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By

Richard K. Green

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School of Business

University of Wisconsin-Madison

975 University Avenue

Madison, WI 53706

rkgreen@facstaff.wisc.edu

608-262-5227(V)

608-265-2738(F)

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Introduction

The Santa Clara County--or the San Jose Metropolitan Area--housing market is distinctive. It not only has the highest median single-family house price--$565,000 in March 2001—of any major market in the United States; it also saw nominal prices rise by 34.5 percent between March 1999 and March 2000, and another eight percent between March 2000 and March 2001, while consumer prices rose much less than three percent annually. Despite widespread reports of layoffs and depressed stock prices in Silicon Valley, median house price has yet to budge much downward in the region.

At the same time, housing supply in the region has been remarkably inelastic. Between December 1995 and December 2000, the national ratio of new jobs to housing permits has averaged 1.8; in Santa Clara County, in has averaged 4.2.[1] The average inventory of the new houses on the market at any one time has recently been less than one month—this contrasts with 3.6 months nationally. [2]

Finally, in recent years, the state of the stock market has been more important to the housing market in Santa Clara County than elsewhere. According to the California Association of REALTORS, households are three times more likely to use proceeds from stock sales for the down-payment on a house in northern California than they are in Southern California (Cauley and Krueger 1999), and in a recent paper, Green (1999)

[1] Data are from the U.S. Census and the Bureau of Labor Statistics.
[2] See the C-25 series.

found that the elasticity of house prices with respect to the Russell 2000 index in Santa Clara was .88, a considerably higher estimate than San Francisco's and especially Los Angeles, where the impact appeared non-existent.

The question, then, is whether the Santa Clara County housing market is different from others because it is so heavily tied to the "new economy," or because it is facing very old economy sorts of constraints. This paper will not pretend to answer that question, but it will present a series of stylized facts about the market that might suggest an answer. Specifically, instead of using a standard organizational structure, it will attempt to answer a series of questions:

1) Why are house prices in Santa Clara County so high?
2) How much does the stock market tell us about the Santa Clara County housing market?
3) Are nominal house prices in Santa Clara County sticky downward?
4) Can we find fundamentals that explain the increase in house prices in Santa Clara County over the past five years?

Why are house prices in Santa Clara County so high?

The traditionally high price *levels* for housing in Santa Clara County arise from a financial phenomenon that substantially precedes the existence of Intel—user cost. The simplified user cost of owner occupied housing for itemizers is just

$$uc = V((i + t_p)(1 - t_y) + m + d - p)$$

where

uc = user cost

V = value

i = the nominal interest rate

τ_p = the property tax rate

τ_y = the income tax rate

m = maintenance

d = depreciation and

π = expected inflation

In equilibrium, the user cost of owning will equal the cost of renting: consequently the terms that are multiplied by V can be viewed as a capitalization rate for owner occupied housing.

Santa Clara County has had an extraordinarily low capitalization rate for housing at least as far back as 1970. The first reason for this is that the average marginal tax rate for taxpayers in the county has long been much higher than the national average (Capozza, Hendershott and Green 1996). Indeed, by 1990, the average marginal tax rate for households in Santa Clara County was, at 28 percent, the highest among major U.S. metropolitan areas.

The reasons for the high tax rates are two-fold: California has among the highest marginal tax rates of any state, and high household income push Santa Clara County denizens into high federal tax brackets.

But while California taxpayers pay large amounts of income tax, they pay relatively little in property taxes, because of the constraints placed on local units of government by Proposition 13. Consequently, two key components of user cost—the income tax rate and the property tax rate—make user cost of owning lower in Santa Clara County than most other places.[3]

The other thing that likely matters, of course, is expected appreciation, and one might expect the expected rate of house price appreciation in Santa Clara county to be higher than it is in most places. After all, house prices in the area have seen periods of extraordinary increase. Moreover, it has had two key ingredients to expectations about rising house prices: incomes that have risen at a faster than average rate, and a relatively inelastic supply of residential land (see Malpezzi 2000).

