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The Consequences of the Housing Boom On Local Government Debt

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Abstract

Using a novel dataset on local government debt and house prices in California, this paper finds that the rise in house prices caused an expansion in local governments debt in the early 2000s. The elasticity between local government debt and house prices, estimated using cross-sectional variation in the share of developable land from Saiz (2010), suggest that a percentage point rise in house prices in a given county beyond the long-term trend is associated with a 0.44 percentage point rise in debt of local governments within the county.

JEL: G23, H20, H71, H74, R30, R53

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1 Introduction

It is well known that household and corporate debt increased in the early 2000s. From 2000 to 2006 household and non-financial businesses' debt grew by over 80% and 40%, respectively. A large and growing literature (starting with Mian and Sufi (2008)) has shown a causal link between the housing boom of the early 2000s and the credit expansion. It is less well known that during the same time period, state and local government debt increased by about 130%.[1] The total outstanding debt of state and local governments is smaller than the household and non-financial business debt (total of $2.7 trillion as of 2006, relative to $13.2 trillion for households and $9 trillion for non-financial businesses) but their actions and financial conditions have a direct effect on their citizens and local economies. For these reasons, understanding what caused the credit expansion of local governments can shed light on the financial constraints they may face and the forces that drive their debt and expenditure decisions.

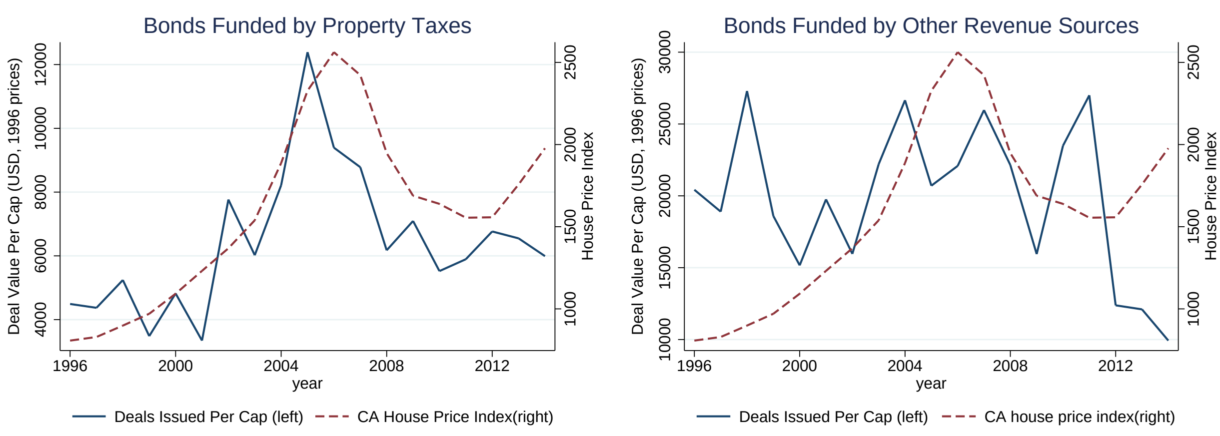
Concurrent to the credit expansion, house prices appreciated across the US. Since many local governments rely on property taxes to finance their ongoing activity, house price fluctuations can have an impact on the local government's finances. In particular, debt might be affected since local governments may choose to shift the expected higher income in the future to higher expenditure in the present. The goal of this research project is to estimate the effects of house price growth on the borrowing behavior of local governments. To this end, I collect

[1]Total debt growth for households, businesses and state and local government debt is based on data from Board of Governments, Federal Reserve, Flow of Funds. Total debt defined as total debt securities and loans.

data for all local government debt issued in the state of California during the housing boom of the early 2000s and compare it to their debt levels prior to the housing boom.

With this data I document a significant increase in local governments' bond issuance during the early 2000s. Decomposing the debt issuance based on the bonds' revenue source reveals an interesting pattern. Figure 1 plots the California house price index and aggregated bond issuance per capita for two groups of bonds based on their funding source: bonds funded by property taxes and all others. The left graph of the figure shows that the total value of bond issuance (per capita) funded by property taxes follows closely the house price index (the dashed line), increasing during the housing boom years and dropping at the bust. During the same time period, as shown in the right graph, bonds funded by other revenue sources do not show a clear pattern with correlation to the housing boom.

Figure 1: Total Bond Issuance Per Capita and California House Price Index



Notes: Bond issuance per capita calculated by aggregating all bond issuance within a county within a given year and dividing by the county population estimate for the same year. The final plot is an aggregate over all counties in California for each year. Source: Author's calculations based on data from Bloomberg and Zillow.com.

To explore the reasons for the increased borrowing of local governments, I test whether the variation of issuance by local governments can be explained by the variation in the house price growth at the county level. Using the share of land available for real estate development in the local area as an instrument for house price growth, I show a causal relationship between house price and debt growth. In particular, I find that a 1 percentage point increase in house prices above their long term trend leads to debt growth of 0.44 percentage points above the historical mean for issuers of debt funded by property taxes, controlling for increased public needs and credit supply. This result is robust to many specifications. Moreover, I find the elasticity is stronger for those in counties with higher home turnover rates and those more likely to be credit constrained.

There are three reasons to analyze local governments in California. First, aggregate annual debt issuance by state and local governments in California is the largest among all states in the US. In 2014 the state and local governments' new debt was over \$60 billion, out of which \$35 billion was of local governments.[2] Second, in contrast to most other states where each local government chooses its own tax rate, in California the property tax general levy is capped at 1% for all jurisdictions (in practice, all jurisdictions set the general tax to the maximum 1% rate). Additional taxes can be levied on properties, but most other taxes cannot be set proportional to the property value. This is a useful setting to simplify the analysis since most tax revenue is not a function of the local government's decisions and does not change much across time and location (Section 3 provides additional information on the property tax system in California). Third, Califor-

[2] Source: Author's calculations based on data from Bloomberg.

nia experienced a significant housing boom in the early 2000s, stronger than any other state. For all these reasons, if local governments' borrowing behavior is affected by house price growth, this affect would be most apparent in California during the housing boom.

While the setting in California make it ideal for this study, its results can be extended to explain the credit expansion of local government debt in the rest of the US. To some varying degrees, the housing boom was wide spread across the country. Second, most local governments in the US depend on property taxes to fund their activities, so that the house price growth should have an effect on local governments similar to the effect found in California. Moreover, the assessment frequency of houses for property tax purposes in most other states is higher than in California, so that local government debt in other states may have been more responsive to the housing boom than the results found for local governments in California.

Explaining the increased borrowing patterns of local governments is important. First, in recent years several local governments have been struggling with debt burdens and pension obligations. Understanding the reasons why bond issuance increased in the early 2000s gives context to the size of current local governments' bonded debt and is important for the discussion of possible bailouts of local governments.[3] Second, if local government debt increased as a result of

[3]To date, no local government was baileddout. The latest assistance to Puerto Rico would also not constitute as a bailout in the usual sense. In response to the Puerto Rico case, on May 2016 republican lawmakers introduced a bill in Congress that, if passed, will "prohibit the use of federal funds to purchase or guarantee obligations of, issue lines of credit to, or provide direct or indirect grants-in-aid to any state (defined to include the District of Columbia and any U.S. territory or possession), municipal, local, or county government".

house price growth, it raises doubts on the local government finance system in which local governments are dependent on a volatile revenue source to finance their (relatively fixed) activities.

The outline of the paper is as follows: Section 2 discusses the contribution of this paper to previous related literature. Section 3 provides in detail the institutional background of property taxes in the United States, and a particular focus on the system in California. Section 4 describes the data sources and construction of the main variables. Section 5 lays out the empirical strategy and presents the main results. Last, Section 7 concludes.

2 Related Literature

This paper is related to several strands of literature. First, it relates to the large literature of urban economics, and in particular papers that study capitalization of local government policy (services, taxes and debt) into local house prices. The capitalization hypothesis is that any differentials among communities which have an effect on households' utility will be capitalized into property values. Tiebout (1956) was the first to develop a formal model of households sorting into communities based on their preferences over various packages of local public services and taxes. Over a decade later, Oates (1969) laid the foundation for empirical analysis of the Tiebout model and the general capitalization theory. Many papers followed documenting empirical evidence of the capitalization theory.[4]

[4] See Ross and Yinger (1999) for a full description of the general capitalization model and a survey of the literature. See Daly (1969) for the first paper to formalize the concept of public debt capitalization.

While the capitalization literature has shown that local governments' policy has an effect on local house prices, the other causal direction hasn't been explored. This paper contributes to the literature by studying the reversed causal direction: Do local house prices affect local governments' borrowing which can then allow for increased public capital expenditures?

This paper is also closely related to a series of papers that document a large credit expansion of households and corporations in the first half of the 2000s and link it to the housing boom (Mian and Sufi (2008), Mian and Sufi (2011), Mian and Sufi (2014), Adelino et al. (2015) and Chaney et al. (2012)). The contribution of the current project to this line of work is to study the borrowing behavior of local governments and to show similar increased borrowing patterns linked to the housing boom.

The third strand of literature studies the effects of house prices on local governments' finances. Lutz (2008) and Lutz et al. (2011) focus on the effects of house prices on property tax revenues and Vlaicu and Whalley (2011) focus on local governments' expenditures. This paper contributes to the literature by studying another aspect of how house price growth affected local governments - their borrowing behavior.

Last, this paper relates to the literature on the effects of credit constraints of individuals, corporations and governments. The main findings in this line of work is that constrained agents under-invest and over-save to deal with unexpected shocks (see, for examples, Dooley (2000) for governments, Fazzari et al. (1988) for firms and Hall and Mishkin (1980) for households). In the context of local governments, Cellini et al. (2010) show that school districts in California under-invest in public facilities due to funding constraints. The current paper will show that credit constrained local governments have a stronger debt response to the income shock caused by the housing boom.

3 Institutional Background

3.1 Local Governments

There are many types of local governments in the US which provide various public services. Two broad types are "general purpose governments", which are county governments and cities, and "specific purpose governments", such as school and college districts, water and sewer, fire, transportation districts, etc. In California alone there are over 5,000 local governments. Each local government has a local governing body (such as a city council or board of supervisors) that makes decisions about its programs, services, and operations. Local residents generally elect the members of local governing bodies.

Most local governments maintain their own budgets, which are divided into two main categories: operating budgets and capital budgets. The operating budget funds current expenditures such as employee salaries, payment for services, and interest payments on debt. The expenditures are financed by current revenues, such as taxes, fees, user charges, and intergovernmental aid. Local governments need to maintain a balanced operating budget, but they can issue short term bonds to cover short term deficits (called "revenue anticipation notes" or "tax anticipation notes"). The capital budget funds (mostly) capital expenditure such as infrastructure construction and improvements. Local governments can issue long term debt to finance these expenditures.[5]

3.2 Property Taxes

Property taxes are the main source of revenue for most local governments. The property tax system in the United States is complex and differs across states in three main dimensions: (a) the government level at which tax rates are set, (b) the level at which taxes are collected and distributed, and (3) the reassessment method and frequency of property valuations.

Proposition 13, passed in 1978, changed fundamentally the property tax system in California in these three dimensions. First, Proposition 13 set the maximum property tax base rate at 1% (and all counties do in fact set it to be at the 1% rate). While in other states the local governments can change the base tax rate to offset fluctuations in property values or offset business cycles,[6] local governments in California cannot do so. The exception to the 1% cap is taxes levied to pay voter-approved bonds. Local governments can levy additional taxes on property owners, but those cannot be proportional to the property's assessed value. The 1% taxes and the voter-approved debt taxes account for nearly 90% of the property tax revenue collected. All told, the effective tax rate in California

[5] For more details on rules of local government deb see Maquire (2011).

