House Prices and City Revenues

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Abstract

Very little is known about what impact recent large upward and downward swings in single-family home values have had on local government budgets. Using a unique 15-year panel of Florida cities that includes both detailed revenue and house price data, we investigate the pathways whereby a change in house price may affect city revenue per capita and test for symmetric effects during housing booms and busts. For the median-sized city, we find that while increases in house price raise revenues, decreases in price have no effect on revenues. In addition, the former impact is small in magnitude. While the strongest pathway is through assessed values, our results illustrate that a change in house price can also affect other sources of revenue besides ad valorem taxes. The overall conclusion is that movements in Florida housing markets are only weakly related to a city’s property taxes and total revenues per capita, which fails to support the argument portrayed in the popular press that house price changes strongly impact local budgets.

Key words: house prices, city revenues, ad valorem

JEL: H20, H71, R20

I. Introduction

Because the property tax is an important source of revenue for cities and the tax is ad valorem, fluctuations in housing values may have significant budgetary consequences for local governments. While this issue has not received much attention from economists in the past, the recent boom and bust cycle in select single-family home markets in the U.S. has moved

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the topic up the collective research agenda. Alm and Sjoquist (2011) and Lutz et al. (2011) provide evidence on how property tax revenues have been impacted by the recent rise and fall in housing values. The key finding of both studies is that housing prices and property taxes are only weakly related and, as a result, property tax collections have remained fairly stable during the housing crisis, at least through the present time. Lutz et al. (2011) use state level data, while Alm and Sjoquist (2011) use both states and sub-state governmental units (townships, cities, counties, and school districts) to conduct their analysis. Changes in house prices are measured at either the state level or the MSA level in these studies. In contrast, we study just cities within the state of Florida and use a constant quality price index computed for each city to relate city revenues to changes in housing prices.

Florida was home to some of the nation’s most accelerated appreciations in housing prices during the first half of the last decade. But starting in Southwest Florida in 2006, prices began to fall suddenly. Like a contagion, depreciations spread eastward and northward across the state until prices had declined throughout the state by the end of 2009.\(^3\) A few years into the real estate booms that were occurring throughout the state, Florida newspapers painted a picture of local governments that were flush in property tax revenues (Kennedy, 2005, Nov. 16; 2006, Jul. 1; 2007, Mar. 25). Sentiments abruptly changed after 2006 to reports about a housing bust that left jurisdictions strapped for cash (Goodnough, 2007, Apr. 7; Nickens, 2008, Feb. 24) and unable to respond (Padgett, 2009, Jun. 29; Wiseman, 2010, Mar. 29).\(^4\) These perceptions, however, were largely anecdotal; the reports provided little hard evidence. Our research is motivated by two questions: 1) Were these characterizations of local budgets correct, and 2) What role did fluctuations in real housing prices play in explaining the changes in budgets that actually occurred?

\(^3\) According to the Federal Housing Finance Agency (FHFA) Housing Price Index, housing prices in Florida surged 120 percent between the fourth quarter of 2000 and the fourth quarter of 2006. Between that last point and the fourth quarter of 2009, prices diminished by 37 percent. This is consistent with the findings of Reinhart and Rogoff (2009), who found average historical house price declines of 35 percent during financial crises.

\(^4\) From 2000 to 2009, Google News archived about 22,000 articles on local government and the property tax in the United States. When housing prices peaked in 2007, Florida was mentioned in 1,130 (31.1 percent) articles. The majority of all other articles, nearly 9,600 (43.8 percent), were written after the housing decline.
The Florida story is told by merging two databases into a unique 15-year panel containing sufficient information to measure how city revenues are affected by single-family home markets in Florida. One database provides detailed statistics on annual city revenues and their sources, while the other contains the annual property tax rolls of each city. We construct tables showing how total revenues and the relative importance of various revenue sources have changed over time, both before and after the housing busts. We do this for all cities as well as for cities broken down by population size. Using two-way (city and year) fixed effects models, we also estimate the effect that city house price (measured from estimating a repeat sales price index for each city) has on total city revenues per capita. Finally, we uncover the pathways whereby a change in house price may affect city revenue per capita. The total effect of house price on per capita revenue and the strength of the individual causal pathways emanating from house price are allowed to vary with whether house prices are going up or down (i.e., we allow for asymmetric effects). All effects are calculated for the median sized city and for the city at the 25th and 75th percentiles within the distribution of city population sizes.

The results reveal a number of interesting findings:

- On average, the size of city government, as measured by real revenue per capita, grew by 32.8 percent between 1995 and 2005.

- Averaged across all Florida cities, the decline in real per capita revenue after 2005 was trivial in magnitude (0.2 percent), which suggests cities were not “strapped for cash.”

- The revenue source that accounts for the largest share of the increase in city revenue per capita is the property tax, but only a small portion of the growth in property taxes is attributable to rising house prices.

- For small- and medium-sized cities, rising house prices are found to increase revenue per capita yet declining house prices have no statistically significant effect on per capita revenue; hence, we find an asymmetric effect.

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• For large cities, neither upward nor downward movements in house price are found to affect per capita revenue.

• City revenues are affected by house price (primarily because changes in house price impact the property tax base), but we also find that four non-ad valorem revenue sources are impacted by changes in house price.

This paper is organized as follows. The next section describes the panel. Section III provides a preliminary look at the data, showing how house prices and revenues have evolved over the course of the panel. Section IV offers a decomposition of the change in per capita revenue that identifies the various pathways whereby a change in house price may affect total city revenue. The estimated models are presented in Section V. Results are discussed in Section VI and the strengths of the pathways are analyzed in Section VII. Conclusions and suggestions for future research are stated in Section VIII.

II. Data

This study relies on a combination of datasets from two state agencies—jurisdictional revenues come from the Florida Department of Financial Services (FDFS) and housing market characteristics are recorded by the Florida Department of Revenue (FDOR). Each of these sources is collected per statutory mandate and is available for public access.

The FDFS data come from “Annual Financial Reports” (AFRs) that cities and counties are required to submit after each fiscal year (s. 218.32, F.S.).\(^5\) In these reports, local governments are required by the FDFS to list aggregate amounts for various sets of defined revenue sources and expenditure categories.\(^6\) The AFRs are gathered for all cities and counties beginning with the 1994 fiscal year and extending through 2008.

The AFRs contain a vast amount of detail. At the finest level, revenue sources cover 22 categories. For the purposes of this study, the fiscal information is aggregated into the

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\(^5\)Fiscal years run from October 1 through September 30 of the following calendar year.