Nevertheless, expected appreciation's contribution to user cost in the region is far harder to discern than property and income tax rates'. In the first place, Capozza, Green and Hendershott (1997) show that income and property tax rates predict rent-to-price ratios exactly as they should, while various measures of expected appreciation have little predictive power at all. This is not surprising in light of the fact that expected appreciation will, perforce, be measured with error, so coefficients on regressors characterizing expectations will be biased downward.

[3] Steve Malpezzi has performed unpublished calculations based on the 1990 census showing the generally low level of property tax rates in California.

But even if we were to assume that the correct measure of expected appreciation would have the exact effect on user cost, and by extension, price that we might predict given theory, it is not at all clear by how much expected appreciation in Santa Clara County would, in fact, reduce use cost. As we will see in time series analysis presented later in the paper, house price appreciation in the county is actually mean reverting, suggesting that over the long term that expectations do not substantially reduce user cost. Indeed, while the region has had extraordinary price run-ups, it has also had periods of extraordinary declines. For example, from June 1989 to February 1991, the nominal median price fell by 15.4 percent. Nevertheless, even if it were the case that expected appreciation in Santa Clara County was not extraordinarily high, the relatively high income tax rates and low property tax rates there assure low user cost and therefore high property values.

Support for the sustainability of high prices in the region is provided in Malpezzi (2000). In that paper, Malpezzi calculated empirical equilibrium relationships between income and house prices using an error-correction framework. Of the 133 metropolitan areas he studied, he found that San Jose had the third highest price to income ratio nationally; only the ratios in Santa Barbara and Santa Cruz were higher. This finding was a long-term phenomenon, based on data for the period 1979 through 1996.

Malpezzi used a regression to explain the differences in house price-to-income ratios across MSAs, and found that they were principally a function of five variables: the level of land use regulation, proximity to a major park, population levels, population change, and the mortgage interest rate. These are, again, rather old economy results. They suggest that equilibrium prices are higher in the presence of inelastic supply; that,

in keeping with Capozza and Helsley's (1990) treatment of the standard urban model, house prices are higher in places with high population and rapid population growth; and that the lower the cost of capital, the higher the capitalized value.

How much does the stock market tell us about the Santa Clara County housing market?

One thing that does make the Santa Clara County housing market distinctive is that there is evidence (Green 1999) that the market is influenced by the stock market. This phenomenon is localized and new.

For stock prices to affect house prices, three conditions must be in place

1) Stock ownership is sufficiently widespread to affect consumption
2) The life-cycle hypothesis is correct and changes in stock values are unanticipated
3) Changes in demand for housing are reflected in changing price rather than quantity (i.e., that supply inelastic).

The first of these is obvious: if the marginal buyer doesn't own shares, the value of equities will not affect directly her housing demand.[4] As recently as 1995, Survey of Consumer Finance Data showed that only 27 percent of households in the United States in 1995 owned any stock (including mutual funds) at the personal level at all, although 37 percent had retirement accounts, some of which presumably contained stocks. Of those households who held stocks directly, the median value of holdings was $8,000. For those

[4] Unless share values have an effect on consumer confidence.

who held mutual funds, the median value was $19,000. Finally, for those holding retirement accounts, the median value was $15,600. The most recent data, however, from 1998, showed that the share of households holding stocks or mutual funds rose to 35.7 percent, and 48.8 percent of households had retirement accounts. Median values for individual stocks, mutual funds, and retirement accounts rose to $17,500, $25,000 and $24,000, respectively, among households who owned any amount in each asset class.

California Association of REALTORS data show that the stock market is particularly important to the housing decision in Northern California. More than 20 percent of households in Northern California use proceeds from sale of stock in order to make the down-payment on a house. This contrasts with only seven percent in Southern California.

As to the second point, changes in expectations about returns to stocks is a crucial component in determining the size of the effect of stocks on house prices. When households invest in stocks, they expect their wealth to evolve according to their expectations about the market, and to plan their consumption accordingly (Ando and Modigliani 1963). But when expectations about wealth change, either because of a particularly large positive realization of a distribution of potential wealth outcomes, or because expectations change, wealth can influence consumption.

We should also note that even if stock prices do not affect consumption, they can affect the housing market. When stock prices rise sharply, households might wish to rebalance their portfolios in order to diversify optimally (Markowitz). The fact that housing is an asset means that rising equity values could lead households to have an investment, as well as a consumption, motive for buying more housing. On the other

hand, work by Brueckner (1997) and Flavin and Yamashita (1998) suggests that the vast majority of households are "overinvested" in housing from a portfolio standpoint, because their desired level of housing consumption dominates portfolio considerations.