[6] For example, in New York State each of the 1,116 "assessing units" determines its tax rate. Rates can change from year to year based on the needs of the local governments that fall within the assessing unit. Source: https://www.tax.ny.gov/pit/property/assess/reform/index.htm

ranges from 1% to 1.58%.[7] For the 2015 fiscal year the total property tax revenue from the 1% rate alone was about 49 billion dollars.[8]

Second, property taxes in California are collected at the county level and are distributed among the local governments within the county. The distribution system within the county, commonly referred as "AB8", is based on the share of each local government in property tax revenue during the mid-1970s (prior to Proposition 13, when each local government determined its own property tax rate) but is also linked to the share of each Tax Rate Area (TRA) in the growth in property tax revenue. Overall, school districts receive the largest portion of the revenue (an average of 43% over the years 2003-2015), although, the distribution shares vary considerably between counties.[9]

Last, under Proposition 13, a property's assessed value is equal to its purchase price adjusted upward each year by the lower of 2 percent or of the state's rate of inflation (CPI), until there is a change of ownership (with some exceptions).[10]

This assessment system creates a slow pace for property values to translate

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[7]Source: https://www.besmartee.com/blog/california-property-tax-complete-list-by-county-2014-2015

[8] Source: http://www.lao.ca.gov/reports/2012/tax/property-tax-primer-112912.aspx

[9]Source: California State Controller's Office, Property Tax Raw Data for Fiscal Years 2003 - 2016, https://bythenumbers.sco.ca.gov/browse?tags=property+tax&utf8=%E2%9C%93

Although school districts receive a large share of property tax revenue their overall funding does not depend on the local property taxes since they receive funding from the state based on a predetermined formula which defines their "revenue limit entitlement". State funding to the school district is equal to the entitlement amount minus the district's share of local property tax revenues. So that in theory school districts could be indifferent to property tax revenue changes. However, if the school's share of property tax revenue is higher than the "revenue limit entitlement", then the school district does not receive state aid, but they keep the "excess" property tax funding. In 2005-2006 there were 79 school districts with excess funding (out of 978 districts). Source: Margaret Weston, " Funding California Schools: The Revenue Limit System", http://www.ppic.org/content/pubs/report/R_310MWR.pdf

[10]In cases of devaluation, either because of market depreciations or due to damage to the property, homeowners can ask for reassessment. Regardless of the property value or changes in the market, homeowners can claim each year a $7,000 exemption from the assessed value of their primary residence.

into increased tax revenue. Appendix A illustrates this point with simulations of a city with 100,000 houses that experience either a one period house price shock or five consecutive house price shocks of 10% each period. These simulations show that it can take decades for assessed house valuation to reflect the house price shocks. A second feature illustrated in these simulations is the importance of home turnover rates - when turnover rates are high, valuations can increase quickly if there are multiple house price shocks (a housing boom). Complimentary to this result, a report by the California Legislative Analyst's Office (LAO) shows that property tax revenues have grown faster than personal income in California (an average annual rate of 7.3% relative to 6.3% since 1979). But the property tax growth has been relatively smoothed over time, not as volatile as the properties' value they are based upon.[11]

3.3 Issuance of Local Government Debt

Local governments are subject to balanced budget rules which limits local borrowing to either short term cash management borrowing or long-term bonds for capital expenditure projects.[12] To issue new long-term general obligation bonds, the local government must receive an approval of the voters. A two-thirds supermajority is required for most local governments with the exception of school districts, community college districts and county offices of education, which, as of November 2000 (Proposition 39), need a 55% supermajority voter approval.

[11] Source: California Legislative Analyst's Office, Understanding California's Property Taxes, November 29, 2012, http://www.lao.ca.gov/reports/2012/tax/property-tax-primer-112912.aspx

[12] Source: http://www.ncsl.org/documents/fiscal/statebalancedbudgetprovisions2010.pdf

Local government bonds (known as municipal bonds) are tax exempt if they meet the rules set by the IRS. In general, the bonds can be used to either finance capital expenditure such as construction, maintenance or repair of infrastructure. New bonds can also be issued to refinance (refund) old debt to improve the bond's terms (lower interest rates or change legal covenants and restrictions but should not extend the maturity or the principal amount of the original bonds that are being refinanced).

Until 2012, cities and counties in California were able to create redevelopment agencies (RDAs) which were a mechanism to fund urban renewal projects from growth in property taxes. These entities would issue long term debt paid by incremental increases to property taxes associated to the project funded. These bonds are considered revenue bonds and are not backed by the full faith of the city or county. The restrictive rules for new bond issuance, the 1% property tax cap and the tax revenue allocation system created large incentives to create RDAs. As such, by the end of the 1980's RDAs received 6% of property tax revenue and by 2008 it reached 12% (Blount et al. (2014)). Since the 1980's the state legislator tried to limit the use of RDAs. One notable regulation, passed in 1993, limited the areas that the cities and counties can define as in need of an RDA.[13] Un February 2012 RDAs ceased operation and successor agencies were responsible for the winding down of the dissolved RDAs assets and obligations.

The empirical analysis that follows will focus on a period where there was no

[13] The new definition was "an area that is predominately urbanized and where certain problems are so substantial that they constitute a serious physical and economic burden to a community that cannot be reversed by private or government actions, absent redevelopment", AB1290

substantial legislation passed (or was being disputed) regarding RDAs. Moreover, in the analysis I discard bonds issued by RDAs since they are designed to create projects and increase property tax revenues and their repayment is only when tax revenue increments can repay the debt and interest, so that these obligations are by definition not a result of increasing house prices but rather are supposed to cause house prices appreciation and increase property tax revenue.

4 Data

4.1 Debt Data

The primary data source for local government's debt data is the Bloomberg L.P. terminal from which I download detailed data of *all* municipal bonds issued in the state of California from January 1995 to June 2006. I choose to end the analysis at the peak of the housing boom in California, after which house prices began to fall and a worldwide financial crisis began. By restricting the sample to the pre-crisis period, the results are not biased from the effects of the financial crisis and the Build America Bonds (BAB) program.[14] Moreover, the instrument for house price growth used in the empirical analysis is successful in describing housing-boom periods, but face some challenges in explaining housing-bust periods.

The main variables from the Bloomberg data are the bonds' declared funding source, the deal value, maturity length and value, the yield and the issuers' credit

[14] A federal program of subsidized municipal bonds initiated in 2009 to stimulate government capital investments.

rating.

Municipal securities are issued as part of a deal (or a series) which includes several securities, each with its own maturity date, maturity size and coupon. I define individual securities as bonds and a group of bonds which are issued by a common issuer, issuance date and deal size define a deal. See appendix C for further details on the construction of the deal size variable.

I exclude bonds issued at the state level and bonds issued by non-profit organizations which are not local governments but are allowed to issue municipal bonds. In addition, for reasons explained in section 3, I exclude from the analysis bonds issued by RDAs. The final sample includes 10,836 deals issued by 2,073 distinct issuers[15] between January 1995 to June 2006.

The CDIAC (California Debt and Investment Advisory Commission) also publishes data on new issued debt of all local governments in California. This data includes non-bonded debt, such as bank loans which are not included in the Bloomberg Data. However, the CDIAC data does not include three important variables. First is the underlying credit rating. This rating reflects the issuer's credit rating, as opposed to the bond's credit rating, which reflects the insurer's credit rating when the bond is insured. Second, the CDIAC data does not provide information on the bonds within the deal, rather it just provides data at the deal level. As explained below, the data on each bond's maturity value is used in the analysis. Third, in many cases the names in the CDIAC data were

[15] To identify the issuer, I use two variables - the issuer name and the first 6 digits of the CUSIP number which identify the issuer. But, some issuers use multiple 6 digits, so I also use the issuer name to identify unique issuers. If the same issuer uses a different 6-digit CUSIP and name, it will be counted as two unique issuers, but the number of such cases is small.

not informative enough to identify the local government. In the Bloomberg data, the name of the issuer is given in full, so that the type of local government can be inferred from the issuer's name and can also be matched (for most) to the State and Local Governments Finances Census data. For these reasons, I use data from Bloomberg for all bonded debt. There are 78 non-bonded debt deals for non-RDA issuers (reduced to 65 when debts issued on the same day by the same issuer are counted as one deal). Since the number is small (relative to over 10,000 deals in the full sample), I exclude these cases in the main analysis, and verify whether the results are robust to including these observations.

The data on the maturity value of each bond within the deal allows me to construct the total indebtedness value for each issuer in each month. To this end, I download issuance data going back to 1960 for all issuers that issued during January 1995 to June 2006. The constructed debt variable is a good proxy for total debt of the local government since local governments mostly issue bonded debt.[16] Early repayments of debt would not be incorporated into this variable, but I can account for cases of refunded debt.

Debt Growth

The ideal measure of debt growth would be the actual debt issuance relative to what the local government would have chosen regardless of the housing boom. Unfortunately, this is not observable and cannot be inferred from the observed borrowing levels.

[16] Based on the data from CDIAC on all local government debt in California, bonded debt is above 98% of all new local government debt in California.

Instead, I use as the credit growth measure the ratio between total actual debt to the mean debt value between the years 1995 to 1997 minus one. All debts are adjusted to inflation and then winsorized at 1% and 99% level in order to eliminate the impact of outliers. Moreover, I exclude in the main analysis issuers that issued only once during 1995-2006 so that the debt growth variable is not based on only one observation of issuance within the sample period.

Related papers that have studied households or firms' credit expansion in the early 2000s define credit growth in alternative ways, each with some drawbacks. Mian and Sufi (2008), Mian and Sufi (2014) and Adelino et al. (2015) consider the change in aggregated total household credit at the zip code level. At a zip code level it is reasonable to expect constantly new debt origination and can allow analysis of debt changes at each period. This approach would not work well for an analysis at the individual local government level. Alternatively, Mian and Sufi (2014) and Chaney et al. (2012) analyze debt growth at the individual and firm level, respectively, defined as the aggregate debt change over the full housing boom period. However, this method does not differentiate between firms that issued at different time periods within the housing boom period, while they may have faced very different house prices. Last, Chaney et al. (2012) analyze debt issuance from year to year at the firm level, but their dependent variable is equal to zero for most periods (periods the firm did not issue new debt). As such, their analysis under-estimates the effect of the housing boom on firm debt. The debt growth variable I use overcomes all these drawbacks.

In addition to regressions with the debt growth variable, I also estimate regressions with the natural log of debt as a dependent variable. Since the regressions will include fixed effects for the local government, the log-log specification will essentially also capture debt growth dynamics.

Interest Rate Spreads

Interest rate spreads are calculated for each bond and defined as the difference between the bond's interest rate to matching maturity Treasury bills at the same day of the bond's issuance. Daily Treasury bill rates are given for 1,3 and 6 months and 1, 2, 3, 5, 7, 10, 20 and 30 years.[17] I interpolate the Treasury bill rates for all other maturities to be able to match to the bond data.

Bonds' Funding Source

At issuance, local governments declare the revenue source funding the debt. The main revenue sources for debt are property taxes, utility income, lease income and special taxes. From this information I construct an indicator variable that takes the value one for bonds funded by property taxes and zero otherwise. I then calculate for each local government the percentage of debt (in real terms) funded by property taxes out of total debt issuance throughout the full sample period. More than 60% of local governments did not issue any bonds funded by property taxes, about 18% issued only bonds funded by property taxes and the rest are distributed evenly between the two extremes. Based on this variable I define an indicator variable for a property tax issuer that takes the value one if the share of bonds funded by property taxes is above 20% and zero otherwise. I

[17] Source: US Department of the Treasury, https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield

verify that the results are not sensitive to this threshold. Table 7 in the appendix presents the main summary statistics for the bond data.

