AGRICULTURAL LAND PRICING MODEL FOR THE IMPERIAL VALLEY

by

Mark Llewellyn Bixby

B.S., Electrical Engineering
Duke University, 1988

Submitted to the Department of Urban Studies and Planning
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Real Estate Development

at the

Massachusetts Institute of Technology

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Signature of Author ______________________________
Mark L. Bixby
Department of Urban Studies and Planning
July 29, 1994

Certified by ______________________________
William C. Wheaton
Professor of Economics
Thesis Supervisor

Accepted by ______________________________
William C. Wheaton
Chairman
Interdepartmental Degree Program in Real Estate Development

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ABSTRACT

The Imperial Valley, located in the southeastern corner of California in Imperial County, is the tenth largest agricultural producing county in the United States. Over 489,000 acres of irrigated land produced nearly a billion dollars of revenue in 1993. The sale of agricultural properties in the Valley is of interest to property owners, farmers, developers, and investors.

This thesis analyzes ten years of agricultural property sales transaction data. A database was built with information from 274 sales transaction records. A regression model was developed to describe the behavior of land price per acre. The benefits of regression analysis and its limitations are discussed for use in the sales comparison approach to appraisal. Local and national economic trends are compared with the model predicted results.

Thesis Supervisor: Mr. William C. Wheaton

Title: Professor of Economics

ACKNOWLEDGEMENTS

I would like to thank the following people:

Mr. Thomas K. Turner for his help collecting and copying hundreds of sales transaction reports, and for his patient responses to my numerous phone calls and faxes.

Mr. Orlando B. Foote, a friend of my father, who gave me the names of the right people to interview to start my thesis research.

Mr. Tyler Lyon for the educational tour of the Valley and for his knowledge and appreciation of the land. Thanks also for the fresh produce I sampled and shared with my family.

Those other nice people listed in the Interview section of the Bibliography who took the time to answer my questions.

My wife Theresa for putting up with me and changing more than her fair share of diapers while I punched in numbers and typed this thesis.

My three month-old son Ryan for just being, so that I was reminded of what is most important in life.

BIOGRAPHICAL NOTE

Mark plans to join the Bixby Land Company, a 100 year old property management and development company based in Long Beach, California, in September 1994. The Company owns and operates commercial properties in the Long Beach area and agricultural properties in the Imperial Valley.

Prior to attending MIT for his Masters degree, Mark worked for NGV Systems Inc., based in Long Beach, CA, from 1991 to 1993. He was a Sales Engineer for the NGV Technologies Company division in 1992 and 1993 responsible for vehicle conversion sales and production scheduling. His other responsibilities included writing conversion system documentation and taking the conversion systems through California Air Resources Board certification.

In 1991 and 1992 Mark was the Northwestern Regional Sales Manager for CNG Cylinder Company, another division of NGV Systems. CNG Cylinder manufactures Compressed Natural Gas (CNG) cylinders for the automotive industry. Mark was responsible for sales calls, presentations, conferences, and shows in his territory. He was also responsible for factory technical support.

From 1990 to 1991 Mark worked as a Sales Engineer for Johnson Controls, Inc., Los Angeles, CA. His job entailed the layout, estimation, and sales of Heating, Ventilation, and Air Conditioning (HVAC) control systems for commercial and industrial buildings.

Mark received his Bachelor of Science in Electrical Engineering, from Duke University, Durham, NC in 1988.

In his free time the author likes bicycling, playing guitar, reading, skiing, surfing, traveling, and building things.

TABLE OF CONTENTS

Chapter	Title	
ONE	**Introduction**	
	I	Imperial Valley and Agriculture
	II	Area Maps
	III	Why Build a Pricing Model?
	IV	Summary of Findings
TWO	**Appraisal of Agricultural Property**	
	I	Appraisal Factors
	II	The Three Method Approach
	III	Previous Use of Regression Analysis
THREE	**Data Collection and Methodology**	
	I	Tax Assessor Records
	II	Sales Transaction Comparisons
	III	Explanation of Input Variables
	IV	Construction of Database
FOUR	**Development of Regression Models**	
	I	Hypothesis of Regression Models
	II	Types of Regression Models
	III	Variables Created for Regression Models
	IV	Model Output
FIVE	**Agricultural Variable Analysis**	
	I	Soils
	II	Crops
	III	Tiling / Drainage
	IV	Other Variables
SIX	**Locational Variable Analysis**	
	I	Proximity to Highways
	II	Proximity to Canals
	III	Proximity to Metro Areas
	IV	Zones
SEVEN	**Changes Over Time**	
	I	Time Dummy Variables
	II	Local Agricultural Price Trends
	III	National Agricultural Price Trends
	IV	Sales Transactions
	V	Population Growth / Development
EIGHT	**Conclusions**	
	I	Regression Models in the Appraisal Process
	II	Future Studies

LIST OF FIGURES

Figure	Description
1-1	Locational Reference Map
1-2	Imperial Valley Map
1-3	Imperial Irrigation District Index Map
1-4	USDA Soil Conservation Service General Soil Map
2-1	Six Key Appraisal Factors
2-2	Histogram of Sales Transaction Data
3-1	Sales Transaction Data Summary
3-2	Soil Classifications
3-3	Metropolitan Area Codes
3-4	Examples of Database Variable Input
4-1	DURB Township and Range
4-2	DURB Township and Range Map
4-3	DZONE Township and Range
4-4	DZONE Township and Range Map
4-5	Examples of Regression Variable Input
4-6	Correlation Table
4-7	Regression Output Model 1
4-8	Regression Output Model 2
4-9	Final Regression Output Models 1 & 2
4-10	Model Predicted $/Acre Graph
5-1	Value of Agriculture Production from Imperial Valley
5-2	Agricultural Production Percentage Breakdown for 1992
5-3	Tiling Spacing Requirements
5-4	Tiling Cost Estimates
7-1	Local Agricultural Price Index Development
7-2	Local Agricultural Price Index Graph
7-3	Local Trend Comparison Graph Year to Year
7-4	Local Trend Comparison Graph Base Year 1983
7-5	USDA Index Numbers: Prices Received by Farmers
7-6	National Trend Comparison Graph Year to Year
7-7	National Trend Comparison Graph Base Year 1983
7-8	Average Sales Transaction Size
7-9	Average Sales Transaction Price per Acre
7-10	Imperial Valley Population and Growth Statistics
7-11	Privately Owned Housing Unit Starts by City
7-12	Privately Owned Housing Unit Starts Totals

CHAPTER ONE

Introduction

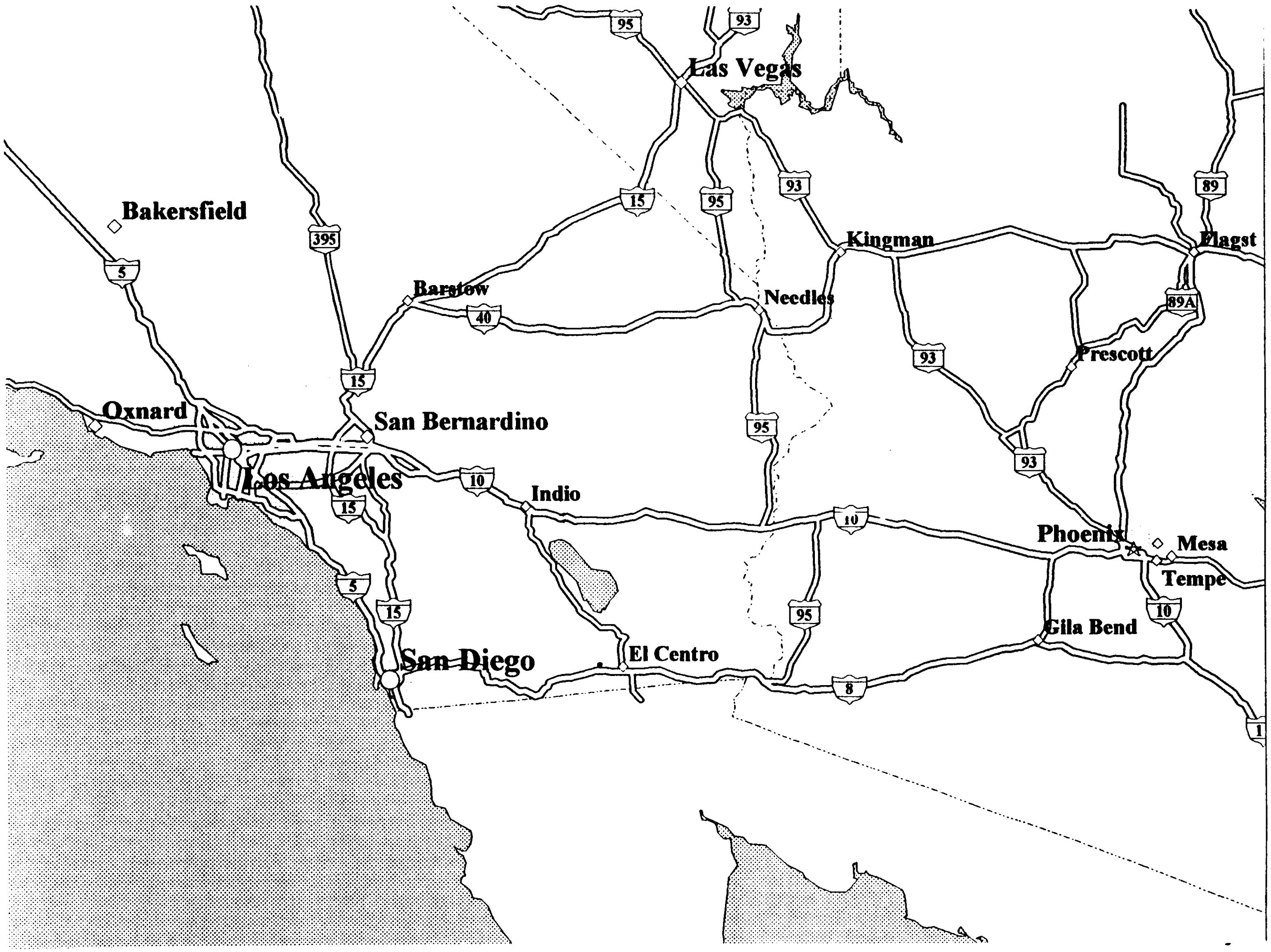
I Imperial Valley and Agriculture

Geographic

Imperial Valley is located in the South-eastern corner of California in Imperial County, bordering San Diego County to the West, Riverside County to the North, Arizona to the East, and Mexico to the South. San Diego is approximately two hours west by car on Interstate Highway 8, and Palm Springs is approximately two hours north by car. Figures 1-1 and 1-2 are included for reference.

Physiography

The Imperial Valley is a great basin sloping at an average of 0.1 percent from the Mexican border to the Salton Sea and covering approximately 990,000 acres (roughly 1550 square miles). Fossil remains indicate that the entire Valley floor was once several hundred feet below sea level and that the head waters of the Gulf of Mexico once extended as far north as the Chuckawalla Mountains (north of the Valley). Over time volcanic forces elevated the land and the Gulf headwaters receded. The nearby Colorado River occasionally flooded and the runoff waters covered the Valley floor with soil and silt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Barstow
Kingman
Flagst
Needles
Prescott
Oxnard
San Bernardino
Los Angeles
Indio
Phoenix
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Figure 1-1

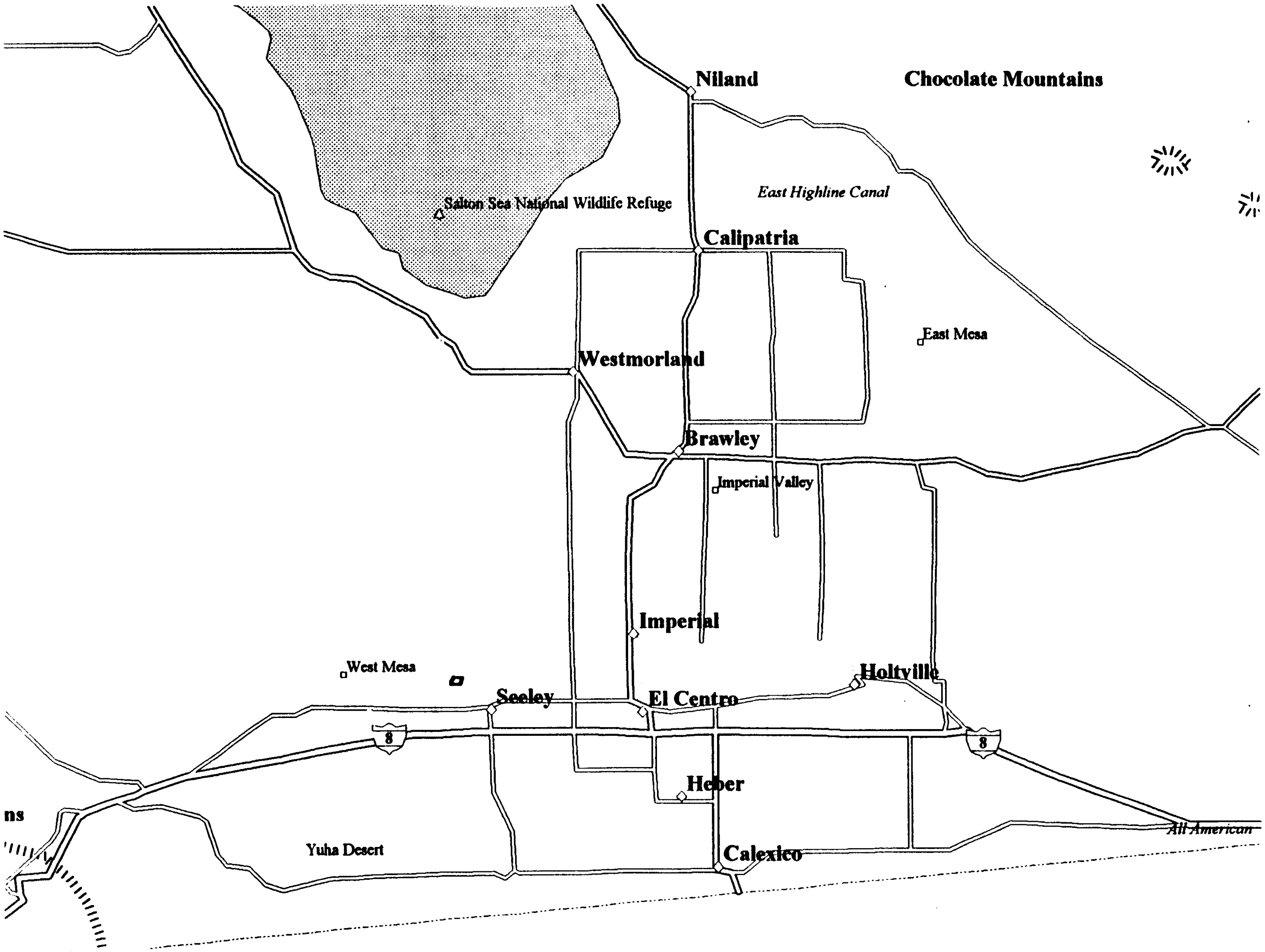
Niland
Chocolate Mountains
East Highline Canal
Salton Sea National Wildlife Refuge
Calipatria
East Mesa
Westmorland
Brawley
Imperial Valley
Imperial
West Mesa
Holtville
Seeley
El Centro
8
8
Heber
ns
All American
Yuha Desert
Calexico

Figure 1-2

deposits rich in nutrients. Current Valley floor elevations range from 230 feet below sea level at the edge of the Salton Sea (1974) to 350 feet above sea level.

Climate

The Imperial Valley soils receive an average annual rainfall of approximately three inches. Without irrigation the soils have little potential for productive farming. The average temperature in January is 54 degrees with a range of 29 to 80 degrees and the average temperature in July is 92 with a range of 66 to 114 degrees.[1]

Development History

The Spanish began the first two missions in the Imperial Valley area near Yuma in 1776. They did not fortify the missions believing the Yuma Indians peaceful. In 1781 the Yuma felt their lands threatened by a group of colonists headed for Los Angeles. All of the inhabitants of the newly built missions were massacred. For many more years the Valley was more an obstacle to cross rather than a destination.

The first clues to the Valley's potential came from the Cahuilla Indians who farmed in the Valley:

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[1] Soil Survey of Imperial County, California, pg. 80.

> Since 1849 the fertility of most of this alluvial plain has been recognized. Dr. Wozencraft then noted it. In an official report to the War Department in 1855 attention was called to the fact that the Cahuilla Indians were raising abundant crops of corn, barley and vegetables in the northwest part of the desert. The soil appeared to be rich for wherever water touched it vegetation was abundant. [2]

Southern Pacific completed a railroad line to Yuma, Arizona in 1877 and two years later the southern east-west railroad was completed. The line ran along the northeastern side of the Valley and Salton Sea on its way to Los Angeles.

The persistence of a number of farsighted entrepreneurs led to the formation of the California Development Company (CDC) in April of 1896. Its mission was to convert the Colorado Desert (as the Imperial Valley was known in the late 1800's) into a productive agricultural region by diverting water from the Colorado River into an irrigation system distributing water throughout the Valley. Initially the CDC had difficulty raising money and convincing settlers to move to the area to farm the soil which was not yet irrigated.

Field work on the first canal began in December of 1900. Construction continued at a furious pace and by February 1902 the Valley had taken on a new character:

> More than 400 miles of canals and laterals were built, more than 100,000 acres of land made ready for water, some 2000 eager

[2] A History of Imperial Valley, pg. 22.

> home seekers had been attracted, the towns of Imperial and Calexico started, and the bankrupt California Development Company turned into a concern worth millions. [3]

By 1905 the CDC ran out of money. They were fighting creditors, lawsuits, and an unruly river which repeatedly broke through dam and levee works. Southern Pacific Railroad, who was interested in the continued development of the Valley, loaned the company $200,000, enough for a controlling interest. By 1909 Southern Pacific chose to get out of the water business and the assets passed into receivership until 1911. The Imperial Irrigation District (IID) was formed to manage the water and properties.

The first canal cut in 1902 from the Alamo River on Mexican soil into the Valley began the long and interesting struggle over water rights from the Colorado River. After extended lobbying efforts on the part of Valley government officials and others, Congress passed the Boulder Canyon Project Act (Swing-Johnson Bill) in 1929 providing for construction of a dam in Boulder Canyon, a hydroelectric generation plant, and the All-American Canal. This guaranteed water rights to the Valley and would eliminate the flooding problems previously experienced.

---

[3] A History of Imperial Valley, pg. 48.

Imperial Irrigation District

The IID is a public utility providing water and power to Imperial County and parts of Riverside County. Today the IID operates the 82-mile-long All-American Canal, 148 miles of main canals, 1,442 miles of laterals, and has a "present perfected right" to 2.6 million acre-feet of Colorado River water. These canals and laterals irrigate approximately 489,000 acres of land, approximately half of all of the land in Imperial Valley. The district also provides power to over 80,000 users from its hydroelectric, steam, gas, and diesel power plants.[4]

Current Demographics

As of January 1, 1992, the Imperial County population was 131,000 with 13,000 employed directly in agriculture. Industry (including agri-business) employed 46,200. "Agriculture is still the largest industry in the county accounting for 28 percent of total wage and salary employment." [5] For populations of the cities see Figure 7-10.

Current Agriculture Rankings

Imperial County is ranked as the 10th largest agricultural producing county in the United States. Over 489,000 irrigated acres produced

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[4] IID Fact Sheets.
[5] Imperial County Annual Planning Information, pg. 10.

nearly a billion dollars of revenue in 1993. Figure 5-1 graphs the last 10 years worth of agricultural production by commodity type.

II Area Maps

Figure 1-1, the Locational Reference Map, shows the city of El Centro in relation to San Diego and Los Angeles. Figure 1-2 is a map of Imperial Valley showing the location of the ten cities (metro areas) referenced later in this thesis.

The Imperial Irrigation District Index Map (Figure 1-3) shows IID map index numbers, township and range numbers, main canals, and city grid outlines.

The USDA Soil Conservation Service General Soil Map (Figure 1-4) shows major soil group breakdowns and highlights the main irrigated crop areas.

III Why Build a Pricing Model?

Price Variation

The sales transaction reports used in the regression analysis had a range in price per acre of agricultural land from $469 to $4,775. These variations were significant enough to warrant a quantitative investigation of the characteristics affecting the price per acre. How much of the variation could a pricing model explain?

Agricultural Appraisal Process

In agricultural appraisal there are three approaches used to derive the value of a property similar to the three approaches in commercial property appraisal. The appraiser determines a price for the property by reconciling the three approaches into a final value estimate. The appraisers interviewed for this thesis place much of the weight of their appraisals on the sales comparison approach.

Regression analysis is a worthwhile addition to the tools used in the comparison approach to appraisal. It is a statistical method used to explain the variation in a dependent variable (for example price per acre of real estate) caused by the change in one or more independent variables (property size, locational characteristics, physical characteristics, etc.) With sufficient quality and quantity of data, regression analysis can be used to ground intuition with statistical evidence computed from raw data. The coefficients calculated in the regression can be used in a model for predicting dependent variable values. Regression analysis is used extensively in the physical, biological, economic, and social sciences to help distill useful information from reams of data.

The same database built for regression analysis can also be used to help pick the most appropriate property transactions for use in grid comparisons.

