The Effect of the Orange County Bankruptcy on Residential Real Estate Prices[γ]

Thomas A. Evans[†]

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Abstract

In order to stem the losses from an unraveling of its failed derivatives investment strategy, Orange County, California, declared bankruptcy on December 6, 1994. The bankruptcy was largely unexpected, providing an interesting natural experiment with which to study the effects of government losses, and presumably government debt, on housing prices. It is estimated that as a result of the $1.7 billion in losses incurred by Orange County, the value of residential real estate dropped by between $1.6 and $3.2 billion. The close overlap between county investment losses and the drop in real estate value indicates a foresighted real estate market that accurately forecasted the eventual increases in taxes and decreases in government services.

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[†] Thomas A. Evans, Department of Economics, University of Chicago, Chicago, Illinois, 60637; tevans@uchicago.edu.

1 Introduction

Orange County declared bankruptcy on December 6, 1994. The bankruptcy stemmed from the unraveling of Orange County's derivatives investment strategy. Robert Citron, Orange County's long time treasurer, had amassed a portfolio of leveraged reverse repurchase agreements and inverse floaters expecting that interest rates would decrease. Between January and December 1994, the Federal Reserve raised the targeted federal funds rate from 3.00 to 5.50%. Orange County's failed investment strategy resulted in the loss of approximately $1.7 billion to the county. The rapid increase in interest rates coupled with the county treasurer's operational independence resulted in general surprise at the bankruptcy announcement.

Orange County's bankruptcy offers a unique opportunity to investigate the impact of unexpected government losses, and presumably government debt, on real estate prices. If myopic individuals fail to realize that current government investment losses will result in either an increase in future taxes or a decrease in future government services, then there would be no change in prices. To the extent that individuals accurately predict future taxes or changes in government services, the value of Orange County real estate would drop. With perfect foresight and lump sum taxes, real estate property values will drop by exactly the amount of the investment losses. With perfect foresight and taxes that cause deadweight loss, a shift in government expenditure away from the efficient level, risk aversion to the distribution of future taxes, or a negative bankruptcy signal, aggregate housing value will drop by more than the investment losses.

There are at least three applications of the empirical estimates of the effect of Orange County's investment losses on real estate prices. First, it has become standard practice to use estimates of the change in housing prices to infer the value of changing amenities, such as for environmental cleanliness, school quality, crime rates, and so on. For example, Chay and Greenstone[2005] estimate that aggregate housing prices increased by $45 billion in response to improvements in air quality resulting from the Clean Air Act; Black[1999] estimates that a 5% increase in test scores increases house prices by 2.5%; and Lynch and Rasmussen[2001] estimate that houses sell for 39% less in high crime neighborhoods.[1] The implication is that there is a close relationship between the change in housing prices and the inherent value that households place on the amenities themselves. However, there is no way to know with any degree of certainty whether the housing market over or under reacts to changes in amenities, rendering assertions regarding the

[1] The papers cited here barely scratch the surface of a large number studies conducted in each of the areas mentioned.

value of amenities suspect. The Orange County bankruptcy episode offers a tentative bridge to ascertain whether the housing market reacts appropriately to changes because the amount of county losses are known to be $1.7 billion. By estimating whether housing prices over or under reacted to the county losses, it will be possible to gauge the accuracy of housing market to changing amenities.

Second, estimating the impact of the county losses on real estate value fills an omission in the public finance literature. There are numerous empirical studies that have investigated the effects of local government expenditures and taxes on property values, but none that have estimated the effect of government debt. Government debt is an important fiscal tool for local governments; understanding the effects of government debt on housing prices will enable policy makers to more accurately weigh its costs and benefits, at least relative to those of raising taxes. As a side note to assessing the effect of debt on property values, it will be interesting to compare the effects of debt and taxes on property values. Ricardo posits that with perfect foresight the effects of debt and taxes would be equivalent. The Orange County bankruptcy offers a unique opportunity to evaluate Ricardo's conjecture at the local level.

In addition, it will be possible to compare the effects of an unexpected negative shock in the real estate market to negative outcomes in the stock market. Jarrell and Peltzman[1985] investigate the effect of product recalls on stock prices. Odean[1998] investigates whether stock market investors are reluctant to realize their losses. The effects of the Orange County bankruptcy on housing prices can be contrasted with the effects of corporate losses on stock prices.

Three difference-in-difference estimators are used to estimate the effect of the Orange County losses on residential real estate prices. Specifically, the change in the value of Orange County real estate will be compared to that of Ventura County[2], before and after the bankruptcy, using three measures of real estate value. First, a comparison of median residential real estate sales prices for the six months before and after the bankruptcy indicates that Orange County prices dropped by $2,300 more than those of Ventura County. Second, Orange County's assessed property[3] value dropped by $1.8 billion between 1994 and 1995, while that of Ventura County increased by $500 thousand - a difference of $2.3 billion in total, or $2,600 per residence. Third, a detailed analysis using individual single family house market sales prices for the six months before and after the bankruptcy finds that Orange County prices dropped by between $1,800 and $3,600 more per house than the drop in Ventura County. In 1994 there were 880,000 residential properties

[2] As will be discussed in more detail in a later section, Ventura and Orange Counties are very similar in various observables, and so Ventura County is a useful control devise for unobservable influences on house prices.

in Orange County, indicating that the value of Orange County real estate dropped by between $1.6 and $3.2 billion relative to that of Ventura County.

Based on the stability of the estimates, it is with reasonable assurance that I conclude that the value of Orange County's residential real estate dropped by between $1.6 and $3.2 billion more than that of Ventura County as a result of the Orange County bankruptcy. The drop in property value compares favorably with the actual $1.7 billion investment loss suffered by Orange County, though prices moderately overreacted, as predicted by the model yet to be presented.

The findings indicate that the residential real estate market is foresighted and takes into account expected changes to future taxes and government spending in a reasonably sophisticated way. This bodes well for using the change in real estate value as a proxy for valuing air quality, schooling, crime, and so on. The one caveat, however, is that due to inherent variability in the real estate market the range of estimates is quite large, indicating the unlikelihood of precise estimates. Further discussion of the results is presented in Section 5.

2 The Orange County Bankruptcy[4]

In 1978 the California electorate passed Proposition 13, the first of several pieces of legislation aimed at reducing state and local taxes, and mandating various government expenditures.[5] The cumulative effect of the legislation was to erode state, county and local governments' ability to raise taxes and finance discretionary spending. Government entities were forced to search for alternative financing.

One of the methods that Orange County, among others, used to raise funds was leveraging their exemplary credit rating to earn interest income. This strategy was made easier through a series of legislative changes during the late 1970's through the early 1990's that expanded the range of acceptable investments, and permitted leveraged investments.[6] In 1993 Orange County's total revenue was $1.326 billion, $160 million (or 12%[7]) of which was raised from interest and rental income, whereas in 1991 only 5% of Orange County's revenue was derived from interest and rental

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[3] The assessed property values in both Orange and Ventura County are full market value sales prices.
[4] For a comprehensive history see either Baldassare[1998] or Jorion[1995].
[5] Among other things, Proposition 13 limited annual property taxes to 1% of their sales price. In 1979 Proposition 4 imposed spending limits on state and local governments, and AB8 shifted property tax revenues from schools to cities. In 1982, AB 79,9 transferred responsibility for providing health care for the medically indigent from state to counties. In 1988 Proposition 98 established minimum state funding levels of schools. In 1992 Proposition 162 repealed taxes on various food items.
[6] See for example AB 346, SB 1151, AB 695, AB 323, SB 2095, SB 962, SB1883, and AB 3576.
[7] See the 1993, County of Orange, Comprehensive Annual Financial Report.

income.[8] To increase interest income, between 1991 and 1994, the total value of OCIP's investment portfolio was expanded from $5.1 to $20.1 billion. In early 1994 OCIP had approximately $7.5 billion in deposits. The deposits were leveraged using $12.6 billion in derivatives - primarily 30 day Reverse Repos[9] and inverse floaters. OCIP contained deposits from 187 public county institutions: localities, school districts, water authorities, and so on.

