# Housing and the Macroeconomy

by

Erika Dreyer Morris

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Economics)
in The University of Michigan
2011

Doctoral Committee:

> Professor Robert B. Barsky, Chair
> Professor Charles C. Brown
> Professor Dennis R. Capozza
> Professor Linda L. Tesar

With love and thanks to my husband,

James Lyle Morris

# Acknowledgements

I would like to thank the following people whose advice, encouragement, and assistance made this dissertation possible: my fellow economics graduate students, in particular Nathan Anderson, Peter DiCola, Jane Dokko, Katherine Guthrie, Sara LaLumia, Jordan Matsudaira, Melinda Miller, Andreas Pape, and Rafael Portillo; my dissertation committee, Bob Barsky, Charlie Brown, Linda Tesar, and Dennis Capozza; and the following friends from St. Ed's and Boston College whose support helped throughout my time in graduate school and beyond, Jennifer DeSantis Kypreos, Loretta Todzia Lewin, and Jill Powell.

Last but certainly not least, I am enormously grateful to my family (immediate and extended) for their encouragement and support. I thank my parents, Noreen Dreyer and Bill Dreyer, for instilling the educational and emotional foundation that enabled me to embark upon, and complete, this journey. I thank my daughters, Madeleine and Shelby Morris, for providing to me their unconditional love and constant joy. Finally, I thank my husband, Jim Morris, for his steadfast love, patience, encouragement, and support.

# Contents

# List of Figures

# List of Tables

Table

# Chapter 1

# Introduction

The housing market and the macroeconomy interact in numerous ways. Changes in home values affect household wealth and therefore affect household consumption decisions. Changes in the macroeconomy affect overall demand for and supply of housing, driving chanes in the housing market. This dissertation offers three papers that examine interactions between the housing market and the macroeconomy.

Chapters 2 and 3 identify the importance of age and expected mobility as transmission channels for wealth effects from owner-occupied housing. Chapter 1 develops a model that considers the user cost of housing in calculations of net housing wealth. Solutions to the model demonstrate that changes in user cost cause changes in net housing wealth to be smaller than corresponding capital gains, and that this relationship differs across households according to age and expected mobility. Changes in the annuity value of net housing wealth are generally much smaller than capital gains, and the age and future mobility of a household each have large, distinct impacts on the effect of housing gains

on consumption.

Chapter 2 presents econometric tests of the model developed in Chapter 1. I use a maximum likelihood Heckman selection model on data from the Panel Study of Income Dynamics (PSID) to estimate household mobility, and use fixed effects regression to examine the links between changes in home prices, stock market wealth, and consumption. Estimation results support many of the model's predictions. I find that the marginal propensity to consume out of housing gains increases with age, and that mobility can affect the response of consumption to home gains for homeowners of all ages. I also find that housing gains have a larger effect on consumption than stock market gains.

Chapter 3 explores linkages between the housing market and business cycles, with a particular focus on housing market dynamics during recessions. It establishes empirical regularities in the markets for both new and existing homes for the following variables: home prices, inventories of unsold homes, sales volumes, the inventory-sales ratio, time on market, and new construction starts. I conclude that home prices are not good indicators of business cycles, and that sales volumes and starts are leading indicators of recessions. I also find that the inventory-sales ratio is the strongest contemporaneous housing market indicator, and that it also seems to predict housing starts. Finally, I find that the markets for new and existing homes move together, apart from the behavior of inventories.

# Chapter 2

# A Model for Examining the Wealth Effect from Home Price Changes

## 2.1 Introduction

Rapidly changing home prices over the past several years have fueled speculation about the impact of unanticipated changes in housing wealth on consumption. Most discussions about this topic equate increases in home prices with increases in wealth. While this is true for accounting wealth, it is not true for economic wealth. Increases in home prices lead to increases in economic housing costs, dampening the effect of housing capital gains on [economic] wealth. The precise relationship between housing capital gains and housing wealth depends on the homeowner's age, whether the homeowner plans to move into a more- or less- expensive home in the future, and the timing of any possible move.

In this paper, I examine the effect of unanticipated changes in housing wealth on consumption. In particular, I determine how age and expected mobility act as transmission

channels from housing capital gains to changes in net wealth and consumption. Until recently, economic costs of housing have largely been ignored in the housing wealth effect literature. Exceptions to this include Campbell and Cocco (2005) and Li and Yao (2006). This paper explicitly models age and expected mobility separately, and discusses the relative impact of each factor.

In Section 2.3, I develop a simple life-cycle model to explain the effects of age and mobility on the response of consumption to windfall housing gains, and compare the marginal propensity to consume out of housing gains ($MPC_{GAINS}$) with the marginal propensity to consume out of non-housing wealth ($MPC_{WEALTH}$).

Analytical solutions to the model yield predicted $MPC_{GAINS}$ for households with different age and mobility profiles. The model predicts that $MPC_{GAINS}$ increases with age, and that $MPC_{GAINS}$ is generally less than $MPC_{WEALTH}$. The marginal effect of mobility on $MPC_{GAINS}$ decreases with the relative price level and appreciation rate of the future home, and the magnitude of this effect decreases with the length of tenure in the current home.

In Section 3.1 of the paper, I use the model's predictions to interpret data from the 1984-2003 waves of the Panel Study of Income Dynamics (PSID). Regressions using household-specific fixed effects show that $MPC_{GAINS}$ increases with age. I also estimate each household's probability of a move and future home value using a maximum likelihood Heckman selection model. Incorporating mobility estimates into the regression equation suggests that for certain age groups, households that expect to move into

more expensive homes have larger $MPC_{GAINS}$ than the average household. Section 3.2 concludes.

## 2.2 Literature

Theoretical predictions about the wealth effect from home price appreciation are mixed. A model of housing costs presented by Dougherty and Van Order (1982) suggests that for an infinitely-lived homeowner, changes in housing prices should be exactly offset by changes in housing costs. Within his study of the impact of bequests on the housing wealth effect, Skinner (1989) notes that finite-lived consumers may have positive wealth effects from home price appreciation. Campbell and Cocco (2005) develop and calibrate a life-cycle model with borrowing constraints to examine the wealth effect from home price appreciation. Their baseline estimates predict a large, positive wealth effect for old homeowners that exceeds that of young homeowners. When they control for endogenous tenure choice, they find that the wealth effect magnitudes reverse: young, less liquid homeowners have larger home price elasticities than old homeowners. Li and Yao (2006) also incorporate borrowing constraints in a life-cycle model to predict that the non-housing consumption of young and old homeowners is more sensitive to home price changes than that of middle-aged homeowners.

Empirical literature has likewise offered mixed results. Juster, Lupton, Smith, and Stafford (2006) estimate zero effect of housing capital gains on consumption for a sample of PSID households over the period 1984-1994. Using data joined from the PSID and

the Consumer Expenditure Survey (CEX) over the period 1976-1981, Skinner (1989) finds no effect of home values on consumption when using fixed effects regression. When he uses a pooled regression, however, he estimates a home value consumption elasticity of 0.06%. A back of the envelope calculation using mean home values and imputed consumption from the 1984-1989 waves of the PSID (the closest available to that time period) suggests that this elasticity is equivalent to a $MPC_{GAINS}$ of approximately 0.02[1]. Case, Quigley, and Shiller (2005) estimate a home price consumption elasticity of between 5% and 8% in US state-level data. Using mean home values and imputed consumption from the PSID, this translates into $MPC_{GAINS}$ between 0.02 and 0.04. A recent working paper by Bostic, Gabriel, and Painter (2005) uses matched household-level data from the Survey of Consumer Finances and the CEX to estimate a home value elasticity of approximately 6%. Using PSID data over the same period, this translates into a $MPC_{GAINS}$ of approximately 0.02. Engelhardt (1996) uses OLS on a cross-section of PSID households to estimate that $MPC_{GAINS}$ is 14.2 cents. Using median regression to reduce the effect of outliers, the estimated $MPC_{GAINS}$ falls to only 2.4 cents. Campbell and Cocco (2005) use repeated cross-sections of household expenditure data and regional home price information to estimate a small, positive consumption response to home prices for young homeowners, and a large positive response for old homeowners. Using mean home values and consumption as reported in their paper, this translates into $MPC_{GAINS}$ of 0.06 for young homeowners, and 0.11 for old

---

[1]Consumption is imputed by subtracting average annual "active savings" from current income. Active savings is composed of contributions to assets, net of capital gains, and is discussed in greater detail in Section 3.1.

homeowners.

The paper that is most closely related to this work is that by Campbell and Cocco, though the two papers differ in some modelling assumptions and empirical approach. First, although their model could handle a scenario in which all households are home-owners, much of the variation in wealth effects by age in Campbell and Cocco's model is driven by borrowing constraints faced by renters who desire to be homeowners. The model presented in this paper allows examination of the separate factors of age and mobility on wealth effects, without possibly confounding effects of borrowing constraints or age-related mobility. Second, the data used by Campbell and Cocco differs greatly from that used in this paper. This paper uses data on a true panel of U.S. households, allowing identification of household-specific changes in housing wealth and consumption. Campbell and Cocco create a synthetic panel of U.K. households by combining cross-sectional household-specific expenditure data from the Family Expenditure Survey with regional and national home price data. The nature of their dataset makes it impossible to identify those households for which the wealth effect should be largest.

## 2.3 Theory

### 2.3.1 Housing Demand & Costs

In this section, I present a theoretical model of the housing sector that follows Dougherty and Van Order (1982) and Poterba (1984). I use partial equilibrium analysis to focus on the effect of changing home prices on consumption, and do not consider how changes

in demand or supply may affect home prices.

In equilibrium, a home's price should equal the present value of its expected service flows. The per-period net service flow from a house owned by household $i$ is equal to the payment one would need to rent that house $R$, minus any "upkeep costs" built into the rent.

$$S_{i,t} = R_{i,t} - [(1 - \tau_y)\tau_p + \delta]H_{i,t} \tag{2.1}$$

Upkeep costs, which include property taxes ($\tau_p$) and depreciation and maintenance ($\delta$), are expressed as fractions of the real home price, $H$. Property taxes are deductible from federal income taxes, so they are included on an after-income tax ($\tau_y$) basis.