Poterba (2000) provides the first broad evidence that holdings have become broad enough and expectations have changed enough to influence consumption. He finds that the marginal propensity to consume is between one and two dollars out of every hundred dollars of equity value gained.

Finally, for wealth to have an influence on house prices, the housing market must be inelastic. This inelasticity can arise from three causes. First, if agglomeration is an important feature of a local economy, location value becomes important, and land available near clusters will be scarce and therefore inelastic. Second, land use regulation can inhibit new construction and cause increases in demand to drive up prices rather than quantities. Finally, geographical barriers to new construction can also cause increases in demand to drive up prices.

Silicon Valley is generally Exhibit A for those explaining the importance of agglomeration economies (see Krugman 1991). Malpezzi and Green (1996) show that San Jose has among the most restrictive land use policies of any metropolitan area in the country. Thus at least two of the three potential sources of house supply inelasticity are present in Santa Clara County.

Green (1999) tested the effect of the stock market on house prices in Santa Clara County by performing a simple bivariate test of Granger Causality. The idea behind Granger Causality is a simple one: if a lagged explanatory variable can improve the forecast of a dependent variable after the lagged dependent variable is taken into account,

the explanatory variable is said to "Granger Cause" the dependent variable. That is, if we estimate

$$y_t = a_o + \sum_{i=1}^{k} a_{t-i} y_{t-i} + \sum_{i=1}^{k} b_{t-i} x_{t-i}$$

and an F-test rejects the hypothesis that the $\exists$s are jointly equal to zero, we may say that we reject the null hypothesis that x does not Granger Cause y. Poterba and Samwick's (1995) empirical tests are much in this spirit[5], although they do not specifically perform Granger tests.

Green used the Russell 2000 index of stock prices to determine whether stock prices led house prices. This index contains the 2000 smallest companies in the Russell stock indexes, and therefore can be viewed as an index of entrepreneurial companies. House prices and stock prices are represented by their first log differences, and the Santa Clara County House Price series is a median sales price series from the California Association of REALTORS.[6] The model that best fit the data reported in that paper had two lags, and rejected the null hypothesis that stock prices did not Granger Cause house prices.

The most striking aspect of the findings of the paper was the contrast between Northern California, where the stock price effect was pronounced, and southern California, where it was non-existent. Moreover, the coefficients from the Russell

[5] PS test whether the Standard and Poor's 500 helps predict consumption of all goods and of luxury goods. They find that it does not help predict consumption of all goods, and only weakly predicts consumption of luxury goods.

[6] Of course, a constant quality series would have been better, but Case-Shiller-Weiss Data are only available on a quarterly basis, whereas the CAR series is monthly. Higher frequency data is key to the analysis here. Haurin, Hendershott and Kim (1991) suggest that using median price instead of constant quality price is generally innocuous.

regression suggested a long-term elasticity of .88 between stock prices in that index and house prices in Santa Clara County.

But the paper leaves a number of unanswered questions. First, we may well ask whether the Russell 2000 is the "correct" index for determining the influence of stock prices on house prices, and, if not, whether the results are robust. Second, we might ask whether Grainger models that incorporate stock prices do a particularly good job of forecasting. The 1999 paper only told us that house price forecasts containing stock information improve on forecast using the house price time series alone.

We therefore perform the same exercise using the NASDAQ and Standard and Poor's 500 Index. The NASDAQ, of course, contains many of the high technology companies with the largest market capitalizations, and the S&P is synonymous with a blue chip index. For all three indexes, we end the regression analysis in June 1998, and then see how well the regression coefficients forecast house prices between July 1998 and March 2001. Table 1 presents coefficients, standard errors, and F-tests of whether the coefficients on the lagged stock index variable are jointly different from zero.[7]

Two things become immediately apparent: all three stock price series add explanatory power to the house price series, and all three stock price series produce very similar in-sample fits to the data.

