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Las Cruces Housing Prices

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LAS CRUCES HOUSING PRICES

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Dedication

This thesis is dedicated to two people that have stuck by me through good times and bad times, Lourdes y Thomas - Mom and Dad. I appreciate your sincere, whole-heartedness, and financial support through this process, without your help I'd probably be on a 10-year track.

LAS CRUCES HOUSING PRICES

by

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Abstract

This study analyzes the median price for existing single-family housing units in Las Cruces, New Mexico. Explanatory factors used in the analysis are real per capita income, the housing stock, real mortgage rates, real apartment rents, and the real price of homes across the United States with data ranging from 1970-2017. Two estimation strategies are used for parameter estimation of the reduced form price equation. Results obtained include various unforeseen outcomes that include unexpected coefficient signs and relatively large elasticities. The most surprising result is that the long-run real rent coefficient has a negative sign, implying that apartments and houses are complements rather than substitutes over the long-run in Las Cruces, New Mexico. Local income and national housing prices are positively correlated with single-family residence prices in the long-run.

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Chapter 1: Introduction

This study analyzes median prices for existing, or previously built, single-family residential houses in Las Cruces, New Mexico. Las Cruces is the seat of Doña Ana County and the second largest metropolitan economy in New Mexico. In spite of that, comparatively little research has been conducted for this urban economy, including its housing market. The Las Cruces metropolitan statistical area is defined as Doña Ana County (USCB, 2010).

Residential real estate is an important sector for any urban economy. This is particularly true in Las Cruces because property taxes, though generally unpopular in the United States, are used to help fund the municipal budget (Cabral and Hoxby, 2010). During the most recent fiscal year for which data are available, nearly $11.1 million in residential and non-residential property taxes accrued to the City of Las Cruces. Of that amount, approximately 68 percent of those revenues are residential property taxes (DFA, 2017). The bulk of the almost $7.5 million in residential property taxes collected between July 2016 and June 2017 are generated by previously built single-family housing units. Changes in prices for that segment of the Las Cruces housing stock can exercise important effects on the municipal coffer.

Las Cruces has a relatively cyclical economy. Subsequent to the Great Recession of 2008, Doña Ana County experienced population losses in 2013 and also lost jobs in both 2009 and 2012. Preliminary estimates further indicate that nominal personal income in Las Cruces exhibited negative growth in 2013 (Fullerton and Walke, 2017). Those surprising fluctuations are likely to have exercised important impacts on the housing market and housing prices. To confirm that conjecture, an econometric analysis of Las Cruces housing prices is undertaken.

Because many aspects of the housing market in Las Cruces have yet to be documented, a fairly elementary approach was employed. Data utilized are collected by the University of Texas at El Paso Border Region Modeling Project. The reduced form model is derived from equating housing supply with housing demand (DiPasquale and Wheaton, 1994). The underlying equations were specified on the basis of data available for the Las Cruces metropolitan economy.

Subsequent sections of the study are as follows. Section two provides a brief review of previously published housing price studies and studies that are related to the economy of Las Cruces. The theoretical model is presented in the third section. Section four summarizes the data employed and the empirical results obtained. Section five encapsulates principal outcomes and offers concluding remarks.

Chapter 2: Literature Review

A variety of studies examine housing supply and demand. A typical approach is to specify separate equations for each of the relationships between the stock of housing and the price of homes. Housing stocks are specified as dynamic functions that evolve over time as determined by new construction and demolition rates (Muth, 1960; Follain, 1979; DiPasquale and Wheaton, 1994; Hedberg and Krainer, 2012). In the region where Las Cruces is located, a variant of this approach is employed for the single-family housing stock and the multi-family housing stock in El Paso, Texas (Fullerton and Kelley, 2008). Both specifications have good empirical properties. Given that, this approach may be applicable to the Mesilla Valley housing market, as well.

A variety of studies have been completed that analyze different aspects of housing demand. As noted by Megbolugbe et al. (1991), there are so many approaches to analyzing housing demand that it is infeasible to include all of them in a single model. It may be feasible to successfully study the behavior of housing prices over time, however, if the analysis takes into account both structural and cyclical factors that influence market conditions. Such constructs generally include data that reflect unit prices, personal income, market demographics, and borrowing costs (DiPasquale and Wheaton, 1994; Chow and Niu, 2015; Gu 2018). Potentially relevant to this study, variables from each of those categories are included in the housing model estimated for El Paso by Fullerton and Kelley (2008).

Smaller urban economies such as Las Cruces frequently observe notable changes in residential dwelling prices due to a variety of factors. Members of the retirement market often relocate to less crowded cities and seek bargains in second home investments. As discussed in

York et al. (2011), Las Cruces observed a 25 percent population increase between 1992 and 2001 in large part due to an inflow of new migrants. Understanding housing prices are important for areas such as the Mesilla Valley. Over the 50 year period between 1950 and 2000, real housing prices appreciated by 157.1 percent in Las Cruces (Gyourko, Mayer and Sinai, 2010). The conceptual strategy developed for this study is discussed in the next section.

Chapter 3: Theoretical Model

Housing prices are affected by multiple variables in any urban economy. The housing supply is specified in manner that is similar to DiPasquale and Wheaton (1994). That approach has the advantage of relying upon variables that are available for Las Cruces and other small metropolitan economies. Equation (1) results from the following steps:

$$\Delta S_t = \alpha_0 + \alpha_1 P_t - \delta S_{t-1}$$

$$S_t - S_{t-1} = \alpha_0 + \alpha_1 P_t - \delta S_{t-1}$$

$$S_t = \alpha_0 + \alpha_1 P_t - \delta S_{t-1} + S_{t-1}$$

$$S_t = \alpha_0 + \alpha_1 P_t + (1-\delta) S_{t-1}$$

$$S_t = \alpha_0 + \alpha_1 P_t + \alpha_2 S_{t-1} \qquad (1)$$

Variables shown above include the Las Cruces housing supply or stock, S, and the median real price for a single-family housing unit in Las Cruces, P. The subscript t is used to denote the time period. Equation parameters are α_i, while δ represents the rate of depreciation of the housing stock. Equation (1) specifies the supply of housing as a function of the current period single-family price of housing and the prior period housing stock. In Equation (1), S is hypothesized to be positively correlated with the contemporaneous lag of P and with a one-year lag of S. The first slope parameter is expected to be greater than zero because higher housing unit prices allow builders to cover higher costs of material and labor (DiPasquale and Wheaton, 1994). The second slope coefficient is expected to be positive because the rate of single-family housing demolition in any given year is generally less than 2 percent of the existing stock (Pitkin and Myers, 2008).

Housing demand is also specified in a manner that is similar to DiPasquale and Wheaton (1994) and Fullerton and Kelley (2008). In Equation (2), P is, again, the median real price for a stand-alone housing unit in Las Cruces. Real income per household in Las Cruces is represented by INC. Real housing payments are denoted by MORT. To control for the non-owner portion of the residential real estate market, a variable for the real price renters must pay, RENT, to occupy housing that is leased appears in Equation (2). The national real median price for single-family houses, NHP, is also included in the specification to reflect investment characteristics of housing demand. This yields:

$$D_t = \beta_0 + \beta_1 PINC_t - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t - \beta_5 P_t \qquad (2)$$

In Equation (2), D is expected to be positively correlated with PINC, RENT, and NHP. As real income per household increases, housing purchases are expected to increase. Rental housing is a substitute good for owner-occupied housing. Accordingly, as rental prices increase, housing purchases will tend to escalate due to both substitution and investment effects (Dusansky and Koc, 2007). Lastly, as the national housing market conditions strengthen, investment demand for housing in Las Cruces is also predicted to swell (Fullerton and Kelley, 2008).

In Equation (2), D is further hypothesized to be negatively correlated with MORT and P. If mortgage rates climb, affiliated real housing payments, MORT, will rise, the pool of qualified borrowers will shrink, and fewer households will attempt to purchase houses (Wilcox, 1990). The slope coefficient for the real price, P, is also expected to be less than zero due to the standard inverse relationship between sales volumes and prices (Vargas Walteros et al., 2018).

To obtain an expression for P (Price), Equations (1) and (2) are set equal to each other, and then solved for P. The resulting reduced form equation expresses P as a function of the exogenous variables PINC, MORT, RENT, and NHP. Equation (3) is developed as shown below:

$S_t = D_t$

$\alpha_0 + \alpha_1 P_t + \alpha_2 S_{t-1} = \beta_0 + \beta_1 PINC_t - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t - \beta_5 P_t$

$\alpha_1 P_t = \beta_0 - \alpha_0 + \beta_1 PINC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t - \beta_5 P_t$

$\alpha_1 P_t + \beta_5 P_t = \beta_0 - \alpha_0 + \beta_1 PINC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t$

$(\alpha_1 + \beta_5) P_t = \beta_0 - \alpha_0 + \beta_1 PINC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t$

$P_t = (\beta_0 - \alpha_0 + \beta_1 PINC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t) / (\alpha_1 + \beta_5)$

$$P_t = \gamma_0 + \gamma_1 PINC_t + \gamma_2 S_{t-1} + \gamma_3 MORT_t + \gamma_4 RENT_t + \gamma_5 NHP_t \qquad (3)$$

The algebra of the coefficients in Equation (3) yields specific hypotheses for each of the explanatory variable coefficients. The intuition underlying the resulting arithmetic signs follows. Two of the slope parameters in Equation (3) are hypothesized to be negative: $\gamma_2 < 0$; $\gamma_3 < 0$. An inverse relationship is posited between the price for single-family housing, P, and the prior period stock of homes, S, due to supply effects and vacancy rates (Wheaton, 1990). The real housing payment slope coefficient, γ_3 is also hypothesized to be negative. That is because rising mortgage payments, MORT, reduce the pool of qualified borrowers and the demand for owner-occupied housing.