For much of his tenure, Robert Citron, the Orange County treasurer, had an exemplary investment track record. Prior to the bankruptcy OCIP had earned an average return of 9.3% per year, as compared to 5-6% for the California treasury. Citron's long term success earned him wide latitude to pursue an investment strategy that was largely independent of county oversight - for much of his tenure annual reports were presented orally.[10]

On January 1, 1994 the target federal funds rate was 3.0%, and the prime rate was 6.0%. Through the remainder of 1994 the Federal Reserve increased the targeted federal funds rate, with the prime rate generally tracking the federal funds' rate moves. By August 16 the target federal funds rate had risen to 4.75%. As interest rates increased during 1994 the total value of OCIP's investment portfolio decreased. The reverse repurchase agreements that OCIP had purchased were structured in such a way that all notes came due monthly, but if both parties agreed they could be rolled over. As interest rates increased, however, it was necessary for OCIP to provide addition collateral since the investments were decreasing in value. Between August and November 1994, OCIP's cash position dropped from approximately $1.4 billion to $350 million.[11] Despite the drop, none of OCIP's ten largest creditors withdrew their funds during the summer and early fall of 1994.

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[8] See the 1991, County of Orange, Comprehensive Annual Financial Review.

[9] Reverse Repos - reverse repurchase agreements - are essentially short term loans backed by some marketable security. OCIP would sell a government bond to a securities dealer, with the agreement that OCIP would then repurchase the bond at a fixed price at some fixed time in the future. In many instances the coupon rate on the bond would be higher than the interest paid on the short-term loan. OCIP would then use the proceeds to purchase additional bonds, and repeat the process, thereby leveraging their investments. Through its leveraging, it was estimated that though OCIP's average maturity of holding was 1.7 years, the average duration was 7.4 years. As a comparison, a typical bond with a maturity of 10 years has a duration of approximately 7.4 years, depending on the coupon rate.

Another popular OCIP investment was inverse floaters. Inverse floaters effectively decrease the coupon rate as interest rates increase. Therefore, during the fall of 1994, as interest rates increased, the market value of inverse floaters decreased.

[10] Changes in state regulations made this absence of oversight legal. For example, SC 389 required local treasurers to issue quarterly reports only at the request of local depositors. A general trend emerged that made reporting laws relatively lenient. In 1993 SB133 required local treasurers to issue quarterly investment reports to all local agencies with money on deposit. The 1983, SB 389, made these reports contingent only on local agencies request. In 1984, resulting from investment losses in San Jose, the reporting requirements were made more strict. By 1990, however, most of these reporting requirements had been either revoked, or allowed to expire. In 1993, SB 443, made quarterly reports optional, even if local agencies asked for them.

[11] Jurion[1995], page36.

By early fall it was becoming apparent to the Orange County treasurer's office that there was a potential for crisis, and it notified the county administration regarding OCIP's difficulties. County administrators hired an outside auditor to report on the plan's losses. Despite these internal discussions, Citron continued to assure both depositors and creditors of the soundness of OCIP's financial position. As late as October 31, 1994, Citron assured the largest investors that OCIP had sufficient cash to cover collateral requirements and deposit withdrawals.

On November 15, the federal funds target interest rate was increased by 0.75%. It was at this point that Irvine Ranch Water District, one of the larger depositors, attempted to withdraw $100 million from OCIP. The withdrawal request increased scrutiny by other large depositors. On November 16 the County-hired auditor filed an internal report indicating that OCIP had suffered a $1.5 billion paper loss.

It wasn't until December 1, however, that Orange County announced publicly that it had suffered a $1.5 billion paper loss. Credit Suisse First Boston called in loans of $1.2 billion due December 6, precipitating a move by the remaining creditors to liquidate their positions. Orange County reacted to these events by declaring bankruptcy - the largest county bankruptcy in U.S. history. During the following six weeks Orange County appointed a committee that liquidated all risky assets. On January 20, 1995, the full tally of OCIP's investment loss was calculated to be approximately $1.7 billion.

In addition to the $1.7 billion investment loss, Orange County may have incurred other bankruptcy related losses. First, there was various litigation expenses related to the bankruptcy. Second, Orange County was forced to extend approximately $800 million in bonds by one year. Orange County and the bond holders agreed to roll over the bonds, but Orange County was forced to increase the interest rate by 95 basis points above previously agreed levels[12], resulting in an additional expense of $7.6 million. Third, in order to emerge from bankruptcy protection, Orange County had to issue long term bonds worth approximately $1 billion. The entire $1 billion bond issuance was rated by Moody's as AAA - the highest rating - because the state of California had passed legislation, as part of Orange County proposal to emerge from bankruptcy, which legally allocated specific Orange County revenue streams to make interest payments. Furthermore, $750 million of the bond issues were guaranteed with an insurance policy.[13] As a result of the AAA bond rating the county did not pay a risk premium on the $1 billion in bonds that it issued. A fourth

[12] The interest rates had been based on the LIBOR. As a result of extending the bonds, the new rate was equal to the previously agreed formula, plus 95 basis points.

bankruptcy related cost was the opportunity cost of the borrowed funds. By law, Orange County is prohibited from borrowing in excess of 1.25% of assessed property value. In July, 1996 Orange County's maximum indebtedness limit was $2.2 billion, and its actual debt was $2.07 billion. Despite listing these additional bankruptcy related costs, with the exception of the $7.6 million in additional financing fees, it has not been possible to obtain an actual numerical estimate of the additional losses (I have no information on the bond's insurance premium, and it is not obvious what the opportunity cost of the credit constraint was.). Since it is not possible to determine exactly the additional losses that Orange County suffered, and because any additional losses would be dwarfed by the magnitude of the investment loss, the $1.7 billion investment loss is taken to be a relatively tight lower bound.

Orange County emerged from bankruptcy on June 12, 1996. The recovery plan was relatively complex requiring agreements by investment plan participants to drop claims against the county; state legislation permitting the transfer of earmarked funds amongst various county agencies; the roll over of bonds due in the near term; and the issuance of additional bonds in order to settle short term claims against the state. Effectively, of the $1.7 billion loss, $1 billion was allocated to the county, and the remaining $700 million to the OCIP participants.[14] The exact distribution of the loss is of secondary importance to the point that Orange County residents incurred the full burden.[15]

The fiscal changes that Orange County undertook in order to emerge from bankruptcy were relatively modest. Public infrastructure expenditures were cut by $50 million per year. The cuts affected flood control, harbors, beaches, parks, redevelopment projects, buses, and transportation projects. The county also increased various county fees: landfill dumping fees, planning and permit fees, parking charges at county beaches and parks, and higher library fines.[16] Based on the length of the recovery bonds that were issued, the effects of the losses were spread over twenty years.[17]

Several warning signals aside, the bankruptcy was largely unexpected. Despite the warnings of Citron's opponent in the treasurer's election regarding the risk of Citron's investment strategy,

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[13] The insurance policy was issued by MBIA Insurance.

[14] At this point in time I have no information on the actions that the individual plan participants took in response to their losses, presumably some combination of increased fees, reallocation of funds, and decreases in spending.

[15] Baldassare[1998] provides some limited information on the distribution of the $700 million in losses that was allocated to OCIP depositors. Specifically, due to the amount of funds that the city of Irvine, the Irvine water authority, and the Irvine school district had deposited in OCIP, residents Irvine would have incurred approximately twice the losses per residence than other localities in Orange County. Irvine is exceptional in its level of exposure to OCIP. However, it is true that the level of exposure to the OCIP is unequal across Orange County, which will increase the standard errors of the estimates.

[16] Source: Table 6-6, page 178, When Government Fails, Baldassare, Mark.

[17] In August of 2005 the $1 billion in bonds outstanding was partially paid down and refinanced.

Citron was reelected on June 7, 1994, with over 60% of the vote, and the backing of all five county supervisors. As a further signal that county administrators were confident of Citron's strategy, on June 14 county supervisors approved $600 million in bonds to be invested in OCIP. Throughout the summer and early fall of 1994 none of OCIP's largest depositors or creditors withdrew their funds - Citron had been assuring both creditors and depositors that OCIP was financially sound. It wasn't until mid November when interest rates increased by 0.75%, an internal auditor indicated a $1.5 billion paper loss, and Irvine Ranch Water District requested to withdraw its funds, that internal questions were raised. Finally, on December 1 it was publicly admitted that OCIP was on the brink of financial crisis. The speed with which OCIP's investment strategy collapsed, and the independence of the county treasurer contributed to the widespread surprise at the bankruptcy announcement. The unexpectedness of Orange County's bankruptcy makes the episode an especially appealing natural experiment.