4.2 Geographic and Demographic Data

To the bond data I augment information at the county in which the local government governs. For cities and counties this is a simple task since the boarders are clear. However, special purpose districts can span multiple counties. For those cases I match the mean value of the counties.

Housing Data

The main house price index I use is the Zillow Home Value Index (ZHVI) from Zillow.com for all homes in a given county at a monthly frequency. This index aims to reflect the median value of all homes (and is not just a median price of houses sold). Unfortunately, the house price index from Zillow is available from 1996 and does not provide data for 10 counties (Alpine, Colusa, Del Norte, Inyo, Merced, Modoc, Mono, Plumas, Siskiyou, Trinity) out of the 58 counties in California.

To complement the Zillow data with a longer history of house prices I use the house price index from the Office of Federal Housing Enterprise Oversight (OFHEO), which provides data for 29 MSAs in California from 1975 to present. With this data I compute a long term linear trend for house prices from 1975 to 2000 (pre-housing boom period). Figure 6 in the appendix presents house prices from 1975 to 2015 at the nine largest MSAs in California. In this figure it is apparent that a linear trend is appropriate, and that during the housing boom house prices clearly deviated from the historical trend.

With the two data sources for house prices I define the house price growth variable as the ratio of house prices to the long term trend minus one. In other words, I look at the deviations of house prices from the "normal" house price levels if they would have continued to increase at their long-term growth rates. The advantage of this growth rate definition is that it does not require a decision on the time interval to calculate the growth rates.

Zillow.com is also the data source for the home turnover rates, provided at the county level at a monthly frequency. The home turnover rate is defined as the share of homes sold out of the stock of homes within the last 12 months (see Table 5 and Figure 3 in the appendix for summary statistics on home turnover rates in California during the housing boom). In addition, I collect data on new construction permits[18] and housing stock,[19] both at annual frequency at the county level.

Population

For counties, cities and special districts I match the population resident within the county, city or area served by the special district. Cities' and counties' population estimates are taken from California Department of Finance.[20] For

[18] Source: Building Permits Survey, https://www.census.gov/construction/nrc/index.html

[19] Source: State of California, Department of Finance, E-8 Historical Population and Housing Estimates for Cities, Counties, and the State, 2000-2010. Sacramento, California, November 2012 and E-8 City/County/State Population and Housing Estimates, 4/1/1990 to 4/1/2000

[20] Tables E-4 (for years 2000-2010) and E-5 (2010-2014) of "Population and Housing Estimates for Cities, Counties, and the State", California Department of Finance, Demographic Research Unit. http://www.dof.ca.gov/research/demographic/reports/estimates/e-5/2011-20/view.php and Department

college and school districts I use school enrolment as the population estimate, which are provided by the California Basic Educational Data System (CBEDS)[21] and the California Community Colleges Chancellor's Office.[22]

Additional demographic information at the county level included in the analysis are: (a) population group ages and race,[23] (b) income per capita,[24] and (c) employment and wages.[25]

4.3 Local Governments' Financial Data

The State and Local Governments Census is an extensive dataset including many variables of revenue, expenditure and debt of all local governments in the US. The data is collected every 5 years (years ending at 2 and 7), so that it would not be ideal for estimating the effects of the 2000s housing boom on local governments' debt. Nonetheless, this data is useful to construct two important variables.

The first variable is constructed as the share of the local government's property taxes income out of total income (the distribution of local governments based on this variable is presented in the appendix, Figure 5). I then define an indicator variable for property-tax dependent governments which takes the value one if

of Finance, "Revised County Population Estimates and Components of Change by County, July 1, 1990-2000". Sacramento, California, February 2005.
http://www.dof.ca.gov/research/demographic/reports/estimates/e-6/1990-2000/ I use the county population estimates to extrapolate population estimates for cities.

[21] I download the data from kidsdata.org: http://dq.cde.ca.gov/dataquest/
and kidsdata.org: http://www.kidsdata.org/topic/558/publicschoolenrollment/table

[22] Source: http://datamart.cccco.edu/Students/

[23] Source: Population and Housing Unit Estimates, Intercensal Estimates:
https://www.census.gov/popest/data/intercensal/index.html

[24] Source: Bureau of Economic Analysis. Downloaded from: State of California, Employment Development Department, Measures of Income:
http://www.labormarketinfo.edd.ca.gov/cgi/dataanalysis/incomeReport.asp?menuchoice=income

[25] Source: County Business Patterns,http://www.census.gov/programs-surveys/cbp/data/datasets.html

the local government's property tax revenue as a share of total revenue is 20% or higher and zero otherwise. With this definition, about 43% of bond issuing local governments (with census data) are defined as property tax dependent issuers.

The second variable I use is the total current expenditure of the local government. Both variables are constructed from the 1997 data which is the closest census year prior to the housing boom period.

Of the 2,073 issuers, I was able to match 1,422 to the census data. Table 10 in the appendix presents summary statistics of the two variables for all local governments in California and for bond issuers. The two groups are similar in terms of the first variable, the share of property tax out of total revenue. However, in terms of the current expenditure variable the issuers have much larger expenditures, relative to the general local government population. Since this is not the full sample of issuers, the regressions in the main analysis do not include the census variables. However, for robustness, I present in the appendix results where the indicator for local governments who issue bonds funded by property taxes is replaced with an indicator of local governments who mainly rely on property taxes based on the variable from the Census of Local Governments. Second, in the appendix I present regression results with the total expenditure used as regression weights.

5 Empirical Analysis

5.1 Empirical Strategy

To estimate the effect of house price growth on local governments' debt growth I exploit the variation in house price growth rates in California. While most of California experienced significant housing appreciations during the housing boom, there is a good amount of variation in the timing and in the magnitude of growth rates between counties. Specifically, I estimate the following regression:

$$g(Debt_{ict}) = \alpha_i + \alpha_{year} + \beta_1 g(HP_{ct}) + \theta X_{ict} + \epsilon_{ict} \tag{1}$$

where $g(Debt_{ict})$ is debt growth of local government i in county c at month t, $g(HP_{ct})$ is the house price growth at county c at time t, X is a vector of control variables (some at the county level and some at the local government level) and α_i, α_{year} are local government and year fixed effects, respectively. Debt and house price growth are defined as the percentage point deviation from their long term values (see Section 4 for more details on the construction of the growth variables).

The regression includes fixed effects for individual local governments to capture time independent effects for each local government that are possibly correlated with other regressors. The year fixed effects capture shocks correlated to all local governments within a given year. Last, variables of demographic and income changes as well as interest rate changes are included to control for demand and supply effects on local government debt growth. The standard errors are clustered at the county level to account for any possible serial correlation and bias introduced by county level rules for local governments' finances.

Next, to identify the channel through which house prices affected local governments, I interact house price growth with indicator variables for types of local governments and estimate the following equation:

$$g(Debt_{ict}) = \alpha_i + \alpha_{year} + \beta_1 g(HP_{ct}) + \beta_2 g(HP_{ct}) \times Type_i + \theta X_{ict} + \epsilon_{ict} \qquad (2)$$

where $Type_i$ is and indicator variable for the type of local government and all other variables are the same as equation (1). The first type is defined based on the funding source for the debt. This indicator takes the value one if the issuer has mainly issued property tax bonds and zero otherwise (see Section 4.1 for more details). If expectations of higher property tax revenue explain the effect of house price growth on local government debt growth, then we would expect an increase in debt for those who mainly issue debt funded by property taxes while issuers of debt funded by other revenue sources will have a smaller or no response to house prices growth.

The second type is defined based on home turnover rates. As discussed before, local governments in areas with higher home turnover rates would be expected to respond more to house price growth if debt increased due to expectations of higher future property tax income. Home turnover rates should not have an effect if other shocks were the main driving force of debt.

The third type is based on credit rating groups which serve as proxies for credit constraints. Rising house prices may increase debt by easing borrowing limits of local governments who receive property tax revenue. Each of the three type interactions is estimated in separate regressions.

Endogeneity Issues

There are potential concerns using a simple OLS estimation to infer causality of the house price growth on debt growth: First, it might be the case that the causality is reversed: local governments borrowing and subsequent investment in public infrastructure increase the value of living in the local area which caused an increase in housing value and influx of population into the area. Second, house prices or construction may be correlated with other local demand shocks. This issue is especially troubling if issuers who are property-tax dependent are more sensitive to these shocks then other local governments. For example, as people become wealthier (resulting of their increased property value) they may demand higher quality schooling services. If this were the case, then, while school districts are dependent on property taxes for their income, their borrowing growth would not be in response to expectations of higher future income but rather it is a result of higher demand for schooling services.

To deal with the endogeneity of housing units or population growth I use a one year lagged growth rates. It is reasonable to assume construction responding to government expenditures will not increase long before the initial funding for the new project has been taken. These variable are not of main interest for this paper since the effect of the housing units and population growth includes two effects - the growth of the tax base and the growth in needs of public services. Thus, I use these variable in the regressions just as a control for increased needs. Similarly, I include one year lagged population of the population at age group k-12 and per capita income at the county level as controls for increased demand for public capital expenditures (and subsequently, increased debt).

To address the endogeneity of house price growth I use an instrumental variable approach. The instrument I use is the share of land available for development within an MSA interacted with mortgage rates.[26] The share of land available for development is the complementary fraction of land unavailability from Saiz (2010). The original unavailable land measure is defined as the share of land within 50km of an MSA's center which is unavailable for residential or commercial real estate development because of terrain constraints, such as land with too steep slopes, and the presence of large water bodies such as oceans, lakes and wetlands. This measure is arguably exogenous to the local government's debt and expenditure decisions, satisfying the exclusion restriction.

The main mechanism exploited is that lower interest rates will increase consumers demand for housing in all areas, but house prices will respond to the interest rate shock differently based on the availability of land that can be developed for housing: house prices in areas with a large share of land available for development will not increase substantially because the increased housing demand will translate to higher construction in the long run and rational buyers will incorpo-

[26] Monthly mortgage rates are the 30 year conventional mortgage rate from the Federal Reserve Bank of St. Louis.

rate this information into the prices they are willing to pay. In contrast, house prices in areas with a low share of land available for development will go up since construction opportunities are limited.

The instrument used is similar to the one used in Chaney et al. (2012) and Vlaicu and Whalley (2011). The difference is that these papers use the housing elasticity measure from Saiz (2010) which includes both an unavailability measure and a component of housing permits regulation. I choose not to use the housing elasticity measure because it includes the regulation component which arguably is not exogenous to the local governments debt decision. Table 1 presents results of the first stage regressions, verifying that the first stage inclusion restriction holds.

Table 1: First Stage Regressions - House Prices and Local Housing Availability

Dependent Variable:	House Price Growth		House Prices (thousands)		ln(House Prices)	
	(1)	(2)	(3)	(4)	(5)	(6)
Land Availability × 30 Year Mortgage Rates	0.06***	0.06***	90.91***	108.57***	0.02***	0.03***
	(0.01)	(0.01)	(2.88)	(3.43)	(0.01)	(0.01)
Fixed Effects:						
Year	Yes	Yes	Yes	Yes	Yes	Yes
County	Yes	Yes	Yes	Yes	Yes	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Adj.-R^2	0.93	0.95	0.89	0.93	0.98	0.99
Observations	3567	2958	3567	2958	3567	2958

Notes: This table presents results of the first stage regression, estimating how a mortgage interest rate shock affects house prices with dependence on the share of land available for housing development. The dependent variable in columns 1 and 2 is detrended house prices as a percentage of long term house prices. The dependent variable in columns 3 and 4 is the Zillow House Value Index divided by 1000 and in columns 5 and 6 it is the natural log of Zillow House Value Index. Columns 1, 3 and 5 do not include additional control variables, while columns 2, 4 and 6 include the control variables used in the second stage regression: the 10-year Treasury rate, the natural log population (regressions 3-6), population growth within the last year (regressions 1-2), natural log of income per-capita (regressions 3-6), income per-capita growth within the last year (regressions 1-2), and natural log of population in school ages. All regressions include fixed effects for year and county. Standard errors, in parentheses, clustered at the county level.
***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

5.2 Main Results

Estimation results for equation (1) are presented in the first two columns of Table 2. OLS results show a positive relationship between house price growth and debt growth. The IV regression in column 2 indicates that the relationship is causal, however the coefficient decreases in absolute value and significance.