The equivalent rent for a home, $R$, is a function of the existing housing stock K. In equilibrium, $R_{i,t}(K_t)$ should be equal to the marginal cost of using a unit of housing services ($u$).

$$R_{i,t}(K_t) = uH_{i,t} \tag{2.2}$$

The marginal cost of housing services is often referred to as the "user cost" of housing. User cost is expressed as a proportion of the real home price, and includes property taxes, depreciation, and the real opportunity cost of funds dedicated to housing, less any expected real home price appreciation $\pi_h$. The real opportunity cost of funds dedicated to housing is equal to the nominal after-tax one-period interest rate $i(1 - \tau_y)$, minus the inflation rate $\pi$. I assume that user cost and its components are constant over all

periods.

$$u = \delta + (1 - \tau_y)(i + \tau_p) - \pi - \pi_H \tag{2.3}$$

Equating a home's price to the present discounted value of all future service flows yields Equation 2.4.

$$H_{i,t} = \sum_{t=0}^{\infty} \frac{S_{i,t}}{(1+r)^t} \tag{2.4}$$

Asset price equilibrium ensures that the real interest rate, $r$, is equal to the after-tax real cost of capital.

$$r = (1 - \tau_y)i - \pi \tag{2.5}$$

### 2.3.2 Net Wealth & Consumption Function

Net economic housing wealth $W_{h_{i,t}}$ is equal to the value of the home ($H_t$), less the present value of the lifetime cost of housing. In other words, it is equal to the present value of services provided by the home minus the present value of the costs of housing. If households are infinitely-lived and there are no frictions, net housing wealth would be equal to zero: the benefits and costs of housing would exactly offset one another. If, however, consumers have finite lives of length T, net housing wealth will be positive and nonzero. Positive net housing wealth arises because the price of the home is determined by its infinite useful life (Equation 2.4), while the household incurs periodic housing costs (Equation 2.3) only for its finite lifetime of $T$ years.

$$W_{h_{i,t}} = \sum_{t=0}^{\infty} \frac{S_{i,t}}{(1+r)^t} - \sum_{t=0}^{T} \frac{uH_{i,t}}{(1+r)^t} \qquad (2.6)$$

This interpretation of positive net housing wealth applies to homeowners who have both finite lifetimes and finite planning horizons. Dynastic households, in which the homeowner fully incorporates the welfare of future generations when making consumption decisions, would have infinite planning horizons, and economic housing wealth would always be zero. If, however, a homeowner plans to leave a fixed amount of money to his or her heirs, then changes home prices would still affect net housing wealth.

Net housing wealth does not explicitly include the mortgage balance or rate. This model considers economic housing wealth, which, in a frictionless world, should be independent of the method of financing. In the absence of market frictions, the after-tax mortgage rate should be equal to the return that could be earned on equity and economic housing wealth would be unrelated to the method of financing. Empirical tests of this model should be equivalent to those that incorporate housing debt, as windfall changes in home equity due to home price changes are independent of the mortgage balance.

Substituting Equation 2.4, the formula for home prices, into Equation 2.6, yields

$$W_{h_{i,t}} = H_{i,t} - \sum_{t=0}^{T} \frac{uH_{i,t}}{(1+r)^t} \qquad (2.7)$$

Equation 2.7 demonstrates that, all else equal, net housing wealth is higher for con-

sumers with shorter expected lifetimes.

I assume that housing is indivisible. In real life, housing consumption can only be changed via moving, construction, or demolition- all of which are expensive and time-consuming. Anyone who has ever purchased a house, or even moved from one rented home to another, would agree that moving costs (e.g. searching for a new home, time packing, transaction costs) can be prohibitively high. These costs suggest that home-owner mobility would resemble a sort of s-S model. Within certain bounds, households will be content to be over- or under-housed, until the difference between their desired and actual consumption outweighs the costs associated with moving. Consequently, I assume that the quantity of housing units consumed is inelastic with regard to the price of housing. Although this will not be true for all households over all price changes, it serves as a useful approximation for many households and is especially appropriate for owner-occupied housing.

In keeping with this assumption, I model the household's consumption function as a function of lifetime wealth, net of housing costs[2]. I assume that the marginal propensity to consume out of wealth, $MPC_{WEALTH}$ ($\mu(T)$), is determined according to the permanent income hypothesis and varies with age. Values of $\mu(T)$ for different life expectancies (values of T) can be seen in Appendix A. Per-period income is equal to $y_t$, and initial other assets are equal to $A_0$. Consumers are risk-neutral.

---

[2]See appendix for derivation of the household's consumption function.

$$c_{i,t} = \mu(T) * \left[ A_0 + \sum_{t=0}^{T} \frac{y_{i,t}}{(1+r)^t} + H_{i,0} - \sum_{t=0}^{T} \frac{uH_{i,t}}{(1+r)^t} \right] \tag{2.8}$$

I include windfall housing gains as changes in $\epsilon_0$, one-time percentage gains in initial home prices.

$$H_{i,t} = H_{i,t-1}(1 + \epsilon_{i,t})$$

$$E_{t-1}[\epsilon_{i,t}] = 0$$

Consumption's response to housing gains depends on how net housing wealth responds to housing gains. As previously discussed, age differences will cause the relationship between net housing wealth and capital gains to differ across consumers. This should result in different observed marginal propensities to consume out of housing gains ($MPC_{GAINS}$). The $MPC_{GAINS}$ should not be confused with $MPC_{WEALTH}$, which is unaffected by housing gains.

In keeping with the structure of most home price series, I model home price changes as percentage changes in home prices. Thus, to solve for $MPC_{GAINS} = \frac{dC}{dH}$, I must solve for $\frac{dC}{d\epsilon} * \frac{1}{H}$ at $t = 0$ [3].

$$\frac{dc_{i,t}}{d\epsilon_{i,t}} = \mu(T) * H_{i,t-1} \left[ 1 - \sum_{t=0}^{T} \frac{u}{(1+r)^t} \right] \tag{2.9}$$

---

[3] $MPC_{GAINS} = \frac{dC}{dH} = \frac{dC}{\frac{dH}{H}} * \frac{1}{H} = \frac{dC_t}{d\epsilon_t} * \frac{1}{H_t}$

$$MPC_{GAINS} = \mu(T) * \left[ 1 - \sum_{t=0}^{T} \frac{u}{(1+r)^t} \right] \qquad (2.10)$$

Adding expected mobility to the model requires simple modifications. I assume that households plan at most one future move, as it is likely that households plan for only one future move at a time. I also assume that both the move's timing and the relative price of the new home are independent of any housing gains. This type of scenario would apply to a household with school-age children that plans to move into a more expensive home in a better school district, or a household expecting a job transfer to a new city. Admittedly, this assumption is unlikely to hold for all households. Should the price of a household's planned future home increase by much more than that of their current home, a household may choose to substitute towards non-housing consumption. Thus, one could view this model as a method of establishing upper bounds for the magnitudes of the predicted effects of mobility on consumption.

I denote the value of household $i$'s the planned second home relative to the original price of the current home as $\gamma_i$. $\gamma_i$ is an historical variable, and does not change if the household experiences windfall gains. $\gamma_i > 1$ if the original price of the future home is greater than the price of the current home. The appreciation rate of the new home is also allowed to vary, allowing for the possibility of migration across metropolitan areas. If a household plans to move to a new city, the price of the household's future home is likely to appreciate at a different rate than the household's current home. $\theta_i$ is the appreciation

rate of household $i$'s new home relative to the original home, $\frac{\epsilon_{i,t}^2}{\epsilon_{i,t}^1}$[4]. $\theta_i > 1$ if the price of

the future home ($H_{2_{i,t}}$) appreciates by a greater percentage than the price of the current

home ($H_{1_{i,t}}$). If the household plans move within its current metropolitan area, $\theta_i$ would

likely be close to 1.

$$H_{i,t}^2 = H_{i,t-1}^2(1 + \theta_i \epsilon_{i,t}^1) \tag{2.11}$$

$$\gamma_i = \frac{H_{i,t}^2}{H_{i,t}^1} \tag{2.12}$$

Assuming that any future move occurs at the end of period K modifies Equation 2.7,

lifetime net housing wealth, as follows:

$$W_{h_{i,t}} = H_{i,t}^1 - \sum_{t=0}^{K} \frac{uH_{i,t}^1}{(1+r)^t} + \left(\frac{H_{i,K}^1}{(1+r)^K} - \frac{H_{i,K}^2}{(1+r)^K}\right) - \sum_{t=K+1}^{T} \frac{uH_{i,t}^2}{(1+r)^t} \tag{2.13}$$

Households' net housing wealth is equal to their current claim to housing services, $H_{i,t}^1$,

minus the total cost of living in the current home, plus the expected difference between

the price of the current home and the future home (any "long"/("short") position in

housing), minus the total cost of living in the future home.

The $MPC_{GAINS}$ can again be found by taking the derivative $\frac{dc_{i,t}}{d\epsilon_{i,t}}$ of the consumption

---

[4]The interesting cases are those for which $\epsilon_{i,t}^1 \neq 0$.

function (Equation 2.14) and dividing by the initial home price, $H_{i,t-1}^1$ :

$$C_{i,t} = \mu(T) * \left[ A_0 + \sum_{t=0}^{T} \frac{y_{i,t}}{(1+r)^t} + W_{h_{i,t}} \right] \tag{2.14}$$

$$MPC_{GAINS} = \mu(T) * \left[ \left( 1 - \sum_{t=0}^{K} \frac{u}{(1+r)^t} \right) + \frac{1 - \gamma_i \theta_i}{(1+r)^K} - \gamma_i \theta_i \sum_{t=K+1}^{T} \frac{u}{(1+r)^t} \right]$$
$$\tag{2.15}$$

The effect of a planned future move on $MPC_{GAINS}$ depends on the time until the move, $K$, the remaining lifetime $T$ of the household, the initial relative price of the future home, $\gamma_i$, and the appreciation rate of the future home relative to the current home, $\theta_i$.

### 2.3.3 Predicted MPC$_{\mathbf{GAINS}}$

Calibrating and solving the model yields predictions of $MPC_{GAINS}$. All else equal, households with shorter expected lifetimes have larger increases in net housing wealth for a given housing gain, and consequently should exhibit larger $MPC_{GAINS}$. $MPC_{GAINS}$ falls with increases in the price or relative appreciation of the planned future home, as higher lifetime costs reduce lifetime net housing wealth. The influence of expected mobility on $MPC_{GAINS}$ diminishes with the number of years until a move.

