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How Well Do Individuals Predict the Selling Prices of Their Homes?

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ABSTRACT

Self-reported home values are widely used as a measure of housing wealth by researchers employing a variety of data sets and studying a number of different individual and household-level decisions. The accuracy of this measure is an open empirical question, and requires some type of market assessment of the values reported. In this study, we examine the predictive power of self-reported housing wealth when estimating housing prices, utilizing the portion of the University of Michigan's Health and Retirement Study covering 1992–2006. We find that homeowners, on average, overestimate the value of their properties by between 5% and 10%. More importantly, we are the first to establish a strong correlation between accuracy and the economic conditions at the time of the property's purchase. While most individuals overestimate the value of their property, those who buy during more difficult economic times tend to be more accurate, in some cases even underestimating the value of their house. We find a surprisingly strong, likely permanent, and in many cases long-lived effect of the initial conditions surrounding the purchase of properties, and on how individuals value them. This cyclicality of the overestimation of house prices provides some explanation for the difficulties currently faced by many homeowners, who were expecting large appreciations in home value to rescue them in case of increases in interest rates, which could jeopardize their ability to live up to their financial commitments.

Keywords: Housing Prices; Self-Reported Housing Values; Panel Data; Instrumental Variables; Sample Selection; Health and Retirement Study

JEL Classifications: C33, C34, E21

1. INTRODUCTION AND MOTIVATION

Housing wealth is one of the pillars of the well-being of Americans families, especially because it represents more than 60% of the average net wealth of U.S. households, according to the Federal Reserve's 2004 Survey of Consumer Finances (SCF).[1] While the current tumultuous times in the housing market seem to indicate the presence of possibly serious errors in predicting the evolution of housing prices and mortgage rates by a nontrivial proportion of homeowners, we know relatively little about the ability of households to predict the market value of their homes in the context of household-level representative surveys using data on sales prices of those properties. While a number of researchers have described the existence of some overestimation in housing values (in the 3% to 6% range in the last studies), as far as we know, we are the first researchers to analyze the predictive power of self-reported housing wealth in an econometric model of sales prices.[2]

Understanding the accuracy of self-reported housing wealth is of great importance in a variety of contexts, since it is a pervasive explanatory variable (either by itself or as a component of net individual or household worth) in just about any empirical analysis or behavioral model of individuals' and households' decision making. For example, it is a key variable in decisions such as retirement (Moore and Mitchell 2000; Engen, Gale, and Uccelo 1999 and 2005; Gustman and Steinmeier 1999; and Lusardi and Mitchell 2007), consumption (Skinner 1989; Case, Quigley, and Shiller 2005; Tang 2006; Agarwal 2007; Campbell and Cocco 2007; and Disney, Gathergood, and Henley 2007), savings (Hoynes and McFadden 1997; Disney, Henley, and Stears 2002; Klyev and Mills 2006; and Juster et al. 2005), and the debt composition of the household (Disney, Bridges, and Gathergood 2006). However, since in household surveys

[1] See Bucks, Kennickell, and Moore (2006). This fraction is considerably lower than in some European countries. For example, in Spain housing wealth represents 87.5 % of net wealth.

[2] Most studies use the American Housing Survey, which follows houses rather than households, or the Survey of Consumer Finances (SCF), which is not a panel data survey. See Agarwal (2007), Kiel and Zabel (1999), and Goodman and Ittner (1992). The first study on this issue was published by Kish and Lansing (1954) using the 1950 SCF, and it was not until Kain and Quigley (1972) that this was revisited. The latter authors acknowledge that "the only accurate estimate of the value of a house is its sale price…" however, due to data limitations, and what they perceived as possibly serious selection problems, their analysis focused, as the early study, on comparisons of households' self-reports with appraisals by experts. The latter can be considered indirect market assessments, since they use information on similar properties and try to control for the observable characteristics of the property.

housing wealth is typically self-reported, it is likely to be exposed to measurement error and its accuracy has not been studied in much detail.[3]

In this research, we take a closer look at the accuracy of self-reported housing wealth using the University of Michigan's Health and Retirement Study (HRS); in particular we look at a rarely used section on capital gains, where sales prices are reported by homeowners. This allows us to compare the self-reported housing values with the self-reported sale prices. In particular, it enables us to estimate a sales price equation as a function of self-reported housing wealth in the previous interview of the panel study.[4] Using ordinary least squares (OLS) regressions, sample selection corrected specifications to control for the possible bias in the ownership decision, and instrumental variables specifications to account for the measurement error problem, we find that, on average, homeowners overestimate the value of their properties by between 5% and 10%. We also show that the overestimation is primarily due to the large expected capital gains implicit in the self-reported home values, especially since the mid-1980s.

There is, however, considerable variation in how accurately homeowners predict the value of their properties depending on when individuals bought their homes. While most individuals overestimate the value of their homes (some by as much as 20%), individuals who acquire their properties during economic downturns tend to be more accurate and, in some cases, even underestimate the value of their houses.

We document a strong correlation between the evolution of our accuracy estimates over time and the business cycle. In periods of high interest rates and declining incomes, the buyers are likely to have lower appreciation expectations due to the declining housing prices and, on average, end up more accurately assessing the value of their homes and, in some cases, even underestimating it. Furthermore, the buyers during the downturns tend to be more educated, which is likely correlated with having better information about the value of their homes. These results establish a surprisingly strong, likely permanent, and in many cases long-lived effect of

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[3] This measurement error and the attenuation bias that goes with it can explain that wealth measures in general (and housing wealth in particular) are, in a number of empirical settings, found not to have a lot of predictive power; see Venti and Wise (2001), Juster et al. (2005), and Tang (2006).

[4] Sales prices do not always reflect market values due to the existence of many complex transactions that include, for example, personal property, land exchanges, and within-family sales. This also means that the terms of the sale could vary over the business cycle. Unfortunately, we cannot assess the importance of these issues with our data. However, it is not obvious whether, in the presence of some or all of these in any data on selling prices, the reported values will be systematically higher or lower than the market values.

the initial conditions surrounding the purchases of properties, and on how individuals value them.

Our results are consistent with the growing evidence that a sizable fraction of homeowners (many of them first time buyers, given the increasing home-ownership rates in the period) who bought their houses in the last decade with soft (and risky) mortgages had high expectations of large appreciations in home values to rescue them in case of increases in interest rates, which jeopardized their ability to live up to their financial commitments.

In section 2, we propose a simple method for testing the accuracy of self-reported housing wealth and introduce some natural instruments to control for measurement error in these types of models in the presence of possible sample-selection bias concerns. We present our data and summary statistics in section 3. The main empirical results are presented and discussed in section 4, and section 5 analyzes the relationship between our accuracy estimates and the business cycle. Section 6 provides some conclusions.