\(^6\)The AFRs for recent years can be found online at [https://apps.fldfs.com/LocalGov/Reports/](https://apps.fldfs.com/LocalGov/Reports/).
12 major revenue categories found within the AFRs, which are described in Table 1. The reported magnitudes are converted into real 2008 dollars using the CPI for the Southeast Region. Each year there are a handful of cities that have missing AFRs. This may be because a particular city had not yet been chartered, was disbanded by voters, or was annexed by a neighboring community. In some years, a city might also decide to ignore the statutory compliance.

The FDOR dataset comprises county tax rolls from each of Florida’s 67 county property appraisers. Annual preparation is required by statute (s. 193.114, F.S.) and supervised by the FDOR (s. 195.002, F.S.). Tax rolls are collected for the purpose of monitoring county property tax assessors. Spanning the years from 1995 to 2009, these rolls align with the FDFS data by year and across jurisdictions.

Three crucial tasks are accomplished with these rolls. First, each individual parcel on a roll has a tax authority code that can place it within a city or unincorporated portion of a county. The tax authority codes identify local jurisdictions according to fiscal boundaries. Postal addresses are much less accurate for fiscal purposes. Second, each tax roll contains the two most recent sales of each property. From those transactions, a basic repeat sales price index is computed for qualified arms-length sales of single-family homes. These indexes capture the change in the real price of single-family housing within each city. Third, by aggregating across the assessed values of all properties located within a particular city, we obtain the annual size of its property tax base.

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7Annual consumer price indexes (CPI) are obtained from the Bureau of Labor Statistics.
8Out of the 397 cities represented in the panel, 219 are perfectly balanced. Within the panel’s first two years, there are 8 cities that enter the sample. During the last two years, 63 cities disappear after disbanding their charter or being annexed. The AFRs are missing for a single year in 6 cities.
9The most recent year’s rolls are available online at ftp://sdrftp03.dor.state.fl.us/. The FDOR’s internal computer network houses files dating back to 2000. Other remaining rolls are stored on disk tapes.
10Tax roll data, such as assessed values and number of parcels, are required to reflect what was true on January 1 of the tax roll year.
11Tax authority codes were assembled over multiple steps. First, a master database was created by downloading codes from county appraiser and tax collector websites. Second, the FDOR provided tax authority codes used by local jurisdictions in 2008. The lists were checked for consistency and merged. Finally, the remaining codes were assigned to jurisdictions after phone calls to various county offices.
12See the Appendix for a description of our repeat sales models and indexes.
After being merged, the FDFS and FDOR datasets form a panel spanning 15 years—1994 through 2008. After dropping cases with missing values and allowing for lagged responses, the final dataset includes roughly 2,700 city/year observations.\(^\text{13}\)

### III. A Preliminary Look at the Data

Figure 1 depicts three panels of alternative repeat sales price indexes (RSIs) for the state, cities, and counties. The first panel shows that movements in the FDOR-based index (i.e., the index we constructed that is described in the Appendix) at the state level are almost identical to those shown by the indexes provided by the Federal Housing Finance Agency (FHFA) and Case-Shiller. The middle and right panels decompose the FDOR RSI into individual city and county measures. An overall trend is present in both images. Rising property values began to appreciate more quickly beginning around 2003, peaked around 2006, and plummeted thereafter. The vertical axes show that a handful of cities saw extreme swings from values of 1,000 down to the mid-200s. In comparison, the county RSIs seldom exceeded 300.\(^\text{14}\)

Table 2 (at the bottom) depicts city means of total revenues per capita for four separate years that span the length of our panel (1995, 2000, 2005, and 2008). Separate means are reported for all cities and cities broken down by population size (small, medium, and large).\(^\text{15}\)

The means support the argument that cities were flush in revenues prior to the housing busts. Over the ten-year period of 1995 to 2005, the real per capita total revenue mean for all cities

\(^{13}\)In addition to losing some city/year observations for the reasons mentioned above, we also drop those city/year observations where the repeat sales sample contained less than 10 observations or where the population in the year is less than 1,000 people. Less than a dozen cities are eliminated because they had less than $100,000 or more than $1,000,000 in total revenues per capita. These steps reduce measurement error in the computation of changes in real house prices. Later, when regressions are run, two years of data are lost because variables are lagged one period and an appreciation rate is calculated for a lagged RSI.

\(^{14}\)In this paper, we focus only on cities. We intend to include counties in the continuation of this project.

\(^{15}\)To define the three city sizes (small, medium, and large), we first determined the population size of the cities at the 25th, 50th, and 75th percentiles within the distribution of city sizes. These are 6,000, 13,000, and 35,000, respectively. Around each city size we estimated an interval of plus or minus 3,000. Thus, small-sized cities have between 3,000 and 9,000 people; medium-sized cities have between 10,000 and 16,000 people; and large-size cities have between 32,000 and 38,000 people.
increased from $1,934 to $2,568, or a 32.8 percent increase. The story remains the same if cities are broken down by population size, but the growth in small-sized cities (45.3%) was more than twice as great as in large-sized cities (21.0%).

Also noteworthy from the means presented in Table 2 is that, overall, they show city revenues have not plummeted in recent years. For all cities and medium-sized cities, the mean per capita revenue is lower in 2008 than in 2005, but only by 0.2% and 3.3%, respectively. However, large cities have experienced more substantial real losses in revenues. These large cities incurred a 12.0 percent decline between 2005 and 2008.

In summary, all local governments in Florida, as measured by the size of their budgets, were much larger in 2005 than in 1995. While city budgets have shrunk in recent years, it has only been large cities that might now be considered “strapped for cash.”

Table 2 also reports for all cities and the city size categories revenue per capita broken down into the 12 revenue categories identified in Table 1. Over each grouping of cities, ad valorem taxes is the revenue category that grew the most from 1995 to 2008. For all cities, the increase in magnitude is $195 and the property tax share of the average city budget grew from 14.0 percent to 18.1 percent. Moreover, again for all cities and for cities within each size category, ad valorem taxes continued to grow after 2005.

While the growth in ad valorem tax revenues paved the way for the expansion in cities’ real revenue per capita between 1995 to 2005, Table 2 shows that many of the other 11 revenue categories also contributed to a continual enlargement of total revenue collections. In fact, looking across the means for all cities, the only category to fall is Fines and Forfeitures.

Because ad valorem tax revenues expanded as a share of the average city budget, one or more of the other revenue categories must have shrunk in share. The only category to ebb significantly in share is General Government Taxes, which declined from 12 percent in 1995 to 8 percent in 2008. This revenue category includes sales taxes and taxes on utility services.

As noted, the means for all cities and those broken down by city size show that ad valorem tax revenues per capita continued to grow after 2005, despite the housing busts that
were occurring throughout the state. However, mean city revenues per capita did decline after 2005. The revenue breakdown displayed in Table 2 suggests that overall revenue fell because of declines in a number of non-ad valorem revenue sources. The all cities averages show post-2005 declines in per capita revenues occurred for the following categories: General Government Taxes, Federal Grants, State Grants, State Shared/PILT, Other Sources, and Miscellaneous. With few exceptions, these same categories of revenues also declined in each of the three city size groups.