3 The Model

The following theoretical description is intended as a simplified representation of the effect of the Orange County bankruptcy on house prices. The model provides predictions of county losses on real estate prices depending on the degree of public myopia and the specific actions the government takes in reaction to its losses.

I assume that prior to the county investment loss people have sorted themselves into the county in which they obtain the highest utility, and that the real estate market is in equilibrium.[18] When housing owners were deciding where to live, they balanced all considerations of housing amenities, government services, property taxes, consumption goods taxes and house prices, and then selected the optimal county. As a result of the sorting, the utility of the marginal Orange County resident will be very similar (identical?) to what their utility would have been if they had selected the next best county.

In order to focus on the relevant details of the effects of unexpected investment losses on the value of Orange County housing prices, I make the following simplifying assumptions. First, houses in Orange County are assumed to be perfectly inelastically supplied.[19] Second, there is a perfectly elastic cross price elasticity of supply of housing outside of Orange County with respect to prices in Orange County. Essentially I am assuming that Orange County is a small county

[18] In this sense the sorting is very similar to an idealized Tiebout equilibrium.

surrounded by large counties; demand shifts in Orange County have no effect on the surrounding counties. I also assume that government services are perfectly elastically supplied by a competitive market, as are all consumption goods. Finally, Orange County's losses will affect each Orange County homeowner equally, so that there is no change in the marginal home owner.

Slightly more formally, assume that the marginal Orange County resident has a utility function for housing such that

$$U = U\left(\overline{H}, G, C\right), \tag{1}$$

where $\overline{H}$ is the fixed amount of county housing they own, G is government services they receive and C is private consumption goods. The government's budget constraint is

$$\overline{P}_G G = T, \tag{2}$$

where $\overline{P}_G$ is the fixed price per unit of government services and T is the total amount of taxes collected per household. The individual budget constraint is

$$\begin{aligned} \overline{M} &= P_H \overline{H} + T + \overline{P}_C C \\ &= P_H \overline{H} + \overline{P}_G G + \overline{P}_C C \end{aligned} \tag{3}$$

where $\overline{M}$ is fixed total individual income, P_H is the price of houses in Orange County, and $\overline{P}_C$ is the fixed price per unit of consumption good.

When deciding how much to pay for a house in Orange County, people compare the utility that they would receive if they bought a house in a surrounding county with the utility that they would receive from buying a house in Orange County. For the marginal home buyer, utility will be identical in Orange County or one of the surrounding counties. The maximum price that the marginal home buyer would be willing to pay for an Orange County house is a price that would make them indifferent to living in Orange County, either before or after the bankruptcy. I use the assumption that the utility of the marginal Orange County resident is unchanged to pin down the price of housing in Orange County; since the housing stock, income, prices of government services and private consumption goods are constant, prices of houses in Orange County must adjust to make the marginal person indifferent between leaving and staying.

From equation (3) an expression for the price of a house can be written as

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[19] Perhaps it would be more accurate to note that land is perfectly inelastically supplied; the effect on housing prices will be identical if housing is elastic.

$$P_H = \frac{\overline{M} - \overline{P}_G G - \overline{P}_C C}{\overline{H}}, \tag{4}$$

subject to the constraint that

$$U\left(\overline{H}, G, C\right) = \overline{U},$$

where $\overline{U}$ is the utility that could be earned from living in a nearby county. Therefore, prior to the bankruptcy, the Lagrangian determining prices in Orange County would have been given by

$$\max_{G,C} P_H^i = \frac{\overline{M} - \overline{P}_G G^* - \overline{P}_C C^*}{\overline{H}} + \lambda\left[U\left(\overline{H}, G^*, C^*\right) - \overline{U}\right]. \tag{5}$$

Notice that in this formulation the homeowner selects both government services and private consumption. Presumably the effect that individuals have on the level of government services is an indirect outcome of the political process. Government services and private consumption are necessary in order to satisfy the utility constraint, but of course every dollar spent on these items reduces the funds available for purchasing a house. The optimal allocation of government services and private consumption will maximize the remaining funds available, and hence maximize the price of houses.

Within the context of the model, the government can react to its losses in one of four ways: increase lump-sum taxes, increase taxes on inelastically supplied housing, increase taxes on elastically supplied private consumption, or cut government spending.[20] Housing prices will react differently depending on the government's reaction to the investment losses and on the degree of public myopia to the pending government actions. The following sub-sections present several predictions of how house prices will react as myopia and the government's reaction to investment losses are varied.

3.1 Lump-Sum Taxes and Perfect Myopia

Consider the case where as a result of losing an amount L per house in investment losses, the government will react by levying a lump sum tax of L per house. If people are perfectly myopic they will not realize what the government's actions are going to be, and therefore will continue to

[20] Perhaps another alternative is to try and tax non-county residents. However, given that this option would always be preferable to taxing county residents, whether there is a bankruptcy or not, presumably all opportunities to tax non-residents have been exhausted.

react as if nothing happened. That is, prices will be set according to equation (5) above: there will be no change in house prices.

3.2 Lump-Sum Taxes and Perfect Foresight

Now consider the situation where the government will react by levying lump-sum taxes of L per house in reaction to the government investment losses of L per house, and the public perfectly foresees the pending government action. Equation (6) presents the new objective function.

$$\max_{G,C} P_H^i = \frac{\overline{M} - \overline{P}_G G^* - \overline{P}_C C^* - L}{\overline{H}} + \lambda\left[U\left(\overline{H}, G^*, C^*\right) - \overline{U}\right]. \qquad (6)$$

Since the taxes are lump sum there is no effect on the optimal level of government spending and private consumption. The only effect is in the budget constraint: people have L less money, and so the price of housing goes down by the exact amount L per house.

3.3 Taxes on Housing with Perfect Foresight

Consider the case where the government reacts to its investment losses by raising taxes on housing. The new budget constraint would be

$$\begin{aligned} \overline{M} &= P_H(1+\tau)\overline{H} + T + \overline{P}_C C \\ &= P_H\overline{H} + P_H\tau\overline{H} + \overline{P}_G G + \overline{P}_C C \end{aligned}. \qquad (7)$$

In order that the additional tax revenues are sufficient to cover the investment losses it must be true that $P_H\tau\overline{H} = L$. Substituting this expression into (7), solving for P_H, and placing it in the Lagrangian yields expression (6) above. That is, taxing inelastically supplied housing would result in house prices dropping by exactly as much that the investment losses - identical to the effect of lump-sum taxes.

3.4 Taxes on Private Consumption with Perfect Foresight

If the government reacts to its investment losses by taxing private consumption then the Lagrangian would be

$$\max_C P_H^i = \frac{\overline{M} - \overline{P}_G G^* - \overline{P}_C (1+t) C^*}{\overline{H}} + \lambda \left[U\left(\overline{H}, G^*, C^*\right) - \overline{U} \right]$$
$$= \frac{\overline{M} - \overline{P}_G G^* - \overline{P}_C C^*}{\overline{H}} - \frac{\overline{P}_C t C^*}{\overline{H}} + \lambda \left[U\left(\overline{H}, G^*, C^*\right) - \overline{U} \right] \quad (8)$$
$$= \frac{\overline{M} - \overline{P}_G G^* - \overline{P}_C C^*}{\overline{H}} - \frac{L}{\overline{H}} + \lambda \left[U\left(\overline{H}, G^*, C^*\right) - \overline{U} \right]$$

If the government raises taxes in by L per property and maintains government services of G^*, then the only way to satisfy the utility constraint is if private consumption is C^*. Therefore, the effect on housing prices, if taxes on private consumption are increased by L and government spending is maintained at its pre-bankruptcy level, is that prices drop by exactly the amount of the losses – identical to the lump-sum and housing tax cases.