2. TESTING THE ACCURACY OF SELF-REPORTED HOUSING VALUES USING SALES PRICES

Suppose that y_i^t represents the actual market value of the homeowner i's house at time t and X_i^{t-1} is the self-reported house value at a point in time before the sale. A simple model to test the accuracy of the reported home value can be written as:

$$y_i^t = \beta X_i^{t-1} + \varepsilon_i \qquad (1)$$

If the homeowners predict the market value of their house accurately, we expect to find that $E[\beta_i \mid X_i^t, \varepsilon_i] = 1$. If homeowners overestimate (underestimate) the value of their home, then the estimated slope coefficient β will be less than (more than) one.[5] Estimating (1) is, in principle, straightforward through a simple conditional moment estimator like OLS, but the

[5] There is no reason to believe that the model should contain a constant, as there is no minimum market value for the houses and the left and right hand side are measuring the same asset. In fact, we have run several empirical specifications with a constant and it comes out to be insignificant, as expected, no matter how we specify the model. In the empirical work, we present results with and without a constant in the regression.

likely presence of unobserved heterogeneity (which could be reflected in the presence of measurement errors in the variables of interest) raises endogeneity concerns and a potential sample-selection bias concern (given that only a relatively small proportion of individuals sell their houses during the period of analysis) complicates the identification. We use three alternative specifications in order to address these issues.

2.1 OLS Specification

In the data we observe the market value of a property when the individual retrospectively reports the price at the time of the sale of a house they owned in the last survey wave. Therefore, the self-reported house value is obtained from the previous wave of data. Given that data is collected only every other year, there may be as many as 24 months between the measurement of the sale price and the self-reported house value. In the interview, individuals are asked about the current market value of their homes rather than to forecast the price for some future period. In order to correct a possible bias in the estimation of the coefficient of interest in equation (1) resulting from a possible appreciation (depreciation) of the value of the house during that time, we control for the number of months between the observances of these two variables.[6] The OLS specification can then be written as follows:

$$y_i^t = \beta X_i^{t-1} + \alpha T + \varepsilon_i \quad (2)$$

where X_i^{t-1} represents the self-reported house value from the previous wave and T represents the number of months between the time the market price refers to and the self-reported home value.

[6] Notice that this discrepancy in the timing of the assessment suggests that the relationship in equation (1) is potentially nonlinear. We have allowed for the difference in months to enter nonlinearly (which could capture changing economic conditions in the months before the sale that could affect the price, such as movements in the interest rates), but results have not changed. One possible alternative would be to adjust all the observed prices to the same time period. This, however, may create some unwanted measurement error since, in many cases, there were only a few months of difference between reports. Also, the only location information in the public releases of the HRS is the region of the residence, so the best we can do is to adjust for the region-level house price index. There is a lot of variation in the change in the house prices, even within the same county, and such a crude adjustment would only provide more measurement error to the variable. More importantly, there is no reason to believe that the house values should keep up with the inflation rate. Nevertheless, we used several methods of adjusting for inflation in addition to simply controlling for time differences. These results were consistent with those reported in the present paper. Additionally, due to the fact that it might be natural to expect β to be higher where there is less of a lag, which suggests T should be interacted with the owner's estimate, we have performed an extensive sensitivity analysis of the consequences of including this interaction term. The results of our preferred specification remain literally unchanged; therefore, the empirical evidence suggests that those who sell shortly after the interview do not systematically report more accurate estimates of the selling price of their properties than those who sell shortly before the following interview.

2.2 IV Specification

As with all survey data, measurement error in the variables of interest is a major concern. We are particularly interested in accounting for potentially noisy self-reports of the house values and reporting errors that may be correlated with measurement errors in other factors or omitted variables. For example, it is natural to expect a degree of inaccuracy in estimating the effect of home improvements and updates done to the property over the years on the value of the house. This component of self-reports could lead to a significant bias in the coefficient of interest. In order to eliminate this bias, we need to capture the true component of the reported home value. To do so, we propose an instrumental variables (IV) approach. If measurement error was not a problem we would expect the β coefficient of the IV estimator to be very close to the 1 from the OLS specification, assuming validity of the instrument set.

The longitudinal structure of our data readily provides us with a candidate for an instrument. Homeowners repeat their house values in consecutive periods. It is natural to conjecture that past self-reported house values are correlated with the recent self-reported house value variable, but are uncorrelated with the disturbances in the actual sale-price equation.[7] We can formally state this IV specification as follows:

$$X_i^{t-1} = \delta_0 + \delta_1 X_i^{t-2} + e_i \tag{3}$$

$$y_i^t = \beta \hat{X}_i^{t-1} + \alpha T + \varepsilon_i \tag{4}$$

where $\hat{X}_i^{t-1}$ represents the predicted values from equation (3). In the empirical analysis, and in order to test the properties of the exclusion restrictions, we also use tenure on the house (that is, the duration of ownership on the house) as an instrument, since it does not show much correlation with the selling price. As we discuss below, both instruments pass the conventional exogeneity test (over-identification test) presented in the literature.

[7] The use of lagged endogenous variables as possible exclusion restrictions in IV estimations has a fairly long tradition, as in Hansen and Singleton (1983), Hall (1988), and Patterson and Pesaran (1992), but it frequently encounters the problem of weak instruments, as in Yogo (2004). In our case, however, the self-reported house value follows a highly autoregressive process, allowing us to strongly reject that we have weak instruments.

Another possible natural exclusion restriction, with likely better theoretical properties, is the difference between X_i^{t-2} (the twice-lagged self-reported value of housing) and X_i^{t-3} (the three–times lagged self-reported value of housing), since it basically eliminates the possibility of any correlation with the person-specific component that might be present in the error term in the equation of interest. Another possible natural exclusion restriction, with likely better theoretical properties, is the difference between X_i^{t-2}, the twice lagged self-reported value of housing, and X_i^{t-3}, the three times lagged self-reported value of housing, since it basically eliminates the possibility of any correlation with the person specific component that might be present in the error term in the equation of interest. We have also estimated this alternative model. While the point estimate of β is slightly lower in this alternative model, we are convinced that we should use the twice-lagged self-reported home value as the main IV specification for several reasons: (1) the alternative IV lacks efficiency that results in much larger standard errors; (2) we lose another 175 observations under the alternative specification; and (3) the overidentification of our preferred specification already gives us good results. We discuss the results using this alternative instrument set in section 4.

2.3 IV with Selection

Given that we observe y_i^t only for the homeowners who sell their houses, and only a relatively small portion of homeowners sell in any given survey wave, we are concerned with selection on unobservables; namely, homeowners who sell their houses may be different from homeowners who do not sell their houses in some unobserved characteristics. If that is the case, the estimated coefficients from OLS and IV may be biased. For example, if homeowners who sell their houses are more knowledgeable about the overall market, their home-value estimates would be more accurate and β coefficients estimated using OLS or IV would be biased towards 1.[8]

However, the selection process here is nonstandard in the sense that individuals have many chances to sell their homes during the survey period, but only do it once. Econometrically that means that we observe a given individual over time making the selling decision repeatedly (mostly choosing not to sell), while we only observe one instance of sale. That means that the

[8] Genesove and Mayer (2001) argue that sellers and nonsellers are quite different in the presence of loss aversion, suggesting the need to control for possible selection bias when using a sample of sellers.

selection equation has both a time-invariant individual-specific component and a time-variant idiosyncratic error term.

In order to purge our OLS or IV estimates of the possible biases resulting from this selection mechanism, we follow a two-step procedure described in Wooldridge (1995), and also in line with the discussion in Hsiao (1986), which provides a consistent (but likely inefficient) estimation procedure[9] without needing the distributional assumptions discussed in Jensen, Rosholm, and Verner (2001), for example.