To summarize what we have learned from Table 2: 1) the evidence is consistent with the idea that Florida cities were “flush” with revenues before housing markets turned downward around 2006; 2) the additional revenues, however, were the result of increases in, not only property taxes, but many other revenue sources; 3) after 2005, total revenues fell, but the magnitude of the decline appears significant only for large cities; 4) averaged across all cities and each city size category, real per capita ad valorem tax revenues continued to climb through 2008; and 5) the post-2005 declines in total revenue per capita were the result of shrinkage in a number of non-ad valorem revenue categories.

IV. House Price and City Revenues: The Pathways

We have documented a number of facts that can be further investigated with our panel. These findings are:


2. Real per capita city revenues grew enormously between 1995 and 2005 and have fallen since 2005.

3. Real per capita ad valorem tax revenues have also grown enormously and have continued to grow through the end of our panel (2008).

Our primary goal is to determine the extent to which the first fact might explain the second two facts. To accomplish this goal, it is useful to decompose changes in a city’s total

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per capita tax revenue resulting from changes in house price into two separate parts—the portion attributable to changes in ad valorem tax revenues and the other part coming from revenue sources that do not include property taxes. We can write:

\[
\frac{d\left(\frac{R}{P}\right)}{dH} = \frac{d\left(\frac{A}{P}\right)}{dH} + \frac{d\left(\frac{S}{P}\right)}{dH}
\]

where \( R \) is total revenue, \( P \) is population, \( A \) is ad valorem tax revenue, \( S \) is non-ad valorem tax revenue, and \( H \) is house price.

The first part (i.e., ad valorem tax revenues) can be further broken down by noting that the properties subject to ad valorem taxes include non-single-family homes, single-family homes with a homestead exemption, and single-family homes without a homestead exemption:\(^1\)

\[
A = B \cdot M \\
= (NSF + SF) \cdot M \\
= (NSF + SF^H + SF^{NH}) \cdot M \\
= (NSF + U^H \cdot V^H + U^{NH} \cdot V^{NH}) \cdot M
\]

where \( B \) is the property tax base, \( M \) is the millage rate, \( NSF \) is the non-single-family property tax base, \( SF \) is the single-family property tax base, \( SF^H \) is the homesteaded single-family property tax base, \( SF^{NH} \) is the non-homesteaded single-family property tax base, \( U^H \) is the number of homesteaded single-family properties, \( V^H \) is the average assessed value of homesteaded single-family properties, \( U^{NH} \) is the number of non-homesteaded single-family properties, and \( V^{NH} \) is the average assessed value of non-homesteaded single-family properties.

\(^1\)To obtain a homestead exemption, a property owner must permanently reside in the home. Homesteaders have been able to receive a $25,000 reduction in taxable value on their homes since a constitutional amendment in 1980. The amount was increased to $50,000 with a 2008 amendment.
Given Eq. (2), differentiating \((A/P)\) with respect to \(H\) yields:

\[
\frac{d(A/P)}{dH} = \frac{d(NSE/P)}{dH} \cdot M + \frac{d(UH/P)}{dH} \cdot V^H \cdot M + \frac{d(V_H/P)}{dH} \cdot U^H \cdot M + \\
\frac{d(U^{NH}/P)}{dH} \cdot V^{NH} \cdot M + \frac{d(V^{NH}/P)}{dH} \cdot U^{NH} \cdot M + \frac{dM}{dH} \cdot \frac{B}{P}
\] (3)

By substituting Eq. (3) into Eq. (1), the various pathways whereby a change in house price may affect a city’s total revenue per capita are shown:

\[
\frac{d(R/P)}{dH} = \frac{d(NSE/P)}{dH} \cdot M + \frac{d(UH/P)}{dH} \cdot V^H \cdot M + \frac{d(V_H/P)}{dH} \cdot U^H \cdot M + \\
\frac{d(U^{NH}/P)}{dH} \cdot V^{NH} \cdot M + \frac{d(V^{NH}/P)}{dH} \cdot U^{NH} \cdot M + \frac{dM}{dH} \cdot \frac{B}{P} + \frac{d(S/P)}{dH}
\] (4)

Each of the seven terms on the right hand side of Eq. (4) reveals a separate pathway whereby a change in house price may influence a city’s total revenue per capita. House price may impact per capita city revenue by changing: 1) the non-single-family property tax base per capita, 2) the number of homesteaded single-family properties per capita, 3) the average assessed value of homesteaded single-family properties per capita, 4) the number of non-homesteaded single-family properties per capita, 5) the average assessed value of non-homesteaded single-family properties per capita, 6) the millage rate, and 7) amounts of revenues coming from sources other than ad valorem taxes.

The decomposition of the effect of house price on city revenue per capita represented by Eq. (4) is just one of many alternative decompositions. Underlying our choice of Eq. (4) are a number of rationales. Separating out homesteaded and non-homesteaded single-family homes is important because, in Florida, increases in the assessed value of homesteaded properties are capped by a constitutional amendment. \(^{18}\) Hence, the value of \(d(V^H/P)/dH\) is

\(^{17}\) Terms including the derivative of population with respect to house price are dropped from Eq. (3) because the derivative is zero. Population level is assumed not to be written as a function of house price.

\(^{18}\) This amendment, commonly labeled “Save Our Homes,” was passed in 1992. The law limits assessment increases on homesteaded properties to no more than 3 percent per annum or the annual rate of inflation.
expected to be smaller than that of $d(V^{NH}/P)/dH$. The effect of house price on the millage rate is separated out to investigate whether city counselors respond to rising home values by reducing the millage rate. Incumbents may see a growing tax base as an opportunity to vote in favor of a cut in the property tax rate, which may gain them favor with their electorate at the time of the next election. Concerns regarding reelection may also result in house price having an asymmetric effect on the millage rate: counselors might lower the tax rate when home values rise but resist increasing the tax rate when home values are in decline. As detailed in the following section, our empirical models allow for asymmetric upward and downward effects. Also of interest is exploring how changes in house price affect sources of revenue other than property taxes. For example, changes in home values may create wealth effects that alter revenue sources tied to local consumption, such as sales taxes or service charges.

Each of the derivatives appearing in Eq. (4) is estimated using our panel. Our empirical models are described in the next section. After the derivatives are estimated, mean values for the other variables appearing in Eq. (4) are inserted so we can ascertain the relative strength of each pathway.