Because of the central role that the residential real estate sector plays in most economies, substantial attention is always given to stand-alone housing prices (Rappaport, 2007; Conefrey and Whelan, 2013). To date, there is very little research that has been published with respect to housing prices in Las Cruces, the second largest metropolitan economy in New Mexico. As a step toward partially filling that gap in the regional housing economics literature, a theoretical model is proposed that takes into account both supply and demand features of housing markets. Because data requirements are fairly reasonable, the model provides an attractive starting point for analyzing relatively small markets that typically do not generate extensive statistical documentation. Empirical assessment of the model is performed in the next section.

Chapter 4: Sample Data

Table 1 contains names, descriptions, units, and sources for the variables included in the data sample. Missing observations exist for four variables in the sample: median Las Cruces single-family housing price (P), median 2-bedroom apartment rent (RENT), single-family housing stock (S), and average monthly mortgage payment (MORT). In the cases of P, RENT, and MORT, linear regression equations are utilized to impute the missing values (Friedman, 1962). In the case of S, missing observations are imputed using percentage changes of households and population to extrapolate the housing stock (Sweet and Grace-Martin, 2012).

Table 1: Variable Names, Definitions, and Units of Measure

Variable	Description	Units	Sources
P	Real Median Single-Family Housing Price	2012 Real $	IHS and BRMP
PINC	Real Income per Capita	2012 Real $	BEA and Census
S	Las Cruces Single-Family Housing Stock	SF Houses	IHS, Economy.com, and BRMP
MORT	Average Real Mortgage Payment	2012 Real $	IHS and BRMP
RM	Real Mortgage Rate	2012 Base	BRMP
RENT	Median Real 2-BR Apartment Rent	2012 Real $	HUD and BRMP
NHP	USA Real Median SF Housing Price	2012 Real $	FRED and BRMP

Notes:
BEA, U.S. Bureau of Economic Analysis.
Census, U.S. Census Bureau.
Economy.com, Moody's Analytics Economy.com.
FRED, Federal Reserve Bank of St. Louis Economic Data.
HUD, U.S. Department of Housing and Urban Development.
IHS, IHS Markit, formerly Wharton Econometrics.
BRMP, University of Texas at El Paso Border Region Modeling Project

In Table 1, real income per capita is listed for PINC instead of real income per household. That change is introduced because of statistical anomalies discovered with income per household. Households are defined as all persons who reside in each housing unit. Because a relatively large percentage of the population in Las Cruces is comprised by out-of-town students that attend New Mexico State University, that affects the estimated number of households. These households are not likely to purchase single-family dwelling units. Given that, real per capita income is employed for the empirical analysis summarized in this section.

Table 2 reports summary statistics for each variable during the sample period. In 2012 constant dollars, the single-family housing price in Las Cruces ranges from a low of $68,138 in 1970 to a high of $162,006 in 2007, on the eve of the financial sector collapse and the "Great Recession." The skewness statistic for P indicates that real housing price data for this sample are distributed symmetrically. Relative to a normal distribution, observations for P are slightly platykurtic. The coefficient of variation for P is 0.21.

Table 2: Summary Statistics

Statistic	P	PINC	S	PCS	MORT	RM	RENT	NHP
Mean	$116,423	$23,070	32,426	0.2162	$806.63	4.6136	$642.16	$198,788
Median	$115,176	$21,062	30,021	0.2145	$790.80	3.9700	$634.41	$192,103
Maximum	$162,006	$33,337	52,695	0.2440	$1,408.04	10.490 0	$774.57	$303,965
Minimum	$68,138	$15,452	14,374	0.1930	$432.16	-1.2200	$584.38	$112,047
Std Dev	$24,469	$5,506	11,857	0.0137	$231.05	2.4265	$39.70	$50,034
Skewness	-0.10	0.45	0.26	0.3624	0.46	0.3748	1.22	0.30
Kurtosis	2.32	1.75	1.82	2.45	2.72	3.09	4.95	2.14
Coef Var	0.21	0.24	0.37	0.06	0.29	0.53	0.06	0.25

Notes:
Sample period, 1970-2017.
Std Dev is an acronym used for standard deviation due to space constraints.
Coef Var is an acronym used for coefficient of variation due to space constraints.

Real per capita personal income has a mean of $23,070 and a median of $21,062. PINC has a standard deviation of $5,506. The third moment indicates that the observations for PINC are fairly symmetric, although a little positively skewed. The fourth moment indicates that PINC is somewhat platykurtic, but the coefficient of variation does not imply that the latter is very pronounced. As shown in Figure 1, P and PINC appear to be positively correlated.

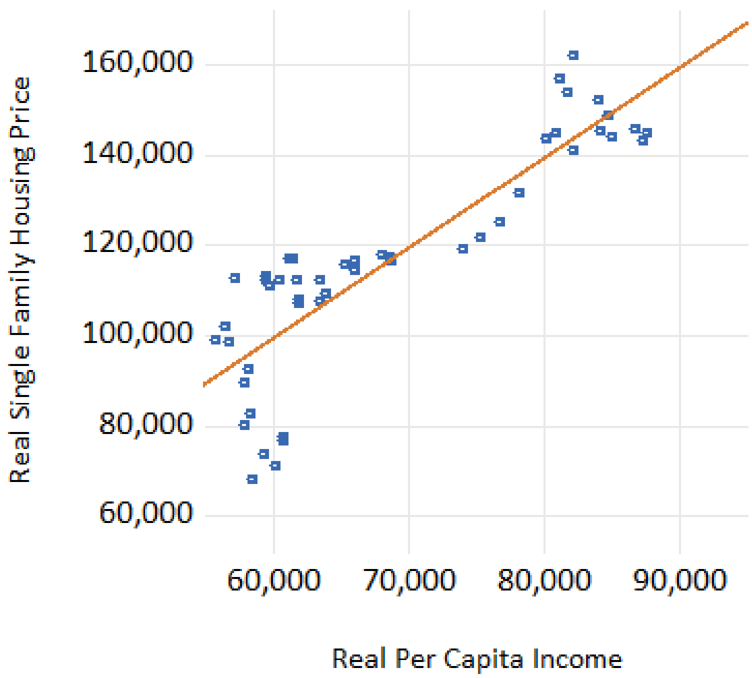

Figure 1. Real House Price and Real per Capita Income Scatter Diagram

In Table 2, the Las Cruces single-family housing stock, S, ranges from a low of 14,374 in 1970 to a high of 52,695 in 2017. S has a mean of 32,426 and a median of 30,021. The standard deviation for S is 11,857. The observations for S are distributed in a fairly symmetric, but platykurtic, manner. At least somewhat reflective of the latter, S has the largest coefficient of variation in Table 2. As can be seen in Figure 2, P and S both increased during the 1970-2017 sample period. Because initial modeling results using S were not successful, the per capita housing stock variable is used in Chapter 5.

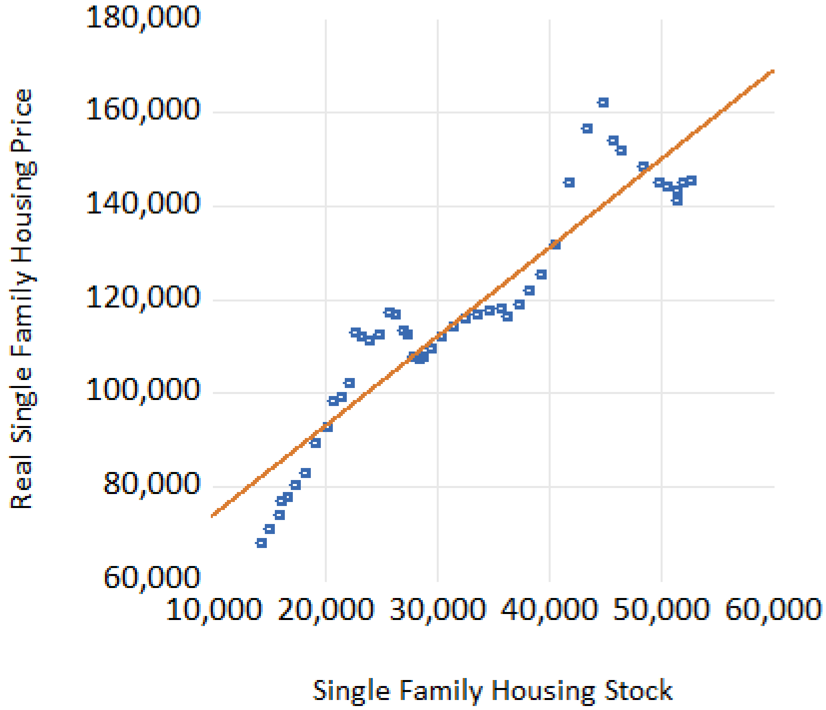

Figure 2. Real House Price and Single-Family Housing Stock Scatter Diagram

In Table 2, Las Cruces single-family per capita housing stock, PCS, ranges from a low of 0.1930 in 1993 and 1994 to a high of 0.2145 in 2017. S has a mean of 0.2162 and a median of 0.2145. The standard deviation for PCS is 0.0137. The observations for PCS are distributed in a fairly symmetric, but slightly platykurtic, manner. As can be seen in Figure 3, P and PCS both increased during the 1970-2017 sample period.