The corresponding IV approach with selection is as follows:

$$Z_{i,t} = 1(a + bHE_i^{t-1} + cX_i^{t-1} + u_i + \kappa_{i,t} > 0) \tag{5}$$

$$X_i^{t-1} = \delta_0 + \delta_1 X_i^{t-2} + e_i \tag{6}$$

$$y_i^t = \beta \hat{X}_i^{t-1} + \alpha T + \lambda_i \pi + v_i \tag{7}$$

where equation (5) is a period-by-period probit estimate of the selling decision, which allows, as discussed by Wooldridge (1995), to account for the likely serial correlation between the selling decisions over time by a given individual. The selling decision depends on home equity at the time of the sale (HE_i^{t-1}) and the expected home value (X_i^{t-1}). Home equity is a natural choice for the exclusion restriction, since on theoretical grounds it should not affect the selling price (and empirically, we do not find evidence to suggest otherwise), and it seems to perform as a summary statistic for a large number of household characteristics and initial conditions such that it is highly correlated with the selling decision.[10] From the period-by-period probit estimates, we

[9] Our case fits the one described in sections 3.2 and 4.2 in Wooldridge (1995). Baltagi (2005) also describes this sample-selection bias correction procedure.

[10] Technically we do not need the exclusion restriction to identify this model given the nonlinearity resulting from the distributional assumption (normality) of the error term in equation (5), but we follow the conventional practice of including at least one likely exogenous variable to provide nonparametric identification to the model. We have also experimented with a different estimation strategy, following Olsen (1980), in which the selection equation is modeled as a linear probability model and, after an error transformation, a correction term is constructed in the spirit of Heckman (1979). The advantage of this technique is that we can easily account for the error structure that includes the individual component and the idiosyncratic component, and we can experiment with the inclusion of a larger number of exogenous variables in the selection equation that were more problematic to include in the nonlinear first stage due to their likely endogeneity, which can be more easily overcome with IV techniques here.

construct an inverse Mills ratio (λ_i) that is used to control for the selection in the main equation (7).[11]

The uncorrected and corrected IV estimates are obtained from estimating the system using the generalized method of moments (GMM), correcting the standard errors for unknown forms of heteroskedasticity, and using the optimal weighting matrix to obtain consistent and efficient estimates, even in the presence of arbitrary serial correlation of the disturbances.[12]

3. THE HEALTH AND RETIREMENT STUDY: SELF-REPORTS ON HOUSE VALUES AND SELLING PRICES

The HRS is a nationally representative longitudinal survey of 7,700 households headed by an individual who was between 51 to 61 years of age at the time of the first interview in 1992–1993; the sixth round of data was collected in 2002. Given its wealth of demographic, health, and socioeconomic data, as well as detailed assets and income sections, the HRS is the data set of choice when analyzing the retirement behavior, savings, and health status of older Americans; however, it has not often been used to analyze questions regarding the housing market. A rarely used section of the HRS provides very detailed information about real estate transactions by households, which allows us to repeatedly observe self-reported house values, as well as the selling prices of properties sold in the 1994 to 2002 period, using the first six waves of the HRS

In this analysis, we include respondents who are financially knowledgeable members of the household who own a house and report the value of their house(s). We restrict our analysis to the first home only, since the second home information is rather incomplete and difficult to match when the transaction involves the second home.[13] In each wave, respondents are asked

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Similar to Olsen (1980), we find essentially identical results using both methods and, since in both cases selection matters very little to our results, we have chosen to present the results of the more traditional selection correction specifications. The results using the alternative specification are available from the authors upon request.

[11] Jiménez-Martín (2006) and Jiménez-Martín and García (2007) use this specification in their panel data models of wage bargaining and Benítez-Silva and Dwyer (2005) and Benítez-Silva et al. (2008) discuss related models using a similar type of specification.

[12] In the implementation of this procedure we have followed the practical suggestions in Baum, Schaffer, and Stillman (2003 and 2007).

[13] In fact, even matching the sale of the first home is rather complicated since the question used asks about transactions on a first or second home. By matching the year in which the house was bought (which is asked both in the assets section and the capital gains section) and using information on whether individuals owned a second home, we have been able to pin down the property actually sold with a high level of accuracy, which we have verified observation by observation.

whether they own a house and to assess the market value of their house if it were to be sold at that point in time. In a different section, individuals are asked whether any transaction occurred since the last wave (buy, sell, or both), the sale price of the house if there was a sale, and the purchase price of the new home. The information about the purchase price and the purchase year of a house was gathered from the households heads in 1992. The purchase price was updated for those who bought a house in the latter waves. We compare the self-reported house value from period *t-1* and the selling price information obtained from period *t* if a sale occurred between survey waves.

Table 1 summarizes the characteristics of the financially knowledgeable homeowners and their assets. The columns break down the sample according to the selection criteria: whether or not individuals sell their house during the six waves—for those that do sell, we divide between the full sample of sellers and the estimation sample. Note that given the longitudinal nature of the sample, homeowners may be observed up to six times, but are asked whether they sold a house they owned on only five of those occasions.

The criteria used to select the estimation sample are the following: from the 1,067 observations we have in the HRS that report valid positive selling prices on their homes and, at the same time, reported a valid value of a home they previously owned, we had to eliminate 204 observations because we did not have valid information about when they bought that home or when they sold it. Not having information on the first of those variables does not allow us to match the property exactly, and not having information on the second prevents us from using the difference in months between the time of the self-report of the value and the time they sold the property, which is an important variable in our econometric model.

We further lose 244 observations because of a missing lagged value of the home they are selling, which is used in the IV-GMM estimation as an exclusion restriction. Using the lagged value of the home essentially eliminates the sales that occurred between the first two waves of the HRS (between 1992 and 1994) or sales by respondents who have not been interviewed for at least three waves. We also lose 20 observations because of missing home equity, which is used in the probit equation in the corrected IV-GMM specification. Finally, we also eliminate homeowners who report a sale price 0.2 times and less or more than 5 times more than the self-

reported house value (a total of 25 individuals). These extreme values occur mostly due to coding errors.[14]

As shown in table 1, those who did not sell a house during the period in which they are observed report lower home values, purchase prices, and capital gains. The average home tenure for sellers is shorter than for nonsellers, but it is still almost 18 years. On the other hand, nonsellers have less home equity, are less likely to be white, have lower educational attainments, and lower earnings. The marital status, average age, and gender composition are similar for both sellers and nonsellers.

Looking at the sellers, we observe that self-reported home values are larger than selling prices by around 2% for the full sample, but only around 0.6% larger for the estimation sample. The estimation sample displays slightly longer tenure in the house that is eventually sold and a slightly greater selling price.

4. MAIN ECONOMETRIC RESULTS

As discussed in section 2, we consider three alternative estimators in order to test the accuracy of self-reported house values. We first estimate an OLS model where we have the original house value and the months between the report of the house value and the sale price on the right hand side, with the sale price as the dependent variable. We control for the months between these two reports in order to control for possible appreciation (or depreciation) in the house's value, as explained in section 2. Our preferred specification is a regression without a constant term, as there is no reason to believe that there will be a minimum sale price and, therefore, a regression through the origin is justified. However, we also present the results when including a constant term. The latter estimates are almost identical and the constant term is not statistically significantly different from zero.

