

# Stock Prices, Housing Prices, Housing Stock Prices, and Fundamentals

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## Abstract

The very small correlation between US owner occupied housing and stock prices over the last thirty years is striking because in a sufficiently simple economy, the correlation between these prices would be one. Conditional on macroeconomic fundamentals, there has been a significantly negative correlation. Real estate investment trusts' and home builders' stocks are positive correlated with other stocks at short horizons and negatively at long horizons. The data suggest that the discount factor applied to housing is negatively correlated with that applied to stocks, but do not rule out the possibility that demand for housing consumption and corporate profits are negatively correlated.

## 1 Introduction

Changes in housing and stock prices in the US have exhibited a correlation close to zero over the past three decades. Figure 1 illustrates the absence of a relationship, plotting the US Office of Federal Housing Oversight's repeated transaction home price index (OFHEO HPI) against the S&P 500 index, (adjusted to exclude dividends, which are discussed later).

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The weak correlation is familiar to those who study household portfolios. See, e.g. Flavin and Yamashita (2002) and Cocco (2005). Green (2002) shows that stock prices Granger caused home prices in the San Francisco Bay Area, but not elsewhere in California, between 1989 and 1998. Quan and Titman (1999) summarize their own and other findings with respect to the relationship between commercial real estate and stock returns. They find a weak relationship in the US, but strong relationships elsewhere.

The absence of strong correlation is striking because stocks and housing are the most important assets for US households (see e.g. Bucks et al. (2006)) and because a natural point of departure for equilibrium models is a correlation of one. Any model of asset prices that implies a large positive correlation between stock and housing prices has performed poorly on an important dimension in recent US history. A satisfactory model of equilibrium in US asset markets must either justify a negatively correlation between housing and stock dividends or justify why investors in stocks would discount at a rate negatively correlated with the rate at which the implicit dividends on homes are discounted.

This paper asks empirically which of the assumptions that give rise to a perfect theoretical correlation between housing and stock prices is violated so severely as to drive the empirical correlation towards zero. The first step is thus to provide sufficient conditions for a perfect correlation.

Consider a closed economy with a fixed quantity of infinitely divisible, non-depreciation land of identical quality and a fixed quantity of capital. The capital produces a stochastic quantity of output each period.  $N$  identical consumers derive utility each period from housing and from direct consumption of capital output. Housing consists only of land and redrawing boundaries between lots to adjust individuals' consumption is costless. Utility is monotonically increasing in the quantity of output and the acreage of land consumed. Other than land and capital ownership, there is no possible saving, and there are no taxes. Suppose further that land ownership and land consumption can diverge at no cost, so that there is both a rental and ownership market for land. Because consumers are identical, they

consume and receive as dividends  $\frac{1}{N}$  of total land expenditures each period and also consume and receive in dividends  $\frac{1}{N}$  of the direct capital output.

If the fraction of consumers' expenditures on land and direct output going to land is constant (e.g. time separable utility with a subutility function of housing and direct output exhibiting wealth and price elasticities of one), then total land rents are a constant fraction of total capital output in every period. This implies that a unit of land has dividends that are perfectly correlated with those of capital. If there are no bubbles or unexploited arbitrage opportunities, this further implies that the unit prices of land and capital are perfectly correlated, as are their log changes. Labeling the price of land as the price of housing, and the price of capital as the price of stock, we have our result.

The next section of this paper describes empirical tests and data used to try to identify which of the assumptions above are violated in a way that leads to such a small empirical correlation between housing and stocks. Section 3 concludes.

## **2 Why are changes in housing and stock prices not positively correlated?**

A common way to estimate the relationship between returns to two assets is to regress returns on one asset on returns on the other, with covariates sometimes included on the right hand side.

In section 1, the discussion of correlation related to changes in prices, rather than total returns. This choice of emphasis is motivated mostly by the fact that the dividends to homeowners are difficult to observe. Rental housing units are different from owner occupied units, so increases in discrete demand for homeownership may lead to reduced rents without any reduction in implicit dividends on owner units. The empirical emphasis is thus on the relationship between housing and stock prices, with correlation between stock dividends and different estimates of implicit rents also considered directly and indirectly.

For these reasons, I focus on equations of the form:

$$\Delta H_t = a + \beta \Delta \text{STOCK}_t + \Delta X_t \gamma + u_t \tag{1}$$

$\Delta H_t$  represents the log change in a measure of housing prices between periods  $t - 1$  and  $t$ .  $\text{STOCK}$  denotes stock prices and  $X$  denotes other macroeconomic variables or prices that might covary with both housing and stock prices. Home price data is available no more frequently than quarterly, and short differences are likely to be measured poorly (see Case and Shiller (1989)). I thus present differences at the one, four, and twelve quarter horizons.

I estimate equations of the form (1) using ordinary least squares. The long difference regressions employ Newey-West standard errors with four or twelve lags. Smaller standard errors are found with longer Newey-West lags or robust standard error estimates, but small samples may bias these down, justifying the assumption of constant variance and uncorrelated errors  $u_t$  past the mechanical correlation induced by overlapping horizons. The consistency of results across horizons suggests that statistical problems related to serial correlation are not driving the estimated relationship between stock and housing prices.

Housing price estimates come from the Office of Federal Housing Enterprise Oversight's House Price Index. OFHEO uses repeated observations of a large panel of US homes (from sales or refinancings) to estimate a price index. Known problems associated with this index are that maintenance and upgrades are not netted out of appreciation, and that there is selection into the dataset based on the size and riskiness of the mortgage and borrower associated with the home. Despite these problems, the OFHEO index is very highly correlated with other measures of home price appreciation, even at the local level. Summary statistics and descriptions for changes in the OFHEO index and other variables are in Table 1.

Stock prices are from the S&P 500 index via CRSP, with prices adjusted to reflect the value of a dollar invested at the beginning of the panel if it were held in the changing component stocks of the index, but did not receive dividends. An alternative concept of

changes in stock market value consistent with the perfect correlation setup above would be the change in the dollar value of all securities traded on the major stock exchanges. As it turns out, CRSP's estimate of the log real change in the total value of all stocks on the NYSE, NASDAQ, and AMEX exchanges has a correlation of .97 with the estimate used here and results are virtually identical if the STOCK measure were replaced with this aggregate.