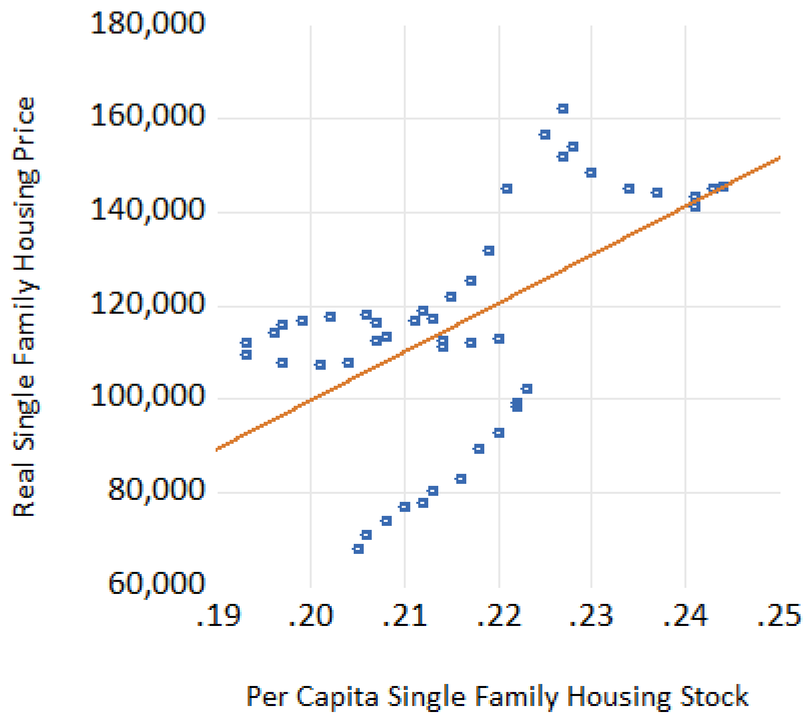

Figure 3. Real House Price and Per Capita Single Family Housing Stock Diagram

Real average monthly mortgage payments, MORT, are reported without property taxes or insurance. The mean for MORT is $807 and the median is $791. The standard deviation is $231 and the coefficient of variation is 0.29. As a consequence of historically high interest rates, mortgage payments reached a maximum of $1,408 in 1982, while the minimum value from 1972 is $432. MORT is approximately symmetric and roughly mesokurtic. Testing with the real mortgage variable, taking into account potential endogeneity, was not successful. Consequently, a real mortgage rate calculated as the difference between the nominal 30-year conventional mortgage rate and the personal consumption expenditures inflation rate is used in Chapter 5.

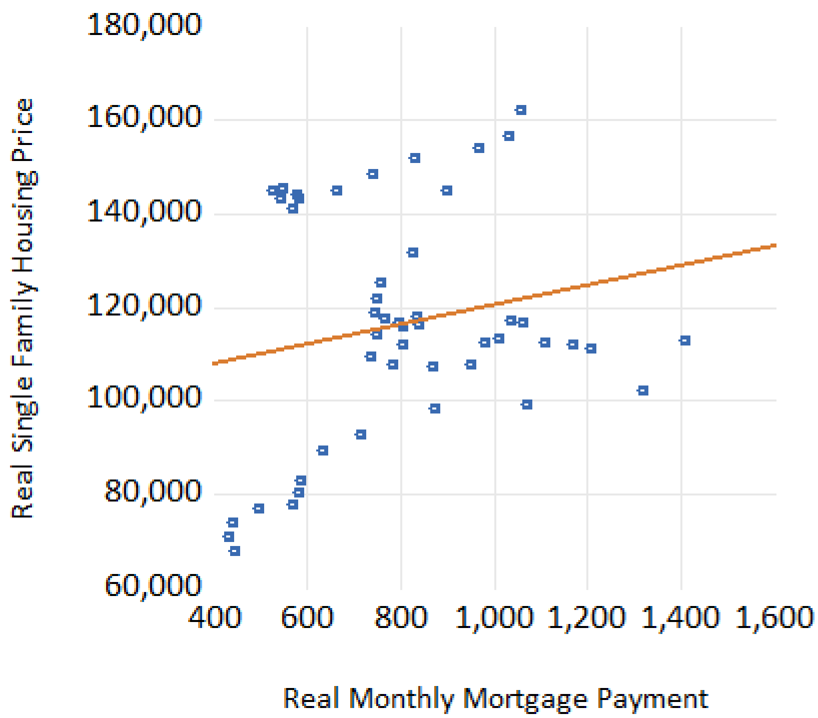

Figure 4. Real House Price and Real Monthly Mortgage Payment Scatter Diagram

The real monthly mortgage rate, RM, is calculated as the difference between the nominal mortgage rate and the personal consumption expenditures deflator inflation rate. The mean for RM is 4.61 and the median is 3.97. The standard deviation is 10.49 and the coefficient of variation is 0.53. As a consequence of historically high interest rates, mortgage rate reached a maximum of 10.49 in 1982, while the minimum value from 1974 is -1.22. RM is approximately symmetric and mesokurtic. As can be seen in Figure 5, single-family housing prices and real mortgage rates seem to be inversely correlated, but that is not a very strong relationship.

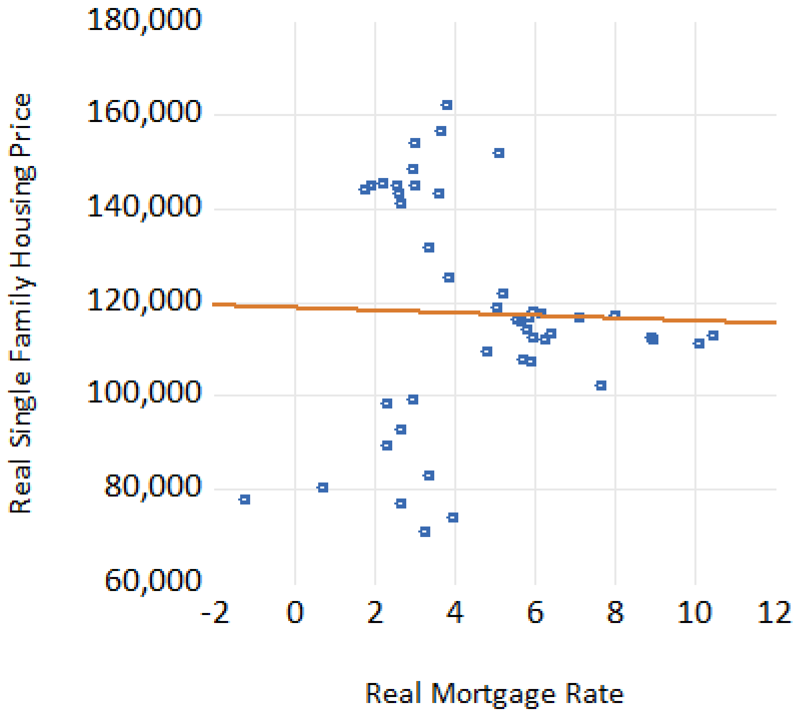

Figure 5. Real House Price and Real Mortgage Rate Diagram

Rental properties are substitutes for owner-occupied residences. Two-bedroom apartment rents are used to approximate the substitute price for this alternative. In Table 2, the sample mean for real RENT is \$642 and the median is \$634. The standard deviation for RENT is \$40, while the sample minimum value is \$584 and the sample maximum is \$775. Higher-end units in this market cause 2-bedroom rents to skew to the right with a third moment of 1.22. The distribution is leptokurtic, however, with a fourth moment value of 4.95. As can be seen in Figure 6, there is no easily discernible relationship between 2-bedroom apartment real rents and housing prices for the 1970-2017 sample period under consideration.

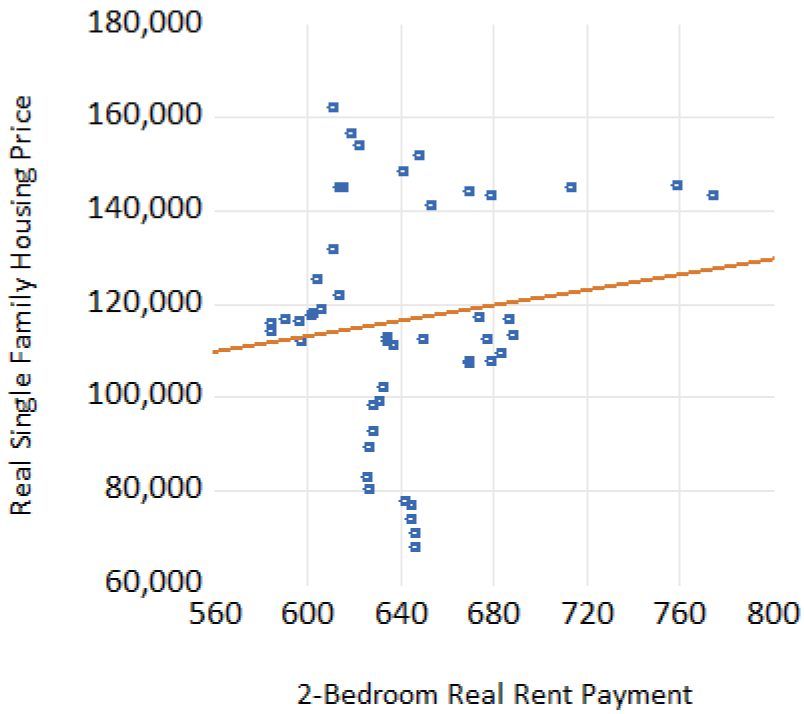

Figure 6. Real House Price and Real Monthly Apartment Rent Scatter Diagram

For the sample period in question, the real national housing price variable mean is .0812 and the median is $192,103. NHP has a maximum of $303,965 and a minimum of $112,407. The standard deviation of NHP is $50,034. Surprisingly, NHP has a coefficient of variation of 0.25 reflecting more volatility than what is estimated for the relatively small Las Cruces housing market. As documented in Table 2, the data for NHP are approximately symmetric and slightly platykurtic. Although the Las Cruces business cycle frequently diverges from that of the national economy, positive correlation between P and NHP seems easy to identify in Figure 7.