We then estimate an IV model specification via GMM, using the previous-period self-reported house value and tenure on the house as exclusion restrictions. Lastly, we estimate the same model, controlling for selection into selling using a period-by-period probit equation

[14] Due to all these restrictions, our estimated sample is reduced to the 574 observations used in the estimations. The results using the full sample of sellers, but using OLS to avoid losing observations due to missing lagged endogenous variables, are quantitatively almost identical to those discussed in the next section. In particular, allowing for a possible selection from the full sample into the estimation sample did not have any effect on the coefficients reported in the paper.

approach. The selection equation contains the reported house value, household characteristics, and home equity.

Table 2 presents the results from the different specifications and estimation strategies. The OLS estimate of β, the coefficient on the self-reported house value, is 0.91. This point estimate implies an overestimation of around 10% in house values.

Given the likely presence of measurement error that can lead to attenuation bias on the coefficient of interest (i.e., β may be biased downwards), we estimate an IV specification, which uses the tenure on the house and the lagged house value as exclusion restrictions. as discussed above. Both the test of weak instruments and the overidentification test indicate that we have valid instruments, and the fact that the standard errors actually decrease compared with the OLS results indicates the robustness and strength of the procedure.[15] The IV results suggest a slightly lower degree of overestimation, since β is estimated to be 0.938, implying an overestimation of more than 6%. The coefficient is not significantly different from 1 at conventional significant levels, but the p-value of the hypothesis that the coefficient is larger or equal to 1 is 0.1173, which is very close to the 10% level of significance, especially taking into account the very conservative computation of the standard errors in order to make them robust to heteroskedasticity and autocorrelation.[16]

Accounting for selection, we find the coefficient of the inverse Mills ratio to be statistically insignificant, suggesting that there is no evidence that sellers differ from nonsellers in unobservable ways.[17] While the coefficient for reported house values increases slightly, the standard errors also increase.

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[15] We follow the suggestions in Bound, Jaeger, and Baker (1995), Staiger and Stock (1997), Stock, Wright, and Yogo (2002), and Baum, Schaffer, and Stillman (2003), and find that we have robust instruments with very large F statistics in the first stage of the IV procedure, considerably larger than the minimum value (around 10) suggested in Staiger and Stock (1997), and also discussed in Stock, Wright, and Yogo (2002), as a good rule of thumb to check whether we are in the presence of weak instruments. Also, the model is overidentified, which allows us to test whether our instruments are exogenous with respect to the error term in the structural equation. A rejection of this test would suggest that the instruments are either not truly exogenous or they should be included in the main regression of interest. In all cases we cannot reject the overidentifying restrictions.

[16] If we use as exclusion restriction the difference between the twice-lagged self-reported home value and the three-times lagged report, the β is estimated to be 0.898, but the standard error almost doubles from 0.051 to 0.096. At the same time, the F statistic to test the strength of the instruments goes down from over 288 to just around 22. These, and other sensitivity analysis results, are available from the authors upon request.

[17] In a related context, but estimating a different type of home sale price equation, Ihlanfeldt and Martínez-Vázquez (1986) also find no evidence of sample-selection bias when estimating an equation of sale prices.

In light of these results, and after performing an exogeneity test robust to violations of the conditional homoskedasticity assumption to assess the appropriateness of the IV specification versus the OLS (Hayashi 2000; Baum, Schaffer, and Stillman 2007), our preferred estimates are the IV results, since we can reject the hypothesis that the reported home values can be taken as exogenous to the price process.

4.1 The Role of Unrealized Capital Gains and the Original Price Paid in Assessing the Accuracy of Housing Wealth

In this section, we investigate whether the two components of the self-reported house value—the original price of the house and the capital gains—play different roles in predicting the market value of a property. The measure of the unrealized capital gains is obtained by subtracting the self-reported original purchase price from the self-reported value of the home.[18]

We reestimate the models discussed above, substituting the original price and the (unrealized) capital gains for the self-reported house value.[19] For individuals who accurately assess the market value of their properties, we would expect that both coefficients would be equal to 1. The presence of inaccuracy translates into a simple restriction that at least one of the coefficients has to be less than 1. While on statistical grounds there is no way to determine which one will be less than 1, on theoretical grounds we expect the capital gains effect to be less than 1 due to the fact that individuals are unlikely to set their reservation selling price below the original nominal price they paid on the property, implying a coefficient associated with the original price variable of no less than 1. This means that individuals use the original price as a reference point when determining what offers to accept. This interpretation is in line with the discussions and

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[18] Unrealized capital gains are inherently risky, especially when accumulated in a lumpy asset such as housing. This issue has received relatively little attention from researchers, even though some prominent policymakers, like former Chairman of the Federal Reserve Alan Greenspan (2002), emphasized the need for further disaggregation in the analysis of household portfolios, with special attention to the differential behavior implied by realized and unrealized capital gains.

[19] The expected capital gains will be heavily time variant, as we do not adjust for inflation and the original purchase price may rather be low. Adjusting for inflation, though, creates additional measurement error. Moreover, philosophically, there is no reason to call the difference between expected price and the adjusted purchase price "capital gains" since there is no reason to believe that house prices will always keep up with the inflation. Nevertheless, we specify additional models adjusting the original purchase price for inflation; the results do not differ in any significant way from the ones reported here.

findings of Genesove and Mayer (2001), who argue that loss aversion on the part of the potential sellers results in a correlation between the selling price and the original price of the property.[20]

The results are presented in table 3. The estimates suggest that homeowners are, on average, much less accurate with respect to their assessment of the role of capital gains for the value of the house compared to the role of the purchase price. Specifically, the marginal effect of the capital gains variable is estimated to be around 0.91, indicating that homeowners may significantly overestimate the contribution of the capital gains to the sale price. Based on our conservative estimates of the standard errors, the p-value of the hypothesis that the coefficient is larger or equal to 1 is 0.077, giving us statistical confidence in our point estimate of the effect of the capital gains.

On the contrary, the original purchase price is reflected almost one-to-one in the selling price; the corresponding coefficient is estimated to be 0.999. This result is consistent with the idea that homeowners are unlikely to accept offers below the original priced paid on the properties.

The latter result suggests a possible role for the business-cycle effects on the accuracy of the estimates through the characteristics of the period in which the household bought the property they eventually sell. For example, those who bought during a buyer's market (maybe due to their expectations of price appreciation or their household characteristics) might tend to eventually underestimate the value of their properties if they later sell in comparatively better times, while the opposite would be true for those who bought during boom years. The next section explores this issue in some detail.

5. THE ACCURACY OF SELF-REPORTED HOUSING WEALTH AND THE BUSINESS CYCLE

Given the characteristics of our data on house purchases and house sales, we observe considerable heterogeneity in the timing of the purchase of the homes subsequently sold, but much less heterogeneity in the timing of the sale. Specifically, we observe sales that took place

[20] For example, if owners base the expected rate of appreciation of their house on the reported price change of the median (or average) home purchased in their region, then they would likely end up overestimating their capital gains since the median home ages relatively less because of the renewal of the housing stock. Another source of possible over- or underestimation that would be reflected in the capital gains measure is a systematic misperception among owners of the value added by certain common updates to the house, such as a new roof or a remodeled kitchen.

between 1994 and 2002, while the period of purchases on these properties spans from 1955 to 2000. This information enables us to explore whether the timing of the purchase and the market conditions at that time could have lasting effects on the accuracy of the individual in reporting the value of their homes.