## **2.1 Unconditional relationship**

In a regression with only STOCK on the right hand side, with 125 quarterly observations from 1976 through 2006, we find that the estimated elasticity of housing prices with respect to stock prices is .042, with a standard error of .027, and an R-squared of .02, and correlation of .14. This is statistically indistinguishable from zero correlation.

## **2.2 Slow adjustment of housing prices**

One might suspect that housing markets adjust to macroeconomic news slowly, because individuals trade infrequently. It could thus be that with longer differences, we would obtain more positive effects of changes in stock market values on changes in housing prices. This is not the case empirically. Repeating the regressions in Table 2 at one and three year horizons, Tables 3 and 4 reveal that the coefficients on  $\Delta$ STOCK become more negative with horizon length. This result is uniform across seven specifications, and this arises with overlapping or non-overlapping horizons. The same monotonic decrease in coefficients occurs in unreported variation in horizon length with the alternative measure of housing returns discussed below. The natural conclusion is that if short term noise obscures a long term relationship, it is a negative, not a positive one.

## 2.3 Land vs. structures

A first assumption in the stripped down model laid out above was that utility over housing comes entirely from consumption of a fixed quantity of land. In reality, the value of housing has at least two sources: location and improvements. A standard view of housing prices (e.g. Muth (1969)), is that willingness to pay for scarce locations drives property values more than the replacement cost of structures and infrastructure. However, replacement costs are not constant, and it is not obvious that real replacement costs must be pro-cyclical. There is no readily available or reliable time series of US market urban land prices.

Three separate regression estimates address this problem. A first way to strip changes in structure prices out of housing prices to leave only land changes is to include the US producer price index for single family residential homes (PPI) as a control  $X$  in equation (1). Given that producer prices are, in fact, procyclical, it is not surprising that the estimated coefficient on the stock market does not increase when PPI is included.

A second approach to the land-structure problem is to estimate the relationship between pure land costs and stock market prices. Davis and Heathcote (forthcoming) build on the OFHEO estimates to create a quarterly per acre land price index for the United States. Their empirical strategy is to combine data on residential structures investment with estimated land to structure ratios to decompose price changes into changes to structure prices and changes to land prices. Confirming intuition, they conclude that land appreciates more rapidly and is more volatile than structures. Table 6 estimates the regressions of the form (1) replacing the HPI with the Davis and Heathcote (forthcoming) land price index on the right hand side.

A final method of separating land from structures is to exploit differences in land prices across metropolitan areas. In addition to a national home price index, OFHEO estimates separate indices for over 300 different metropolitan areas. It is not controversial that certain coastal markets have higher land prices than others. Under the assumption that land prices represent a larger share of home value in markets with high land prices, we should obtain a

better estimate of whether land and stock prices are correlated with each other by focusing on markets known to have high land prices. This assumption is vindicated by estimates of the elasticity of substitution between land and structures. Thorsnes (1997) and others estimate an elasticity no greater than one at the time of construction, so that for new homes, there would be no relationship between land price and the land share of value. As homes age, though, structures depreciate and land value, on average, rises. The greater is land appreciation, the greater the land share will then be, assuming home improvement is not as elastic with respect to land value as is initial construction. We can thus expect in a cross section to see land's share of total home value will increase with land prices in a cross section of completed homes.

Table 5 presents regressions of average changes in prices in San Jose and 11 metropolitan areas within the Boston, San Francisco, Los Angeles, and New York consolidated metropolitan areas. These areas were chosen because there can be no doubt that these are among the markets with the most expensive land in the US and because their populations are sufficiently large that the OFHEO price estimates should be reasonable.<sup>1</sup> Coastal areas also have less elastic new supply than interior regions.<sup>2</sup>

Figure 2 plots the HPI time series, the Davis and Heathcote (forthcoming) series, and the coastal subset of the HPI. We find that the coastal and land specializations of the HPI look very similar, with the latter series amplifying changes to the HPI.

We fail to find a significant unconditional relationship between changes in the stock market and changes in home prices. Indeed, comparing Table 3 with Tables 5 and 6, the estimated relationship between  $\Delta\text{STOCK}$  and coastal housing prices and land prices are uniformly more negative than on US housing prices generally. In some specifications, the estimated coefficient on stocks is significantly more negative with the land price proxies as dependent variables than with housing prices.

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<sup>1</sup>An earlier version of this paper used 2004 political contributions and population density to construct a continuous proxy for expensive and coastal markets in the broader set of metropolitan areas. The results there were consistent with those presented here.

<sup>2</sup>See, e.g. Green et al. (2005).

While land in desirable locations is scarce, land in general is not. Urban economics emphasizes the role of commuting costs in generating land value. One might thus imagine that increasing transportation costs are good for housing values but bad for the rest of the economy. In some specifications of (1), changes in CPI estimates of real transportation costs are included as a conditioning variable  $X$ . In fact, we find the estimated coefficient on  $\Delta\text{TRANSPORT}$  to be consistently, and sometimes significantly, negative.

A further difference between reality and the stylized model presented in the introduction is that structures can be built when home prices are high, attenuating the effect of demand on prices. Likewise, investment in new companies can reduce the value of stock market capital. In unreported regressions, including neither current nor lagged change in building permits or aggregate investment significantly increases the estimated coefficient on  $\Delta\text{STOCK}$ .

In sum, these results do not support the notion that fluctuations in construction costs or levels mask an underlying positive relationship between land and stock prices.

## 2.4 Taxes

Summers (1981) argued that the US tax code makes inflation more favorable to home owners than to stock owners, since mortgage interest is tax deductible and because housing dividends and capital gains are untaxed. While margin interest is deductible for stock owners, and capital gains can be deferred and receive basis step-up at death, inspection of Figure 1 lends credence to Summers's idea. In the high inflation years 1976 to 1982, housing outperformed stocks in appreciation. As inflation waned, the relative appreciation of stocks improved.

