Las Cruces Housing Prices

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Abstract
This study analyzes the median price for existing single-family housing units in Las Cruces, New Mexico. The proposed theoretical model accounts for the interplay between supply and demand sides of a metropolitan housing market. Annual frequency data are collected for a 1975-2017 sample period. Preliminary empirical results confirm several of the hypotheses associated with the underlying analytical model.

Keywords
Housing Economics; Las Cruces, New Mexico; Applied Econometrics

JEL Classification
R15, Regional Econometrics; R21, Housing Demand; R31, Housing Markets

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 fairly 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. 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 is employed. Data utilized are collected by The University of Texas at El Paso Border Region Modeling Project. The reduced form model is derived by equating housing supply with housing demand (DiPasquale and Wheaton,

1994). The underlying equations are 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 reviews estimation outcomes and offers concluding remarks.

2. Literature Review

A typical approach to modeling residential real estate supply is to specify 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 should be applicable to the Las Cruces housing market, as well.

A variety of studies have analyzed 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 is 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).

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. More broadly, during 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.

3. Theoretical Model

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:

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

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.

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

In Equation (2), D is expected to be positively correlated with INC, 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 INC, MORT, RENT, and NHP. Equation (3) is developed as shown below:

$$S_t = D_t$$
$$\alpha_0 + \alpha_1 P_t + \alpha_2 S_{t-1} = \beta_0 + \beta_1 INC_t - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t - \beta_5 P_t$$
$$\alpha_1 P_t = \beta_0 - \alpha_0 + \beta_1 INC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t - \beta_5 P_t$$
$$\alpha_1 P_t + \beta_5 P_t = \beta_0 - \alpha_0 + \beta_1 INC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t$$
$$(\alpha_1 + \beta_5) P_t = \beta_0 - \alpha_0 + \beta_1 INC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t$$
$$P_t = (\beta_0 - \alpha_0 + \beta_1 INC_t - \alpha_2 S_{t-1} - \beta_2 MORT_t + \beta_3 RENT_t + \beta_4 NHP_t) / (\alpha_1 + \beta_5)$$
$$P_t = \gamma_0 + \gamma_1 INC_t + \gamma_2 S_{t-1} + \gamma_3 MORT_t + \gamma_4 RENT_t + \gamma_5 NHP_t \quad (3)$$

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.

Three of the five slope coefficient signs in Equation (3) are hypothesized to be positive: $\gamma_1 > 0$; $\gamma_4 > 0$; $\gamma_5 > 0$. As real incomes per household increase, INC, the demand for housing services should also increase, causing the median price for existing units to rise. As the real price for rental units, RENT, goes up, consumers are expected to look for substitute forms of housing, leading to greater demand for owner occupancy, and resulting in higher purchase prices. Finally, as national housing prices, NHP, strengthen, investment demand for residential real estate assets in regional markets such as Las Cruces should also increase in response to greater rates of return.

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 receive extensive statistical documentation. Empirical assessment of the model is performed in the next section.

4. Sample Data

Table 1 contains names, descriptions, units of measure, 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 Name	Description	Units	Sources
P	Real Median Single-Family Housing Price	2012 Real $	IHS BRMP
INC	Real Income per Capita	2012 Real $	BEA Census

MORT	Average Real Mortgage Payment	2012 Real $	IHS BRMP
RENT	Median Real 2-BR Apartment Rent	2012 Real $	HUD BRMP
NHP	USA Real Median SF Housing Price	2012 Real $	FRED BRMP
S	Las Cruces Single-Family Housing Stock	SF Houses	IHS ECON BRMP

Notes:
BEA, U.S. Bureau of Economic Analysis.
Census, U.S. Census Bureau.
ECON, 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 INC 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. A relatively large percentage of the population in Las Cruces is comprised by out-of-town students that attend New Mexico State University and 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 banking 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	INC	S	MORT	RENT	NHP
Mean	$116,423	$23,070	32,426	$806.63	$642.16	$198,788
Median	$115,176	$21,062	30,021	$790.80	$634.41	$192,103
Maximum	$162,006	$33,337	52,695	$1,408.04	$774.57	$303,965
Minimum	$68,138	$15,452	14,374	$432.16	$584.38	$112,047
Std Dev	$24,469	$5,506	11,857	$231.05	$39.70	$50,034
Skewness	-0.10	0.45	0.26	0.46	1.22	0.30

Kurtosis	2.32	1.75	1.82	2.72	4.95	2.14
Coef Var	0.21	0.24	0.37	0.29	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. INC has a standard deviation of $5,506. The third moment indicates that the observations for INC are fairly symmetric, although a little right-skewed. The fourth moment indicates that INC is somewhat platykurtic, but the coefficient of variation does not imply that the latter is very pronounced.