Figure 7. Real Las Cruces House Price and Real National House Price Scatter Diagram

The sample data are non-stationary and heteroscedastic. To reduce the risk of spurious correlation, most of the data are log-transformed and first differenced. RM is reported as a percent and is only first differenced. Table 3 reports summary statistics for the differenced data. First differences of logarithmically transformed variables provide percentage change estimates. The annual percentage change of the median real price of a single-family house in Las Cruces ranges from a minimum of -5.1 percent in 2008 to a high of 9.9 percent in 1982. The skewness statistic for DLNP indicates it is relatively symmetric, though a little right skewed. The fourth moment indicates that DLNP is slightly leptokurtic. The coefficient of variation is 0.499 due to a relatively large standard deviation of 0.032.

Table 3: First Differenced Log Transformed Summary Statistics

Statistic	DLNP	DLNPINC	DLNPCS	DRM	DLNRENT	DLNNHP
Mean	0.0162	0.0164	0.0037	-0.0253	0.0034	0.0212
Median	0.0128	0.0181	0.0051	-0.2050	0.0024	0.0259
Maximum	0.0998	0.0945	0.0239	4.7100	0.1450	0.1168
Minimum	-0.0507	-0.0488	-0.0205	-3.8800	-0.1703	-0.0945
Std Dev	0.0324	0.0248	0.0112	1.3929	0.0447	0.0438
Skewness	0.5698	0.1633	-0.5892	0.7490	-1.0390	-0.3933
Kurtosis	3.4520	4.4464	2.4673	5.5673	9.7526	3.3730
Coef Var	2.00	1.51	3.03	-55.06	13.15	2.07

Notes:
Sample period, 1970-2017.
Std Dev is an acronym used for standard deviation due to space constraints.
Coef Var is an acronym used for coefficient of variation due to space constraints.

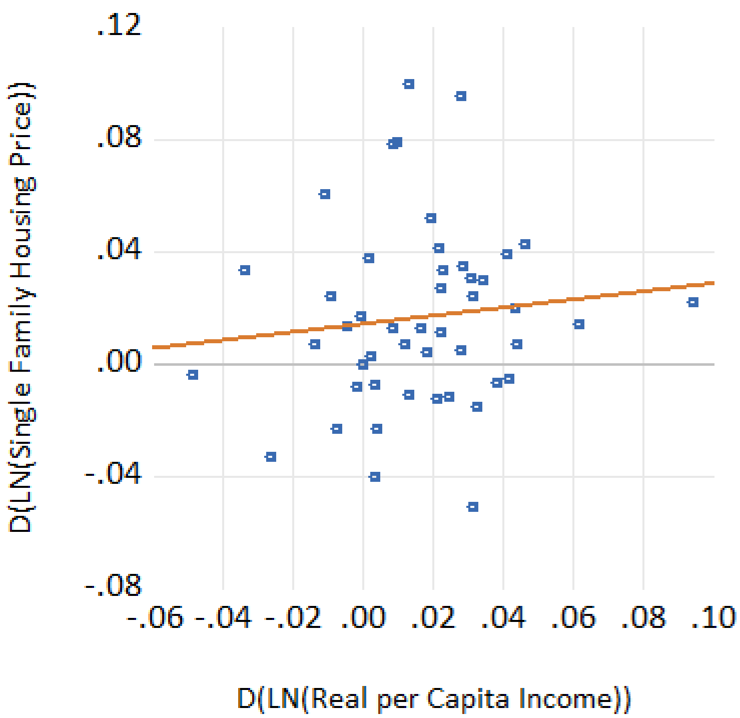

Figure 8. First Differenced Log Transformed Real House Price and First Differenced Log Transformed Real per Capita Income Scatter Diagram.

DLNPINC for real per capita income has a mean of 0.016 and a median of 0.018. Real per capita income in Las Cruces grew at a maximum rate of 9.5 percent in 2001. It contracted at a rate of 4.9 percent in 2013. DLNPINC has a standard deviation of 0.025. The third moment indicates that the observations are symmetric. The kurtosis statistic indicates a leptokurtic distribution. In contrast to Figure 1, the positive correlation shown in Figure 8 is much less discernible.

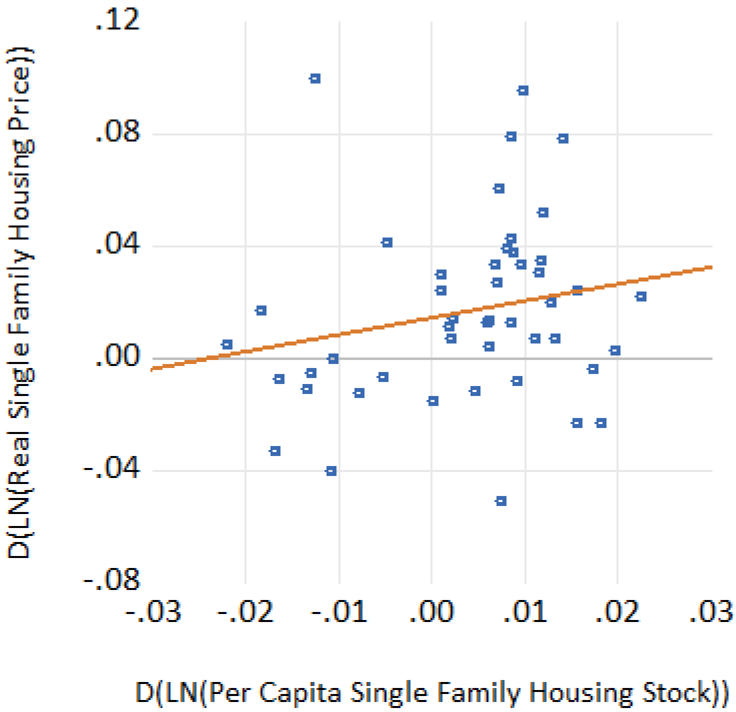

Figure 9. First Differenced Log Transformed Real House Price and First Differenced Log Transformed per Capita Single-Family Housing Stock Scatter Diagram

The first difference of the natural logarithm of Las Cruces per capita single-family housing stock DLNLCPCS, has a mean of 0.0037 and a standard deviation of 0.112. In 1992, DLNPCS reached a low of -0.1983. That occurred because population grew more rapidly than the housing stock. The DLNPCS maximum growth rate of 0.0239 occurred in 2001 when the housing stock grew at a faster pace than population. Figure 9 indicates that positive correlation may exist between DLNP and DLNPCS.

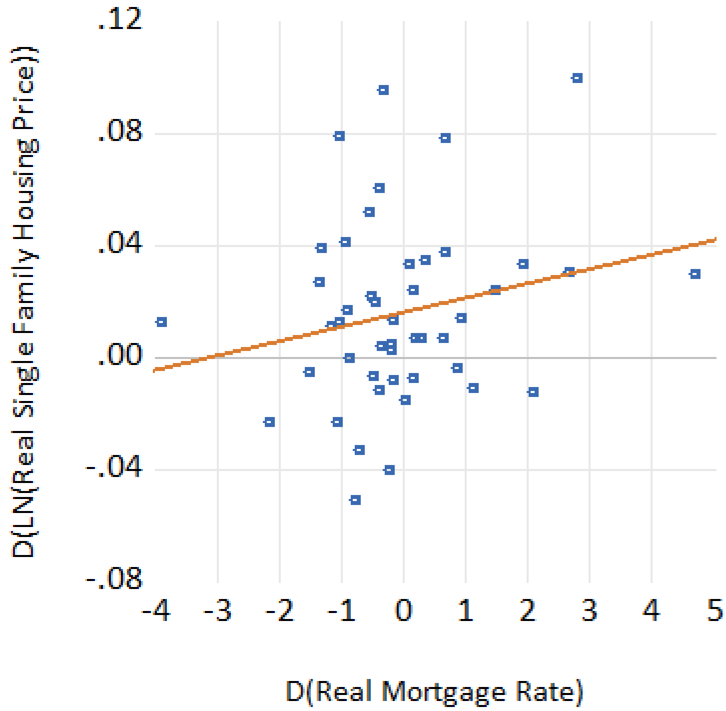

Figure 10. First Differenced Log Transformed Real House Price and First Differenced Mortgage Rate Scatter Diagram.

The real mortgage rate, RM, is calculated by subtracting the percentage change of the personal consumption expenditure price index from the 30-year national conventional fixed mortgage rate. RM has a mean and median of -0.0253 and -0.2050, respectively. The RM data are fairly symmetric at 0.7490 and leptokurtic. As can be seen in Figure 10, the relationship between D(LN(P) and D(RM) is not very clear.