Figure 1 also shows that changes in housing and stock prices were not strongly correlated in either the high inflation period or the lower inflation period after 1982. Tables 2 through 5 include specifications (column (3)) that estimate equation (1) before and after the mid-point of the sample, 1992. In each case, the correlation and estimated elasticity are insignificantly more positive in the overall period than in the latter period, when inflation was surely less salient. Alleviation of inflation concerns does not appear to generate a strong positive

correlation between housing and stock prices.

Another approach to inflation is to include changes in anticipated inflation as an  $X$  element in equation (1). The Livingston Survey, compiled by the Philadelphia Federal Reserve Bank, provides biannual data on forecasters' estimates of changes to inflation (similar results arise with the University Michigan's survey of inflation expectations). The relationship between stocks and housing prices becomes more negative when the controls  $X$  are introduced.<sup>3</sup>

More generally, changes to tax law are bound to generate a relative preference for housing or stock in household portfolios. To explore whether major changes in federal tax laws have driven the negative relationship between stocks and houses, Tables 2 through 5 also include specifications that exclude the years of some notable tax overhauls and the subsequent years. Column (2) in each table excludes the years: 1981, 1982, 1986, 1987, 1997, 1998, 2001, 2002, 2003 and 2004. Given the very small and mixed sign changes in the coefficient on  $\Delta\text{STOCK}$  on changes in home prices, there is scant evidence that changes in tax laws mask a positive correlation between housing and stock prices. The exclusion of tax change years eliminates the years 2001 through 2004, particularly notably period of disconnect between housing and stock prices, so the absence of a result is all the more remarkable.

The reversal of fortunes of houses and stocks around the advent of the George W. Bush presidency calls any causal role for taxes into serious question. After 2001, income tax deductions became smaller and the corporate tax burden lighter. If taxes were a dominant force, the natural guess at general equilibrium effects is that these changes would have increased stock values relative to housing values. That relative prices moved in the opposite direction suggests that taxes are not the dominant force behind the absence of positive correlation.

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<sup>3</sup>Unreported regressions at the 12 quarter horizon that exclude the  $\Delta\text{LIV}$  inflation control but include other macro variables generate a significantly more negative coefficient on  $\Delta\text{STOCK}$ , so inflation appears to play some role. When  $\Delta\text{LIV}$  is the only conditioning  $X$ , there is no change in the coefficient on  $\Delta\text{STOCK}$ .

## 2.5 Disconnect between stock and housing dividends

The closed representative agent Cobb Douglas endowment economy described above is a poor description of the US economy. One deficiency of the model relates to the timing of dividends, profits, and rental expenditures. Firm profits are likely to be reinvested in new capital or repurchased shares. Consumers can invest in riskless securities, new businesses, augmented capital stocks of existing firms, and residential structures. Thus land rents will generally not be a constant share of output. Further, firms consume land and a large fraction of US commercial real estate is owned outside of publicly traded firms.

A seemingly straightforward way to determine if stock dividends are correlated with housing rents is to calculate a simple correlation between an estimate of corporate dividends per dollar of outstanding stock value and an estimate of residential rents.

Table 7 presents correlations among two different measures of real estate rents and two different measures of dividends. The measures of rents are the US consumer price index residential rent series (CPIRENT), which is based on repeated observations of the same unit. An alternative measure is available only starting in 1985. APTRENT comes from the private National Real Estate Index (NREI). The measures of dividends are the weighted average dividend rate on the three major US stock exchanges as calculated by CRSP (DIVRATE), and the estimated dividend rate paid by REITs that invest directly in real property, as calculated by the National Association of Real Estate Trusts (REITDIV).

The results in Table 7 do not support the idea that real estate dividends, particularly residential real estate dividends, are highly correlated with stock market dividends. Indeed, we find a negative correlation between REIT and stock dividends that grows in magnitude with horizon length, and a correlation very close to zero between residential rents and stock dividends at a short horizon. Over a long horizon, we find a negative correlation between the APTRENT series and total dividends, but a positive correlation between the CPI shelter series and total dividends.

Correlations in Table 7 must be viewed with caution. A first problem relates to the

reinvestment problem described above. While REITs must dispose of a large fraction of their earnings in the form of dividends to qualify for tax benefits, most firms' investors prefer earnings to be retained for tax purposes, and the extent of the tax preference varies with tax rates. The cause of dividends is the subject of a very long literature, see e.g. Fama and French (2001). This appears not to be a problem, however, in that corporate profits after tax behave very similarly to total dividends in correlation structure.

A second problem with dividend correlations is that estimates of changes in apartment rents need not be associated with changes in the dividends to homeowners. A difference between measured rents and dividends can arise simply because rents may be measured with error. While the CPI series shows rising real rents after in the early 2000s, the NREI shows falling real rents.<sup>4</sup> This results in a correlation close to zero between the two time series over long horizons. Further, the discrete choice between owning and renting housing implies that increased demand for owner occupied housing will be associated with decreased rents. If the NREI series is correct, this was likely the case in the early 2000s. Given these concerns, we learn little about the relationship between owners' implicit dividends and flow returns to stock owners from Table 7.

## 2.6 Frictions in the rental housing market

The model that yields perfect correlation between housing and stock prices assumed that individuals can own and consume different quantities of housing. In practice, owning less housing than one consumes while still owning a home can only be roughly approximated by rolling over short positions in real estate companies. The price of owner housing conditional on supply thus reflects both consumption and investment demand for housing.

If this gap between investment demand for housing and housing prices were the driving force between the absence of correlation between housing and stock prices, we might expect

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<sup>4</sup>Anecdotal evidence and the fact that NREI is more highly correlated with REIT dividends support the NREI view. The *American Housing Survey* supports the CPI view. One might suspect a difference between market rents and actual leases for incumbent renters, but it is not clear why incumbent renters would pay increasing real rents in a depressed market.

to see a more positive correlation between assets that are related to implicit dividends to owners, but that can be separated from housing consumption.