IV Summary of Findings

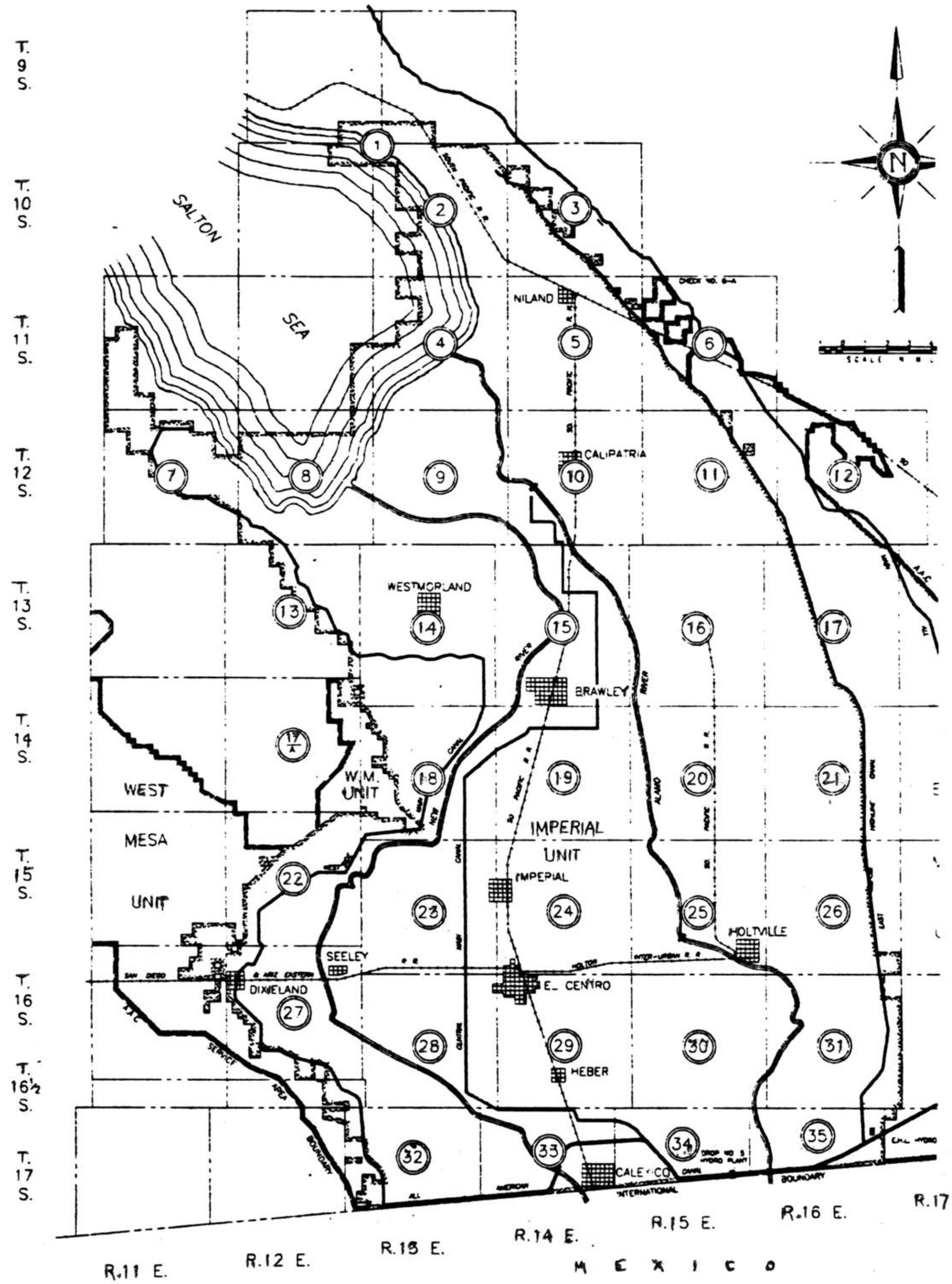
Two regression models were created to describe the variation in agricultural land price per acre. Both regression models had adjusted R^2 numbers of approximately 50% indicating the models have similar predictive abilities. These numbers are high enough to conclude that the model is useful in the property appraisal process.

Eleven variables were found to be statistically significant (not including the time dummy variables). Both the level of tiling and the recorded crop types impacted the pricing model. The effect of urban influence was demonstrated as expected, meaning the model predicts that properties closer to urban areas have a higher sales price per acre than other similar outlying properties. However the area of urban influence was small and the majority of outlying sales transactions were unaffected by urban development patterns.

Locational analysis (unrelated to urban zones) demonstrated significant price differences between certain zones within the Valley. These differences can be partially explained by the distribution of soil types in an area, and may also reflect an information effect where the buyer is aware of the quality of crops grown on surrounding properties.

The time dummy variables had the greatest single impact on the price per acre, affecting prices by as much as 33% in some years. It was difficult to link these price effects to local economic trends other than the impact of the whitefly infestation in 1991 and 1992. The model predicted prices seemed to follow the movements in national agricultural indices but in a more radical fashion.

Figure 1-3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BRAWLEY
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IMPERIAL UNIT
IMPERIAL
SEELEY
DIXIELAND
EL CENTRO
HOLTVILLE
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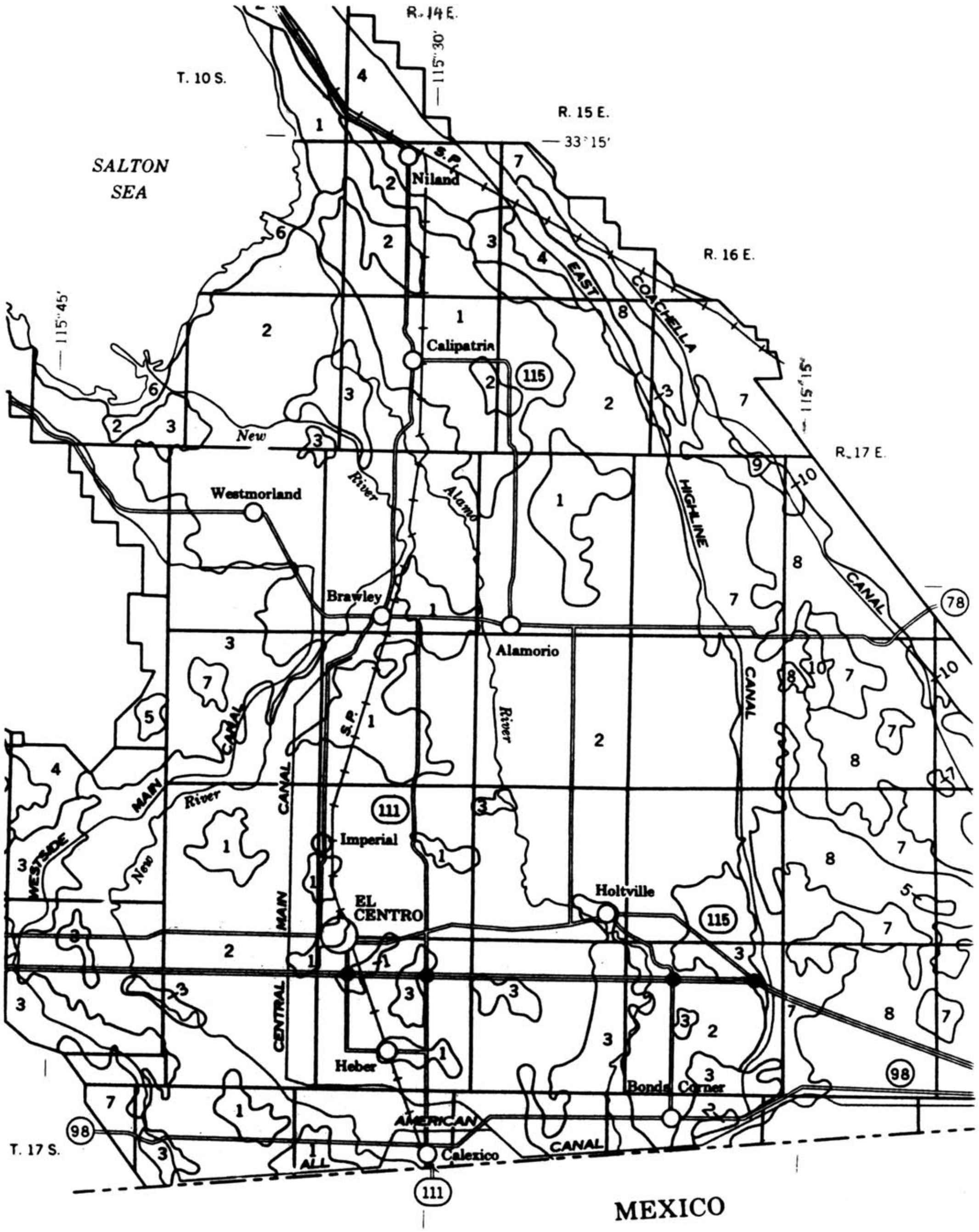
Figure 1-4



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SALTON SEA
R. 16 E.
115°45'
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R. 17 E.
Niland
Calipatria
Westmorland
Brawley
Alamorio
Imperial
EL CENTRO
Holtville
Heber
Bonds Corner
Calexico
New River
Alamo River
EAST HIGHLINE CANAL
COACHELLA CANAL
WESTSIDE MAIN CANAL
CENTRAL MAIN CANAL
ALL AMERICAN CANAL
S.P.
115
111
78
98
T. 17 S.
MEXICO

CHAPTER TWO

Appraisal of Agricultural Property

I Appraisal Factors

Three Agricultural Appraisers were interviewed for their thoughts on appraisal methodology, Mr. Jack Durrett, Mr. Andrew Erickson, and Mr. Thomas Turner. Mr. Durrett is an appraiser for Imperial County Assessor's office. Previously he worked for the Farm Credit Services Southwest where he prepared a number of the Federal Land Bank of Sacramento Farm Sales Reports used as a data source for this thesis. Mr. Durrett described six key appraisal factors he used for property valuation:

FIGURE 2-1
Six Key Appraisal Factors

Factor	Physical Description	Valuation
Soils	100% Class II 100% Class III < 50% Class IV*	Excellent Average Fair
Size	40 - 60 acres < 40 acres > 160 acres	Equal Lessor Lessor
Shape	Regular/Rectangular Other	Average Below Average
Location	Proximity to Towns	Higher - Closer
Access	Highway Paved Road Dedicated Not Gravel	Excellent Above Average Average Below Average
Farmland Improvements	Concrete Ditch 1/4 Mile Irrig. Runs Other Length Irrig. Runs 100' Tiling Spacing	Average Average Below Average Average

* - Soil type # 114 is considered Class IV

Mr. Erickson listed soil types, farm improvements and location as the key factors in property valuation. He explained that location essentially determines soil types. Parts of the Valley are known for their soil qualities and the prices paid for particular properties reflect the knowledge of surrounding soil types. Mr. Erickson discussed tiling/drainage as the most important aspect of farm improvements, and mentioned ditch quality (concrete as average) and leveling as other important improvements. Mr. Erickson also discussed the shape of a property as a factor and pointed out problems with non-rectangular fields including: short row irrigation, more difficult tractor and land preparation work, more difficult crop dusting.

Mr. Turner emphasized soil type and tiling/drainage as the key factors in his property valuations. He listed other farmland improvements, access roads to the property, shape, and location as other factors that have less influence on property prices.

II The Three Method Approach

There are three methods for property valuation prescribed in *The Appraisal of Rural Property*. Each method has its merits and pitfalls but knowledgeable use of all three methods leads to an accurate property appraisal value. The methods are described below:

1. The value indicated by recent sales of comparable properties in the market (the sales comparison method).
2. The value of a property's net earning power based on a capitalization of net income (the income capitalization method).
3. The current cost of producing a replica of the improvements, less loss in value from depreciation, added to land value (the cost method).[6]

The valuations from each method of appraisal are then reconciled, a process by which the relative merit of each approach is considered and weighed in light of the information available on the piece of property.

Sales Comparison Method

The appraiser reviews comparable property sales to determine what price the sale property should bring on the open market. The comparison approach for rural property concentrates on the land value which includes agriculture-related improvements to the land but not structures such as buildings, sheds, homes, or barns. Non-land improvements are simpler to appraise using the cost approach and these values can be added to the price of the property, however there is no guarantee that a buyer is willing to pay what the seller has invested in non-agriculture related improvements.

---

[6] The Appraisal of Rural Property, pg. 30.

Because each property has different physical characteristics the appraiser must determine the key factors which affect the transaction price of the comparable properties and adjust the value of the appraised property accordingly. It is important that the appraiser ensure that the data obtained on comparable sales is accurate and that the comparable sales transactions were at arm's length (i.e. conducted under fair market conditions with no extraordinary conditions forcing the purchase or sale).

To determine the impact of variations between comparable property sales the appraiser must attempt to isolate the variation in a single characteristic for each characteristic which influences the sales price:

> There are a number of acceptable methods for relating the sales to the subject property and for increasing or decreasing the price indication for the variations. Variations and adjustments between the comparable and the subject property may be related on a percentage basis, as a price per unit, or as a lump sum adjustment.[7]

The common method for determining variations is to set up a series of data grids from which adjustment factors can be derived for variations in time of sale, soil variations, etc. This may be a difficult process when there are more influential property characteristics than there are comparable property sales. The appraiser's experience and knowledge of the area is most important when this is the case.

---

[7] The Appraisal of Rural Property, pg. 133.

According to the appraisers interviewed the sales comparison method is usually employed with three to five comparable property sales chosen. Mr. Turner described his method as searching his files for 10 to 12 property sales with similar characteristics then picking three to five comparable sales for use in a grid comparison.

Income Capitalization Method

The income capitalization method is used to analyze the future benefits of ownership of a property. The capitalization rate indicates the relationship between the annual net earnings (or projected net earnings) from the property and the value or sales price:

1. Estimate the typical rental data, crop rotations, yields, and average commodity prices for the area.
2. Estimate potential gross income for the property on either ownership or rental basis.
3. Estimate and deduct expenses of operation to derive net operating income (net income before recapture).
4. Select an applicable capitalization method and technique.
5. Develop the appropriate rate or ratios.
6. Complete the necessary computations to derive an economic value indication by the income capitalization approach.[8]

Farm income streams are inherently unsteady from year to year. Mr. Turner explained that he uses a direct one year's rental rate capitalization method (in the fourth step listed above) as recommended

[8] The Appraisal of Rural Property, pg. 172.

by the American Society of Farm Managers and Rural Appraisers (ASFMRA).

In 1992 local tenant farmers ran 64.8% of the total number of farms in the Imperial Valley with the remaining 35.2% owner operated. Property rental rates ranged from $50 to $200 per *net* acre per year in the Valley. Agricultural property capitalization rates in 1992 in the United States ranged between three to six percent. Mr. Turner stated that capitalization rates in the Imperial Valley were usually in the range from four to five percent. Using the single year direct capitalization method these rates imply land prices per net acre of between $1,000 and $5,000.

The average waste acre percentage from the sales transaction data on the Imperial Valley is 9.1%. If we decrease the property value estimates by 9.1% for the change from total acres to *net* acres the price range per total race shifts downward, from $910 to $4,550. Figure 2-2 is a histogram of total acre transaction prices from the data set for this thesis. This range of prices captures the majority of transactions represented in the histogram.

HISTOGRAM OF SALES TRANSACTIONS
(10 YEARS COMPARISON DATA)

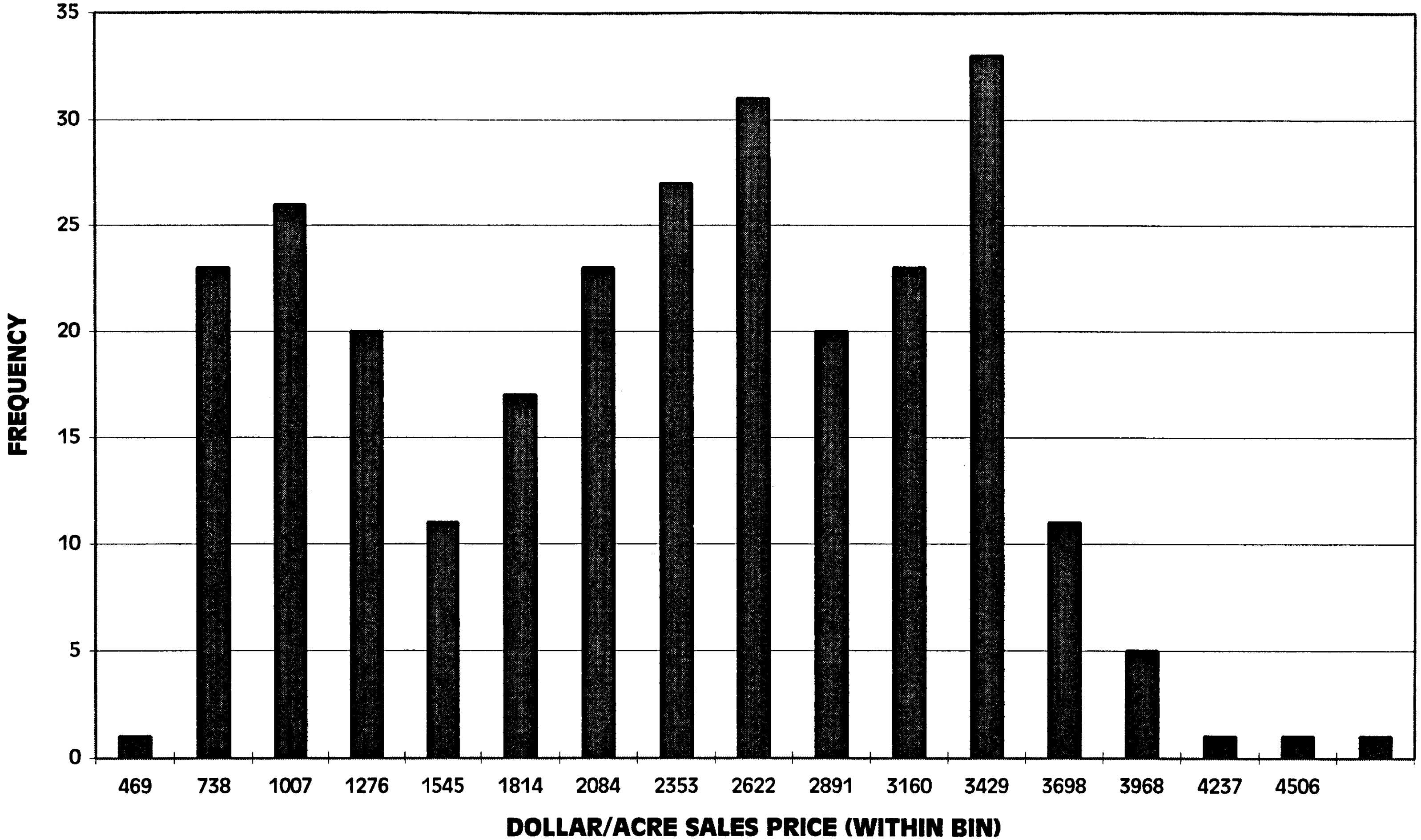


Figure 2-2

Cost Method

The cost method attempts to estimate the value of reproducing or replacing the improvements to the property while depreciating for the physical deterioration, functional obsolescence, and external obsolescence. This method is less well suited to estimating a market value for agricultural properties because the value of the land and its productive potential is usually the main component of agricultural property value. The cost approach however is very useful for establishing bounds on property prices and is commonly used in the appraisal process.

III Previous Use of Regression Analysis

A number of regression studies on the effects of property characteristics on agricultural land values have been published. Palmquist and Danielson[9] studied erosion and soil quality related effects on the price of agricultural land. They used two years of land transaction data on properties in North Carolina and concluded that soil quality had an effect causing these land values to differ by as much as 60%. They described their Hedonic regression equation as performing "quite well" and believed the results helpful:

> The results can provide an estimate of the average increase in land value due to drainage. This information can be combined

---

[9] A Hedonic Study of the Effects of Erosion Control and Drainage on Farmland Values.

> with drainage cost estimates in deciding whether or not to drain land.

In another study by King and Sinden[10] data was gathered from five years of sales transactions of agricultural property in the Manilla Shire, New South Wales, Australia. Fifty transactions were selected for use in the study. The buyers, sellers, and agents were interviewed for their knowledge of the factors affecting the transaction price. The authors developed four different models of price formation to test with the data. They found a number of interesting results including:

> Buyers valued a given state of soil conservation and proximity to the nearest town more highly than the sellers... the positive influence of the geographic scope of search shows an information effect... Previous, unsuccessful attempts by the seller to sell had a negative influence on final price.

Canning and Leathers[11] constructed a regression model to describe the changes in land and building value due to changes in parameters (taxes and inflation) that change over time. Their study used USDA data series on land and building values.

---

[10] Price Formation in Farm Land Markets.
[11] Inflation, Taxes, and the Value of Agricultural Assets.

CHAPTER THREE

Data Collection and Methodology

I Tax Assessor Records

The County Tax Assessor's office maintains a database with over 12,000 recorded property transactions for the last two years through March 1994. The records from prior years were available but not in a computerized format. The County database does not record the parcel size, a critical variable for a pricing model. Location, another important variable, is recorded in the County Tax Assessor's format which requires county tax assessor maps to locate properties. This combination of factors ruled out a pricing model study using County Tax Assessor data.

II Comparisons From Ten Years of Sales Transactions

At the Farm Credit Services Southwest (FCSS) Mr. Turner maintained a file containing comparison sales transaction reports dating back to 1967 that he and his predecessors had assembled. For each year there were approximately 20 to 50 transactions records kept for use in property appraisal. Mr. Turner agreed to duplicate 10 years of reports for a quantitative study of comparable sales transaction data. Figure 3-1, Sales Transaction Data Summary graphs the number and year of the comparison sales transactions used in the database as well as the total acreage per year those transactions represent.