Not only are the results robust across the series in the sense that all three stock series have statistical significance, the coefficient point estimates are reasonably similar : the two S&P coefficients add up to .5, the two Russell coefficients add up to .36, and the

[7] We pre-tested all of these series, which are in log first differences, to make sure they were stationary. They were. See Hamilton (1994).

two NASDAQ coefficients add to the smallest total, .32. This produces elasticities of 1, .88, and .44. While the statistical difference among these estimate is marginal, it is interesting that the index that most represents the "old economy" produces a higher elasticity than the newer economy indexes.

We may now use these models to forecast. We assume that house prices are a function only of the movement and stock prices and past fitted house price values determined by the stock prices. The resulting out-of-sample forecasts are disappointing to say the least (See figure 1). None of the stock indexes predict anything remotely like the house price increases we have seen in Santa Clara County over the past two and one-half years: the maximum value that any of the indexes predicts is $412,000, whereas the median house price in the county peaked at $577,000.

The other striking thing is that over the past year or so, the housing market in Santa Clara County has become decoupled from the NASDAQ. Between February 2000 and February 2001, the NASDAQ declined by 44 percent in value, and predicted a 31 percent decline in house prices. In the meantime, the median house price rose by 19 percent. Because they decline far less than the NASDAQ, the Russell 2000 and the S&P did a better job of forecasting prices: the Russell essential produced a forecast of zero price growth, while the S&P predicted a decline of about 4.7 percent. While these forecast errors are obviously smaller, they remain large.

Are Santa Clara County house prices sticky downward?

As we just noted, all two of the three stock indexes predicted a decline in house prices that did not materialize. It may therefore be reasonable to ask whether nominal

house prices might be sticky downward. There could be two explanations for price stickiness: nominal loss aversion, and the nature of the index we are using.

Mayer and Genesove (2000) used the bust in the Boston condominium market to show that there is a tendency on the part of homeowners to resist downward price pressures in housing markets by "hanging on" until they get the price they want. This would explain why time-on-market would rise substantially: that rather than sell below a personal reservation price, homeowners simply do not sell. This nominal loss aversion explanation is controversial, but the Mayer and Somerville paper makes a strong case for it. It is perhaps worth mentioning that while the sale price of a house in Santa Clara County in March 2001was eight percent higher than it was in the preceding March, existing home sales volume declined by 31 percent during this time.[8]

Much less controversial is the fact that median house price series tend to attenuate actual volatility in the housing market, because they do not control for the quality of the housing stock sold at a particular time. Thus the underlying prices of houses may in fact have fallen in Santa Clara County, but buyers have responded by buying higher quality houses than they would have in a higher price environment. We should note, however, that stickiness caused by this phenomenon works in both directions.

In any event, we tested for stickiness by performing the regressions described above and adding an asymmetry term. Specifically, we now estimate:

$$y_t = a_o + \sum_{i=1}^{k} a_{t-i} y_{t-i} + \sum_{i=1}^{k} b_{t-i} x_{t-i} + \sum_{i=1}^{k} g_{t-i} dx_{t-i}$$

[8] As I am writing this, I have learned that from April 2000 to April 2001, median house price declined by 5 percent and volume was off by 40 percent.

where d is an indicator variable that is equal to one when x is positive and is equal to zero when x is negative. If the γ are jointly different from zero and positive, the positive influence on stock prices would be greater than the negative influence, meaning that the house price response to falling nominal stock prices would be sticky downward.

We perform this regression three separate times using the three different stock indexes (table 2). Our results are not encouraging: in all three cases, the F-statistic for the test that the γs are different from zero are well under the 90 percent critical value. We can thus find no evidence of downward price stickiness.[9]

Can we find fundamentals that explain the increase in house prices in Santa Clara County over the past three years?

While there is some evidence that the stock market influences house prices in Santa Clara county, a vector-auto-regression model containing house prices and stock prices alone fails to predict the trajectory of house prices in Santa Clara County between late 1998 and early 2001. We therefore look at developing a reduced-form equation that contains a variety of fundamentals to better explain—and forecast—the past 30 months or so.