3.5 Cuts in Government Spending with Perfect Foresight

If the government cuts government spending by exactly the amount of its investment losses the objective function becomes

$$\max_C P_H^i = \frac{\overline{M} - \overline{P}_G G^f - \overline{P}_C C^f - L}{\overline{H}} + \lambda \left[U\left(\overline{H}, G^f, C^f\right) - \overline{U} \right]. \quad (9)$$

When the level of government spending drops from G^* to G^f private consumption must increase from C^* to C^f to satisfy the utility constraint. The government must cut spending by L per person to satisfy its budget constraint, indicating that

$$\overline{P}_G \left(G^* - G^f \right) = L ,$$

or rearranging,

$$\overline{P}_G G^f = \overline{P}_G G^* - L . \quad (10)$$

Substituting (10) into (9) yields

$$\max_C P_H^i = \frac{\overline{M} - \overline{P}_G G^* - \overline{P}_C C^f}{\overline{H}} + \lambda \left[U\left(\overline{H}, G^f, C^f\right) - \overline{U} \right]. \quad (11)$$

The effect of a drop in government spending on housing prices comes down to the net effect of private consumption on the budget constraint. If government spending was initially at the efficient point and than decreased by L per person (away from the efficient point), total expenditure on

private consumption must increase by an amount in excess of L to satisfy the utility constraint. If private consumption increases by more than L then the budget constraint decreases by more than L, indicating that house prices drop by more than the government losses.[21]

3.6 Summary of Theoretical Predictions

As a result of the government's investment losses it must either raise taxes or cut spending, or presumably some combination of the two. The model just presented highlights the possible effects of the government's actions on housing prices. First, if people are perfectly myopic to the effect of the investment losses, then there will be no effect on prices. As people exhibit foresight, housing prices will drop in response to the investment losses. If people have perfect foresight and the government raises lump-sum taxes, property taxes, or sales taxes, house prices will drop by exactly the amount of the investment losses. If people have perfect foresight and the government reacts to the investment losses by cutting government spending, house prices will drop by more than the investment losses.

There are two other factors that may affect Orange County housing prices that have not been discussed to this point: risk aversion to future taxes, and a bankruptcy signal. First, as discussed in Barro[1974], Barro[1989] and Chan[1983], among various others, if home owners are risk averse to their uncertain share of future taxes, then the drop in real estate prices will overreact to investment losses. Chan specifically demonstrates using a consumer budget constraint that if taxes are lump sum, and the distribution of future tax shares is uncertain, consumers will reduce their first period consumption in the event of a debt-financed tax cut. The implication of Chan's analysis for housing prices is, if property owners are risk averse, that unexpected government losses, or debt, decrease housing prices in excess of the investment losses. Second, house owners may interpret the Orange County investment losses as a signal that there has been either poor oversight by county administrators, or incompetence with regard to the handling of county funds. The implication for either of these two conclusions is that there is an increased possibility of additional negative outcomes; the signal would induce real estate prices to overreact to the county's investment losses.

[21] If it is assumed initially that government services are inefficiently high, then decreases in government services would result in a drop in real estate prices that are lower than the drop in expenditure because they would be valued at less than dollar for dollar. Bradbury, Mayer, and Case[2001] provide some indication that drops in different kinds of government spending has different results on housing prices, indicating that at the margin not all government services are equally valued.

4 Empirical Analysis of the Change is Housing Prices

The following analysis estimates the effect of Orange County's $1.7 billion investment loss on the value of Orange County residential real estate. The strategy being employed throughout is to compare the change in housing prices in Orange County relative to the change in housing prices in Ventura County, before and after the bankruptcy. The difference-in-difference strategy is appropriate because Orange County's investment loss was unexpected, and the treatment and control groups are well defined.

Ventura County is selected as the control county because it is proximate to Orange County, and the two counties are similar in observables. A comparison of various descriptive statistics for counties in southern California confirms the logic of using Ventura County for this purpose. Table 1 presents county level descriptive statistics from the 2000 census for southern California. Ventura County appears to be most similar to Orange County, especially with respect to income and housing characteristics. For example, the Orange and Ventura County median house prices were $270,000 and $248,700, while the next closest median house price is $227,200 in San Diego. The median family incomes in Orange and Ventura County were $64,611 and $65,285, while the next closest median income was $53,438 in San Diego County.

An additional reason for selecting Ventura County, rather than San Diego or Los Angeles County, is that both San Diego and Los Angeles were experiencing financial difficulties of their own. San Diego County had suffered approximately $300 million in investment losses during 1994 resulting from failed leveraged investments. Los Angeles County was projecting a $1.2 billion budget shortfall during the 1995-1996 fiscal year related to the difficulty of increasing revenues while simultaneously adhering to mandated expenditures.

Three different data sets will be used to estimate Orange County's change in house prices. First, median housing prices will be used. Second, a comparison of the assessed property values for the two counties will be made. Third, a data set containing individual, single family, house prices will be used. The results are presented in the following three sub-sections.

4.1 Analysis Using Median Sales Data

Figure 1 presents the monthly median housing prices for Orange County, and five surrounding counties in southern California, between June 1994 and June 1995.[22] The vertical line represents December 1994. It is immediately obvious that the Orange County median housing price

drops exactly at the point of the bankruptcy declaration. Between December 1994 and January 1995, the median Orange County housing price drops by $11,000.

Figure 1 provides tentative evidence that median housing prices in the surrounding counties may also have adjusted in December 1994. Both Ventura and San Diego County's median housing prices dropped between November and January (by $9,000 and $8,000). San Bernardino, Riverside, and Los Angeles' median housing prices were roughly stable over the period. A regression of the monthly median housing prices for the five counties surrounding Orange County, on county fixed effects and a bankruptcy dummy variable (equal to zero for months prior to the bankruptcy and one for months after) indicates that the average median housing price dropped by $4,500 after Orange County's bankruptcy. For the twelve month period around the bankruptcy it appears that there may also have been a slight downward trend in median housing prices; however, a regression identical to that just mentioned, except that a time trend is included, indicates no significant downward trend[23]. The reason for the drop in real estate prices in the counties surrounding Orange County is not immediately obvious, but may be related to the increased interest rates, general economic conditions, or from a fear that their county may be exposed to bankruptcy risk similar to that of Orange County.

Due to the fact that both Orange County and the surrounding counties' median prices dropped at the time of the Orange County bankruptcy, it is useful to control for unobserved effects on housing prices by including Ventura County. A regression comparing the change in median housing prices for the six months before and after the bankruptcy indicate that Orange County prices dropped by $2,300 more than those of Ventura, though the coefficient is statistically insignificant.

4.2 Analysis Using Assessed Property Values

A simple difference-in-difference analysis is performed using the reported assessed property valuations for Orange and Ventura Counties contained in each county's Comprehensive Annual Financial Reports. The reports indicate that the assessed value of Orange Country dropped from $178.76 billion in 1993-94 to $176.97 billion in 1994-95, a drop of $1.8 billion. Ventura County's assessed property value increased slightly from $44.4 in 1994 to $44.97 billion in 1995, an increase of $500 million. Orange County's assessed value dropped by $2.3 billion relative to that of Ventura

[22] Median housing price data was provided by Dataquick, Inc.
[23] The trend coefficient is -$42 per month with a t-statistic of -0.52.

County. While it would be imprudent to place too much weight on this estimate, the magnitude of the drop is strikingly similar to the magnitude of Orange County's investment losses.

4.3 Analysis Using Micro Sales Data

In order to carry out detailed analysis of the effect of the bankruptcy on housing prices, a data set of individual residential sales prices for both Orange and Ventura Counties was purchased for all closings between June 1, 1994, and June 30, 1995. The data set only includes properties characterized as "Residential Single Family".[24] The analysis that follows restricts consideration to those properties that were coded as single unit structures, which eliminated 250 observations.

Table 2 presents various descriptive characteristics for all residences captured in the data set. The data has been separated to present summary statistics for Orange and Ventura County both before and after the bankruptcy. Houses in Orange County are on average more expensive, smaller, and older than those of Ventura County. The average Orange County sales price dropped by over $9,300 after the bankruptcy while the average Ventura sales price dropped by $7,800. The housing characteristics were stable for each county before and after the bankruptcy. It seems reasonably obvious that there must be some data errors since the minimum and maximum observations in each category are unbelievable. As a result, it will be necessary to reduce the effect of the outliers during the formal empirical analysis.