Mr. Turner explained that when an appraiser at FCSS learned of an agricultural property sale, he gathered the necessary information to complete a comparable sales transaction report. The appraiser collected this information from the County records, visits to the property/ies, USDA SCS Soil maps, and Imperial Irrigation District tiling maps. The data was verified with two sources, either the county, the buyer, the seller, or the real estate agent. Transaction data from 1984 to 1988 was recorded on Federal Land Bank of Sacramento Farm Sales Reports. From 1989 to 1992 the data was recorded on Western Farm Credit Bank Farm Sales Reports. Both reports are from the same organization but the report name was changed in 1988. In 1994 Mr. Turner began computerizing his reports for easier access and immediate use in his appraisals.

SALES TRANSACTION DATA SUMMARY

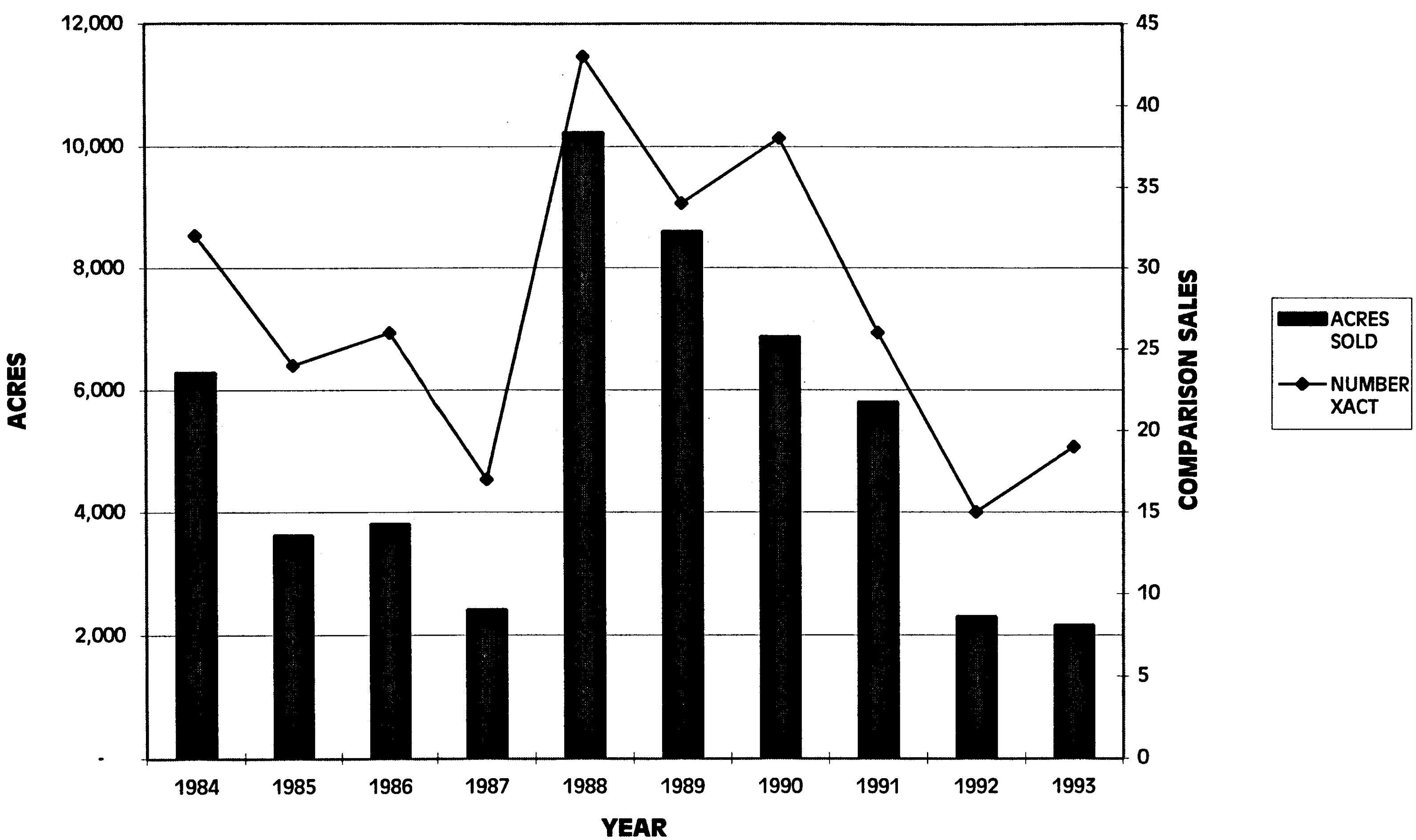


Figure 3-1

FIGURE 3-2
Soil Classifications

Soil #	Soil Name	Storie Index	Permea-bility	Acres	Acre %
Class I					
105	Glenbar Clay loam	58	mod	2,951	0.3
117	Indio loam	100	mod	9,169	0.9
Class II					
100	Antho loamy fine sand	85	mod	4,134	0.4
101	Antho-Superstition complex	77	mod	8,416	0.9
106	Glenbar clay loam, wet	37	mod	4,239	0.4
107	Glanbar complex	52	mod	12,894	1.3
108	Holtville loam	50	slow	2,804	0.3
109	Holtville silty clay	30	slow	3,628	0.4
110	Holtville silty clay, wet	59	slow	70,547	7.1
118	Indio loam, wet	60	mod	13,625	1.4
119	Indio-Vint complex	90	mod	29,643	3.0
120	Laveen loam	76	mod	2,322	0.2
137	Rositas silt loam, 0 - 2% slopes	90	rapid	3,737	0.4
142	Vint loamy very fine sand, wet	57	slow	31,545	3.2
143	Vint fine sandy loam	100	rapid	13,066	1.3
144	Vint and Indio very fine sandy loams, wet	60	mod	15,462	1.6
Class III					
111	Holtville-Imperial silty clay loams (slc)	59	slow	2,242	0.2
112	Imperial silty clay	36	slow	1,405	0.1
115	Imperial-Glenbar slc, wet, 0 - 2% slopes	34	mod	203,659	20.6
116	Imperial-Glenbar slc, 2 - 5% slopes	38	mod	2,162	0.2
121	Meloland fine sand	47	slow	10,748	1.1
122	Meloland very fine sandy loam, wet	43	slow	41,734	4.2
123	Meloland and Holtville loams, wet	43	slow	11,483	1.2
126	Niland fine sand	36	slow	2,846	0.3
127	Niland loamy fine sand	50	slow	2,088	0.2
132	Rositas fine sand, 0 - 2% slopes	62	rapid	77,301	7.8
133	Rositas fine sand, 2 - 9% slopes	56	rapid	40,748	4.1
135	Rositas fine sand, wet 0 - 2% slopes	36	rapid	22,626	2.3
136	Rositas loamy fine sand, 0 - 2% slopes	85	rapid	90,896	9.2
138	Rositas-Superstition loamy fine sands	85	modslow	11,373	1.2
139	Superstition loamy fine sand	85	modslow	12,877	1.3
Class IV					
103	Carsitas gravelly sand, 0 - 5% slopes	26	rapid	7,011	0.7
114	Imperial silty clay, wet**	22	slow	123,401	12.5
124	Niland gravelly sand	21	slow	7,884	0.8
125	Niland gravelly sand, wet	13	slow	9,820	1.0
128	Niland-Imperial complex	17	slow	6,974	0.7
130	Rositas sand, 0 - 2% slopes	57	rapid	22,608	2.3
131	Rositas sand, 2 - 5% slopes	54	rapid	1,590	0.2
Class V					
113	Imperial silty clay, saline	3	slow	5,679	0.6
134	Rositas fine sand, 9 - 30% slopes	49	rapid	19,401	2.0
	Water			3,288	0.3
	Other			19,414	2.0
			Totals	**989,450**	**100.0**

** - # 114 is listed as a Class 3 in texts but is considered Class 4 in value.

III Explanation of Input Variables

Month and Year - The month (M) and year (YR) of each transaction were input.

Township and Range - The Township (TWNS) and Range (RNGE) of each transaction were recorded for use in sorting property sales by location. Each individual Township and Range is approximately six miles by six miles.

Crops - Each sales transaction report provided information on the primary (CROP1) and secondary (CROP2) crops raised on the property. On some reports the crop type was spelled out and on most reports the crop type was numerically coded with the Federal Commodity Codes (Fed Code 1 and 2). The crops listed most often included alfalfa (181), sugar beets (132), cotton (121), and wheat (101/102). In the years 1990 and later the sales transaction reports often recorded field crops (33) as primary crop with no secondary listing.

Soil Classification - In 1981 the United States Department of Agriculture, Soil Conservation Service completed the most recent and thorough *Soil Survey of Imperial County, California,* written for use by farmers, ranchers, developers, builders, planners, and others. It contains soil type descriptions, maps and tables, and is published in conjunction with a series of 37 detailed soil maps which break down the soils of the Valley into 44 separate soil types. These maps are used by the Soil Conservation Service when recommending the type, size, depth, and spacing of tiling lines for properties requiring drainage improvements. Appraisers also use the maps to determine the makeup of the soils when appraising properties.

The soil types are grouped into eight Capability Classes (I through VIII) which represent the suitability of soils for most kinds of field crops. In Imperial Valley the first four classes of soils are of interest for cultivation:

Class I	soils have few limitations that restrict their use.
Class II	soils have moderate limitations that reduce the choice of plants or that require special conservation practices, or both.
Class III	soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.
Class IV	soils have very severe limitations that reduce the choice of plants, or that require very careful management or both.[12]

The percentages of each soil type within a group were added to obtain the total percentage of a Capability Class. The variables CL1, CL2, CL3, and CL4 were input.

[12] Soil Survey of Imperial County, California, pg. 41.

Figure 3-2 is a reproduction of Table 3 reorganized by soil class numbers with the addition of Storie Index and permeability descriptions. The Storie Index rating is relative measure of the suitability of the soils for crop production within the Imperial Valley. A rating of 100 is the most favorable rating, 0 the least favorable. The permeability descriptions are associated with numbers (see Figure 5-3) which indicate the drainage rate in inches per hour.

Zoning - The variable ZONE recorded the property zoning. Some of the transaction sales reports indicated two types of zoning; the type of the largest portion was entered. A2 is the standard agricultural zoning code used in the Valley. A3 is the heavy agricultural zoning code which allows for uses such as feedlots, processing plants, and standard agriculture.

Parcel Size - The variable SIZE recorded the total acre size of the property transaction.

Irrigated Acres - The variable ACRES recorded the size of the irrigated portion of the property which excludes houses, sheds, roads, canals, and other "wasted" property.

Price - The variable PRICE$ recorded the total property transaction sales price including broker sales commission paid by the buyer. The variable BLDGS$ recorded the appraised value of the buildings and improvements exclusive of agricultural improvements. The land value is the difference between the two variables.

Tiling Code - The variable TILE is a qualitative variable created by the author to code the perception of the level of tiling. The variable was recorded as follows:

1. Tiled effectively; meets SCS recommendations, or spacing < 150'
2. Tiled but needs additional tiling to meet SCS recommendations, or tile spacing at >150'
3. Not tiled, or less than 50 % tiled >150'

Shape Code - The variable SHAP is another qualitative variable code created by the author to try to capture the importance of the property layout discussed by the appraisers interviewed. The following guidelines were used:

1. Rectangular/regular
2. Irregular rectangular/triangular
3. Irregular/Obstacles (ditches, canals, railroad, etc.)

Access Code - ACXS is the third qualitative variable used to capture the quality of the access to the property. The codes were assigned if the property had access provided by:

1. Paved Interstate/ State /County Highway (at least one side)
2. Paved road/good gravel (at least one side)
3. Unpaved, dirt only, or excessively long gravel road

Major Highways - Six major highways cross the Valley, state highways 86, 111, and the 115 are the major north-south state thoroughfares. Interstate 8 runs east-west passing through El Centro between Yuma and San Diego. State highways 78 and 98 cross the Valley east-west.

The variable MHWY is the distance by car from an edge of the property to the nearest state highway or interstate highway. An Imperial County road map was used and the distances have an estimated accuracy of +/- 1/2 mile. It was expected that this variable would have a statistically significant effect on the property values because access to the property is important for leased machinery, maintenance, harvest, etc.

County Highways - County Highways 26, 27, 28, 29, 30, 31, 32, 33, and 80 comprise a grid work of access roads to a majority of the Valley. The variable CHWY is the distance by car to the nearest county highway or state highway or interstate highway. As mentioned above the accuracy is estimated at +/- 1/2 mile and the results were expected to be significant to the model.

Canals - The All-American Canal runs westward from the Colorado River to supply the Westside Main Canal, Central Main Canal, and the East Highline Canal which flow north through the Valley. The Imperial Irrigation District owns, maintains, and operates these canals and all water users pay water fees to the IID. These main canals feed a series of laterals which deliver water to each property. The IID also maintains the drainage ditch system which collects runoff and drainage water and delivers it to the Alamo or New Rivers. The Rivers flow into the Salton Sea.

The variable CANAL measured the flow distance from the nearest main canal in miles to the property. The distances were estimated from an Imperial County road map and not traced along canal laterals. This variable was not expected to have much significance in a pricing model so the distances were estimated rather than laboriously traced along plat book maps.

Metro Areas - The variable METR is a measure of the distance to the nearest metropolitan area from the list of ten areas below. The AREA variable is a three character code for the metro area nearest the property listed below in Figure 3-3.

FIGURE 3-3
Metropolitan Area Codes

Westmoreland	WES	El Centro	ELC
Niland	NIL	Seeley	SEE
Calipatria	CAL	Holtville	HOL
Brawley	BRA	Heber	HEB
Imperial	IMP	Calexico	CLX

IV Construction of Database

The database was constructed on a Microsoft Excel 5.0 Spreadsheet. The input data contains 274 rows of 23 columns totaling 6,302 data entries. Each transaction consisting of 23 entries was assigned a code number for reference to the appraiser's transaction sheet should there be questions about the data. Example database variable input data is shown in Figure 3-4. Additional variables which were created for use in the regression models are discussed in Chapter 4.

Figure 3-4

DATABASE VARIABLE INPUT

		LOCATION		CROPS		SOIL CLASSIFICATION						PARCEL	IRRIG	ACRES		TOTAL	LAND VALUE		CODE			DISTANCE (MILES) TO:					#
M	YR	TWNS	RNGE	CROP1	CROP2	CL1	CL2	CL3	CL4	TOT	ZONE	SIZE	ACRES	WASTE	PRICE$	BLDGS$	ACRE	IRRACRE	TILE	SHAP	ACXS	MHWY	CHWY	CANA	METR	AREA	CODE
1	84	13	12	181	132	-	0.26	0.74	-	1.00	A2	56.4	54.0	2.4	162,000	-	2,872	3,000	2	2	2	0.5	0.5	-	4.0	WES	1
1	84	15	15	181	132	-	0.14	0.45	0.41	1.00	A2	800.0	720.0	80.0	2,250,000	-	2,813	3,125	3	1	2	3.0	0.5	9.0	9.0	HOL	3
1	84	15	13	181	132	-	0.66	0.34	-	1.00	A2	180.0	164.0	16.0	396,000	-	2,200	2,415	1	2	1	1.0	-	1.0	4.0	ELC	22
1	84	11	14	121	132	-	-	0.59	0.41	1.00	A2	86.0	74.0	12.0	170,000	-	1,977	2,297	1	1	2	2.5	2.5	4.0	5.0	NIL	25
2	84	14	16	181	121	-	-	0.50	0.50	1.00	A2	80.0	75.0	5.0	240,000	-	3,000	3,200	3	1	1	5.0	-	2.0	8.0	HOL	2
2	84	14	13	181	121	-	0.24	0.76	-	1.00	A2	119.0	113.0	6.0	386,750	-	3,250	3,423	2	2	2	5.0	0.5	-	4.0	BRA	4
2	84	11	14	121	132	-	0.45	0.51	0.04	1.00	A2	80.0	77.0	3.0	279,054	-	3,488	3,624	2	1	3	3.5	3.5	2.0	5.0	NIL	29
2	84	11	14	121	132	-	0.38	0.62	-	1.00	A2	79.0	75.0	4.0	271,806	-	3,441	3,624	1	1	2	3.0	3.0	2.0	6.0	NIL	30
2	84	13	12	121	132	-	1.00	-	-	1.00	A2	40.0	37.0	3.0	100,000	-	2,500	2,703	1	1	2	2.0	2.0	1.0	8.0	WES	31
2	84	11	15	121	132	-	-	0.83	0.17	1.00	A2	125.5	120.0	5.5	434,890	-	3,465	3,624	1	1	2	3.5	3.5	2.0	6.5	NIL	32
3	84	16	15	181	121	-	0.93	0.07	-	1.00	A2	160.0	150.0	10.0	496,000	-	3,100	3,307	2	2	2	3.0	2.0	8.0	4.0	HOL	26
3	84	16	16	181	339	-	0.44	0.56	-	1.00	A2	420.0	392.0	28.0	1,680,000	27,500	3,935	4,216	1	2	1	2.0	-	2.0	11.0	HOL	27
3	84	16	13	181	121	-	0.55	0.45	-	1.00	A2	81.0	76.0	5.0	274,000	-	3,383	3,605	1	1	2	2.0	0.5	3.0	5.0	ELC	28
4	84	14	14	132	121	-	-	0.69	0.31	1.00	A2	200.0	191.0	9.0	128,000	6,000	610	639	2	1	3	2.0	2.0	4.0	5.0	IMP	21
4	84	14	13	181	121	-	0.51	0.34	0.15	1.00	A3	240.0	229.0	11.0	864,000	-	3,600	3,773	3	1	1	1.0	-	1.0	6.0	BRA	24
5	84	12	11	181	121	-	0.95	0.05	-	1.00	A2	320.0	240.0	80.0	995,000	-	3,109	4,146	2	1	2	1.0	1.0	1.0	13.0	WES	23
6	84	15	16	181	132	-	0.38	0.62	-	1.00	A2	98.0	88.0	10.0	325,000	2,000	3,296	3,670	2	1	2	7.0	1.0	-	5.0	HOL	19
7	84	15	15	181	132	-	0.03	0.91	0.06	1.00	A2	80.0	74.0	6.0	176,000	-	2,200	2,378	2	1	3	3.0	0.5	5.0	3.5	HOL	7
7	84	16	16	181	132	-	-	0.48	0.52	1.00	A2	160.0	150.0	10.0	517,000	-	3,231	3,447	2	1	1	2.0	-	2.0	7.0	HOL	9
7	84	12	15	181	132	-	0.33	0.67	-	1.00	A2	275.0	230.0	45.0	600,000	-	2,182	2,609	2	1	3	6.0	6.0	-	13.0	CAL	16
7	84	11	14	121	132	-	-	1.00	-	1.00	A2	80.0	76.0	4.0	215,980	-	2,700	2,842	1	1	3	4.0	4.0	1.0	10.0	CAL	17
7	84	13	15	181	132	-	0.06	0.16	0.78	1.00	A2	80.0	74.0	6.0	240,000	-	3,000	3,243	3	1	2	1.5	1.5	9.0	10.0	BRA	18
8	84	16	16	181	132	-	0.04	0.92	0.04	1.00	A2	783.0	749.0	34.0	3,000,500	130,000	3,666	3,832	2	1	1	-	-	3.0	6.0	HOL	10
8	84	15	14	181	132	-	-	0.60	0.40	1.00	A1	15.0	11.0	4.0	117,000	80,000	2,467	3,364	3	1	2	2.0	0.5	5.0	4.0	IMP	13
8	84	15	15	181	101	-	0.10	0.90	-	1.00	A2	80.0	76.0	4.0	224,000	-	2,800	2,947	3	1	1	2.0	-	6.0	2.0	HOL	14
8	84	16	12	181	132	-	0.40	0.52	0.08	1.00	A2	163.0	160.0	3.0	574,500	-	3,525	3,591	3	2	1	3.0	-	2.0	7.0	SEE	20
9	84	13	15	181	121	-	-	0.60	0.40	1.00	A2	145.0	136.0	9.0	400,000	-	2,759	2,941	3	1	2	1.0	1.0	2.0	8.0	BRA	5
9	84	16	14	181	101	-	0.85	0.15	-	1.00	A2	112.9	108.0	4.9	366,762	-	3,249	3,396	1	1	2	1.0	1.0	2.0	2.0	HEB	15
10	84	16	15	181	132	-	-	0.56	0.44	1.00	A2	39.0	33.0	6.0	115,000	-	2,949	3,485	1	1	2	1.0	1.0	6.0	8.0	ELC	6
10	84	16	14	181	132	-	0.18	0.76	0.06	1.00	A2	390.0	368.0	22.0	1,300,000	-	3,333	3,533	2	2	1	0.5	0.5	7.0	2.0	ELC	8
10	84	14	15	181	132	-	0.35	0.65	-	1.00	A2	160.0	142.0	18.0	520,000	-	3,250	3,662	1	1	1	2.0	-	6.0	11.0	BRA	11
10	84	17	16	181	132	-	0.40	0.60	-	1.00	A2	560.0	515.0	45.0	1,900,000	35,000	3,330	3,621	2	2	1	-	-	2.0	4.0	CLX	12
1	85	14	14	132	121	-	0.10	0.33	0.57	1.00	A2	1,073.0	1,023.0	50.0	2,680,000	17,000	2,482	2,603	3	2	1	-	-	-	2.0	BRA	43
1	85	16	13	181	132	-	0.47	0.53	-	1.00	A2	82.0	75.0	7.0	305,000	-	3,720	4,067	1	1	2	1.5	1.5	2.0	3.0	ELC	53

CHAPTER FOUR

Development of Regression Models

I Hypothesis of Regression Models

Multiple regression analysis tools are available in the more recent versions of Lotus 123 and Microsoft Excel, as well as in complete statistical software packages like SSPS (Statistical Package for the Social Sciences) and STATA. Excel 5.0, the software used for most of the regression and analysis work in this thesis, is limited to analysis of 16 variables (including the dependent variable). For the final regression run which included 10 dummy year variables (for a total of 22 variables) SSPS Version 6.0 was used.