We therefore move from the realm of nominal prices to real prices. We estimate the following model:

[9] I also ran EARCH models to test for asymmetry in the conditional variance of the Santa Clara County housing market. One might expect that leveraging effects would mean that negative house price innovations would cause more volatility than positive innovations. The EARCH coefficient suggested, however, that there are no such asymmetries.

$$price_t = a + b_{t-1} price_{t-1} + b_{t-12} price_{t-12} + due_{t-1} + ksfper_{t-1} + nmfper_{t-1} + v\, realmr_{t-1} + g_{t-1} stock_{t-1} + g_{t-2} stock_{t-2}$$

where *price* is real house price, *ue* is the Santa Clara Country unemployment rate, *sfper* is single family housing permits, *mfper* is multifamily permits, and *realmr* is the real mortgage interest rate, based upon the Federal Home Loan Bank series, and deflated by the Consumer Price Index. House prices and stock prices are in log first differences. The explanatory variables are lagged to avoid endogeneity. The data are monthly.

The reason for choosing the unemployment rate is it gives us a measure of the overall health of the economy. The single-family and multifamily permit data give us a proxy for new housing supply. Mayer and Somerville (2000) point out that housing construction is a sensible explanatory variable in a price change equation, because it represents the gross *change* in the housing supply, rather than the level of the housing supply. The interest rate gives an indication of the cost of capital, and the stock price enters as before. The real interest rate measure is naïve: I subtract the change in CPI from the Freddie Mac 30-year rate reported in *Secondary Mortgage Markets.* The reason for using the first and twelfth autoregressive lag is that they simply best fit the data, and the twelfth lag controls for seasonality. Ideally, we would also have a term reflecting migration and population growth, but such data are not available on a monthly basis. We know from decennial census data that even annual estimates of county level populations are rather unreliable. We also know that population growth in Santa Clara Country mirrored national population growth throughout the 1990s, so there were no extraordinary new population pressures there.

The results, reported in Table 3, show that the median house price in Santa Clara County is mean-reverting in the short-term, and is seasonal. The coefficients on the stock price index, in this regression the S&P 500, continue to be statistically different from zero, although now only the first lag seems to matter. Unemployment rates and building permit levels seem to have no impact on price. The real mortgage interest rate is significant at the 95 percent level. This suggests that while the direct supply measure—building permits—does not affect price, supply is somewhat inelastic, at least in the short-run. If supply were elastic, lower mortgage rates would produce new construction, and therefore lead to lower rents. This rent response would mean that the interest rate decline would not be capitalized into prices.

For forecasting purposes, we try a more parsimonious model that includes only house prices, stock prices, and the mortgage interest rate. The model with the first and twelfth lags in the autoregressive process, S&P 500, and the naïve measure of the real mortgage interest rate now forecasts a bit better: the out-of-sample peak price is now $644,000 for May 2000, and there is a small, although non-secular, fall from that peak. Note that while the forecast price levels are a bit above actual prices, the general "shape" of the out-of-sample forecast is quite similar to the actual price series (Figure 2). On the other hand, when we use the NASDAQ as the stock price index, we still get a substantial predicted decline in prices.

There is some irony in these results. The variables that allow us to get an out-of-sample forecast that is not embarrassing are the S&P index and the mortgage interest rate: two staples of the old economy.

Conclusions

The results presented above suggest that the Santa Clara County housing market is sensitive to stock market values, and that the sensitivity survives the addition of other variables to a Santa Clara County house price equation. We also find that two key old-economy house price determinants—interest rates and supply conditions—help explain the trajectory of house prices in the county.

We should also note that housing markets in the San Francisco Bay Area have often not behaved the way economic fundamentals models would predict (Meese and Wallace 1994). It is therefore not surprising that even our best forecasting model makes errors as large as $100,000 out of sample.

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Table 1

Grainger Tests of Whether Stock Prices Cause House Prices: Three Different Stock Indexes (January 1989-June 1998)

	Russell 2000	**S&P 500**	**NASDAQ**
House Price$_{t-1}$	-.44 (.09)	-.43 (.09)	-.43 (.09)
House Price$_{t-2}$	-.04 (.09)	-.04 (.09)	-.03 (.09)
Stock Price$_{t-1}$	.21 (.08)	.25 (.11)	.17 (.09)
Stock Price$_{t-2}$	.15 (.09)	.25 (.01)	.14 (.08)
Constant	.001 (.003)	-.001 (.004)	.001 (.003)
F-Statistic	5.76	4.82	5.05
R^2	.22	.21	.21
N	112	112	112

Note: Standard Errors in Parenthesis.