Table 3 presents preliminary regressions for the purpose of presenting the trends in house prices in both Orange and Ventura County. Regression 1 presents the mean monthly changes in housing prices in Orange County relative to that of November 1994 (the month before the bankruptcy), after controlling for various observable characteristics. Only Orange County data has been included in Regression 1. Each monthly date indicates a monthly fixed effect, where November 1994, has been omitted. For the six months prior to the bankruptcy there were no statistically significant variations in monthly mean housing prices in Orange County. However, all seven months after the bankruptcy have monthly mean housing prices that are significantly lower than that of November 1994. The range of the monthly drop in prices after the bankruptcy is $3,032 to $5,721, and the mean drop is $4,730. Regression 2 is identical to that of Regression 1 except that log price is the predicted variable. Again there is no statistical difference in housing

[24] Other categories that are available for purchase include residential condominiums, cooperatives, manufactured homes, and apartments. In total there are approximately 13,000 observations in these categories, of which close to 12,000 are condominiums. It is not clear that the inclusion of condominiums would have been useful since the monthly assessment fee typically associated with condominiums was not observed.

prices for any month before the bankruptcy, whereas monthly log prices are significantly lower in every month after the bankruptcy. Regression 3 and 4 use only Ventura County data. There are no significant differences in Ventura county prices prior to the bankruptcy. For four of the seven months after the bankruptcy there is no significant difference between that of November 1994, and for three of the months there is a difference. The range of the monthly drop in prices after the bankruptcy is $37 to $5,181, and the mean drop is $2,160. The same pattern is repeated in Regression 4, which uses Ventura County data and log prices. The regressions presented in Table 3 indicate that whatever the effects of the bankruptcy on real estate prices, they were stronger and more pronounced in Orange than Ventura County.

In order to estimate the change in Orange County housing prices before and after the bankruptcy, relative to the changes in Ventura County, two additional variables have been created. First, a Bankruptcy fixed effect is set equal to zero for all observations prior to the bankruptcy in December 1994, and equal to one after. Second, a Bankruptcy*Ventura interaction variable is equal to one for Ventura County observations after the bankruptcy, and zero otherwise. The Bankruptcy coefficient should be interpreted as the average drop in Orange County housing prices after the bankruptcy announcement, and the Bankruptcy* Ventura interaction should be interpreted as the difference in the change in Ventura County housing prices relative to those of Orange County. It is expected that the Orange County housing prices dropped by more than those of Ventura County, so that the Bankruptcy coefficient will be negative, and the Bankruptcy*Ventura coefficient will be positive.

In addition to the bankruptcy fixed effect terms, a comprehensive set of descriptive variables has been included. Of special note is the inclusion of ZIP code fixed effects.[25] The ZIP code effects capture neighborhood effects on prices, including school effects, proximity to the ocean and major transportation arteries, and so on. In alternative specifications school district and town fixed effects have been included in place of the ZIP code effects, without any qualitative impacts.

The problem of the erroneous extreme value data points that were highlighted in the discussion related to Table 2 - the descriptive statistics - will be handled in three different ways. First, a robust estimator is used in Regression 5. The robust estimator uses a two stage estimation

[25] In a typical difference-in-difference estimator it is necessary to include dummy variables for the treatment group, the time period, as well as an interaction dummy. The individual ZIP code dummies effectively substitute for the treatment dummy variable.

procedure where particularly influential observations are assigned a lower weight.[26] In Regression 5 the point estimate on the Bankruptcy dummy is negative, that on the Bankruptcy*Ventura dummy is positive, and both are significantly different from zero, as expected.

As a second attempt to reduce the problems caused by the erroneous extreme value observations in Regression 6, a quantile regression is estimated. The quantile regression, or least absolute deviation estimator, compares median prices, as opposed to averages in ordinary least squares. The least absolute deviation estimator emphasizes the middle of the distribution rather than the tails, which should reduce the effect of outliers. The point estimate on the Bankruptcy dummy is negative, that on the Bankruptcy*Ventura dummy is positive, and both are significantly different from zero, as expected.

As a final attempt to control for the erroneous extreme values, Regression 7 uses ordinary least squares, but extreme price observations have been deleted. Specifically, all house prices less than $100,000 or greater than $1,500,000 have been deleted (870 observations). In Regression 7 the point estimate on the Bankruptcy dummy is negative and that on the Bankruptcy*Ventura dummy is positive. While the Bankruptcy coefficient is statistical insignificant, the Bankruptcy*Ventura point estimate is significant. The estimates for Regression 7 are sensitive to the selected cut-off limits. When the lower limit was below $80,000, the Bankruptcy*Ventura coefficient was negative. When the lower limit was increased above $80,000 the Bankruptcy*Ventura coefficient turned positive, and the coefficient became significant at a lower limit of $100,000. The estimated Bankruptcy*Ventura coefficient was not nearly as sensitive to adjusting the upper price bound. One shortcoming of dropping the tails of the price distribution as a way to conform the problem of extreme data points is that prices were not the only extreme variables; there are extreme values in the all of the included variables.

Regressions 5, 6, and 7 provide reasonable indication that Orange County real estate prices dropped more than those of Ventura County. The Bankruptcy and Bankruptcy*Ventura coefficients in Regression 5 were -0.016 and 0.0181. At the median Orange County, November 1994, housing price of $200,000, this indicates that Orange County prices dropped $3,200 after the bankruptcy, and that the drop was $3,620 more than the drop in Ventura County. Similarly, the coefficient estimates in Regression 6 indicate that Orange County prices dropped $3,300, and that

[26] The robust regression "performs an initial screening based on Cook's distance >1 to eliminate gross outliers prior to calculating starting values and then performs, as suggested by Li (1985), Huber iterations followed by bi-weight iterations."

the drop was $2,640 more than Ventura County. Finally, the coefficient estimates in Regression 7 indicate that Orange County prices dropped $1,800 and that the drop was $2,000 more than Ventura County.

Using the fact that there were approximately 880,000 residential properties in Orange County in 1994, it is possible to obtain an estimate of the drop in the value or Orange County real estate resulting from the $1.7 billion investment loss. Using the just presented point estimates that indicate that the median Orange County residence dropped by between $2,000 and $3,600 more than Ventura County, it is estimated that Orange County residential real estate dropped by between $1.76 billion and $3.17 billion. At the low end of the range the estimated drop is almost identical to the actual investment losses the Orange County suffered. The high end of the estimated drop indicates that Orange County real estate dropped by an amount 1.8 times larger than the actual investment loss.

Table 5 presents various alternative specifications. In all cases the previously described robust regression estimator is used to estimate the difference in the change in Orange County house sales prices relative to the change in Ventura County, before and after the Orange County bankruptcy. The full set of control variables used in Table 4 is included. In each of the eight regressions presented in Table 5, different time periods are used to calculate the difference-in-difference coefficient. For example, in Regression 8 the house sales prices for the five months before and after the bankruptcy are used; in Regression 9 the four months before and after are used; and so on. Only the coefficient representing the change in Orange County prices relative to Ventura County is presented – labeled in Table 5 as the "Diff-in-Diff Coefficient." The "Prob>F" column indicates the statistical significance of the Diff-in-Diff Coefficient. The "Change in Orange County House Prices" uses the estimated coefficient and calculates the estimated relative drop in the median Orange County house price. The "Change in Orange County Real Estate" simply multiplies the individual drop in prices by the 880,000 residential properties to arrive at an estimate of the aggregate drop in Orange County real estate value.

As the number of months surrounding the Orange County bankruptcy used for the difference-in-difference analysis are reduced from five to two months, in Regression 8 through 11, the estimated effect of Orange County's investment losses increases. In Regression 8 it is estimated that Orange County real estate drops by $1.57 billion, and in Regression 11 it is estimated that the drop is $2.94 billion.

Regression 12 includes fixed effects for every County-Month interaction. The County-Month interactions are interpreted as the average monthly sales price in each county. Using the monthly average sales prices, the Difference-in-Difference Coefficient was calculated for specific pairs of months. For example, the November/December comparison compares the change in Orange County's house prices between November and December 1994, with the change in prices in Ventura during the same two months. The November/December comparison is made because these are the two months immediately surrounding the bankruptcy. However, due to the fact that it often takes many weeks from the time that a housing contract is signed until the transaction is completed, it is useful to compare other combinations of months. Table 5 includes comparisons of the October/December, November/January, and October/January changes. Regression 12A and 12B indicate that the drops in real estate prices in Orange County during the respective comparisons were significantly different from zero, and that the aggregate drop in Orange County real estate prices was $3.28 billion or $4.09 billion. In Regression 12C and 12D there was no significant drop in Orange County real estate relative to Ventura County. It seems that the natural variation in monthly housing prices make it difficult to isolate the effects of the bankruptcy between individual months.[27]

5 Discussion

The range of the estimated drop in the value of Orange County's residential property value from the previous section was $1.57 to $4.09 billion. Despite these estimates, I prefer to focus on the results from the robust regression estimators that used multiple months to estimate the drop in Orange County real estate value. The robust estimators provide a reasonable and easily interpretable method for controlling for the extreme values in the data, and the multiple month estimates result in some smoothing of the inherent large variation in real estate prices. In the robust, multiple month estimators, the range in the drop in Orange County real estate is $1.57 billion to $3.17 billion. I consider the other estimators to be robustness checks on the results; the quantile estimator, the truncated estimator, and the monthly pair comparisons provide reasonable assurance that the results are stable across estimators.