Multiple regression equations explain the variation in a dependent variable (for example price per acre of real estate) caused by the changes in the independent variables (property size, locational characteristics, physical characteristics, year of sale, etc.) The beta coefficients calculated in a regression run are used in a model for predicting dependent variable values if they are statistically significant.

To develop a model with the highest descriptive ability it is important to avoid multicollinearity. This means avoiding use of highly correlated independent variables in the regression equation:

> When multicollinearity is severe -- that is, when two or more of the independent variables are highly correlated with one another -- we can run into difficulties interpreting the results of *t* tests on the individual parameters.[13]

The correlation analysis tool in Excel 5.0 was used to create a correlation table (Figure 4-6) to review the statistical relations between variables. There were no significant correlations between variables by design so the model avoided multicollinearity problems.

II Types of Regression Models

Multiple regression model building is the process of adding, deleting, and substituting variables and their types and formats into a multiple regression equation. The standard linear multivariate regression model is stated below where **E(y)** is the expected value of the dependent variable, β represents the beta coefficients, **x** represents the independent variables, **n** represents the number of variables used in the model:

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n \quad \text{(Model 1)}$$

[13] Intro to Statistics, pg. 529.

A second model type is the natural logarithmic-linear model which has the following form:

$$E(y) = e^{\beta_0} \bullet e^{\beta_1 x_1} \bullet e^{\beta_2 x_2} \bullet \ldots \bullet e^{\beta_n x_n} \quad \text{(Model 2)}$$

Taking the natural logarithm of both sides results in the following equivalent equation:

$$\ln [E(y)] = \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n \quad \text{(Model 2)}$$

The natural logarithm of the left hand side (original dependent variable) is taken creating a new variable which is entered as the dependent variable. Model 2 is entered into the regression software packages in the same manner as the linear model. The natural log-linear model described above is most appropriate in cases where the dependent variable **y** increases or decreases by a percentage (factor), instead of by a fixed amount, as **x** increases.[14]

The software regression analysis tools calculate a number of statistics for each regression "run" including four statistics for each variable which are referred to in this thesis; the beta coefficients, *t* statistics, and the adjusted multiple coefficient of determination (adjusted R^2). As more variables are added to a regression model

[14] Intro to Statistics, pg. 557.

the coefficient of determination (R^2) will increase even if the variables added are not significant and do not contribute to the descriptive ability of the model. The adjusted R^2, a statistic which adjusts for the number of variables in the model, is used.

III Variables Created for Regression Models

The standard variables entered in the regression are referred to as interval variables. Variables which take on values of only 1 or 0 are referred to as non-interval or dummy variables. In this thesis all dummy variables are prefaced with a D; for example DDEV standing for dummy development variable.

$PERACRE - This variable is the difference between PRICE$ and BLDG$ divided by SIZE.

L$PRACRE - This is the natural log of the variable $PERACRE.

SIZEACRE - Simply the size of the property in acres.

WST% - This variable is the waste acres (SIZE less ACRE) divided by SIZE. The average value of this variable is 9.1%.

DCL2, DCL3, DCL4 - These are equal to 1 if the value in their respective Capability Class CL2, CL3, and CL4 is greater than 0.75.

DTILE - This is equal to 1 if TILE is equal to 1.

DCROP - This is equal to 0 when the primary crop CROP1 is 181 (Alfalfa) and the secondary crop CROP2 (Sugar Beets) is 132 *or* if CROP1 is equal to 33 (Field Crops). These common numbers appear to have been the default crop description used by the appraisers. DCROP is equal to 1 for any crops other than the default crops.

DDEV - This is a locational variable equal to 1 if METR is less than 3 (miles) *and* the metro area variable AREA is equal to BRA, IMP, or ELC.

DDEV2 - This is another locational dummy variable which is equal to 1 if METR is less than 2 (miles) *and* the metro area variable AREA is equal to BRA, IMP, ELC, HOL, CLX, or CAL.

DURB - This is a third locational dummy variable which is equal to 1 if the Township and Range (TWNS, RNGE) variables equal any of the following pairs:

FIGURE 4-1
DURB Township and Range

T	R	T	R	T	R	T	R
12	14	14	14	15	15	17	14
13	13	15	13	16	13	17	15
13	14	15	14	16	14		

These Township and Range pairs cover those areas designated in the Imperial County General plan for development which include the metro areas of Brawley (BRA), Imperial (IMP), El Centro (ELC), Holtville (HOL), Calexico (CLX), and Calipatria (CAL).

FIGURE 4-3
DZONE Township and Range

ZONE 1		ZONE 2		ZONE 3		ZONE 4		ZONE 4		ZONE 5	
T	R	T	R	T	R	T	R	T	R	T	R
11	11	14	11	16	11			12	15	15	15
12	11	14	12	16	12	10	12	12	16	15	16
12	12	14	13	16	13	10	13	13	15	15	17
13	11	14	14	16	14	10	14	13	16	16	15
13	12	15	11	17	11			13	17	16	16
13	13	15	12	17	12	11	12	14	15	16	17
13	14	15	13	17	13	11	13	14	16	17	15
		15	14	17	14	11	14	14	17	17	16
						11	15			17	17
						12	13				
						12	14				

DZ1, DZ2, DZ3, DZ4, DZ5 - These are dummy variables created from the TWNS and RNGE variables. The variables are equal to 1 if the Township and Range pairs fall within the respective zone categories listed in the Figure 4-3 below. Figure 4-4 highlights the zones.

Figure 4-2

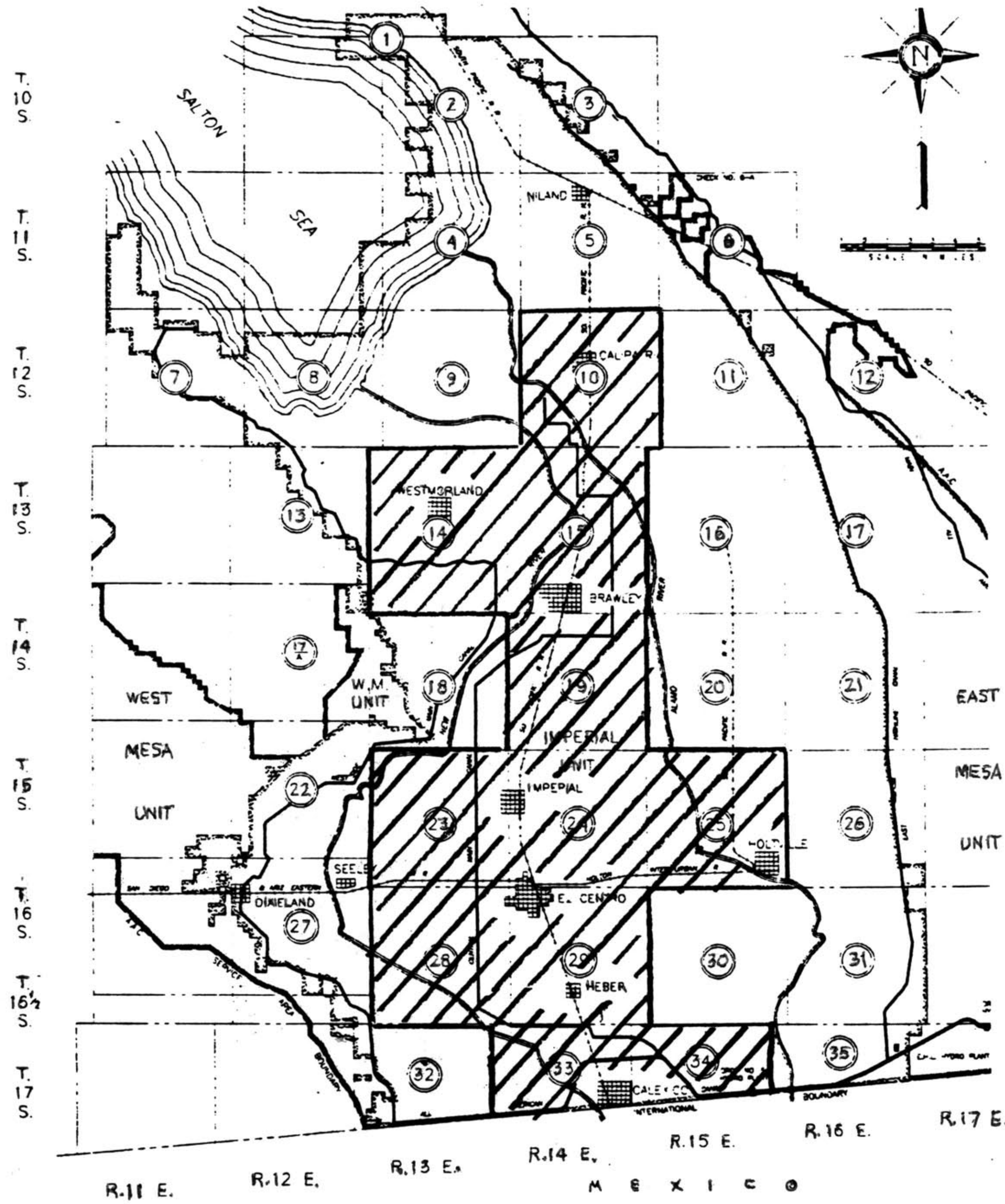
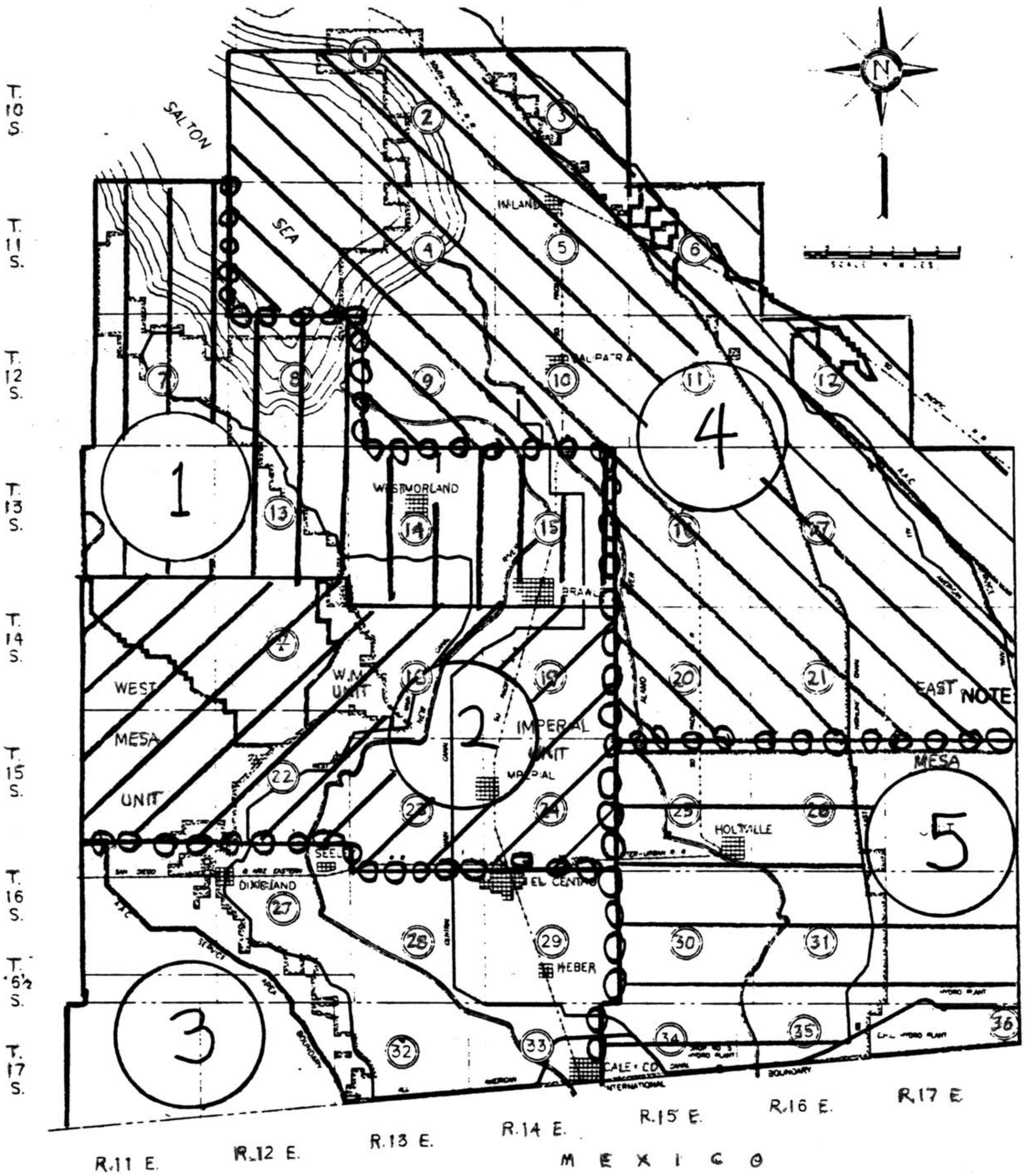

SALTON
SEA
NILAND
WESTMORLAND
BRAWLEY
WEST
MESA
UNIT
W.M.
UNIT
IMPERIAL
UNIT
IMPERIAL
EAST
MESA
UNIT
SEELEY
DIXIELAND
EL CENTRO
HEBER
CALEXICO
INTERNATIONAL
BOUNDARY
T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
T. 14 S.
T. 15 S.
T. 16 S.
T. 16½ S.
T. 17 S.
R.11 E.
R.12 E.
R.13 E.
R.14 E.
R.15 E.
R.16 E.
R.17 E.
M E X I C O
N

Figure 4-4



T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
T. 14 S.
T. 15 S.
T. 16 S.
T. 16½ S.
T. 17 S.
SALTON
SEA
INLAND
CALIPATRIA
WESTMORLAND
BRAWLEY
WEST MESA UNIT
W.M. UNIT
IMPERIAL UNIT
IMPERIAL
EAST MESA
NOTE
HOLTVILLE
SEELEY
DIXIELAND
EL CENTRO
HEBER
CALEXICO
INTERNATIONAL
BOUNDARY
R.11 E.
R.12 E.
R.13 E.
R.14 E.
R.15 E.
R.16 E.
R.17 E.
MEXICO
N
1
2
3
4
5

D84, D85, D85, D87, D88, D89, D90, D91, D92, D93 - These are equal to 1 if YR equals 84 for D84, YR equals 85 for D85, etc.

DCH - This dummy variable is equal to 1 if the variable CHWY is equal to 0 (in other words equal to 1 if the property is located adjacent to a County highway) and equal to zero otherwise.

DMH - This dummy variable is equal to 1 if the variable MHWY is equal to 0 (in other words equal to 1 if the property is located adjacent to a state or interstate highway) and equal to zero otherwise.

DZONE - This dummy variable is equal to 1 of the zoning code was equal to A3, heavy agriculture.

Figure 4-5 is an Excel spreadsheet with sample regression input variables.

REGRESSION VARIABLE INPUT

MODEL 1	MODEL2	INDEP VAR. = = >				SOIL TYPES						ZONES							YEARS				
$PERACRE	L$PRACRE	SIZEACRE	WST%	CHWY	DCL2	DCL3	DCL4	DTILE	DCROP	DDEV	DZ2	DZ3	DZ4	DZ5	D85	D86	D87	D88	D89	D90	D91	D92	D93
2,872	7.9629	56.4	0.04	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,813	7.9418	800.0	0.10	0.50	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2,200	7.6962	180.0	0.09	-	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1,977	7.5892	86.0	0.14	2.50	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,000	8.0064	80.0	0.06	-	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,250	8.0864	119.0	0.05	0.50	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
3,488	8.1571	80.0	0.04	3.50	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,441	8.1434	79.0	0.05	3.00	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2,500	7.8240	40.0	0.08	2.00	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3,465	8.1505	125.5	0.04	3.50	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,100	8.0392	160.0	0.06	2.00	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
3,935	8.2775	420.0	0.07	-	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
3,383	8.1264	81.0	0.06	0.50	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
610	6.4135	200.0	0.05	2.00	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
3,600	8.1887	240.0	0.05	-	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
3,109	8.0422	320.0	0.25	1.00	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3,296	8.1004	98.0	0.10	1.00	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2,200	7.6962	80.0	0.08	0.50	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
3,231	8.0806	160.0	0.06	-	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2,182	7.6879	275.0	0.16	6.00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2,700	7.9009	80.0	0.05	4.00	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,000	8.0064	80.0	0.08	1.50	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,666	8.2069	783.0	0.04	-	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2,467	7.8106	15.0	0.27	0.50	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2,800	7.9374	80.0	0.05	-	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
3,525	8.1675	163.0	0.02	-	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2,759	7.9225	145.0	0.06	1.00	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,249	8.0860	112.9	0.04	1.00	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2,949	7.9891	39.0	0.15	1.00	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
3,333	8.1117	390.0	0.06	0.50	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
3,250	8.0864	160.0	0.11	-	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3,330	8.1108	560.0	0.08	-	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2,482	7.8168	1,073.0	0.05	-	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0
3,720	8.2213	82.0	0.09	1.50	0	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0

Figure 4-5

IV Model Output

Both the linear (Model 1) and the natural logarithm-linear (Model 2) regression models were tried. Initial runs on Excel did not include the year dummy variables. These models had adjusted R^2 values of approximately 39%. Regression outputs are shown in Figures 4-7 and 4-8.

For the final regression runs the time dummy variables were added to the Excel spreadsheet and then imported into SPSS. The final version of Model 1 had an adjusted R^2 (adjusted multiple coefficient of determination) of 51.1%, and Model 2 had an adjusted R^2 of 49.9%. The higher the adjusted R^2 the better the model is at predicting the price per acre. The addition of the time dummy variables added nearly 12% to the explanatory ability of the models. Only Model 1 results are discussed in the remaining chapters because the use of standard dollar units is more intuitive than natural log exponents and both models offer similar descriptive ability.

A two-tailed 95% confidence interval (confidence coefficient) was used for all regression runs. The *t* statistics are calculated for each independent variable and a variable is considered statistically significant if the t statistic for that variable is close to or greater than 2.0 or close to or less than -2.0, a widely accepted rule-of-thumb for significance at the .05 level (1 - 0.95).

For complete regression results of both models see Figure 4-9, Summary Regression Output.