Predicted results are sensitive to the model's calibration. Inflation and the nominal in-

terest rate both have large impacts on predicted $MPC_{GAINS}$, largely due to their importance in the discount rate. With this in mind, I chose parameter values according to two criteria: that they reflect empirical data when considered individually, and that they yield a reasonable real interest rate when used in Equation 2.5. I chose parameters that yield a real interest rate of 3.2%, which is comparable to the average real rate of 3.1% observed between 1984 and 2003[5].

I set the marginal tax rate equal to 20% for all households, and assume that property taxes and depreciation are both equal to zero[6]. General price inflation is constant and equal to 2%, and there is no expected change in real home prices. The nominal one-period interest rate is 6.5%.

Table 2.1 demonstrates that age has a very large impact on the predicted value of $MPC_{GAINS}$. Predicted $MPC_{GAINS}$ for a household that doesn't plan to move and expects to live for another 60 years (approximately 18 years old[7]) is less than one cent, while the predicted $MPC_{GAINS}$ for a household that plans to live for another 20 years (approximately 62 years old) is almost 3.5 cents. Predicted $MPC_{GAINS}$ for a household expecting another 5 years of life (approximately 89 years old) is 15.5 cents.

The importance of age in determining $MPC_{GAINS}$ is rather surprising. Most papers that consider the effect of age on the housing wealth effect do so only as a proxy for ex-

---

[5]This was calculated using market yield on one-year constant maturity Treasury securities as the nominal interest rate, and the 1996 GDP deflator series for inflation.

[6]In this model, the marginal tax rate is equal to the average tax rate. 20% is comparable to the average tax rate as calculated by the NBER TAXSIM model, available at http://www.nber.org/taxsim. (Feenberg and Coutts 1993)

[7]Age-specific conditional life expectancy is drawn from Arias (2004)

pected mobility. Younger households are expected to move into more expensive homes, and older households are expected to move into less expensive homes. Data from the PSID covering the period 1984 - 2003 demonstrate that this assumed pattern may be an oversimplification. Almost 33% of homeowners aged 65 and over who choose to move, move into a more expensive home, compared to 44% of moving homeowners aged 34 and younger. These data recommend evaluating age on its own merits. Age affects $MPC_{GAINS}$ through two channels: first, by determining the period over which housing costs are incurred, and thereby affecting net wealth, and second through its effect on $MPC_{WEALTH}$, determining the annuity value of wealth increases.

Comparison of $MPC_{WEALTH}$ (shown in the Appendix) and $MPC_{GAINS}$ illustrates the importance of considering user cost when evaluating the effect of capital gains. $MPC_{WEALTH}$ for a household with 40 years left to live is equal to 0.041, but the household's $MPC_{GAINS}$ (if it doesn't plan to move) is only equal to 0.012. If capital gains were equal to increases in net wealth, a household's predicted response to a $10,000 gain would be an annual consumption increase of $410. Considering user cost leads to a predicted response of only $120 per year.

Mobility has been emphasized in the literature as the main reason that housing wealth effects should vary across households, while the independent effect of age has been largely ignored. A comparison of Table 2.1, which shows $MPC_{GAINS}$ across age groups, with Tables 2.2 and 2.3, which show the difference between $MPC_{GAINS}$ for movers and non-movers for different price scenarios, demonstrates that age is just as important. If all houses appreciate at the same rate, and movers plan to purchase homes that are ini-

tially 50% less expensive, $MPC_{GAINS}$ is at most 9.5 cents greater for movers than for non-movers (Table 2.2). Though this marginal effect of moving may seem quite large, it applies to households with a conditional life expectancy of only five years– corresponding to homeowners with approximately 89 years of age. This would apply to a very small proportion of the population. It also relies on the household planning to move in 1 year. For households approximately 62 years of age, the $MPC_{GAINS}$ of movers is greater than that of non-movers by only 4.4 cents.

The timing of any possible move also affects $MPC_{GAINS}$. Moves that occur farther in the future have smaller effects on $MPC_{GAINS}$, due to a shorter period of time incurring costs of the second home, and to the present value discounting of those costs. If a household's expected lifetime is 60 years, the effect of a move that occurs 20 years into the future is approximately half of the size of the effect of moving in 1 year.

Table (2.3) demonstrates that the marginal effect of moving to a home that is initially 50% more expensive is symmetrical to that of moving to a home that is initially 50% less expensive.

The effect of potential migration is shown in Table (2.4). Differences in rate of price appreciation across the current and future home magnifies the effects of expected mobility. If the price of the planned future home was initially 50% more expensive than the current home, and its price appreciation is double that of the current home, moving reduces $MPC_{GAINS}$ by 17.5 cents for a household that has 20 years remaining lifetime and plans to move within one year. Doubling the rate of price appreciation of the new

home almost quadruples the marginal effect of moving.

## 2.4 Conclusion

The calibrated model presented in this chapter demonstrates that the presence of user cost results in both age and expected mobility having significant and independent effects on the wealth effect from home price changes. The wealth effect of a given capital gain is almost double for a homeowner aged approximately 62 years old (with approximately 20 years left to live) than it is for a homeowner aged 18 years old (with approximately 60 years left to live). The effect of mobility can cause homeowners to have a counterintuitive consumption response to home price changes- a homeowner planning to move into a more expensive home in the future may actually decrease consumption in response to a home price increase.

## 2.5 Exposition- Marginal Propensity to Consume

This section derives the household's consumption function and calculates theoretical estimates of the marginal propensity to consume out of wealth ($\mu$). Assume households have constant relative risk aversion (CRRA) utility and stochastic discount factor $\beta$. Each period, households have the option to consume ($c$) or save in risk-free asset $A$. Lifetime utility is given by equation 2.16.

$$U = \sum_{t=1}^{T} \beta^t \frac{c_t^{1-\theta}}{1-\theta} \tag{2.16}$$

The lifetime budget constraint equates the present values of consumption and wealth:

$$\sum_{t=1}^{T} \frac{c_t}{(1+r_t)^t} \leq A_o + \sum_{t=1}^{T} \frac{y_t}{(1+r_t)^t} \tag{2.17}$$

Maximization of 2.16 subject to 2.17 yields the Euler Equation

$$c_{t+1} = c_t(\beta R)^{\frac{1}{\theta}} \tag{2.18}$$

Combining 2.17 and 2.18 yields the household consumption function, where $R_t = (1 + r_t)$:

$$c_t[1 + (\beta R)^{\frac{1}{\theta}} R^{-1} + (\beta R)^{\frac{2}{\theta}} R^{-2} + ... + (\beta R)^{\frac{T}{\theta}} R^{-T}] = A_o + \sum_{t=0}^{T} \frac{y_t}{(1 + r_t)^t} \qquad (2.19)$$

Equation 2.19 shows that the the marginal propensity to consume ($\mu$) is equal to

$$\frac{1}{1 + \sum_{t=1}^{T} ((\beta R)^{\frac{1}{\theta}} R^{-1})^t}$$

for the finite-lived consumer. For the infinite-lived consumer, $\mu = 1 - R^{-1}(\beta R)^{\frac{1}{\theta}}$.

$$c_t = \mu \left[ A_o + \sum_{t=0}^{T} \frac{y_t}{(1 + r_t)^t} \right]$$

If $\beta = 0.97$, $\theta = 0.8$, and $R = 1.032$, $\mu$ for the infinite-lived consumer is 0.03. Estimates of $\mu$ for finite-lived consumers range from 0.500 to 0.034 depending on expected future lifespan.

| Lifetime (Age) | $MPC_{WEALTH} = \mu(T)$ |
|:---:|:---:|
| 1 (100+) | 0.500 |
| 5 (89) | 0.175 |
| 10 (77) | 0.102 |
| 20 (62) | 0.062 |
| 40 (39) | 0.041 |
| 60 (18) | 0.034 |
| $\infty$ | 0.030 |

## 2.6 Tables

Table 2.1: $MPC_{GAINS}$ by Age (Not Moving; $\theta = 1, \gamma = 1$)

| Lifetime | Tenure | | | | | |
|---|---|---|---|---|---|---|
| (Age) | 1 | 5 | 10 | 20 | 40 | 60 |
| 1 (100+) | 0.500 | | | | | |
| 5 (89) | 0.154 | 0.154 | | | | |
| 10 (77) | 0.077 | 0.077 | 0.077 | | | |
| 20 (62) | 0.034 | 0.034 | 0.034 | 0.034 | | |
| 40 (39) | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | |
| 60 (18) | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |

Table 2.2: Marginal Effect of Mobility on $MPC_{GAINS}$– Future home has same price appreciation, and is initially 50% less expensive

| Lifetime | Tenure | | | | | |
|---|---|---|---|---|---|---|
| (Age) | 1 | 5 | 10 | 20 | 40 | 60 |
| 1 (100+) | 0.000 | | | | | |
| 5 (89) | 0.095 | 0.000 | | | | |
| 10 (77) | 0.062 | 0.050 | 0.000 | | | |
| 20 (62) | 0.044 | 0.037 | 0.029 | 0.000 | | |
| 40 (39) | 0.034 | 0.029 | 0.024 | 0.016 | 0.000 | |
| 60 (18) | 0.031 | 0.027 | 0.023 | 0.016 | 0.007 | 0.000 |

Table 2.3: Marginal Effect of Mobility on $MPC_{GAINS}$– Future home has same price appreciation, and is initially 50% more expensive ($\theta = 1, \gamma = 1.5$)

| Lifetime | Tenure | | | | | |
|---|---|---|---|---|---|---|
| (Age) | 1 | 5 | 10 | 20 | 40 | 60 |
| 1 (100+) | 0.000 | | | | | |
| 5 (89) | -0.095 | 0.000 | | | | |
| 10 (77) | -0.062 | -0.050 | 0.000 | | | |
| 20 (62) | -0.044 | -0.036 | -0.029 | 0.000 | | |
| 40 (39) | -0.034 | -0.029 | -0.024 | -0.016 | 0.000 | |
| 60 (18) | -0.031 | -0.027 | -0.023 | -0.016 | -0.007 | 0.000 |

Table 2.4: Marginal Effect of Migration on $MPC_{GAINS}$– Future home has double the price appreciation, and is initially 50% more expensive ($\theta = 2, \gamma = 1.5$)

| Lifetime | Tenure | | | | | |
|---|---|---|---|---|---|---|
| (Age) | 1 | 5 | 10 | 20 | 40 | 60 |
| 1 (100+) | 0.000 | | | | | |
| 5 (89) | -0.381 | 0.000 | | | | |
| 10 (77) | -0.249 | -0.201 | 0.000 | | | |
| 20 (62) | -0.175 | -0.146 | -0.115 | 0.000 | | |
| 40 (39) | -0.136 | -0.117 | -0.097 | -0.064 | 0.000 | |
| 60 (18) | -0.125 | -0.109 | -0.091 | -0.064 | -0.029 | 0.000 |

# Chapter 3

# An Empirical Examination of the Wealth Effects from Home Price Appreciation

## 3.1   Empirical Analysis

Estimation of the wealth effect from home price appreciation is made difficult by the lack of appropriate data. Datasets tend to have good information on either expenditures or on wealth. Those that contain both types of information are generally limited in scope. The Health and Retirement Study (HRS) contains excellent data on both expenditures and wealth; however, it focuses entirely on households aged 50 and over, and is therefore unsuitable for examination of wealth effects across the age spectrum. Other surveys with information on asset and expenditure data, such as the CEX, lack any panel component. These data limitations have led many to create synthetic panels of data, including Skinner (1989) and Campbell and Cocco (2005), and others to use aggregate data (Case, Quigley, and Shiller 2005).