Real estate investment trusts own housing and other rental real estate assets. But for the divorce between rents and owners' implicit dividends, REIT dividends might thus be a good proxy for owner dividends. A second complication is that REITs sell their properties fairly frequently, so that capital gains as well as changes in rents likely affect REIT dividends. There is also a bias of uncertain sign in REIT shares: REITs lease space to public companies as well as to households. High commercial rents reduce firm profits by increasing real estate costs if firms are net renters of space. However, we do not know if residential demand drives up commercial rents or vice versa. If it is the latter, then rents are high exactly when firms are producing at high levels and presumably enjoying high profits.

Anecdotal evidence suggests that home builders' profits are driven primarily by changes in land value between the time they acquire raw land and the time they sell entitled and improved homes. Home builders' profits thus reflect homeowner demand for land, but these profits are driven by fluctuations in prices rather than rents. REITs and home builder stocks are thus a useful but imperfect proxy for claims on dividends on owner occupied housing untainted by consumption demand for housing.

Table 8 lists the correlations among log real changes in the S&P 500 index, the NAREIT equity appreciation index, and the prices of the following home building firms that are components of the Philadelphia Stock Exchange housing sector index (HGX): Beazer Homes, DR Horton, Hovnanian Enterprises, KB Home, Lennar Home, Pulte Homes, Ryland Group, and Toll Brothers. All indices are designed to exclude returns from dividends. I assembled the home builders' index by averaging the firms' capital gains based on average firm price across quarters. Firms missing from historical data are simply excluded from the relevant averages. The index likely contains some bias, because firms that were once large but presently out of business are excluded.

Table 8 shows that the S&P 500, REIT stocks, and homebuilder stocks are all highly

correlated at a quarterly level. Not surprisingly, the three house price indices, which come all or in part from the national HPI, are highly correlated with each other. Over a twelve quarter horizon, we find negative correlations between stocks and all measures of housing prices, as well as between stocks in general and real estate stocks.

It is thus not altogether surprising that the correlations between REIT shares and owner housing and between builders' stock and housing are smaller than the correlations among housing stocks. It is surprising, however, that the correlations between housing prices and real estate stock prices are approximately the same size as the correlations between stocks in general and real estate stocks in the short run, given what happens in the long run. On a daily basis, the relationship between builder stocks and stocks in general is even stronger: the regression coefficient of total market return (including dividends) on average home builder total return is 1.14 and the correlation is .52.

In the short run, then, we have evidence that there is a strong positive correlation between some real estate prices and stock prices in general. But this relationship disappears in the long run. The divorce between consumption and investment demand for housing does not explain the absence of positive correlation in prices in a simple way.

## **2.7 Other model failures related to macroeconomic conditions**

A related intuitive investment demand explanation for the gap between stock and housing prices also fails to explain the data. A glance at the *Survey of Consumer Finances* strongly suggests that the marginal consumer/investor of owner housing is not the same person as the marginal stock investor. Stocks are owned by a much narrower and wealthier segment of the population than houses. For this reason, different types of output would have different effects on the assets' demands. For example, labor income might be a more important generator of housing demand than capital income. As it turns out, controlling for wages conditional on GDP makes the estimated effect of  $\Delta\text{STOCK}$  on housing prices more negative, not less negative. Relatedly, in unreported regressions, we find that at longer horizons, the effect of

unemployment on housing is significantly more positive than the effect of unemployment on stocks. Boyd et al. (2005) observe that unemployment bears both good and bad news to asset markets. We might expect that the bad news would be worse for labor income dependent housing prices, but this is not so. So a divorce between workers' investment demand for housing and capitalists' investment demand for stocks does not appear to drive the main result.<sup>5</sup>

More generally, we might expect different macroeconomic conditions to affect the housing and stock markets differently, given we do not live in a world as Table 1 describes the data sources used for conditioning variables ( $X$  in equation (1)).

Columns (5) and (7) of Tables 2 through 6 estimate the relationship between real changes stocks and home prices conditional on real changes in macroeconomic variables and housing related stocks. In addition to GDP, these regressions include changes in the 10 year treasury yield (T10), the unemployment rate (UE), estimated wages (WAGE), changes in the Livingston Survey's averaged forecast inflation (LIV), and changes in CPI estimated real transportation costs (TRANSPORT).<sup>6</sup>

We find that the relationship between stock and housing prices becomes more negative, even significantly so, in the presence of covariates. At the quarterly level, the coefficient on  $\Delta$ STOCK falls significantly from .042 to -.051. At longer horizons and using land proxies as a dependent variable, the change in  $\Delta$ STOCK's coefficient becomes more negative when covariates are included.

Most of the fall in the coefficient on  $\Delta$ STOCK appears to be driven by the inclusion of  $\Delta$ WAGE. We also see that real interest rates have a significantly negative relationship with housing prices conditional on changes in stock prices. The jump in housing prices relative to stock prices in the early 2000s exemplifies this relatively greater effect of interest rates

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<sup>5</sup>This is noteworthy in light of the result in Ait-Sahalia et al. (2004) that differences in consumption patterns of investors and ordinary consumers may explain the failure of the Consumption CAPM.

<sup>6</sup>Using an alternative measure of inflation expectations from the University of Michigan consumer survey yields virtually identical results. Likewise, using changes in the 1 year, rather than 10 year treasury rate, or including both, does not affect the results.

on housing prices. Separate regressions also find a significant relationship between housing prices and GDP that does not exist for stocks.

Columns (6) and (7) reveal that including average changes in stock market valuations of REITs and home builder shares ( $\Delta\text{RESTOCK}$ ) significantly reduces the estimated coefficient on stocks in general in the short run but not the long run.

### 3 Conclusions

In a simple economy, stocks and houses would be similarly correlated with common macroeconomic phenomena; positively with GDP and wages, and negatively with real interest rates. These theoretically common factors are highly correlated with housing prices and have been found to drive commercial real estate prices; see Quan and Titman (1999). Presumably for this reason, real estate stocks comove with stocks in general at short horizons. However, home prices move almost orthogonally to stock prices and the correlation between real estate stocks and stocks in general becomes more negative as the horizon widens.