CORRELATION TABLE

	SIZEACRE	WST%	CHWY	DCL2	DCL3	DCL4	DTILE	DCROP	DDEV	DZ2	DZ3	DZ4	DZ5	DZ5
SIZEACRE	1.0000													
WST%	0.0193	1.0000												
CHWY	0.0397	0.0133	1.0000											
DCL2	(0.0472)	(0.0861)	0.0894	1.0000										
DCL3	0.0020	0.0456	(0.0794)	(0.2364)	1.0000									
DCL4	(0.0688)	(0.0194)	0.0185	(0.1069)	(0.2517)	1.0000								
DTILE	(0.1115)	(0.0661)	0.1039	0.0457	(0.0412)	(0.0332)	1.0000							
DCROP	0.0196	(0.0377)	0.1376	(0.0717)	0.0105	0.2130	(0.0279)	1.0000						
DDEV	(0.0624)	(0.0765)	(0.0864)	(0.0003)	0.1438	(0.0997)	(0.0943)	(0.1441)	1.0000					
DZ2	(0.0252)	0.1127	(0.0836)	(0.0513)	0.0614	0.0278	(0.0523)	(0.0853)	0.2429	1.0000				
DZ3	(0.0108)	(0.0389)	(0.0712)	(0.0145)	0.0284	(0.0912)	(0.1485)	(0.1319)	0.1034	(0.2502)	1.0000			
DZ4	0.0658	(0.1004)	0.2360	(0.1344)	(0.0183)	0.1840	0.0850	0.3302	(0.2015)	(0.3223)	(0.3612)	1.0000		
DZ5	(0.0251)	0.0216	(0.1138)	0.0575	(0.0164)	(0.1216)	0.0697	(0.1586)	(0.0988)	(0.2150)	(0.2409)	(0.3104)	1.0000	
DZ5	0.3086	(0.0251)	0.0216	(0.1138)	0.0575	(0.0164)	(0.1216)	0.0697	(0.1586)	(0.0988)	(0.2150)	(0.2409)	(0.3104)	1.0000

Figure 4-6

SUMMARY REGRESSION OUTPUT (EXCEL 5.0)

MODEL 1

DEPENDENT VARIABLE: $PERACRE

Regression Statistics	
Multiple R	0.6499
R Square	0.4224
Adjusted R Square	0.3935
Standard Error	748.5689
Observations	274.0000

ANOVA

	df	SS	MS	F	Significance F
Regression	13	1.07E+08	8.20E+06	1.46E+01	1.60E-24
Residual	260	1.46E+08	5.60E+05		
Total	273	2.52E+08			

	Coefficients	tandard Error	t Stat	P-value	Lower 95%
Intercept	2565.4230	183.8957	13.9504	0.0000	2203.3087
SIZEACRE	-0.2154	0.2006	-1.0741	0.2838	-0.6103
WST%	-1996.3691	728.4291	-2.7406	0.0066	-3430.7399
CHWY	-78.5269	34.0651	-2.3052	0.0219	-145.6055
DCL2	520.6455	170.1559	3.0598	0.0024	185.5867
DCL3	-339.1370	102.7979	-3.2991	0.0011	-541.5594
DCL4	-542.4378	163.4755	-3.3182	0.0010	-864.3421
DTILE	234.3464	99.5159	2.3549	0.0193	38.3868
DCROP	-344.8217	112.3893	-3.0681	0.0024	-566.1307
DDEV	498.2055	179.4125	2.7769	0.0059	144.9191
DZ2	-342.9521	178.7847	-1.9182	0.0562	-695.0022
DZ3	332.1264	172.0888	1.9300	0.0547	-6.7386
DZ4	-273.8740	167.7848	-1.6323	0.1038	-604.2640
DZ5	586.1295	177.6125	3.3000	0.0011	236.3877

Figure 4-7

SUMMARY REGRESSION OUTPUT (EXCEL 5.0)

MODEL 2

DEPENDENT VARIABLE: L$PRACRE

Regression Statistics	
Multiple R	0.6512
R Square	0.4241
Adjusted R Square	**0.3953**
Standard Error	0.4310
Observations	274.0000

ANOVA

	df	SS	MS	F	Significance F
Regression	13	35.5521	2.7348	14.7253	1.1277E-24
Residual	260	48.2871	0.1857		
Total	273	83.8391			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	7.8395	0.1059	74.0491	0.0000	7.6310
SIZEACRE	-0.0001	0.0001	-1.2793	0.2019	-0.0004
WST%	-0.9888	0.4194	-2.3578	0.0191	-1.8145
CHWY	-0.0429	0.0196	-2.1856	0.0297	-0.0815
DCL2	0.2371	0.0980	2.4207	0.0162	0.0442
DCL3	-0.1601	0.0592	-2.7054	0.0073	-0.2766
DCL4	-0.3360	0.0941	-3.5700	0.0004	-0.5213
DTILE	0.1161	0.0573	2.0261	0.0438	0.0033
DCROP	-0.2888	0.0647	-4.4638	0.0000	-0.4162
DDEV	0.2504	0.1033	2.4240	0.0160	0.0470
DZ2	-0.2298	0.1029	-2.2328	0.0264	-0.4325
DZ3	0.1474	0.0991	1.4882	0.1379	-0.0476
DZ4	-0.2013	0.0966	-2.0837	0.0382	-0.3915
DZ5	0.2553	0.1023	2.4972	0.0131	0.0540

Figure 4-8

SUMMARY REGRESSION OUTPUT (SPSS)

MODEL 1
Dependent Variable PERACRE

Multiple R	0.7418
R Square	0.5503
Adjusted R Square	**0.5109**
Standard Error	672.2731

Analysis of Variance (ANOVA)

	df	SS	MS
Regressio	22	138,806,732	6,309,397
Residual	251	113,439,728	451,951
Total	273	252,246,460	
F	13.96		
Signific. F	-		

Variable	B	%EFFECT/UNIT*	SE B	T stat
(Constant)	3,411.98		205.58	16.5960
SIZEACRE	-0.22	0.0%	0.18	-1.2220
WSTPRCT	-1,647.14	-48.3%	677.12	-2.4330
CHWY	-67.56	-2.0%	31.25	-2.1620
DCL2	518.41	15.2%	157.26	3.2970
DCL3	-223.50	-6.6%	97.55	-2.2910
DCL4	-483.81	-14.2%	152.48	-3.1730
DTILE	187.47	5.5%	91.53	2.0480
DCROP	-525.60	-15.4%	112.88	-4.6560
DDEV	367.81	10.8%	169.86	2.1650
DZ2	-402.52	-11.8%	164.76	-2.4430
DZ3	344.36	10.1%	158.30	2.1750
DZ4	-295.74	-8.7%	153.88	-1.9220
DZ5	392.42	11.5%	165.05	2.3780
D85	-479.09	-14.0%	187.88	-2.5500
D86	-662.23	-19.4%	191.47	-3.4590
D87	-1,353.64	-39.7%	207.79	-6.5150
D88	-973.12	-28.5%	168.20	-5.7860
D89	-1,021.93	-30.0%	176.04	-5.8050
D90	-1,045.82	-30.7%	168.19	-6.2180
D91	-793.96	-23.3%	195.96	-4.0520
D92	-1,123.56	-32.9%	223.02	-5.0380
D93	-957.17	-28.1%	209.47	-4.5690

* - Additive effect on constant

MODEL 2
Dependent Variable LPRACRE

Multiple R	0.7343
R Square	0.5392
Adjusted R Square	**0.4988**
Standard Error	0.3923

Analysis of Variance (ANOVA)

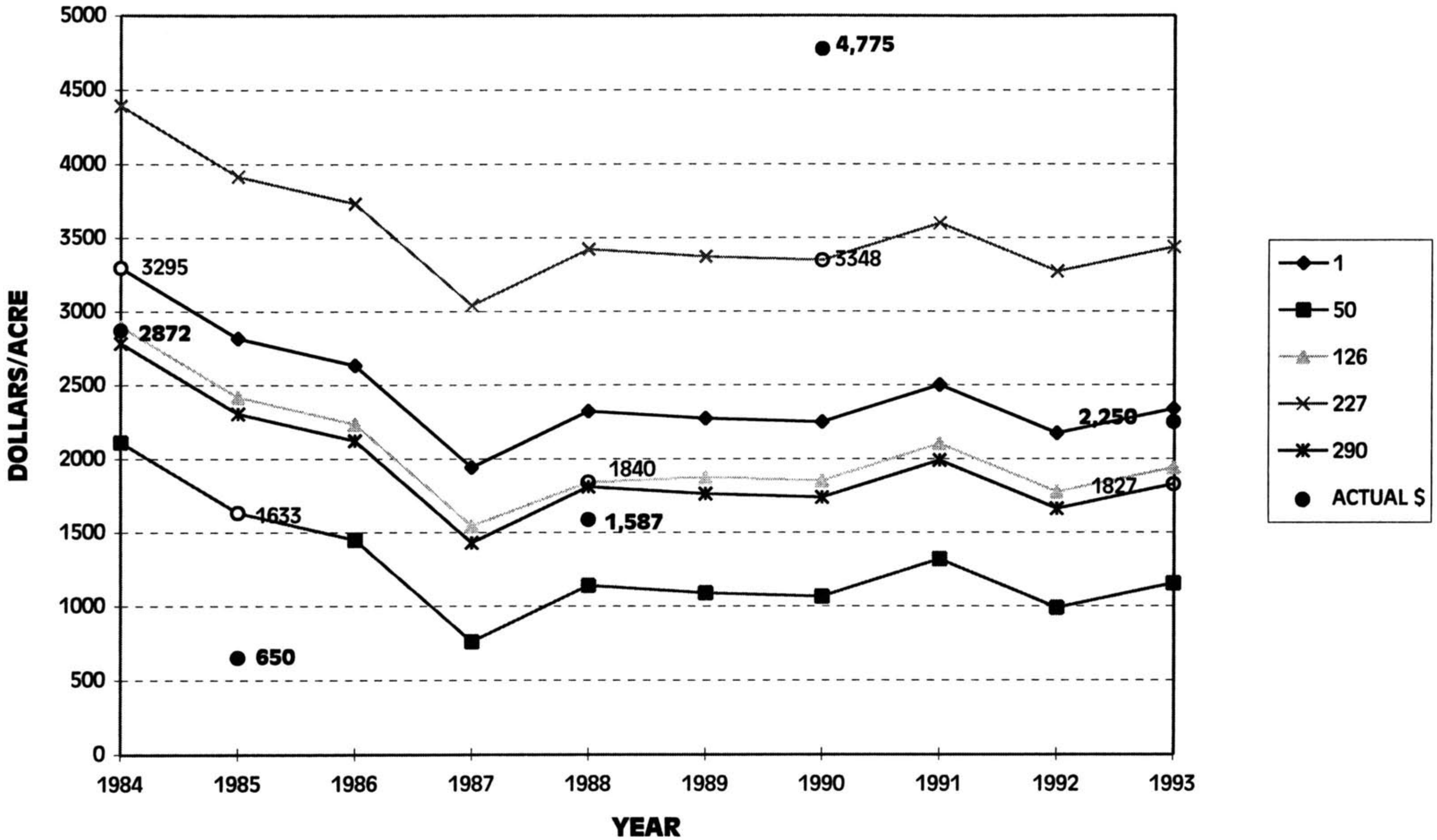
	df	SS	MS
Regression	22	45.21	2.055
Residual	251	38.63	0.154
Total	273	83.84	
F	13.35		
Signific. F	-		

Variable	B	%EFFECT/UNIT**	SE B	T stat
(Constant)	8.3206		0.1200	69.3550
SIZEACRE	-0.0001	0.0%	1.07E-04	-1.3020
WSTPRCT	-0.8044	-55.3%	0.3951	-2.0360
CHWY	-0.0385	-3.8%	0.0182	-2.1140
DCL2	0.2429	27.5%	0.0918	2.6470
DCL3	-0.0917	-8.8%	0.0569	-1.6100
DCL4	-0.2855	-24.8%	0.0890	-3.2080
DTILE	0.0956	10.0%	0.0534	1.7890
DCROP	-0.4075	-33.5%	0.0659	-6.1860
DDEV	0.1670	18.2%	0.0991	1.6850
DZ2	-0.2695	-23.6%	0.0961	-2.8030
DZ3	0.1464	15.8%	0.0924	1.5840
DZ4	-0.2193	-19.7%	0.0898	-2.4420
DZ5	0.1389	14.9%	0.0963	1.4420
D85	-0.2687	-23.6%	0.1096	-2.4510
D86	-0.3593	-30.2%	0.1117	-3.2150
D87	-0.7329	-52.0%	0.1213	-6.0450
D88	-0.5653	-43.2%	0.0982	-5.7590
D89	-0.5472	-42.1%	0.1027	-5.3270
D90	-0.5526	-42.5%	0.0981	-5.6300
D91	-0.5326	-41.3%	0.1144	-4.6570
D92	-0.6501	-47.8%	0.1301	-4.9950
D93	-0.5080	-39.8%	0.1222	-4.1560

** - Multiplicative effect on constant

Figure 4-9

MODEL PREDICTED PRICE/ACRE FOR FIVE PROPERTY SALES TRANSACTIONS



Prices shown are **Actual** and Predicted; **Actual** prices are marked in the year sold.

Figure 4-10

CHAPTER FIVE

Agricultural Variable Analysis

I Soils

The majority of the soil types in the irrigated portion of the Valley fall into the Capability Classes II, III, and IV. Figure 3-2 shows that Class I soils make up less than three percent of the soils in the Valley. For each property transaction the percentage of each soil type was recorded in the variables CL1, CL2, CL3, or CL4. By definition these four variables add to 1.00. Because there were very few observations of properties with Class I soils, and because including all four soil variables in a regression would lead to multicollinearity problems, only CL2, CL3, and CL4 were included in trial regression models.

During the model building phase the initial regression runs indicated that the soil type variables were not statistically significant without some modification. The variables DCL2, DCL3, DCL4 were created with the idea that buyers might evaluate the property soil types by considering the percentage makeup of the Capability Classes. DCL2, DCL3, DCL4 were statistically significant.

Model 1 calculated beta coefficients (additive effects) for DCL2 = +518.41, DCL3 = -223.50, and DCL4 = -483.81. One interpretation of these results is, holding everything else constant, that the predicted price for a property with 75% or more Class II soil types versus a property with 75% or more Class III is +741.91. In short buyers were willing to pay significantly more for properties composed of a majority of the more productive soils as expected.

II Crops

Agricultural production dollar values from 1983 to 1992 are summarized by commodity type in Figure 5-1. Figure 5-2 shows percentage breakdowns of 1992 gross agricultural production value into commodity types with a further breakdown within field crop production.

The original thesis plan was to run regressions with the major crop types as variables. During the data entry process it became apparent from the sales transaction records that nearly 75% of the observations were for alfalfa and sugar beets (primary and secondary crops) or field crops. Figure 5-2 shows that alfalfa and sugar beet crops made up 60.9 percent of the Imperial Valley

VALUE OF AGRICULTURE FROM IMPERIAL VALLEY

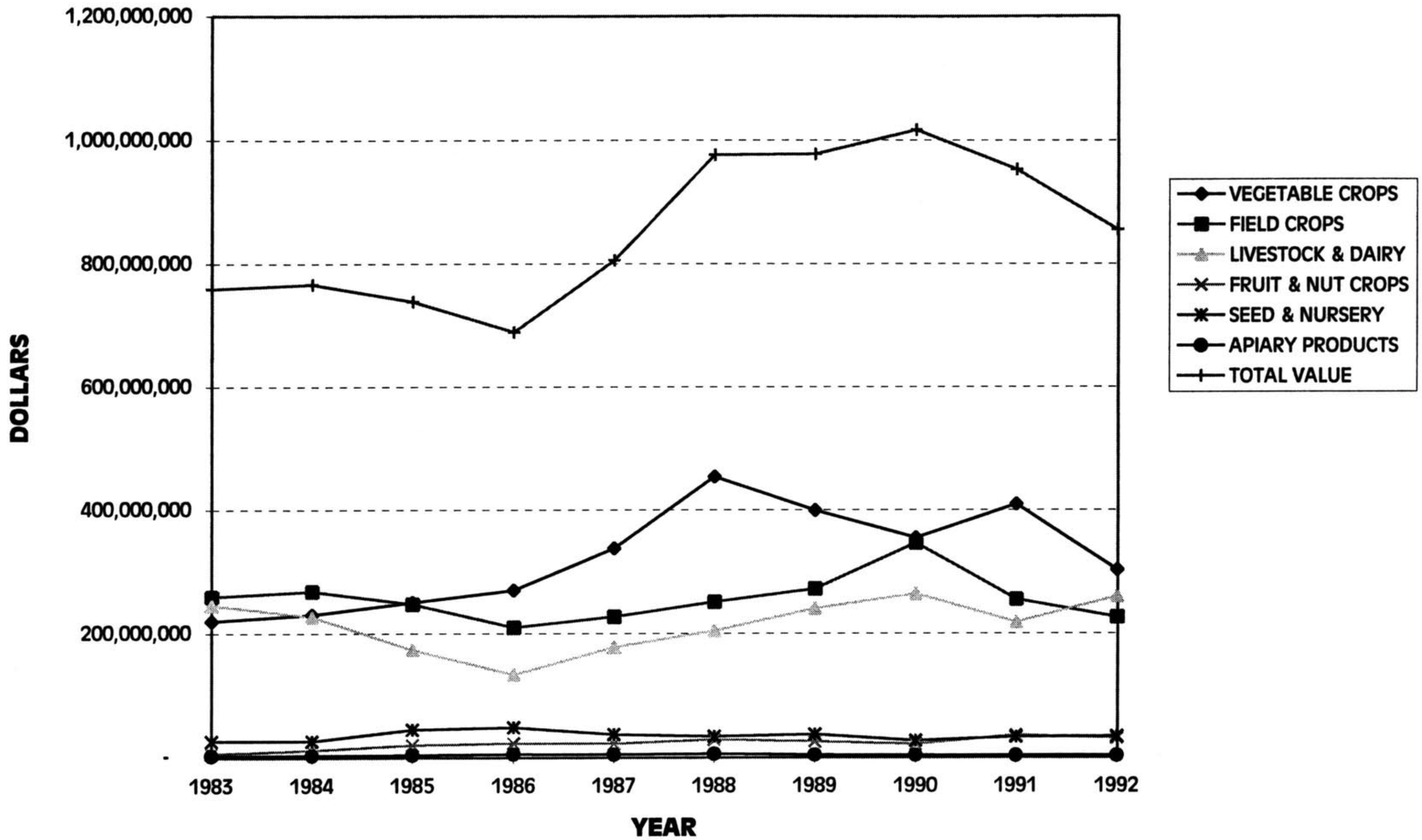
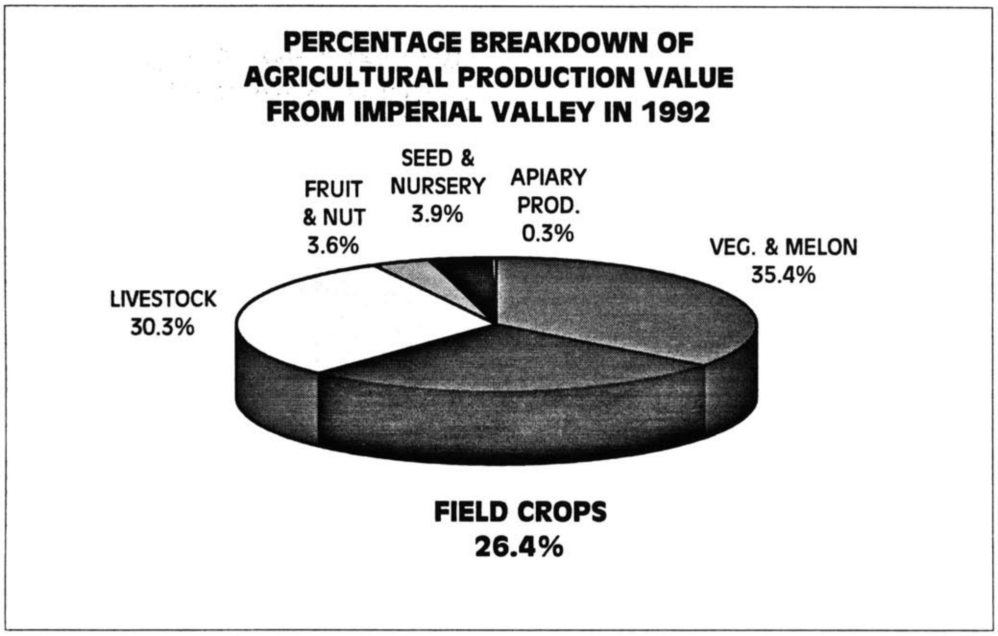
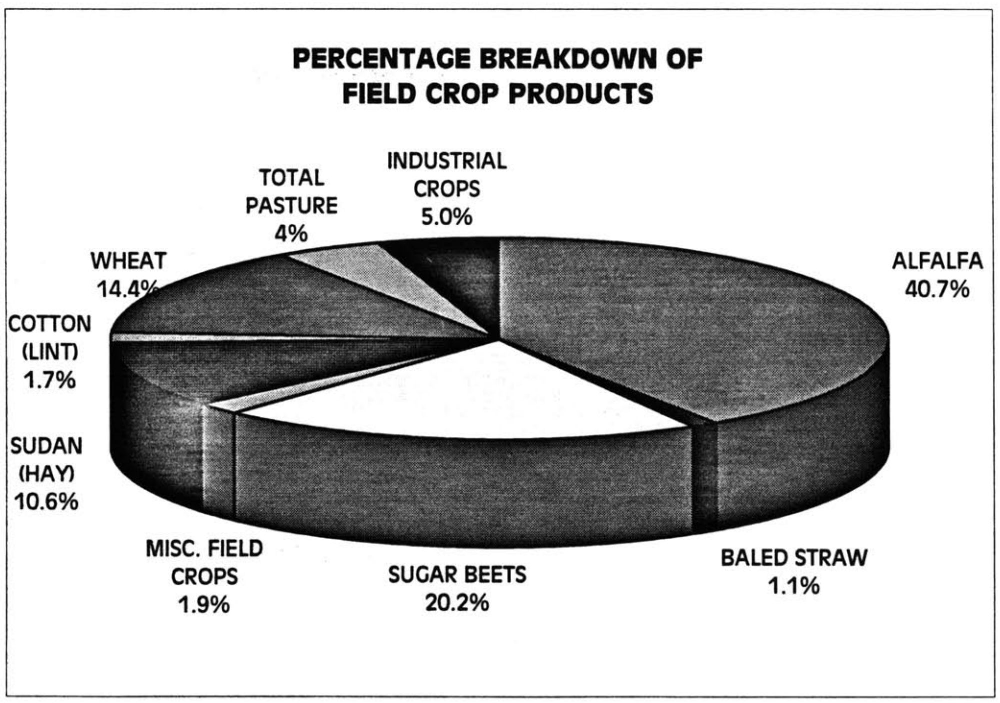


Figure 5-1

Figure 5-2


PERCENTAGE BREAKDOWN OF
AGRICULTURAL PRODUCTION VALUE
FROM IMPERIAL VALLEY IN 1992
SEED & NURSERY 3.9%
FRUIT & NUT 3.6%
APIARY PROD. 0.3%
VEG. & MELON 35.4%
LIVESTOCK 30.3%
FIELD CROPS 26.4%


PERCENTAGE BREAKDOWN OF
FIELD CROP PRODUCTS
TOTAL PASTURE 4%
INDUSTRIAL CROPS 5.0%
WHEAT 14.4%
ALFALFA 40.7%
COTTON (LINT) 1.7%
SUDAN (HAY) 10.6%
MISC. FIELD CROPS 1.9%
SUGAR BEETS 20.2%
BALED STRAW 1.1%

agricultural production value for 1992. The acreage reported under cultivation in 1992 was 190,262 for Alfalfa and 39,307 for Sugar Beets.[15] Together this accounts for 229,569 acres, more than half of the 489,000 acres under cultivation.

