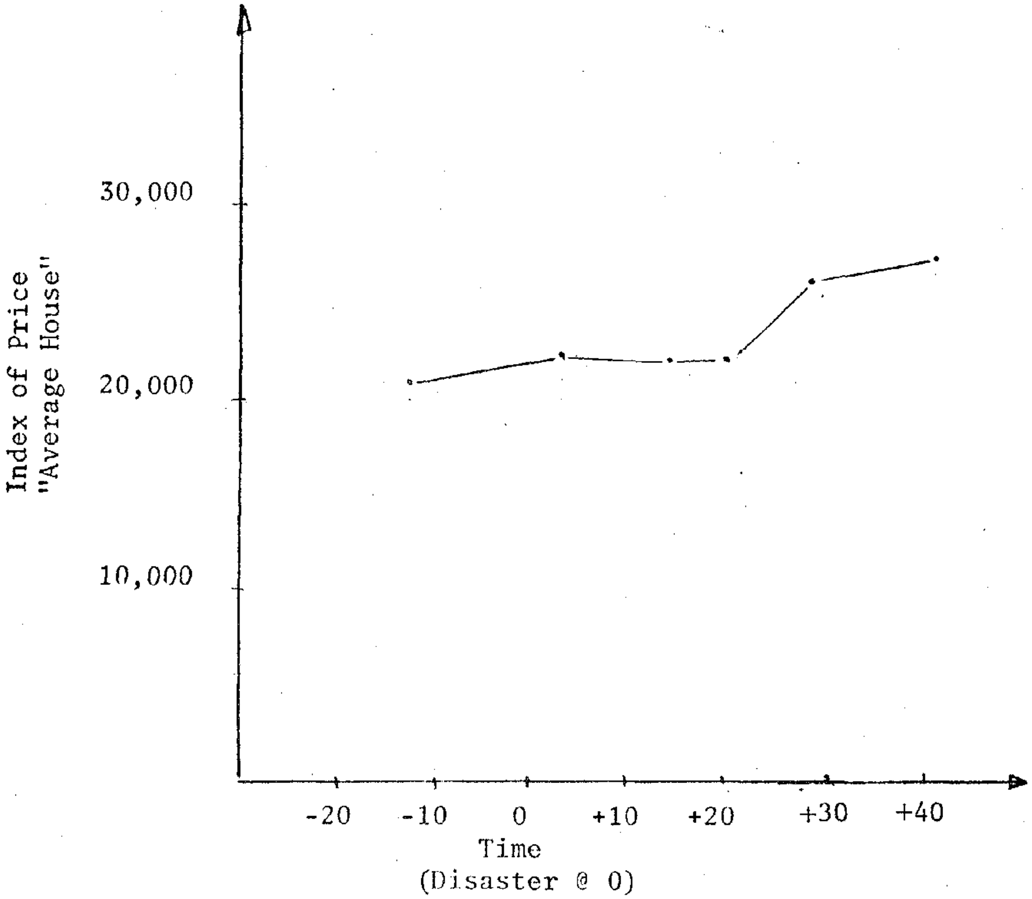


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 16.9 years old, 1,110 square feet of living area, on a 28.7 square foot lot.

Figure IV-9

SAN FERNANDO, CALIFORNIA

EARTHQUAKE, JULY 9, 1971

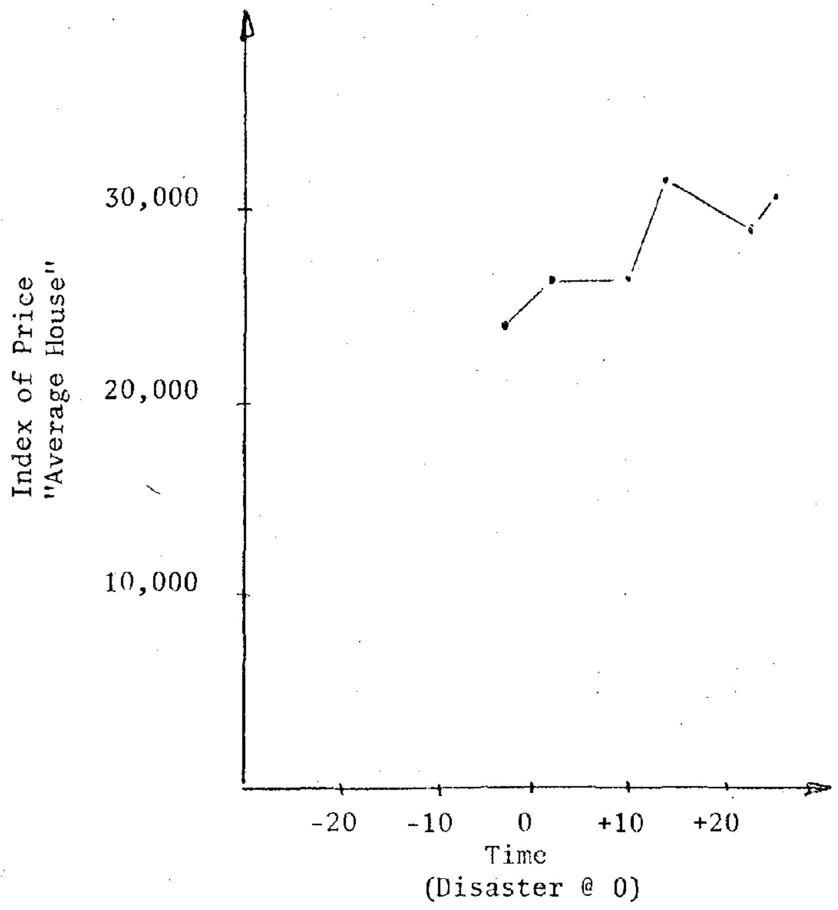


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 23 years old, 1,231 square feet of living area, on a 8,561 square foot lot with a 1.7 car garage.

Figure IV-10

XENIA, OHIO

TORNADO, APRIL 3, 1974



Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 25 years old, 1,482 square feet of living area, on a 7,050 square foot lot with a 1.2 car garage.

to San Fernando. The impact of risk should show up as shift in the demand for housing which would result in a greater degree of price variation unexplained. This would be a clue that some non-economic factor was influencing the market. Note that in Figure IV-9 depressed prices only last twenty months, after which a sharp upturn, consistent with the change in consumer prices, is observed.[1] If the above explanation is correct, then it appears that the disaster induced sense of risk decays rather quickly.

As was pointed out in the conceptual framework chapter, these paths, although suggestive of the cost changes, are not sufficient evidence. A final decision as to whether disasters cause an increase in building costs must await the next chapter. Before looking into the approach developed there, the results of a number of short studies will be reported next.

B. Detailed Study of New Orleans (Hurricane Betsy, 1965)

The price paths presented above strongly point to the existence of rising costs under certain conditions. Where data was available, an attempt was made to extend the analysis to price changes within the community. The purpose of these more detailed studies was to determine whether (1) socio-economic characteristics of neighborhoods influenced reconstruction; (2) degree of damage sustained impact price; and (3) the "new" housing responded any differently from that demonstrated by the "average" house.

To answer these questions, several sub-models of the housing market in New Orleans and Darwin were developed. The most detailed work was performed with the New Orleans data. However, many of the findings are corroborated

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[1] Telephone interviews with real estate agents in both San Fernando, California and Ankorage, Alaska, confirmed that the markets in each community were depressed for some time during the post-disaster period.

by separate analyses of the Darwin experience (not reported here). The analyses about to be described reflect the general strategy outlined above, i.e., collecting data by area within the city and then estimating a price index for a series of periods, with the disaster punctuating the middle of the range.

The location of the districts used in the study are shown in Figure IV-11. Note that some are within and some outside the flood boundaries. This was done in order to determine whether market demand spills over into undamaged neighborhoods bordering on those areas that had been hard hit. Although not attempted, it was possible to categorize districts according to average depth of flooding. The results from the breakdown "flood, no flood, and partial flooding" did not appear to warrant this added detail.

1. Socio-economic Characteristics of Neighborhoods

Initial attempts to analyze New Orleans' sales records focused on a more general model of price. Recalling from the literature review and the results just presented, the price of housing was determined to be a function of both a home's physical appearance (and construction) as well as the amenities afforded by the neighborhood. The preceding set of results did not incorporate neighborhood income, amenities, racial mix or other exogenous factors. By restructuring the regression equation to incorporate these elements, it was thought that the price paths could be refined and the R^2's boosted.

Specifically, price was related to the same factors reviewed above plus two additional variables; the percentage of non-white homeowners in the neighborhood and the average income.

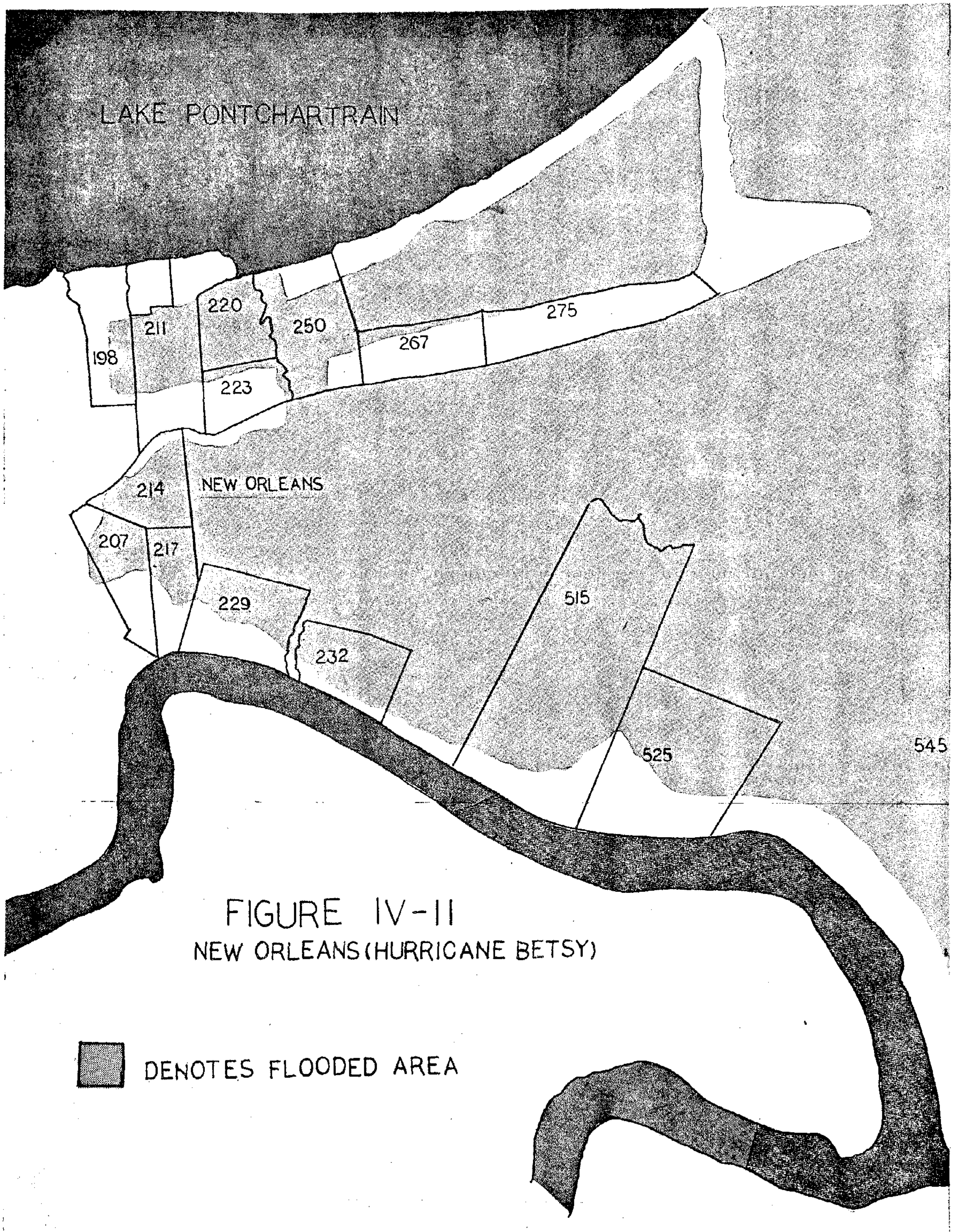

FIGURE IV-11
NEW ORLEANS (HURRICANE BETSY)

The expression tested was as follows:

(4) $P = a_1 \text{ SQFT} + a_2 \text{ LOTAR} + a_3 \text{ AGE} + a_4 \text{ COND} + a_5 \text{ NW} + a_6 \text{ I} + b$

Where:

NW is the percentage of non-white residing in a real estate district.

I is the average income of the district.

All Others:

SQFT is square feet of living area.

LOTAR is the lot area in square feet.

AGE is the age of the structure.

COND is the condition of the structure.

a_1 through a_6 and b are the regression coefficients and intercept respectively.

In constructing the model in the fashion just described, it is assumed that home buyers evaluate living area and other housing characteristics independent of location within the city. Income and racial effects simply shift the relationship (change the intercept). As a contrast to this approach, the price path for each individual district was measured. By so doing, differences between districts were forced to show up in a shift both in the slope and intercept.

As it turned out, income and racial mix did not significantly enhance the model. The coefficients turned out to be significant in a number of time periods and most often the signs were what one would expect. However, the R^2 did not increase by more than two to three percent. As a result, further effort to include social factors was abandoned, leaving a final model which focused on the physical characteristic of the structure alone.

The model of individual districts showed that even in the disaggregated version, prices seemed to be uninfluenced by the disaster. This appeared to hold regardless of whether the districts were caught in the flood or bordered it. See Figures III-12, III-13, and III-14 for the results. A detailed display of the regression statistics are provided in the Appendix A.

2. The Price of New vs. Used Housing

One criticism that could have been leveled at the conceptual framework is that the used housing market is quite distinct from that for new housing. In New Orleans, it was possible to check this possibility. The condition code, by indicating the condition of the home upon sale, also provided a means of detecting new homes. Sorting the data according to new structures, a set of regressions were performed, the results for which are reported in Appendix A, Page A-31. Overall, there appeared to be no major difference in price paths for either housing category. A comparison of new vs. used housing by flood condition was also performed, the results of which are reported in the following section.

3. The Impact of Damage on Housing Prices

In Harrisburg, Elmira, and Corning, real estate sales were broken down into two categories, those structures within the flooded area and those outside. Figures IV-15 through IV-19 show the price paths for each.[1] In the case of New Orleans, a large body of sales information

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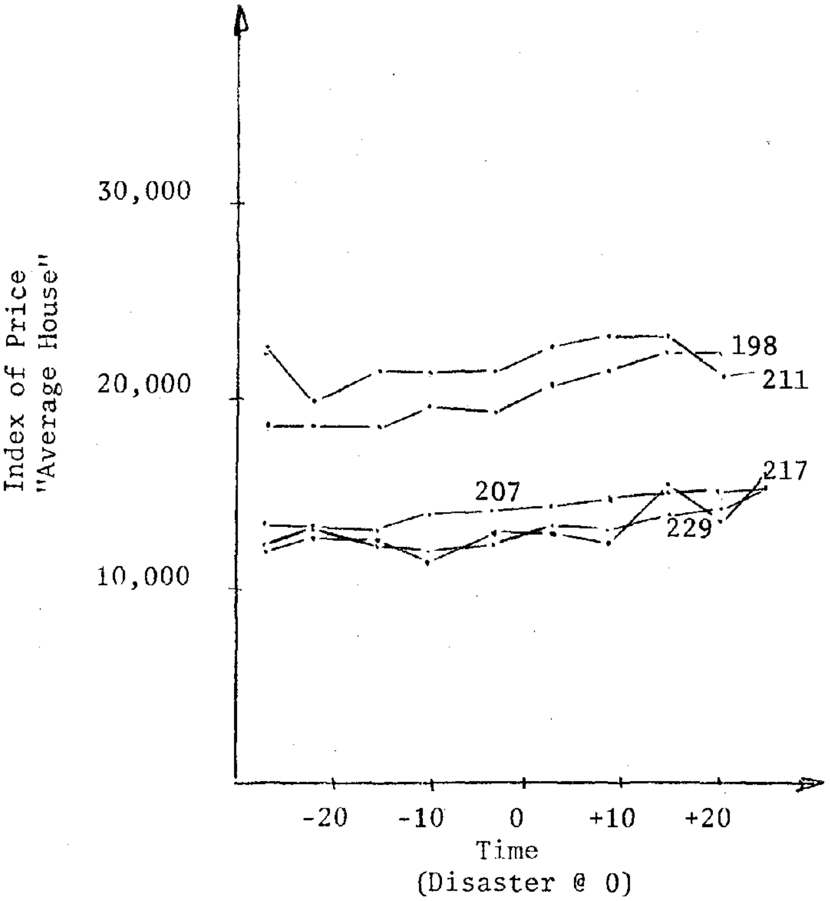
[1] The impact of flooding was captured by inserting a dummy variable into the regression equation (1 indicating a structure in the floodway and 0 for those outside the floodway). This strategy is based on the assumption that the characteristics of housing would be valued the same regardless of whether in the flood plain or not. The locational factor is captured by a shift in the intercept. In New Orleans, sufficient data was available to run individual neighborhoods separately.