V. Estimated Models

We estimate two-way (city and year) fixed effects models to relate the house price appreciation rate to percentages changes in revenue per capita, the non-single-family property tax base per capita, the number of homesteaded single-family properties per capita, the average assessed value of homesteaded single-family properties per capita, the number of non-homesteaded single-family properties per capita, the average assessed value of non-homesteaded single-family properties per capita, the average assessed value of non-

\footnote{Because we use a log functional form, we actually estimate for each size class of cities the percentage change in each possible pathway variable in response to a one-percentage point change in the house price appreciation rate. The derivative change in the per capita amount is obtained by multiplying our estimate by the mean value of the variable for the particular size class of cities. Hence, while $H$ is the house price in Eq. (1)–(4), in our estimated equations $H$ is the house price appreciation rate.}
homesteaded single-family properties per capita, the millage rate, and sources of revenue other than ad valorem taxes.\textsuperscript{20}

To illustrate, consider the model we estimate that relates the percentage change in total revenues per capita to the house price appreciate rate (H):

\[
\left( \frac{R}{P_{it}} \right) = \alpha_i + \gamma_t + \beta_0 H_{i,t-1} + \beta_1 I_{i,t-1} + \beta_2 P_{i,t-1} + \beta_3 H_{i,t-1} \cdot P_{i,t-1} + \epsilon_{it} \tag{5}
\]

where $\alpha_i$ is a vector of city fixed effects, $\gamma_t$ is a vector of year fixed effects, $I_{i,t-1}$ is last year’s per capita income of the county containing the city, and $P_{i,t-1}$ is last period’s city population. All variables other than H (i.e., the dependent variable and the controls) are measured in logs.

A one-year lag in the independent variables was selected because having no lag or a lag longer than one year provided an inferior fit.\textsuperscript{21} All values are expressed in 2008 dollars using the CPI for the Southeast Region. $I$ and $P$ are control variables.\textsuperscript{22} $H$ and $P$ are interacted because preliminary estimation revealed that the effect of $H$ on a majority of the pathway variables varied between large and small cities.\textsuperscript{23}

To allow an increase in house price to have a different effect from a decrease in house price, we modified Eq. (5) to allow for asymmetric effects:

\[
\left( \frac{R}{P_{it}} \right) = \alpha_i + \gamma_t + \beta_0 H_{i,t-1} + \beta_1 H_{i,t-1} \cdot U_{i,t-1} + \beta_2 H_{i,t-1} \cdot P_{i,t-1} + \beta_3 H_{i,t-1} \cdot U_{i,t-1} \cdot P_{i,t-1} + \beta_4 I_{i,t-1} \cdot U_{i,t-1} + \beta_5 P_{i,t-1} + \beta_6 U_{i,t-1} + \epsilon_{it} \quad \tag{6}
\]

\textsuperscript{20}The repeat sales price index (RSI) we estimate for every city shows the annual cumulative percentage changes in price that has occurred since the base year (1995). House price appreciation is computed for city $i$ in year $t$ as \(\frac{RSI_{it} - RSI_{i,t-1}}{RSI_{i,t-1}} \times 100\).

\textsuperscript{21}A one-year lag is consistent with the fact that all Florida properties are required to be assessed annually at current market values. In this sense, Florida is unique. Most states have an assessment lag because assessed values are only brought up or down to match market values periodically (e.g., every 3 to 5 years).

\textsuperscript{22}Annual values for these variables are provided by the Bureau of Business and Economic Research at the University of Florida. They are reported for each year in the Florida Statistical Abstract.

\textsuperscript{23}To reduce the number of decimal places reported for the estimated coefficients, city population is measured in 1,000s and all per capita amounts are per 1,000 population.
where \( U_{i,t-1} = 1 \) if \( H_{i,t-1} > 0 \) and, again, all variables other than \( H \) are measured in logs.

VI. Results

The top panel in Table 3 presents the results from estimating Eq. (5), which is based on the assumption that an increase and decrease in house price has symmetric effects on the dependent variables. The bottom part corresponds to Eq. (6), which allows house price to have upward and downward asymmetric effects.\(^{24}\) To determine whether \( H \) has asymmetric effects, we implemented a two-step methodology. First, we checked to see if both the up and down estimated partial derivatives are significantly different from zero (by a two-sided test at the 10% level). If both coefficients are significant, we conducted a \( t \)-test to determine whether the difference in coefficients is statistically significant. When this happens, we concluded that \( H \) has an asymmetric effect. Second, if one coefficient is significantly different from zero, while the other is not, we concluded there is an asymmetric effect.

Because \( H \) is interacted with population (actually the log of population), the partial derivatives showing the effect of \( H \) on the log of one of our dependent variables must be calculated for a particular city size. As before, we used the city size distribution to define a small-sized city as one at the 25th percentile (6,000 people), a medium-sized city as one at the 50th percentile (13,000 people), and a large-sized city as one at the 75th percentile (35,000 people). Partial derivatives \( (\partial \log y / \partial H) \) are calculated for each sized city, where \( y \) represents a dependent variable. The results are presented in Table 4.

An overview of the results presented in Table 4 shows that the partial derivatives estimated for large cities are, with few exceptions, statistically insignificant. Our investigation

\(^{24}\)In estimating the asymmetric models, the issue arises whether there is sufficient upward and downward movement in house price to identify possible asymmetric effects. To address this issue, we constructed Appendix Table 1. Our panel of city/year observations is broken into subgroups where \( H \) is greater than 10, between 0 and 10, between -10 and 0, and less than -10. Frequency counts are tabulated for all years (1996–2008), for the first half (1996–2001) and the second half (2002–2008) of our panel. Over all years, \( H \) is positive for 74% (2011) of the observations and negative for 26% (707). There are also numerous large positive and negative changes in \( H \), with 36% (984) of the observations having an \( H \) greater than 10 and 7% (183) having an \( H \) less than -10. Sufficient variation is present.

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of these findings revealed that the assessed value of single-family homes per capita falls dramatically as city population rises above its median value. At the 75th percentile, the value is roughly half the median value. This is not unexpected. When city size reaches the upper tail of the size distribution, the population is increasingly housed in multi-family units (apartments, townhomes, and condominiums). As a result, changes in the prices of single-family houses become relatively unimportant in affecting the local economy or the city’s budget. Below, we focus our discussion on the results obtained for small- and medium-sized cities.

Although our primary interest is the effect that the house price appreciation rate has on city revenue per capita, it is also worthwhile to estimate the effect that the appreciation rate has on ad valorem tax revenue per capita. While the latter effect does not enter our pathways equation (Eq. (4)), its magnitude aids in our understanding of house price effects and serves as a check on the reasonableness of the derivative estimates that are reported.