[27] Other researcher who have investigated the effect of various changes on real estate prices do not select individual months either side of the exogenous change as their reference points. Due to the magnitude of standard errors in real estate estimators it is seldom possible to tease out the effects of the changes in such a short sample. Typically the period of analysis compares the average prices for between one and two years before and after the treatment occurs.

Given that Orange County's losses were $1.7 billion, the range of the drop in residential property value of $1.57 to $3.17 is similar. The overlap between the investment and real estate losses indicates that the real estate market is foresighted, and that home buyers take into account county level fiscal policies in a relatively sophisticated way. If anything, real estate values overreacted to the county losses. Given the predictions of the model presented in Section 3 - especially with respect to the predicted effects of cuts in government spending, risk aversion, and a bankruptcy signal - this is not surprising.

The drop in Orange County real estate prices do not seem to be driven by the recession that had gripped southern California during the early 1990's. Between 1990 and 1993 Orange County's unemployment increased from 2.9 to 6.7%, yet in 1994 Orange County's unemployment rate fell to 5.8%, and then decreased even further to 5.5% in 1995. Median family income followed a similar pattern in that it fell from $56,380 in 1991 to $54,380 in 1993, before stabilizing at $54,413 in 1994 and growing by 2% to $55,507 in 1995.

The relative drop in Orange County's real estate prices does not appear to be an artifact of an appreciation in Ventura County's real estate prices, or relative economic performance. As demonstrated in the Table 3 regressions, Ventura County's real estate prices dropped on average by approximately $2,000 in the six months after Orange County's bankruptcy. After controlling for interest rate moves, Ventura County's real estate prices are found to have changed only slightly after Orange County's bankruptcy. For example, in regressions 5 through 7 the coefficients indicate that the average change in a Ventura County house price was between -$600 and $400, though the change is never statistically different from zero. Ventura County's economic performance was similar to that of Orange County. For example, Ventura County's unemployment rate followed a pattern similar to that of Orange County; in 1993 Ventura's unemployment rate reached 8.7% before dropping to 7.3% in 1994 and 6.9% in 1995.

Additional factors that may have affected Ventura County's housing prices, but not those of Orange County might include significant improvements in the Ventura County government's income or investment accounts. Neither of these possibilities seems likely. Because the assessed value of Ventura County real estate was stable, so were property taxes: total property taxes increased by $3 million between 1994 and 1995. Ventura County's investment fund did increase $200 million between 1994 and 1995, which may have had an effect on Ventura County's real estate prices. The net change in investment funds between that of Orange County's drop of $1.7 billion and Ventura's increase of $200 million is $1.9 billion.

The empirical results will be compared with three related fields of research – the efficiency of the residential housing market, the effects of government debt, and the stock market - in the following subsections.

5.1 Efficiency of the Real Estate Market

Despite its size and value, for reasons having to do with large transaction costs, infrequent turn over, heterogeneity in housing stock, and so on, an open question remains whether the real estate market is efficient. Gau[1985], and Case and Shiller[1989], test the weak form efficient market hypothesis (the hypothesis that it is not possible to use previous prices to earn abnormal returns). Gau detects some autoregressive tendencies in commercial property the Vancouver, Canada, market between 1971 and 1980. Case and Shiller use a weighted repeat sales index to test weak form efficiency in the residential real estate market. They conclude that despite some limited ability to predict future prices based on current prices, due to the magnitude of transaction cost, it would be very difficult to take advantage of any inefficiency.

Studies that have investigated whether the real estate market is semi-strong form efficient (the hypothesis that it is impossible to use any publicly available information to earn abnormal returns) have yielded mixed results. Linneman[1986], the most widely cited of these studies, estimates that publicly available information can be used to earn excess returns, but that the excess returns are insufficient to cover high residential transaction costs. Several other studies that have attempted to test semi-strong efficiency in the real estate market include Ford and Gilligan[1988] who find that house prices dropped in response to lead abatement laws by approximately the amount of the cost of removing lead; Delaney and Smith[1989] who find that new housing prices dropped by the amount of newly assessed impact fees; and Skantz and Strickland[1987] who find that housing prices did not initially react to an unexpected flood, but did react to changes in insurance premiums.

The empirical results presented herein generally support semi-strong market efficiency. Housing prices in Orange County dropped immediately after the bankruptcy announcement slightly in excess of the $1.7 OCIP losses. The immediate drop in real estate prices indicates that owners were unable to avoid the incidence of the county losses.

The inability to reject market efficiency in real estate bodes well for using changes in real estate prices as an estimate of the value of amenities such as air quality, public school quality, crime, and so on. The speed of response of real estate prices to the Orange County investment losses, and

the similarity between the magnitude of the drop and the actual losses, provide support for the strategy of using real estate values as a proxy for valuing housing related amenities. It must be noted, however, that there is a large amount of variation in the estimated drop making it difficult to obtain precise estimates.

5.2 The Effect of Government Debt on Real Estate Prices

There are three primary fiscal instruments through which local governments can affect real estate prices: taxing, spending, and debt. To date the effect of government taxes and spending have received considerable treatment. An early empirical example is Oates[1969] who finds that property taxes exert a negative effect on residential real estate prices and that government spending exert a positive effect. Two recent examples of research into the effect of government spending on housing prices include Bradbury, Mayer and Case[2001], and Lang and Jian[2004]. These two papers exploit Massachusetts Proposition 2½, which limited property taxes to 2.5% of assessed property values, to estimate the effect of government spending on property values. Each paper finds that communities where the tax constraint was binding had reduced property values and those communities that were able to find ways to increase government revenue through other means had increased property values.

I have been unable to find any empirical papers that attempt to estimate the effect of local government debt on property values. This is an important omission because it is not an infrequent occurrence for local governments to experience fiscal distress.[28] If it is reasonable to assume that government investment losses have the same effect on property values as government debt, then the results presented herein are the first to estimate the effect of debt on property values.

Ricardo[29] discusses the potential for the effects of government debt and government taxes to have the same outcome. If taxpayers have sufficient foresight they will anticipate the eventual effects of government debt, and take precautions in the present. Barro[1974] formalized Ricardo's analysis, and applied it specifically to the effect of the debt-tax mix on consumption: under the assumptions of lump sum taxes, infinitely lived individuals and perfect loan markets, there will be no difference between debt and taxes as a means of financing government expenditures on private consumption. While in analyzing Orange County's unexpected investment losses, and subsequent bankruptcy, it is not straightforward to test Barro's formulation of Ricardian equivalence, it is

[28] A simple count finds 207 Chapter 9 bankruptcy filings since 1978.
[29] See for instance Ricardo[1951, vol. 1, pp. 244-49].

possible to get some indication of Ricardo's broader formulation of the equivalence between debt and taxes: the impact of investment losses (debt) during the Orange County bankruptcy on housing prices can be compared with the effect of changes in property taxes on housing prices.

The obvious difficulty in isolating the effect of taxation or debt on property values is the simultaneous equation system that determines both government revenue and expenditures. Rosen[1982] offers a solution to the simultaneity problem for property taxes. Rosen investigates the effect of Proposition 13 on housing prices in northern California. Proposition 13 reduced property taxes in many localities by setting a strict formula for determining property taxes across California. The magnitudes of property taxes changes were quite different across tax areas due to different initial rates. Rosen exploits the changes in property taxes to estimate their effect on housing prices in 64 San Francisco Bay area jurisdictions. Rosen estimates that the changes in housing prices fully capitalized, in present value, the change in property taxes. This finding would be confusing if a cut in property taxes resulted in a cut in valuable government services. However, due to a provision of the legislation, if localities were left with budget shortfalls as a result of the property tax changes, the state government would make up the difference.

Rosen's finding that real estate prices fully capitalized property tax changes closely matches the effect of the unexpected Orange County losses (debt) on real estate prices. Due to the fact that Orange County responded to its debt by increasing taxes on elastically supplied goods and cutting elastically supplied government services, rather than increasing taxes on inelastically supplied housing, it is reasonable that housing prices dropped more from government losses than changes in property taxes. The finding that an unexpected change in government investment losses has a similar effect on real estate prices as changes in property taxes supports Ricardo's conjecture.