Figure IV-12

NEW ORLEANS

DISTRICTS WITH PARTIAL FLOODING



198--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 16.2 years old, 1,400 square feet of living area, 5,850 square foot lot in "average" condition. (Code 4.8)

211--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 20.9 years old, 1,540.1 square feet of living area, 5,996.3 square foot lot in "average" condition. (Code 5.1)

207--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 49.3 years old, 1,621 square feet of living area, 3,900 square foot lot in "fair" condition. (Code 3.8)

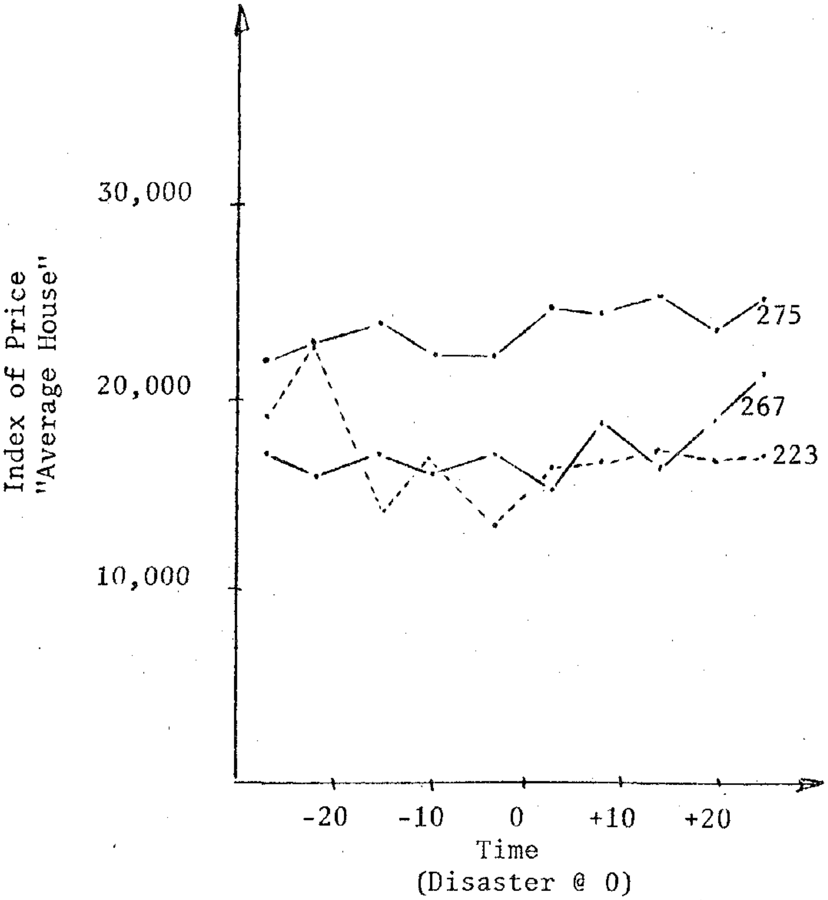
217--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 50.3 years old, 1,599.3 square feet of living area, 3,631.9 square foot lot in "fair" condition. (Code 4.0)

229--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 47 years old, 1,515 square feet of living area, 4,077 square foot lot in "fair" condition. (Code 4.1)

Figure IV-13

NEW ORLEANS

DISTRICTS--NO FLOODING



275--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 4.2 years old, 1,546 square feet of living area, 6,055.6 square foot lot in "good" condition. (Code 6.0)

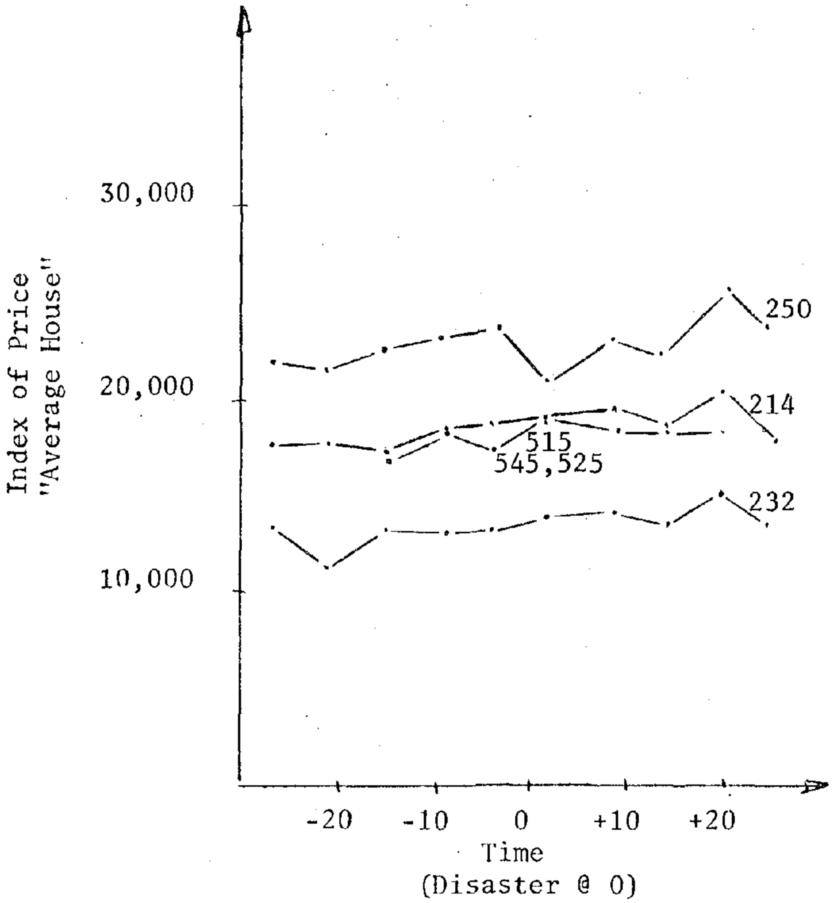
267--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 12.1 years old, 1,385.1 square feet of living area, 6,618.2 square foot lot in "average" condition. (Code 4.9)

223--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 18.2 years old, 1,240 square feet of living area, 5,720 square foot lot in "average" condition. (Code 4.8)

Figure IV-14

NEW ORLEANS

DISTRICTS FLOODED



250--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 7.2 years old, 1,570 square feet of living area, 7,300 square foot lot in "average" to "good" condition. (Code 5.5)

214--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 25 years old, 1,450 square feet of living area on a 5,500 square foot lot in "average" condition. (Code 4.8)

515, 545, and 525--Sales price of the "average" house, given the regression equations for each period. The "average" house was defined as 5.7 years old, 1,215.5 square feet of living area, 6,090.2 square foot lot in "good" condition. (Code 5.9)

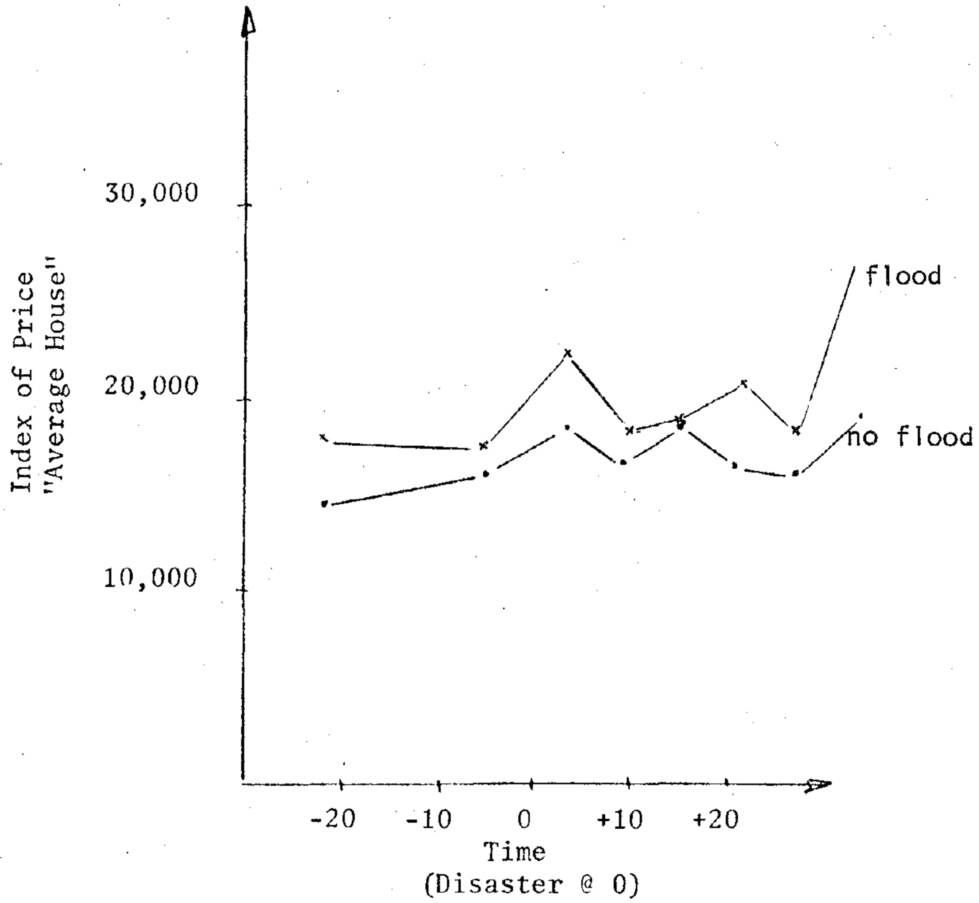
232--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 28.3 years old, 1,300 square feet of living area, 5,200 foot lot in "fair" to "average" condition. (Code 4.4) created the opportunity of measuring price paths for heavily flooded, moderately flooded, and not flooded zones of the city.

The paths displayed for Harrisburg (Figure IV-15) and Elmira (Figure IV-16) suggest that a shortgage of housing caused prices in the floodway to climb slightly faster than those elsewhere. In Corning (Figure IV-17), just the opposite occured, i.e., the market for housing in the floodway lagged behind other areas of the city. New Orleans (Figure IV-18), indicates no substantial difference in the price paths. How can such a disparity in results be reconciled? In all but New Orleans, the sales record did not specify the condition of the structure upon sale. It is possible that damaged structures were being sold in these cities. If so, the path for Corning may not be consistent, i.e., the "average" house changed in quality after the flood. If so, the flood zone price paths for these three communities may be biased downwards. In the New Orleans study, this problem did not arise since the condition of the structure upon sale was reported. By normalizing for condition, the price paths should be more reliable. Since little change in price was observed in any of the three flood categories shown in Figure IV-18, one may conclude that disaster effects were localized. It doesn't appear that prices in areas adjacent to the floodway were bid up in value, nor did the shortage of housing cause much change in price in areas severely damaged. Possibly in smaller towns such as Harrisburg and Elmira, the observed slight upward surge in price can be supported. One piece of evidence from the analysis of the New Orleans data tending to support the Harrisburg and Elmira experience, is the path of prices for <u>new</u> homes (Figure IV-19).

Figure IV-15

HARRISBURG, PENNSYLVANIA

HURRICANE AGNES (FLOOD), JUNE, 1972

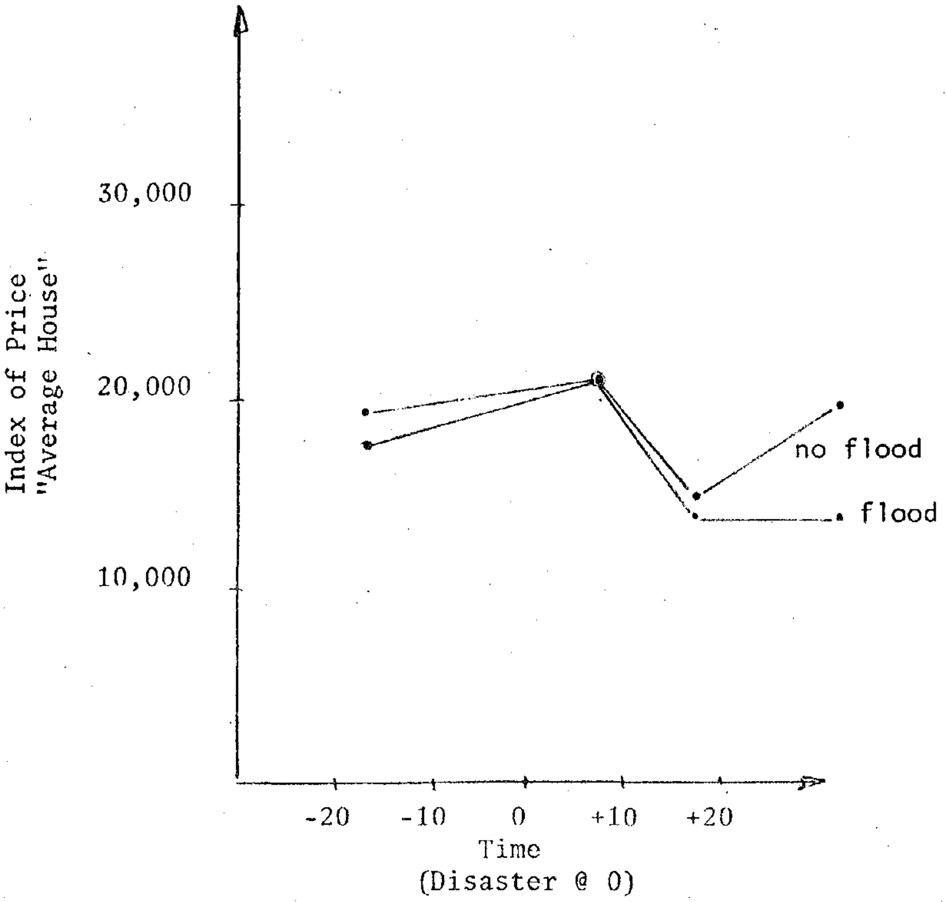


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 17 years old, 780 square feet of living area with a basement.

Figure IV-16

ELMIRA, NEW YORK

HURRICANE AGNES (FLOOD), JUNE, 1972

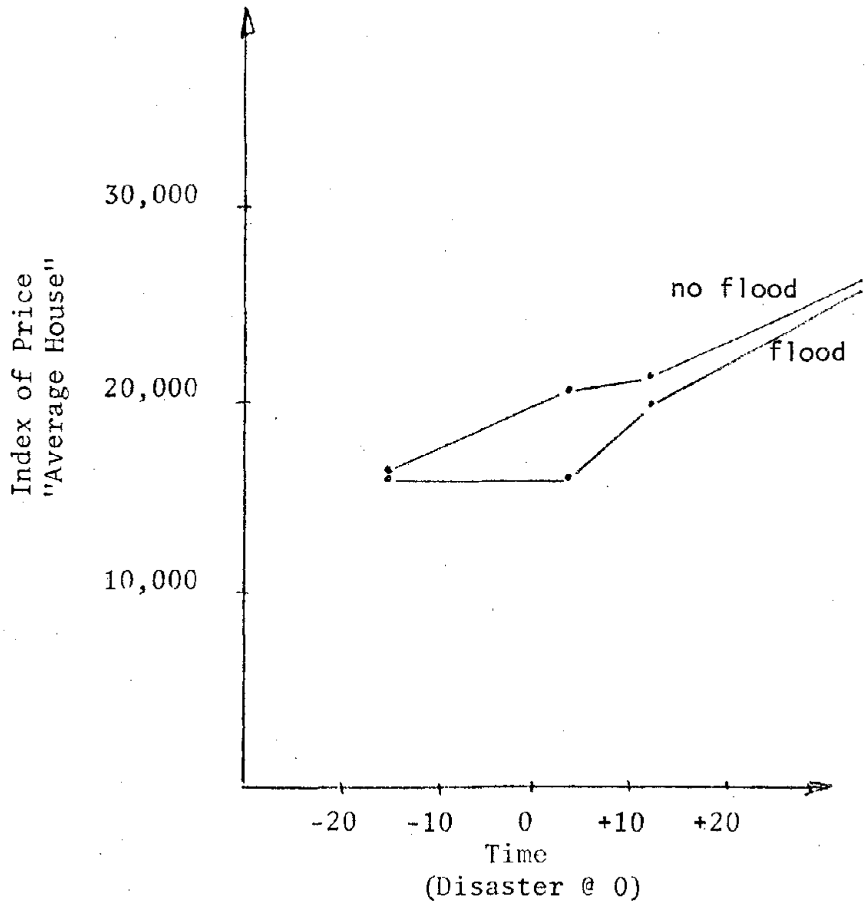


Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 38.7 years old, 842.6 square feet of living area, on a 7,138 square foot lot.