A variety of intuitive stories for the difference between housing and stock prices fail to explain the data. We find that home prices are more sensitive to macroeconomic phenomena than are stock prices, but conditioning on macroeconomic variables moves the estimated relationship between stocks and housing prices from zero to significantly negative. Introducing labor income as a separate conditioning variable only makes the price relationship more negative. The absence of a positive relationship between housing prices and stock prices also cannot be explained by the difference between land prices and housing prices. Considering years in which neither taxes nor inflation should have had strong effects does not restore a positive relationship, and recent relative price movements seem to run in the opposite direction as changes in tax preference. The fact that REIT shares have a negative relationship with stocks in general over long horizons casts doubt on the gap between consumption and investment demand for owner housing as a crucial explanation.

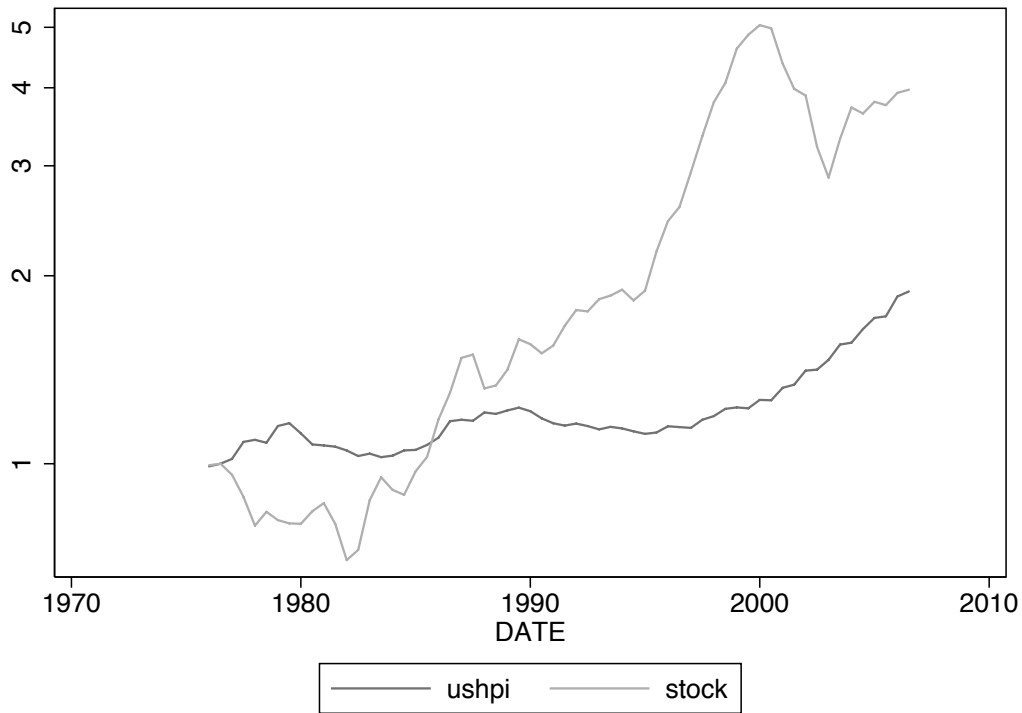
A simple interpretation of these results is that holding savings constant, increased portfolio demand for housing implies reduced portfolio demand for stocks, perhaps through flights to and from quality. This substitution would induce a negative correlation in prices. The fact that stocks outpaced housing during the dot com boom, but housing performed extremely well in the aftermath give credence to this interpretation. Why real estate stocks, which are leveraged bets on the macroeconomy and have considerable volatility, represent “quality” is not clear. Essentially this is similar to the existence of bubbles in the housing and stock markets. Whether the recent price changes in the stock and housing markets represent a bubble has been a matter of dispute.<sup>7</sup>

Changes in real estate rents relative to incomes have been used by Van Nieuwerburgh and Lustig (2005) and Piazzesi et al. (2007) to help resolve the equity premium puzzle. However, Davis and Martin (2006) find that Consumption CAPM models cannot simultaneously explain housing and stock prices. Indeed, it is hard to see how a common stochastic discount factor can simultaneously price uncorrelated assets unless dividends are negatively correlated. The puzzling relationship between residential rents and stock market returns may have led the CCAPM papers to the peculiar conclusion that the marginal utility of wealth falls when housing rents rise. Depending on which rental time series one believes, there was either a zero or negative correlation between rents and corporate profits and dividends over the last two decades. Whether this arose due to a true negative relationship between the unobservable real dollar value of owner housing services per unit and firm profits or due to unobservable substitution between renter and owner housing due to portfolio considerations is an important and difficult question left to future research.

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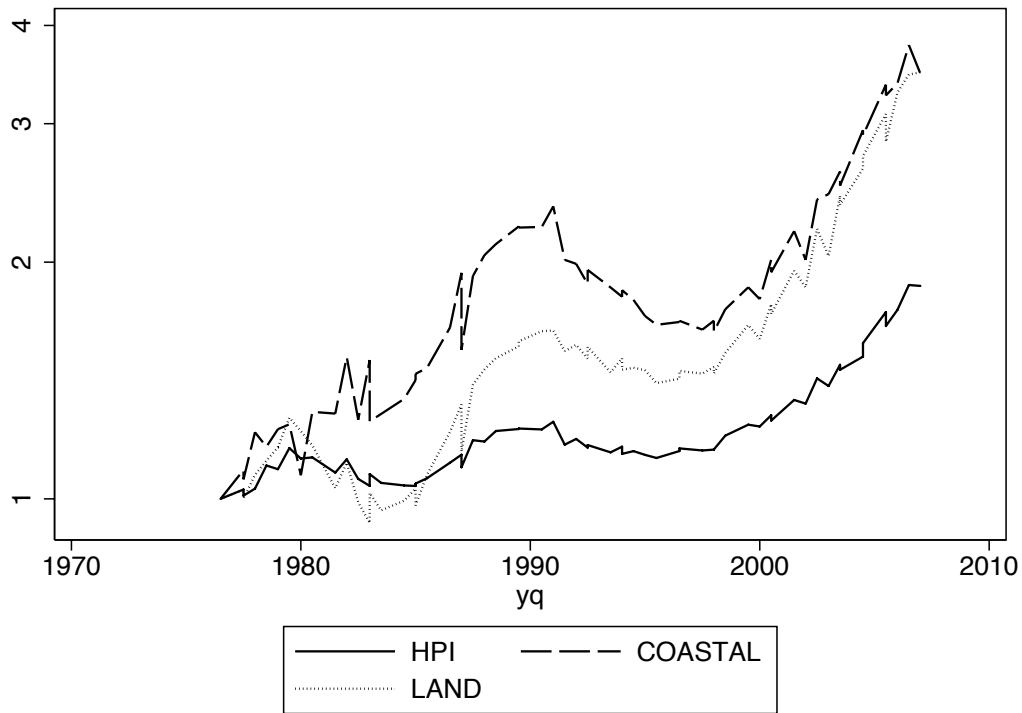
<sup>7</sup>Case and Shiller (2003) see a housing bubble, Himmelberg et al. (2005) do not.