The results are reported in Column (2) of Table 3. \( H \) and its interaction with city size are statistically significant both individually and jointly. For small-sized cities, an increase in house price raises ad valorem tax revenue per capita, while a decrease in price has an insignificant effect. Hence, we conclude there is an asymmetric effect. An explanation for this asymmetry is that county tax assessors may be more responsive to increases than to decreases in market values. Evidence in support of this explanation is presented below. Another explanation for this asymmetry involves Florida’s “recapture rule.” The rule specifies that on homesteaded properties, even if market values are falling, the assessor is allowed to raise the homeowner’s assessed value by 3% or the rate of inflation, whichever is lower. This holds as long as the assessed value is less than the market value.\footnote{A gap between assessed and market value develops over time as a homeowner resides in a homestead as long as market value is rising faster than 3% per annum.} Hence, a reduction in house price would reduce the tax revenue generated by non-homesteaded single-family homes (about 25% of the single-family stock on average), but there would be no reduction in revenue obtained from homesteads. Finally, we find that an appreciation of house price increases the number of both homesteaded and non-homesteaded parcels per capita (which increases the
property tax base), while a decrease in price has no effect on these numbers. Although an increase in house price raises property tax revenue per capita within small-sized cities, the magnitude of the effect is quite small. On average, property tax revenues per capita equal $329 per year in these cities. Our estimate suggests that this number would rise by only $1 if the appreciation rate were to increase 10 percentage points.

For medium-sized cities, the results are less clear. The house price down effect is marginally significant, while the up effect is marginally insignificant. The two coefficients are not significantly different from one another. The partial derivative from the symmetric effects model is marginally insignificant (p-value = 0.16). Why do medium-sized cities have weaker results than small-sized cities? The finding may reflect two facts: 1) the mean assessed value of single-family homes per capita is about $10,000 less in medium-sized cities, so a one-percentage point change in the appreciation rate causes less of a change in the dollar amount of assessed value within these cities, and 2) a slightly larger percentage of the total assessed value of single-family homes is represented by homesteads in these cities, so the assessment cap is more binding.

Next, we estimated versions of Eq. (5) and Eq. (6) for all of the revenue categories listed in Table 1 other than ad valorem tax revenue. This was done to define the revenue sources that should be included as part of Eq. (4)’s \( d(S/P)/dH \). In some cases, we were interested in the effect of \( H \) on a particular type of revenue, which led us to estimate Eq. (5) and Eq. (6) for a subcategory of revenue. For example, General Government Taxes consist of sales taxes and taxes on utility services. Wealth effects from increases in \( H \) might encourage greater local spending and thereby higher sales tax revenue. Hence, separate equations were estimated for sales tax revenue per capita and utility services tax revenue per capita. Another interesting subcategory is impact fees under the revenue category labeled Miscellaneous. In times of declining housing prices, cities may turn to impact fees as an alternative to increasing millage rates. For the following non-ad valorem revenue sources, \( H \) is found to have at least one statistically significant effect (at the 10% level, by a two-sided test) in either the symmetric
or asymmetric models for either small-sized or medium-sized cities: federal grants, fines and forfeitures, impact fees, and general government revenue. Thus, we include these revenue categories in our estimations of \( d(S/P) / dH \).\(^{26}\)

The estimated effects of \( H \) on the percentage change in total revenue per capita are shown in Column (1) of Table 3. For both small-sized and medium-sized cities, an increase in house price is found to increase revenues, while a decrease has no statistically significant impact. Hence, we conclude that house price has an asymmetric effect on total revenue per capita. A number of factors account for this asymmetry. First, as noted above, \( H \) has the same asymmetric effect in property tax revenues per capita and this revenue category is the largest revenue source of the cities in our sample. Second, \( H \) also has the same asymmetric effect on two non-ad valorem revenue categories—federal grants and general government revenue.\(^{27}\)

Paralleling the estimated effects of \( H \) on property tax revenues, while increases in house price raise total revenue per capita, the magnitude of the effect is modest in size. At the mean values of total revenue per capita ($2,075 for small cities and $2,000 for medium cities), a 10-percentage point increase in \( H \) would raise total revenue per capita by about $14 and $8 in small- and medium-sized cities, respectively.

The first parameter that appears in our pathways equation is \( d(NSF/P) / dH \). For both small- and medium-sized cities, \( H \) is found to have a positive symmetric effect on the non-single family property tax base per capita (see Column (3) of Table 3). This relationship may partly be the result of changes in home values altering local spending (via a wealth effect), which in turn affects the market value of commercial property. On the other hand, the relationship may arise because changes in land values impact, in the same direction, both commercial and residential property values.

The next four parameters of the pathway equation relate to the effects that \( H \) has on

\(^{26}\)Recall that we estimate \( d(\log(S/P)) / dH \) and therefore \( d(S/P) / dH = d(\log(S/P)) / dH \cdot (S/P) \)

\(^{27}\)The up effect for federal grant revenue is significant for medium-sized cities and marginally insignificant for small-sized cities. The up effect for general government revenue is significant for small-sized cities and marginally insignificant for medium-sized cities.
the number and assessed value of single-family homes. In both small- and medium-sized cities, $H$ has an asymmetric effect on the number of single-family homes per capita (see Columns (4)–(7) of Table 3). For both homesteaded and non-homesteaded homes, the size of the stock is significantly impacted by an increase in house price, but not by a decrease. A similar influence is picked up by the per capita amount of average assessed value per home. As expected from Florida’s cap on increases in homesteaded assessed value, the effect of $H$ on assessed value is larger (by roughly two times) if the house is not homesteaded.

As noted previously, when assigning annual assessed values, county property tax assessors may respond more strongly to an increase in home price than to a decrease in home price. This is confirmed by the results obtained for non-homesteaded single-family homes, where there is no cap on increases in assessed value. An increase in house price raises the average per capita amount of assessed value per home, while a decrease in home price has an insignificant effect.\textsuperscript{28}

The next parameter in the pathways equation is the millage rate. Somewhat surprisingly, neither increases nor decreases in house price are found to affect this rate (see Column (8) of Table 3). Hence, we find no statistical support for the idea that city counselors respond to political motivations by lowering millages as home values rise. Councils also do not increase the millage as house price declines. This latter result is not surprising given that declines in price do not cause a reduction in total revenues per capita.

The final parameters entering the pathways equation are the derivatives on the non-ad valorem sources of revenue that we reported earlier as being affected by $H$ (see Columns (9)–(12) of Table 3). These are federal grants, fines and forfeitures, general government revenue, and impact fees.

The symmetric models show that $H$ has a statistically significant effect on federal grant revenue per capita for both small- and medium-sized cities. In the asymmetric models, the up

\textsuperscript{28}Property tax assessors in Florida are elected. Non-homesteaded property owners frequently have their primary residence elsewhere. Hence, the tax assessor has a reduced incentive to lower assessed values as house price declines.
effect is significant for medium-sized cities and marginally insignificant for small-sized cities ($p$-value = 0.18). The down effects are highly insignificant. The reason why an increase in house price would raise a city’s federal grand revenue is unclear. A possible, but hardly compelling, explanation is that cities experience a wealth effect as house price rises that results in more resources being allocated to grantsmanship.