It is likely that a majority of the sales transactions were for properties which had been producing alfalfa and sugar beets as recorded on the transaction reports. However it appears that these descriptions became more of a default description of crops. Many of the later sales transaction reports started recording field crops (33) as the crop type.

It is interesting to note that very few of the recorded transaction codes recorded the sale of a property producing melons or lettuce, crops with a higher potential profits per acre than alfalfa or sugar beets (given the proper soil types and conditions). This may indicate that the properties which are successful with high profit crops are less likely to change hands, an idea which makes intuitive sense.

The variable DCROP captured a pricing difference when the crop recorded by the appraiser on the sales transaction report was other

[15] The Imperial County Agricultural Crop and Livestock Report for 1992, pg. 3.

than a standard or default crop description. The Model 1 regression calculated DCROP as significant with a negative beta coefficient of -525.60. There are 70 observations out of 274 transactions with DCROP equal to 1.

One explanation for the negative coefficient of DCROP is that buyers pay less for properties which had been producing crops other than alfalfa, sugar beets, melons, or other vegetables like lettuce. These "other" crops would likely have lower average profits per acre.

The appraisers interviewed mentioned crop type as another consideration when evaluating a property. Areas within the Valley are known for good production of certain crops as discussed in Chapter Six, Section IV. Buyers will pay more for a property which is known for successful crop production. Mr. Turner was quick to point out that an evaluation of the property should not include property value calculations based on the previous owner's crop production. This is done to avoid biasing an appraisal by the previous property management and farming practices as they impacted crop production.

II Drainage / Tiling

The Imperial Valley receives its irrigation waters from the Colorado River which is highly saline, carrying as much as 2,000 pounds of salts per acre-foot of water. Drainage is critical to productive farming in the Imperial Valley:

> Leaching--applying sufficient amounts of irrigation water to flush salts out of the soil--is essentially preventing salts from accumulating and affecting crop production. The water not used by the plants passes through the root zone, carrying away the dissolved salts with it.[16]

Approximately 90 percent of the irrigated acreage in the Valley has been tiled according to the tables in *the USDA Soil Conservation Service Soil Survey*. Tiling is a term describing a gravity-fed drainage network of rows of perforated plastic tubing. The field rows are connected to main drain tubes which discharge the excess irrigation water into drainage ditches or into sumps which are pumped into drainage ditches. The drainage tubes are buried between four and eight feet deep in the soil. Drainage tubing is installed by specialized trench tiling machines which dig the trench, install the tube in a sand-gravel envelope, and fill the trench in a single step. During installation the trench depth is automatically controlled using a laser leveling system.

---

[16] Layperson's Guide to Agricultural Drainage, pg. 5.

The USDA Soil Conservation Service has recommendations for tiling spacing, size, and depth for each soil type and configuration. Nearly all property owners follow these guidelines for proper functioning drainage. Mr. Turner and Mr. Erickson related rules-of-thumb for the spacing of tiling drainage lines as shown in Figure 5-3 below.

FIGURE 5-3
Tiling Spacing Requirements

Drainage Quality	Permeability (inches/hour)	Spacing Distance
Very Slow	2	< 44′
Slow	3	44′-80′
Mod. Slow	4	80′-138′
Moderate	5	138′-250′
Mod Rapid	6	250′-440′

Figure 5-4 shows an estimate of tiling costs for a standard installation design (leveled, rectangular field). Mr. Erickson explained that because of the expense of tiling, farmers often "split-it-out." This means a property or field is tiled at spacings wider than recommended, for example at 150 feet instead of 75 feet. The up-front cost is reduced and the drainage may be improved enough for productive farming. The owner has the option of adding additional lines in-between the original lines at a later date if necessary.

FIGURE 5-4
Tiling Cost Estimates [17]

	8" Main & 3" Rows		8" Main & 4" Rows	
SPACING	**TILE**	**SURVEY**	**TILE**	**SURVEY**
50'	$772.32	$22.76	$823.80	$22.76
100'	$403.97	$13.74	$428.85	$13.74
150'	$298.46	$11.37	$315.74	$11.37

Tiling Code

The final regression run output, Model 1 shown in Figure 4-9, determined that property tiled at spacings less than 150 feet and/or properties tiled to SCS recommendations had predicted values $187.47 (DTILE beta coefficient), more per acre than a property without tiling (all other variables held constant). This amount is slightly more than half of the average installation cost estimate of $310 per acre for tiling at a 150' spacing. For properties requiring tiling at a 50' spacing the estimated costs were $847 per acre as shown in Figure 5-4.

Why was the tiling variable not more explanatory? Tiling drainage depreciates and deteriorates like any other hard asset. A large portion of the 441,944 acres of tiling in the Valley was installed

[17] Estimates from Lidco Inc. pricing sheet based on 160 acre (gross) lot. incl. survey costs.

prior to the 1960's when longer-lasting plastic tubing became the standard. The older clay drainage lines are not as reliable as the more recently installed plastic tubing and are likely to affect the valuation of the tiling. The tiling variable did not capture date of installation or type of construction distinctions.

The sales transaction reports also varied in the amount of information available on the tiling condition of the property. The data itself may not have been as accurate as possible. A more detailed study would have involved pulling all 274 of the property tiling records at the IID. The tiling type and condition on the date of the sale would have to be determined.

IV Other Variables

The variable WST%, the waste acres (SIZE less ACRE, divided by SIZE) was expected to have a negative effect on price per acre for the obvious reason that the higher the amount of wasted space the lower the amount of productive space for a given piece of property. The average value of WST% was 9.1% for all of the properties in the transaction data used for this thesis.

On larger properties the waste acre percentages on average were slightly lower. The reason is that access roads, storage areas, etc. take up a lesser percentage of the space, an economy of scale effect. However most properties are broken into parcels of 40, 60, or 80 acres for irrigation purposes; this helps to push the average wasted space percentage towards the 9.1% number mentioned earlier. Properties with odd shapes generally had a higher waste percentage number.

Model 1 calculated the WST% beta coefficient as -1647.14. A property with 10 percent waste acres versus a property with 15 percent waste acres (all other variables held constant) would have a predicted price difference of $82.36 per acre.

In general it is understood that price per acre for larger property transactions is lower than for smaller property transactions of similar property quality. The reasoning is that there were costs associated with subdividing and providing services to smaller properties when they were subdivided; those costs were reflected in the sales price. As expected, the variable SIZEACRE had a negative beta coefficient of -0.22/acre, but the t statistic was not quite significant and the coefficient impact on price per acre quite small.

DZONE was dummy variable attempt to determine if there was a price preference for the A3 zone classification. The *t* statistics were not significant so the variable was not included in the model.

CHAPTER SIX

Locational Variable Analysis

I Proximity to Highways

Access to a property was a factor considered by the appraisers interviewed for this thesis. CHWY was a measure in miles from the property to the nearest state, interstate, or Imperial County highway. The Model 1 regression found CHWY statistically significant with a beta of -67.56 per mile distance per acre transacted.

DCH is a dummy variable equal to 1 if the variable CHWY is equal to 0 (if the property is located adjacent to a highway). CHWY proved less statistically significant and was not used in the final model.

MHWY, a measure of the distance to the nearest state or interstate highway proved statistically insignificant so the variable DMH was created, a dummy variable equal to 1 if the property is located adjacent to a state or interstate highway. This also proved insignificant and was not included in the model.

The implications of these results are that location close to a state or interstate highway did not significantly affect the price per acre, but the proximity to a county highway infrastructure was significant. The beta coefficient for CHWY was negative, as expected: the farther a property from a county access road, the lower the predicted property sales price per acre.

II Proximity to Canals

CANAL, the distance to a major canal, did not have a statistically significant influence on the pricing models. CANAL was eliminated as an independent variable. Proximity to a canal is not a major factor to consider when purchasing a property because the IID owns the property on which the canals and laterals traverse the Valley. When irrigated property is purchased the IID is obligated to provide water to the operator for specified prices.

III Proximity to Metro Areas

The specific metro area a property was nearest was expected to influence property prices according to normal real estate economic principles: the larger the metro area and the greater the speed of its growth, the larger the expected zone of influence on surrounding farm property values [18]. Proximity to a metro area is also important for access to farm service firms, processing plants, etc. The variable METR, a measure of the distance to the nearest metro area by itself did not prove statistically significant. This can be explained because the distances were measured to the nearest of the 10 metro areas in the Valley; only larger and growing metro areas (El Centro, Calexico, Brawley, Imperial) have a far reaching urban influence on property prices.

The variable DDEV was created using information from the variables AREA and METR. It equaled 1 for properties located within three miles of Brawley, El Centro, or Imperial, growing cities centrally located in the Valley. DDEV was statistically significant with a Model 1 beta coefficient of +367.81. This means that the predicted sale price for properties located near these metro areas is $367.81/acre greater than the predicted price for a similar property not near these areas.

DDEV2 was also created from AREA and METR. It equaled 1 if the property transaction was within two miles of Brawley, Calexico, Calipatria, El Centro, Holtville, or Imperial. DDEV2 did not prove statistically significant.

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[18] *The Economics of Real Estate Markets*, Chapter 2.

DURB was another attempt to establish an urbanization influence using the Township and Range (TWNS, RNGE) variables shown in Figure 4-1. DURB proved statistically insignificant, most likely because of the measure imprecision from using the Township and Range variables. A single grid is approximately six miles by six miles; a property transaction recorded for that grid therefore has an accuracy of +/- 8.48 miles ($6 \times 2^{1/2}$).

IV Zones

I asked Mr. Turner to divide the Valley into zones which might have locational characteristics creating pricing differences between zones. The variables DZ1, DZ2, DZ3, DZ4, DZ5 equaled 1 if the Township and Range pairs fell within the categories listed in the Figure 4-3. To avoid problems with multicollinearity one of the five DZ variables was not used in the regression.

Zone 1 describes the area northwest of Brawley below the Salton Sea and is the default variable. The Model 1 beta coefficients predicted prices for properties outside of zone 1; properties outside of zone 1 were worth more or less than equivalent zone 1 properties by an amount equal to the beta coefficient.

Zone 2 (DZ2) which describes property to the northwest of El Centro and southwest of Brawley has a beta of -402.52 indicating a lower predicted value than a zone 1 property with the same characteristics. This is most likely related to the soil type makeup in that zone.

Zone 3 (DZ3) describes the area southwest of El Centro which is known for its crop productivity. The beta coefficient of +344.46 indicates its value above a property of similar characteristics in Zone 1.

Zone 4 (DZ4) describes the Niland area west of Brawley and the Salton Sea. This area is known for its poorer quality soil types and has a lower beta of -295.74.

Zone 5 (DZ5) West of El Centro and surrounding Holtville is known for good vegetable crop production and has a beta of +392.42.

The *t* statistics for the zone dummy variables were all significant and the beta coefficients large enough to indicate that the location of a property (independent of urban location) within the Valley exerted an influence on price per acre. While it is obvious that the location of a property determines the soil types, the results of the zone analysis indicate that buyers were conscious of the areas surrounding the property. Buyers were likely to pay more/less for areas known for better/poorer production.

CHAPTER SEVEN

Changes Over Time

I Time Dummy Variables

D84, D85, D85, D87, D88, D89, D90, D91, D92, D93 were created from the YR variable. All of the sales in the database took place in one of the years between 1984 and 1993. Again, to avoid problems with multicollinearity, one of the variables, D84 was eliminated from the regression run and used as the reference year. Addition of the time dummy variables to Model 1 increased the predictive ability of the model (adjusted R^2) from 39.4% to 51.1% (for Model 1), a dramatic 12% improvement indicating that the date of the sale had a very significant impact on the sales price per acre. The price effects for some years was as great as 30.7% (Model 1) different from the reference year. See Figure 4-9, the final regression output, for the beta coefficients and *t* statistics.

To gain a better understanding of why the year of sale had such a price impact the factors which affect property valuation over time must be reviewed.

II Local Agricultural Price Trends

Information on crop acreage, yields, and gross value of agricultural production in Imperial County is reported yearly in the "Imperial County Agriculture and Livestock Report", published by the County Agricultural Commissioner's Office. The County records the commodities sold by the unit (lb, cwt, bale, ctn, sack, unit, ton, or acre), the average price for commodity units during harvest, and the land area in acres used for each commodity.

To track the changes in agricultural prices over time a Local Agricultural Price Index, Figure 7-1, was created based on commodities sold from Imperial Valley. Field crops, vegetables and melons, and livestock, the three largest commodity groups, were chosen to represent the Valley's production. The prices of the commodities in each group were weighted by the percentage makeup of that commodity group. Then the unit prices of each commodity were multiplied by the percentage of its commodity gross dollar value within that commodity group. Figure 7-2 graphs the local agricultural index numbers over time. Note that there was a change in reporting method for certain crops beginning in 1989; adjustments were made to keep the agriculture index consistent.

LOCAL AGRICULTURAL PRICE INDEX

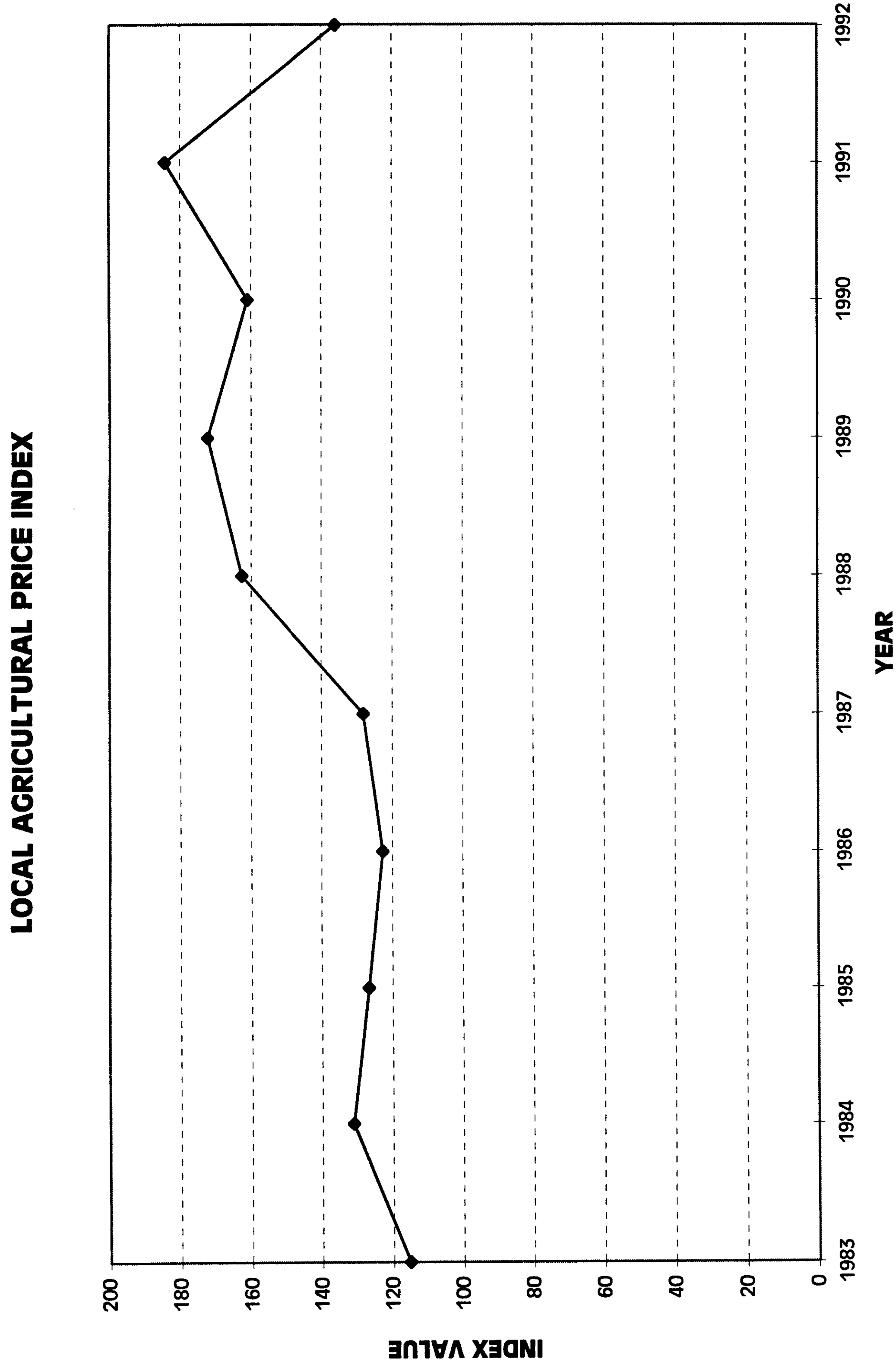
	% TOTAL	% GRP	%SGRP	WEIGHT	UNIT	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	COUNT	UNIT
FIELD CROPS	**26.4%**	28.7%															
ALFALFA	40.7%		47.4%	13.6%	TON	96.80	87.73	90.80	70.37	85.12	91.88	120.00	129.70	73.36	61.14		
SUDAN	10.6%		12.3%	3.5%	TON	70.00	70.00	65.00	67.85	70.00	90.00	85.00	101.83	87.50	69.00		
SUGAR BEETS	20.2%		23.5%	6.7%	TON	40.64	39.47	35.56	36.98	36.57	38.04	41.96	44.28	43.47	38.54		
WHEAT	14.4%		16.8%	4.8%	TON	140.00	130.00	122.00	115.00	109.00	140.00	126.00	122.00	150.00	154.00		
			100.0%														
LIVESTOCK	**30.3%**	32.9%															
CATTLE	86.4%		95.6%	31.4%	HEAD	63.63	65.52	59.21	56.20	65.76	70.11	73.61	77.15	72.74	72.54		
SHEEP	4.0%		4.4%	1.5%	HEAD	62.50	61.93	67.28	67.58	74.68	82.01	66.05	59.25	48.10	64.46		
			100.0%														
VEG. / MELON	**35.4%**	38.4%															
CANTALOUPE	10.4%		16.6%	6.4%	TON	320.87	429.62	265.67	258.00	274.95	373.01	197.60	341.60	389.60	200.40		TON
CARROTS	23.7%		37.8%	14.5%	TON	160.00	151.25	206.80	206.78	180.00	121.60	317.00	307.00	378.50	287.50		TON
LETTUCE	20.7%		33.0%	12.7%	TON	171.15	218.04	229.76	238.57	245.06	541.03	395.00	182.50	230.50	195.50		TON
ONIONS	7.9%		12.6%	4.8%	TON	78.00	192.49	166.00	149.59	203.26	89.42	232.50	336.00	587.00	250.50		TON
			100.0%														
CANTALOUPE											CHANGE IN	4.94	8.54	9.74	5.01	40	SACK/BAG
CARROTS											REPORTING	6.34	6.14	7.57	5.75	50	SACK/BAG
LETTUCE											METHOD	7.90	3.65	4.61	3.91	50	SACK/BAG
ONIONS												4.65	6.72	11.74	5.01	50	SACK/BAG
		100.0%		100.0%													

WEIGHTED INDEX VALUES

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
FIELD CROPS										
ALFALFA	13.15	11.91	12.33	9.56	11.56	12.48	16.30	17.62	9.96	8.30
SUDAN	2.48	2.48	2.30	2.40	2.48	3.18	3.01	3.60	3.10	2.44
SUGAR BEETS	2.74	2.66	2.40	2.49	2.47	2.56	2.83	2.98	2.93	2.60
WHEAT	6.73	6.25	5.86	5.53	5.24	6.73	6.05	5.86	7.21	7.40
LIVESTOCK										
CATTLE	20.01	20.60	18.62	17.67	20.68	22.04	23.15	24.26	22.87	22.81
SHEEP	0.91	0.90	0.98	0.98	1.09	1.19	0.96	0.86	0.70	0.94
VEG. / MELON										
CANTALOUPE	20.46	27.39	16.94	16.45	17.53	23.78	12.60	21.78	24.84	12.78
CARROTS	23.25	21.97	30.05	30.04	26.15	17.67	46.06	44.60	54.99	41.77
LETTUCE	21.72	27.67	29.16	30.27	31.10	68.65	50.12	23.16	29.25	24.81
ONIONS	3.78	9.32	8.04	7.24	9.84	4.33	11.26	16.27	28.43	12.13
INDEX	**115.21**	**131.16**	**126.66**	**122.64**	**128.12**	**162.62**	**172.33**	**161.00**	**184.28**	**135.98**

Figure 7-1

Figure 7-2


LOCAL AGRICULTURAL PRICE INDEX
INDEX VALUE
0
20
40
60
80
100
120
140
160
180
200
YEAR
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992

Crop Problems

The Imperial Valley experienced an infestation of whiteflies during 1991 and 1992 which caused widespread crop damage:

> In 1991, whitefly damage to Imperial Valley agriculture was estimated a $130 million in crop losses and caused the loss of thousands of jobs. Crop losses in Imperial county during 1992 were estimated at $100 million.[19]

The effects of the whitefly invasion are seen clearly in Figure 5-1 in the downward movement on the graph in years 1991 and 1992. Further comparison in Figures 7-3 and 7-4 shows that the pricing index remained rather constant confirming the loss in volume of commodity sold from the Valley.