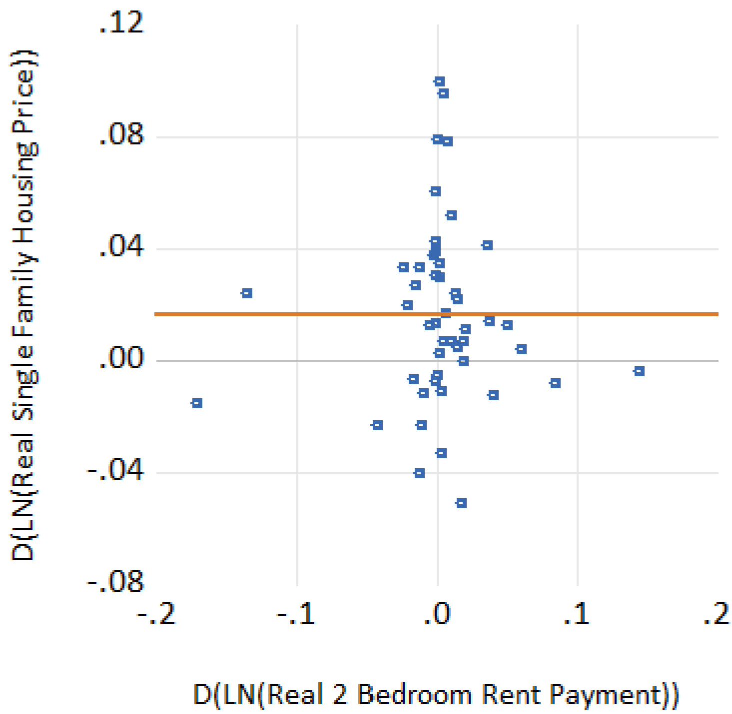

Figure 11. First Differenced Log Transformed Real House Price and First Differenced Log Transformed Real Monthly Apartment Rent Scatter Diagram.

Las Cruces rental units are hypothesized to be substitutes for owner-occupied residences. In Table 3, the sample mean for the first difference of the log-transformed for Las Cruces rents is 0.0034, with a median of 0.0024. The standard deviation is 0.0447, while the sample minimum is -0.1703 and the maximum is 0.1450. These data are left skewed and leptokurtic. In Figure 11, there appears to be no clear relationship between the percentages changes of P and RENT.

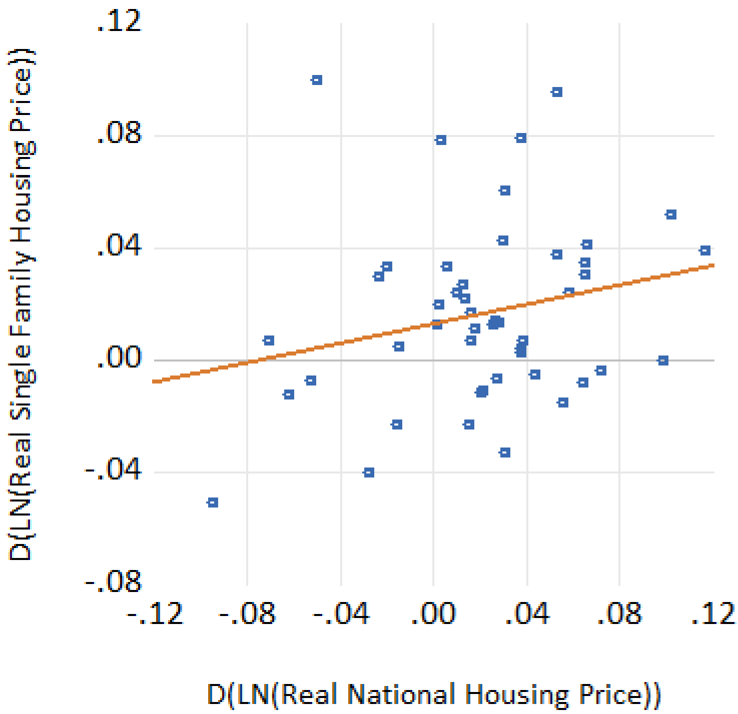

Figure 12. First Differenced Log transformed Real House Price and First Differenced Log Transformed Real National Housing Price Scatter Diagram.

The first difference of the logarithm the real national housing price variable has a mean and median of 0.022 and 0.026, respectively. The national housing price data reflects a maximum of 0.1168 in 1973. In contrast, in 2008, national housing price had a minimum of -0.0945. This variable has a coefficient of variation of 0.500, which is very similar to that of the Las Cruces housing price. DLNNHP is left skewed, but mesokurtic. As shown in Figure 12, a positive correlation seems to exist between DLNP and DLNHP.

Chapter 5: Empirical Analysis

As outlined using the theoretical framework presented in Chapter 3, the price of single-family homes is analyzed using an ARDL approach. The median Las Cruces single-family housing price (P) is modeled as a function of per capita income (PINC), per capita housing stock (PCS), real mortgage rate (RM), real rents (RR), and the national median single-family housing price (NHP).

Table 4: Reduced Form Equation GLS ARMAX Output for LN(P)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.3795	1.4019	1.6974	0.0976
LN(PINC)	0.3445	0.1027	3.3536	0.0018
LN(PCS)	-0.1294	0.3192	-0.4055	0.6873
RM	0.0092	0.0040	2.3327	0.0249
LN(RR)	-0.0048	0.1104	-0.0431	0.9659
LN(NHP)	0.4607	0.0901	5.1111	0.0000
AR(1)	0.8368	0.0880	9.5133	0.0000
AR(7)	-0.3000	0.0765	-3.9229	0.0003

R-squared	0.9822	Mean dependent var	11.6527
Adjusted R-squared	0.9790	S.D. dependent var	0.2113
S.E. of regression	0.0306	Akaike info criterion	-3.8846
Sum squared resid	0.0365	Schwarz criterion	-3.5697
Log likelihood	99.2878	Hannan-Quinn crit.	-3.7661
F-statistic	307.8049	Durbin-Watson stat	1.8829
Prob(F-statistic)	0.0000		

Table 4 reports estimation results for the reduced form version of the model shown in Equation (3). Due to the presence of serially correlated residuals, a generalized least squares (GLS) autoregressive moving average exogenous (ARMAX) estimator is employed (Pagan, 1974). Because of that, autoregressive parameters are included at lags 1 and 7. The latter may result from the long time periods sometimes required for regional housing markets to re-attain equilibrium following shocks (Riddel, 2000). All but two of the coefficient signs in Table 5 align with the null hypotheses discussed for Equation (3). The implications of the slope coefficient magnitudes are discussed, next.

The information in Table 4 indicates that 10 percent growth in real per capita income, PCINC, leads single-family housing prices in Las Cruces to increase 3.4 percent. A 10 percent increase in the per capita housing stock, PCS, is associated with a 1.3 percent price decline, but the latter coefficient has a computed t-statistic of only -0.406. The most surprising outcome is that the parameter estimate for the real mortgage rate variable, RM, is greater than zero and also satisfies the 5-percent significance criterion. The positive sign for the RM coefficient is unexpected because higher mortgage rates shrink the pool of qualified borrowers and, by extension, the demand for owner-occupied properties.

The slope coefficient for the real apartment rent variable, RR, is less than zero. On the surface, that implies that owner-occupied housing and rental units are complementary goods rather than substitutes in Las Cruces. Similar to nearby El Paso, TX, as national housing prices, NHP, increase, single-family housing values also grow in a statistically reliable manner (Fullerton and Kelley 2008). Given the unanticipated results shown in Table 4, additional analysis is completed using an ARDL approach.

The graphs in Chapter 4 indicate that many of the variables in the sample are non-stationary. Unit root testing is completed using logarithmically transformed versions of PINC, PCS, RR, and NHP. RM is expressed in percentage terms and is not transformed. Table 5 reports augmented Dickey-Fuller (ADF) test results.

Table 5: ADF Test Results

Variable	Intercept				Intercept and Trend			
	Level		First Difference		Level		First Difference	
	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
LN(P)	-2.02	0.2885	-3.95	0.0036	-2.40	0.3735	-4.13	0.011
LN(PINC)	-0.13	0.9396	-6.99	0.0000	-2.60	0.2828	-6.95	0.000
LN(PCS)	-0.86	0.7927	-2.85	0.0598	-1.35	0.8632	-2.94	0.160
RM	-1.89	0.3348	-6.22	0.0000	-2.69	0.2466	-6.19	0.000
LN(RR)	1.74	0.4060	-6.81	0.0000	-1.99	0.5928	-7.02	0.000
LN(NHP)	-0.31	0.9150	-4.56	0.0007	-4.58	0.0034	-4.50	0.004

Note: MacKinnon (1996) one-sided p-values are reported.

Lag length selection for the ADF tests is conducted using the Akaike information criterion (Pindyck and Rubinfeld, 1998). The ADF test statistics in Table 5 indicate that none of the variables are stationary in levels. After first differencing, five of the six series are found to be stationary at the standard 5-percent significance threshold. The exception is PCS, the per capita housing stock variable, for which the p-value does not quite satisfy the standard significance yardstick. Although that outcome is somewhat discouraging, the patterns shown in Table 3 and Figure 9 indicate that, for practical purposes, the first difference of LN(PCS) is stationary. As long as none of the variables are integrated of order 2, I(2), ARDL analysis can be completed.

Because of degree of freedom constraints, a maximum of four lags of the dependent and explanatory variables are employed. The model for single family housing prices selected by Akaike Information Criterion is ARDL(2,3,4,0,4,1). Output for that specification is shown in Table 6.