More recent waves of the PSID offer a solution to this problem. For the five year periods

ending in 1989, 1994 and 1999, and biannually ever since, the PSID has asked respondents for detailed data on wealth stocks and flows that can be used to impute household expenditures over those periods. Earlier studies, such as Engelhardt (1996) and Juster, Lupton, Smith, and Stafford (2006) have also used this method to evaluate wealth effects. I follow these authors and construct a measure of non-housing "active savings" for each household $i$, consisting of purchases of assets, net of capital gains. It is equal to the change in total non-housing wealth over the period, less capital gains, inheritances and gifts, and net transfers of assets by people moving into or out of the household.[1] Active savings represents the amount of current income that is saved, rather than spent. Thus, all else equal, an increase in active savings represents an equivalent decrease in consumption.

I use the fixed effects estimator to estimate the effect of capital gains on non-housing active savings ($AS$). Fixed-effects regression allows a separate intercept $\alpha_i$ for each household $i$, eliminating any bias that may come from time-invariant household-specific omitted variables such as household-specific preferences for savings. The fixed effects estimator allows this intercept to be correlated with other explanatory variables $X$, such as income. This estimation method is equivalent to a regression of deviations from household-specific means.

$$AS_{i,t} = X_{i,t}\beta + \alpha_i + \epsilon_{i,t} \tag{3.1}$$

[1]Total non-housing wealth is generated and reported by the PSID for the years 1989, 1994, 1999, 2001, and 2003. I calculate total non-housing wealth for 1984 by subtracting net housing equity from total wealth.

Explanatory variables include age of the household head, housing capital gains (in dollars), stock market capital gains (in dollars), average family income, and change in family income. I use the White heteroskedasticity- consistent variance estimator, and allow errors to be correlated within households.

Dummy variables for each year are included to capture the effect of interest rate changes or other macroeconomic factors that could affect household savings behavior. (This could be written as a time-invariant error term in the regression equation, $\alpha_t$). Regressions are estimated for households that were homeowners over the entire period.[2]

### 3.1.1  Data

The PSID is a longitudinal study conducted annually between 1968 and 1997 and biannually ever since. Home value and demographic data are available from 1968 onwards. As discussed, active savings for each household can be calculated on a periodic basis for the years 1989-2003.

The specific wealth categories used to calculate active savings include net purchases of stocks, annuities, real estate (other than the primary home), net investments in farms or businesses, and changes in non-collateralized debt.[3] Active savings for household $i$

---

[2]Regressions were also estimated including households that transitioned from owning to renting over the period, calculating capital gains as the sum of capital gains for periods in which they were owners. Results are were very similar to those including only households that remained owners throughout the period, and are available upon request.

[3]In 1999, 2001 and 2003, respondents were asked specifically about holdings of private annuities or IRAs. Prior to 1999, holdings of stocks or bonds in IRAs were considered part of stock holdings or "other assets".

between periods $t$ and $t + j$ is calculated as follows:

$$\text{Active Saving}_{i_{t,t+j}} = \Delta\text{non-housing wealth}_{i_{t,t+j}} - \text{Financial Capital Gains}_{i_{t,t+j}}$$

I exclude any cases with inheritances or transfer of assets by movers into or out of the household because the form of the asset inherited or transferred is not reported in the PSID, but does affect calculation of capital gains and active savings. Table 3.1 illustrates this problem.[4]

Capital gains over the wealth reporting period $t, t + j$ are calculated for assets in non-home real estate, farm or business, stocks, and IRAs (including private annuities).

$$\text{Capital gains}_{i_{t,t+j}} = (\text{Real estate value}_{i_{t,t+j}} - \text{Real estate value}_{i,t}) -$$

$$(\text{Real estate purchases}_{i_{t,t+j}} - \text{Real estate sales}_{i_{t,t+j}}) + (\text{Business value}_{i_{t,t+j}} -$$

$$\text{Business value}_{i,t}) - (\text{Business purchases}_{i_{t,t+j}} - \text{Business sales }_{i_{t,t+j}}) +$$

$$(\text{Stock value}_{i,t+j} - \text{Stock value}_{i,t}) - (\text{Stock purchases}_{i_{t,t+j}} - \text{Stock sales}_{i_{t,t+j}}) +$$

$$(\text{IRA value}_{i_{t,t+j}} - \text{IRA value}_{i,t}) - (\text{IRA purchases}_{i_{t,t+j}} - \text{IRA sales}_{i_{t,t+j}})$$

The term "stock" is used loosely to refer to stock in publicly held corporations, mutual funds, and investment trusts. Before 1999, "stocks" also includes stocks held in IRAs. From 1999 onwards, holdings in IRAs are reported. Before 1999, capital gains

---

[4]Had these cases been included, any inheritance or transfer should also be subtracted from active savings because they represent changes in wealth that are unrelated to income or consumption.

in stock portions of the IRA would be captured in the measure stock gains. Capital gains in government or corporate bonds are missed throughout the interview period, as bonds are only captured in "other assets", for which purchase and sale questions are not included.

Calculation of housing and stock capital gains variables that are used as explanatory variables must account for the timing of any gains experienced in that wealth reporting period. As discussed in Section 2.3, any gain or loss should affect consumption (and active saving) permanently. Consider the wealth reporting period 1984-1989. A gain or loss incurred between 1984 and 1985 should affect active savings for every year of the five year period, whereas a gain incurred between 1988 and 1989 should affect active savings for only one year. To account for this effect, I multiply each annual gain by the number of years that it should affect consumption in that wealth reporting period. If a gain variable is not available annually (e.g. stock gains, and post-1997 house gains), I multiply the gain by the average number of years it might affect consumption over the wealth reporting period.

For example, suppose wealth and real estate improvements are reported at periods t and t+5, and home values are reported annually. In that case, housing capital gains are as follows:

Housing capital $\text{gains}_{i_{t,t+5}} = 5 * \text{gains}_{i_{t,t+1}} + 4 * \text{gains}_{i_{t+1,t+2}} + 3 * \text{gains}_{i_{t+2,t+3}} + 2 * \text{gains}_{i_{t+3,t+4}} + 1 * \text{gains}_{i_{t+4,t+5}} - 3 * \text{improvements}_{i_{t,t+5}}$

Housing capital gains are calculated only for periods in which the household was a homeowner, and are set equal to zero for any period in which the household moves. There are several instances in which households don't report having moved, but do report a change in ownership status with a corresponding change in home value. Capital gains for any period in which there is an ownership transition (even without a move) are set equal to zero.

Average family income for a wealth reporting period is the simple average of annual incomes. I annualize flow variables by taking the average over the pertinent period, and convert all wealth and income variables to real, 1996 dollars.

Exclusion of changes in housing wealth from active saving relies on the implicit assumption that active saving in housing does not change in response to windfall housing gains. In other words, I assume that homeowners do not alter their mortgage payments or make home improvements when home values unexpectedly rise. This assumption seems more reasonable for earlier years of data: the percentage of households reporting additions or improvements to real estate over the PSID's $10,000 threshold rises from 8% over the five year period between 1984 and 1989 (1.6% per year) to 8% over the two year period 2001-2003 (4% per year). If housing gains do encourage households to make real estate improvements, excluding improvements may understate active savings.'

I break households into three categories, depending on the age of the household head. Category 1 includes households aged 34 and under. Category 2 includes households

aged 35 through 49. Category 3 includes households aged 50 and older. Each age group represents approximately one third of the sample.

My analysis relies on calculating changes in household wealth variables. If the reported level of a variable is top coded or bottom coded, it is impossible to calculate true changes in the level of that variable. Consequently, I exclude all top- or bottom-coded observations, rather than Windsorizing censored data. Several cases are dropped to keep bottom coding consistent across years. Stock value, business value, non-home real estate value, net proceeds from sale of business, net proceeds from sale of real estate, and net proceeds from sale of stock all report negative values in 1989, but not in other years. Business value only reports negative values in 2003. I exclude all cases with negative values for these variables. I also drop observations for which the respondent replied "don't know" or refused to answer.

Visual inspection of PSID data suggests that outliers due to coding error may obscure the relationships between the explanatory variables and active savings. For example, a household reported a nominal home value of $4,000 in 1991, $35,000 in 1992, $3,000 in 1993, and $5,500 in 1994, and did not report moving in that time frame. The reported value of $35,000 should likely represent a value of $3,500. I drop cases such as this by excluding cases for which active savings, % capital gains in stocks, % capital gains in housing, and annualized change in family income fall within the top or bottom 1% of observations. I also exclude the the top 1% of observations of average family income as

outliers.[5] The number of cases that are dropped by excluding outliers is noted in Table 3.2, and their effects on summary statistics are shown in Table 3.3.

### 3.1.2 Regressions Examining Effect of Age

I begin with a baseline regression that forces the relationship between capital gains and active savings to be constant across households of different ages. As illustrated by the model in Section 2.3, the response of active savings to capital gains should depend on the age of the household, so this regression is not likely to represent the true effects of home price appreciation on savings.