Figures 7-3 and 7-4, Local Trend Comparison Graphs show the percentage change from year-to-year and percentage change from the base year, respectively. They were created from totals from the following figures: Figure 5-1, Value of Agriculture from Imperial Valley; Figure 5-1, Local Agricultural Price Index; Figure 7-12, Privately Owned Housing Starts Imperial County Totals; and in Figure 4-10, Model Predicted Price per Acre.

[19] Appraisal Report of Kristina Bryant Sones, pg. 4.

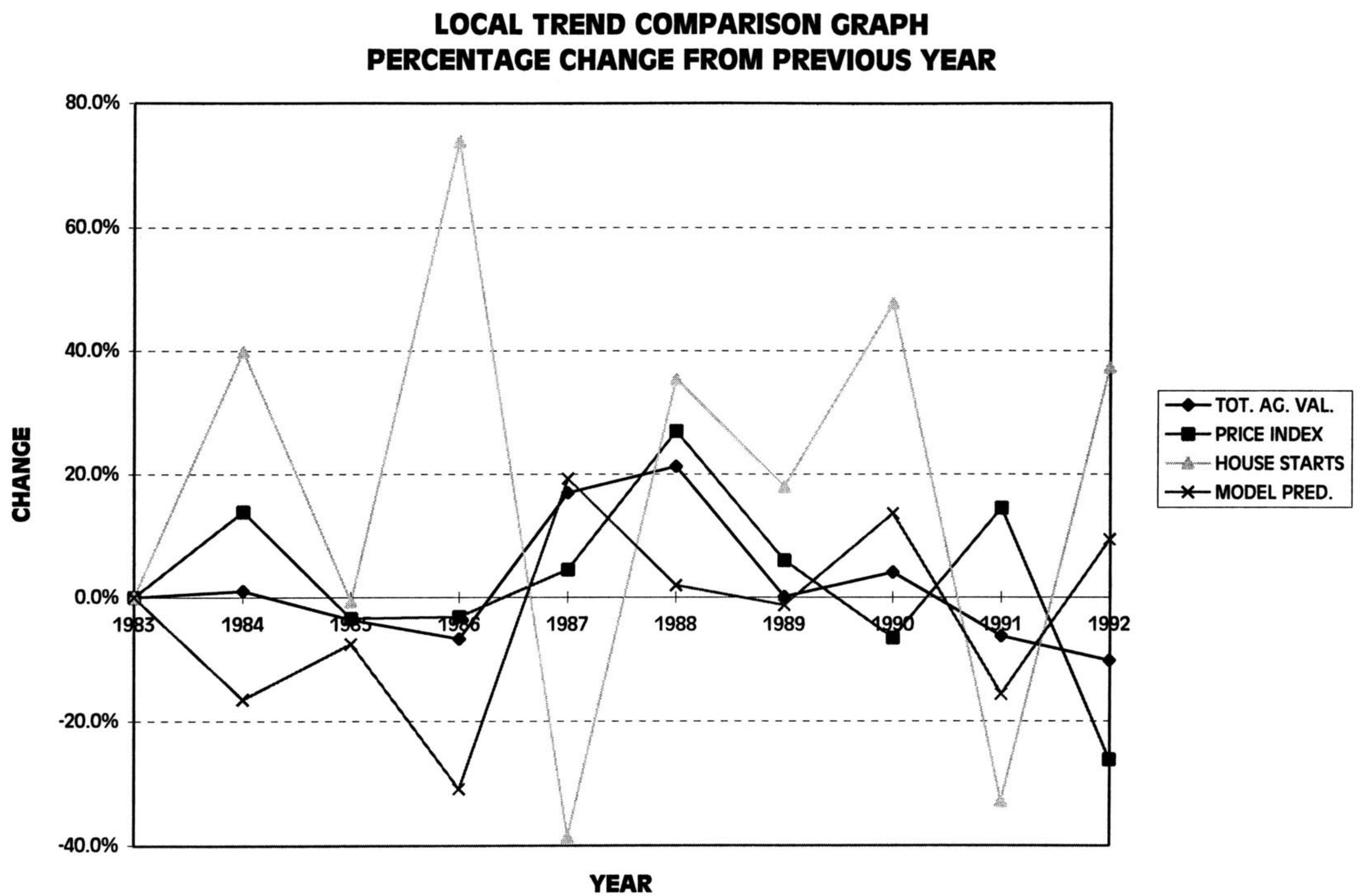

LOCAL TREND COMPARISON GRAPH
PERCENTAGE CHANGE FROM PREVIOUS YEAR
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
CHANGE
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
YEAR
TOT. AG. VAL.
PRICE INDEX
HOUSE STARTS
MODEL PRED.

Figure 7-3

LOCAL TREND COMPARISON GRAPH
PERCENTAGE CHANGE SINCE BASE YEAR 1983

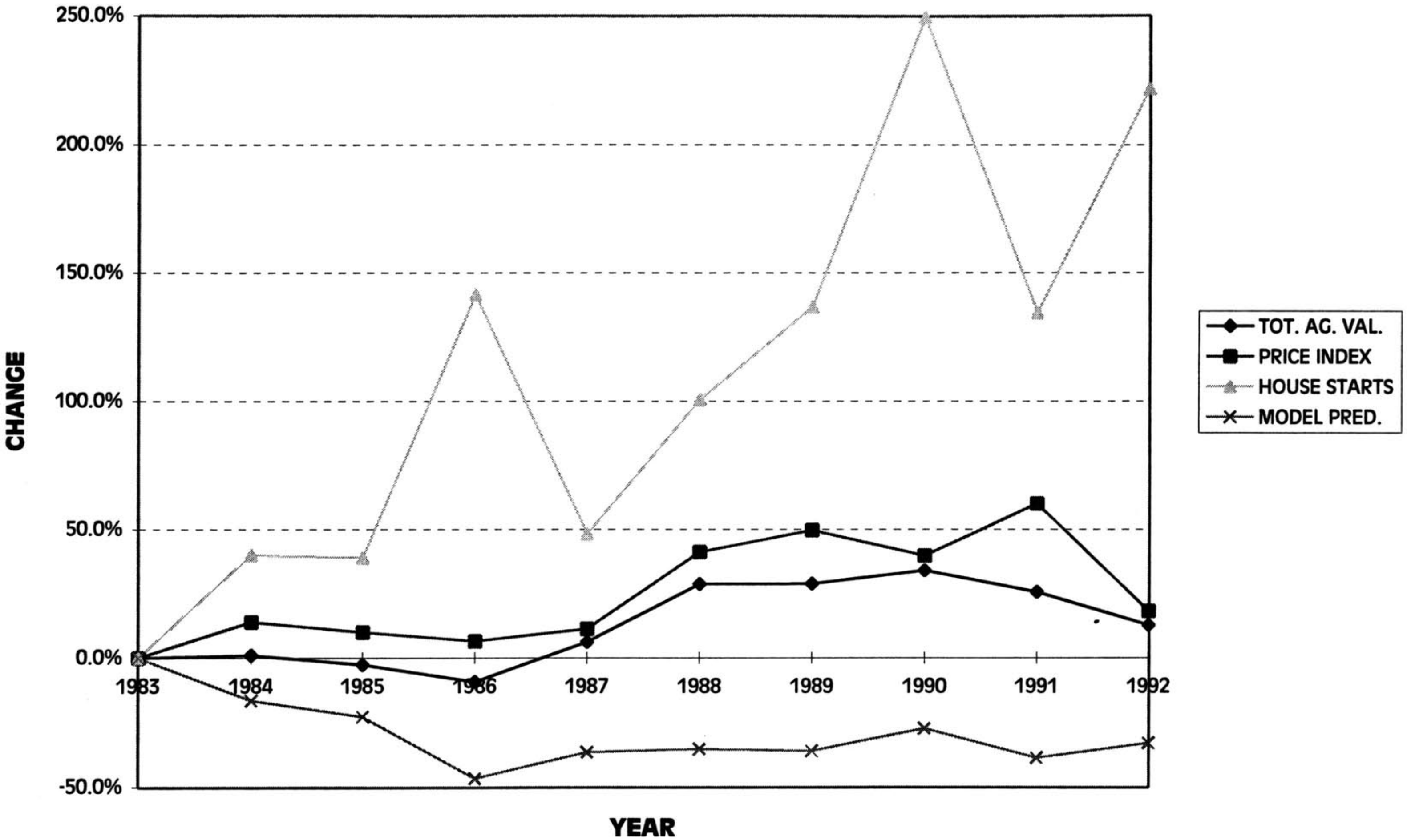


Figure 7-4

III National Agricultural Price Trends

The model predicted trend did not correlate closely with the local trends studied above. National agricultural statistics published in the 1992 USDA Agricultural Statistics proved more explanatory than local trend statistics in the movement of price per acre over the last decade. Figure 7-5 shows table 562 from the USDA Agricultural Statistics Annual 1992: Prices received by farmer: Index numbers by groups of commodities and parity ratio, United States. The Parity ratio and All farm products Index are graphed in Figures 7-6 and 7-7, National Trend Comparison Graphs. The Parity Ratio is a ratio of Index of Prices Received by farmers for crops to the Parity Index (the Parity Index is a measure of the prices paid by farmers for commodities). The All farm products Index is a composite of the other commodity indices shown in Figure 7-5.

There appears to be better correlation between the model predicted price changes and these ratios. The Parity Index and All Farm Production Index decline from 1984 to 1986 and then climb from 1986 to 1990. The model predicted prices follow a similar pattern over that period but with greater drops and rises. The sudden drop in the model predicted prices after 1990 is explained primarily by the whitefly invasion discussed earlier.

Table 563.—Prices received by farmers: Index numbers by groups of commodities and parity ratio, United States, 1977–91

[1910–14 = 100]

Year	Food grains	Feed grains and hay	Cotton	Tobacco	Oil-bearing crops	Fruit	Fruit for fresh market [1]	Commercial vegetables	Commercial vegetables for fresh market	Potatoes, sweet potatoes, and dry edible beans	All crops	Meat animals	Dairy products	Poultry and eggs	Livestock and livestock products	All farm products	Parity ratio [2]
1977	275	316	511	972	652	370	362	498	658	363	433	564	594	228	481	457	66
1978	336	320	466	1,061	608	509	522	522	695	379	456	757	647	243	595	524	70
1979	403	360	490	1,145	670	534	546	548	717	333	501	937	736	252	708	602	71
1980	452	417	583	1,219	664	458	462	562	722	469	539	878	798	254	691	614	65
1981	456	446	566	1,363	718	480	478	677	887	643	580	848	842	264	688	633	60
1982	401	378	469	1,489	575	647	673	629	790	455	524	876	831	252	696	609	55
1983	407	452	531	1,505	663	475	474	649	847	445	554	831	830	270	679	615	56
1984	394	459	554	1,484	708	747	794	661	873	570	599	854	823	308	701	649	58
1985	365	385	474	1,492	546	666	693	642	807	448	519	802	779	271	654	585	52
1986	300	309	462	1,339	502	627	642	650	811	411	461	817	766	293	666	561	51
1987	282	268	503	1,255	518	673	711	724	969	458	459	921	764	244	703	578	52
1988	378	378	485	1,260	704	686	714	699	892	449	545	949	747	269	722	631	54
1989	428	404	503	1,451	665	717	740	721	948	673	580	983	829	313	770	673	55
1990	338	388	548	1,483	611	694	714	707	950	687	548	1,088	837	298	820	681	54
1991 [3]	316	371	553	1,559	594	992	1,059	677	927	508	561	1,047	747	282	776	666	51

[1] Fresh market for noncitrus, and fresh market and processing for citrus. [2] Ratio of Index of Prices Received to the Parity Index; (Index of prices paid by farmers for commodities and services, interest, taxes, and farm wage rates). [3] Preliminary.

National Agricultural Statistics Service. These indexes are computed using the price estimates of averages for all classes and grades for individual commodities being sold in local farm markets. In computing the group indexes, prices of individual commodities have been weighted by average quantities sold during 1971–73. (See table 566 for data on 1977 = 100 basis.)

Figure 7-5

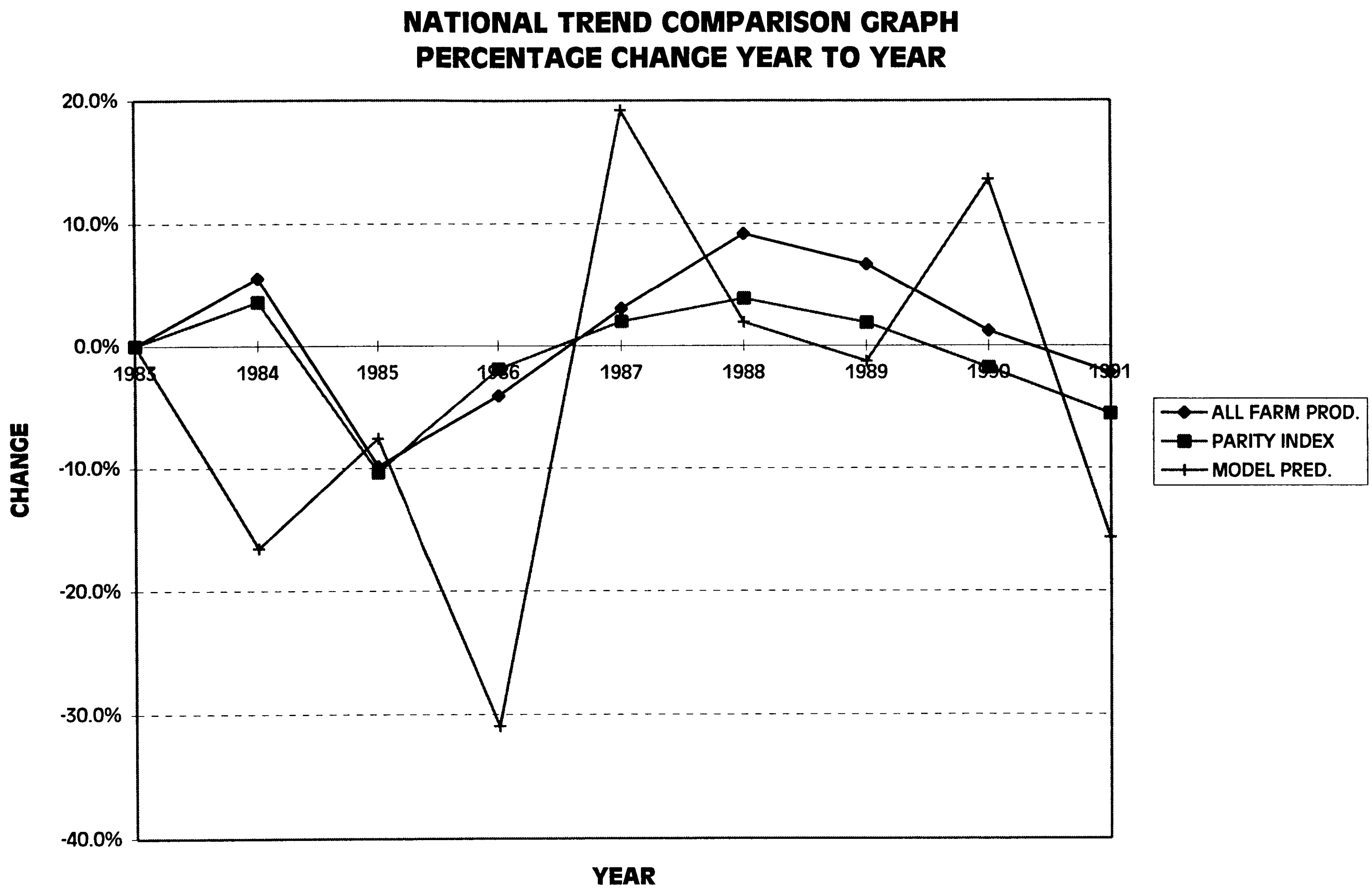

NATIONAL TREND COMPARISON GRAPH
PERCENTAGE CHANGE YEAR TO YEAR
20.0%
10.0%
0.0%
-10.0%
-20.0%
-30.0%
-40.0%
CHANGE
1983
1984
1985
1986
1987
1988
1989
1990
1991
YEAR
ALL FARM PROD.
PARITY INDEX
MODEL PRED.

Figure 7-6

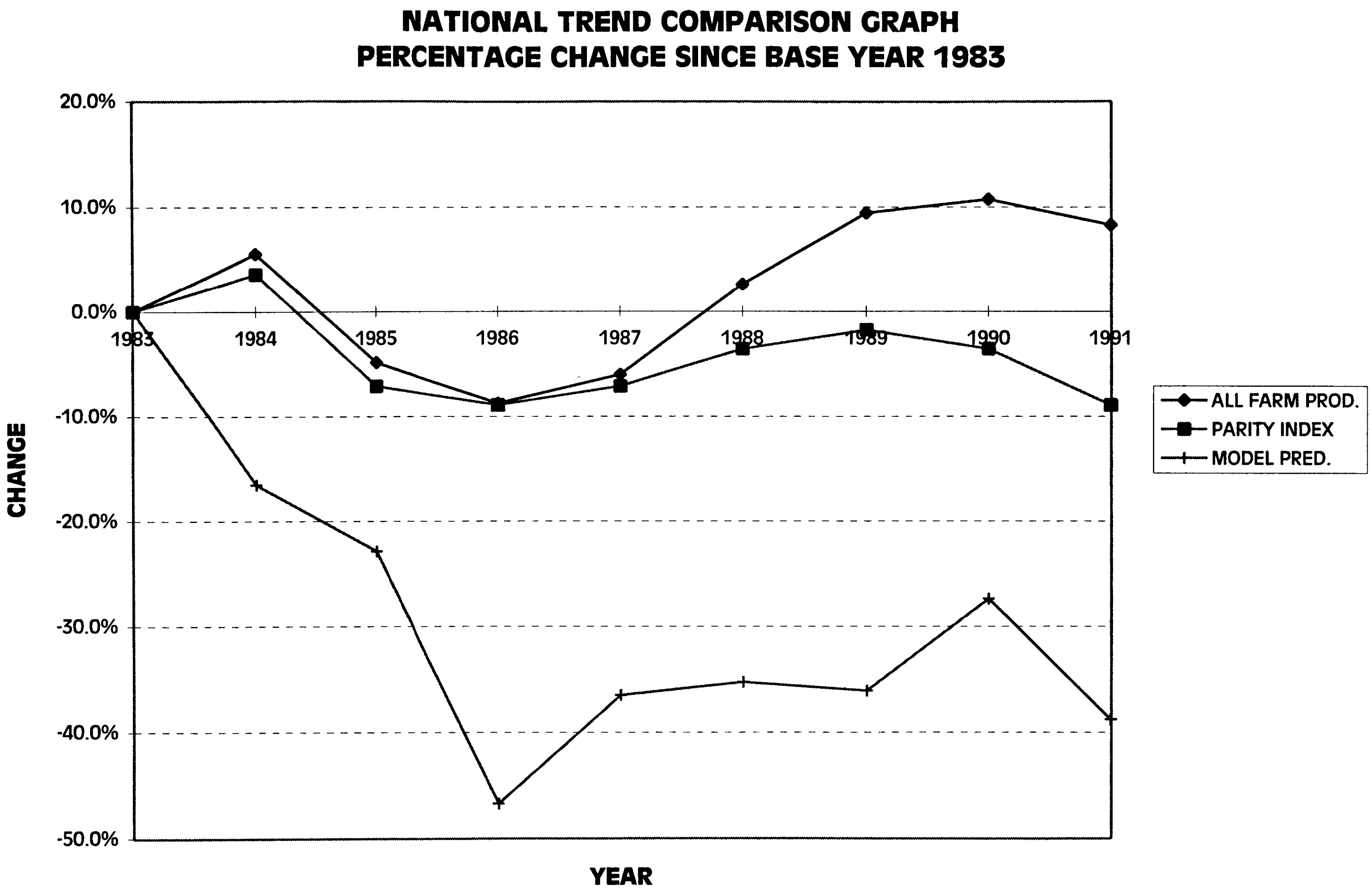

NATIONAL TREND COMPARISON GRAPH
PERCENTAGE CHANGE SINCE BASE YEAR 1983
20.0%
10.0%
0.0%
-10.0%
-20.0%
-30.0%
-40.0%
-50.0%
CHANGE
1983
1984
1985
1986
1987
1988
1989
1990
1991
YEAR
ALL FARM PROD.
PARITY INDEX
MODEL PRED.

Figure 7-7

IV Sales Transactions

Figure 7-7 graphs the average sales transaction size in acres by year. Figure 7-8 graphs the average sales transaction price per acre and weighted average price per acre. For clarification, the average sales transaction price per acre was the average of the individual sales transaction price per acre. The weighted average price per acre was the total acreage (in the thesis database) sold divided by the total dollar value of acreage sold (in each year). While the trend in Figure 7-8 shows a sharp drop in average price per acre from 1984 to 1988, this graph fails to capture the quality of the properties sold in those years and might be misleading without other confirming information.

V Population Growth / Development

Imperial Valley population grew from 92,110 in 1980 to 109,303 in 1990, an 18.7 % increase over a decade. Shown below in Figure 7-9 are the Imperial County population numbers by city for 1992 and 1993. There was a marked increase in total County population of 10.2% from 1992 to 1993. Much of this was due to the construction and opening of two new state prisons in the Valley area.