The symmetric models show that $H$ significantly affects fines and forfeitures in small-sized cities. In medium-sized cities, the effect falls just beneath the 10% significance level ($p$-value = 0.11). The asymmetric models yield insignificant results. $H$ may increase these revenues because they vary with the level of economic activity within the community and the latter is likely correlated with changes in housing values.

General government revenue includes sales taxes and taxes on utility services. These revenues are found to rise with an increase in house price, but only in small-sized cities. This effect may result from a house price-induced wealth effect that increases local spending. Local spending and the demand for utility services will also rise as the result of the housing construction that is caused by a higher house price. Similarly, the symmetric models (but not the asymmetric models) show that $H$ positively affects impact fees in both sized cities. This is expected given that we find a positive relationship between $H$ and the size of the single-family housing stock.

VII. Estimating the Importance of Each Pathway

The results from our analysis of the pathways whereby a change from $H$ can possibly affect a city’s total revenue per capita are reported in Table 5. The partial derivatives which are inserted into Eq. (4) to determine the relative strength of each pathway are those obtained from the symmetric models. The symmetric, rather than asymmetric, model results are used because a symmetric effect is sometimes found and, in most of the other cases, the

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When the symmetric effect is significant but both of the asymmetric effects are insignificant, this suggests that for this particular dependent variable there is insufficient variation in $H$ to separately identify the asymmetric effects.

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symmetric coefficient is highly similar to the up coefficient obtained from the asymmetric models. Recall, usually, increases in house price affect the dependent variable, while decreases in house price are found to be insignificant. Of the possible pathways, eight are found to have a non-trivial impact on total revenue per capita.\textsuperscript{30} These are listed in Table 5.

Surprisingly, federal grant revenue is the strongest pathway for small-sized cities and the second strongest pathway for medium-sized cities. As noted above, it is unclear why $H$ might affect these revenues. We suggest that future researchers seek to confirm this result and, if confirmed, provide an explanation. The second strongest pathway for small cities, and the strongest pathway for medium-sized cities, is the non-single family property tax base. The third strongest pathway for both city sizes is homestead parcels. As noted above, an increase in $H$ causes a rise in the stock of these homes, which expands the property tax base and, thereby, total revenue per capita. The order of importance of the rest of the pathways are the same between small- and medium-sized cities. In order of declining importance, they are: the value of non-homesteaded homes, the number of non-homesteaded homes, fines and forfeitures, and general government revenue.

The central conclusion that can be drawn from Table 5 is that house price influences a city's total revenue per capita largely by altering its property tax base. However, there are a number of non-ad valorem sources of revenue that also play an important role.

\section*{VIII. Conclusions and Future Research}

This paper provides one of the first empirical analyses of how local government budgets have been affected by the boom and subsequent bust in markets for single-family homes. The conventional wisdom in Florida has been that the run-up in single-family home values left local governments flush with revenues, while the post-2005 downturn in values left them strapped for cash. Our results confirm that cities were flush with revenue by the time

\footnote{While impact fees are found to be positively impacted by $H$, the pathway effect is small in magnitude. Hence, it is not included in the table.}
housing markets collapsed in 2006. They also suggest that growth in property taxes heavily contributed to the rise in the typical city’s real revenue per capita. The data, though, lend little support to the idea that the rise in housing values was behind the growth in property taxes and total revenues per capita. Our regression results suggest that an increase in housing price does raise revenue per capita, but the magnitude of the effect is modest in size.

Regarding the downturn in housing markets that occurred after 2005, mean real per capita revenue declined by only 0.2 percent across all cities, which suggests that cities were not “strapped for cash.” In fact, during the post-2005 period, real ad valorem tax revenues per capita continued to grow. This observation is consistent with our regression results that show declines in house price have no impact on revenue per capita.

As expected, we find that the change in the property tax base is a strong pathway whereby a change in house price affects city revenues per capita. However, we also document that house price affects revenues by altering the amount received from four non-ad valorem sources of revenue. An especially large effect is found for federal government revenue. All of the above findings suggest that the relationship between house price and city revenue per capita is complex and that it is wrong to conclude that changes in house price, by altering ad valorem tax revenues, drive local budgets up or down.

Our key finding—that house price has an asymmetric effect on city revenue per capita—is largely explained by 1) the ancillary finding that house price has an analogous asymmetric effect on ad valorem tax revenues per capita, 2) the latter represent the largest source of revenues to the cities in our sample. Our results suggest a number of reasons for why property taxes follow house price upward but not downward: 1) property tax assessors in Florida are more responsive to increases than to decreases in house prices, 2) increases, but not decreases, in house price affect the size of the single-family housing stock, and 3) declines in house price only reduce property tax revenues if the home is not homesteaded or if the home is homesteaded but lacks a wedge between market and assessed values.

The final factor listed above may play an important role in whether the asymmetric rela-
tionship we find between house price and city revenue persists into the future. If house price continues to fall, an increasing number of homesteaded homeowners will see their wedge between market and assessed values disappear. If there is no wedge, local tax assessors cannot raise assessed values (by the recapture rule) and must lower assessed values to match the decline in housing prices. This would cause property tax revenues to decline, especially in those smaller cities that have a large share of the property tax base represented by homesteads.

Regarding future research, we intend to replicate this city analysis for Florida counties. Approximately one-half of Florida’s population lives in unincorporated county areas, so a complete picture of how fluctuations in house price affect local budgets in Florida must include both cities and counties. Moreover, there are reasons to believe that counties may respond differently than cities to changes in house price. For example, in Florida only counties can adopt local option sales taxes. No attempt has been made to analyze why some counties—and not others—adopt these taxes and whether recent adoptions are related to the booms and/or busts that have occurred within local housing markets. Changes in the composition of local taxes can have important implications on the regressivity/progressivity of the overall tax structure.

Another important area for future research is to determine whether our conclusion, that housing price and local budgets are not strongly related, is applicable to states other than Florida. Florida has a number of characteristics that make its revenue system different from that of the typical state. For example, the state has no income tax, local property tax assessors are elected rather than appointed, increases in the assessed values of homesteaded properties are capped, and tax savings resulting from the assessment cap can be transferred to a new home (commonly referred to as “portability”). All of these features distinguish Florida from other states and may contribute to the weak relationship we find between house price and city revenue per capita. Hence, it is possible that house price and revenue per capita may be more strongly related in states with more traditional revenue systems.
References

Kennedy, J., November 2005. With an extra $3.2 billion, Florida prepares to spend; a revenue windfall could bring on the budget squabbling. Orlando Sentinel.
Padgett, T., June 2009. Florida’s property taxes go wacky in housing slump. TIME.