Figure IV-17

CORNING, NEW YORK

HURRICANE AGNES (FLOOD), JUNE, 1972



Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 58 years old, 972 square feet of living area on a 7,080 square foot lot with a full basement.

Figure IV-18

NEW ORLEANS

FLOODED, NOT FLOODED AND PARTIALLY FLOODED DISTRICTS

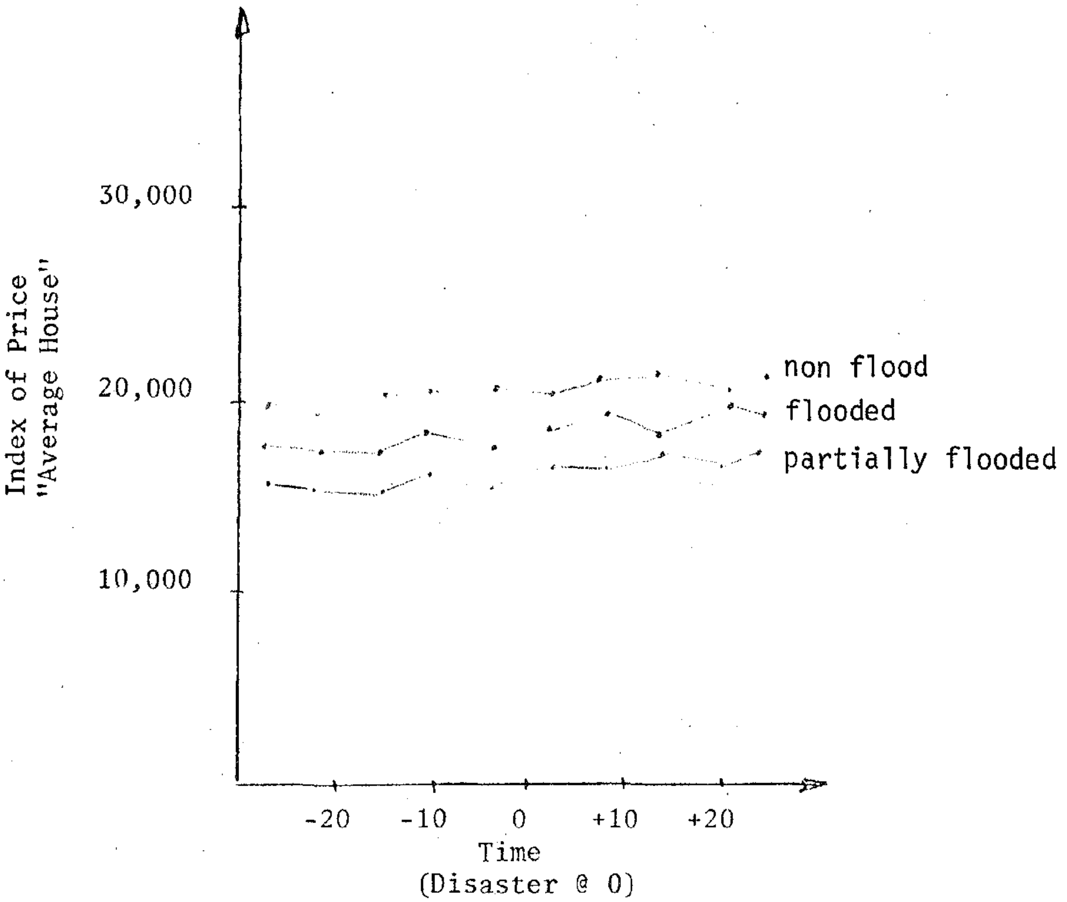
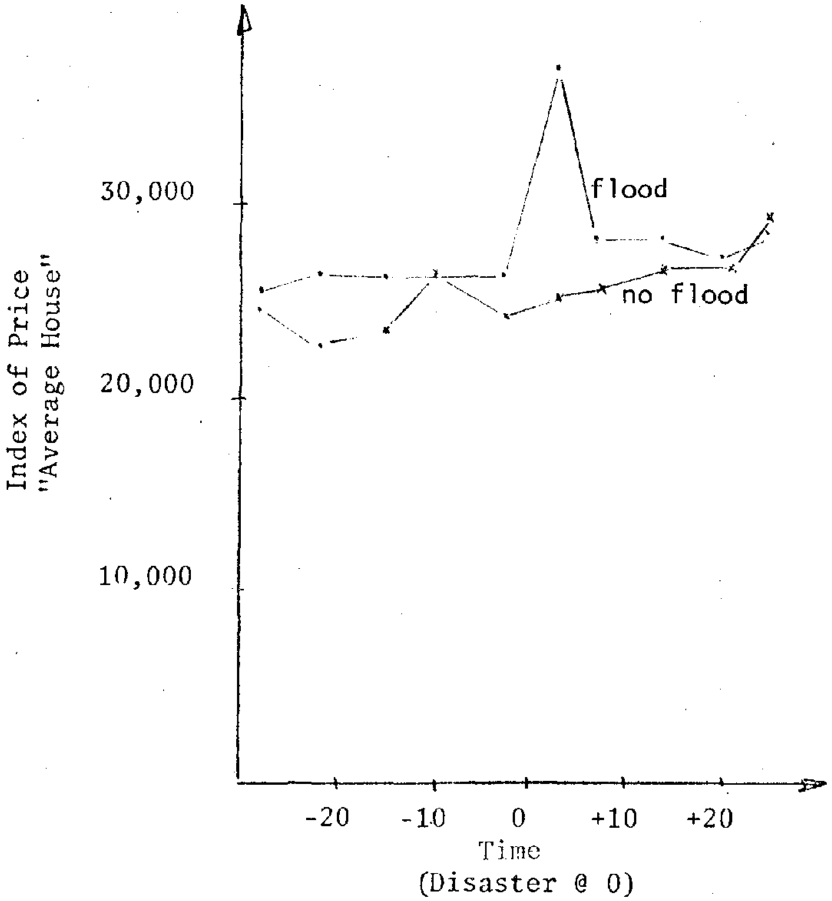


Figure IV-19

NEW ORLEANS

NEW HOUSES



Flooded Districts--Sales price of the "average" house, given the regression shown for each period. The "average" house was defined as "new", 1,760 square feet of living area, on a 5,980 square foot lot in "new" condition.

Districts Not Flooded--Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as "new", 1,700 square feet of living area, 5,840 square foot lot in "new" condition.

The change in price after the flood is very abrupt albeit short lived, lasting less than ten months. The change was observed in the flooded areas only, suggesting that new housing was in great demand after the event but that the demand did not spill over into neighboring sections of the city. Another explanation for the difference in paths is that the New Orleans experience occurred before flood insurance and flood plain zoning were major issues. In 1972, the emphasis given flood plain management may have induced a different price response than that observed in the mid 1960's.

4. Other Tests

A number of studies were performed with the New Orleans data in order to check several assumptions used in the model's construction. Since the condition code simply represented a scale from 1 to 7, there was no reason, a priori, to include code as a separate continuous variable. One problem that could have been encountered was a nonlinearity in its influence. Moving from two to three could have increased value more than if condition improved from a four to a five. In order to test this possibility, a separate estimate of house price was undertaken with the condition code included as a dummy variable. The six dummies did not show up consistently from period to period. However, in plotting them when they were statistically significant, it appeared that the assumption of linearity was not unreasonable. Hence, in the New Orleans' regressions, "condition" was used as a continuous variable.

In the case of New Orleans, more information was received than we had the resources to process. However, success with simple descriptions, such as living area, led to a test of an expanded set of factors. Two variables were added; one concerning housing type (ranch, two-story, tri-level, etc.), the other reflecting the nature of construction (brick, frame, stucco, etc.). Again, dummies were used to capture the influence of these factors. However, it was seldom that the R^2 increased more than five percent. Since 75 to 80 percent of the variation in price was already being explained with the simpler version, the truncated model was retained.

V. APPLICATION OF THE HOUSING MARKET MODEL

The results discussed in the preceeding section suggest the general tendency of housing prices in the post-disaster period. A more precise way of describing the market adjustment path is through simulation. Recall in Chapter II, the description of an economic model of the housing market. The demand price for housing was hypothesized to be a function of the quantity available and income. The price, in turn, was thought to be signal to contractors. If the price exceeded construction costs, then it was argued that new construction would accelerate. As new completions expanded the housing stock, the price would fall along with future period construction activity. The material to follow outlines testable model of such a theory. Given the price paths developed earlier, along with data for housing stock, cost, and new construction, a simulation of post-disaster prices was carried out. The path was then recreated assuming that the disaster never occurred. By simulating this second path, it was possible to show the adjustment of the housing market with respect to some fixed yardstick, that is some "normal" path of prices.

In a broader sense, demand price should be influenced by more than income and housing stock. As shown in the following schematic diagram, permanent income[1] should be the stimulant to price. Income after a disaster is likely to rise as clean-up crews from outside the region converge on the community. However, this form of employment is only temporary and will not stimulate the

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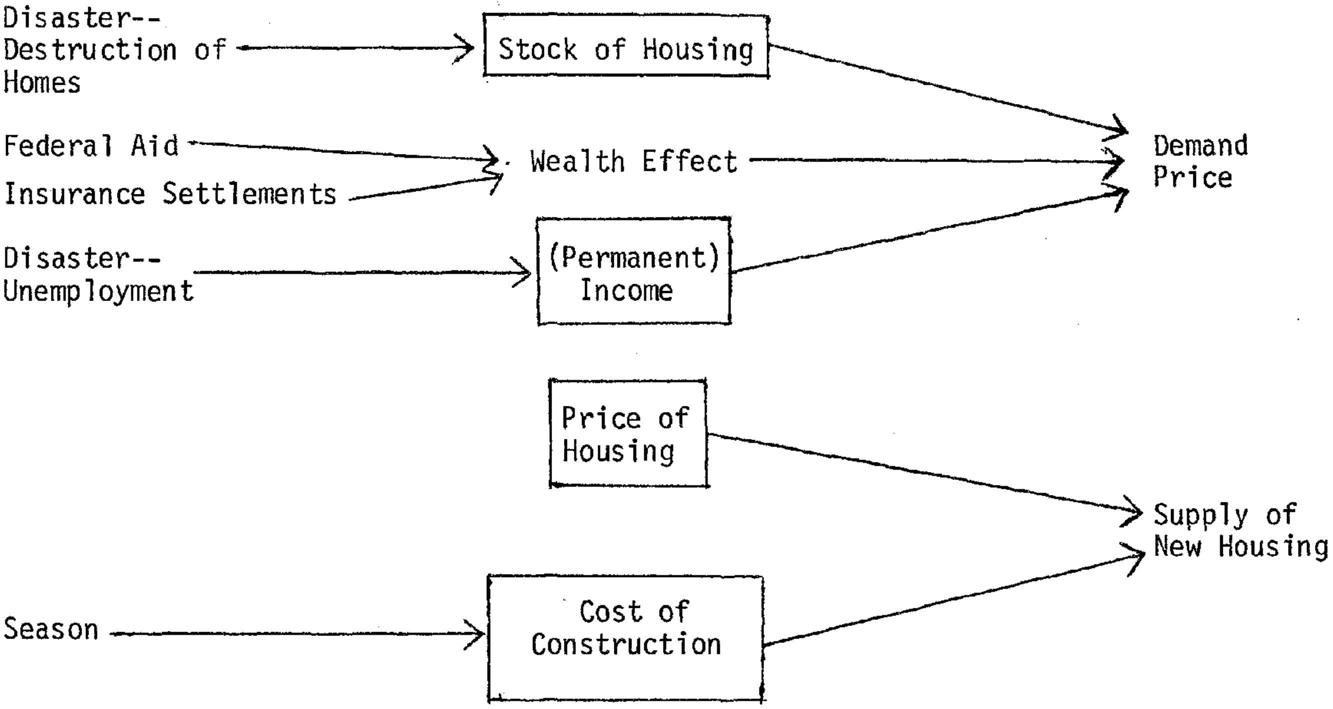
[1] Permanent income is defined as income upon which individuals plan consumption expenditures. Temporary employment would not stimulate housing demand even though measured income is affected.

housing market. Another factor omitted from the model is the impact of the disaster on the community's wealth. If wealth declines, then it is quite likely that this will have a depressing effect on the quantity of housing demanded. Lastly, the cost of construction will be sensitive to the season in which it is carried out. Repair after the great Alaskan earthquake was in some instances conducted in the winter months at substantially higher costs.[1] Hence, there are in some locations two supply or cost relationships, one for the summer months and another for off-season building. Due to the limited amount of data available to estimate demand and supply, the factors just mentioned were eliminated from the model leaving only the most basic ingredients (those shown in boxes).

Figure V-1

SCHEMATIC DIAGRAM OF THE HOUSING MODEL



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[1] Plastic sheeting was draped over structures creating huge tents within which work could be continued throughout the winter.

A. An Econometric Model of the Housing Market

Following the model sketched in Figure V-1, the demand price for housing is hypothesized to be a function of housing stock and income.

$$(5)\quad \log \frac{P_t}{CPI_t} = a + b_1 \log Q_t + b_2 \log (INCOME_t)$$

Where:

P_t	is the price of an "average" house at some point in time, t.
CPI_t	is the consumer price index at time t. This provides a measure of housing price relative to the price of other consumer goods.
Q_t	is the stock of housing in any period, t.
$INCOME_t$	is the employment in the community at a point in time, t.
a_1, b_2, and b_2	are the intercept and regression coefficients respectively.

The left-hand side of (5) shows the price developed from the regression equations of Chapter IV, divided by the consumer price index. The consumer price index was obtained from the Bureau of Labor Statistic's Consumer Price Index: U.S. City Average and Selected Areas. The index used here omits the price of housing services so that the resultant measure is a truer price of all <u>other</u> goods. This was done in order to isolate the relative price of housing in contrast to all other goods in the economy. Therefore, $\frac{P_t}{CPI_t}$ should detect the difference between price increases flowing from a general round of inflation and those stemming from scarcity. It is only the latter price change that is of relevance to this investigation. Q_t is the stock of housing measured in single-family units. The housing stock for each site was obtained from the Bureau of the Census' Construction Reports: Housing Authorized by Building Permits and Public Contracts by interpolation. This provided a rough benchmark of the initial stock. Given the initial stock, building permits were added by time period to obtain a time profile of Q_t. Dollar income was not available for all sites, so number of workers was substituted instead. The use of employment level could bias the results, in that the relationship between employment and income may be imperfect. However, it was thought that the short time period involved for each estimation would allow the safe substitution of employment for income. Employment figures were obtained from the Bureau of Labor Statistics' Employment and Earnings Report.

Log transformations were selected because they were found in previous studies to provide a slightly better explanation of housing price.[1] Tests of this equation form were compared to the purely linear version and tended to confirm this observation. One additional benefit of the log transformation is that it yields an estimate of demand elasticity which is insensitive to stock. This point will be developed later in the Chapter.

On the supply side of the problem, the quantity of new construction is given by,

$$(6) \quad \log (q_t) = c + d_1 \log (P_t) - d_2 \log (COST_t)$$

Where:

q_t is the number of new building permits issued in period t.

$COST_t$ is the Dodge Cost Index for a similar sized city in the same state.

c, d_1, and d_2 are the intercept and regression coefficients respectively.

(6) reflects the hypothesis that permits would be issued in relation to the real price of housing, i.e., the selling price normalized for cost of building in surrounding communities. In using cost indexes for other than the disaster

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[1] See Revier (1978) and Van de Water (1974).

stricken area, a "normal" escalation in cost is captured. One would expect that quantity of new housing permits would be sensitive to this form of cost. If P_t and $COST_t$ increased in the same proportion, then the profit picture remains unchanged. However, if P_t rises faster than $COST_t$, then the profitability of building is enhanced and new construction activity would be expected. Hence, the signs displayed in (6) make economic sense.

The inclusion of $COST_t$ can also be justified in that communities, aside from the one sustaining damage, are in a state of relative equilibrium. By this, it is meant that the housing market for these communities is not normally in a state of rapid adjustment. Hence, the cost of building (including a normal return) should be equivalent to price. If so, then the cost index is also a measure of price. Holding P_t in the disaster stricken community fixed, an increase in cost (price) elsewhere will induce local contractors to shift operations elsewhere. This is especially true if local costs have risen in response to materials and labor shortage. So, once again, $COST_t$ should be inversely related to starts.

The foregoing discussion shouldn't be misinterpreted to mean that increased construction will only occur if profitability increases. In estimating the coefficients d_1 and d_2 in (6), we may find the former large relative to the latter. This would mean that the industry is very responsive to change in real price.

Finally, an accounting relationship is needed to indicate how the housing stock responds to destruction and new construction.

$$(7) \quad Q_t = Q_{t-1} - DES_t + q_{t-1}$$

The variables here are self-explanatory. The stock of housing in any period, t, depends upon the preceding period's stock less the number destroyed plus any completions. Because of data limitations, q_t is defined as a building permit. It was assumed that one period would elapse before the permit would be converted to a completion. That is why q_{t-1}, rather than q_t, is included in (7).