The estimation results for equation (2) are presented in Tables 2 and 3. Regressions in columns 3 and 4 in Table 2 include an interaction of house price growth with an indicator for issuers of bonds funded by property taxes. Once the interacion term is included the coefficient on the house price growth variable is not significant, while the interaction term is positive and significant with an estimate of 0.6 in the OLS estimation and 0.44 in the IV estimation. This result provides strong evidence that house prices caused an increase in local government debt through the property tax channel - local governments who expected an increase in their future income due to the rising house prices increased their debts while local governments who do not depend on property taxes did not change their debt in response to the house price boom, controlling for credit and demand forces.

Column 5 reports results for the sample of periods with positive debt issuance to estimate the intensive margin effect of house price growth on issuance growth. The coefficient estimate is lower than those estimated on the full sample (0.33). The last column presents results of a linear probability model which captures the extensive margin effect of house price growth on local government issuance.

The results of this regression indicate that the probability of issuance increases as house prices are higher for issuers of bonds funded by property tax and does not have a significant effect for others.

Table 2: House Price Growth and Borrowing Behavior

Dependent Variable:	Debt Growth					Positive Issuance
Estimation Method:	OLS (1)	IV (2)	OLS (3)	IV (4)	IV (5)	OLS (6)
House Price Growth	0.22***	0.16*	-0.05	0.02	0.08	0.00
	(0.06)	(0.09)	(0.07)	(0.19)	(0.10)	(0.01)
× Issuers of Bonds			0.60***	0.44***	0.33**	0.61***
Funded by Propert Taxes			(0.20)	(0.04)	(0.13)	(0.03)
Fixed Effects:						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Local Government	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.28	0.14	0.30	0.19	0.27	0.15
Observations	94989	94989	94989	94989	3428	137508

Notes: Columns 1 through 5 present regression estimates of the effect of house price growth on local government debt. For all these regressions the dependent variable is the debt growth defined as the percentage point deviation of the local government's debt from its mean debt level s of 1995 to 1997. Regressions 1-4 include only observations with data for the instrument variable and those that issued at least once in the pre-boom period. The house price growth variable is defined as percentage point deviation of house prices from their long term trend. Column 5 repeats the IV regressions over the sub-sample of observations with positive debt issuance. Column 6 presents results of an OLS regression with an indicator for positive issuance period as the dependent variable. All regressions include the following control variables (not reported above): months since last issuance, the10-year risk free interest rate and county level controls: one year lag of housing units growth, population growth and natural log of population at k-12 ages, and per capita income. In addition, all regressions include year and individual local government fixed effects. Standard errors are clustered at the county level for all regressions. ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level.

Table 12 in the appendix presents results of estimating the specification in column 4 of Tables 2 on sub-groups of local governments by the type of services they provide: counties, cities, school, college and special districts. The main result of this table is that cities, school and college districts who issue debt funded by property taxes increased their debt in response to the increasing house prices. Counties and special districts of all types and cities, school and college districts who issue debt funded by revenue other than property taxes did not response to the house prices in terms of debt levels.

Next, I move to estimate whether the effects of house prices on local government debt change with respect to the home turnover rates in the local area and with respect to the local government's credit availability. As shown in columns 1 and 2 of Table 3, for local governments in areas of very low home turnover rates (recall home turnover rate quartiles are defined on the full set of counties and across time) the effect of house price growth is insignificant. For local governments in all other home turnover groups the coefficient is positive and significant. Moreover, the coefficients are higher at the higher home turnover quartiles. The IV regressions provide similar effects but slightly lower estimates.

Second, I interact house prices with the issuers' underlying credit rating (binned to four groups: unrated, BBB-rated, A-rated and those rated AA and AAA) which serves as a proxy for issuers' credit constrains. This proxy is similar to those used in earlier papers such as FICO score or net worth when identifying credit constrained households (for example, Hall and Mishkin (1980)), and bond-credit rating and asset size when identifying credit constrained firms (for example, Denis and Sibilkov (2009)).

Results are presented in columns 3 and 4 in Table 3. The coefficient over house price growth is insignificant for both the OLS and IV specifications. This reflects that those unrated did not respond to house price growth. However, the interaction term of the house price growth variable with the higher credit rating groups are positive and significant. Second, the coefficients are higher for issuers

Table 3: House Prices Growth and Borrowing Behavior by Issuer Type

Dependent Variable:	Debt Growth			
Interaction Terms:	Home Turnover Quartiles		Credit Rating Groups	
Estimation Method:	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
House Price Growth	-0.04	0.04	-0.12	0.10
	(0.07)	(0.05)	(0.22)	(0.27)
× interaction term (listed above):				
Group 2	0.39***	0.37***	0.67***	0.58***
	(0.09)	(0.05)	(0.08)	(0.08)
Group 3	0.48***	0.41***	0.40**	0.35*
	(0.10)	(0.05)	(0.19)	(0.18)
Group 4	0.67***	0.52***	0.22*	0.19*
	(0.05)	(0.05)	(0.07)	(0.1)
Fixed Effects:				
Year	Yes	Yes	Yes	Yes
Local Government	Yes	Yes	Yes	Yes
Adj. R^2	0.30	0.13	0.28	0.13
Observations	94989	94989	94989	94989

Notes: This table presents results estimating the effects of house prices on local governments types whom are more likely to be affected by the house price growth. For all these regressions the dependent variable is the ratio between the local government's detrended debt over its mean debt level during 1995 to 1997. The main independent variables are the detrended house prices as a percent of the long term trend and the detrended house prices interacted with issuer-type variable reported at the top of the columns. Columns 1 and 3 are estimated with an OLS regression and columns 2 and 4 estimated with an IV method. The instruments are availability land measure interacted with interest rates and this variable interacted with the interaction variables listed in the top of the columns. All regressions include year and local government fixed effects and standard errors are clustered at the county level. All regressions include the following control variables (not reported above): months since last issuance, the10-year risk free interest rate and county level controls: one year lag of the natural log of the average annual wage, housing units growth, population growth and natural log of population at k-12 ages, and per-capita income.
***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

rated BBB and decreases as credit rating improves.

5.3 Robustness Checks

In this section I test if the results are robust to other measures of the debt growth variable. First, I construct the debt growth variable based on an alternative method to calculate total debt. Instead of estimating total debt as the total maturity values of outstanding bonds, I discount the bonds in each month by the risk free rate with the same maturity. This variable is more volatile since it depends on the interest rates at each month. But its advantage over the former debt variable is that by discounting the bonds I capture changes in the effective duration of the local governments' debt. I run the same regressions as before and the quantitative results remain about the same.

Second, instead of growth rates regressions, I estimate a log-log specification (OLS and IV) with the natural log of total real debt as the dependent variable and the main independent variables are the natural log of house prices and an interaction with an indicator for issuers of bonds funded by property taxes. For the IV regressions I instrument house prices with the same instrument as before, the share of land available interacted with mortgage rates.

I run this specification over the full sample and then interacted with the home turnover and credit rating groups. All the regressions include fixed effects for local governments so that these regressions estimate changes in the logs and essentially the interpretation of the results is the same as in the main sepcificaion.

Results are presented in Table 13 in the appendix. Qualitatively, the main results hold, that higher house prices are correlated with higher property-tax-funded debt issuance. Quantitatively, the elasticities are about the same (~ 0.54). In the home turnover rates regressions the results support the same hypothesis that local governments who issue mostly property tax bonds in areas with higher home turnover rates react more to house prices than similar local governments in areas with lower turnover rates. The coefficients for the unrated credit rating group is insignificant while for those rated they are significant, positive but decreasing as the credit rating improves.

Third, I test the sensitivity of the results to the definition of local governments who issue bonds funded by property tax. First, I try various cutoff points for the share of debt funded by property taxes out of all debt issued by the local government (recall, in the main specification the cutoff is 20%). The results do not change much. Next, I use an alternative definition for property-tax dependent issuers based on the local government's revenue source (see section 4 for more details on this variable). The results, presented in Table 14, are consistent with the main results presented in Table 2.

The fifth column in Table 14 repeats the IV estimation with regression weights based on total expenditure of the local governments as of 1997 so that larger local governments have a larger impact on the regression estimates. Results indicate that including the weights does not impact the estimate or the regression fit.

Next, I consider the impact of the sample used. In the main analysis I use the sample of issuers with data on land availability (the instrumental variable). OLS regression results remain about the same when including the full sample, with slightly higher estimates.

Last, I estimate all the regressions with variations of the time period used to calculate the mean debt level starting at 1994 as well as estimating the regressions with all issuers (the main analysis includes only those who have issued at least twice during 1996-2006 so that debt levels are not based on one issuance observation). The results remain about the same.[27]

[27]For the sake of conciseness I do not report the results for the debt growth defined with the alternative

5.4 Interest Rate Spread Analysis

How did investors respond to increasing debt levels of the local governments and did they incorporate expected revenue growth in the debt pricing? To answer these questions I estimate the following equation:

$$\begin{gathered} S_{ijct} = \alpha_i + \alpha_{year} + \beta_1 g(HP_{ct}) + \beta_2 \mathbb{1}\{PropTax\}_j + \\ \beta_3 g(HP_{ct}) \times \mathbb{1}\{PropTax\}_j + \theta X_{ijct} + \epsilon_{ict} \end{gathered} \tag{3}$$

where S_{ijct} is the interest rate spread of bond j issued by local government i in county c at month t. The spread is defined as bond j's interest rate minus the matching maturity Treasury bills as of the same day of issuance. $g(HP_{ct})$ is the house price growth in county c at month t, defined as the ratio of house prices to the long term house price trend minus one. $\mathbb{1}\{PropTax\}_j$ is an indicator variable for bonds funded by property taxes. X_{ijct} are control variables, including a variable for bond maturity and the bond's rating, and α_i, α_{year} are local government and year fixed effects, respectively.

Estimating this equation with OLS regressions is sufficient since reversed causality and a correlation to a common shock are not a concern, once controlling for the risk free interest rates, lagged population growth and income. Results of the regression are presented in the first column of Table 4. The results indicate that house price growth enters the equation with a negative sign (-0.13, at 10% significance level). When house prices increase by 100% (above their trend) interest

total debt variable and results of the alternative period of mean debt levels. The results are available upon request.

rate spreads decrease by 13 basis points. Second, the coefficient for the indicator variable of bonds funded by property taxes is negative (-0.1, at 1% significance level) but the magnitude is small - controlling for the issuer, bonds funded by property taxes receive 0.1 basis point lower interest rate spreads relative to bonds funded by other revenue sources. Third, the interaction of the two variables is significant and negative with a coefficient of -0.06.