The point estimate for housing capital gains is equal to zero, rather than negative as the model predicts. This finding is consistent with those of Engelhardt (1996) and Juster, Lupton, Smith, and Stafford (2006), who also find zero effect of housing gains when using household-specific fixed effects. This finding could be driven by the age effect of young households, who have very little predicted effect of changes in housing wealth on consumption. It could also reflect heterogeneous household mobility: a zero effect would be consistent with some households planning to move into more expensive homes, and others planning to stay in their homes or downsize. The estimated effect of stock gains is also zero, rather than negative as predicted by the model.

---

[5]The % capital gain in home is the only variable that is available every interview between 1984 and 2003. If a household's reported housing capital gain is in the top or bottom 1% of observations for a given year, then the household is marked as an outlier for the entire reporting period. For example, suppose a household reports a housing capital gain in 1992 that is in the 99th percentile. The household would be marked as an outlier for the entire 1989-1994 wealth reporting period. All other variables are available only once in each wealth reporting period.

The coefficient on average annual income should approximate the active saving rate, the average proportion of income converted to non-housing active saving. The estimated coefficient on this variable has the expected positive sign, and is equal to 0.07. Annualized change in family income is included to proxy for expected future income growth, and is expected to have a negative coefficient. Households with high past income growth may expect to have high future income growth, and would save less out of current incomes than households with lower expected income growth rates. The coefficient on this variable is not significantly different from zero at the 10% level.

Regression II allows the response of active savings to capital gains to vary by age. Solutions to the model in Section 2.3 suggest that, all else equal, the link between active savings and capital gains should be negative, and that the strength of this relationship should increase with age. Results of this regression support the model's general pattern of predictions by age. The coefficient on housing gains for older households is significantly more negative than that for young households (the omitted age category) at the 5% level. The coefficient on housing gains for young households is equal to 0.15, suggesting that they increase active savings when home prices rise. The omitted mobility variable helps explain this response. The majority of households who move from one owner-occupied home to another move into more expensive homes, and young households are more likely to move than older households. If young households plan to move into more expensive homes within the same geographical area, they should increase active savings when home prices rise.

The estimated responses for households aged 35 and older are both -0.01, equal to

$MPC_{GAINS}$ of 0.01. Holding mobility constant, households aged between 35 and 50 have a predicted $MPC_{GAINS}$ of 0.012– almost exactly the value estimated by the regression. Households aged 50 and older have a predicted $MPC_{GAINS}$ equal to 0.034. The slightly lower estimated response could reflect presence of a bequest motive, though the predicted value is within the 95% confidence interval around the estimate.

The estimated responses to stock market gains are negative for all age groups, though none of are significantly different from zero at the 10% level. This result is surprising. Assets held in stocks do not have the associated "user cost" associated with owner-occupied housing, so economic wealth should change by the full amount of any stock capital gains or losses. In the absence of liquidity constraints, transaction costs, or other market frictions, the relationship between stock market gains and and active savings should be determined by the household's age-appropriate $MPC_{WEALTH}$. As shown in the Appendix, the predicted effect of a dollar increase in stock market wealth on active savings for the youngest group should be between -3.4 cents and -4.1 cents. Though these values are well within the 95% confidence interval around the point estimate, the lack of precision around estimates for stock gains suggests that other factors may be affecting the relationship between stock gains and active savings. Estimated responses to average family income and change in family income are virtually unchanged from those estimated in Regression I.

I also experiment with dropping households with major changes in family composition, such as marriage, divorce, or a new head of household, in case active savings for these households changes for reasons that are not directly related to changes in wealth or

income. I find that dropping households with major changes in family composition has little effect.

### 3.1.3 Predicting Expected Mobility

I introduce expected mobility by predicting the expected value of a future home for each household.

Using an unbalanced panel of PSID homeowners over the period 1975 through 2003, I estimate each household's likelihood of making at least one move in the next 10 years, and the relative value of the future home[6]. Due to limited data availability, I am only able to predict whether the household is likely to move into a more or less expensive home, not whether the households is likely to migrate to another geographical area. I then use the coefficients from the mobility estimates to predict the expected value of a future home for each household in the active savings sample.

I jointly estimate the likelihood of moving and relative value of a future home purchase using a maximum-likelihood Heckman sample selection procedure. Presumably, the factors that affect a household's decision to move are related to the factors determining the quantity of housing purchased in case of a move. For example, households facing very high moving costs would move less frequently, and make larger adjustments to household consumption when they do move. If moving costs are not perfectly measured, this could result in a negative correlation between the household's probability of moving and relative trade value. This correlation between the error terms means that estimating a

---

[6]Due to data limitations, the actual time horizon used varies between 10 and 11 years in the future.

35

household's relative value of a trade by using OLS on a sample of trade values for mover households would yield biased results. The maximum likelihood Heckman selection procedure corrects for this bias (Greene 2003).

Whether or not the household chooses to move is represented by the following equation:

$$z_{i,t}^* = \mathbf{w'_{i,t}}\gamma_{\mathbf{i,t}} + u_{i,t} = 1 \text{ if } z_{i,t}^* > 0, \text{ and } 0 \text{ otherwise} \tag{3.2}$$

$z_i^*$ is not directly observed- instead, we observe only whether the household moves ($z_i = 1$) or doesn't move ($z_i = 0$). The quantity of housing that a household chooses to purchase, $y_i$, is only observed if the household moves. $\rho$ is the correlation between the error of the selection equation (Equation 3.2) and the regression equation (Equation 3.3).

$$y_{i,t} = \mathbf{x'_{i,t}}\beta_{\mathbf{i,t}} + \epsilon_{i,t} \text{ observed only if } z_i^* > 0 \tag{3.3}$$

$$(u_i, \epsilon_i) \sim \text{bivariate normal } [0, 0, 1, \sigma_\epsilon, \rho]$$

I allow errors to be correlated across time within households, and exclude any cases for which the relative value of the new home falls in the top or bottom 1% of outliers.

The quantity of housing purchased is a function of observed covariates $x_i$, which include age of household head (in decades), sex of head of household, marital status (married or unmarried), whether the household is currently employed, family size, change in family

size over the past 2 years, average family income over the past four years (in $1,000's), change in family income over the past four years (in $1,000's), and home value (in $1,000's). Following Boehm, Herzog, and Schlottman (1991) in their study of mobility, migration, and tenure choice, I include the number of moves made by the household over the past four years to proxy for household-specific mobility preferences.

The selection equation modelling whether or not the household moves depends on most of the preceding variables, except that the change in family size is included as its absolute value. Although whether the family is growing or shrinking should affect affects whether it desires more or less housing, only the absolute value of that change should determine whether the household chooses to move. The selection equation also includes responses to the question, "Would you say you definitely will move (in the next few/ couple of years), probably will move, or are you more uncertain?"[7].

Results are presented in Table 3.4. The first panel of the table displays estimates of the relative value of the household's future home, and the second panel demonstrates how each covariate affects the household's probability of moving.

Dummy variables representing each household's self-reported likelihood of moving have the greatest numerical importance on whether or not the household moves in the next 10 years. Households that don't plan to move are the omitted group. House-

---

[7]This question was asked in every wave of the sample except 1994 and 1995. In 1994, households were instead asked for the probability that they might move. I used each household's reported probability to assign it a value of 'definitely", "probability", "uncertain" or "not moving". Categorizing probabilities of less than 21 as "not moving", between 21 and 51 as "uncertain", between 51 and 95 as "probably" and greater than 95 as "definitely" resulted in a similar proportion of respondents in each group as is observed for 1992, 1993, and 1996.

holds that report they "definitely" will move are much more likely to move than other households. Those that report they "probably" will move or are "more uncertain" about moving are also more likely to move than households who don't plan to move. The probability of moving decreases with age, likely reflecting more stable employment and less need for additional space caused by growing families. Households who have moved more frequently over the past four years are, as expected, more likely to move. Households with a married or employed head are less likely to move. Those with larger families are less likely to move, having already adjusted housing consumption as needed. Neither average family income, change in family income, nor house value has much effect on the household's probability of moving.

The relative value of the future home ($\gamma$) is measured relative to a base value of 100. A household that moves into a 10% more expensive home would have a trade value of 110. The estimated value of $\gamma$ decreases with the age of the household head, consistent with the notion that older households are more likely to move into less expensive homes. $\hat{\gamma}$ also decreases with the number of moves made by the household over the past four years. Households that are employed tend to move into more expensive homes, likely due to better future earning prospects. Households with larger families tend to move into less expensive homes. These households have likely already adjusted their housing consumption accommodate their current household members, and any future move would be to decrease housing expenses. Growing families, represented by recent increases in family size, move into more expensive homes. The relative value of the new home also increases with higher current income, though past changes in family income have little

numerically or statistically significant effect. The relative value of the future home decreases with the value of the household's current home. This likely reflects households consuming the most housing in middle age, and decreasing housing consumption later in life.

Point estimates of variables in both equations are generally statistically significant at the 5% level. The sign of each variable's effect on the household's probability of moving are also consistent with Boehm, Herzog, and Schlottman (1991). A Wald test finds that independence of the moving and trade value equations can be rejected at the 1% confidence level.

I use coefficients estimated from the mobility model for data between 1975 and 2003 to predict mobility for households in the active savings sample. I calculate each households expected value of a trade as follows, where $\hat{\lambda}$ is the household's estimated probability of moving, and $\hat{\gamma}$ is the predicted relative trade value. Not moving is equivalent to a relative trade value of 100.

$$E[\text{trade}] = \hat{\lambda} * (\hat{\gamma}) + (1 - \hat{\lambda}) * (100)$$

A household with zero probability of moving would have an expected trade value of 100. Households that are likely to move into more expensive homes will have expected trade values greater than 100, while households that are likely to move into less expensive homes will have trade values less than 100. The magnitude of the distance from 100 depends on both the probability of moving and the relative value of the new home.

The average sample household has a 52% probability of moving within the next 10 years, and is likely to move into a house that is 16% more expensive. Statistics summarizing predicted likelihood of moving within the next 10 years, relative trade value, and expected value of a trade are reported in Table 3.5.

### 3.1.4 Regressions Examining Effect of Mobility

I examine the effect of expected mobility by restricting Regression II to households with different mobility characteristics. If home prices move together and future mobility is an important factor in determining household savings and consumption decisions, households that expect to move into more expensive homes should increase consumption when home values rise, and households that plan to move into less expensive homes should decrease consumption when home values rise. Results for these regressions are reported in columns III and IV of Table 3.3.