5.3 Comparison of Stock Market and Real Estate Market

Using the empirical results presented herein, it is possible to compare the effects of unexpected government losses in the real estate market to unexpected corporate losses in the common stock market. Jarrell and Peltzman[1985] investigate the effect of product recalls on the pharmaceutical and automotive industries. By comparing the magnitude of the direct costs of the product recall to the magnitude of the drop in company stock prices, they are able to estimate whether the stock prices over or under react. They find that stock prices drop by more than the recall costs, and that the drops are persistent. Furthermore, they find that the stock prices of competitors also drop, rather than rising, as might be expected from customers switching vendors.

The drops in competitor stock prices might indicate that stock owners estimate some common industry wide shock resulting from product recalls.

While Orange County real estate prices overreacted to county losses, similar to stock prices overreacting to product recalls, it is not true that the value of real estate prices in Ventura County also dropped (That is, the drop in Ventura County can be explained within the empirical model, primarily from interest rate moves.). This finding may indicate that whereas the stock market infers some industry level risk, there is no inference of cross-county level risk in real estate.

The Orange County bankruptcy might be a useful episode with which to evaluate prospect theory, as presented in Kahneman and Tversky[1991], in the real estate market. One implication of prospect theory is the disposition effect - the tendency to hold on to losing investments too long, and sell winning investments too quickly. Odean[1998] finds strong evidence for the disposition effect by analyzing 10,000 investment accounts. Genesove and Mayer[2001] find that condominium sellers take longer to sell when prices drop lower than expected.

My very preliminary analysis does not find any support for the disposition effect in the Orange County real estate market. By simply comparing the number of property closing in Orange County with the number in surrounding counties, there is no obvious decrease in the number of house closings in Orange County after the bankruptcy relative to other years and to Ventura County. The Orange County bankruptcy might be a useful natural experiment with which to further evaluate the disposition effect.

6 Conclusion

Orange County's bankruptcy in late 1994 offers a unique natural experiment with which to estimate the effects of government losses (debt) on real estate prices. The Orange County Investment Pool lost approximately $1.7 billion from its failed leveraged investment strategy. As a result, the value of Orange County residential property dropped by between $1.6 and $3.2 billion; the drop in real estate prices compares favorably with the investment losses. To the extent that the real estate prices overreacted to the county losses can be explained by risk aversion, the negative signal sent by the bankruptcy declaration, and the fact that the county reacted to the losses by cutting valuable government services which caused deadweight loss.

The similarity in the amount of the county investment losses and the magnitude of the drop in aggregate real estate values indicates that the real estate market is reasonably foresighted and efficient. This finding supports other research that has found that semi-strong market efficiency

could not be rejected in the real estate market, but runs counter to tests of weak form market efficiency. Moreover, the similarity in the county investment losses and drop in real estate value provide empirical support for the strategy of estimating the value of changes in amenities - such as air quality, education, and crime reduction - by estimating the change in housing prices.

The effect of the Orange County bankruptcy on real estate prices will be useful to the field public finance since it provides an estimate of the effects of local government debt on property values. The effect of debt on housing prices fills a gap in the literature that has estimated the effects of property taxes and various forms of government spending on real estate prices, but not debt. Local governments can now more completely evaluate the economic trade-offs between government spending, taxes, and debt. The similarity in the effect of debt and taxes on real estate prices provides support for Ricardian equivalence in its general form.

While the effect of the effect of the Orange County bankruptcy on real estate prices was investigated herein, the bankruptcy episode offers various additional promising avenues of research. For example, a thorough comparison between the reaction of the stock market and housing market to unexpected losses could be conducted. Furthermore, the Orange County bankruptcy could be used as the basis for studying the effect on local government's ability to raise revenue and withstand financial distress.

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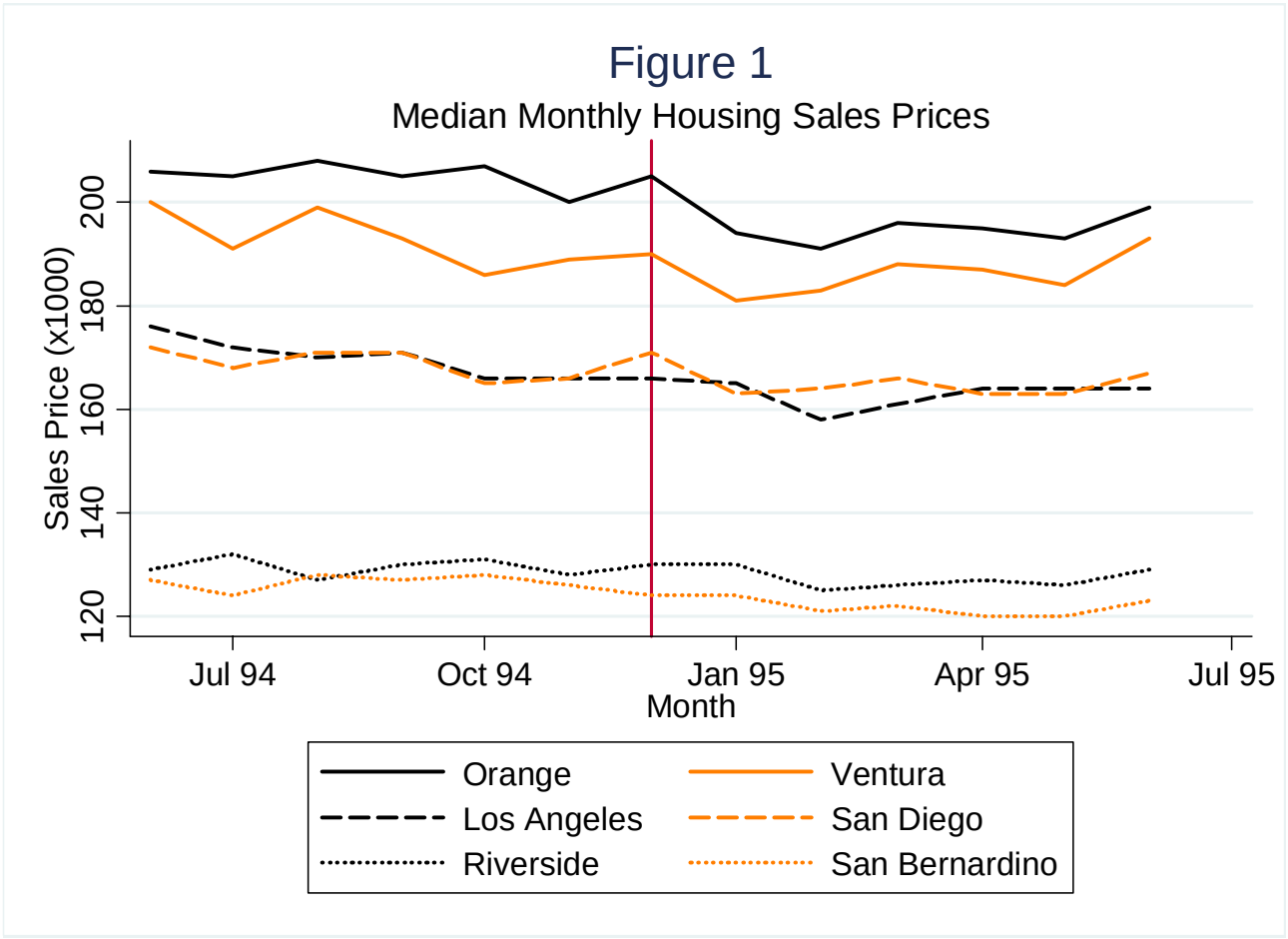
Figure 1
Median Monthly Housing Sales Prices
Sales Price (x1000)
120
140
160
180
200
Jul 94
Oct 94
Jan 95
Apr 95
Jul 95
Month
Orange
Los Angeles
Riverside
Ventura
San Diego
San Bernardino

TABLE 1
Descriptive Characteristics for Six Southern California Counties

	Orange	Ventura	San Diego	Los Angeles	San Bernardino	Riverside
% White	64.8	69.9	66.5	48.7	65.6	58.9
% Black	1.7	1.9	5.7	9.8	6.2	9.1
% Asian	13.6	5.3	8.9	1.9	3.7	4.7
% Hispanic	30.8	33.4	26.7	44.6	36.2	39.2
% High School Graduate or Higher	79.5	80.1	82.6	69.9	75	74.2
% Bachelor's Degree or Higher	30.8	26.9	29.5	24.9	16.6	15.9
% In Labor Force	65.5	66.2	65	60.5	58.2	60.6
Median Household Income	58820	59666	47067	42189	42887	42066
Median Family Income	64611	65285	53438	46452	48409	46574
Per Capita Income	25826	24600	22926	20683	18689	16856
% Individuals Below Poverty	10.3	9.2	12.4	17.9	14.2	15.8
% Occupied Housing	96.5	96.6	95.6	95.8	86.6	87.9
Median housing value	270000	248700	227200	209300	146500	131500
Median month mortgage	1717	1671	1541	1524	1268	1202

Note: Data are from the 2000 U.S. Census Bureau. All monetary values are in 1999 dollars.