Table 2

Grainger Tests of Whether Stock Prices have Asymmetric Impacts on House Prices: Three Different Stock Indexes (January 1989-June 1998)

	Russell 2000	**S&P 500**	**NASDAQ**
House Price $_{t-1}$	-.44 (.10)	-.44 (.10)	-.44 (.09)
House Price $_{t-2}$	-.04 (.09)	-.06 (.09)	-.03 (.09)
Stock Price $_{t-1}$	.19 (.17)	.29 (.24)	.13 (.16)
Stock Price $_{t-2}$	.02 (.17)	.01 (.24)	-.006 (.16)
Stock Price $_{t-1}$*(1 if change > 0, 0 otherwise)	.02 (.29)	-.07 (.35)	.08 (.26)
Stock Price $_{t-2}$*(1 if change > 0, 0 otherwise)	.28 (.29)	.38 (.35)	.28 (.25)
F-Statistic on asymmetry terms	.48	.55	.73
N	112	112	112

Table 3
Market Fundamentals Models

	(i)	(ii)	(iii)
House Price$_{t-1}$	-.32 (.09)	-.30 (.09)	-.30 (.09)
House Price$_{t-12}$	.22 (.08)	.22 (.08)	.21 (.07)
S&P 500 $_{t-1}$	.30 (.10)	.31 (.10)	
NASDAQ $_{t-1}$			.24 (.07)
"Real" Interest Rate $_{t-1}$	-4.02 (1.93)	-4.18 (1.91)	
Single Family Permits $_{t-1}$ (000)	.02 (.03)		
Multi Family Permits $_{t-1}$ (000)	.00 (.02)		
Unemployment Rate $_{t-1}$	-.15 (.28)		
Constant	.02 (.03)	.016 (.008)	.014
N	101	101	101
R^2	.22	.21	.22

Figure 1: Santa Clara County House Price Out-of-sample Forecasts Based on Various Stock Indexes

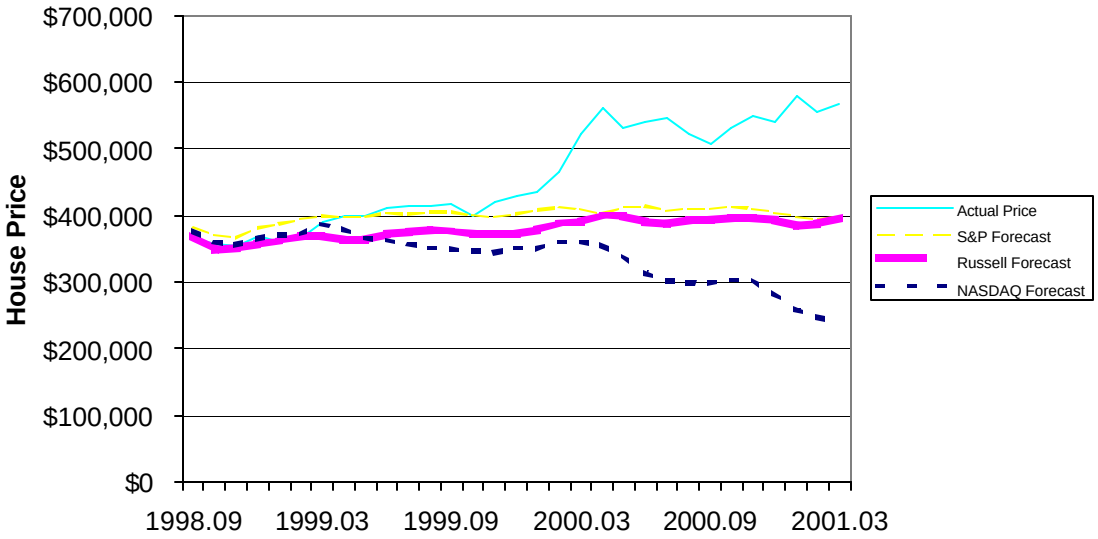

Figure 2: Santa Clara County House Price Forecast with Fundamentals