B. Estimation of Demand and Supply

The model was tested with data collected in Rapid City, Xenia, and New Orleans. These three cities provide a reasonable range of size (population) and disaster magnitude. It would have been desirable to test the model with each of the sites in the study, but time and resources precluded this possibility. Table V-1 displays the regression results by site. Two equations are shown for each; one capturing the responsiveness of contractors to price and costs (supply), the other indicating the sensitivity of housing price to quantity of housing and income. The equation forms vary slightly from that presented above. The prime difference lies in the introduction of a lagged quantity term. The reasons for this change are:

1. Housing prices appeared to respond slowly to supply changes. In testing the equations, it was found that two period lags worked best in predicting price in New Orleans and Xenia while one period worked best in Rapid City. This phenomenon is consistent with economic theory in that it takes time for markets to respond to disequilibrating shocks. Specifically, it takes time for demands to become effective. Those displaced from their homes may have to wait for Federal loans to be processed before then can actively participate in the market.

Table V-1
Demand and Supply
New Orleans, Rapid City, Xenia

NEW ORLEANS

(1) Demand $$\log \frac{P_t}{CPI_t} = -1.51 - \underset{(-1.81)}{.59 \log (Q_{t-2})} + \underset{(3.05)}{.52 \log (INCOME_t)}$$

$N = 8$
$R^2 = .88$
$F = 18.2$

(2) Supply $$\log (q_t) = 55.78 + \underset{(1.45)}{16.09 \log P_t} \underset{(-1.78)}{-18.62 \log (COST_t)} \underset{(-.77)}{-.29 \log (q_{t-1})}$$

$N = 8$
$R^2 = .58$
$F = 1.8$

RAPID CITY

(1) Demand $$\log \frac{P_t}{CPI_t} = 1.12 - \underset{(-1.55)}{1.27 \log (Q_{t-1})} + \underset{(5.20)}{3.01 \log (INCOME_t)}$$

$N = 6$
$R^2 = .90$
$F = 14.3$

(2) Supply $$\log (q_{t-1}) = -17.83 + \underset{(1.88)}{7.38 \log (P_t)} - \underset{(-1.42)}{11.53 \log (COST_t)}$$

$N = 6$
$R^2 = .62$
$F = 2.5$

XENIA

(1) Demand $$\log \frac{P_t}{CPI_t} = -3.04 - \underset{(-3.00)}{.98 \log (Q_{t-2})} + \underset{(1.44)}{1.73 \log (INCOME_t)}$$

$N = 6$
$R^2 = .78$
$F = 3.5$

(2) Supply $$\log (q_{t-2}) = -41.89 + \underset{(3.91)}{13.86 \log (P_t)} - \underset{(2.14)}{12.83 \log (COST_t)}$$

$N = 6$
$R^2 = .87$
$F = 10.3$

2. Quantity of new housing permits tended to lead price changes. This is clearly inconsistent with the model developed above, where it was postulated that contractors would respond to price changes. It appears that permits to build may not be a good indication of when new housing is completed. A lag between the date of issuance and the start/completion date may be as much as six to twelve months. Given this observation, the theory offered above was amended slightly. Contractors are assumed to issue permits in response to the perceived demand for housing. They should be willing to do so, given that construction costs have yet to rise. As building begins, costs escalate at the same time prices for the existing housing stock climb. Hence, the contractor is able to pass on the increased costs. If, as this process unfolds, the cost of building outpaces price, the number of new starts can be adjusted downward. Equally possible, is a reduction in home quality or size. In any event, the use of building permits or permit valuation may not be the best measure of when new houses were begun. The permit enables one to start building, but the starting date can be postponed for up to one year. Even if postponed beyond that date, the contractor need only reapply for a minimal fee. For the purposes of the model, these problems can be finessed by allowing q_t to lead P_t. If the pattern of starts is just delayed, then the model will still capture the responsiveness of q_t and P_t.

3. Another technique shown in Table V-1, is the Koyck lag (New Orlenas, supply). This approach postulates a continuous adjustment process where each period q_t changes in some proportion to the difference between last period's construction level and the equilibrium

level. With a little algebra, it can be shown that this lag reduces to the form shown for the New Orleans supply equation. The dependent variable is lagged on the right hand side. The only difference between the results achieved in this equation and that provided elsewhere is that the coefficients for price and cost must be divided by adjustment rate.[1]

Using the equations in Table V-1, a price path was computed for each disaster site. A graph of the results is given in Figures V-2 through V-4. These paths reflect the simulated pattern of price given an initial housing stock (Q_t) and price (P_t); the pattern of construction costs elsewhere ($COST_t$); and the consumer price index (CPI_t). With these initial conditions, it was possible to determine the movement of the market through time. Initial price

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[1] The adjustment rate can be shown to be one minus the coefficient of log q_{t-1}. The long-run quantity of new housing q_t* depends upon the observed current price and cost, i.e., P_t and $COST_t$.

$$q_t{}^* = c + d_1 P_t - d_2 (COST_t)$$

Assume that builders change their construction plans by some function of the difference between actual building starts and that desired. That is,

$$q_t - q_{t-1} = B (q_t{}^* - q_{t-1}), \text{ where } 0 \leq B \leq 1$$

Combining the above two equations, it can be shown that

$$q = Bc + Bd_1 P_t + Bd_2 COST_t + (1 - B) q_{t-1}$$

In estimating this last equation, the coefficient of q_{t-1} provides B. Given B, c, d_1 and d_2 can be computed. With d_1 and d_2, the supply price elasticities can be computed.

Figure V-1

Price Path With and Without Disaster

New Orleans, Louisiana (Hurricane Betsy, 1965)

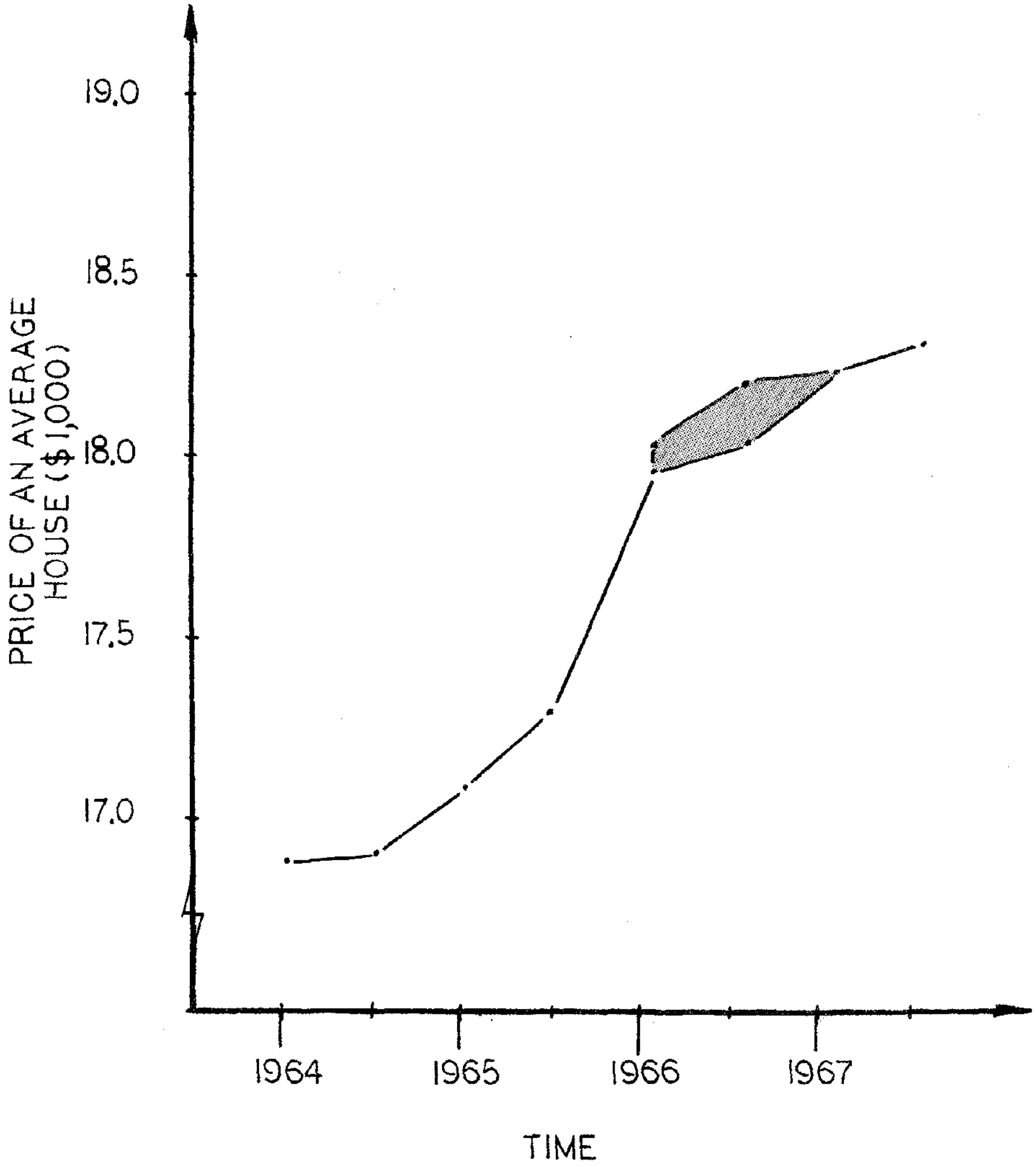


Figure V-2

Price Path With and Without Disaster

Xenia, Ohio (Tornado, 1974)

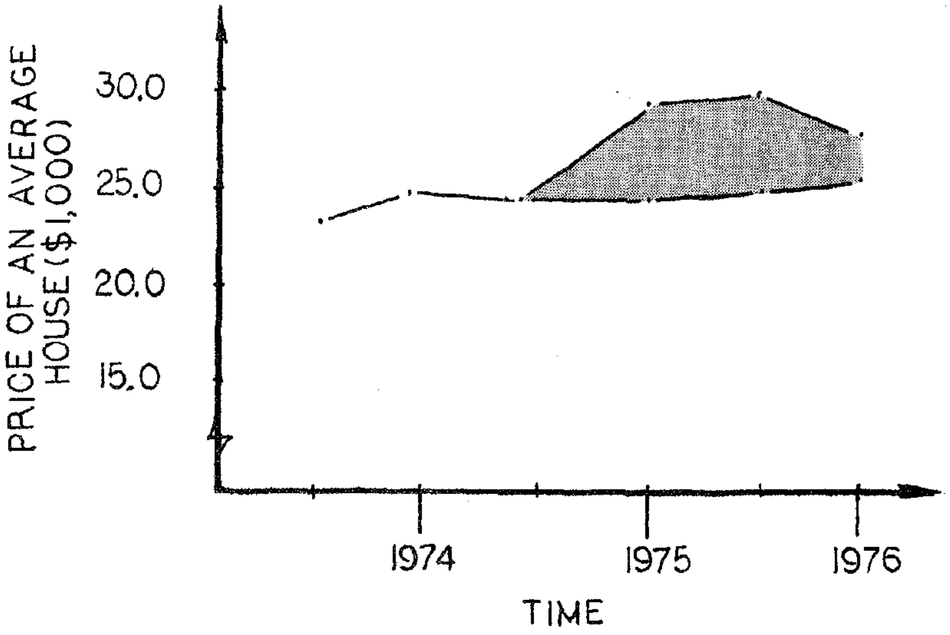
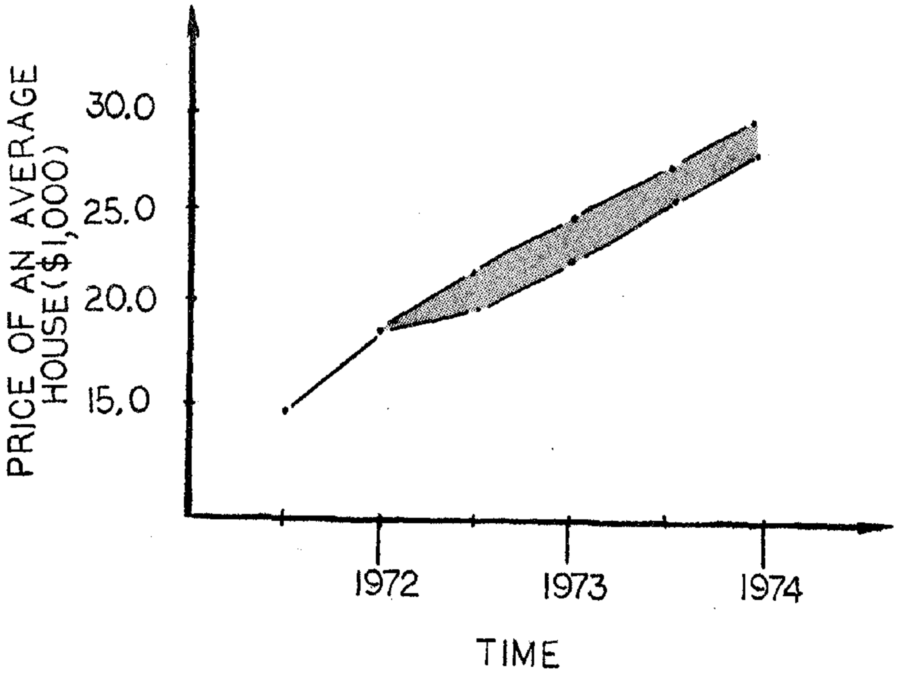


Figure V-3

Price Path With and Without Disaster

Rapid City (Flash Flood, 1972)



and cost influences new construction. New construction and local income shapes price. Price and cost in the next period cause builders to replan production. The process continues period by period yielding the price paths shown. The lower set of prices were simulated given that the geophysical event either did not occur or did not damage property. The shaded area in each case then represents the difference between the two, or the rise in cost due to the disaster.

The importance of developing the model becomes very apparent when viewing the New Orleans case. Prices appeared to climb quickly after the disaster. One could interpret the response to be a product of Hurricane Betsy. However, the factors responsible for this change were: (1) an acceleration in the rate of growth of the consumer price index and (2) an increase in personal income.[1] The disaster induced price effects did not show up until 1966. It is dangerous, therefore, to just look at the price changes in isolation and conclude that the disaster is solely responsible.

The price path shown in Figures V-2, V-3, and V-4 show two other interesting results. In Rapid City, the price change appears to be more prolonged than in either Xenia or New Orleans. This can be explained in part by the fact that it is a growing community. Hence, it is more difficult to reestablish the destroyed housing stock and maintain growth in new housing. Xenia, on the other hand, is a bedroom community for the economically declining Dayton area. The duration of disequilibrium should, therefore, be shorter than in the Rapid City case. The construction trades in Xenia could take aim at fixed target; whereas in Rapid City, the equilibrium housing stock continued to expand.

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[1] It is an unlikely possibility that the income changes were partially induced because of the disaster.

In two cases (Xenia and New Orlenas), the price path without the disaster merges with the observed price path. This indicates that the shift in price is only a temporary phenomenon. To some, this may seem to be a strange result. Yet, there is no reason why the increased price should be maintained. Incomes in the communities have not been altered permanently by the disaster, and the housing stock is eventually restored. What then happens to homeowners who rebuild at the higher costs. They will not be able to pass on the increases and will, therefore, incur capital losses. Even though the Rapid City path had not approached a "normal" path after two years, it too is likely to fall eventually into a pattern suggested by the Xenia and New Orleans cases.

C. Computation of Demand and Supply Elasticities

Tables V-2 and V-3 display demand and supply elasticities computed from equations shown in Table V-1.[1] The elasticity of demand (or supply) is the responsiveness of quantity demanded (or supplied) to a one percent change in price. If the demand elasticity turns out to be ten, then this means that a slight increase in price is enough to drive consumers from the market, i.e., quantity demanded will shrink significantly. An inelastic relationship implies just the opposite; a large change in price will have a disproportionately

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[1] The elasticity of demand can be computed directly from Table V-1. In the case of New Orleans,

$$\log \frac{P_t}{CPI_t} = -1.51 - .59 \log (Q_{t-2}) + .52 \log (INCOME_t)$$

Taking the derivative of this expression with respect to Q_{t-2} yields

$$\frac{d\left(\frac{P_t}{CPI_t}\right) \Big/ d\,(Q_{t-2})}{\frac{P_t}{CPI}} = -\,.59\,\frac{1}{Q_{t-2}}$$

Dividing by the left-hand side and by .59 yields the elasticity measure sought.

small impact on quantity consumed. Using Rapid City as an example, a demand elasticity of .79 indicates that a one percent rise in price will reduce quantity demanded by .79 percent. Given the nature of the problem at hand, this may seem to be a strange way to describe the relationship between price and quantity. It would be more apropos to ask how price responds to a one percent change in quantity. The price flexibility coefficient captures this influence; using demand once again, a one percent change in quantity leads to a 1.27 percent change in price. For New Orleans, price is observed to be less responsive, changing by .60 percent.[1]

Table V-2

Demand Elasticities

City	Price Flexibility Coefficient	Demand Elasticity	
		Price	Income
Rapid City, SD	1.27	.79	2.36 (3.01)
New Orleans, LA	.60	1.68	.88 (.52)
Xenia, OH	.98	1.02	1.76 (1.72)

These estimates compare favorably with the results of other studies Reid (1962), Lee (1964), and De Leeuw (1971) estimated the price elasticity of demand to be 1.0, 1.05 to 1.90, and .71 to .47, respectively.