Figure 1: Real Stock and Housing Prices: 1976-2006



**Notes:** Stock prices are the S&P 500 index, adjusted to exclude dividends. Home prices are the US Office of Federal Housing Enterprise Oversight repeated sales price index. Both are normalized to 1.0 in 1976, first half and deflated by the US Consumer Price Index for non-housing goods. Mean values of each index calculated for half years. Index levels are plotted in logs. Log scale.

Figure 2: Different Measures of House and Land Prices: 1976-2006



**Notes:** HPI is the OFHEO home price index. COAST is the average of 12 sub-indices of the OFHEO data, confined to metropolitan areas within the New York, Boston, San Francisco, Los Angeles and San Jose consolidated metropolitan areas. Indices are normalized to 1.0 in 1976. Log scale.

Table 1: Summary statistics – 4 quarters overlapping horizons

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
$\Delta$ HPI	Log change in OFHEO home price index	119	.04	.064	-.07	.24
$\Delta$ LAND	Log change in Davis and Heathcote (forthcoming) US per acre land price	119	.08	.12	-.18	.40
$\Delta$ COAST	Log change in OFHEO home prices for 12 Coastal MSAs	119	.08	.12	-.21	.40
$\Delta$ STOCK	Log change in no dividend S&P 500 index (daily data via CRSP)	119	.10	.22	-.51	.68
$\Delta$ PPI	Log change in Producer Price Index for single family home builders	75	-.003	.03	-.07	.10
$\Delta$ GDP	Log change in BEA GDP estimate	119	.06	.04	-.03	.19
$\Delta$ UE	Log change in BEA estimate unemployment	119	-.03	.20	-.38	.40
$\Delta$ WAGE	Log change in BEA estimate of wages paid	119	.05	.04	-.02	.17
$\Delta$ T10	Log change in 10 year treasury yield (monthly )	119	-.04	.21	-.57	.49
$\Delta$ LIV	Log change in Livingston Survey estimate of nominal inflation (average of 2 quarters, q's 1 and 3 interpolated)	119	-.04	.27	-.72	.92
$\Delta$ APTRENT	Log change in NREI proprietary US apartment rent per	54	.02	.06	-.09	.14
$\Delta$ TRANSPORT	Log change in ratio of CPI transportation cost to CPI for non-shelter goods (monthly )	119	.005	.04	-.07	.14
$\Delta$ RESTOCK	Average log change of NAREIT index and index of 8 home builders (averaged daily for home builders index)	119	.09	.25	-.54	.72
$\Delta$ CPIRENT	Log change in ratio of CPI rent of residence to CPI for non-shelter goods (monthly)	119	.01	.03	-.04	.09
$\Delta$ TOTDIV	Log change in total dividends paid (daily data from CRSP)	119	.07	.12	-.26	.64
$\Delta$ REITDIV	Log change in NAREIT equity REITs' dividend index	119	-.12	.17	-.58	.31

**Notes:** All log changes except inflation, unemployment, and treasury rates are real, deflated by the US consumer price index excluding shelter items.

Table 2: Regressions with log changes in the OFHEO home price index as dependent variable – 1 quarter differences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta$ STOCK	0.042 (0.027)	0.043 (0.037)	0.037 (0.046)	0.021 (0.034)	-0.051* (0.024)	-0.019 (0.027)	-0.102** (0.023)
$\Delta$ PPI				0.839** (0.202)			
$\Delta$ RESTOCK						0.117** (0.021)	0.111** (0.019)
$\Delta$ GDP					0.373 (0.210)		0.083 (0.191)
$\Delta$ UE					-0.006 (0.033)		-0.032 (0.029)
$\Delta$ WAGE					0.479* (0.225)		0.716** (0.202)
$\Delta$ T101					-0.061** (0.022)		-0.017 (0.021)
$\Delta$ LIV					0.056** (0.017)		0.038* (0.015)
$\Delta$ TRANSPORT					-0.247* (0.121)		-0.125 (0.108)
Constant	0.010** (0.003)	0.006* (0.003)	0.017** (0.005)	0.012** (0.003)	0.000 (0.002)	0.009** (0.002)	0.001 (0.002)
Observations	125	85	56	81	125	125	125
R-squared	0.02	0.02	0.01	0.19	0.47	0.22	0.59
Exclusions	None	Taxes	Pre-92	Pre-87	None	None	None

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Column (2) excludes years of and after major tax reforms: 1981, 1982, 1986, 1987, 1997, 1998, 2001, 2002, 2003 and 2004. Column (3) excludes observations before 1992. Column (4) includes data starting in 1987, when the producer price index for single family residential (PPI) became available. OLS standard errors in parentheses, \* denotes significance at 5%, \*\* at 1%.

