Determinants of Interstate Differentials in the Real Median Price of Single Family Homes

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ABSTRACT

This empirical study investigates determinants of interstate real median home price differentials for the year 2005. While the literature on geographic cost-of-living differentials is well developed, the literature on geographic housing price differentials is much less so. Given the relatively large impact of housing prices on overall living costs, this research seeks to address this issue and shed light on specific factors influencing the real median price of housing across states. The OLS results imply that the real median price of a single-family home in a state is positively a function of the state's population growth rate, its per capita income, and its relative amount of shoreline on major bodies of water, and negatively a function of toxic waste releases in the state, the state's geographic area, and the presence of right-to-work laws in the state.

Keywords: *Housing Prices; Population Growth; Pollution; Right-to-Work Laws*

INTRODUCTION

The determinants of geographic living-cost differentials (L-CDs) in the U.S has attracted the interest of a large number of researchers, including Cebula (1980; 1989), Cebula and Todd (2004), Cobas (1978), Ostrosky (1983), McMahon (1991), Nord (2000), and Kurre (2003). The study of geographic L-CDs is of interest given that such differentials have consistently been found to be significant in explaining geographic mobility in the U.S. [Renas (1978; 1980; 1983); Cebula (1978; 1993); Cebula and Alexander (2006); Ashby (2007)]. Most of the published L-CD related research to date has tended to focus on states, metropolitan areas, or counties.

Less well developed is the literature on interstate housing price differentials. Based on the most recent consumer price index methodology, expenditures on residential housing constitute approximately 40 percent of total expenditures by consumers. Furthermore, as Ashby (2007, p. 686) observes, "...housing...is the main driver of cost-of-living differences between states." Moreover, given the recent turbulence in housing markets nationwide, an investigation of interstate differentials in housing prices is of interest in its own right and may shed light on the factors accounting for the substantial variations in housing market performance across the country. Accordingly, this empirical study focuses on the single most important component of L-CDs, that of housing prices, by investigating determinants of real median prices on single-family homes across states for the year 2005.

THE FRAMEWORK

Consistent in principle with the research on L-CDs, the perspective underlying this analysis of housing prices is that factors affecting housing supply and housing demand, including the relative attractiveness of a geographic area in terms of amenities and dis-amenities, influence those housing prices. Factors that elevate housing demand or represent amenities tend to elevate overall housing prices in an area, whereas factors tending to increase the relative supply of housing or reduce the desirability of an area, i.e., dis-amenities, lead to lower housing prices in that area.

In this empirical analysis, the dependent variable, *PHOMEj,* is defined as the median price of single-family homes in state j in 2005, scaled/divided by the overall cost of living index for state j for 2005. Thus, *PHOMEj* is the *real* median price of single-family homes in each state. Data are unavailable for two states, Maine and New Hampshire, leaving a total of 48 states for empirical investigation.

It is expected that the greater the net population growth rate *(POPGRj)* in an area, the greater the growth in the overall demand for housing in the area, thus yielding higher housing prices, *ceteris paribus.* In other words, positive net growth in the population base, whether attributable to endogenous growth or net in-migration, would contribute to the demand for available housing and create upward pressure on housing prices.

Higher per capita income in an area (PCIj) is expected to raise the overall demand for housing in the area and hence the overall level of home prices in the area, *ceteris paribus.* Previous research [Cebula (1980; 1989), Cebula and Todd (2004), Cobas (1978), Ostrosky (1983), and Kurre (2003)] has found that the average overall price level in a regional economy responds positively to an increase in per capita income, the effects of which are transmitted to regional price levels through an increase in the overall demand for goods and services. Naturally, a parallel effect is anticipated for median home prices. Given that housing is a normal good, the demand for housing is expected to increase as per capita income rises in a state, thus contributing to higher median prices on single-family homes in the state, *ceteris paribus.*

Whereas *POPGRj* and PCIj may jointly help to explain interstate home price differentials, other factors very likely play significant roles as well. For example, a coastal location is deemed by many to be highly desirable. Indeed, it is hypothesized here that for many persons there is a value associated with closer proximity to large bodies of water, i.e., in this case, either the Gulf of Mexico, the Pacific Ocean, the Atlantic Ocean, or the Great Lakes. Similar to the logic offered in Cebula and Toma (2007) and Cebula and Todd (2004), it is expected that coastal location *(COASTj)* exercises a positive impact on median home prices because many people may be willing to pay a premium for living in a coastal area, *ceteris paribus.* Alternatively stated, the value of coastal location is capitalized into housing prices.