The income elasticities in Table V-2 indicate the responsiveness of quantity demanded to income. Using Rapid City as an example once again, a one percent rise in employment (income) leads to a 2.36 percent increase in

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[1] The use of logs in estimation of demand should insure a constant elasticity for a wide range of quantities.

quantity of housing demanded. As with price elasticity, one could ask how income changes will impact the price of housing. These figures are given in parentheses to the right of the income elasticities shown in Table V-2. A one percent change in income will lead to a 3.01 percent change in real price, holding quantity fixed. This last point deserves additional comment. If the Federal government provides disaster relief which is interpreted as income, then the price of existing housing will increase three times faster than the growth in perceived income.

The supply elasticities shown in Table V-3 indicate that the construction industry is fairly responsive to nominal price (P_t).

Table V-3

Supply Elasticities

	Supply Elasticity		
City	Price	Cost of Housing in Neighboring Communities	Net Elasticity
Rapid City, SD	7.38	-11.53	-4.15
New Orleans, LA	14.47	-14.16	.30
Xenia, OH	13.85	-12.83	1.02

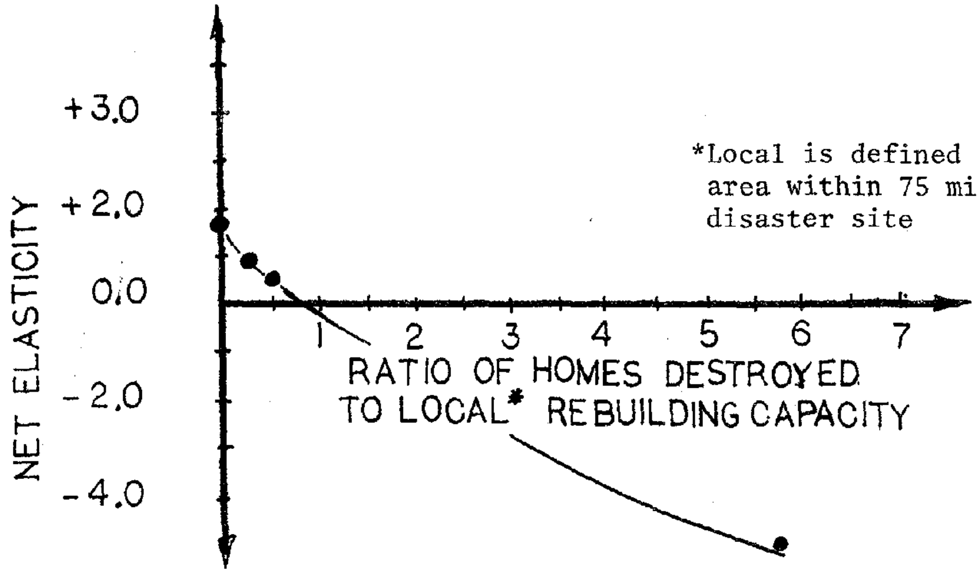
For example, a one percent change in price in Rapid City will boost new construction by 7.38 percent. In New Orleans and Xenia, the percentages are 14.47 and 13.85 respectively. However, new construction is also sensitive to the change in housing prices occurring elsewhere. Recall that the supply equation contains two arguments, price and cost. Cost could be interpreted as the price of housing elsewhere, if it is assumed that the housing markets of surrounding areas were in equilibrium. If a contractor was faced with a one percent increase in local housing prices, matched by a one percent increase in other communities, then his decision as to where to build will depend upon local costs. If these costs prove to be higher than in other areas, fewer local permits would be issued. The second column in Table V-3 illustrates the impact of a change in non-local construction costs on new permits. As one would expect, the relationship is negative; the higher the prices elsewhere, the fewer new permits issued. In Rapid City, a one percent increase in local price matched by a one percent increase in neighboring communities will diminish new construction activity locally. This seems at first unreasonable especially after a disaster. But consider what is happening; in Rapid City, damages exceeded the capacity of local construction personnel. Pressure on costs meant that housing could not be replaced for the same price. Hence, given the option of building in Rapid City at a one percent increase in price, or elsewhere at a similar increase in price, construction activity would move elsewhere. This, of course, did not happen because the price of housing was not limited to the cost increases (and, therefore, price increases) occurring elsewhere. Prices climbed in response to both a rise in income, and a decline in the housing stock. These forces were sufficiently strong to induce a relatively rapid expansion in new construction.

The last column in Table V-3 shows the net elasticity for the three sites; that is, the responsiveness of building permits to an overall increase in housing prices (both local and non-local). In Rapid City, the net elasticity is negative, meaning that increasing price meant a decline in local construction activity. In New Orleans, the elasticity was .30, while in Xenia it was 1.02. One plausible argument is that cost increases in Rapid City exceeded that occurring in either New Orleans or Xenia. As a result, the quantity of new construction was sensitive to local housing prices, i.e., the increase in P_t would have to be disproportionately large in order to justify an increase in construction. Increased costs for either Xenia or New Orleans appears to be not as serious, since the net elasticities are positive.

It was suggested in Chapter II that the supply relationship would be sensitive to the size of the construction work force, in relation to the rebuilding effort. Although this factor was not explicitly incorporated into the estimation of supply, it may be that the range of net elasticities shown in Table V-3 reflects this. In New Orleans (1965), six thousand units were completed in a normal year. The disaster destroyed two thousand and heavily damaged an estimated additional three thousand. In Xenia, the situation was very much similar. However, in Rapid City, nearly one thousand homes were destroyed or heavily damaged while new building permits averaged only 150 to 200 per year. Revier (1978), in a study of tax incidence, measured net supply elasticity in a manner similar to the way developed here. He estimated the value to be 1.9. A plot of the three estimates developed in this study along with Revier's (Figure V-4), gives some insight into the impact of disaster magnitude on rebuilding effort. The diagram indicates that during normal periods, the construction industry is fairly responsive; a one percent increase in price will cause approximately a two percent increase in the quantity of new construction. However, after a disaster, the industry is less responsive to price changes. At the extreme, in Rapid City, it would have required a substantial price increase above that occurring in surrounding areas to result in acceleration in new construction.

Figure V-4

Responsiveness of Housing Supply to the Requirement to Rebuild



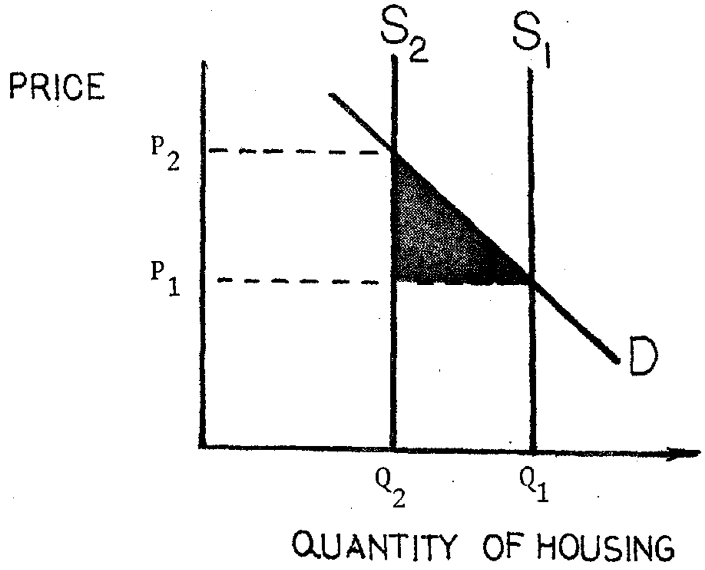
On the surface, at least, these elasticities suggest that a substantial increase in housing prices would be required before damaged structures would be replaced. However, when viewing the price paths shown in Figures V-1 through V-3, large increases are not observed. This is because the demand side contains the price increases. This limitation induces a weaker response from the construction industry. One result of this is the prolonged period of adjustment, illustrated in Figure V-3. In other words, a housing shortage could induce both a rise in prices and an elongation of the reconstruction period. In Rapid City, it took over two years to repair and rebuild damaged properties. Is this observation consistent with the model? The annual increase in housing prices is shown to be on the order of approximately twenty percent (Figure V-3). During the same period, Pierre, South Dakota experienced price increases amounting to almost seven percent.[1] Using the elasticities in Table V-3, the local change in price of 20 percent implies a 150 percent increase in starts. The 7 percent price increase outside of Rapid City converts to a 70 percent decline in starts. The net effect is an 80 percent increase in new construction. Given a pre-disaster capacity of 200 new homes per year, the 1,000 homes lost could be replaced in a little over 2 years.

D. Further Discussion of the Results

Analysis of the problem yielded results which strongly suggest the existence of a rising cost of repair under certain conditions. However, the welfare implications of such a phenomenon are not obvious. If the focus of attention is on the disaster victim, then increasing prices is truly to the detriment of this one group. They are forced to absorb the higher

Figure V-5

Measurement of Disaster Losses



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[1] The figure was computed for the period 1972/1973 from the Dodge Building Cost Indexes (1977).

cost of repair, providing that insurance did not cover the loss.[1] These higher levels of loss show up in the demand relationship. In Figure V-5 above, the disaster reduces the housing stock from Q_1 to Q_2. If price effects are ignored, then losses will be estimated as P_1 times $Q_1 - Q_2$, the loss in housing times the pre-disaster price. If price effects are observed, then the loss should include the shaded triangle. The entire area under the demand curve between Q_2 and Q_1 is the real measure of the lost value. In assessing the benefits of disaster mitigating measures, the value to be derived may be substantially larger than anticipated, if price effects are ignored.

The price paths shown in Figures V-2, V-3, and V-4 can be used to compute the additional loss in value (the shaded triangle of Figure V-5). Dollar damage computed at pre-disaster prices is simply the pre-disaster value (from the lower curve) times the number of homes destroyed. Additional loss resulting from a shrinkage in supply (the shaded triangle) is one-half the difference between the upper and lower curves times the number of structures lost. The results for Rapid City, Xenia and New Orleans indicate the latter values to be 8, 13 and 2 percent of the former for the respective cities.

This accounting stance is reasonable, given that the victim is the focus. If attention is turned to the entire community, then the conclusions are not so clear cut. First, those who own undamaged housing, at least for the short-run, are wealthier; their homes appreciate in value. So, some of the loss sustained by the victim is a gain to the non-victim; that is, the wealth in the community is redistributed. It should be noted that even though capital gains accrue to

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[1] In this instance, the insurance company would absorb the higher costs whenever the deductible is exceeded.

all homeowners in the community, they are realized by only those who sell. Therefore, it is hard to argue that the average non-victim is any better off. On the one hand, the non-victim may have a greater potential set of opportunities (given the increased value of his home); however, the implicit rent on appreciated property should increase as well. The two effects should at least partially cancel. Following similar reasoning, material and labor in short supply can command higher prices. Even though it is argued that "profiteering" is not widely observed following a disaster, it has been observed in Darwin and elsewhere. To the extent that supply prices rise, creating rents for some contractors, a redistribution of wealth is again taking place. It may be that this phenomenon is the exception, in which case a redistribution of this type can be ignored. The point, however, is still valid; that is, an accounting for net loss is much more difficult to assess given the broader focus of the community.

VI. SUMMARY OF THE RESULTS AND IMPLICATIONS FOR POLICY

The transformation from a handwritten draft to a typed final report at times imbues empirical work with a deceptive credibility, often undeserved. This doesn't mean that the model or the conclusions reached in the preceding chapters should be ignored. It is, instead, a plea to use the results with extreme care. To emphasize this point, a number of the study's deficiencies should be aired once again. First, the econometric model of the housing market, although theoretically sound, does not account for the fact that building permits led price changes. The model is built on just the opposite situation--price is a signal to contractors to issue permits. We can only speculate as to why the lead-lag structure is reversed. It may be that permits to build are not a good predictor of actual construction start dates. The issuance of the permit may simply imply intention to rebuild and may not indicate when. Even if this assumption turned out to be correct, the question still remains, why were so many permits issued so early? The answer is not very clear, but one possibility is that permits were issued in response to past prices and costs. Price did climb in response to the forces of supply and demand, albeit slowly. Cost would change only after rebuilding had begun. But, in order for this to take place, permits would first have to be issued. Our best guess is that permits were obtained, but construction was delayed as costs escalated. If data concerning start dates could be obtained, this theory could be tested. Another problem encountered was the measure of quantity. Building permits do not account for changes in dwelling quality or size. A better measure would have been permit valuation normalized for any change in cost. Unfortunately, this measure is not readily available for communities the size of Rapid City and Xenia.

Lastly, the number of periods, representing the data base, was dangerously low in each of the three cities. The resultant signs for the coefficients were correct, however, the t values were not very encouraging (averaging about 1.5).

This list of shortcomings should awaken the user to the limitations of the results. Just as important, however, is the positive side of the ledger. Even though the econometric model was applied to just a fraction of the entire sample of communities, the price paths plotted for the others provide valuable insights. In looking at the paths in isolation, the following conclusions emerge:

1. Disasters caused a detectable price dislocation in less than half of the sample.

2. For those communities that did sustain an increase in price, the impact never exceeded 25 percent; and more often, was within the 10 to 15 percent range.

3. New Orleans (Hurricane Betsy) sustained as much damage as any major disaster which occurred during the decade of the 60's. Yet, only a slight shift in housing prices was detected. This was true for the city as a whole, as well as for individual districts. The price paths for areas experiencing heavy and moderate damage were identical to those bordering zones sustaining no loss. These observations held for districts with a high percentage of non-white

residents as it did for areas of differing levels of income. In short, the disaster did little to change the path of housing prices regardless of how the data was analyzed.

4. As in almost every study, the data assembled to answer one question can be used to shed light on other problems. In several communities, the real estate sales data was collected for both flood plain and non-flood plain properties. In some instances, flooding depressed the value of homes located in the flood plain relative to those on higher ground (e.g., Corning). In other instances, the situation was either unchanged (e.g., New Orleans) or reversed (e.g., Elmira). A number of explanations can be offered for this difference in market behavior. It could be that flood plain regulations are influencing the market or that damage and potential damage is being discounted.

5. Another by-product of the price paths is a measure of the reconstruction period. As was pointed out above, an increase in price was observed for several disasters. Darwin, Xenia, and Rapid City, to name the most dramatic. In all three cases, the path was similar. At first, the path remained unchanged for a period of 3 to 6 months. Beyond this point, prices accelerate, flatten and decline slightly until the pre-disaster trend is attained. None of the cases showed an adjustment lasting more than three years. This pattern may be a reasonable proxy for duration of reconstruction.

6. In San Fernando, the price of housing appeared to flatten rather than accelerate. This tendency lasted nearly two years, at which time, prices turned abruptly upward.

Notwithstanding earlier remarks concerning the shortcomings of the econometric model, there are some bright spots.

1. The demand and supply elasticities are well within the range of previous estimates.

2. The estimates of net supply elasticity make sense when disaster magnitude is brought into the picture. The results suggest that local price changes may have to be rather significant, compared to those occurring in neighboring communities, if a rapid reconstruction is desired. This is more true for communities that cannot readily draw upon large pools of construction talent, such as in Rapid City where the requirement to rebuild was nearly seven times the local capacity. In other cases, such as in New Orleans and Xenia (drawing upon Dayton's resources) the construction work force was sufficiently large so that repair could be undertaken without incurring a significant escalation in local costs. For these two cities, the net supply elasticity should be and was greater than observed for Rapid City.

3. Most important of all, the model provides a framework for assessing loss, and the impact of policy. This is true even if the empirical relationships developed in Chapter V prove to be in error.

The study results point strongly to an escalation in cost following disaster. Assuming that these conclusions are verified in future research, what do the findings imply for public policy? First, they strengthen the case for both land use management and the adoption of earthquake resistent building technologies. It is doubtful, however, that the 10 to 20 percent increase in loss suggested in Chapter V will awaken the interest of the typical homeowner. However, such an escalation in repair costs may catch the eye of public officials. Consider two possible situations. One, a large or moderate earthquake loosens Federal purse strings resulting in a barage of liberal disaster relief measures. Two, a program of financial incentives is instituted to undertake pre-disaster repair or condemnation of hazardous buildings. The model should help untangle the relative merits of each alternative. Abstracting from distributional considerations, the relief measures do nothing to retard the earthquake induced collapse in housing stock. Federal aid can be interpreted as a supplement to income which simply expands demand for housing, putting additional pressure on prices. This both increases the magnitude of loss, which is a disbenefit to aid, but it also induces a more rapid recovery. The higher prices cause new construction to expand according to the supply curve. For large disasters, a dollar spent on relief may end up stimulating a price increase, leaving the victim's financial position little changed. Hence, at least under these circumstances, the beneficiaries of public relief are not the targeted group, the victims. Those who own undamaged housing or material and skills in short supply turn out to be the beneficiaries of aid.