Regression III restricts the sample to households with (predicted) expected trade values greater than 105% of their current home's value. This group includes households with high probabilities of moving into slightly more expensive homes, and households with low probabilities of moving into much more expensive homes. Restricting the sample to households that are predicted to move into more expensive homes has little effect on the young group of households. The coefficient on housing gains for young households (the omitted group) is 0.14, and is statistically significantly different from zero at the 10% level.

Summarizing predicted expected trade values by age helps explain why restricting the sample to households that expect to move into more expensive homes has very little effect on the estimated response for young households. As shown in Table 3.6, the average young household has an expected trade value of 116. Restricting the sample to households with trade values greater than 105 eliminates less than 25% of young households.

Surprisingly, restricting the sample to households that expect to move into more expensive homes results in larger savings offsets for the middle aged and older groups of households. The estimated $MPC_{GAINS}$ for the middle aged group of households is approximately 0.05, much larger than the 0.01 cent estimated for the entire sample. Older households have a savings offset that is 27 cents lower than that of young households, equivalent to an estimated $MPC_{GAINS}$ of 0.13.

The increased savings offset for middle and older households may reflect greater substitutability between housing and non-housing consumption for those groups of households. Unlike younger households, older households are less likely to require more space to accommodate growing families. Older households who are more likely to move into more expensive homes may more readily substitute towards non-housing consumption if home prices rise, rather than increasing non-housing savings so that they can afford a more expensive home in the future. These households may also substitute towards housing consumption if home prices fall.

The estimated coefficients on stock market gains become slightly more negative than

those in Regression II, though they are still not significantly different from zero at the 10% level. Coefficients on average family income and change in family income are largely unchanged from those estimated using the full sample.

Regression IV restricts the sample to households with (predicted) expected trade values less than 90% of their current home's value[8]. The pattern of coefficients across age groups remains similar those estimated using the entire sample- young households have positive responses, while the middle aged and older groups of households have slightly negative responses. The coefficient on housing gains for young homeowners becomes more positive- the opposite direction than what is expected. Young households (the omitted group) that are predicted to move into less expensive homes increase non-housing active savings by 49 cents for each dollar in housing gains. Though this estimate has a large standard error, a 95% confidence interval around the estimate still excludes zero. One possible explanation for this puzzle is that very few young households actually expect to move into less expensive homes. Examination of responses to the PSID question "Why might you move" supports this hypothesis. Between 1975 and 1993 (years for which detailed responses to this question were available), only 0.6% of households in the youngest age group reported that they might move to contract housing, compared to 1.3% of the middle aged group and 2.3% of the older group. The positive relationship between active savings and home prices for young homeowners may reflect their general expectation that any move would be into a more expensive home. Even

[8]I also try restricting the sample to households with expected trade values less than 95% of their current home's value, however, an F-test can't reject joint insignificance of all of the explanatory variables at the 10% level.

if young households expect their probability of migrating to a different area to be high, they may respond to the uncertainty of whether it would be a more or less expensive area by increasing savings when their own home price rises.

Another explanation is that some young homeowners do plan to move into less expensive homes, and that they are reallocating wealth in anticipation of future changes in housing consumption. If households respond to rising prices by using home equity to purchase non-housing assets, the coefficient on housing gains will have a positive bias.

Estimates from the restricted sample for middle-aged and older households move in a direction that is consistent with the model's predictions. With point estimates of -0.03 and -0.02, respectively, these coefficients are slightly more negative than those in Regression III. Tables 2.1 and 2.2 suggest that if households plan to move into homes that are initially 50% less expensive 5 years in the future, households in the middle age group should offset savings by approximately 4 cents for each dollar in housing gains, and households in the older age group should offset savings by approximately 7 cents. The theoretical coefficients for both of these age groups fall easily within the 95% confidence intervals around the coefficient estimates for these groups of homeowners.

The coefficient on average family income, which was positive in the full sample, is negative and not statistically significant in the restricted sample.

## 3.2 Conclusion

This paper demonstrates how age and expected mobility should affect the responsiveness of consumption and saving behavior to capital gains. Section 2.3 demonstrates that the theoretical $MPC_{GAINS}$ is an increasing function of age and a decreasing function of the relative initial value and appreciation rate of a future home. The effect of mobility on $MPC_{GAINS}$ decreases with the time until a move. This paper also illustrates how the response of consumption to housing capital gains should differ from the response of consumption to changes in the value of other types of assets, such as stock market gains.

This paper is the first to establish a significant empirical link between between housing and consumption using household-specific fixed effects on a true data panel. Section 3.1 of this paper illustrates the importance of allowing responses to housing gains to vary by age. Restricting the coefficient on capital gains to be constant across households may explain why Juster, Lupton, Smith, and Stafford (2006) find no significant effect of housing on active savings, despite using a similar fixed effects strategy on PSID data. I find that households under the age of 35 increase active savings by approximately 15 cents for each dollar in housing gains, equivalent to an $MPC_{GAINS}$ of -0.15. Households aged 35-50 decrease active savings between 1 and 5 cents for each dollar in housing gains ($MPC_{GAINS}$ in the range of 0.01 and 0.05), and households aged 50 and over decrease active savings by up to 13 cents for each dollar in housing gains ($MPC_{GAINS}$ equal to 0.13.) Regression results support the theory that mobility also affects $MPC_{GAINS}$,

though not always as expected. For homeowners aged 35 and over, restricting the sample to those that expect to move into less expensive homes results in a slightly larger $MPC_{GAINS}$.

Empirical results also highlight the importance of separating capital gains into different asset classes. The theory presented in Section 2.3 illustrates that asset classes are not fungible- a dollar in housing capital gains should have a different impact on consumption than a dollar in stock capital gains, even in the absence of market frictions. My estimates support the aggregate-level results of Case, Quigley, and Shiller (2005) that find housing gains have a larger impact on consumption than stock market gains.

## 3.3   Tables

Table 3.1: Illustration of Potential Effects of Inheritances, Gifts, and Transfers of Assets by Movers In and Out on Active Savings

| | Inheritance Type | A Inheritance Amount | B Δ Wealth | C Capital Gains | B-A-C Active Saving |
|---|---|---|---|---|---|
| 1 | Non-home property | $10,000 | $10,000 | $10,000 (Δ property value) | -$10,000 |
| 2 | Cash | $10,000 | $10,000 | $0 | $0 |

Consider a household that receives an inheritance of real estate worth $10,000 in 1994. In response to the question "During the last five years, have you (or anyone in your family living there) received any inheritances of money or property worth $10,000 or more?" (G228, 1994) the household responds "yes", and to the question "How much was it worth altogether, at that time?" (G230, 1994) the household responds "$10,000".

The inheritance would increase the "real estate" asset category by $10,000. The household would likely answer "No" to the question "Since January 1989, did you (or anyone in your family living there) buy any real estate other than your main home, such as a vacation home, land, or rental property?" (question G164, 1994), causing the increase in real estate holdings due to the inheritance to be attributed to capital gains. Both inheritances and capital gains are subtracted from the change in total wealth, resulting in an active saving decrease of $10,000.

If instead the household instead inherited $10,000 cash, it would cause non-home wealth to rise by $10,000 without affecting capital gains. The cash inheritance would have no effect on active savings.

Transfers of assets into or out of the household by people moving would similarly affect results.

Table 3.2: Number of Cases with Inheritances, Transfers, and Outlying Observations

|  | | 1989 | 1994 | 1999 | 2001 | 2003 |
|---|---|---|---|---|---|---|
| Inheritance/ Transfers | 455 | 437 | 454 | 318 | 320 | |
| **1% Outliers** | | | | | | |
| Home % kgains | | | | | | |
| | high | 34 | 44 | 32 | 33 | 33 |
| | low | 34 | 43 | 32 | 33 | 39 |
| Home % kgains, periodic effect | | | | | | |
| | | 211 | 298 | 243 | 66 | 72 |
| Active Saving | | | | | | |
| | high | 48 | 49 | 42 | 57 | 60 |
| | low | 48 | 49 | 42 | 57 | 60 |
| Average family income | | | | | | |
| | high | 74 | 120 | 104 | 75 | 79 |
| Change in family income | | | | | | |
| | high | 53 | 56 | 50 | 63 | 67 |
| | low | 53 | 56 | 50 | 63 | 67 |
| | | | | | | |
| Total Outliers (full set, some intersect) | | 435 | 567 | 495 | 325 | 357 |

Table 3.3: Active Savings is Dependent Variable

| | I | II | III | IV | Means | Means |
| | | Interact | Likely | Likely | Full | Drop |
| | Baseline | Age, Gains | Up | Down | Sample | Outliers |
|---|---|---|---|---|---|---|
| Active Saving | | | | | 1778.94 | 1888.47 |
| | | | | | (562.67) | (170.08) |
| Age 35-49 | -339.59 | -346.66 | 278.40 | 18812.84 | 42.24 | 42.21 |
| | (1020.48) | (1019.70) | (1332.77) | ( 11165.50) | (4.14) | (4.14) |
| Age 50+ | 2202.33 | 2197.86 | 4755.42 | 18404.40 | 63.90 | 63.68 |
| | (1557.53) | (1555.37) | (2455.51) | (11626.11) | (10.35) | (10.28) |
| House K Gain | 0.00 | 0.15 | 0.14 | 0.49 | 1277.72 | 1194.59 |
| | (0.01) | (0.06) | (0.08) | (0.21) | (140.81) | (95.79) |
| (Age 35-49)*home gains | | -0.16 | -0.19 | -0.52 | | |
| | | (0.07) | (0.09) | (0.22) | | |
| (Age 50+)*home gains | | -0.16 | -0.27 | -0.51 | | |
| | | (0.07) | (0.09) | (0.21) | | |
| Stock K Gain | -0.01 | -0.05 | -0.10 | -0.90 | 756.10 | 684.69 |
| | (0.00) | (0.11) | (0.11) | (0.63) | (1488.46) | (670.20) |
| (Age 35-49)*stock gains | | 0.03 | 0.03 | 0.90 | | |
| | | (0.11) | (0.11) | (0.63) | | |
| (Age 50+)*stock gains | | 0.04 | 0.10 | 0.88 | | |
| | | (0.11) | (0.11) | (0.63) | | |
| Avg. fam Y | 0.07 | 0.07 | 0.09 | -0.04 | 62534.10 | 55884.87 |
| | (0.02) | (0.02) | (0.05) | (0.06) | (628.46) | (324.29) |
| $\Delta$ in famY | 0.02 | 0.03 | -0.01 | 0.07 | 1722.15 | 1661.02 |
| | (0.05) | (0.05) | (0.09) | (0.15) | (198.75) | (66.83) |
| Observations | 11158 | 11158 | 4630 | 2491 | 12381 | 11183 |
| Households | 5195 | 5195 | 2680 | 1489 | | |

Standard errors are in parentheses. Intercept and year coefficients are excluded.