Table 6: ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LN(P(-1))	0.7256	0.1646	4.4086	0.0002
LN(P(-2))	-0.4301	0.1473	-2.9196	0.0075
LN(PINC)	-0.2066	0.1690	-1.2228	0.2333
LN(PINC(-1))	0.1639	0.2301	0.7124	0.4831
LN(PINC(-2))	-0.2144	0.2320	-0.9242	0.3646
LN(PINC(-3))	0.5423	0.1711	3.1697	0.0041
LN(PCS)	-0.6824	0.5573	-1.2245	0.2326
LN(PCS(-1))	-0.3050	0.8207	-0.3716	0.7134
LN(PCS(-2))	0.0527	0.8807	0.0598	0.9528
LN(PCS(-3))	-0.0952	0.8926	-0.1066	0.9159
LN(PCS(-4))	1.6618	0.6787	2.4487	0.0220
RM	0.0088	0.0029	3.0417	0.0056
LN(RR)	-0.1413	0.1129	-1.2516	0.2228
LN(RR(-1))	-0.2466	0.1205	-2.0463	0.0518
LN(RR(-2))	-0.3968	0.1423	-2.7884	0.0102
LN(RR(-3))	-0.2069	0.1150	-1.7989	0.0846
LN(RR(-4))	-0.1368	0.1121	-1.2203	0.2342
LN(NHP)	0.0902	0.1066	0.8459	0.4060
LN(NHP(-1))	0.2217	0.1084	2.0450	0.0520
C	9.8153	1.9775	4.9634	0.0000

R-squared	0.9927	Mean dependent var	11.6829
Adjusted R-squared	0.9869	S.D. dependent var	0.1818
S.E. of regression	0.0208	Akaike info criterion	-4.6034
Sum squared resid	0.0104	Schwarz criterion	-3.7924
Log likelihood	121.2757	Hannan-Quinn criter.	-4.3027
F-statistic	171.4399	Durbin-Watson stat	2.4652
Prob(F-statistic)	0.0000		

*Note: p-values and any subsequent tests do not account for model selection.

Table 7 summarizes results for a Breusch-Godfrey serial correlation LM test (Asteriou and Hall, 2016). The null hypothesis is that the residuals are not serially correlated. The computed F-statistic indicates that the null hypothesis fails to be rejected and that autocorrelation is not problematic at two lags.

Table 7: Serial Correlation Test Results

Breusch-Godfrey Serial Correlation LM Test

F-Statistic	3.1151	Prob. F(2,22)	0.0644

Table 8 summarizes results for a Breusch-Pagan-Godfrey heteroscedasticity test (Asteriou and Hall, 2016). The null hypothesis that the residuals are homoscedastic. The computed F-statistic is fairly small, indicating that the null hypothesis fails to be rejected and that heteroscedasticity is not present.

Table 8: Heteroscedasticity Test Results

Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-Statistic	1.1577	Prob. F(19,24)	0.3628

Table 9 summarizes outcomes for an ARDL bounds test. The computed F-statistic is 7.15, exceeding the 1-percent critical value for both upper bounds. That implies that a cointegrating relationship is possible (Narayan, 2005).

Table 9: ARDL Bounds Test		
Test Statistic	Value	k
F-statistic	7.147276	5
	Critical Value Bounds	
Significance	I(0) Bound	I(1) Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

As additional diagnostic checks, CUSUM and CUSUMSQ tests for parameter stability are carried out (Johnston and DiNardo, 1997). The CUSUM plot of the cumulative sum of recursive residuals in Figure 13 confirms that the model parameters are stable over time as the computed statistics fall within the 5-percent critical bounds. In Figure 14, the CUSUMSQ plot strays slightly above the upper band of the 5-percent confidence interval the six year period between 1998 and 2003. The cumulative sum of squares of the recursive residuals returns to within the 5-percent critical bounds from 2004 through 2017. On balance, the results point to parameter stability, albeit with less than textbook clarity.

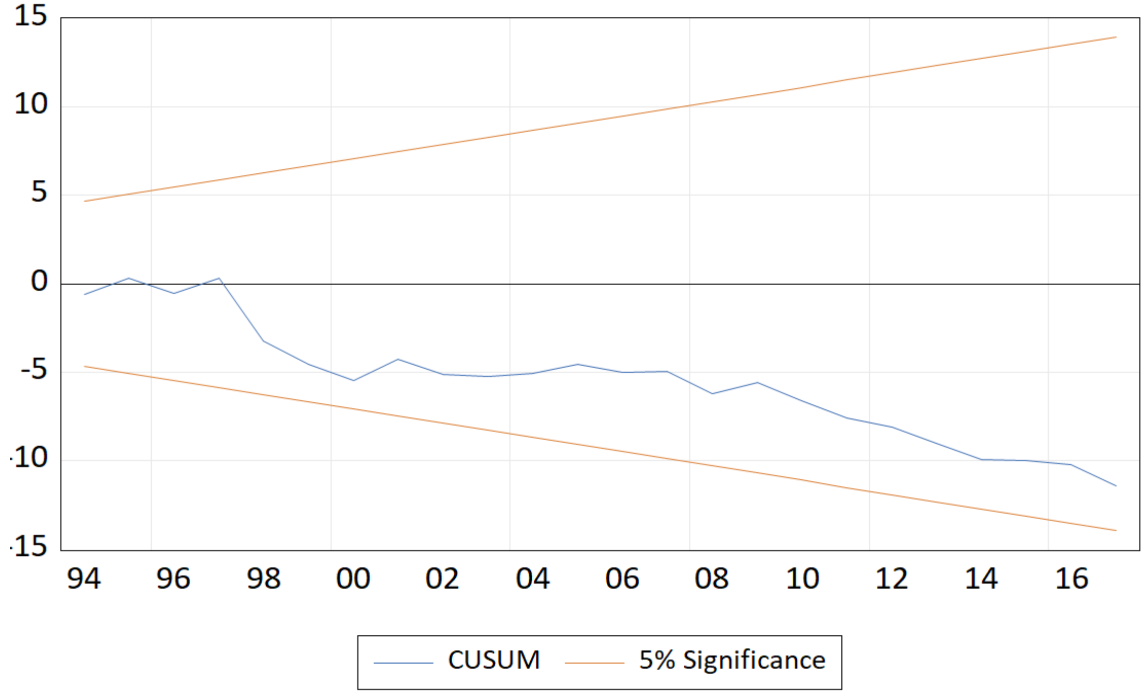

Figure 13. CUSUM Plot for Parameter Stability

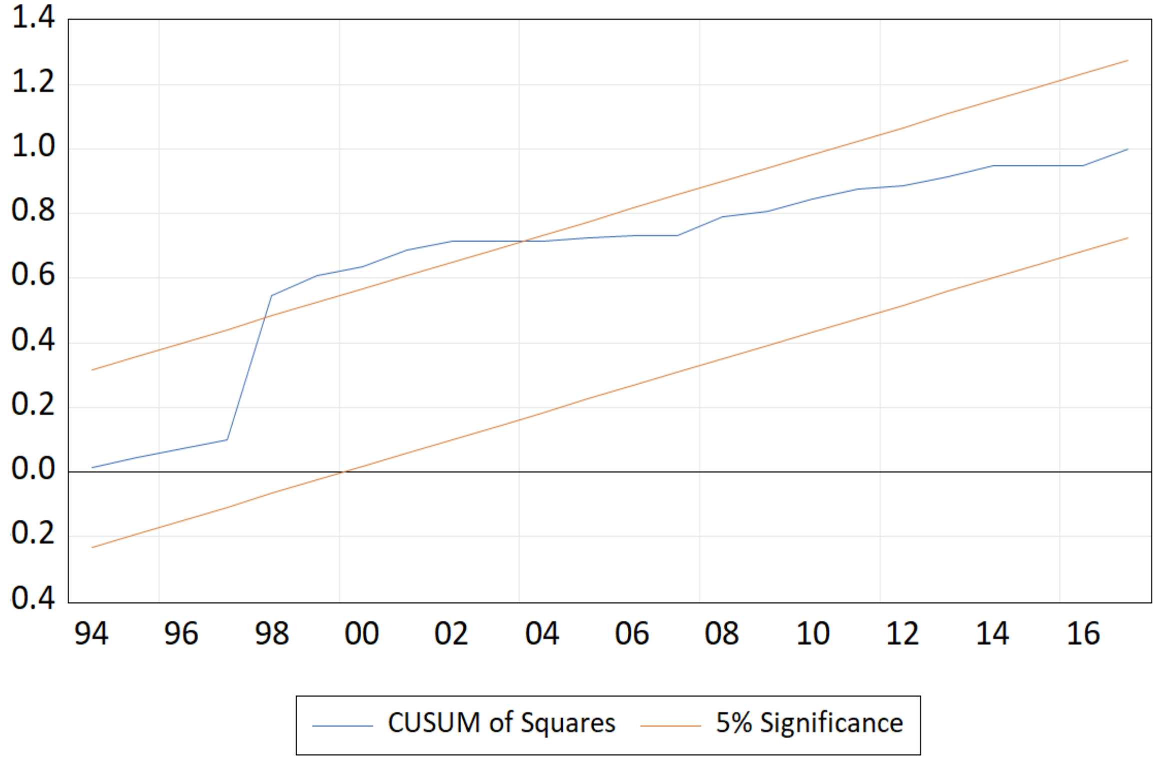

Figure 14. CUSUMSQ Plot for Parameter Stability

Estimation results for the long-run cointegrating model are shown in Table 11. A one-year lag of the residuals for this equation is used as a regressor in the error correction model (ECM) that is discussed below. The ECM coefficient estimated for the lagged error term is expected to be less than zero.