Next, the role of climate has been shown to be a determinant of migration and thus may be capitalized in housing prices [Cebula (1978)]. In this analysis, climate is proxied by average annual heating degree days (HOD]). This variable is lower in warmer climates, reflecting the desirable feature of warmer temperatures that presumably may be capitalized into housing prices. Accordingly, *PHOMEj* is expected to be negatively related to *HDDj, ceteris paribus,* since increases in *HDDj* reflect colder climate. In addition, the effect of toxic chemical releases (TOXj), measured on a per square mile basis, on *PHOMEj* is considered. This variable reflects pollution conditions in each state, and as an undesirable feature, is also expected to be capitalized into housing prices. In particular, higher levels of toxic chemical releases in a state are expected to be considered a dis-amenity for would-be home buyers and are thusly expected to reduce the demand for and hence the real median price of single-family homes in that state, *ceteris paribus.*

Very often, the quality of public education is a significant factor driving the demand for housing. Cebula (1978) and Cebula and Alexander (2006) demonstrate that population migration is, in part, positively affected by public school related expenditures. All else equal, then, perceived better public schools are likely to increase the demand for housing, thus creating upward pressure on *PHOMEj.* The effect of the quality of public schools on median home prices is modeled in this study by using the average public school teacher salary in each state relative to the U.S. average, *TCHALj.* In other words, this variable is adopted as a control for the quality of public schools across the states. Accordingly, *PHOMEj* is expected to be positively related to *TCHSALj, ceteris paribus.* Alternatively stated, it is expected that perceived better public school quality is capitalized into housing prices.

The remaining two variables considered in the analysis characterize supply side factors that may affect median home prices across the states. First, the greater the overall land area *(AREAj)* in a state, the greater the overall availability of land for use in residential, commercial, or industrial applications. With a greater overall supply of land in a state, all else equal, the equilibrium price of land is expected to be lower. Given that home prices in part reflect the price of the land upon which they are constructed, it is expected that *PHOMEj* is inversely related to *AREAj.* Second, Section 14(b) of the Taft-Hartley Act provides that each state shall have the right to enact "right-to-work" laws, laws that provide workers/employees the legal right to refuse to join unions in their place of employment. By nature, states with right-to-work laws (RTWj) tend to be states with weaker labor union influence. Accordingly, as in Cebula (1980) and Ostrosky (1983), it is argued that because of weaker labor union power, the unit costs of production are lower in states having right-to-work legislation. These lower labor costs also presumably apply to the home construction industry. The lower labor costs of home construction in right-to-work states are in turn then presumably reflected in lower median prices on single-family homes, *ceteris paribus.*

EMPIRICAL MODEL AND FINDINGS

Based on the eclectic model developed above, several versions of the following basic reduced-form equation are estimated:

$$PHOMEj = a + b\ POPGRj + c\ PCIj + d\ COASTj + e\ HDDj + f\ TOXj + g\ TCHSALj + h\ AREAj + i\ RTWj + u \quad (1)$$

where:
PHOMEj = the nominal median single-family home price in state *j* in 2005, divided/scaled by the overall cost of living index for state j in 2005 (the latter index has a mean value = 100.00);
a = constant;
POPGRj = the estimated net percentage population growth rate in state *j,* 2000-2004;
PCIj = the per capita income in state], 2004;
*COASTj =*a relative measure of the amount of land along coastal areas of states with major bodies of water, namely, the Gulf of Mexico, the Pacific Ocean, the Atlantic Ocean, and the Great Lakes; variable *COASTj* defined as the number of miles of general coastline on a major body of water divided by the land area of the state;
HDDj = average annual heating degree days in state j;
TOXj = toxic chemical releases into the air, water, or land of state j, in thousands of pounds, divided by *AREAj, 2004;*
TCHSALj = the ratio of the average salary for a public school teacher in state j to the average salary of a public school teacher in the U.S. as a whole, 2004;
AREAj = the geographic area of state j, expressed in square miles;
RTWj = a binary variable indicating whether state j is a right-to-work state: *RTWj =* 1 for those states where right-to-work laws are in effect, and *RTWj =* 0 otherwise; and
u= stochastic error term.