Figure 1 illustrates the high (negative) correlation between nominal and real interest rates and the number of home sales in the United States.[21] In fact, the correlation coefficient between the historical series of total home sales and nominal interest rates is –0.59, and the real interest rates is –0.31. This correlation is especially strong up to the mid-1990s; after that, the boom in the housing market took over, fueled by an unprecedented availability of sophisticated (and risky) mortgage products. The latter included interest-only mortgages, the ability to make the downpayment thanks to an automatic second mortgage on the property, and the growth of subprime loans with risk-based adjustments of the interest rates. There is mounting evidence that the availability of these risky conditions was fueled by the ability of banks to securitize the loans, as recently discussed in Keys et al. (2008), Mian and Sufi (2008), and Hampel, Schenk, and Rick (2008). We note that the correction in the home sales figures, which started in 2006 and has continued during 2007 (with a drop of 13% in home sales), seems to be bringing this relationship more in line with the historical trend.

The correlation between interest rates, borrowing costs, and housing prices is well documented (Harris 1989; Reichert 1990; Poterba 1991; Englund and Ioannides 1997; Sutton 2002; and Tsatsaronis and Zhu 2004)[22] and, while its correlation with home sales has been much less discussed, there is a long tradition in economics that supports the predictive power of interest rate measures with respect to the evolution of the economy (Sims 1980; Stock and Watson 1989). For example, Bernanke (1990) shows how the interest rate measure we have used here, the Federal Funds Rate, is a good predictor of a large number of indicators of the real economy. More recently, Mishkin (2007) and Taylor (2007) have discussed the link between monetary policy and the housing market. Interestingly, home sales and home prices have had a

[21] The nominal interest rate reflects the federal funds rate historical annual series published by the Board of Governors of the Federal Reserve System (http://www.federalreserve.gov/releases/h15/data.htm). The real interest rate is computed as the nominal interest rate minus the CPI reported by the Bureau of Labor Statistics in that year. Data on home sales and home prices come from the U.S. Statistical Abstract 2008 online edition, published by the U.S. Census Bureau (http://www.census.gov/compendia/statab/). Home sales are the result of the sum of new-home sales and existing-home sales, while home prices are for existing-home family homes sold in a given year. For 2007 we use the data provided by the National Association of Realtors (www.realtor.org).

[22] The historical series of prices we use shows a correlation of negative 0.44 with the nominal interest rate.

strong historical relationship since the late 1960s (see figure 2, which shows a correlation of 0.93) and this has been especially strong since the mid-1990s.[23] It was only during the recessions of the early 1980s and early 1990s that we saw a break in the acceleration of prices resulting from the drop in home sales in those periods.

The evidence from figures 1 and 2 supports using the nominal interest rate as a measure of the business cycle of the housing market. To investigate the relationship between the business cycle and the self-reported home values, we estimated additional specifications of the models discussed above. First, we introduced business-cycle measures (interest rates and macroeconomic conditions in the year of the purchase) as additional regressors in the models estimated in the previous subsection. The results were essentially unchanged, suggesting that the self-reported housing value already accounts for that variation. Then we reestimated our preferred specifications, dividing the sample depending on the year of purchase of the property eventually sold, and compared those results with the evolution of the business cycle.

In figure 3 we present the results of this exercise. We plot estimates for every year between 1960 and 1998. The graph presents the estimate of β in equation (4) (using IV) for the purchases by each of the calendar years, where the first coefficient refers to purchases before or in 1960. As we move forward in time, the coefficient reported is the result of a larger and larger number of observations. By the time it gets to 1998, it includes essentially all the observations and therefore is almost equal to the one reported in the third column of table 2.[24] From the graph it is quite clear that with the exception of a few observations in the 1960s and a few observations in the late 1990s, the level of accuracy of the self-assessed value of the house moves in a fairly narrow range, suggesting fairly accurate estimates.

In the same figure, we also plot the prevalent nominal interest rate in the economy in that year. The graph shows a strong positive correlation between the evolution of our estimates and

[23] This should not come as a surprise since housing starts have also followed the same trend, as discussed in the report by the Joint Center for Housing Studies (JCHS 2007). Housing starts dropped more sharply during 2006 and the latest figures indicate that the drop continued during 2007. At the same time, the proportion of vacant houses (both rental and homeowner vacancy rates) out of the total housing inventory were near their all-time high at the end of 2006 and the end of 2007. As discussed by Glaeser, Gyourko, and Saks (2005), both supply and demand matter when studying the dynamics of the housing market, since limits on supply will fuel price increases in the presence of strong demand. Glaeser and Gyourko (2007) present a dynamic rational expectations model of the housing market to explain the evolution of quantities and prices in this market. Notice as well that the homeownership rate dropped during 2007 and, in the fourth quarter, stands at a seasonally adjusted 67.7%, the lowest rate since the second quarter of 2002 (U.S. Census Bureau, http://www.census.gov/hhes/www/housing/hvs/hvs.html).

[24] Our results are robust to this particular way of presenting how the accuracy estimate evolves over time. Alternative characterizations, one of which we use in later figures, provide essentially the same pattern.

the interest rate; the correlation coefficient between the series of our estimates and the interest rate is 0.566. In fact, a regression of our 39 estimated coefficients on the series of interest rates and a constant delivers an R^2 of 0.32 and a very significant positive coefficient on the interest rate measure.[25] Notice that the increasing trend of the interest rates up to the early 1980s translates in a trend towards an eventual decrease in overestimation of the properties, and in some periods towards a slight eventual underestimation of the house values. The 1990s, a time of mostly falling interest rates, are correlated with a trend towards overestimation of housing values.

Figures 4 and 5 further support the evidence of the countercyclicality of the accuracy estimates (or cyclicality of the presence of overestimation): Periods of declining median household income (measured by the 5-year moving average of the growth of household income) and active expanding monetary policy (evident from the 5-year moving average of the growth in nominal interest rates) are associated with more accuracy in the estimation (and even underestimation) of the value of the properties. One likely explanation for this evidence is portrayed in figure 6, where we plot the trends in the growth of housing prices over the last decades. Those who bought during a slowing housing market could have lower appreciation expectations, which could end up being more realistic, or even pessimistic, at the time of the sale. In figures 4–6, the estimates of β are the result of using the purchases in the five years before each of the calendar years shown.

This interpretation of the results is consistent with the link between nominal interest rates and the formation of housing-price appreciation expectations emphasized by Harris (1989), and more recently by Mishkin (2007). Moreover, it is in broad agreement with the relationship between states of the economy, the housing market, and housing-price appreciation expectations discussed in Case and Shiller (1988), where good economic times (housing booms) are associated with very optimistic expectations of buyers regarding the evolution of housing prices.