Table 3: Regressions with log changes in the OFHEO home price index as dependent variable – 4 quarter differences overlapping horizons

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta$ STOCK	-0.025 (0.046)	-0.012 (0.041)	-0.073 (0.043)	-0.076 (0.055)	-0.100** (0.022)	-0.043 (0.034)	-0.130** (0.020)
$\Delta$ PPI				0.581 (0.521)			
$\Delta$ RESTOCK						0.136** (0.034)	0.103** (0.027)
$\Delta$ GDP					0.007 (0.215)		-0.355 (0.247)
$\Delta$ UE					0.064 (0.049)		0.013 (0.046)
$\Delta$ WAGE					0.919** (0.287)		1.180** (0.268)
$\Delta$ T10					-0.129** (0.036)		-0.064 (0.038)
$\Delta$ LIV					0.164** (0.018)		0.120** (0.022)
$\Delta$ TRANSPORT					-0.200 (0.185)		-0.128 (0.161)
Constant	0.043** (0.014)	0.032** (0.008)	0.067** (0.017)	0.054** (0.017)	0.007 (0.012)	0.033** (0.010)	0.007 (0.010)
Observations	119	79	56	75	119	119	119
Exclusions	None	Taxes	Pre-92	Pre-87	None	None	None

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Column (2) excludes years before and after major tax reforms: 1981, 1982, 1986, 1987, 1997, 1998, 2001, 2002, 2003 and 2004. Column (3) excludes observations before 1992. Column (4) includes data starting in 1987, when the producer price index for single family residential (PPI) became available. Newey-West standard errors with 4 lags in parentheses, \* denotes significance at 5%, \*\* at 1%.

Table 4: Regressions with log changes in the OFHEO home price index as dependent variable – 12 quarter differences overlapping horizons

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta$ STOCK	-0.108 (0.080)	-0.094 (0.051)	-0.193* (0.078)	-0.172 (0.093)	-0.204** (0.056)	-0.059 (0.039)	-0.176** (0.024)
$\Delta$ PPI				-0.190 (0.869)			
$\Delta$ RESTOCK						0.215** (0.047)	0.138** (0.031)
$\Delta$ GDP					-0.003 (0.490)		-0.277 (0.228)
$\Delta$ UE					0.099 (0.052)		0.028 (0.041)
$\Delta$ WAGE					1.436** (0.504)		1.388** (0.287)
$\Delta$ T1012					-0.174** (0.043)		-0.061 (0.038)
$\Delta$ LIV					0.201** (0.039)		0.158** (0.024)
$\Delta$ TRANSPORT					-0.240 (0.225)		-0.247 (0.209)
Constant	0.157** (0.055)	0.137** (0.026)	0.219** (0.060)	0.191* (0.079)	-0.028 (0.024)	0.082** (0.029)	-0.012 (0.023)
Observations	103	64	56	59	103	103	103
Exclusions	None	Taxes	Pre-92	Pre-87	None	None	None

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Column (2) excludes years before and after major tax reforms: 1981, 1982, 1986, 1987, 1997, 1998, 2001, 2002, 2003 and 2004. Column (3) excludes observations before 1992. Column (4) includes data starting in 1987, when the producer price index for single family residential (PPI) became available. Newey-West standard errors with 12 lags in parentheses, \* denotes significance at 5%, \*\* at 1%.

Table 5: Regressions with average log changes in the OFHEO home price index for Boston, New York, San Francisco, San Jose, and Los Angeles Metropolitan Areas as dependent variable – 4 quarter differences with overlapping horizons

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta$ STOCK	-0.046 (0.082)	-0.004 (0.084)	-0.159 (0.090)	-0.163 (0.102)	-0.183** (0.064)	-0.073 (0.065)	-0.239** (0.061)
$\Delta$ PPI				0.560 (1.034)			
$\Delta$ RESTOCK						0.210** (0.062)	0.191** (0.057)
$\Delta$ GDP					0.064 (0.563)		-0.604 (0.609)
$\Delta$ UE					0.196 (0.105)		0.102 (0.089)
$\Delta$ WAGE					2.071** (0.678)		2.552** (0.695)
$\Delta$ T10					-0.190* (0.089)		-0.070 (0.098)
$\Delta$ LIV					0.234** (0.049)		0.152** (0.048)
$\Delta$ TRANSPORT					0.032 (0.478)		0.163 (0.454)
Constant	0.089** (0.023)	0.062** (0.017)	0.097** (0.036)	0.082* (0.034)	0.000 (0.023)	0.074** (0.019)	0.000 (0.021)
Observations	119	79	56	75	119	119	119
Exclusions	None	Taxes	Pre-92	Pre-87	None	None	None

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Column (2) excludes years before and after major tax reforms: 1981, 1982, 1986, 1987, 1997, 1998, 2001, 2002, 2003 and 2004. Column (3) excludes observations before 1992. Column (4) includes data starting in 1987, when the producer price index for single family residential (PPI) became available. Newey-West standard errors with 4 lags in parentheses, \* denotes significance at 5%, \*\* at 1%.

Table 6: Regressions with log changes in Davis and Heathcote (forthcoming) estimated US land prices as dependent variable – 4 quarter differences with overlapping horizons

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta$ STOCK	-0.012 (0.101)	0.049 (0.073)	-0.168 (0.091)	-0.162 (0.103)	-0.195** (0.059)	-0.045 (0.072)	-0.233** (0.054)
$\Delta$ PPI				0.355 (0.871)			
$\Delta$ RESTOCK						0.248** (0.064)	0.130* (0.060)
$\Delta$ GDP					0.020 (0.377)		-0.435 (0.457)
$\Delta$ UE					0.067 (0.092)		0.003 (0.088)
$\Delta$ WAGE					1.613** (0.547)		1.940** (0.524)
$\Delta$ T10					-0.267** (0.074)		-0.185* (0.081)
$\Delta$ LIV					0.280** (0.036)		0.224** (0.047)
$\Delta$ TRANSPORT					-0.800* (0.390)		-0.711 (0.367)
Constant	0.081** (0.028)	0.060** (0.015)	0.123** (0.031)	0.107** (0.030)	0.023 (0.022)	0.063** (0.022)	0.023 (0.021)
Observations	119	79	56	75	119	119	119
Exclusions	None	Taxes	Pre-92	Pre-87	None	None	None

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Column (2) excludes years before and after major tax reforms: 1981, 1982, 1986, 1987, 1997, 1998, 2001, 2002, 2003 and 2004. Column (3) excludes observations before 1992. Column (4) includes data starting in 1987, when the producer price index for single family residential (PPI) became available. Newey-West standard errors with 4 lags in parentheses, \* denotes significance at 5%, \*\* at 1%.