Based on the arguments provided in Section 11 above, it is expected that:

$$b > 0, c > 0, d > 0, e < 0, f < 0, g > 0, h < 0, I < 0 \quad (2)$$

The data sources are, as follows:

COAST: http://www.infoplease.com/ipa/A0001801.html, and web-sites of the Department of Natural Resources of various Great Lakes states; *RTW:* U.S. Census Bureau (2005, Table 640);
PC1, AREA, POPGR, PHOME, TCHSAL, TOX, HDD: http://sdc.state.nc.us.

Table 1 provides the basic descriptive statistics for all of the variables considered.

TABLE 1. DESCRIPTIVE STATISTICS

Variable	Mean	Standard Deviation	Maximum	Minimum
PHOME	163,767.9	59,061.7	350,476.9	91,381.2
PC!NC	29,076.4	4,574.5	45,898.0	22,263.0
POPGR	3.85	3.34	16.90	-3.10
LAND	72,712.1	87,237.0	571,949.0	61.0
RW	0.46	0.50	1.00	0.00
TOX	0.658	0.718	2.970	0.001
TCHSAL	0.940	0.140	1.224	0.709
HDD	4,877.4	2,194.7	8,812.0	0.0
COAST	0.008	0.019	0.117	0.000

Table 2 provides the correlation coefficients among the explanatory variables shown in equation [11. As shown, arguably only the correlations between PCI and *TCHSAL* (+0.75) and between *RTW* and *TCHSAL* (-0.63) are at all noteworthy. This is likely to account for inconsistencies in significance for *TCHSAL* when it appears in the estimated models along with *RTW* and *PCINC,* as shown in the OLS estimations provided in Table 3. For this reason, several versions of equation [1] are estimated.

TABLE 2. CORRELATION COEFFICIENTS

	PCINC	POPGR	LAND	RW	TOX	TCHSAL	HDD	COAST
PCINC	1.-00							
POPGR	-0.17	1.00						
LAND	-0.08	0.25	1.00					
RW	-0.45	0.27	0.02	1.00				
TOX	-0.08	-0.14	-0.31	-0.11	1.00			
TCHSAL	0.75	-0.07	-0.01	-0.63	0.21	1.00		
HDD	0.24	0.29	0.19	-0.33	-0.18	0.11	1.00	
COAST	0.09	-0.02	-0.13	-0.26	-0.01	0.27	-0.21	1.00

Estimating several versions of equation [1] by OLS, using the White (1980) correction for heteroskedasticity, yields the results provided in Table 3. The terms in parentheses below the estimated parameters are t-statistics.

TABLE 3. OLS REGRESSION RESULTS, DEPENDENT VARIABLE IS *PHOMEj*

Variable	Model 1	Model 2	Model 3	Model 4
Constant	-89,788.6**	-76,886.0**	-121,289.7**	-95,139.4*
	(-2.20)	(-2.63)	(-2.56)	(-1.98)
POPGRj	+7,114.2**	+8,700.2***	+7,849.3***	+7,221.8***
	(+8.66)	(+8.59)	(+9.67)	(+8.88)
PCIj	+5.56***	+7.87***	+5.124**	+5.79***
	(+2.93)	(+7.94)	(+2.25)	(+3.73)
COASTj	+467,586.4*	+749,040.0***	+605,330.8**	
	(+1.72)	(+4.114)	(+2.17)	
HDDj	-4.78			-5.88*
	(-1.51)			(-1.95)

TOXj	-21,132.1**	-11,402.3***	-18,991.3**	-18,290.8**
	(-2.46)	(-3.05)	(-2.26)	(-2.56)
TCHSALj	+123,741.1		+138,241.0	+133,122.4*
	(+1.36)		(+1.25)	(+1.86)
AREAj	-0.107***	-0.104***	-0.129***	-0.113**
	(-2.71)	(-2.84)	(-4.29)	(-2.64)
RTWj	-23,373.2**	-23,379.1***	-15,294.0**	-28,146.4**
	(-2.46)	(-2.92)	(-2.04)	(-2.57)
R^2	0.83	0.78	0.81	0.81
adjR^2	0.80	0.75	0.78	0.78
F-statistic	24.0	25.0	24.4	24.7

***indicates significance at the 1 percent level.
** indicates significance at the 5 percent level.
* indicates significance at the 10 percent level.