Table 4: House Prices and Interest Rate Spreads

Dependent Variable:	Interest Rate Spread		
Sample:	All	Turnover Qaurtiles	
		Lowest	HIghest
Estimation Method:	OLS	OLS	OLS
	(1)	(2)	(3)
House Price Growth	-0.13*	0.27	-0.42**
	(0.08)	(0.43)	(0.17)
Bonds funded by property tax	-0.11***	-0.07	-0.24***
	(0.04)	(0.08)	(0.08)
House Price Growth ×	-0.06**	-0.16	-0.16***
Bonds funded by property tax	(0.03)	(0.54)	(0.07)
Fixed Effects:			
Year	Yes	Yes	Yes
Local Government	Yes	Yes	Yes
Adj. R^2	0.55	0.46	0.48
Observations	104706	4589	36667

Notes: This table present the estimates of the effect of house prices on interest rate spreads for local government bonds. The dependent variable is the interest rate on each local government bonds of fixed or zero coupons minus the matching maturity treasury bills (in percentage terms). The first column presents an OLS estimation with the main explanatory variable is the house price growth defined as the ratio between house price and their trend minus one, an indicator variable for bonds funded by property taxes and an interaction of the two. The second column repeats the first estimation for the sub-sample of issuers in areas with low home turnover rates and the third column repeats the estimation for the sub-sample of issuers in areas with high home turnover rates. All four regressions include year and local government fixed effects and are cluster standard errors at the local government level. The control variables included in the regression but not reported above are: at the bond level: bond maturity, rating and indicator variables for zero coupon, revenue, callable and insured bonds. At the county level: natural log of population and income.
***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

Next, I estimate equation (3) over the subsample of issuers in areas of low and high home turnover rates (defined as the lowest and highest home turnover rate quartiles, respectively). For issuers in counties with low home turnover rates, the coefficient on all three variables is insignificant. In contrast, for issuers in counties with high home turnover rates all coefficients are significant and larger in absolute value.

Overall, the results are concurrent with the story that the market internalized the expectations of higher future revenue and provided credit at lower rates for those with higher income growth prospects. Moreover, these results suggest that local governments were not issuing debt beyond levels that the investors believed were sustainable.

6 Conclusion

During the early 2000s households, corporations, state and local governments increased their debt levels by unprecedented magnitude. The effects of the households' credit expansion have been said to have brought on the biggest financial crisis since the great depression. The effect of the state and local governments' credit expansion is taking its tool slower but is apparent in many states. Understanding the origins of their credit expansion is important for the political discussion about the solutions to the financial difficulties many local governments face today. This paper provides a partial explanation for the great credit expansion of local government debt in the early 2000s.

Using data on local governments in California I show a causal relationship between the increasing house prices and local governments' debt, explained by the property tax channel. I estimate that local governments who are exposed to property tax revenue increased their debt by 0.44 percentage points in response to a percentage point increase in house prices above their long-term trend. In contrast, all other issuers did not respond to the increasing house prices, controlling for credit supply and demand forces.

Moreover, I find the effect to be stronger for local governments in counties with high home turnover rates and for issuers who are more likely to be credit constrained. These results can be rationalized with a multi-period spatial model (presented in Appendix B) where local governments are able to issue debt based on expectations of higher future income when house prices grow.

In addition, I find interest rate spreads (at time of issuance) were lower for local governments in areas with higher house price growth and even lower for those issuing debt financed by property taxes. These results indicate that investors internalized the house price growth and did not perceive the increased debt to be beyond the means of the local government.

This paper did not address whether the increased debt of local governments was used for real improvements and construction of infrastructure or whether the increased debt allowed local governments to increase their current consumptions, such as increasing employees' wages. I plan to tackle this question in future work.

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Appendices

A Simulated Property Tax Revenue Growth

Since property assessments for tax purposes is updated only with a change in ownership, then home turnover rates (defined as the percentage of homes sold out of the stock of homes within a defined period) will determine how quickly the total assessment value in the area will increase as a result of a house price shock. Consider two extreme cases: suppose home turnover is practically zero so that very few house sales can cause the house price index to rise and yet assessment values will not grow. At the other extreme case, suppose the home turnover rate is 100% so that assessment values increase at the same rate as the house price growth rate.

The mean home turnover rate in California during the housing boom was 6.9%, but rates varied across counties and periods from as low as 2.6% to 16.3% (Table 5 and Figure 3). As can be expected, there is a positive correlation between home turnover rates and house price growth rates (Figure 2).

Figure 2: House Price Growth and Home Turnover Rates, 2001-2006

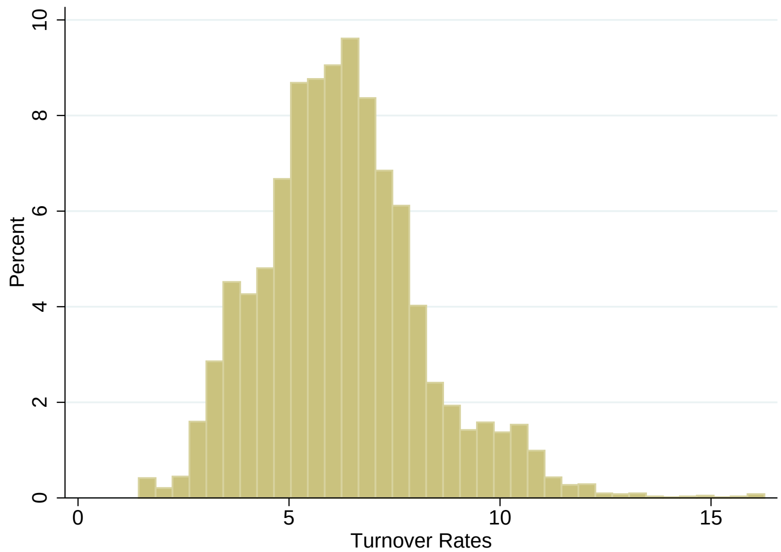
Notes: Each observation is a data point for one month for each county in California during 2001-2006. House price growth defined as the deviation of the Zillow house value index from the long term trend in percentage of the long term trend. Home turnover rates are defined as the share (in percentages) of homes in a county sold within the last 12 months. Source: Author's calculations based on data from Zillow.com.

Table 5: Home Turnover Rates in California, 2001 - 2006

	Mean	SD	Min	Max
Full Sample	6.86	1.94	2.64	16.27
Lowest Quartile	4.68	0.63	2.64	5.44
Highest Quartile	9.49	1.38	7.89	16.27

Notes: home turnover rates are defined as the share (in percentage) of all homes in a given area that were sold in the past 12 months. Quartiles are defined over the full sample of counties in California, monthly frequency, during 2001-2006. Source:Author's calculations based on data from Zillow.com.

Figure 3: Histogram of Home Turnover Rates in California, 2001-2006

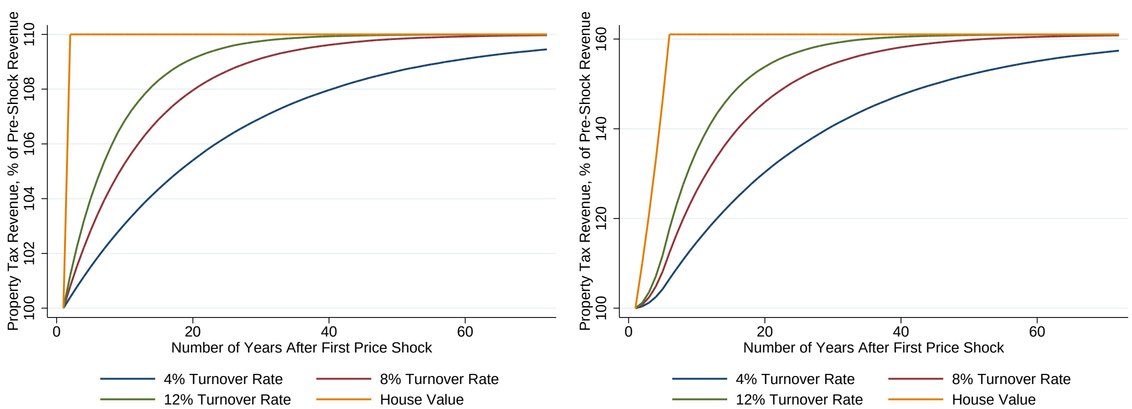


Source: Zillow.com.

To illustrate how long it can take for property tax revenue to increase as a result of an increase in house prices, I simulate a city with 100,000 houses hit by a single and multi-period house price shock of 10% each period and then houses are sold randomly at a given home turnover rate. Three main results come out of these simulations. First, when I simulate a single-period house price shock, the assessment value (and as a result, also the tax revenue) increases very slowly. The left graph in Figure 6 plots the property tax growth response to a single 10% house prices shock for three home turnover rates. The figure shows that even for a relatively high home turnover rate (12%) it takes over 40 years for the properties' assessments and property tax revenue to fully capture the 10% house price growth. For low turnover rates (4%) even 70 years is not enough to capture a one-period house price shock. Panel A of Table 6 presents the percentage increase of property tax revenue after the first 5, 10, 20 and 30 years after the shock. Second, in contrast, multi-period house price growth has a (relatively) quick effect on the assessment value and tax revenue growth (see right graph in Figure 6 and panel B in Table 6). Third, the simulations show there is a non-linear (but monotonic) relationship between the home turnover rate and the speed of the assessment value and property tax revenue growth.

Figure 4: Property Tax Growth in Response to Real Estate Shocks

(a) One Year 10% Shock (b) Five Consecutive 10% Shocks



Notes: Based on author's simulations.

Table 6: Property Tax Growth in Response to Real Estate Shocks

Turnover Rate	Horizon (years) 5	10	20	30
A. One-Year 10% House Price Shock				
4%	0.9%	1.8%	3.1%	4.2%
8%	1.8%	3.2%	5.1%	6.3%
12%	2.6%	4.3%	6.3%	7.4%
B. Five-Years 10% House Price Shock				
4%	2.5%	7.1%	15.8%	22.7%
8%	4.8%	13.0%	26.0%	34.4%
12%	6.9%	17.9%	32.7%	40.8%

Notes: Based on author's simulations.

From these results we can form predications that a single-period house price growth shock should not have an effect on local government's borrowing since it will take decades for the local government's income to grow in response to the house price growth. In contrast, a housing boom of several consecutive years can have an effect on borrowing since income is expected to grow as a result of the housing boom within a shorter time-span. As home turnover rates are higher we can expect higher response to house price growth. Having said that, these simulations also show that the elasticity between debt and house price growth is expected to be less than 1 because assessments grow at a slower rate than house prices.

B Theoretical Model

The model I use builds upon the Rosen (1979), Roback (1982) and Brueckner (1983) spatial equilibrium framework and adds to it (a) a layer of housing market dynamics, (b) a local government which can increase the amenities in its location, (c) this local government can borrow in order to move resources from the future to the present and (d) the local government's tax revenue depends on the home turnover rates in the area. While the first two features have been shown before (in particular, Diamond (Forthcoming)), the two last features are new to the literature.

The model consists of many islands, each with many infinitely lived households, private producing firms and one local government.[28] Since each particular

[28]In the model, local governments serve households in a defined geographic island and all local governments have identical functionality. In practice, local governments can overlap geographic areas and one geographic

local government is small and does not affect the equilibrium outside of its island the setup can be simplified to have just one island and an outside option which allows for migration. I use the following convention in the notation: variables with an upper bar are fixed exogenously and are common to all local governments, variables with an upper tilde sign are random variables (shocks), and lower subscripts describe the period for time-contingent variables.

The model includes two periods of interest, period 0 and 1. All actions take place at one of these two periods, although households live indefinitely so house prices are priced accordingly. Period 0 is the initial period before any shocks are observed. Between period 0 and 1 the island experiences a shock to the local amenities (denoted by $\tilde{a}$) and a productivity shock (denoted by $\tilde{z}$). The new local amenities and productivity of islands are observed by all agents in the model. Households choose freely where to live before period 1 begins (migration is costless). Their decision will be based on rational expectation of what other households and local governments will choose to do (a Nash Equilibrium). At period 1 governments make a policy decision in terms of capital expenditure paid by new issued debt. Once migration decisions are made, households work and derive utility from consumption of private goods and public amenities.

area can be served by many local governments of various functionalities.