Table 10: Long-Run Cointegrating Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.8153	1.3628	7.2025	0.0000
D(LN(P(-1))	0.4301	0.0968	4.4437	0.0002
D(LN(PINC))	-0.2066	0.1381	-1.4965	0.1476
D(LN(PINC(-1)))	-0.3279	0.1485	-2.2077	0.0371
D(LN(PINC(-2)))	-0.5423	0.1432	-3.7867	0.0009
D(LN(PCS))	-0.6824	0.4050	-1.6848	0.1050
D(LN(PCS(-1)))	-1.6192	0.5040	-3.2127	0.0037
D(LN(PCS(-2)))	-1.5666	0.4810	-3.2569	0.0033
D(LN(PCS(-3)))	-1.6618	0.5756	-2.8872	0.0081
D(LN(RR))	-0.1413	0.0798	-1.7710	0.0893
D(LN(RR(-1)))	0.7406	0.1641	4.5135	0.0001
D(LN(RR(-2)))	0.3438	0.1141	3.0135	0.0060
D(LN(RR(-3)))	0.1368	0.0942	1.4526	0.1593
D(LN(NHP))	0.0902	0.0771	1.1694	0.2537

R-squared	0.7759	Mean dependent var	0.0146
Adjusted R-squared	0.6678	S.D. dependent var	0.0329
S.E. of regression	0.0189	Akaike info criterion	-4.8307
Sum squared resid	0.0104	Schwarz criterion	-4.2225
Log likelihood	121.2757	Hannan-Quinn criter.	-4.6051
F-statistic	7.1735	Durbin-Watson stat	2.4652
Prob(F-statistic)	0.0000		

* p-value incompatible with t-Bounds distribution.

Table 11 summarizes the coefficients for the long-run levels model. All of the coefficients in Table 11 are statistically significant, indicating long-run dependency. However, only the coefficients for personal income, PINC, and national housing prices, NHP, are as hypothesized.

Table 11: Long-Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN(PINC)	0.4048	0.113	3.5829	0.0015
LN(PCS)	0.8969	0.2058	4.3577	0.0002
RM	0.0125	0.0036	3.5256	0.0017
LN(RR)	-1.6019	0.2947	-5.4354	0.0000
LN(NHP)	0.4426	0.0990	4.4719	0.0002

As expected, P is positively correlated with PINC. The coefficient magnitude for PINC indicates that a 10 percent increase in real per capita income leads single-family housing prices in Las Cruces to increase by 4.0 percent. That suggests that long-run income growth translates into fairly substantial housing value increases in the Mesilla Valley.

The long-run coefficients for PCS, RM, and RR are not as hypothesized. An inverse relationship between P and PCS is expected because an increase in the stock of single-family units should drive down prices due to supply effects. The result in Table 11 is in contrast to what is reported in Table 4, although the standard deviation for the PCS coefficient in Table 4 is fairly large.

The positive sign for the RM coefficient in Table 11 is also surprising. That is because rising mortgage rates raise monthly payments on housing loans. That reduces the pool of qualified borrowers in housing markets.

The sign of the RR coefficient in Table 11 is less than zero. That implies that owner-occupied housing and rental units, as approximated by two-bedroom apartments, are complementary goods rather than substitute goods over the long-run in Las Cruces. Given that Las Cruces is the home of New Mexico State University, that outcome may reflect the long-run relationship between enrollments and full-time staffing requirements at the campus. Greater numbers of students increase the demand for rental units. That also increases the numbers of faculty and other professional staff members, many of whom will purchase residential real estate properties. At -1.6, however, the implied relationship of P with respect to changes in RR seems too elastic.

The other coefficient that exhibits the hypothesized sign in Table 11 is that for NHP. All else equal, a 10 percent increase in national housing prices is associated with a 4.4 percent increase in single-family housing values. Las Cruces is a retirement destination. Higher values of NHP tend to be associated with greater mobility. Migrants who sell houses in one region can bid up housing values in destination markets such as Las Cruces.

Table 12: Error Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.8153	1.3628	7.2025	0.0000
D(LN(P(-1)))	0.4301	0.0968	4.4437	0.0002
D(LN(PINC))	-0.2066	0.1381	-1.4965	0.1476
D(LN(PINC(-1)))	-0.3279	0.1485	-2.2077	0.0371
D(LN(PINC(-2)))	-0.5423	0.1432	-3.7867	0.0009
D(LN(PCS))	-0.6824	0.4050	-1.6848	0.1050
D(LN(PCS(-1)))	-1.6192	0.5040	-3.2127	0.0037
D(LN(PCS(-2)))	-1.5666	0.4810	-3.2569	0.0033
D(LN(PCS(-3)))	-1.6618	0.5756	-2.8872	0.0081
D(LN(RR))	-0.1413	0.0798	-1.7710	0.0893
D(LN(RR(-1)))	0.7406	0.16416	4.5135	0.0001
D(LN(RR(-2)))	0.3438	0.1141	3.0135	0.0060
D(LN(RR(-3)))	0.1368	0.0942	1.4526	0.1593
D(LN(NHP))	0.0902	0.0771	1.1695	0.2537
CointEq(-1)	-0.7045	0.0979	-7.1985	0.0000

As noted above, the one-year lag of the residuals for the long-run cointegrating equation shown in Table 11 is used as regressor in the ECM equation. Estimation outcomes for the short-run ECM equation are summarized in Table 12. Similar to the long-run results, there are several surprising results shown in the short-term ECM results.

The most unexpected results in Table 12 are the negative coefficients for the per capita personal income variable lags, PINC. Because housing is a normal good, the correlation between P and PINC is hypothesized as positive. When incomes grow, housing prices should increase.

The estimated parameters for the lags of the per capita housing stock variable, PCS, are negative as hypothesized. Unexpectedly, however, Table 12 indicates that a 10 percent increase in PCS leads to a 49 percent decline in P. That seems unusually elastic for a durable good like single-family residential units.

The short-run cross-price elasticities for real rents, RR, are positive in Table 12. That matches what is conjectured for these coefficients. The magnitudes imply that a 10 percent increase in RR results in an 11 percent increase the price of existing homes as the demand for owner occupancy rises in response, at least in the short-run.

In Table 12, the short-run elasticity for national housing prices, NHP, is positive as postulated. That parameter has a relatively large standard error associated with it. All else equal, a 10 percent increase in the national price of homes generates a 0.9 rise in P. That may be reasonable since investment demand for residential real estate assets is, typically, a long-run process.

The sign for the error correction parameter is less than zero. It also satisfies the 5-percent significance criterion. However, the ECM coefficient magnitude in Table 12 suggests that approximately 70 percent of any deviation from equilibrium is corrected within one year. Approximately 1.4 years are required for complete equilibrium re-attainment. While that may seem fairly rapid, recent evidence indicates that housing markets may be more responsive than was previously the case (Zabel, 2016).

Chapter 6: Conclusion

Las Cruces is the second largest metropolitan economy in New Mexico. In spite of that, the economy of Las Cruces, including the housing market, has not been very extensively researched. To partially fill that gap in the applied economics literature, this study completes an econometric analysis of existing single-family home price fluctuations. A small scale theoretical model is developed as the starting point for the analysis.

Two estimation strategies were used for parameter estimation of the reduced form price equation. One relies on a generalized least squares output that can correct for autoregressive errors (GLS ARMAX). The second employs an autoregressive distributed lag procedure (ARDL) with an error correction model (ECM). Results obtained include numerous unexpected outcomes that include unexpected coefficient signs and/or implausibly large elasticities. Those outcomes point to at least three potential future research questions.

One is that the theoretical model is not appropriately designed for a housing market like that of Las Cruces. A second is that empirically modeling housing prices for small metropolitan economies may be unduly difficult due to data constraints and excessive volatility. To shed light on that question will require similar econometric analyses for other small and medium sized urban economies. A third is that a structural modeling approach is not well-suited to the empirical dissection of residential real estate prices in Las Cruces. If that is the case, an atheoretical modeling approach might be worth applying to data for this housing market. A logical starting point for such an effort would involve vector autoregression analysis.

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Appendix A: Data

Table 13: Annual Historical Data

Year	PNOM	P	PCINC	RPINC	NOMNHP	POP
1970	$14.276	$68.138	$3,237	$15,452	$23,475	70.254
1971	$15.531	$71.109	$3,536	$16,189	$25,225	72.726
1972	$16.673	$73.819	$3,664	$16,220	$27,525	76.553
1973	$18.261	$76.722	$4,022	$16,899	$32,600	76.909
1974	$20.423	$77.714	$4,516	$17,183	$36,050	78.888
1975	$22.870	$80.330	$4,729	$16,612	$39,275	81.979
1976	$24.860	$82.779	$5,147	$17,138	$44,225	85.259
1977	$28.643	$89.548	$5,535	$17,305	$48,900	88.302
1978	$31.723	$92.728	$6,093	$17,811	$55,850	92.193
1979	$36.694	$98.505	$6,561	$17,612	$62,750	93.741
1980	$40.916	$99.162	$7,168	$17,373	$64,750	97.012
1981	$45.919	$102.137	$8,084	$17,981	$68,950	99.623
1982	$53.555	$112.852	$8,644	$18,215	$69,225	103.448
1983	$55.535	$112.251	$9,395	$18,989	$75,375	107.627
1984	$57.019	$111.054	$9,880	$19,243	$79,950	112.474
1985	$59.672	$112.305	$10,454	$19,675	$84,275	116.321
1986	$63.523	$117.007	$10,918	$20,111	$92,025	120.474
1987	$65.465	$116.977	$11,257	$20,114	$104,700	125.032
1988	$65.802	$113.157	$11,394	$19,593	$112,225	130.016
1989	$68.217	$112.402	$12,358	$20,363	$120,425	132.957
1990	$68.381	$107.932	$12,943	$20,429	$122,300	136.593
1991	$70.152	$107.146	$13,417	$20,493	$119,975	141.228
1992	$72.373	$107.669	$14,163	$21,070	$121,375	146.995
1993	$75.455	$109.526	$14,505	$21,054	$126,500	153.049