Appendix - Constructing a Repeat House Sales Index

Bailey et al. (1963) offer one of the earliest methods for computing a repeat sales index (RSI). Alternative weighting methods have been suggested, one of the most famous by Case and Shiller (1989), but the original RSI remains extremely robust. The RSI performs well in large samples with small periods between a property’s most recent and second most recent sales, which characterizes the dataset used in this study.

Before computing an RSI with the FDOR data, a series of filters eliminate sales from the possible parcels encompassed by the RSI. Only qualified sales are used, defined as being arms-length, single-family residential house transactions. Additional filters eliminate extreme outliers from the sample. Properties are allowed to remain if the two most recent sales occur in the same year, but the sales prices must differ. If livable space is less than 500 ft$^2$ or greater than 6000 ft$^2$, the property is dropped. The price per square foot must be greater than $10 and less than $1,000. Finally, the most recent sale must have occurred between 1994 and 2008, the years of the available tax rolls.

The FDOR RSI is computed by estimating the following regression equation:

$$ RSI_t = \log \frac{P_r}{P_s} = \sum_{i=1994}^{t} D_i \beta_i + u_t $$

where the subscripts denote $r$ as the most recent sales price and $s$ as the second most recent sales price. The variable $P$ is the sales price. A dummy variable $D_i$ takes on values equal to $D_r = 1$ in the year of the most recent sale, $D_s = -1$ in the year of the second most recent sale, and zero elsewhere. The subscript $i$ goes from 1994 to the year $t$ for which the RSI is being computed. There are some exceptions to this pattern. If a jurisdiction does not exist in 1994, then the $i$ subscript begins later in the first year that registers qualified sales. Jurisdictional indexes are normalized to a base of 100 in those first years, which coincide
with 1994 in 80 percent of the sample’s cities. The final step is to pass the $\hat{\beta}_t$ coefficients back through an exponential transformation to compute annual RSIs after the base year of $i$ as

$$RSI_t = RSI_i \cdot (e^{RSI_t} - 1) + RSI_i$$

which recursively shows how the RSI will not update if housing prices did not change in a year. For instance, if house sales remain the same, then the $\hat{\beta}_t = 0$ so the right hand side above will be $RSI_i \cdot (e^0 - 1) + RSI_i = RSI_i$. This process is repeated over each year to construct annual RSIs. The RSI is calculated for each year $t$ in a city. Properties are then aggregated by counties and the state to compute those RSIs.

The FDOR RSI is computed for nearly 400 cities over 67 counties and it uses exact property sales information. The municipalities are extracted by using a tax authority, or district, code that is available in the tax rolls. The advantage to using the tax authority code is that mailing addresses are not always accurately reported. Also, a parcel might be identified by an address inside a municipality, but it might only pay taxes to the county because it officially lies in an unincorporated region. To overcome this problem with address locations, a master list of tax authority codes is assembled based on information from property appraiser offices and a file provided by the FDOR. In the end, it is possible to assign every parcel across the state into a municipal or unincorporated area. As a city annexes parcels from other tax authority districts, those properties will be picked up from that year onward in the municipality’s RSI. Essentially, the FDOR RSI is an exact housing price index that matches parcels to cities based on where they pay their taxes.

Appendix Table 1.
How Often Does House Price Move Up and Down?

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$10 &lt; H$</td>
<td>$f$ 984 (36.20)$a$</td>
<td>$f$ 217 (17.96)</td>
<td>$f$ 767 (50.79)</td>
</tr>
<tr>
<td>$0 &lt; H \leq 10$</td>
<td>$f$ 1037 (38.15)</td>
<td>$f$ 546 (45.20)</td>
<td>$f$ 491 (32.52)</td>
</tr>
<tr>
<td>$-10 \leq H \leq 10$</td>
<td>$f$ 514 (18.91)</td>
<td>$f$ 343 (28.39)</td>
<td>$f$ 171 (11.32)</td>
</tr>
<tr>
<td>$H &lt; -10$</td>
<td>$f$ 183 (6.73)</td>
<td>$f$ 102 (8.44)</td>
<td>$f$ 81 (5.36)</td>
</tr>
<tr>
<td>Total</td>
<td>$f$ 2,718</td>
<td>$f$ 1,208</td>
<td>$f$ 1,510</td>
</tr>
</tbody>
</table>

$a$ Percentages of total movements for that period are in parentheses.
Figure 1: Repeat Sales Indexes (Arms-Length Transactions of Single-Family Houses)

(a) State
(b) Cities
(c) Counties
Table 1
Revenue Categories

<table>
<thead>
<tr>
<th>Revenue Category</th>
<th>Examples/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Ad Valorem Taxes</td>
<td>Property value taxes</td>
</tr>
<tr>
<td>(2) General Government Taxes</td>
<td>Local option sales taxes, utility service taxes</td>
</tr>
<tr>
<td>(3) Federal Grants</td>
<td></td>
</tr>
<tr>
<td>(4) State Grants</td>
<td></td>
</tr>
<tr>
<td>(5) State Shared</td>
<td>State revenue sharing, state payments in lieu of taxes</td>
</tr>
<tr>
<td>(6) Local Grants</td>
<td>Grants from other governmental reporting entities to be used for specific purposes</td>
</tr>
<tr>
<td>(7) Service Charges</td>
<td>Reflects all revenues stemming from charges for current services</td>
</tr>
<tr>
<td>(8) Licenses and Permits</td>
<td>Franchise fees, building permits</td>
</tr>
<tr>
<td>(9) Fines and Forfeitures</td>
<td>Fines and penalties; forfeitures include proceeds from the sale of property seized by law enforcement agencies</td>
</tr>
<tr>
<td>(10) Other Sources – Transfers</td>
<td>Revenues from a constitutional fee officer including payment for goods provided or services performed</td>
</tr>
<tr>
<td>(11) Other Sources</td>
<td>Revenues from proprietary non-operating sources</td>
</tr>
<tr>
<td>(12) Miscellaneous</td>
<td>Impact fees, rents and royalties, contributions and donations</td>
</tr>
</tbody>
</table>
Table 2
City Means of Revenues Per Capita by Source of Revenue