Housing gains are calculated using annual and biannual data, while other variables are
  available less frequently. Thus, mean housing gains are calculated from more observations
  than other variables.

"Likely up" includes households with expected trade values greater than 105.

"Likely down" includes households with expected trade values less than 90.

Table 3.4: Mobility Estimates: Heckman Selection Model

| Variable | Coefficient | (Std. Err.) |
|---|---|---|
| Equation 1 : Relative Trade Value (100=same price) | | |
| Age (in decades) | -9.63 | (2.06) |
| # moves in past 4 years | -13.49 | (1.82) |
| Married (1=yes) | 23.85 | (6.16) |
| Currently employed (1=yes) | 22.44 | (6.16) |
| Family size | -7.30 | (1.64) |
| $\Delta$ family size | 4.91 | (1.64) |
| Average family Y (in $1000's) | 0.54 | (0.07) |
| $\Delta$ family income (in $1000's) | 0.06 | (0.04) |
| House value (in $1000's) | -0.39 | (0.04) |
| Equation 2 : Selection Equation- Probability of Moving | | |
| will "definitely" move within 3 yrs. | 1.33 | (0.05) |
| "probably" move within 3 yrs. | 0.87 | (0.04) |
| "uncertain" about moving | 0.61 | (0.04) |
| Age (in decades) | -0.13 | (0.01) |
| Sex of head (1=male) | 0.27 | (0.07) |
| # moves in past 4 years | 0.25 | (0.02) |
| Married (1=yes) | -0.26 | (0.06) |
| Currently employed (1=yes) | -0.24 | (0.04) |
| Family size | -0.06 | (0.01) |
| $\Delta$ family size, absolute value | -0.01 | (0.01) |
| Average family Y (in $1000's) | 0.00 | (0.00) |
| $\Delta$ family income (in $1000's) | 0.00 | (0.00) |
| House value (in $1000's) | 0.00 | (0.00) |
| athrho | -0.14 | (0.03) |
| lnsigma | 4.98 | (0.08) |

Table 3.5: Summary Statistics: Likelihood of Moving, Relative Trade Value

| Estimated Variable | Mean | Standard Deviation |
|---|---|---|
| Probability of Moving within next 10 years- $\hat{\lambda}$ | 0.52 | 0.19 |
| Relative Trade Value $\hat{\gamma}$ | 116.58 | 86.95 |
| E[Trade] | 102.2 | 29.4 |

Table 3.6: Predicted Expected Trade Value, by Age

| Age Group | Mean | Standard Deviation |
|---|---|---|
| Age $< 35$ | 115.96 | 25.50 |
| Age 35-49 | 105.37 | 29.65 |
| Age 50+ | 93.45 | 27.68 |

# Chapter 4

# Recession Dynamics in the Markets for New and Existing Homes

## 4.1 Introduction

Housing is key to the well-being of the overall macroeconomy. Comprising 32% of total household assets, changes in the stock of housing wealth have significant impacts on household spending (Bucks, Kennickell, Mach, and Moore 2009) [1] [2]. Furthermore, investment in new housing plays a pivotal role in declines in GDP growth during contractions (Leamer 2007, Falk and Lee 2004). Increased awareness of housing's importance in determining economic fluctuations has resulted in a growing body of literature about the determinants of home prices and new construction starts. However, fundamental questions about the relationships among housing market indicators, and their connections to other economic variables, remain unanswered. The benchmark model of home

---

[1] This figure includes all households, not just those that own homes.

[2] The impact of housing on economic household wealth is only partially offset by the present value of user cost. See Morris (2007)

price behavior fails to match stylized facts about housing starts and prices. Even basic questions regarding the flexibility of home prices and the nature of the relationship between new and existing homes- which are typically evaluated as separate "markets"- has received scant attention. This paper describes the behavior of six key housing market indicators in the four-year periods spanning peaks in economic activity, and offers general patterns to inform future models of the market for owner-occupied homes.

Standard Q-theory developed by Poterba (1984) ties home prices directly to construction costs. In long-run equilibrium, home prices equal construction costs. Whenever changes in demand cause home prices rise above construction costs, builders respond by increasing supply. Supply continues to increase until construction costs (which increase with construction demand) and prices are again in equilibrium. Poterba's model predicts that increases in demand should cause prices to increase, followed by an increase in new construction starts. Volumes and market times play no role in this model.

Empirical research has revealed several inconsistencies between the data and Poterba's standard Q model. Contrary to the predictions of Poterba's model, changes in new construction starts frequently precede changes in prices (Leamer 2007, Topel and Rosen 1988). Additionally, starts seem to depend largely on volume measures such as the inventory-sales ratio, as mentioned by Topel and Rosen (1988) and explored by Falk and Lee (2004). Finally, home prices appear to be less variable than Poterba's model predicts, with nominal home prices rarely falling.

The tendency of the housing market to exhibit fluctuations in starts, sales volumes, and

inventory-sales fluctuations, rather than prices, forces us to rethink the existing model of housing investment. This paper seeks to inform development of a new model of housing investment by establishing stylized facts for the single-family housing market. In keeping with the outsized role that housing plays in driving declines in GDP growth in recessions, I focus on business-cycle behavior during the 48 months surrounding the beginning of recession [3]. Contrary to prior literature, which typically focus on the behavior of either new homes or existing homes, I examine and compare the dynamics exhibited by new and existing homes.

I focus on empirical regularities of housing market indicators for both new and existing homes over the period 1963 to 2010, focusing on behavior during the 7 recessions occurring in this period: 1969, 1973, 1980, 1981, 1990, 2001, and 2007. Specifically, I focus on the movements of 4 variables for both new and existing homes: median home prices, inventories of unsold homes, home sales, the inventory-sales ratio (months supply) of unsold homes, and the movements of 2 variables for new homes only: time on market of new unsold homes and housing starts. I examine the behavior of these variables in the market for new homes over the period 1963-2010, and for existing homes over the period 1968-2010 [4].

I identify the following key regularities about the market for new and existing homes:

1. In general, new and existing homes exhibit similar behavior. The one notable exception to this pattern is the behavior of inventories.

_____

[3]NBER business cycle dates are used to identify recessions.

[4]Price and sales volume data are the only existing home indicators available from 1968 onwards. All other series are available from 1982 onwards.

2. Home prices are not good contemporaneous indicators of business cycles.

3. Sales volumes and starts are both leading indicators of recessions, both falling prior to prices.

4. Inventory behavior differs for new and existing homes. New home inventories are leading, procyclical indicators of new home price changes, while existing home inventories are much less cyclical, and have lower predictive power for home price changes.

5. The inventory-sales ratio is the strongest contemporaneous housing market indicator for both new and existing homes.

6. Both new and existing home sales appear to show similar dynamics. However, existing home sales exhibit much more persistence and less volatility than new home sales.

## 4.2 Business Cycle Behavior

We examine the behavior of single-family homes over the period 1963-2010, with a particular focus on the 48-month window surrounding each business cycle peak during that time period.

### 4.2.1   The Markets for New and Existing Homes

The housing market is comprised of two markets: new homes and existing homes. The market for used homes is over five times as large as that for new homes, with new home sales averaging 63,000 units per year and existing home sales averaging 336,000 units per year (see Table 4.1). Research on home prices typically studies price changes in a market without any consideration of potential pricing differences between new homes and existing homes (e.g., Case and Shiller (1989) and Capozza, Hendershott, and Mack (2004)). Research on inventories of unsold homes, sales volumes, and time to sale typically consider one market or the other (e.g., Falk and Lee (2004), Topel and Rosen (1988)), or use repeat sales indices that make no distinction between whether the first sale in the record was of a new construction home or an existing home (e.g. Anglin, Rutherford, and Springer (2003)).

One might argue that because the new and existing home markets compete for buyers, there is no reason to believe that conclusions drawn from one market wouldn't apply to the other. However, supplier decisions in the two markets could differ in ways that would affect pricing and sales dynamics. Suppliers of new homes (typically real estate developers) should operate as manufacturers of any durable good, factoring expected prices, construction costs, and inventory carrying costs into their decision to supply new homes. Supply (and eventual sales) of existing homes, on the other hand, may be correlated with factors that affect homeowners desire to alter their housing consumption. For example, large changes in employment-related mobility, or changes in birth, marriage,

or retirement rates, could each cause large exogenous changes in the supply of existing homes for sale. Unlike new home developers, suppliers of existing homes also must procure and consume new housing upon any sale, mitigating any effect of price changes on their decision (Morris (2007)).

Accordingly, in this paper I treat new and existing homes as two distinct series and compare findings across the two.

### 4.2.2 Data

I obtain national data for single-family housing indicators for both new and existing homes. The Census Survey of Construction (Census) provided monthly data on new home prices, sales, inventories, and starts over the period January 1963 through March 2010. Data on time on market for homes sold in a particular month are also obtained from the Census, from 1975 onwards. The National Association of Realtors (NAR) provided monthly data on existing home prices and sales volumes from January 1968 through March 2010, and data on inventories of unsold homes from January 1982 through March 2010 [5]. National data on time on market are not available for existing homes. I deflate all prices using the BLS CPI index for all items, less shelter.

---

[5]Special thanks to Thomas J. Doyle, Research Marketing Manager at the National Association of Realtors, for his asssitance providing these data series.

### 4.2.3 Prices

I begin by examining the behavior of prices. Home prices are important due to their effect on household balance sheets (though they may have lesser impacts on true household wealth, as shown in Morris (2007)), and for their presumed importance in determining new construction starts (Poterba 1984). Additionally, the price flexibility of long-lived durable goods such as new homes could have broad implications for the effectiveness of monetary policy at a macroeconomic level, as illustrated by Barsky, House, and Kimball (2007).