In addition to a possible lasting effect of the housing cycle on the expected pace of home appreciation, the cyclical nature of the accuracy may also reflect changes in the composition of buyers during the business cycle, with richer, more educated buyers being the ones entering (or reentering) the market in rougher economic times. While the work of Wolfe (1984) comparing

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[25] The regression coefficients imply that a 1% increase in the nominal interest rate increases the β coefficient by 0.0119 from a constant estimated to be 0.8741.

buyers in 1974 (a housing market trough) to those in 1980 (close to a peak) suggests few significant differences in basic demographics (such as age, marital status, gender or race) once demographic trends are accounted for, we find in our data that those who bought during more difficult economic times, especially the early 1980s, tend to be more educated, with 80% of them having a college degree or more, compared with less than 60% during other periods. Given the correlation of education with income and wealth, this is in line with the discussions in Harris (1989).

All this suggests that in good economic times there is a larger number of buyers who are (eventually) overly optimistic regarding how much their properties are worth. This is precisely what is believed to have happened since the beginning of this decade and until 2005–2006, when a wave of buyers (many of them first-time owners, which pushed the homeownership rates to historical highs in the 2003–2006 period) responding to easy credit conditions—with possibly overly optimistic expectations about the evolution of house prices—planted the seed of the current mortgage crisis in the United States by accepting mortgage terms that were set to explode in the short to medium run.

6. CONCLUSIONS

For most Americans, in particular those with low- and medium-levels of income, their homes are their main asset, and many of the important decisions they make through their lives cannot be analyzed without thoroughly understanding how to appropriately measure this source of wealth. As real estate prices have become more volatile, it has become imperative that we study the investment component of housing wealth. This is the first study to use an econometric framework to test the accuracy of one of the most important wealth measures—the self-reported house value—from sales data.

Our results show that homeowners, on average, overestimate the value of their properties by between 5% and 10%. We also find that the overestimation is mostly related to capital gains, while owners tend to accurately translate the original price that they paid for the house into the home's current market value.

There is, however, considerable variation depending on when they bought their homes. This points to the persistence of the economic fundamentals surrounding the time that

individuals decide to purchase a home at a given price, which ends up reflecting in the self-assessed valuation of that property close to the time of the sale.

While most individuals overestimate the value of their properties, individuals who bought during more difficult economic times tend to be more accurate and, in some cases, even underestimate the value of their houses. We find a strong correlation between accuracy and the economic conditions (measured by the prevalent interest rate, the growth of household income, and the growth of median housing prices) at the time of the purchase of the property. Those who bought during tougher economic times are, on average, more accurate in their assessments.

Our results provide some explanations for the difficult situation currently faced by a growing number of homeowners. The pattern that we document is consistent with the buildup of unrealistically optimistic expectations regarding the rate of home price appreciation among individuals who bought in good economic times or times of loose credit. In turn, these individuals take on risky financial commitments that make them more dependent on price appreciation to build equity in order to accommodate an adverse event, such as an increase in interest rates.

Our underlying methodology can be extended to analyze many other components of households' portfolios that may also be affected by the overestimation of capital gains, including stock market wealth, real estate investments, and even pension wealth.

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Table 1. Summary Statistics

Variable Names	Sellers				Nonsellers	
	Full Sample		*Estimation Sample*			
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Selling Price	140,022	114,673	148,549	126,029		
Self-Reported House Value	143,199	108,510	149,531	115,741	122,947	111,984
Original Purchase Price	79,929	85,219	83,300	91,382	56,838	74,982
Capital Gains	63,269	75,570	66,230	77,664	66,109	84,833
House Tenure	17.41	11.30	18.47	11.45	21.28	11,41
Home Equity	103,911	98,623	104,607	101,091	96,101	95,982
Bachelor's Degree	0.3779	0.485	0.404	0.491	0.28	0.448
Professional Degree	0.1411	0.348	0.155	0.362	0.109	0.311
Married	0.726	0.446	0.73	0.44	0.747	0.434
White	0.886	0.317	0.885	0.319	0.782	0.412
Age	61.52	5.84	62.57	5.33	61.53	5.65
Male	0.559	0.496	0.564	0.496	0.543	0.498
Earnings	87,820	113,314	85,507	111,116	75,525	119,157
Number of Observations	836		574		18,144	

Table 2. The Accuracy of Self-Reported House Values

Dependent Variable: Sale Prices	OLS		OLS, no constant		IV-GMM		Corrected IV-GMM	
	Coeff.	**St. Err.**	**Coeff.**	**St. Err.**	**Coeff.**	**St. Error**	**Coeff.**	**St. Error**
Self-Reported House Value	0.9066	0.109	0.9129	0.0783	0.9382	0.0519	0.9603	0.0919
Months between the Report and the Sale	795.46	481.22	915.04	564.93	655.9	419.93	711.624	453.099
Constant	3,029	17,090	-		-		-	
Inverse Mills Ratio	-		-		-		-1,767.3	6,685.68
Adj. R-squared	0.6998		0.8744		-		-	
Test of Overidentifying Restrictions	-		-		Cannot Reject, P-val.=0.78		Cannot Reject, P-val.=0.92	
Test of Weak Instruments	-		-		Reject, F(2,571)=288.54		Reject, F(2,570)=56.26	
Number of Observations	574		574		574		574	

Table 3. The Role of Capital Gains and Original Purchase Price

Dependent Variable: Sale Prices	OLS		OLS, no constant		IV-GMM		Corrected IV-GMM	
	Coeff.	St. Err.	Coeff.	St. Err.	Coeff.	St. Error	Coeff.	St. Error
Expected Capital Gains	0.8051	0.121	0.8122	0.096	0.91801	0.0576	0.876	0.0918
Original Purchase Price	0.978	0.117	0.9848	0.089	0.999	0.0878	0.9051	0.0754
Months between the Report and the Sale	833.85	485.59	965.23	562.74	550.74	443.10	608.90	440.39
Constant	3,330.68	16,742	-		-		-	
Inverse Mills Ratio	-		-		-		3,198.78	5,384.6
Adj. R-squared	0.7068		0.8774		-		-	
Test of Overidentifying Restrictions	-		-		Cannot Reject, P-val.=0.42		Cannot Reject, P-val.=0.32	
Test of Weak Instruments	-		-		Reject, F(2,570)=289.17		Reject, F(2,569)=96.57	
Number of Observations	574		574		574		574	