Contrast this situation to the provision of pre-disaster financial assistance to strengthen buildings. This policy is pointed at the supply side of the problem. If such incentives diminish the loss of housing, then the benefit will lie in the reduction in damage, evaluated at post-disaster prices (see Chapter V, section D for a further discussion of loss measurement). It seems clear, that given both options, the strengthening program is far superior to aid. It is superior both because of its efficiency <u>and</u> because the groups targeted for assistance will be better served; recall the discussion in Chapter V concerning the distributional impacts stemming from the price increases.

In the past, bouts with severe inflation have led policy makers to implement, or at least threaten, wage and price controls. It is not inconceivable that an acceleration in housing prices after a major disaster may result in application of the same approach. Politicians will most likely see the market adjustment as a result of "profiteering." How would this solution affect recovery? The institution of wage and price controls alone will elongate the reconstruction period. Without an increased price, contractors will not be able to justify the higher costs which would be incurred as supply expands. Even in Darwin, where reconstruction was carried out by means of mass production, prices and costs rose substantially. It is common belief that the construction industry is a fairly mobile one; clean-up crews from New Jersey were observed in Rapid City, crews from Sydney and Melbourne contracted to build in Darwin. However, as in any production process, mobility of one ingredient can be offset by immobility of another. It is likely that cement will be in short supply as a result of any post-earthquake rebuilding effort. In the rebuilding of Darwin, cement had to be shipped from as far away as Hong Kong.[1] It is costly to ship this commodity over substantial distances, hence the supply curve for new construction may be quite inelastic in spite of the possibility that labor is mobile.

The Darwin experience offered several interesting solutions for dealing with those immobilities. The public officials there quickly recognized the need for facilities to accommodate the influx of builders and skilled tradesmen from the South. As a result, a camp was established on the outskirts of the town.

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[1] Cement shortages never materialized in Alaska (1964) because at that time, the economy was slack. Cement plants that had been built for construction of military facilities were idle.

The camp consisted of a cleared area with utilities provided. Contractors were then able to bring mobile housing to the site, thereby creating temporary quarters for the work force. Another strategy employed to contain construction costs was mass production of housing. A series of cyclone-resistant designs were developed within six months and 500-unit contracts were let with major contractors from the South. The strategy led to new innovations in construction which resulted in substantial cost savings.[1] The one major disadvantage of this approach was the rather homogeneous stock of homes which some in Darwin found to be aesthetically unappealing.

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[1] This does not mean that local builders lacked creativity. A fairly large group of owner/builders emerged during reconstruction. They demonstrated an equal ability to innovate and cut costs.

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APPENDIX A

DARWIN, AUSTRALIA

CYCLONE, 1974

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT					
	SALES PRICE ($/1,000)1/	PRPR2/	CATGRY3/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
+ 5.0	37.7	.96	3.91	-4.81	6	.86	8.7
+ 7.9	44.0	.54	8.20	6.38	16	.61	6.9
+10.8	41.4	.58	11.17	-4.00	23	.70	24.9
+14.2	42.6	.65	9.87	-2.38	31	.60	23.7
+17.0	45.7	1.07	7.96	-9.77	32	.68	17.6

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as a $35,000 home, partially damaged.

2/ PRPR is the selling price of the home prior to the disaster. It represents the assessed value as of December, 1974.

3/ CATGRY is a scale from 1 to 3. 1 is a structure still damaged. 2 and 3 are structures repaired to pre- and post-disaster code respectively. A value of 1.5 was used to compute the above price paths.

CORNING, NEW YORK

HURRICANE AGNES (FLOOD), JUNE, 1972

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT								
	SALES PRICE ($/1000) 1/	SQ.FT. 2/	AGE 3/	LOTAR 4/	FLOOD 5/	CONSTANT	BSMNT 6/	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-15.3	16.6 a/ 16.3 b/	7.2	- 12.1	.825	- 335	- 4,571	90.5	70	.40	8.6
3.7	21.0 15.9	16.11	46.1	.369	-5,028	-11,147	11.8	35	.63	9.9
12.2	21.5 19.9	10.59	- 17.5	-.949	-1,676	26,863	-79.3	36	.40	4.0
35.4	26.8 26.1	3.43	-150.0	.151	- 638	22,955	81.59	34	.34	2.9

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 58 years old, 972 square feet of living area on a 7,080 square foot lot with a full basement.
- a/ Price of property located outside flooded area (used 0 for value of flood).
- b/ Price of property located within flooded area (used 1 for value of flood).

2/ SQ.FT. is square feet of living area.
3/ Age is measured in years.
4/ Lotar is lot area in square feet.
5/ Flood is a dummy variable to indicate whether the property was located in the flooded area.
6/ BSMNT is basement.

XENIA, OHIO

TORNADO, APRIL 3, 1974

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT							
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	GARAGE	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
- 3.5	24.1	8.16	-113.0	-.130	3,015	12,167	17	.74	12.3
2.1	26.5	17.40	-207.4	-.157	389	6,602	33	.63	14.8
9.9	26.3	9.64	-150.0	.675	2,621	7,908	28	.77	23.0
14.2	31.7	27.42	-165.3	.104	-1,320	-7,032	14	.68	7.8
22.8	28.7	12.24	-312.9	-.086	4,925	13,098	39	.72	25.1
25.4	30.6	10.38	- 58.7	.104	8,805	5,394	13	.54	4.6

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 25 years old, 1,482 square feet of living area, on a 7,050 square foot lot with a 1.2 car garage.

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ Lotar is lot area in square feet.

SAN DIEGO, CALIFORNIA

FIRES, SEPTEMBER 20, 1970

Months rior to r After isaster)	DEPENDENT	INDEPENDENT									
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	GARAGE	CODE 56 5/	CODE 57 5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
- 5.1	23.4	10.20	- .2	-.119	967.	-2,406	-3,325	10,745	102	.68	33.6
6.1	24.6	14.02	-54.0	.114	731.	-1,343	-2,795	6,841	39	.74	15.0
21.5	25.0	13.78	28.5	-.280	540.	-1,576	-2,921	9,515	45	.89	53.2
27.7	25.4	5.60	-166.9	.0001	3,204.	-1,155	- 901	16,427	32	.70	9.6
31.8	28.7	13.8	-13.6	.163	1,560.	-2,855	-4,044	8.867	45	.87	40.6

1/Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 15 years old, 1,190 square feet of living area, on a 7,650 square foot lot with a 1.5 car garage.

2/SQ.FT. is square feet of living area.

3/Age is measured in years.

4/Lotar is lot area in square feet.

5/Code 56 and Code 57 are dummy variables referring to specific locations within the city. (33% and 32% of the sample respectively; the remaining 35% is captured by the constant).

SAN FERNANDO, CALIFORNIA

EARTHQUAKE, JULY 9, 1971

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT							
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	GARAGE	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-11.9	20.9	6.55	- 85.7	.240	1,051	11,003	106	.71	65.5
4.2	22.1	3.61	- 98.6	.716	939	6,018	21	.72	13.9
9.2	22.0	9.56	-112.7	.030	934	10,986	34	.78	30.8
15.1	22.4	5.63	-181.9	-.034	1,592	17,275	35	.39	6.4
20.7	21.8	7.29	-203.9	-.350	- 273	20,992	25	.65	12.1
29.5	26.0	8.31	- 78.4	.629	- 664	13,307	42	.51	11.8
43.2	27.1	23.07	41.9	.055	277	- 3,161	36	.83	45.0

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 23 years old, 1,231 square feet of living area, on a 8,561 square foot lot with a 1.7 car garage.

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ Lotar is lot area in square feet.

RAPID CITY, SOUTH DAKOTA

FLASH FLOOD, JUNE, 1972

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT						
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-10.3	15.9	9.1	-558.4	-183.9	20,064	13	.59	6.8
3.5	19.2	6.44	- 75.6	118.2	9,886	39	.49	13.3
9.8	23.1	11.38	-194.6	45.33	11,067	33	.48	11.2
14.7	23.1	13.16	32.4	195.4	2,362	22	.22	4.6
21.5	25.6	27.1	50.8	239.9	-12,229	16	.71	13.3
33.4	31.1	22.2	-222.4	--	10,271	16	.77	--

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 16.9 years old, 1,110 square feet of living area, on a 28.7 square foot lot.
2/ SQ.FT. is square feet of living area.
3/ Age is measured in years.
4/ Lotar is lot area in square feet.

ATLANTA, GEORGIA

TORNADOES, MARCH 31, 1973 and MARCH 24, 1975

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT									
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	GARAGE	CODE J 5/	CODE M 5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-29.7	35.5	7.77	25	.148	4,532	- 8,177	-14,023	15,009	35	8.8	35.1
-20.3	36.8	9.66	-380	.194	3,302	-13.987	8,075	21,810	34	.92	50.1
-14.3	40.7	12.96	- 30	$.68 \times 10^{-2}$	3,863	-12,734	- 1,182	15.647	34	.85	25.3
- 8.7	48.6	26.37	- 95	-.092	171	-15,380	- 6,139	9,385	30	.88	27.2
- .3	34.1	8.31	-927	.762	-2,204	-10,431	10,370	29,311	15	.98	83.5
3.1	47.3	23.97	- 59	-.032	-1,572	-15,698	- 7,498	12,486	46	.81	27.3
9.7	48.5	22.42	-401	.004	4,053	0	- 2,765	15,816	12	.94	12.1
16.6	49.2	23.33	31	.279	5,400	-10,229	-12,166	- 644	42	.87	39.9
21.0	49.3	16.87	- 33	.060	8,923	-15,375	- 3,099	10,943	36	.81	20.0
27.6	47.9	21.13	-647	.131	756	-14,593	8,212	24,252	43	.89	50.1
34.3	49.5	19.7	-441	.243	4,520	-18,438	- 1,226	22,619	49	.88	49.1

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 21.3 years old, 1,617.1 square feet of living area, on a 18,033.7 square foot lot, with a 1.2 car garage.
2/ SQ.FT. is square feet of living area.
3/ Age is measured in years.
4/ Lotar is lot area in square feet.
5/ Code J and Code M are dummy variables referring to specific locations within the city.

ELMIRA, NEW YORK

HURRICANE AGNES (FLOOD), JUNE, 1972

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT							
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	FLOOD5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-15.6	17.7a/ 19.4b/	10.75	3.7	.242	1,698	6,788	36	.29	3.2
7.9	21.1 21.1	- 1.12	-14.7	.823	- 40	16,721	35	.33	3.7
18.2	15.1 14.0	2.98	-34.5	.348	-1,160	11,464	66	.19	3.7
32.9	19.9 13.6	3.79	-53.7	.838	-6,274	12.549	28	.38	3.5

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 38.7 years old, 842.6 square feet of living area, on a 7,183 square foot lot.
   a/ Price of property located outside the flooded area (used 0 for value of flood).
   b/ Price of property located within the flooded area (used 1 for value of flood).

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ Lotar is lot area in square feet.

5/ Flood is a dummy variable to indicate whether the property was located in the flooded area.

HARRISBURG, PENNSYLVANIA

HURRICANE AGNES (FLOOD), JUNE, 1972

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT									
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	AREA A 4/	AREA B 4/	FLOOD5/	CONSTANT	BSMNT6/	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-21.5	14.3a/ 17.8b/	12.95	133.0	- 26.7	17,148	3,528	1,926	--	62	.71	22.4
- 5.3	15.9 17.3	3.76	- 2.3	-2,764	18,239	1,325	13,050	--	56	.75	24.1
3.4	18.2 22.1	30.85	14.6	850	8.024	3,929	- 4,468	--	37	.77	16.4
9.5	16.7 18.1	14.51	72.4	- 278	20,901	1,492	4,117	--	54	.76	24.6
15.2	13.2 18.5	6.64	48.1	-2,820	19,182	328	21,254	--	43	.91	61.6
21.3	16.5 20.6	24.4	88.1	2,696	22,177	4,165	-34,823	308	32	.83	21.0
27.2	15.0 18.1	8.98	2.7	1,007	23,908	2,182	8,919	--	35	.93	62.6
33.8	19.4 27.6	3.41	88.3	-4,968	26,289	8,193	22,524	-70	36	.92	57.5
41.2	18.8 20.1	11.41	15.5	- 502	24,179	1.278	9,550	--	48	.96	143.7

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 17 years old, 780 square feet of living area with a basement.

a/ Price of property located outside the flooded area (used 0 for the value of flood).

b/ Price of property located within the flooded area (used 1 for the value of flood).

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ Area A and Area B are dummy variables referring to specific locations within the city.

5/ Flood is a dummy variable to indicate whether the property was located in the flooded area.

6/ BSMNT is basement.

ROCKDALE COUNTY, GEORGIA

TORNADOES, MARCH 31, 1973

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT						
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
- 5.4	34.7	18.98	44.3	.001	1,165	46	.78	54.1
3.3	40.7	18.18	175.0	.093	5,736	30	.76	32.2
10.2	39.4	7.24	-190.4	.001	28,210	8	.16	1.4
15.2	43.6	27.71	- 36.2	.079	- 6,020	30	.72	26.4
22.4	40.8	23.20	- 38.2	.072	- 845	7	.43	2.5
29.0	43.9	20.68	16.0	.027	7,075	42	.72	35.9

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 9 years old, 1,750 square feet of living area, on a 19,000 square foot lot.

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ Lotar is lot area in square feet.

JOHNSTOWN, PENNSYLVANIA

FLASH FLOOD, JULY, 1977

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT						
	SALES PRICE ($/1000)1/	SQ.FT.2/	AGE3/	BSMNT4/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-14.4	33.6	18.9	-201.4	69	13,397	80	.46	21.9
5.5	38.6	22.9	-228.5	153	6,891	36	.42	7.7

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 20 years old, 915 square feet of living area with a full basement.

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ BSMNT is basement.

LOVELAND, COLORADO

BIG THOMPSON FLASH FLOOD, JULY, 31, 1975

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT						
	SALES PRICE ($/1000)[1]	SQ.FT.[2]	LOTAR[3]	GARAGE	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
- 4.4	35.5	6.91	.209	4,807	17,242	28	.61	12.4
1.0	36.0	8.07	.934	4,222	9,432	29	.56	10.5
4.1	36.8	9.68	.230	2,781	17,860	22	.65	11.3
7.3	38.3	10.23	.674	376	17,482	35	.75	30.4
10.3	39.5	11.93	.244	2,150	18,500	47	.77	48.8
12.7	39.2	13.48	.044	7,433	10,479	23	.64	11.1
16.2	45.2	24.88	.083	2,283	9,442	38	.63	19.1
19.1	55.5	15.9	.609	12,025	6,336	27	.67	15.3

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 1,265.1 square feet of living area on a 10,861.5 square foot lot with a 1.5 car garage.

2/ SQ.FT. is square feet of living area.

3/ Lotar is lot area in square feet.

MADISON COUNTY, MISSISSIPPI

TORNADO, MARCH 29, 1976

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT										
	SALES PRICE ($1/1000)1/	SQ.FT.2/	AGE3/	LOTAR4/	GARAGE	ROOMS	FIREP5/	BATHS	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTI
- 1.6	32.0	19.65	-40.0	.007	927	1,506	1,381	5,548	-16,428	41	.88	41.7
3.6	40.7	26.21	-47.1	-.006	2,926	- 915	1,932	5,052	-12,339	66	.89	73.4
10.1	33.8	23.40	52.3	-.003	1,788	-1,124	5,009	5,024	- 6,283	35	.92	56.7
15.2	36.4	20.20	-71.0	.043	--	838	4,262	2,729	- 2,978	58	.77	33.6
22.2	35.8	8.70	3.68	.061	55	3,145	4,809	15,821	-24,974	33	.79	18.1

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 10 years old, 1,450 square feet of living area on a 25,000 square foot lot with a 1.5 car garage, 1.75 baths and 6 rooms.

2/ SQ.FT. is square feet of living area.

3/ Age is measured in years.

4/ Lotar is lot area in square feet.

5/ FIREP is fireplace.