TABLE 2
Descriptive Statistics

Orange County Before Bankruptcy

	Mean	Std. Dev.	Minimum	Maximum
Price	263291	182770	500	7000000
Bathrooms	2.2	0.66	0.25	8
Rooms	6.8	1.5	1	66
House area	1803	736	7	12196
Lot size	8023	21361	2	905000
Year built	1967.6	14.1	1895	1996

Orange County After Bankruptcy

	Mean	Std. Dev.	Minimum	Maximum
Price	253992	216992	1000	9959000
Bathrooms	2.17	0.70	0.25	8
Rooms	6.8	1.7	1	87
House area	1786	779	65	12480
Lot size	7865	14864	1	718740
Year built	1966.9	14.9	1896	1997

Ventura County Before Bankruptcy

	Mean	Std. Dev.	Minimum	Maximum
Price	238681	171130	1000	7671000
Bathrooms	2.38	0.78	0.25	9.5
Rooms	6.9	1.5	2	16
House area	1926	878	448	12655
Lot size	15588	118196	1057	6969600
Year built	1974.3	16.2	1887	2004

Ventura County After Bankruptcy

	Mean	Std. Dev.	Minimum	Maximum
Price	230852	147857	5000	3100000
Bathrooms	2.36	0.82	0.25	9.5
Rooms	6.9	1.5	2	20
House area	1924	927	388	9468
Lot size	13600	37680	1500	1298959
Year built	1974.3	16.8	1900	2004

Note: Before Bankruptcy data include the six months including June through November, 1994 and the After Bankruptcy data include December, 1994, through June, 1995. All data are for single family residences that sold in market transactions, as provided by Dataquick, Inc.

TABLE 3
Preliminary Regression Results for Housing Prices

	(1) Orange Price	(2) Orange log(Price)	(3) Ventura Price	(4) Ventura log(Price)
June, 1994	1511	0.0054	436	0.005
July, 1994	172	0.0019	1637	0.010
August, 1994	773	0.0055	140	0.006
September, 1994	-919	-0.0028	-914	0.0002
October, 1994	-320	0.0004	-1899	-0.004
November, 1994	Omitted	Omitted	Omitted	Omitted
December, 1994	-3083**	-0.0195***	-1184	-0.0001
January, 1995	-4165***	-0.0214***	-1976	-0.0093
February, 1995	-4944***	-0.0246***	-4240**	-0.0225***
March, 1995	-5267***	-0.0249***	-4994***	-0.0169**
April, 1995	-4069***	-0.0182***	-2290*	-0.0090
May, 1995	-5829***	-0.0315***	-640	0.0049
June, 1995	-5757***	-0.0305***	189	0.0048
Bathrooms	227	0.0187***	666	-0.0023
Rooms	-497**	0.0005	-220	0.0117***
House Size (ft^2)	70.0***	0.0003***	122***	0.0003***
Lot Size (ft^2)	5.48***	0.00002***	174***	6.7×10^{-6}***
Year Built	617***	0.0025***	30***	0.0045***
ZIP Code Fixed Effects	Included	Included	Included	Included
Observations	14791	14791	8388	8388
R^2	0.95	0.93	0.95	0.93

Note: *, **, and *** indicate statistical significance at the 90, 95 and 99 percent confidence interval, respectively. All regressions have been estimated using an estimator that is robust to extreme values. Regressions (1) and (2) include only data from Orange County. Regressions (3) and (4) include only data from Ventura County. The predicted variable in Regressions (1) and (3) is price, and the predicted variable in Regressions (2) and (4) is log(Price). The date variables are monthly dummy variables.

TABLE 4
Regression Results for Housing Prices

	(5)	(6)	(7)
	Robust log(Price)	Quantile Log(Price)	OLS-Truncated log(Price)
Bankruptcy Fixed Effect	-0.016***	-0.0165***	-0.009
Bankruptcy*Ventura Fixed Effect Interaction	0.0181***	0.0132***	0.010*
Prime Interest Rate	-0.0082**	-0.0095**	-0.014***
Bathrooms	0.0183***	0.0249***	0.053***
Bathrooms*County	-0.0202***	-0.0216***	-0.031***
Rooms	0.0004	0.0003	0.0067***
Rooms*County	0.0107***	0.0147***	0.0257***
House Size (ft^2)	3.1×10^{-4}***	3.3×10^{-4}***	3.0×10^{-4}***
House Size*County	8.0×10^{-6}*	-2.7×10^{-5}***	-1.1×10^{-4}***
Lot Size (ft^2)	2.2×10^{-5}***	4.7×10^{-6}***	9.0×10^{-7}***
Lot Size*County	-1.6×10^{-5}***	-2.8×10^{-6}**	7.4×10^{-8}
Year Built	0.0026***	0.0018***	-0.0004**
Year Built*County	0.0020***	0.0027***	0.0044***
Intercept	2.39***	2.89***	9.45***
ZIP Code Fixed Effects	Included	Included	Included
Observations	23179	23179	22309
R^2	0.93	0.48	0.49

Note: Robust standard errors are presented in the parentheses. *, **, and *** denote significant with 90, 95 and 99 percent confidence respectively. The predicted variable is log(Price) in all other regressions. Regression (5) uses an estimator that is robust to extreme values on the full sample. Regression (6) uses a least absolute deviation, or quantile, estimator on the full sample. In Regression (7) the full sample has been restricted by eliminating those observations where the recorded price was either below $100,000 or greater than $1,500,000. R^2 is not applicable (N/A) in any of the robust estimators because it is not possible to be calculated in this type of estimator.

TABLE 5

Robustness Checks on the Bankruptcy Effect

		Diff-in-Diff Coefficient	Prob>F	Change in Orange County House Prices	Change in Orange County Real Estate
Regression (8)	Five months before and after bankruptcy	0.0089**	0.0483	-$1777	-$1.57 billion
Regression (9)	Four months before and after bankruptcy	0.0113**	0.0241	-$2251	-$1.98 billion
Regression (10)	Three months before and after bankruptcy	0.0142**	0.0267	-$2814	-$2.48 billion
Regression (11)	Two months before and after bankruptcy	0.0169***	0.0100	-$3344	-$2.94 billion
Regression (12A)	November/December comparison	0.0188**	0.0503	-$3730	-$3.28 billion
Regression (12B)	October/December comparison	0.0235**	0.0152	-$4644	-$4.09 billion
Regression (12C)	November/January comparison	0.0121	0.269	-$2396	-$2.11 billion
Regression (12D)	October/January comparison	0.0167	0.127	-$3318	-$2.92 billion

Note: *, **, and *** denote significant with 90, 95 and 99 percent confidence respectively. The predicted variable is log(Price) in all regressions. In each regression the full set of control variables have been included. Additionally, dummy variables have been included in order to be able to calculate the change in housing prices in Orange County relative to those in Ventura County for the time period indicated. Regression (8) includes dummies for the five months before and after the bankruptcy; Regression (9) includes dummies for the four months before and after the bankruptcy; and so on. In Regression (12) includes the full set of control variables and monthly dummy variables for each month/county interaction. The Diff-in-Diff coefficient represents the change in average Orange County house prices relative to those of Ventura County for the specified months. The Prob>F statistic is the test that the Diff-in-Diff coefficient is significantly difference from zero. The Change in Orange County Prices is calculated relative to the change in Ventura County at the median price of $200,000. The Change in Orange Counts Real Estate multiplies the Housing Price by 880,000 (the number of properties in Orange County) to get an estimate of the aggregate drop in the Orange County real estate prices.