Figure 1. Interest Rates and Home Sales in the United States, 1960–2007

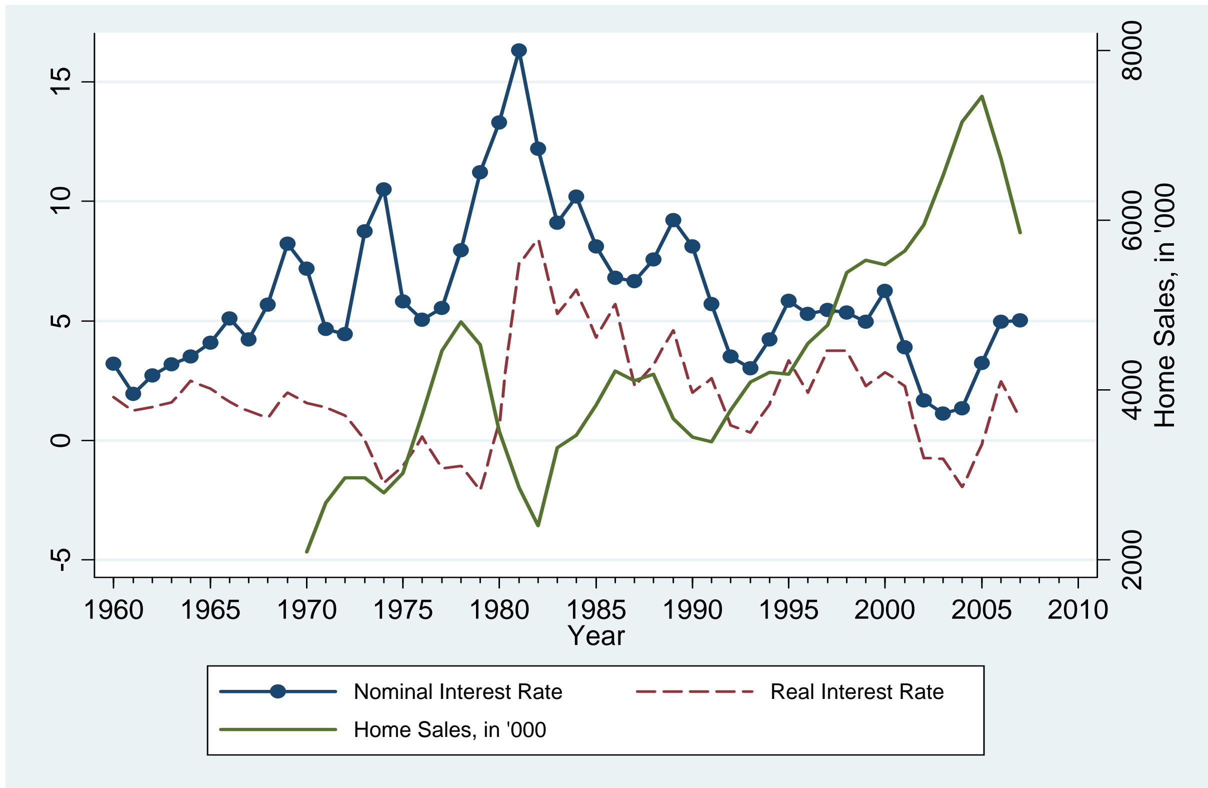

Figure 2. Home Sales and Home Prices in the United States, 1968–2007

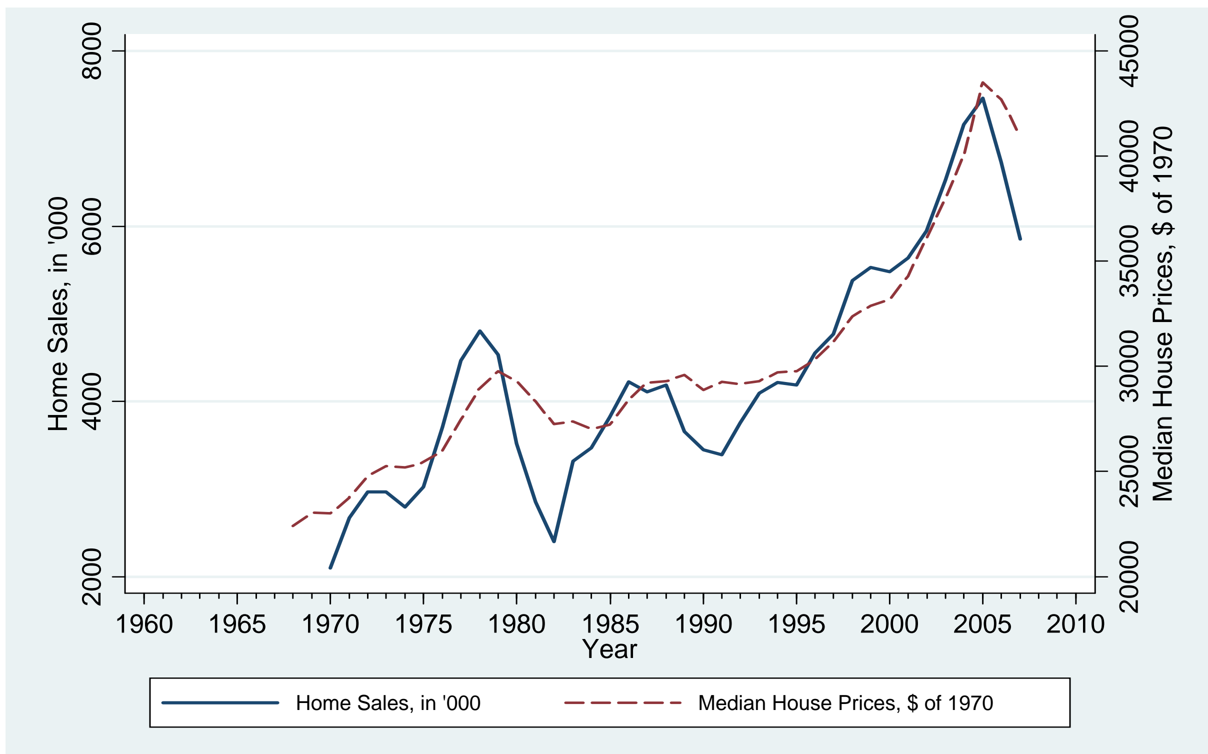

Figure 3. Estimated β Coefficient and Confidence Bands from Equation (4) and Interest Rates