NEW ORLEANS

DISTRICTS FLOODED

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT.[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.3	17.7	-1.1	13.97	.0089	.080	-40.33	80	.82	90.9
-21.5	17.1	-1.1	18.24	.0000	.050	25.31	89	.69	48.9
-15.1	17.5	-1.4	7.58	.0077	.074	11.44	131	.79	125.5
- 9.6	18.3	-1.1	16.16	.0033	.085	-20.72	135	.70	78.2
- 3.2	17.4	-1.2	9.55	.0049	.085	1.65	120	.77	102.0
2.5	18.3	- .8	14.89	.0031	.053	27.08	73	.68	40.7
8.6	19.4	-1.0	10.82	.0008	.104	3.26	162	.68	84.7
14.0	18.1	-1.3	10.47	-.0003	.063	62.47	129	.60	49.3
20.5	19.8	-1.4	8.04	.0022	.120	- 1.83	120	.86	182.6
24.9	19.4	- .2	23.06	.0040	.107	-97.7	41	.91	100.2

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 18.4 years old, 1,430 square feet of living area, 5,700 square foot lot in "above average" condition. (Code 5.2)
2/ Age in measured in years.
3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.
4/ Lotar is lot area in square feet.
5/ SQ.FT. is square feet of living area.
6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICTS PARTIALLY FLOODED

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6/]							
	SALES PRICE ($/1000)[1/]	AGE[2/]	COND[3/]	LOTAR[4/]	SQ.FT[5/]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.4	15.4	-1.07	14.62	.0124	.067	-29.96	200	.74	141.4
-21.6	15.1	- .49	17.41	.0111	.048	-32.17	188	.68	99.7
-15.5	15.0	-1.16	13.49	.0063	.059	14.74	236	.77	200.0
- 9.9	16.0	-1.02	20.84	.0105	.055	-23.29	213	.74	152.5
- 3.4	15.7	-1.21	18.15	.0069	.058	2.32	201	.73	135.5
2.6	16.5	-1.28	12.54	.0078	.066	20.59	153	.80	156.5
8.6	16.4	-1.10	16.36	.0111	.056	- 3.31	182	.70	104.7
14.4	17.2	-1.82	13.12	.0029	.110	.59	128	.80	128.6
20.4	16.4	- .68	15.22	.0087	.049	6.61	161	.75	123.2
25.0	17.3	-1.19	9.62	.0059	.064	50.60	86	.71	53.7

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 38.5 years old, 1544 square feet of living area, on a 4,625 square foot lot in "fair" to "average" condition. (Code 4.4)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

HALF FLOODED AREA--NEW HOUSING

INSUFFICIENT SAMPLE

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6/]							
	SALES PRICE ($/1000)[1/]	AGE[2/]	COND[3/]	LOTAR[4/]	SQ.FT[5/]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC

NEW ORLEANS

DISTRICTS NOT FLOODED

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT6/							
	SALES PRICE ($/1000)1/	AGE2/	COND3/	LOTAR4/	SQ.FT5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.3	19.5	-2.8	4.33	.0038	.091	44.88	182	.76	146.3
-21.9	19.2	-3.2	9.69	.0047	.077	31.17	163	.78	140.1
-15.2	20.1	-2.5	7.83	.0037	.097	21.49	139	.87	229.3
- 9.6	20.5	-3.5	5.19	.0042	.091	55.37	132	.83	160.1
- 3.1	20.9	-2.7	3.44	.0059	.095	45.16	135	.83	153.4
2.9	20.5	-3.0	12.13	.0051	.062	47.74	117	.78	104.5
8.5	21.2	-1.5	13.82	.0040	.109	-29.51	162	.76	130.1
14.2	21.5	-1.7	11.71	.0049	.093	3.97	118	.85	169.7
20.1	20.7	-1.4	15.99	.0027	.091	-13.92	165	.91	393.7
24.9	21.3	-1.6	12.17	.0121	.088	-37.94	68	.83	87.3

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 9.9 years old, 1,440 square feet of living area, on a 6,000 square foot lot in "above average" condition. (Code 5.5)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shwon have values in excess of 2.

NEW ORLEANS

DISTRICT 250

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT 6/							
	SALES PRICE ($/1000) 1/	AGE 2/	COND 3/	LOTAR 4/	SQ.FT 5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.3	22.2	-2.49	.387	.0133	.103	-21.10	17	.88	30.5
-21.8	21.4	-3.72	14.41	.0089	.086	-37.85	27	.95	125.2
-15.3	22.4	-2.22	2.91	.0044	.083	64.51	30	.87	49.1
- 9.9	22.8	1.06	9.40	.0024	.111	-23.24	19	.94	66.9
- 3.4	23.3	-5.32	7.29	.0001	.064	130.66	22	.89	45.6
3.1	20.4	-6.50	.81	.0027	.065	125.01	17	.88	31.7
8.2	22.8	-1.65	4.22	.0-02	.121	25.21	50	.72	31.9
13.9	22.0	-1.71	5.55	.0001	.109	30.51	30	.72	19.9
20.8	25.2	-1.47	8.79	.0012	.122	13.70	39	.96	212.0
25.1	23.0	- .72	14.52	.0049	.108	-49.91	25	.92	70.9

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 7.2 years old, 1,570 square feet of living area, 7,300 square foot lot in "average" to "good" condtion. (Code 5.5)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 214

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT.[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.2	17.6	- .77	17.31	.0077	.073	=35.81	31	.58	11.5
-21.7	17.5	.24	23.20	.0077	.015	- 6.87	25	.52	7.7
-14.7	17.1	-2.12	13.32	.0129	.064	- 3.29	29	.77	24.6
- 9.8	18.1	-3.87	35.88	.0018	.108	-60.90	29	.58	10.7
- 3.4	18.7	-1.08	15.82	.0019	.073	21.45	23	.45	5.6
2.7	18.6	.238	20.08	-.0046	.049	38.07	22	.73	15.5
9.0	19.7	-1.22	25.03	.0065	.081	-54.18	32	.62	13.5
14.0	18.3	-1.18	4.92	.0071	.028	109.02	25	.46	6.1
20.5	20.3	-3.18	19.19	.0048	.109	6.02	26	.78	23.8
25.0	17.6	.59	56.6	-.0207	.178	-254.4	10	.73	7.0

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[1] Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 25 years old, 1,450 square feet of living area, 5,500 square foot lot in "average" condition. (Code 4.8)

[2] Age is measured in years.

[3] Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

[4] Lotar is lot area in square feet.

[5] SQ.FT. is square feet of living area.

[6] All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 232

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.4	13.1	- .76	11.37	.0063	.059	- 7.18	31	.79	29.5
-21.5	11.0	- .69	4.20	-.0026	.030	84.96	30	.58	11.0
-15.1	12.9	- .87	10.61	.0065	.052	5.49	37	.82	43.4
- 9.8	12.7	- .41	15.85	.0026	.064	-27.80	33	.86	50.4
- 2.8	12.9	- .76	14.94	.0038	.048	3.23	40	.85	57.6
2.9	13.6	- .82	18.25	.0037	.047	- 1.42	17	.72	11.5
8.7	14.1	- .26	16.89	.0090	.072	-46.26	32	.74	22.9
14.3	13.3	- .76	14.76	.0008	.006	4.57	23	.59	9.1
20.7	14.8	-1.15	5.63	.0000	.066	70.82	26	.81	26.8
24.3	13.0	- .21	13.95	.0050	.112	-97.39	6	.99	3,210.6

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[1] Sales prices of the "average" house, given the regression equations shown for each period. The "average" house was defined as 28.3 years old, 1,300 square feet of living area, 5,200 square foot lot in "fair" to "average" condition. (Code 4.4)

[2] Age is measured in years.

[3] Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

[4] Lotar is lot area in square feet.

[5] SQ.FT. is square feet of living area.

[6] All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 522

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6/]							
	SALES PRICE ($/1000)[1/]	AGE[2/]	COND[3/]	LOTAR[4/]	SQ.FT[5/]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-15.2	169.9	-1.3	-4.00	.006	.09	55.00	30	.64	13.6
- 9.0	181.8	-2.0	9.00	.003	.12	-24.00	47	.60	18.4
- 3.7	173.5	-2.9	5.00	.002	.09	39.00	33	.78	29.4
1.5	192.6	-3.1	14.00	.008	.06	6.00	15	.75	11.6
8.8	185.1	-4.0	17.00	.003	.09	- 4.00	44	.61	17.8
14.1	183.1	-2.5	5.00	.004	.08	95.00	49	.77	40.4
19.7	183.4	-2.9	8.00	.004	.09	19.00	25	.84	32.0

1/ Sales prices of the "average" house, given the regression equations for each period. The "average" house was defined as 5.7 years old, 1,215.5 square feet of living area, 6,090.2 square foot lot in "good" condition. (Code 5.9)
2/ Age is measured in years.
3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.
4/ Lotar is lot area in square feet.
5/ SQ.FT. is square feet of living area.
6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 275

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT 6/							
	SALES PRICE ($/1000) 1/	AGE 2/	COND 3/	LOTAR 4/	SQ.FT. 5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.4	220.8	-3.0	1.00	.004	.09	64.0	103	.66	63.2
-21.9	230.6	-2.8	8.00	.003	.07	68.0	94	.59	34.1
-15.1	237.4	-3.1	-1.00	.005	.09	87.0	90	.81	96.0
- 9.5	225.3	-3.8	-1.00	.002	.09	96.0	88	.79	83.3
- 3.1	220.6	-6.9	5.00	.010	.11	11.0	85	.80	85.4
2.6	244.1	-2.3	2.00	.002	.10	75.0	72	.72	45.9
8.2	239.1	-2.4	0.00	.010	.10	34.00	79	.78	71.8
13.8	250.6	-4.3	2.00	.001	.10	96.00	42	.73	29.4
20.1	232.6	-2.3	5.60	.009	.09	15.00	55	.91	132.8
24.8	254.7	-4.6	-5.10	.008	.09	117.00	19	.82	22.1

1/ Sales prices of the "average" house, given the regression equations shown for each period. The "average" house was defined as 4.2 years old, 1,546 square feet of living area, 6,055.6 square foot lot in "good" condition. (Code 6.0)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 267

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6/]							
	SALES PRICE ($/1000)[1/]	AGE[2/]	COND[3/]	LOTAR[4/]	SQ.FT[5/]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-26.7	172.2	-1.4	1.00	.006	.100	6.00	28	.77	24.2
-21.8	159.8	- .7	9.00	.004	.09	-27.00	44	.71	27.9
-15.6	169.3	- .5	9.00	-.000	.12	-35.00	27	.83	32.5
- 9.4	160.5	-3.3	18.00	-.000	.05	43.00	14	.85	19.8
- 3.7	171.0	-2.2	1.00	.002	.10	41.00	20	.98	20.42
3.6	150.7	-4.2	5.00	-.002	.05	121.00	18	.78	15.9
9.1	186.2	- .7	44.00	.003	.12	-207.00	30	.80	30.1
14.4	160.8	- .8	4.00	-.004	.11	25.00	26	.93	78.0
19.7	187.8	-2.7	17.00	.004	.08	2.00	54	.95	255.8
25.0	212.7	-3.6	-18.00	.015	.12	79.00	24	.88	44.6

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 12.1 years old, 1,385.1 square feet of living area, 6,618.2 square foot lot in "average" condition. (Code 4.9)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area is square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 223

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT6/							
	SALES PRICE ($/1000)1/	AGE2/	COND3/	LOTAR4/	SQ.FT.5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-26.9	19.0	.89	.40	.0081	.101	1.00	24	.87	41.2
-22.2	23.4	6.30	.59	.0078	.100	-51.87	25	.88	43.2
-14.8	13.9	-6.64	8.01	.0067	.100	58.64	22	.81	24.1
- 9.8	17.1	-1.52	3.98	.0087	.063	51.45	30	.86	44.4
- 2.8	13.5	-8.86	5.52	.0156	.059	107.17	21	.84	27.0
3.5	16.3	-2.40	11.75	.0089	.044	44.79	27	.70	16.0
8.7	16.8	- .87	14.73	.0064	.058	4.66	54	.68	28.7
14.5	17.2	-1.13	15.13	.0094	.065	-14.00	51	.72	32.5
20.5	15.9	- .28	21.31	.0042	.070	-48.91	57	.79	53.4
24.9	16.1	- .48	19.7	.0129	.065	-79.57	25	.77	21.6

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 18.2 years old, 1,240 square feet of living area, 5,720 square foot lot in "average" condition. (Code 4.8)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 198

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT.[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.3	18.2	-5.85	5.32	.0110	.076	80.55	28	.90	59.6
-21.8	17.8	2.51	16.74	.0072	.032	-29.64	15	.67	8.0
-15.6	18.0	-3.22	10.21	.0030	.051	94.33	33	.48	8.4
- 9.2	19.5	-6.84	8.13	.0121	.084	79.33	19	.90	42.0
- 3.7	19.1	-3.88	13.15	.0062	.077	46.25	23	.76	18.6
2.0	20.4	-4.60	9.10	.0073	.092	63.79	25	.81	26.9
8.1	21.1	-11.12	2.34	-.0015	.097	252.72	16	.89	31.7
14.5	21.7	-3.13	24.26	.0007	.087	25.56	10	.88	18.2
20.2	21.7	-3.05	9.58	.0219	.060	8.83	12	.94	45.2
24.6	INSUFFICIENT SAMPLE TO COMPUTE COEFFICIENTS						5		

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 16.2 years old, 1,400 square feet of living arear, 5,850 square foot lot in "average" condition. (Code 4.8)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 211

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT.[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.2	223.2	-2.2	8.00	.012	.11	-13.00	46	.84	60.5
-21.6	196.9	-1.5	15.00	.008	.07	- 4.00	49	.62	18.2
-15.5	212.1	.2	17.00	.010	.08	-62.00	51	.88	84.8
-10.0	211.7	-3.2	5.00	.022	.08	- 2.00	56	.89	103.8
- 3.7	213.2	-3.1	18.00	.006	.08	27.00	56	.78	45.1
2.7	224.1	-1.6	14.00	.012	.08	- 9.00	39	.83	47.6
8.7	230.1	-1.8	24.00	.014	.06	-31.00	41	.62	17.1
14.00	228.4	-3.1	2.00	.004	.15	28.00	32	.95	134.2
20.3	208.2	.2	22.00	.007	.07	-58.00	37	.53	11.3
24.9	213.2	- .8	11.00	-.004	.07	90.00	21	.36	3.8

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 20.9 years old, 1,540.1 square feet of living area, 5,996.3 square foot lot in "average" condition. (Code 5.1)
2/ Age is measured in years.
3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.
4/ Lotar is lot area in square feet.
5/ SQ.FT. is square feet of living area.
6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 207

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT 6/							
	SALES PRICE ($/1000) 1/	AGE 2/	COND 3/	LOTAR 4/	SQ.FT 5/	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.3	13.2	-3.5	- 1.94	.0081	.058	30.77	40	.57	14.1
-21.3	12.9	- .16	23.59	.0004	.063	-56.73	45	.46	10.4
-15.5	12.8	- .85	8.60	.0104	.045	24.21	35	.89	67.2
-10.0	13.8	- .28	20.33	.0066	.035	- 7.83	44	.67	22.6
- 3.1	13.8	- .92	12.34	.0006	.043	64.66	38	.60	15.1
2.7	14.0	-1.01	17.28	.0013	.057	26.21	30	.81	31.3
8.8	14.5	- .70	5.74	.0190	.051	1.03	25	.80	24.7
14.8	14.5	- .26	16.61	.0027	.056	- 6.57	22	.76	17.8
20.1	14.6	- .25	20.28	.0029	.061	-28.56	27	.77	22.7
25.2	14.5	- .91	3.95	.0083	.051	60.19	19	.72	12.7

1/ Sales prices of the "average" house, given the regression equations for each period. The "average" house was defined as 49.3 years old, 1,621 square feet of living area, 3,900 square foot lot in "fair" condition. (Code 3.8)
2/ Age is measured in years.
3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.
4/ Lotar is lot area in square feet.
5/ SQ.FT. is square feet of living area.
6/ All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 217

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6/]							
	SALES PRICE ($/1000)[1/]	AGE[2/]	COND[3/]	LOTAR[4/]	SQ.FT[5/]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.3	117.2	- .6	10.00	.007	.04	18.00	47	.57	12.3
-21.9	124.4	- .6	7.00	.012	.04	.90	31	.78	28.2
-15.5	125.3	- .8	12.00	.004	.05	23.00	41	.82	46.5
- 9.9	101.8	- .8	20.00	.008	.03	-15.00	44	.61	17.8
- 2.9	129.1	- .3	10.00	.013	.03	9.00	27	.66	13.7
2.6	131.0	-1.2	7.00	.007	.04	74.00	28	.70	16.5
8.9	126.3	- .8	12.00	.001	.04	51.00	36	.75	27.3
14.8	152.2	- .6	17.00	.001	.06	15.00	23	.80	22.5
20.7	136.8	- .6	15.00	.008	.04	14.00	39	.80	38.6
25.2	161.2	-1.2	4.00	.001	.06	106.00	16	.43	3.8

[1/] Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as 50.3 years old, 1,599.3 square feet of living area, 3,631.9 square foot lot in "fair" condition. (Code 4.0)

[2/] Age is measured in years.

[3/] Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

[4/] Lotar is lot area in square feet.

[5/] SQ.FT. is square feet of living area.