<table>
<thead>
<tr>
<th></th>
<th>All Cities</th>
<th>Small-sized Cities</th>
<th>Medium-sized Cities</th>
<th>Large-sized Cities</th>
<th>All Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ad Valorem Taxes</td>
<td>310</td>
<td>304</td>
<td>302</td>
<td>311</td>
<td>310</td>
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<tr>
<td>General Govt. Taxes</td>
<td>234</td>
<td>261</td>
<td>210</td>
<td>258</td>
<td>234</td>
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<tr>
<td>Federal Grants</td>
<td>43</td>
<td>32</td>
<td>111</td>
<td>48</td>
<td>43</td>
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<tr>
<td>State Grants</td>
<td>19</td>
<td>29</td>
<td>61</td>
<td>49</td>
<td>19</td>
</tr>
<tr>
<td>State Shared/PILT</td>
<td>110</td>
<td>112</td>
<td>121</td>
<td>106</td>
<td>110</td>
</tr>
<tr>
<td>Local Grants</td>
<td>11</td>
<td>17</td>
<td>25</td>
<td>27</td>
<td>11</td>
</tr>
<tr>
<td>Service Charges</td>
<td>715</td>
<td>736</td>
<td>852</td>
<td>934</td>
<td>715</td>
</tr>
<tr>
<td>Licenses and Permits</td>
<td>38</td>
<td>48</td>
<td>70</td>
<td>117</td>
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<td>Fines and Forfeitures</td>
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<td>Other Sources-Transfers</td>
<td>173</td>
<td>177</td>
<td>204</td>
<td>217</td>
<td>173</td>
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<tr>
<td>Other Sources</td>
<td>63</td>
<td>105</td>
<td>214</td>
<td>146</td>
<td>63</td>
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<tr>
<td>Miscellaneous</td>
<td>158</td>
<td>155</td>
<td>233</td>
<td>233</td>
<td>158</td>
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<tr>
<td>Total Revenues</td>
<td>1934</td>
<td>1977</td>
<td>2568</td>
<td>2562</td>
<td>1934</td>
</tr>
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</table>

Notes:
- Sample sizes range from 287 to 388, depending on year and category.
- Small-sized cities are cities with population between 3,000 and 9,000 people.
- Medium-sized cities are cities with population between 10,000 and 13,000 people.
- Large-sized cities are cities with population between 32,000 and 38,000 people.
- The reported value is the real revenue amount in 2008 dollars.
- The revenue amount as a percentage of total revenue is reported in parentheses.
- The acronym PILT refers to Payments in Lieu of Taxes.
### Table 3

Estimated Effects of Changes in Appreciation Rate (H) from Symmetric and Asymmetric Models

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Homesteaded Homes</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>0.0014***</td>
<td>0.0008**</td>
<td>0.0018***</td>
<td>0.0012***</td>
<td>0.0006**</td>
<td>0.0012***</td>
<td>0.0013***</td>
<td>0.0000</td>
<td>0.0116**</td>
<td>0.0017**</td>
<td>0.0095</td>
<td>0.0010**</td>
</tr>
<tr>
<td>H·log(Population)</td>
<td>-0.0004***</td>
<td>-0.0002**</td>
<td>-0.0005***</td>
<td>-0.0004***</td>
<td>-0.0002**</td>
<td>-0.0004***</td>
<td>-0.0003**</td>
<td>0.0000</td>
<td>-0.032*</td>
<td>-0.0005*</td>
<td>-0.023</td>
<td>-0.003**</td>
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<tr>
<td><strong>Non-Homesteaded Homes</strong></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>0.0009</td>
<td>0.0024</td>
<td>0.0025</td>
<td>0.0004</td>
<td>-0.0015</td>
<td>0.0007</td>
<td>-0.011</td>
<td>0.0000</td>
<td>0.0183</td>
<td>0.0033</td>
<td>0.0412</td>
<td>0.0001</td>
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<tr>
<td>H·log(Population)</td>
<td>-0.0014</td>
<td>-0.0251</td>
<td>0.0054</td>
<td>-0.0117</td>
<td>-0.085**</td>
<td>-0.0172</td>
<td>0.0136</td>
<td>-0.0000</td>
<td>-0.1859</td>
<td>0.0356</td>
<td>-0.1181</td>
<td>0.0086</td>
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<td><strong>Other Revenue Sources</strong></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>H</td>
<td>0.0006</td>
<td>-0.0017</td>
<td>-0.0008</td>
<td>0.0011</td>
<td>0.0027*</td>
<td>0.0006</td>
<td>0.0029*</td>
<td>0.0000</td>
<td>-0.0114</td>
<td>-0.0024</td>
<td>-0.0366</td>
<td>0.0010</td>
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<tr>
<td>H·log(Population)</td>
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<td>-0.0005</td>
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<td><strong>General Govt. Revenue Per Capita</strong></td>
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<tr>
<td>H·log(Population)</td>
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<td>-0.0394</td>
<td>-0.3148**</td>
<td>-0.1710**</td>
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<td>-0.0247</td>
<td>-0.7996**</td>
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<td>-0.1571</td>
<td>-0.3270</td>
<td>3.2523**</td>
<td>-0.1728</td>
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</table>

**R²**

| (12) General Govt. Revenue Per Capita | 0.9115 | 0.9552 | 0.9697 | 0.9385 | 0.9976 | 0.9394 | 0.9938 | 0.9264 | 0.9278 | 0.9216 | 0.9653 | 0.6701 |
| **Observations** | 2,718 | 2,718 | 2,718 | 2,718 | 2,718 | 2,718 | 2,718 | 2,718 | 2,718 | 2,718 | 2,716 | 2,718 |

---

a All estimated equations include year and city fixed effects. Dependent variables, except for the millage rate, are measured in logs.

b Standard errors robust to heteroskedasticity and serial correlation are reported in parentheses.

*, **, *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.
To indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Standard errors robust to heteroskedasticity and serial correlation are reported in parentheses.

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<th>(9000)</th>
<th>(10000)</th>
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<th>(12000)</th>
<th>(13000)</th>
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<td>(4)</td>
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<td>(6)</td>
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W. Doerner & K. Ihlanfeldt — House Prices and City Revenues

Submission to Regional Science and Urban Economics

Table 4
Table 5
Estimates of Pathways Whereby House Price Affects City Revenues Per Capita

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Small-Sized Cities</th>
<th>Medium-Sized Cities</th>
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<tr>
<td></td>
<td>Dollar Change</td>
<td>Percentage Change</td>
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<td>Non-SF Tax Base</td>
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<td>Value of Homesteaded Parcels</td>
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<td>0.002476</td>
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<td>Value of Non-Homesteaded Parcels</td>
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<td>Federal Grants Revenue</td>
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<tr>
<td>Fines and Forfeitures Revenue</td>
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<td>General Government Revenue</td>
<td>1.0</td>
<td>0.000498</td>
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</table>

\(a\) The “Dollar Change” is the dollar change in total revenue per capita from the effect that a one-percentage point change in the appreciation rate has on each pathway variable. The “Percentage Change” is the percentage change in total revenue per capita from the effect that a one-percentage point change in the appreciation rate has on each pathway variable.