In Model 1 of Table 3, five of the eight estimated coefficients are statistically significant at beyond the five
percent level with the expected signs, whereas one is significant at the five percent level with the expected sign. The F-statistic is significant at the one percent level, attesting to the overall strength of the model. The coefficient of determination from Model 1 is 0.83. Thus, the variables in the model jointly explain over four-fifths of the variation in median home prices across the 48 states in the data set.

The specification in Model 2 drops the two variables in Model 1 that are not statistically significant at generally accepted levels, *HDDj* and *TCHSALj.* The estimated parameters and t-statistics are very similar for the remaining variables in the model, thus attesting to the robustness of the results. Two other specifications are provided in Table 3 in which *HDDj* and COASTj are alternatively dropped from the model when re-estimated. The coefficient of determination and the F-statistic from each of the four models presented in Table 3 are nearly identical, the t-statistics are for the most part similar, and the signs on the estimated parameters are consistent with expectations.

The coefficient on variable *POPGRj* is positive and significant at the one percent level across all specifications presented in Table 3. Thus, there is evidence that the greater the population growth rate in a state, the higher the real median price on single-family homes in that state. Greater population growth implies a greater demand for housing, thus resulting in higher home prices. The coefficient on variable *PCIj* is positive and significant at well beyond the one percent level in each model estimated. Given that housing is a normal good, increasing income generates greater demand for housing and drives up the real median price of a single-family home in a state. The variable *COASTj* is positive and significant at beyond the ten percent level in one specification, at the five percent level in another specification, and at the one percent level in yet another specification. These results imply that the desirability of coastal location along or relatively near the Gulf of Mexico, the Pacific Ocean, the Atlantic Ocean, or the Great Lakes tends to be capitalized as a premium into home prices. As compared to the desirable amenity of a coastal location, there is only very modest empirical support for the notion that cold climate, as proxied by *HDDj,* is capitalized into real median home prices: *PHOMEj* is found to be inversely related to *HDDj* at only the six percent significance level in one of two specifications presented, i.e., in Model 4. Although it remains intuitively plausible that warmer temperatures in southern climates may be capitalized into home prices, the empirical support for this hypothesis in the present data set is marginal.

By contrast, the dis-amenity characterized by the toxic waste releases standardized by land area in a state, *TOXj,* is clearly capitalized into home prices. The coefficient on *TOXj* is negative and significant at beyond the five percent level in all four sets of results presented in Table 3. Thus, greater relative levels of pollution in a state are associated with real lower median prices on single-family homes. Two other variables, *AREAj* and *RTWj,* enter the model with negative coefficients that are significant at or beyond the five percent level across the four specifications. Thus, *PHOMEj* is inversely related to the availability of land in a state, *AREAj.* Given that land costs are not an inconsequential component of housing price, this result is as expected. The real median price of a single-family home in a state is also a decreasing function of the presence of right-to-work legislation *(RTWj)* in that state. This presumably occurs because such legislation leads to weaker labor unions and lower unit labor costs that reduce the overall cost of home construction. Finally, the estimated coefficient on *TCHSALj* is positive as expected in the models where it is present, but it is significant at the ten percent level only in Model 4. This variable thus proves to be a statistically insignificant factor in explaining the real median price on single-family homes across states.

CONCLUSION

This empirical study finds that, for the year 2005, the real median price of a single-family home in the j^{th} state was an increasing function of the population growth rate in the state, the state's per capita income, and location of the state on either of the Gulf of Mexico, the Pacific Ocean, the Atlantic Ocean, or the Great Lakes. In addition, the real median price of a single-family home was found to be a decreasing function of pollution, land area, and right-to-work laws. Although colder temperatures were found to potentially reduce median home prices, whereas the relative level of public school teacher salaries *potentially* increased median home prices, the evidence regarding both of these factors is relatively weak.

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