[6/] All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICT 229

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6/]							
	SALES PRICE ($/1000)[1/]	AGE[2/]	COND[3/]	LOTAR[4/]	SQ.FT[5/]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.6	11.8	- .53	14.96	.0074	.035	- 1.40	39	.52	11.4
-21.8	12.8	- .34	15.53	.0099	.038	-17.75	48	.72	31.2
-15.4	12.3	-1.09	7.41	.0007	.036	86.35	76	.68	41.3
-10.3	12.0	- .63	14.99	.0079	.030	10.52	51	.73	34.8
- 3.4	12.5	- .53	13.84	.0098	.032	4.38	57	.70	34.2
2.9	13.4	- .54	9.79	.0050	.047	27.45	31	.75	23.6
8.4	13.4	- .76	14.12	.0081	.048	26.47	64	.63	27.6
14.4	13.8	- .93	12.82	.0097	.055	6.30	41	.75	30.4
20.5	14.0	- .44	10.11	.0047	.043	35.08	46	.74	32.5
24.9	15.3	- .94	25.54	.0158	.051	-48.65	25	.78	22.7

1/ Sales prices of the "average" house, given the regression equations for each period. The "average" house was defined as 47 years old, 1,515 square feet of living area, 4,077 square foot lot in "fair" condition. (Code 4.1)

2/ Age is measured in years.

3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

4/ Lotar is lot area in square feet.

5/ SQ.FT. is square feet of living area.

6/ All variables shown have values in excess of 2.

NEW ORLEANS

FLOODED AREA--NEW HOUSING

(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT.[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.6	25.6			.0035	.092	73.01	105	.63	91.3
-21.7	26.4			.00128	.121	43.54	62	.68	64.5
-15.2	26.2			.0057	.109	35.73	62	.77	101.4
- 3.3	26.5			.0397	.056	-71.20	31	.62	25.2
2.9	37.3			.0094	.108	126.24	22	.48	10.6
8.4	28.2			.0188	.185	-155.18	23	.70	26.7
13.7	28.3			.0283	.126	-108.02	9	.92	47.8
19.8	27.4			.0291	.073	-21.68	42	.85	114.8
24.4	28.8			.0596	.049	-154.67	8	.81	16.0

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[1] Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as "new", 1,760 square feet of living area, on a 5,980 square foot lot in "new" condition.

[2] Age is measured in years.

[3] Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.

[4] Lotar is lot area in square feet.

[5] SQ.FT. is square feet of living area.

[6] All variables shown have values in excess of 2.

NEW ORLEANS

DISTRICTS FLOODED--NEW HOUSING

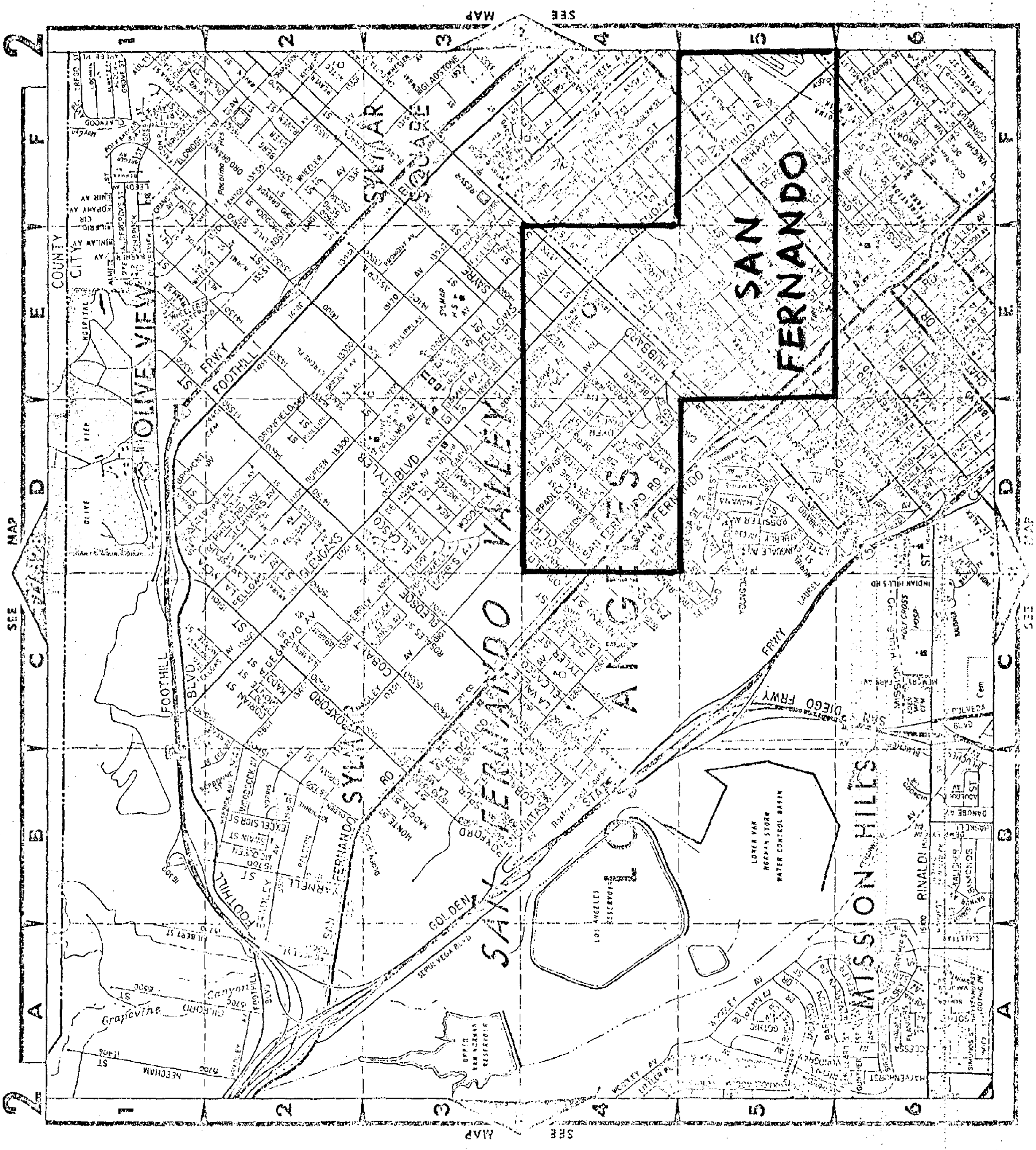
(Months Prior to or After Disaster)	DEPENDENT	INDEPENDENT[6]							
	SALES PRICE ($/1000)[1]	AGE[2]	COND[3]	LOTAR[4]	SQ.FT.[5]	CONSTANT	SAMPLE SIZE	ADJUSTED R^2	F STATISTIC
-27.2	24.3			.0170	.095	-17.54	10	.87	30.5
-21.4	22.4			.0104	.126	-50.53	8	.94	54.9
-15.2	23.4			-.0018	.109	59.12	17	.89	65.1
- 9.7	26.4			.014	.127	-67.26	26	.56	16.9
- 3.5	24.1			.0046	.106	33.43	22	.87	71.6
2.8	25.2			.0072	.108	26.15	11	.78	18.7
8.5	25.8			.0003	.093	97.75	47	.62	38.9
13.9	26.3			.0064	.117	26.75	45	.71	54.8
20.7	26.9			.0027	.133	26.70	35	.87	119.7
25.1	29.5			.0023	.119	80.51	16	.88	57.8

1/ Sales price of the "average" house, given the regression equations shown for each period. The "average" house was defined as "new", 1,700 square feet of living area, 5,840 square foot lot in "new" condition.
2/ Age is measured in years.
3/ Condition is a 7 point scale ranging from poor (1) to new (7). 5 is average.
4/ Lotar is lot area in square feet.
5/ SQ.FT. is square feet of living area.
6/ All variables shown have values in excess of 2.

B

APPENDIX B

Maps Showing Locations of Areas Sampled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SAN FERNANDO VALLEY
SYLMAR
SYLMAR SQUARE
OLIVE VIEW
MISSION HILLS
COUNTY
CITY
FOOTHILL FRWY
GOLDEN STATE
SAN DIEGO FRWY
FOOTHILL BLVD
SAN FERNANDO RD
SEPULVEDA BLVD
HUBBARD
GLENOAKS
TYLER
BRADLEY
LOS ANGELES RESERVOIR
LOWER VAN NORMAN STORM WATER CONTROL BASIN
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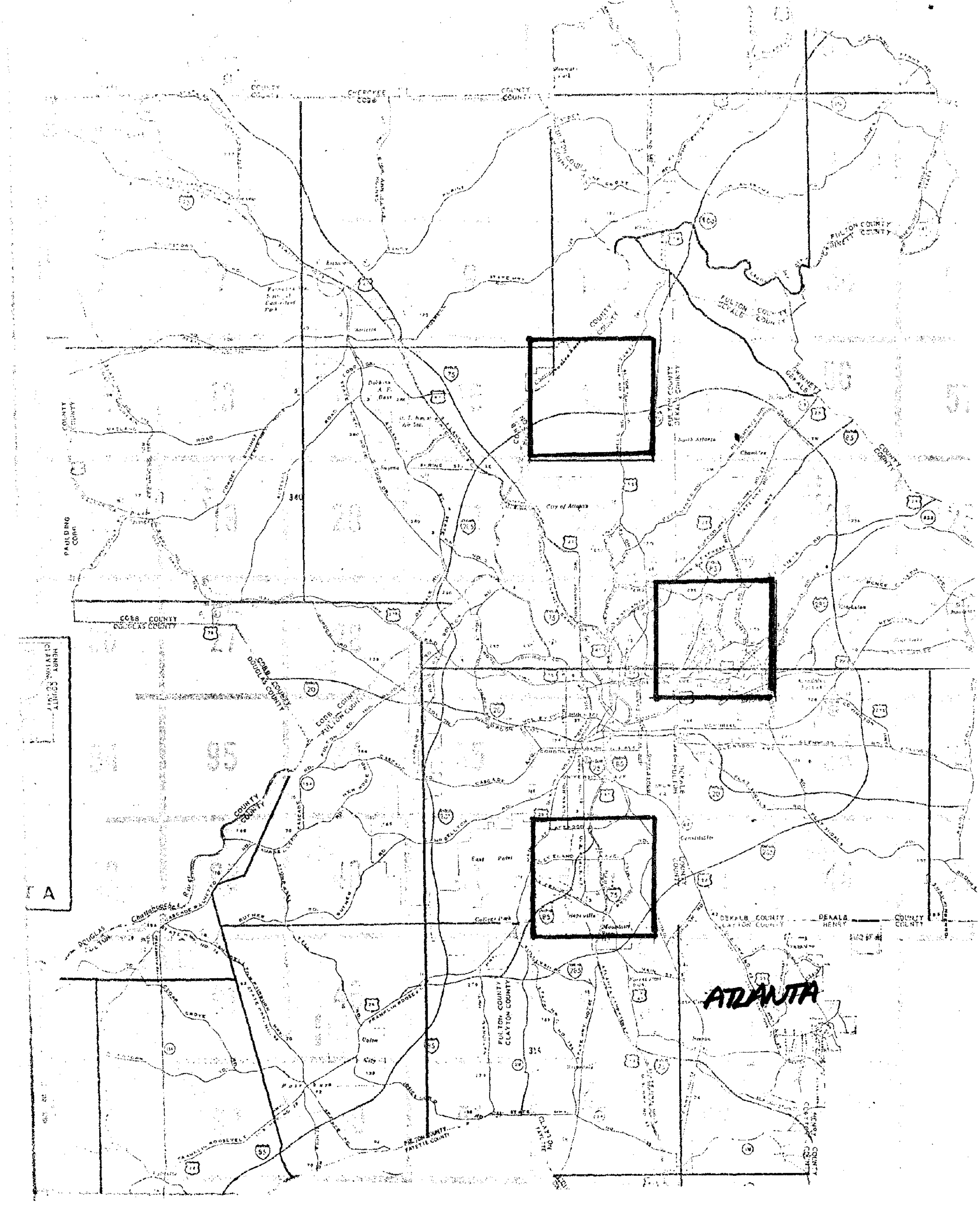
CHEROKEE
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DEKALB COUNTY
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PAULDING
COBB
COBB COUNTY
DOUGLAS COUNTY
COBB COUNTY
FULTON COUNTY
Dobbins A.F. Base
Marietta
Smyrna
City of Atlanta
North Atlanta
Chamblee
East Point
College Park
Hapeville
Union City
Chattahoochee River
DOUGLAS
FULTON
FULTON COUNTY
CLAYTON COUNTY
DEKALB COUNTY
CLAYTON COUNTY
HENRY
FULTON COUNTY
FAYETTE COUNTY
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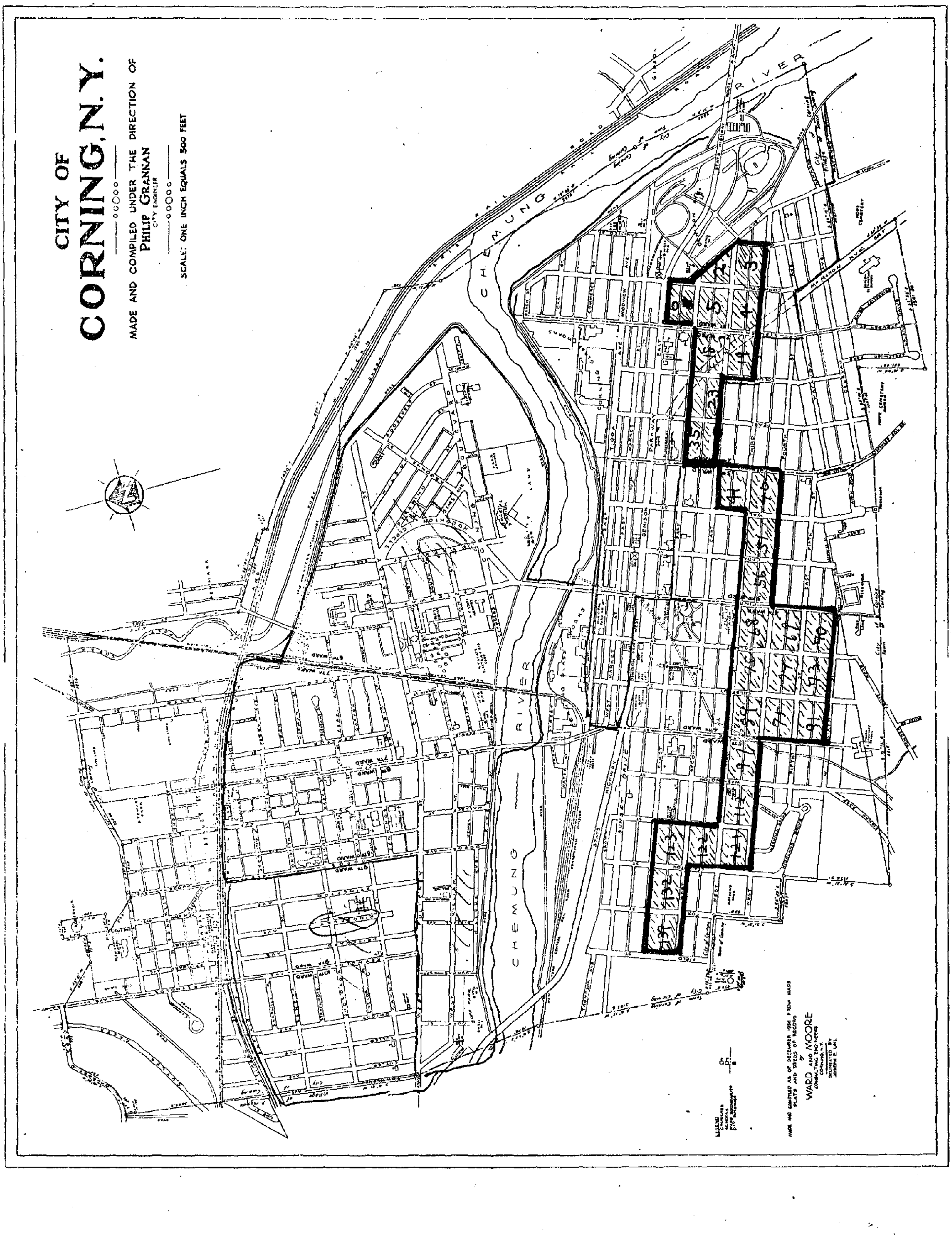
CITY OF
CORNING, N.Y.
MADE AND COMPILED UNDER THE DIRECTION OF
PHILIP GRANNAN
CITY ENGINEER
SCALE: ONE INCH EQUALS 300 FEET
CHEMUNG RIVER
CHEMUNG RIVER
LEGEND
CHURCHES
SCHOOLS
WARD BOUNDARIES
CITY BUILDINGS
MADE AND COMPILED AS OF DECEMBER 1954 FROM MAPS
PLATS AND DEEDS OF RECORD
by
WARD AND MOORE
CONSULTING ENGINEERS
CORNING, N.Y.
DELINEATED BY
JOSEPH E. UHL
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