B.1 Households

There are many identical households (the number of households is denoted by N_t). Each household provides one unit of labor[29] and earns wage w_t. The wages are spent on consumption of private goods (c_t, the price of which is normalized to 1 for each unit) and rent (r_t) to absentee homeowners for one unit of housing each period. Households cannot save or borrow.

Households derive utility from consumption of private goods and the level of local amenities (a_t) in their area of residence. Local amenities are a function of the past amenities level, the amenities shock component and the local government's capital expenditure (g_t). Once the shocks are observed, all households choose their residence location which will maximize their utility based on rational expectations of where other households will live and the local governments' actions.

Households cannot choose the level of amenities, the government's expenditure or taxes, but they can choose to move freely in and out of the island ("vote with their feet", Tiebout (1956)). In equilibrium it must be that each household is located in the island that maximizes its utility, and since all households are identical, the utility of all households will be the same and equal to the outside utility, denoted by $\bar{V}$. Using the indirect utility function, we get the following equilibrium condition for households:

$$V(w_t, r_t; \tilde{a}, g_t) = \bar{V} \tag{4}$$

[29] The model can be extended to allow workers to choose the level of labor and include utility from leisure.

where w_t is wages, r_t is rent, $\tilde{a}$ is a local amenities shock and g_t is the public capital expenditure.

B.2 Firms

The island has many identical and competitive firms with a production function in the form of $X_t = F(N_t; \tilde{z}, g_t)$ where N_t is the population in the island, $\tilde{z}$ is a productivity shock and g_t is the local government's capital expenditure. Firms' profits are equal to production minus the wage to workers w_t. Competition among firms will drive workers' wages to their marginal productivity. In equilibrium, profits must be zero across all locations. Otherwise, firms will move to more profitable areas, drive wages up and profits will go down to zero. Suppose the production function has constant returns to scale in labor so that we can define the cost function of creating one unit of output as C, which must equal to price of the private good:[30]

$$C(w_t; g_t, \tilde{z}) = 1 \tag{5}$$

B.3 Housing Market

Assume that the marginal cost of new construction is described by a function of population on the island at each period (N_t) and the marginal cost of con-

[30] An example for a production function where public expenditure do not have an effect on production would be $f(N_t; \tilde{z}) = \tilde{z}N_t$ and this will imply $w_t = \tilde{z}$. In such a case, producing one unit of output will entail hiring $\frac{1}{\tilde{z}}$ workers. The unit cost function would be $C = \frac{w_t}{\tilde{z}}$. An attractive feature of the unit cost function when the production function has constant returns to scale is that $C_w = N_t/X_t$. Another production function (again with constant returns to scale) where public capital expenditure does have an effect on productivity is the one used in Diamond (Forthcoming): $f(N_t; \tilde{z}) = (\tilde{z} + B(g_t))N_t$. Then the unit cost function is $C = \frac{w_t}{\tilde{z}+B(g_t)}$

struction (denoted by δ) which differ across islands but constant over time.[31] The marginal construction cost is more responsive to population changes when the land available for development is low. The construction market is competitive so that in each period the housing value from the supply side will be equal to the marginal construction costs of new housing (a function of population and the land available for development). Each household lives in a house, so that if many people want to move into the island construction will take place.

The demand for new houses will be driven by the rent tenants are willing to pay. The value of a house from the demand side (H^d) is the present value of the house's cash flows (discounted by $1 + \bar{r_0}$, the alternative rate of return for homeowners). At time 1 the value of the house can be described as the present value of infinite rent minus taxes.[32]

$$H_1^d = \frac{(r - \tau H_1)(1 + \bar{r_0})}{\bar{r_0}} \rightarrow H_1^d = \frac{r(1 + \bar{r_0})}{\bar{r_0} + \tau(1 + \bar{r_0})}$$

This gives the common result that rent is a fraction of the house value, denoted by ρ. This fraction is constant when taxes and interest rates are fixed.

In equilibrium, the demand and supply for housing will be equal, such that:

$$\frac{r}{\rho} = H(N; \delta) \tag{6}$$

[31] One common form for the marginal cost of construction (used in Saiz 2010, Diamond (Forthcoming) and Glaeser et al. (2006)) is $K + \delta \log(N_t)$. High values of δ means that construction costs increase more for the same population growth.

[32] Unless there are new shocks, all house prices are equal in the future.

B.4 Equilibrium in the Labor and Housing Markets

The three equilibrium conditions described in equations (4), (5) and (6) pin down population, wages and house prices, all as a function of the government's policy. Describing changes to the equilibrium as a result of external shocks or resulting from a change of the local government's policy depends on the specific functional form chosen for the utility, production of goods and housing functions.

Having said that, even with these general functional forms, I can describe some equilibrium features based on the three conditions set above. First, since land is not part of the production function, rent captures all the increase in utility from shocks or public expenditure (as in Rosen (1979)). The reason for this is that any exogenous shock or change in the government's policy that will increase (decrease) utility on the island will cause migration pressure into (out of) the island which in turn will cause changes to wages and rents until utility on the island is equal to $\bar{V}$. Since households observe the shocks on all islands and they cannot save, then transition to a new equilibrium is immediate, all migration takes place just before period 1 and the variables rent and wages will be the same for period 1 and onward.

Second, the housing supply and house prices do not directly change with respect to shocks or government policy, but they do respond to population changes. The extent of housing units growth vs. house price growth will depend on the land supply elasticity measure. If the land supply elasticity is low, the response of the house prices and rent will be high to changes in the island's population.

B.5 Local Governments

The government has an ongoing expenditure level at period 0, denoted by g_0 and it is committed to this expenditure level at all periods. These expenditures can be thought of as the payroll expenses and recurring constant expenditures required to provide public services. Households do not consider higher levels of g_0 to have value so that the migration does not depend on this expenditure, but governments cannot reduce it. The government's revenue is based only on property taxes proportional to the houses' value and its current expenditure must be equal to or lower than the tax revenue (a "balanced budget rule"). The number of houses is equal to the household population size, so that this condition implies at the initial period $g_0 \leq \tau_0 H_0 N_0$, where H denotes the house value, N the population size and τ denotes the property tax rate.

At time 1 the government chooses its level of public capital expenditure, g_1 based on the observed shocks. This expenditure increases the value of amenities for households and possibly for firms. Public spending is financed by debt issued at period 1 and is repaid in future periods from property tax revenue. The net interest rate, set at the national level, is $\bar{R}$.

Since this model is supposed to explain the behavior of local governments in California it is appropriate to incorporate the assessment system in the state. As explained in detail in section 3, house value assessments are updated to market value only with a change in ownership (or renovation). Recall that homeowners are absent and their motivations to sell are not modeled. Therefore, I assume each island has a turnover rate (denoted by γ) exogenously determined. Suppose first that there is no new houses built. Then, the new tax base (TB) in period 1 can be described as follows:

$$TB_1 = (1-\gamma)H_0N_0 + \gamma H_1 N_0$$

At period 2 the tax base will be:

$$TB_2 = (1-\gamma)^2 H_0N_0 + (1-(1-\gamma)^2)H_1N_0$$

At period M the tax base will be:

$$TB_M = (1-\gamma)^M H_0N_0 + (1-(1-\gamma)^M)H_1N_0$$

Next, suppose the turnover rate is only a reflection of the new homes being built and sold (old houses do not change ownership). Then the turnover rate is: $\gamma = \frac{N_1 - N_0}{N_1}$ and the tax base in period 1 is:

$$TB_1 = H_0N_0 + H_1(N_1 - N_0) = H_0N_0 + \gamma H_1 N_1$$

After the first migration resulting from the shocks and government spending there is no more migration so that the housing stock is fixed from period 1 an onward. If the number of new homes is small relative to number of existing homes, then the new tax base in period M is approximately:

$$TB_M = (1-\gamma)^M H_0 N_0 + (1-(1-\gamma)^M) H_1 N_0 + H_1(N_1 - N_0)$$

Keeping all else equal, regardless of the land elasticity measure, in islands with low home turnover rates ($\gamma \to 0$), the total tax revenue will not increase (by much) and the government will not be able to borrow against future income. Second, tax revenue will increase more for islands with high land supply elasticity (in line with the theory of Saiz (2010) and Glaeser et al. (2006)), but the rate of growth will be governed by the home turnover rates.

B.6 The Local Government's Problem

Households maximize utility and firms maximize profits, but what do governments maximize? There are several alternatives to model the government's objective, such as a benevolent social planner who maximizes utility of its citizens, or a profit maximizing government (such as Brennan and Buchanan (1980) and Diamond (Forthcoming)). I choose to use a government which maximizes house value for homeowners (or equivalently, discounted rents value net of taxes) subject to borrowing limits set at the credit market. Since homeowners are approving the new debt, this maximization objective seems reasonable.

If the government does not internalize its effects on households' and firms' decisions, then optimal expenditure will be at the point where the marginal dollar of spending will not increase rents anymore:

$$\frac{dr}{dg} = 0 \tag{7}$$

Using equilibrium conditions described in equations (4), (5) and (6), the optimal public expenditure will solve:[33]

$$V_w \cdot \frac{C_g}{C_w} = V_A \cdot \frac{dA}{dg} \tag{9}$$

The right hand side (RHS) of this equation is a decreasing function with respect to g (decreasing marginal value of local government spending on amenities). Suppose the public expenditure is not productive, then $C_g = 0$ and optimal public expenditure is at the point where $dA/dg = 0$. If public expenditure is productive,

[33] To see the effects of public spending on equilibrium population choices, I take the derivatives of the indirect utility and cost functions with respect to g:

$$V_w\left(\frac{\partial w}{\partial g} + \frac{\partial w}{\partial N}\frac{\partial N}{\partial g}\right) + V_r\left(\frac{\partial r}{\partial N}\frac{\partial N}{\partial g}\right) + V_A\left(\frac{\partial A}{\partial g} + \frac{\partial A}{\partial N}\frac{\partial N}{\partial g}\right) = 0 \tag{1'}$$

$$C_w\left(\frac{\partial w}{\partial g} + \frac{\partial w}{\partial N}\frac{\partial N}{\partial g}\right) + C_g = 0 \tag{2'}$$

The first equation depicts that any increase in public spending will increase utility directly through the amenities channel and indirectly through the wage channel. However, this increased utility will be offset by the disutility associated with more congestion, lower wages driven by more population and higher rent. The second equation depicts that any cost saving from higher quality amenities in the island will be offset by higher wages.

Rearranging equations (1') and (2') in such a way that would show the full derivative of the rent with respect to public capital expenditure:

$$\frac{dr}{dg} = \underbrace{-\frac{1}{V_r}}_{\geq 0} \underbrace{\left(\underbrace{V_w}_{\geq 0}\underbrace{\left(-\frac{C_g}{C_w}\right)}_{\geq 0} + \underbrace{V_A}_{\geq 0}\underbrace{\frac{dA}{dg}}_{\geq 0}\right)}_{\geq 0} \geq 0 \tag{8}$$

Equation 8 shows that higher public expenditure should increase rent (and by extension - house prices). This is the standard urban economics result. Later in this model I show that through the government's borrowing channel, government spending can be a function of house prices.

then $C_g < 0$ and optimal expenditure is at a higher level of expenditure.

In this setting, a positive "preference shock" will shift the RHS up so that the optimal expenditure is higher. A shock to productivity will not affect the optimal public capital expenditure if $C_g = 0$ and is ambiguous if $C_g < 0$.

The borrowing limit is a function of the future tax revenue and interest rates. The government will be able to borrow debt of M periods up to the amount equal to the present value of the excess tax revenue.

$$g_1 \leq \sum_{j=1}^{M} \frac{TB_j \cdot \tau - g_0}{(1+\bar{R})^j} \tag{10}$$

Unfortunately, for some local governments condition (10) will be binding and public spending will be below the optimal level.