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.

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.

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 statistic of 4.95.

For the sample period in question, the real national housing price variable mean is $198,788 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 exists between P and NHP.

5. Empirical Analysis

Parameter estimates for Equation (3) using levels data are shown in Table 3. Most of the coefficient signs match those of the null hypotheses described above. Of concern, however, is the notable departure associated with the real mortgage

payment. The parameter for that variable has a positive sign. To counter the risk of spurious regression output, a second version is estimated using differenced data.

Table 3. Levels Equation Output

Dependent Variable: LN(LCP)
Method: Least Squares
Sample (adjusted): 1971 2017
Include observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LN(INC)	1.1252	0.1320	8.5254	0.0000
LN(PCS)	-0.1108	0.1604	-0.6906	0.4937
LN(RM)	0.3150	0.0354	8.9054	0.0000
LN(RENT)	0.1427	0.1359	1.0504	0.2997
LN(NHP)	0.1570	0.0985	1.5935	0.1187
C	-3.9555	1.1969	-3.3047	0.0002

R-squared	0.9517	Mean dependent var.	11.653
Adjusted R-squared	0.9458	S.D. dependent var.	0.2113
S.E. of regression	0.0492	Akaike info criterion	-3.1995
Sum squared resid.	0.0993	Schwarz criterion	-2.8307
Log likelihood	78.073	Hannan-Quinn criter.	-2.9780
F-statistic	161.41	Durbin-Watson stat.	0.7572
Prob(F-statistic)	0.0000		

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

Estimation output obtained using differenced data is summarized in Table 4. These results bode even less well for the theoretical model, at least in the context of analyzing single-family housing price fluctuations in Las Cruces. Two of the coefficients exhibit signs contrary to those hypothesized. One is the parameter estimate for housing stock per capita, PCS. The other is that for the real mortgage rate, RM. The former is concerning because, all else equal, increases in the housing supply should lower housing prices. The latter is disquieting because higher mortgage rates should shrink the pool of qualified borrowers and reduce both sales and prices.

Positive signs are reported in Table 4 for the parameter estimates for remaining explanatory variables. For real per capita income, INC, and the real national housing price, NHP, the elasticity magnitudes in Table 4 seem plausible. For real 2-bedroom rents, RENT, the slope coefficient is so close to zero that it can be concluded that a reliable statistical relationship is not present in this sample.

Table 4. First Differenced Variables Equation Output

Dependent Variable: D(LN(LCP))
Method: Least Squares
Sample (adjusted): 1971 2017
Include observations: 47 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(LN(INC))	0.1724	0.2113	0.8011	0.4278
D(LN(PCS))	0.2789	0.4704	0.5929	0.5566
D(LN(RM))	0.0622	0.0548	1.1347	0.2633
D(LN(RENT))	0.00003	0.0002	0.1812	0.8571
D(LN(NHP))	0.1453	0.1134	1.2817	0.2073
C	0.0096	0.0062	1.5517	0.1286

R-squared	0.1093	Mean dependent var.	0.0156
Adjusted R-squared	-0.0021	S.D. dependent var.	0.0325
S.E. of regression	0.0325	Akaike info criterion	-3.8936
Sum squared resid.	0.0423	Schwarz criterion	-3.6551
Log likelihood	95.552	Hannan-Quinn criter.	-3.8042
F-statistic	0.9813	Durbin-Watson stat.	1.3554
Prob(F-statistic)	0.4411		

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

6. Conclusion

Las Cruces is the second largest metropolitan economy in New Mexico. In spite of that, relatively little econometric research has been completed for it. This study attempts to partially address that gap in the regional economic literature by analyzing housing price fluctuations in this urban economy. To that end, a theoretical model is proposed that takes into account residential real estate dynamics.

Empirical analysis is conducted using original data in levels and also using logarithmically transformed first differenced data. Parameter estimation results in both cases are fairly inconclusive. Of particular concern are results that indicate that Las Cruces housing prices increase when the housing supply increases and, also, when real mortgage rates increase. Given those outcomes, additional research for this metropolitan economy and for other medium- and small-sized housing markets appears warranted before reaching any firm conclusions.

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