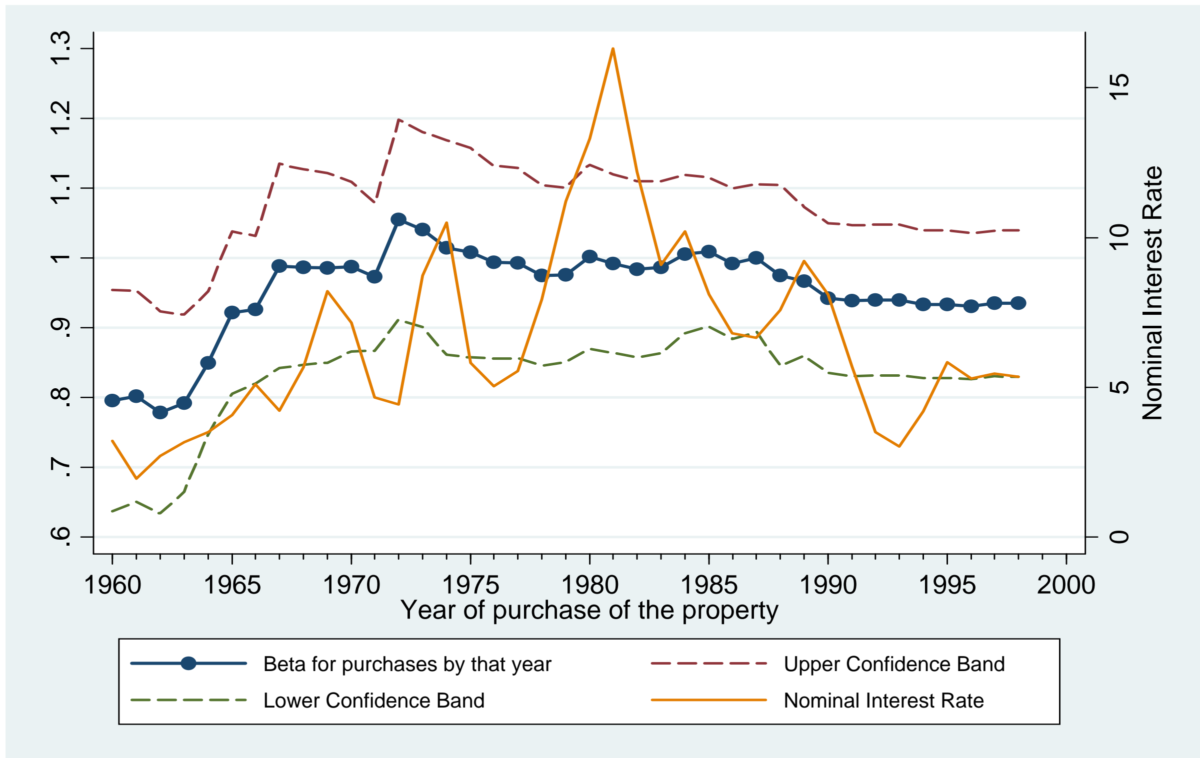

Figure 4. 5-year Moving Average of Estimated β Coefficients and 5-year Moving Average of the Growth in Median Household Income in the United States

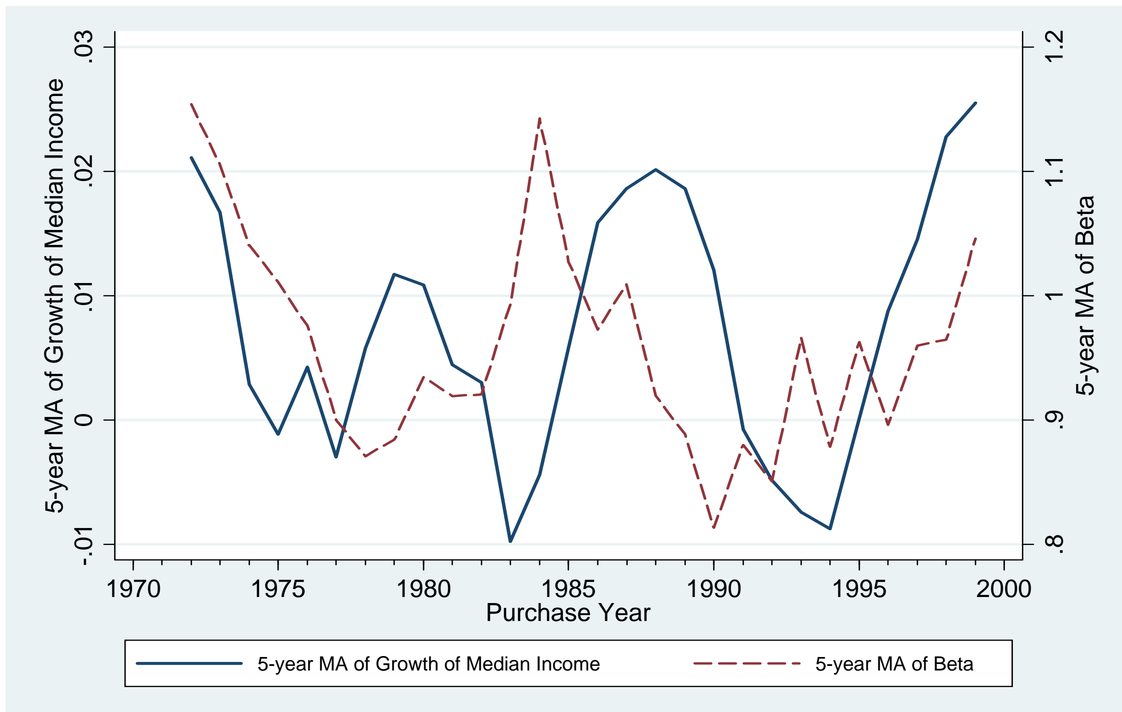

Figure 5. 5-year Moving Average of Estimated β Coefficients and 5-year Moving Average of the Growth of Nominal Interest Rates

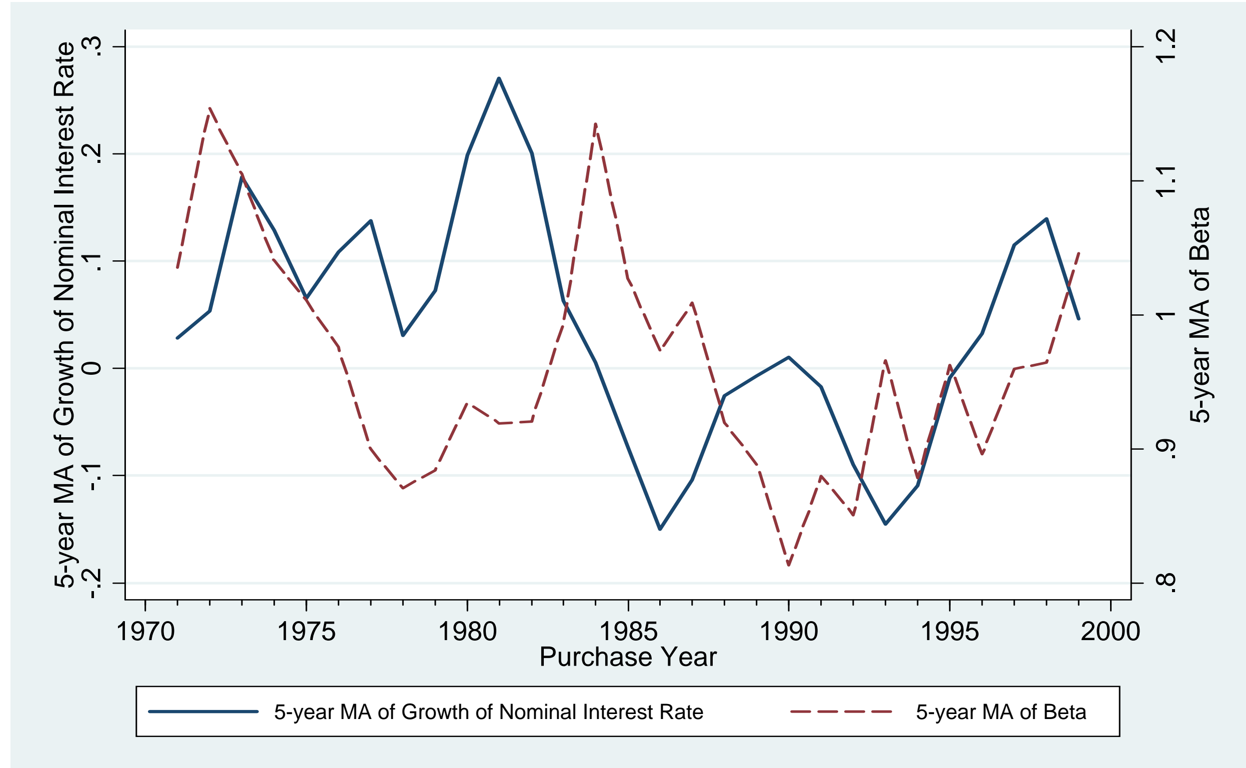

Figure 6. 5-year Moving Average of Estimated β Coefficients and 5-year Moving Average of the Growth in Median Housing Prices in the United States