Summary

The main predictions of this model can be summarized as follows: local governments who are not constrained by a borrowing limit will have a positive correlation between their spending level and house prices growth only by the common correlation to the amenities or productivity shocks. For these governments ("unconstrained local governments"), the home turnover rate in the local area does not have an effect on the optimal government spending and borrowing. In contrast, for local governments with binding borrowing limits ("credit constrained local governments"), the optimal capital spending will increase as house prices or population grow and as home turnover rates are higher the elasticity to house price or population growth will be higher.

C Summary Statistics

Table 7: Summary Statistics, Main Regression Variables, All Issuers

	Mean	Median	SD	25th	75th	Obs.
Debt Growth						
All periods (including periods of zero issuance)	0.28	0.10	0.63	-0.13	0.83	162240
Periods with positive debt issuance	0.67	0.67	0.53	0.16	1.24	6592
New debt is funded by property tax	0.92	1.24	0.46	0.57	1.24	1595
New debt funded by other revenue source	0.59	0.48	0.52	0.12	1.24	4997
ln (Debt)						
All bonds	16.26	16.22	1.57	15.41	17.19	178476
Bonds funded by property tax	16.28	16.23	1.60	15.39	17.23	76387
Ex. bonds funded by property tax	16.20	16.19	1.48	15.42	17.08	102089
Interest Rate Spread	-0.11	-0.29	1.09	-0.85	0.47	180421
Bond Maturity	11.19	10.00	7.47	5.25	15.63	226072
Purpose (1=Construction or capital improvments)	0.50	0.00	0.50	0.00	1.00	20990
House Price Growth						
All counties	0.40	0.22	0.48	-0.00	0.70	5784
All counties with land availability data	0.46	0.31	0.50	0.01	0.78	3568
Counties at areas of low land availability	0.55	0.54	0.47	0.12	0.86	1310
Counties at areas of high land availability	0.27	0.02	0.45	-0.05	0.48	1309

Notes: Debt growth is defined as the ratio of total debt to the mean debt level for each issuer from July 1996 to June 2006 minus 1. Interest rate spread is calculated for bonds with zero or fixed coupons and is defined as the difference between the bond rate and the matching maturity Treasury rate. House price growth is defined as the ratio of house price index over the long term trend index minus 1. Number of observations: Debt growth and ln(Debt) - one observation per issuer at a monthly frequency, bond purpose - one observation per bond deal, interest rates and bond maturity - one observation per bond, house prices - one observation per county at the monthly frequency.
Source: Bloomberg, Zillow.com. Saiz (2010), U.S. Treasury.

Table 8: Main Variables Means by Funding Source

	Property Tax Issuers	All Others
Debt growth	0.66	0.19
ln(debt, real)	16.67	17.16
ln(house price)	12.45	12.41
House price growth	0.46	0.46
Home turnover rate	6.86	7.11
Expenditure (mill USD)	132.7	54.7
Property tax share of revenue	0.28	0.14
Income per capita	28711.61	27805.05
Population (mill)	2.28	2.51

Source: Bloomberg, Zillow.com, Census of State and Local Government Finances.

Table 9: Distribution of Local Governments in California and Bond Issuers by Type

	All Local Governments	Bond Issuers
Total	4502	2073
Counties	58	48
Cities	470	294
School District	998	701
College Districts	80	64
Special Districts	2142	549
Other	754	417

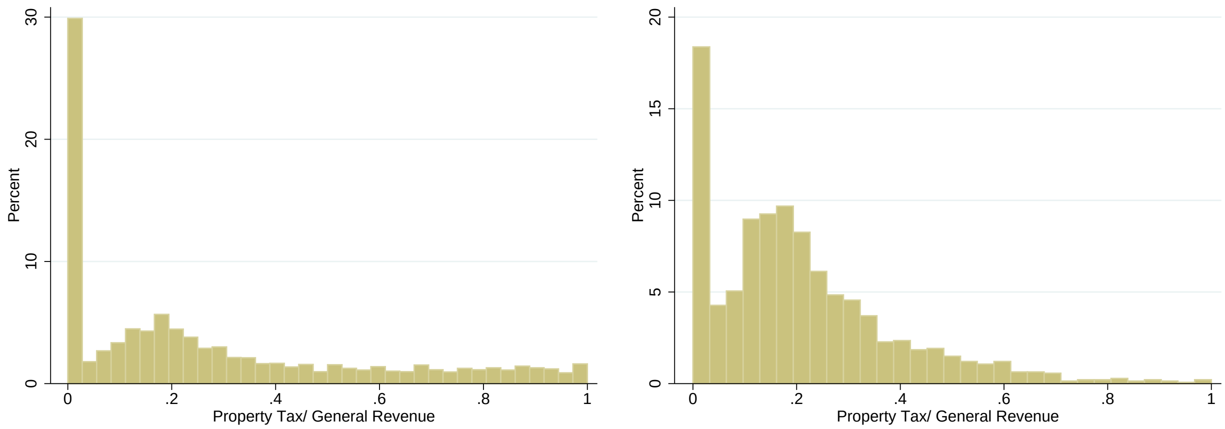
Notes: San Francisco is both a county and a city. In this table San Francisco is counted once as a county.
Source: 1997 State and Local Governments Census data and bond data from Bloomberg.

Table 10: Summary Statistics of Financial Census Data

	All Local Governments			Bond Issuers		
	Mean	Median	SD	Mean	Median	SD
Property tax share of total revenue						
Total	0.25	0.16	0.28	0.21	0.18	0.18
County	0.12	0.12	0.05	0.12	0.12	0.05
City	0.15	0.14	0.08	0.16	0.15	0.08
School District	0.28	0.24	0.14	0.30	0.26	0.15
College District	0.26	0.26	0.26	0.25	0.28	0.22
Special District	0.29	0.11	0.34	0.14	0.02	0.24
Current Expenditure (mill USD)						
Total	24.76	1.16	237.56	68.86	14.60	416.58
County	638.71	155.97	1662.60	747.89	233.94	1793.32
City	61.12	14.57	344.56	80.89	23.23	403.84
School District	27.89	7.66	126.47	42.62	17.37	162.83
College District	36.54	29.28	33.39	42.35	32.78	32.38
Special District	5.89	0.29	41.21	19.54	3.63	44.30

Notes: San Francisco is both a county and a city. In this table San Francisco is counted once as a county.
Source: 1997 State and Local Governments Census data and bond data from Bloomberg.

Figure 5: Property Tax Revenue as a Share of Total General Revenue
Local Governments in California, 1997



All Local Governments   Bond Issuing Local Governments

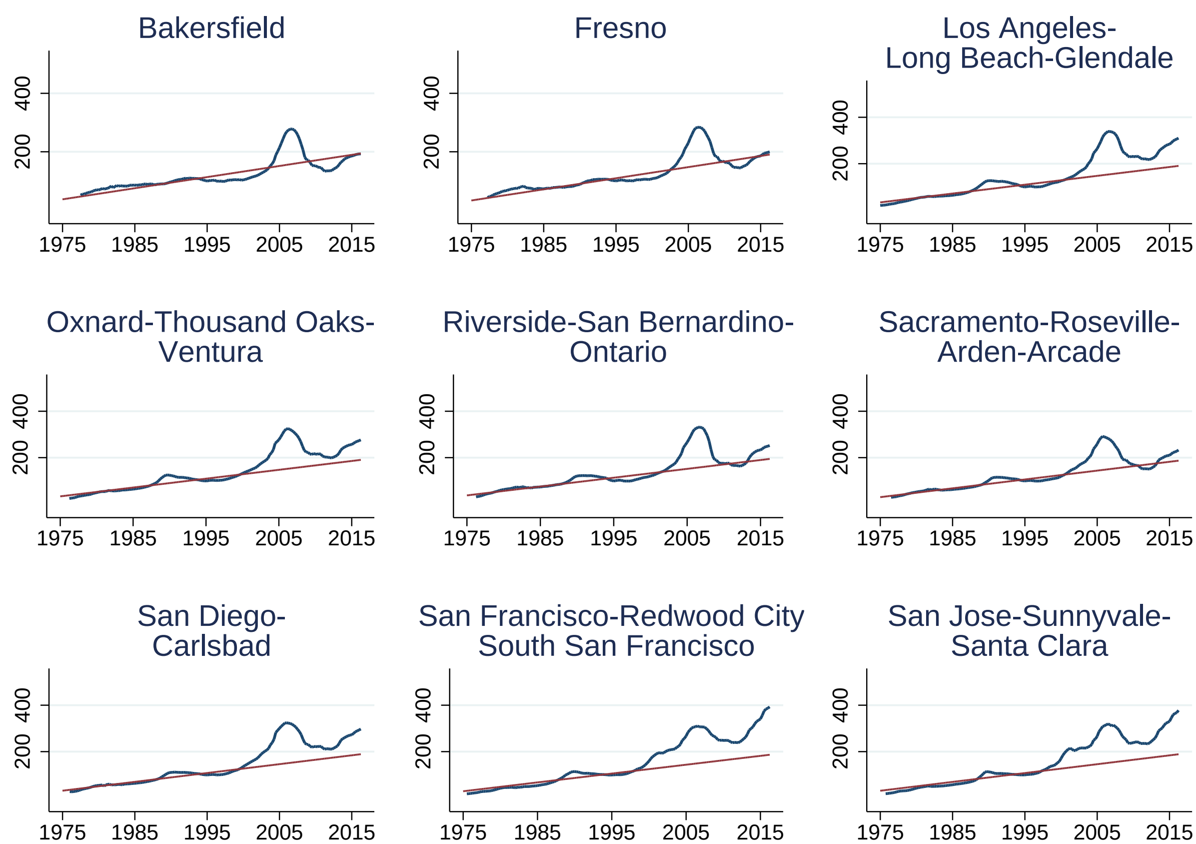
Source: Author's calculations based on data from State and Local Governments Finances Census.

Table 11: Mean Bond Issuance by Issuing Groups (Millions USD, 1996 prices)

	Mean	Median	SD	25th percentile	75th percentile	Obs.
All bonds	25.72	8.76	78.19	4.12	20.40	11615
A. Bond's Funding Source						
Property taxes	19.41	8.68	48.18	4.34	19.06	2766
All other	27.69	8.79	85.35	4.04	20.92	8849
B. Credit Rating Groups						
Low & unrated	19.59	7.27	58.06	3.32	16.54	5394
BBB rated						
A rated	23.96	9.71	60.55	4.72	21.73	3490
AA/AAA rated	40.06	11.32	119.93	5.18	28.61	2731
C. Population Size						
Smallest	9.19	3.79	18.52	1.52	7.75	377
2nd quartile	10.30	4.75	30.97	2.31	9.76	1127
3rd quartile	11.49	6.44	16.92	3.38	12.61	2499
Largest	33.65	11.46	94.71	5.18	26.86	7550
D. Home Turnover Rates						
Smallest	9.19	3.79	18.52	1.52	7.75	377
2nd quartile	10.30	4.75	30.97	2.31	9.76	1127
3rd quartile	11.49	6.44	16.92	3.38	12.61	2499
Largest	33.65	11.46	94.71	5.18	26.86	7550
E. Local Government Services Type						
County	51.40	12.59	171.64	5.41	33.12	696
City	19.40	8.19	40.44	3.79	17.70	3001
School district	15.19	7.67	41.13	3.79	15.76	3498
College district	27.92	15.39	41.16	5.86	34.76	306
Special district	39.39	10.27	95.08	4.64	31.27	2312

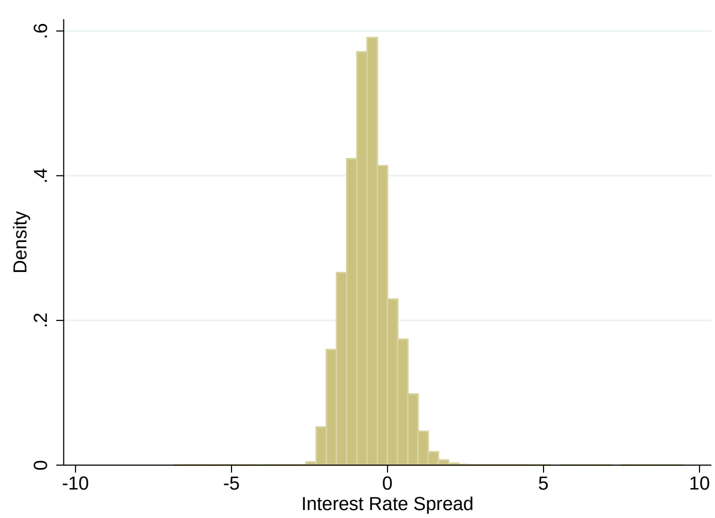
Source: Author's calculations based on data from Bloomberg.