Table 7: Correlations among different measures of stock and residential housing dividends – 1 quarter (top panel) and overlapping 12 quarter (bottom panel) differences

	$\Delta$ TOTDIV	$\Delta$ REITDIV	$\Delta$ CPIRENT	$\Delta$ APTRENT	$\Delta$ GDP
$\Delta$ TOTDIV	1.0000				
$\Delta$ REITDIV	-0.0503	1.0000			
$\Delta$ CPIRENT	-0.0068	0.0795	1.0000		
$\Delta$ APTRENT	-0.0397	0.3054	0.2895	1.0000	
$\Delta$ GDP	0.1142	-0.0550	0.5630	0.4401	1.0000

	$\Delta$ TOTDIV	$\Delta$ REITDIV	$\Delta$ CPIRENT	$\Delta$ APTRENT	$\Delta$ GDP
$\Delta$ TOTDIV	1				
$\Delta$ REITDIV	-0.30	1			
$\Delta$ CPIRENT	0.25	0.17	1		
$\Delta$ APTRENT	-0.15	0.69	0.05	1	
$\Delta$ GDP	0.42	0.25	0.22	0.62	1

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Data from the national real estate index is available only starting in 1995.

Table 8: Correlations among price changes for the S&P 500, home builder stocks, and the NAREIT equity REIT index – 1 quarter (top panel) and 12 quarter overlapping (bottom panel) differences

	$\Delta$ STOCK	$\Delta$ REIT	$\Delta$ BUILD	$\Delta$ HPI	$\Delta$ COAST	$\Delta$ LAND
$\Delta$ STOCK	1.0000					
$\Delta$ REIT	0.3511	1.0000				
$\Delta$ BUILD	0.3461	0.4041	1.0000			
$\Delta$ HPI	0.1371	0.4777	0.3558	1.0000		
$\Delta$ COAST	0.1279	0.3921	0.2531	0.8633	1.0000	
$\Delta$ LAND	0.1719	0.4136	0.3770	0.9076	0.8025	1.0000

	$\Delta$ STOCK	$\Delta$ REIT	$\Delta$ BUILD	$\Delta$ HPI	$\Delta$ COAST	$\Delta$ LAND
$\Delta$ STOCK	1.0000					
$\Delta$ REIT	-0.1361	1.0000				
$\Delta$ BUILD	-0.2164	0.3664	1.0000			
$\Delta$ HPI	-0.3155	0.3376	0.6834	1.0000		
$\Delta$ COAST	-0.3331	0.3563	0.4796	0.8582	1.0000	
$\Delta$ LAND	-0.1658	0.2099	0.6678	0.9282	0.8535	1.0000

**Notes:** All dollar values are deflated by the US consumer price index, excluding shelter items. Data run from 1976 through 2006.

## References

- Aït-Sahalia, Yacine, Jonathan A. Parker, and Motohiro Yogo**, “Luxury Goods and the Equity Premium,” *Journal of Finance*, 2004, 59 (6), 2959–3004.
- Boyd, John H., Jian Hu, and Ravi Jagannathan**, “The Stock Market’s Reaction to Unemployment News: Why Bad News Is Usually Good for Stocks,” *Journal of Finance*, 2005, 60 (2), 649–672.
- Bucks, Brian K., Arthur B. Kennickell, and Kevin B. Moore**, “Recent Changes in U.S. Family Finances: Evidence from the 2001 and 2004 Survey of Consumer Finances,” *Federal Reserve Bulletin*, 2006, 92, A1–A38.
- Case, Karl E. and Robert J. Shiller**, “The Efficiency of the Market for Single-Family Homes,” *The American Economic Review*, March 1989, 79 (1), 125–137.
- and —, “Is There a Bubble in the Housing Market?,” *Brookings Papers on Economic Activity*, 2003, 2, 299–342.
- Cocco, Joao**, “Portfolio Choice in the Presence Housing,” *The Review of Financial Studies*, 2005, 18 (2), 535–567.
- Davis, Morris A. and Jonathan Heathcote**, “The Price and Quantity of Residential Land in the United States,” *Journal of Monetary Economics*, forthcoming.
- and **Robert F. Martin**, “Housing, House Prices, and the Equity Premium Puzzle,” 2006. Working Paper, University of Wisconsin.
- Fama, Eugene F. and Kenneth R. French**, “Disappearing dividends: changing firm characteristics or lower propensity to pay?,” *Journal of Financial Economics*, 2001, 60 (1), 3–43.
- Flavin, Marjorie and Takashi Yamashita**, “Owner-Occupied Housing and the Composition of the Household Portfolio,” *American Economic Review*, 2002, 92 (1), 345–362.

- Green, Richard K.**, “Stock prices and house prices in California: new evidence of a wealth effect?,” *Regional Science and Urban Economics*, 2002, *32* (6), 775–783.
- , **Stephen Malpezzi, and Stephen K. Mayo**, “Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources,” *American Economic Review*, May 2005, *95* (2), 334–339.
- Himmelberg, Charles, Christopher Mayer, and Todd Sinai**, “Assessing High House Prices: Bubbles, Fundamentals and Misperceptions,” *Journal of Economic Perspectives*, Fall 2005, *19* (4), 67–92.
- Muth, Richard F.**, *Cities and Housing*, Chicago: University of Chicago Press, 1969.
- Nieuwerburgh, Stijn Van and Hanno Lustig**, “Housing Collateral, Consumption Insurance and Risk Premia: an Empirical Perspective,” *Journal of Finance*, 2005, *60* (3), 1167–1219.
- Piazzesi, Monika, Martin Schneider, and Selale Tuzel**, “Housing, Consumption and Asset Pricing,” *Journal of Financial Economics*, 2007, *83*, 531–569.
- Quan, Daniel C. and Sheridan Titman**, “Do Real Estate and Stock Prices Move Together? An International Analysis,” *Real Estate Economics*, 1999, *2* (2), 183–207.
- Summers, Lawrence H.**, “Inflation, the Stock Market, and Owner-Occupied Housing,” *The American Economic Review*, 1981, *71* (2), 429–434.
- Thorsnes, Paul**, “Consistent Estimates of the Elasticity of Substitution between Land and Non-Land Inputs in the Production of Housing,” *Journal of Urban Economics*, 1997, *42* (1), 98–108.