AVERAGE SALES TRANSACTION SIZE

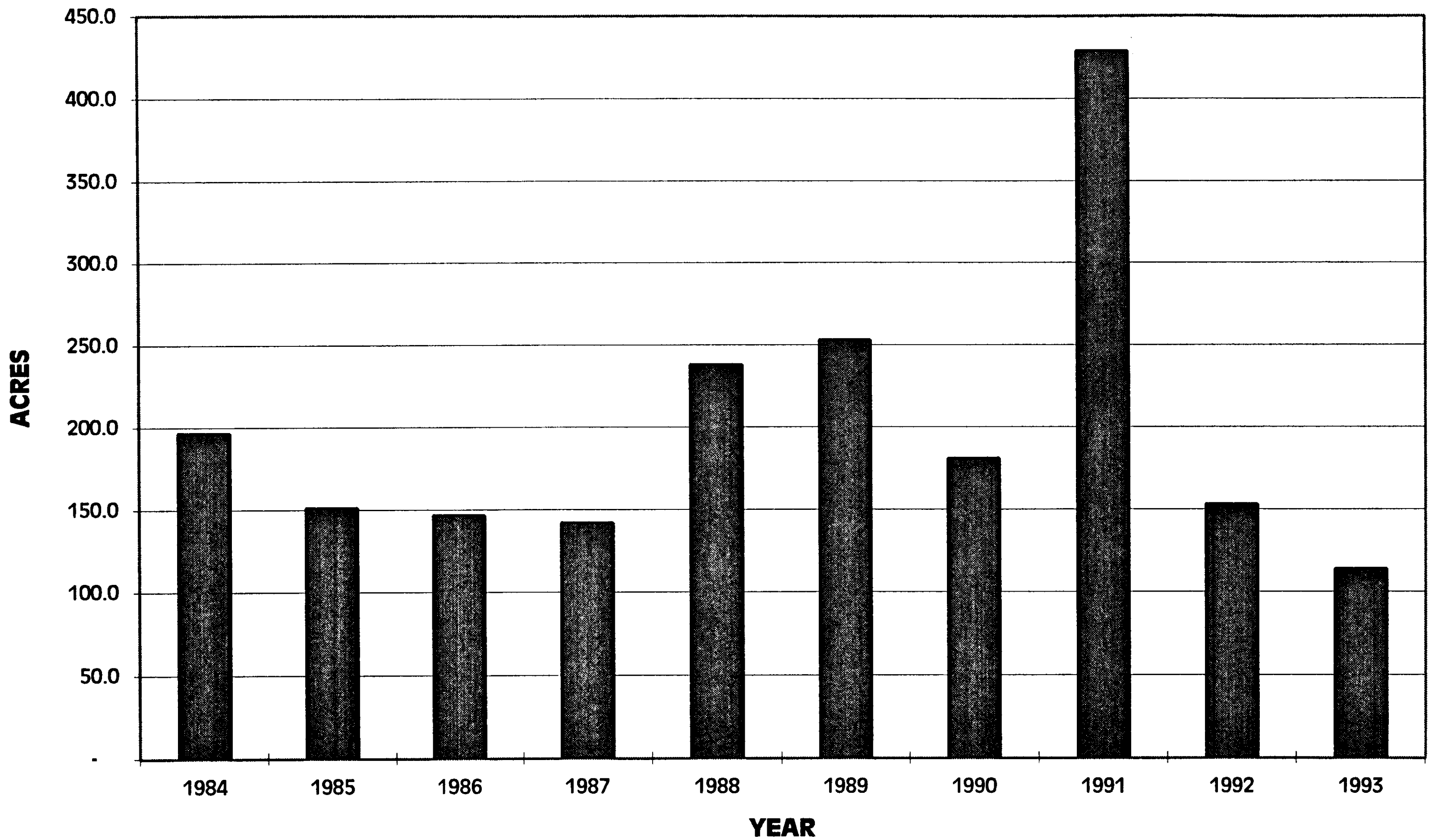


Figure 7-8

AVERAGE SALES TRANSACTION PRICE / ACRE

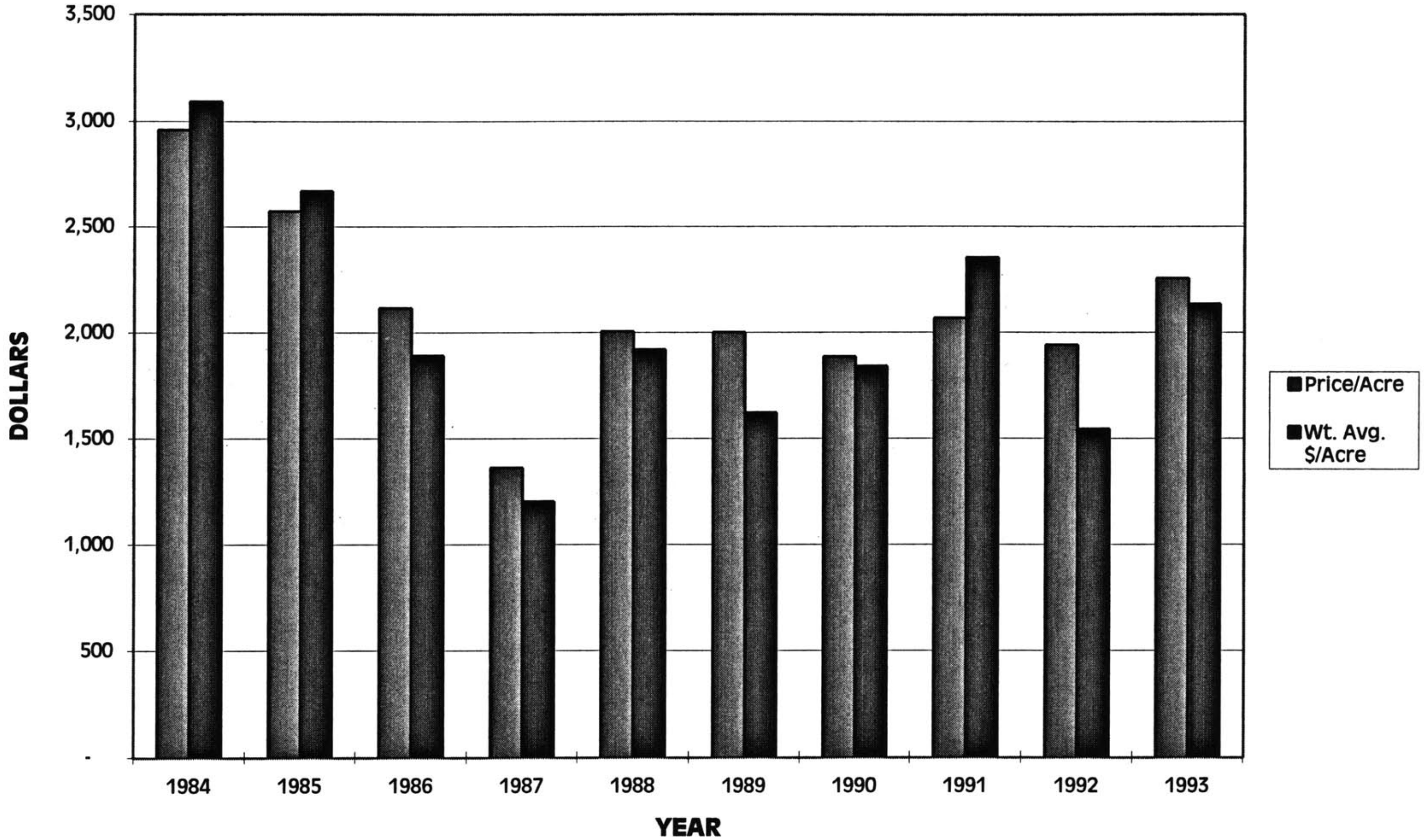


Figure 7-9

FIGURE 7-10
Imperial County Population [20]

	Jan. 1, 1992	Jan. 1, 1993
Brawley	120,350	131,000
Calexico	20,250	21,450
Calipatria	2,920	22,250
El Centro	34,950	6,825
Holtville	5,125	36,450
Imperial	4,530	5,475
Westmoreland	1,480	5,550
Un-incorporated Area	29,300	1,610
Imperial County Total	118,900	131,000

Development

The Land Use Plan of the Imperial County General Plan (Revised October 1993) has revised county zoning plans and designated specific Urban and Community Areas. Section III of the plan, Goals and Objectives, states the following:

Goal 1: Preserve commercial agriculture as a prime economic force.

Objective 1.1 Encourage the continued agricultural use of prime/productive agricultural lands.

Objective 1.2 Discourage the location of incompatible development adjacent to productive agricultural lands

Objective 1.3 Identify compatible agricultural-related uses appropriate for location in agricultural areas.

[20] Imperial County Annual Planning Information, pg. 4.

In 1993 the County placed a two year moratorium on the development of properties for uses other than agriculture outside of the designated urban areas. Thus the potential for urban/suburban development of the majority of agricultural properties in the Valley has been drastically reduced if not completely eliminated by the County plans. In pricing terms the development option for those properties outside the County Urban Area dropped to zero when these provisions were enacted.

The builders in the area mentioned that when the County plans were released the value of land in those areas properly zoned for development jumped drastically. This was no surprise, simply an illustration of the law of supply and demand.

Residential housing demands are met by a number of local and national home builders offering tract housing. Lewis Homes, G-MAC Development, and Sunset Ridge Limited are selling homes priced from approximately $70,000 to $200,000.

To investigate the correlation between the changes in agricultural land prices in the Valley and the level of development statistics from the U.S. Bureau of the Census in *Construction Reports,* *Building Permits*, Privately Owned Housing Units Authorized in Permit Issuing Places (Annuals 1983 through 1992) were graphed. Figures 7-11 and 7-12 graph the number of housing starts by city and County totals, respectively.

The general trend in the number of permits issued over the last decade is increasing. The sporadic jumps appear normal for the housing construction industry. Figures 7-3 and 7-4 show that there was little if any correlation between the number of housing starts and the model predicted trend in price per acre. One explanation is that the urban and pure agricultural land markets prices were disjointed even before the County took steps to control the areas and scope of development.

The addition of a new large USA / Mexico border crossing near Calexico has already influenced land prices near the crossing and around the planned interstate sections connecting the border crossing to Interstate 8. With the passage of NAFTA the Imperial Valley is expected to gain importance as an international transportation corridor. This is likely to encourage growth of other industries in the Valley further diversifying the local economy and raising urban land values. As long as the new County zoning codes are strictly enforced the pricing effects of the agricultural land market should remain disconnected from the urban land market.

**PRIVATELY OWNED HOUSING UNIT STARTS
BY CITY IN IMPERIAL COUNTY**

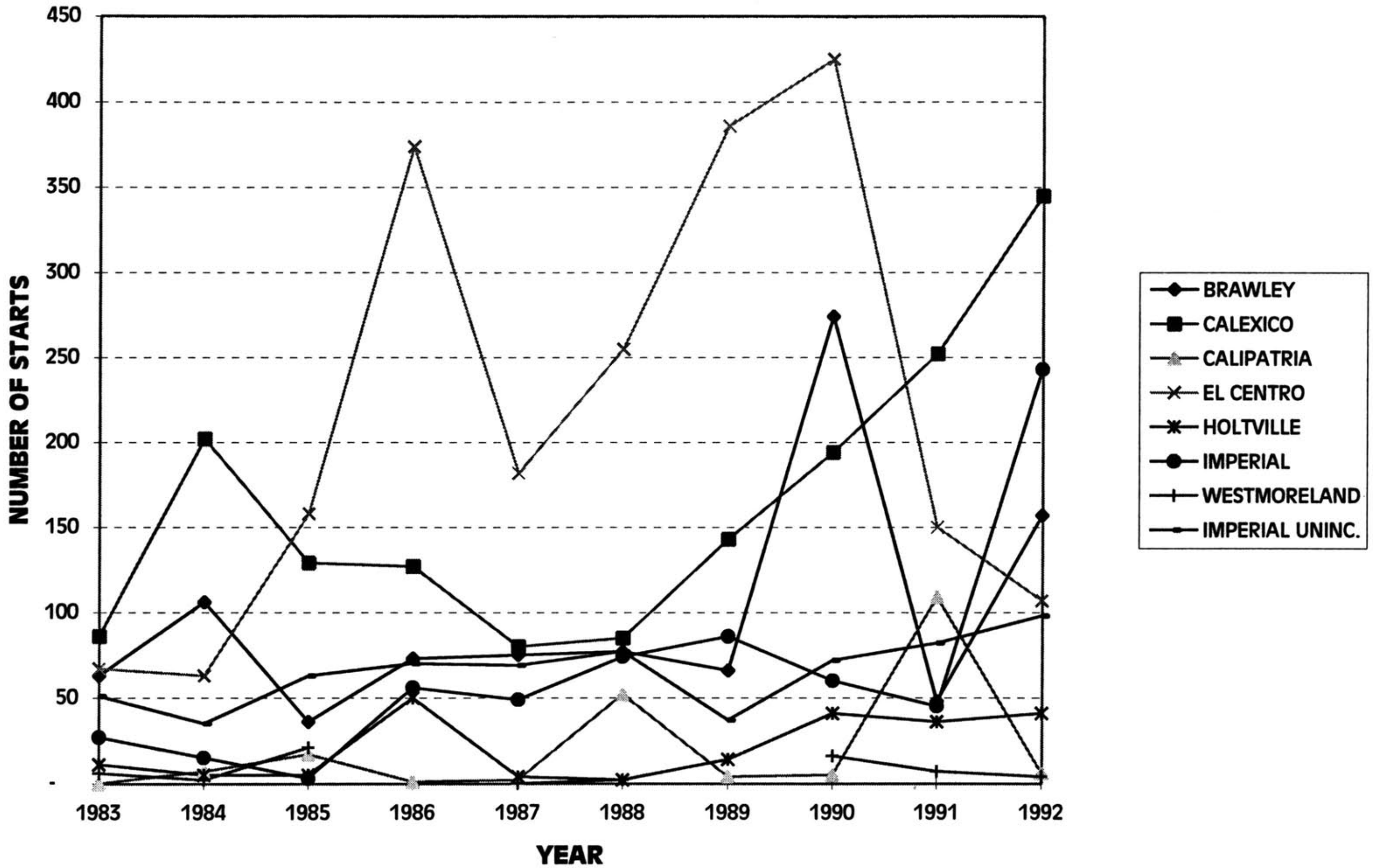


Figure 7-11

PRIVATELY OWNED HOUSING UNIT STARTS
IMPERIAL COUNTY TOTALS

Figure 7-12

CHAPTER EIGHT

Conclusions

I Regression Models in the Appraisal Process

High adjusted R^2 numbers in the 60 to 80 percent range are always a goal in regression analysis. Model 1 had an adjusted R^2 (adjusted multiple coefficient of determination) of 51.1%, and Model 2 had an adjusted R^2 of 49.9%. These numbers are good enough to state that the models can be used for property price prediction. Yet the model is only a tool to aid in the comparison approach. There will always be properties with special characteristics which a model fails to recognize. When this is the case there is no substitute for appraisal experience and knowledge of the market.

It should be noted that this thesis was focused on pricing agricultural properties. Properties sold for speculation on urban and suburban development were not included in the sales transaction database. While the effect of urban influence was demonstrated by the significance of the variable DDEV, this thesis did not attempt to prove this well understood pricing behavior.

Locational zone analysis (not related to urban influence) demonstrated significant price differences between certain zones within the Valley. These differences can be partially explained by the distribution of soil types in an area, and may also reflect the information effect where the buyers were aware of the quality of crops grown on surrounding properties.

The time dummy variables had the greatest single impact on the price per acre, affecting prices by as much as 33% in some years. It was difficult to link the model predicted price effects to local time series variable trends other than the effect of the whitefly invasion in 1991 and 1992. The model predicted effects appear more aligned with national agricultural trends. This indicates buyer sophistication and a general awareness of alternatives to the purchase of property in the Imperial Valley. There remains the question of why the Valley experienced more depressed property prices in the mid-1980's than is explained by the price indices.

II Future Studies

Model building is an on-going process. Developing a more accurate model takes repeated tries with additional information. Future studies might include collection of more accurate data on:

1. Tiling/drainage - age, type, condition
2. Irrigation ditch condition - concrete, dirt, run lengths
3. Crops grown - types, yields

Another topic to investigate is the effects of federal farm subsidies on property values in the Imperial Valley (if any).

An advantage of creating a regression database is the ability to use the assembled information in other ways. The database of property transactions can be sorted by certain characteristics (price range, soil types, location, access, tiling condition, date) to obtain a subset of the sales transaction records similar to those of a property being valued. Once the subset is created the number of variables in the regression can be limited so the transaction sample size needed for the regression is smaller. For example, a regression might be run with forty transactions records with five to eight variables. With this approach it is possible to develop very accurate pricing model estimates.

BIBLIOGRAPHY

Publications

Anderson, David R., Dennis J. Sweeney and Thomas A. Williams. *Introduction to Statistics,* 2nd ed. St. Paul, MN: West Publishing Company, 1991.

"Annual Planning Information, Imperial County". Los Angeles, CA: Employment Development Department, State of California, 1993.

Canning, Patrick N., and Howard D. Leathers. "Inflation, Taxes, and the Value of Agricultural Assets." *Land Economics*, November 1993, 69(4): 389-403.

"City of Imperial Annual Report 1993-1994".

Construction Reports, Building Permits, Privately Owned Housing Units Authorized in Permit Issuing Places, Annuals 1983 to 1992, U.S. Bureau of the Census: Washington D.C.

DiPasquale, Denise, and William C. Wheaton. *The Economics of Real Estate Markets*. (forthcoming) Prentice Hall.

"Guide Lines to Production Costs and Practices 1992-1993, Vegetable Crops, Circular 104-V". Holtville, CA: University of California, Imperial County, Cooperative Extension, 1992.

Herdt, Robert W., and Willard W. Cochrane. "Farm Land Prices and Farm Technological Advance." *Journal of Farm Economics,* 48 (May) 1966: 243-71.

"Imperial County Agricultural Crop and Livestock Report". El Centro, CA: Imperial County, 1992, 1991, 1990, 1988, 1987, 1985, 1983.

"Imperial County General Plan, Land Use Element." El Centro, CA Imperial County, 1993.

"Imperial Irrigation District Annual Report 1992".

"Imperial Irrigation District Fact Sheets." Imperial, CA: Public Information Office, 1994.

Imperial Irrigation District Plat Book. Imperial County, California. El Centro, CA: Imperial Irrigation District, 1994.

"Information Booklet for Builders and Developers". City of Brawley, Economic and Community Development Project, 1993.

Kang, Han-Bin, and Alan K. Reichert. "An Empirical Analysis of Hedonic Regression and Grid-Adjustment Techniques in Real Estate Appraisal." *AREUEA Journal*, Vol. 19, No. 1, 1991:70-91.

Kincheloe, Stephen C. "Linear Regression Analysis of Economic Variables in the Sales Comparison and Income Approaches." *The Appraisal Journal*, October 1993: 576-86.

King, David A., and J.A. Sinden. "Price Formation in Farm Land Markets." *Land Economics*, February 1994, 70(1): 38-52.

"Layperson's Guide to Agricultural Drainage". Sacramento, CA: Water Education Foundation, 1986.

Lewis-Beck, Michael S. *Applied Regression, An Introduction*. Newbury Park, CA: Sage Publications, 1980.

New Crops, New Uses, New Markets. 1992 Yearbook of Agriculture. Washington, D.C.: USDA, U.S. Government Printing Office, 1992.

Palmquist, Raymond B., and Leon E. Danielson. "A Hedonic Study of the Effects of Erosion Control and Drainage on Farmland Values." *American Journal of Agricultural Economics*, 71 (Feb) 1989: 55-62.

Soil Survey of Imperial County California, Imperial Valley Area. El Centro, CA: USDA Soil Conservation Service, 1981.

SPSS for Windows, Base System Users Guide, Release 6.0. SPSS Inc., 1993.

The Appraisal of Rural Property. Chicago, Il: American Institute of Real Estate Appraisers, 1983.

"The Colorado River and Imperial Valley Soils, Bulletin no. 1075". El Centro, CA: Imperial Irrigation District, 4th prt.

Tiling Cost Quotes:
La Bolsa, Inc., courtesy Mr. Darwin D. Cohee.
Lidco, Inc., courtesy Mr. Carter Taylor.

Tout, Otis B. *The First Thirty Years*. San Diego, CA: Otis B. Tout, Publisher, 1931.

USDA Agricultural Statistics 1992, Washington D.C.: U.S. Government Printing Office, 1993: Tables 104, 196, 246, 360, 676.

Interviews

Mr. Hal Barton
City Planner
City of Imperial

Mr. Richard Cabanilla
Planning Division Manager
Imperial County

Mr. Steve Cameron
USDA Soil Conservation Service

Mr. Darrell Dotson
Appraiser
Erickson & Smith Appraisals

Mr. Jack L. Durrett
Appraiser
Imperial County

Mr. Andrew Erickson
Appraiser
Erickson & Smith Appraisals

Mr. Orlando B. Foote
Attorney
Horton, Knox, Carter & Foote

Mr. Stan Gordon
Chairman
Sunset Ridge Limited

Mr. Timothy Howard
Financial Analyst/Project Manager
Lewis Homes

Mr. Ronald E. Hull
Director Public Information & Community Services
Imperial Irrigation District

Ms. Judy Luker
Supervisor
Imperial County Tax Assessor's Office

Mr. Efrain Silva
Associate Planner
City of El Centro

Mr. Richard Sinclair
Drainage/Engineering
Imperial Irrigation District

Thomas K. Turner
Appraiser
Imperial-Yuma Appraisal Service
Farm Credit Services

Mr. Raymond W. Walters
Data Processing Manager
Imperial County