1994	$78.884	$112.163	$14,668	$20,856	$130,425	157.530
1995	$82.156	$114.406	$15,645	$21,787	$133,475	161.014
1996	$85.041	$115.945	$15,902	$21,680	$140,250	165.618
1997	$87.130	$116.761	$16,377	$21,946	$145,000	169.081
1998	$88.436	$117.577	$17,251	$22,935	$151,925	172.057
1999	$89.974	$117.862	$17,544	$22,982	$160,125	173.889
2000	$91.122	$116.473	$18,423	$23,548	$167,550	175.098
2001	$94.917	$119.036	$20,638	$25,882	$173,100	176.496
2002	$98.505	$121.929	$21,581	$26,713	$186,025	178.464
2003	$103.110	$125.198	$22,499	$27,319	$192,125	182.045
2004	$111.262	$131.810	$23,517	$27,860	$218,150	184.939
2005	$125.857	$144.976	$24,879	$28,658	$236,550	189.199
2006	$139.792	$156.764	$25,770	$28,899	$243,750	193.701
2007	$148.135	$162.006	$27,041	$29,573	$244,950	197.853
2008	$145.029	$153.992	$27,869	$30,522	$229,550	200.855
2009	$143.137	$152.122	$28,961	$31,172	$215,650	205.401
2010	$142.207	$148.588	$30,197	$31,294	$222,700	210.203
2011	$142.483	$145.197	$30,786	$31,061	$224,900	212.869
2012	$144.017	$144.017	$31,365	$30,997	$244,400	214.162
2013	$145.387	$143.456	$30,434	$29,522	$266,225	213.651
2014	$145.296	$141.246	$31,835	$30,505	$285,775	213.536
2015	$147.688	$143.211	$33,628	$32,454	$294,150	213.567
2016	$151.162	$145.021	$34,553	$32,740	$305,125	214.207
2017	$154.422	$145.581	$35,362	$33,337	$322,425	215.579

Year	S	PCS	NMORT	NOM30YINT	RM
1970	14,374	0.193	$93.48		
1971	15,008	0.193	$94.39	7.54	3.29
1972	15,939	0.196	$99.27	7.38	3.97
1973	16,145	0.197	$118.13	8.04	2.66
1974	16,704	0.197	$150.14	9.19	-1.22
1975	17,478	0.199	$165.66	9.05	0.71
1976	18,389	0.201	$176.52	8.87	3.38
1977	19,211	0.202	$203.02	8.85	2.34
1978	20,297	0.204	$244.27	9.64	2.69
1979	20,789	0.205	$326.16	11.20	2.32
1980	21,563	0.206	$441.41	13.74	2.97
1981	22,167	0.206	$593.91	16.64	7.68
1982	22,733	0.207	$668.20	16.04	10.49
1983	23,349	0.207	$578.23	13.24	8.98
1984	24,078	0.208	$620.84	13.88	10.1
1985	24,947	0.208	$589.66	12.43	8.94
1986	25,717	0.21	$562.11	10.19	8.01
1987	26,412	0.211	$594.80	10.21	7.13
1988	27,005	0.212	$587.57	10.34	6.43
1989	27,477	0.212	$595.39	10.32	5.95
1990	27,929	0.213	$601.74	10.13	5.74
1991	28,406	0.213	$570.34	9.25	5.9
1992	28,927	0.214	$527.74	8.39	5.72
1993	29,573	0.214	$508.47	7.31	4.82
1994	30,469	0.215	$565.08	8.38	6.29
1995	31,549	0.216	$537.89	7.93	5.83

1996	32,652	0.217	$591.89	7.81	5.67
1997	33,710	0.217	$594.36	7.60	5.86
1998	34,761	0.218	$576.12	6.94	6.15
1999	35,830	0.219	$638.61	7.44	5.95
2000	36,252	0.22	$657.43	8.05	5.57
2001	37,374	0.22	$594.70	6.97	5.05
2002	38,383	0.221	$606.97	6.54	5.22
2003	39,429	0.222	$622.66	5.83	3.88
2004	40,539	0.222	$698.38	5.84	3.35
2005	41,883	0.223	$779.86	5.87	3.02
2006	43,495	0.225	$920.11	6.41	3.69
2007	44,856	0.227	$968.18	6.34	3.8
2008	45,883	0.227	$910.60	6.03	3.03
2009	46,559	0.228	$783.28	5.04	5.13
2010	48,402	0.23	$708.47	4.69	2.98
2011	49,917	0.234	$649.54	4.45	1.91
2012	50,690	0.237	$579.58	3.66	1.75
2013	51,458	0.241	$588.46	3.98	2.63
2014	51,436	0.241	$585.50	4.17	2.67
2015	51,566	0.241	$558.95	3.85	3.6
2016	52,036	0.243	$550.54	3.65	2.58
2017	52,695	0.244	$582.58	3.99	2.23

Year	RENTNOM	RR	NOMNHP	NHP	PCE
1970	$135.45	$646.49	$23,475	$112,047	0.210
1971	$141.17	$646.35	$25,225	$115,494	0.218
1972	$145.71	$645.12	$27,525	$121,868	0.226
1973	$153.42	$644.59	$32,600	$136,963	0.238
1974	$168.66	$641.78	$36,050	$137,177	0.263
1975	$178.44	$626.77	$39,275	$137,952	0.285
1976	$188.07	$626.22	$44,225	$147,260	0.300
1977	$200.55	$627.00	$48,900	$152,879	0.320
1978	$215.02	$628.50	$55,850	$163,252	0.342
1979	$234.01	$628.21	$62,750	$168,452	0.373
1980	$260.40	$631.09	$64,750	$156,924	0.413
1981	$284.46	$632.72	$68,950	$153,365	0.450
1982	$300.91	$634.09	$69,225	$145,872	0.475
1983	$314.02	$634.73	$75,375	$152,353	0.495
1984	$326.85	$636.60	$79,950	$155,717	0.513
1985	$345.28	$649.83	$84,275	$158,608	0.531
1986	$365.85	$673.87	$92,025	$169,506	0.543
1987	$384.25	$686.59	$104,700	$187,085	0.560
1988	$400.48	$688.69	$112,225	$192,989	0.582
1989	$411.30	$677.71	$120,425	$198,426	0.607
1990	$424.29	$669.71	$122,300	$193,039	0.634
1991	$438.36	$669.53	$119,975	$183,243	0.655
1992	$456.76	$679.52	$121,375	$180,569	0.672
1993	$470.83	$683.44	$126,500	$183,621	0.689
1994	$419.96	$597.13	$130,425	$185,447	0.703
1995	$419.96	$584.82	$133,475	$185,870	0.718

1996	$428.62	$584.38	$140,250	$191,217	0.733
1997	$440.53	$590.34	$145,000	$194,310	0.746
1998	$452.43	$601.51	$151,925	$201,985	0.752
1999	$460.01	$602.59	$160,125	$209,758	0.763
2000	$467.00	$596.92	$167,550	$214,162	0.782
2001	$483.00	$605.73	$173,100	$217,086	0.797
2002	$496.00	$613.94	$186,025	$230,260	0.808
2003	$498.00	$604.68	$192,125	$233,280	0.824
2004	$516.00	$611.29	$218,150	$258,438	0.844
2005	$533.00	$613.97	$236,550	$272,485	0.868
2006	$552.00	$619.01	$243,750	$273,342	0.892
2007	$559.00	$611.34	$244,950	$267,886	0.914
2008	$586.00	$622.21	$229,550	$243,735	0.942
2009	$610.00	$648.29	$215,650	$229,186	0.941
2010	$614.00	$641.55	$222,700	$232,694	0.957
2011	$604.00	$615.50	$224,900	$229,183	0.981
2012	$670.00	$670.00	$244,400	$244,400	1.000
2013	$785.00	$774.57	$266,225	$262,689	1.013
2014	$672.00	$653.26	$285,775	$277,807	1.029
2015	$700.00	$678.78	$294,150	$285,234	1.031
2016	$744.00	$713.77	$305,125	$292,728	1.042
2017	$805.00	$758.91	$322,425	$303,965	1.061

Vita

Steven L. Fullerton was born in El Paso, Texas. He graduated from Cathedral High School in 2010 where he was All-City in Baseball and Football. After transferring to New Mexico State University (NMSU), he received a Bachelor of Business Administration with a major in Management and a Minor in Economics in 2014. While pursuing his undergraduate degree, he worked for The Hatch Chile Store, Talavera Business Consulting, and the El Paso Diablos. His senior econometrics project on Major League Baseball Wins was published in *Research in Business & Economics Journal*.

After graduating from NMSU, he was admitted to the Master of Science in Economics program at UTEP in June 2014. While in graduate school, Steven initially worked as a Financial Analyst with United Bank of Paso del Norte, later as a Business Loan Analyst with WestStar Bank, and finally as Associate Director and Economist with the University of Texas at El Paso (UTEP) Border Region Modeling Project. As a graduate student at UTEP, he co-authored two sports economics research studies that were published, respectively, in *Applied Economics Letters* and in *Journal of Economics & Political Economy*.

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This thesis/dissertation was typed by Steven Fullerton.