Figure 6: House Price Index in the nine largest MSAs in California, 1975-2015



Notes: This figure presents the OFHEO house prices at the nine largest MSAs in California. The red line represents a linear regression line based on each individual MSAs data from 1975 to 2000.

Figure 7: Histogram of Interest Rate Spreads



Source: Author's calculations based on data from Bloomberg and Treasury.

D Additional Details

D.1 Definition of a Deal and Constructing the Deal Value

As explained in Section 4, I define individual securities as bonds and a group of bonds which are issued by a common issuer, issuance date and deal size define a deal. This definition of a deal has its drawbacks, as it may create deals which include both insured and uninsured bonds, bonds with different purposes, funding sources and federal tax status. Another drawback to this deal definition is that it can cause two types of errors. The first type of error inflates the volume of deals in the case that bonds of the same deal are recorded over a few days. In such a case, the methodology above will count this one deal multiple times (as the number of distinct days the bonds of the same deal are recorded). The second type of error will underestimate the volume of deals in the case when multiple deals were issued by the same issuer, at the same date and at the same amount. In such a case, the methodology above will count these multiple deals as a single deal and its value is just a fraction of the real volume issued that day. To identify these errors and fix them, I check the difference between the aggregate amount of maturity size of all bonds within a deal and the deal value size. With the exception of zero-coupon bonds, the aggregate amount of maturity values of all bonds within a deal should be close to the value of the total deal value, so that in cases where there was a large discrepancy I check manually the bond's disclosure papers and correct.

D.2 Construction of the Credit Rating

The rating recorded in Bloomberg is the most updated rating for the issuer or insurer at the time the bond expired (matured or was called early) and not the rating at time of issuance. Many papers of municipal bonds simply assume the credit ratings hasn't changed and use the recorded rating from Bloomberg. But this assumption is incorrect. For example, suppose the researcher downloads the rating at July 2008 for a two-year bond issued with insurance by AMBAC in January 2007. The true rating of the bond was AAA at time of issuance, but by July 2008 AMBAC was downgraded to AA-. So the bond will be recorded as a AA- rated bond. For the insurance companies, the rating changes are known, but such changes are also fairly common for municipalities' ratings. Moreover, using the most recent Bloomberg's credit rating as is, will yield many cases where a group of bonds issued on the same date by the same issuer will have different credit ratings since they matured at different periods and the issuer's credit rating changed throughout those periods. To deal with this issue, I use the rating recorded for the first maturing security within a deal to be the initial rating of all the securities within the same deal. I use S&P rating when it is available. When it is not available, I use the Moody's rating, and I use Fitch's rating when the former two are missing (very few such cases). Insured bonds have a dual rating - the bond's rating reflecting the insurer's credit strength and the underlying rating reflecting the municipality's credit strength. I calculate the initial underlying rating with the same procedure as described for the bond rating.

I test the procedure in multiple ways to correct for technical mistakes. First, in cases where the deal includes bonds with and without insurance, I test whether the underlying rating for the insured bonds is the same for the bond ratings of the uninsured bonds. For all cases where this is not the case I check manually what was the underlying rating and correct it. Second, in cases where the issuer has multiple deals issued on the same date with different issuer rating I check and fix manually to see what was the true rating.[34] In some unique cases deals received different rating and this was not a mistake (for example, when the funding source of the two deals is different).

Unfortunately, this procedure still leaves many bond deals or issuers without a rating. To increase the number of rated bond deals or the underlying rating of insured bonds, I go through the following procedure: (a) if an issuer issued another deal on the same day (both uninsured) with a recorded rating, then the same rating will be placed to the bond deal with the missing rating. (b) if the issuer issued two deals with insurance, then the underlying rating will pass to the bond deal with missing underlying rating. (c) if an issuer issued two deals on the same day, one with insurance and the other uninsured, and either the underlying rating for the insured bonds is missing or the bond rating for the uninsured bonds is missing, then the corresponding rating will be placed to the bond with the missing data. (d) if the issuer issued another deal within 60 days

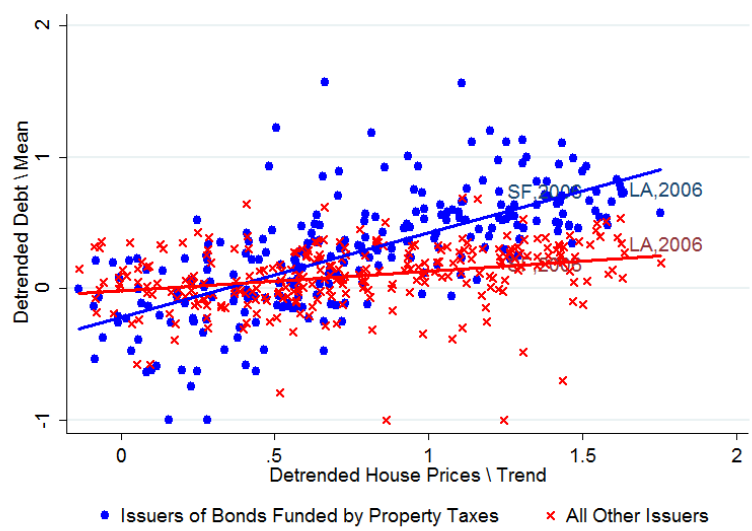
[34] There are over 100 such cases. The do-file correcting for these cases can be provided by the author by request.

(before or after the issuance of the bond with missing rating), then the missing rating bond will receive the same rating as the bond with rating that has been issued within the 60 days interval.

I then group the letter-rating to four groups: 1 - unrated bonds and bonds rated below BBB. 2 - bonds rated BBB, 3 - bonds rated A, 4 - bonds rated AA and above.

E Additional Regressions

Figure 8: Local Government Debt Growth vs. House Price Growth by Issuer Type



Notes: Each observation in this figure represents aggregated debt growth and house price growth at the county, year and issuing type of local government level. Issuing type of local governments is defined based on the main funding source of the local governments' bonds - whether it is property taxes or all other funding sources. Debt growth is defined as debt levels over the mean as of 1995-1997 minus one. House price growth defined as house price levels over the long term house price trend minus one. See Section 4 for more details.

Table 12: House Prices Growth and Borrowing Behavior by Local Government Type

Dependent Variable:	Debt Growth				
Sample:	Counties	Cities	School Districts	College Districts	Special Districts
Estimation Method:	IV	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)
House Price Growth	0.33	-0.03	-0.07	0.37	-0.07
	(0.45)	(0.07)	(0.21)	(0.44)	(0.11)
× Issuer of bonds	-0.41	0.29**	0.26**	1.00***	-0.06
funded by property taxes	(0.29)	(0.13)	(0.10)	(0.32)	(0.11)
Fixed Effects:					
Year	Yes	Yes	Yes	Yes	Yes
Local Government	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.27	0.25	0.42	0.64	0.30
Observations	2652	21615	26173	2079	25102

Notes: This table presents results of estimating on sub-samples of local government types an IV regression of debt growth over house price growth and an interaction term between house price growth and an indicator for property tax bond issuers (comparable to column 4 in Table 2 which is on the full sample if issuers). The subsample is noted at the top of each column. All regressions include the following control variables (not reported above): months since last issuance and county level controls: natural log of the average annual wage, natural log of the average employment, population growth within the last year, per-capita income. In addition, the regressions include fixed effects for year and for the individual local government. The number of observations for all sub-groups does not sum up to the number of observations in the full sample because there are some local governments which are not classified as any of the above five groups.
***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

Table 13: House Prices and Debt Issuance - log-log specification

Dependent Variable:	ln(Total Debt, 1996 USD)					
Estimation Method:	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Zillow House Value Index)	0.03	1.00	0.17*	0.40	0.02	0.36
	(0.08)	(0.68)	(0.08)	(0.86)	(0.07)	(0.76)
× Issuers of bonds funded	0.56***	0.54***				
by property taxes	(0.05)	(0.06)				
× interaction term:			Turnover Rates		Credit Rating	
Group 2			0.38**	0.35***	0.91**	0.72**
			(0.16)	(0.06)	(0.41)	(0.31)
Group 3			0.51***	0.50***	0.49**	0.39*
			(0.04)	(0.06)	(0.22)	(0.21)
Group 4			0.73**	0.58***	0.30**	0.24*
			(0.36)	(0.17)	(0.13)	(0.12)
Fixed Effects:						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Local Government	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.39	0.34	0.36	0.25	0.36	0.28
Observations	114012	114012	114012	114012	114012	114012

Notes: This table present the estimates of the effect of house prices on local governments borrowing by regressing the natural log of total debt (in real terms) over natural log of the Zillow House Value Index. All regressions include fixed effects for year and local government. The control variables included in the regression but not reported above are: Months since last issuance and at the county level I control for: income per capita and one year lagged of natural log of population, population in k-12 ages and housing units. Standard errors are clustered at the county level.
***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

Table 14: House Price Growth and Borrowing Behavior Using Census Data

Dependent Variable:	Debt Growth				
Estimation Method:	OLS	IV	OLS	IV	IV
	(1)	(2)	(3)	(4)	(5)
House Price Growth	0.21*	0.13*	0.05	0.45	0.42
	(0.11)	(0.08)	(0.12)	(2.22)	(2.35)
× Propert Tax			0.55**	0.48***	0.47***
Dependent Issuers			(0.26)	(0.10)	(0.17)
Fixed Effects:					
Year	Yes	Yes	Yes	Yes	Yes
Particular Local Gov'	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.37	0.35	0.38	0.10	0.11
Observations	87312	87312	87312	87312	87312

Notes: Columns 1 through 5 present regression estimates of the effect of house price growth on local government debt. For all these regressions the dependent variable is the debt growth defined as the percentage point deviation of the local government's debt from its mean debt level s of 1995 to 1997. These regression include the sub-sample of local governments with data from the 1997 State and Local Governments Census data (1,422 issuers), with data for the instrument variable and those that issued at least once in the pre-boom period. The house price growth variable is defined as percentage point deviation of house prices from their long term trend. The second independent variable of interest is an interaction of the house price growth variable with an indicator for property tax-dependent local governments, defined as local governments who receive over 20% of their total revenue from property taxes. Column 5 repeats the IV regressions and uses as regression weights the local governments' total expenditure as of 1997. All regressions include the following control variables (not reported above): months since last issuance, the10-year risk free interest rate and county level controls: one year lag of housing units growth, population growth and natural log of population at k-12 ages, and per-capita income. In addition, all regressions include year and individual local government fixed effects. Standard errors are clustered at the county level for all regressions.
***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level.