Poterba (1984) describes a Q-theory model of the housing sector in which households demand existing home structures to the point where the service flow from housing (i.e., marginal benefit from housing) equals the user cost of housing (i.e., the cost of owning and occupying a home, including after-tax depreciation and mortgage costs, repair costs, and any expected future capital gain or loss). In equilibrium, both of these are equal to the amount a household would pay to rent the same home. Increases in the supply of new homes come from new construction. Supply of new homes is tied directly to the prices of homes- as prices for homes rise relative to construction costs, builders increase construction and the stock of housing increases[6].

Poterba's model predicts that home prices are fully flexible, responding immediately to changes in demand. The model predicts a positive correlation between home prices and investment, and that home price changes should lead new construction starts.

---

[6]Poterba allows for an upward-sloping long-run supply curve that reflects increasing marginal costs due to scarce inputs.

In contrast to the predictions of Poterba's model, however, the prevailing view among academics has been that home prices tend not to be flexible downwards. In a 2007 paper, Leamer (2007) reassures readers who might be troubled by the possibility of falling home prices, writing "comfort yourself with the thought that home prices never go down; well almost never, and if they do, the decline is not very much." Genesove and Mayer (2001) devote an entire paper to the subject, exploring loss aversion as an explanation for observed downside price inflexibility in the Boston housing market in the 1990s. Barsky, House, and Kimball (2007) are among the few who question the conventional (empirical) wisdom, citing lack of evidence that new homes should have sticky prices.

More detailed microeconomic evidence has also historically shown little concern that home prices might fall. In its annual filing to the Securities and Exchange Commission for 2004, publicly-traded high-end home builder Toll Brothers makes no mention of the possibility that home prices might fall and adversely affect its business. Rather, it makes the general statement that "[o]ur business can be affected by changes in general economic and market conditions", and that the company faces the risk that it may be "unable to raise sales prices enough to compensate for higher costs" (Toll Brothers 2004). It is only recently that Toll Brothers' annual report offered language regarding falling prices. In its 2009 annual report, it discusses adding incentives (which would decrease the quality-adjusted price of housing) and discounting prices in efforts to reduce inventories of unsold homes (Toll Brothers 2009).

Figure 4.1 illustrates inflation-adjusted prices of new and existing single-family homes.

As expected, the prices of new and existing homes track each other closely, with the spread between the two tightening over the 1994-2009 period.

Figure 4.1 illustrates the resistance that home prices have historically shown to downside movements. With the exception of a few isolated episodes, existing home prices rarely fell. This downside resistance is even more clearly illustrated in a chart of nominal home prices (see Figure 4.2).

### 4.2.3.1   Recession Behavior

Figure 4.4 illustrates behavior of median (log) prices for new and existing homes over 4 year windows surrounding individual business cycle peaks occurring between 1969 and 2007, and Figure 4.3 shows average behavior across those peaks. Overall, the graphs demonstrate that home prices do not always fall during recessions, and that that new home prices tend to be more sensitive to downturns during recessions than existing home prices

New home prices tend to change very little in the 24 month period leading into a recession, falling on average by less than 2%. Once a recession begins, prices fall, on average, by an additional 8%. The 2007 recession had an unusually large impact on new home prices, with prices falling approximately 20% in the 24 months following the start of the recession. However, this behavior is not consistent across all recessions: new home prices actually rose during the 2001 recession, and remained relatively constant during the 1973 recession.

Prices of existing homes also change very little in the 24 month period leading into a recession. Despite a slight (3%) hump-shaped increase and decrease in the 2 year pre-peak period, on average, existing home prices are at the same point 24 months prior to a business cycle peak as they are at the month of the peak. Following the peak, existing home prices decline by approximately 4% over the following the 24 months. As with new home prices, this behavior is not consistent across all recessions: home prices rose slightly during the 1969 and 2001 recessions.

In general, existing home price declines appear later than those of new home prices. This can be at least partly explained by differences in construction of the two data series. New home sales data are based on data at the time a contract is signed or a deposit is accepted, whereas existing home sales statistics are based on the closing of a transaction. According to the Census website, the time between contract and closing on a new home is typically between 30 and 60 days. Thus, one would expect the same price change to show up in new home prices one to two months earlier than in existing home prices (U.S. Census 2007).[7]

Graphs in Figure 4.4 show that the 1981 and 2007 recessions are the only ones marked by sustained, dramatic declines in both new and existing home prices. In the 24 months prior to the 1981 and 2007 business cycle peaks, prices fell approximately 10% and 14%, respectively. Over the ensuing 14 months, prices continued to fall by an additional

---

[7]However, during downturns in the housing market or times of high contract cancellations, new home sale prices may appear artificially high. While the sales price of an existing home reflects that actual transaction price, the sales price of a new construction home is the original price agreed upon by the buyer and seller at the initial time of sale, and does not reflect any cancellations or price negotiations that may occur after that time.

9% in the 1981 recession, and 20% in the 2007 recession. The 1990 recession also showed a sustained, dramatic decline in new home prices, with new home prices falling almost 20%, but existing home prices recovered most of their 10% decline within a year of the recession's start.

The severity and persistence of the price declines during the 1981 and 2007 recessions may be due, in part, to the length of those recessions. The 1981 recession lasted 16 months, and the 2007 recession lasted 18 months (much longer than the average 11.1 months across all post-war recessions[8]. Another possible explanation is unemployment- the 1981 and 2007 recessions were the only two recessions in which national unemployment rates rose above 10%. The 1990 recession, which had a stronger and more persistent effect on prices for new homes than for existing homes, only lasted 8 months. Though unemployment peaked at 7.7% in the two-year period after the business cycle peak, it rose rapidly during the recession (by 1.3% during the 8 -month period), and continued to climb even after the recession officially ended.

These data suggest that housing prices may be better indicators of employment conditions than overall macroeconomic conditions. With the exception of 1981, 1990, and 2007, new and existing home prices fall less than 10% in any of the recessions studied, and the higher magnitude price declines tend to occur over years, rather than months. Analysis of autocorrelations reinforces this conclusion, with home prices showing a large degree of persistence. Correlation of home prices with the previous month's prices

---

[8]Prior to the 2007 recession, the longest recorded contractionary period as defined by the NBER was 16 months (for recessions beginning in November 1973 and July 1981).

exceeds 0.98 for both new and existing homes. Strong autocorrelations remain over longer periods, with autocorrelations of 0.66 for new homes and 0.62 for existing homes after 40 periods. Volatility of the two series differs in ways similar to the longer-term price changes of the two series. Existing home prices are slightly lower and less volatile than new homes both during recessions and over the entire time period considered (see Table 1).

Additionally, new and existing home prices demonstrate slightly different dynamics. New home prices appear to be more flexible than existing home prices, showing larger and more persistent declines. Persistent declines in national existing home prices occurred only during very long recessions with unusually high unemployment levels. This lends support to Genesove and Mayer's (2001) argument that existing homeowners are resistant to sell their homes if doing so would require incurring a capital loss (whether due to loss aversion, capital constraints, or other factors).

### 4.2.4  Sales

#### 4.2.4.1  Theory

Poterba's (1984) model suggests that price is the key factor in clearing the housing market. In situations where excess inventory is on the market, price decreases could help spur sales. However, contrary to Poterba's model, prices and sales volumes tend to move together. Additionally, as shown in Table 4.1, the volatility of sales transactions is much higher than that of prices.

One possible explanation for this comovement anomaly is offered by a a key difference between the benchmark model and the data. Poterba's model utilizes a standardized unit of housing that is essentially a commodity, whereas actual housing units differ in terms of location, size, amenities, and style. This heterogeneity introduces complexity into the pricing process: sellers have no precise method for assessing the value that buyers place on the features offered by their property. A sale may take time to occur either because a property is overvalued (as in Anglin, Rutherford, and Springer (2003)), or because it takes time for the right buyer to sift through available properties.

Wheaton (1990) utlizes heterogeneity in the housing market to develop a search and matching model in which homeowners purchase a new home before selling their old home. In this model, vacancy rates can have strong effects on both time to sale and prices, and increases in home prices may occur in conjunction with increases in sales volumes.

Another possible explanation is related to the fact that the high cost of (consuming) housing (relative to other goods) means that many homeowners that would like to purchase a new home must first sell their old home, due to either an inability or unwillingness to simultaneously own two homes. This dependency can lead to a multiplier effect, in which each additional home sale facilitates yet another sale, releasing pent-up demand that could lead to rising prices and sales volumes.

The effect of this multiplier can be quantified using the formula

$$M = \frac{1}{1 - \psi}$$

where $M$ is the multiplier and $\psi$ is the fraction of repeat purchasers of primary homes.

Data from NAR allow me to calibrate this formula to offer more precise predictions of the multiplier effect. According to NAR, the majority of home purchases each year (approximately 60% - 70% annually) are purchases of primary residences[9]. Of those 60%-70%, approximately 60% of home purchases were by repeat homebuyers, indicating that approximately 36%-42% of total annual home purchases (in recent years) were attributable to households that were repeat buyers of a primary home[10]. As many of those repeat buyers are either unwilling or unable to incur the risk and carrying costs of purchasing a new home before selling their current home, a large portion of those 36% to 42% of annual house transactions themselves depend on another home sale occurring. Setting $\psi = 0.40$ indicates that each sale of an existing home can facilitate up to $0.67$ additional sales.[11]

---

[9]Other types of purchases are investment home or vacation home purchases. The portion of annual home sales that are due to vacation or investment home purchases can vary significantly, with an historical high of 40% in 2005 and more recent levels of 33% in 2007 and 30% in 2008.

[10]According to NAR¡, 41% of home purchases in 2007 were by first-time homebuyers. This fraction likely rose in 2009 and 2010 due to recent tax incentives for first-time homebuyers.

[11]This formula yields an upper bound on the potential multiplier effect of a purchase of an existing home. Purchases of new homes do not directly facilitate additional sales. Thus, the accelerator theory would lead to higher autocorrelations for existing home sales than for new home sales.

### 4.2.4.2 Results

Sales of existing homes are much greater than those of new homes, as shown in Table 4.1. Over the period 1982-2009, sales of existing homes are 5.2 times sales of new homes. Sales of new homes have risen over time, from approximately 57,000 units per month in the period 1963-2009, to almost 63,000 units in the period 1982-2009.[12]

New home sales exhibit strong procyclical behavior that leads the business cycle. As shown in Figure 4.7, new home sales fall, on average, by approximately 30% in the 24 months prior to a business cycle peak, reaching a low approximately 3 periods into the recession. They then rise by approximately 20% in the 24 months following a business cycle peak.

Behavior during individual recessions is generally very similar to the average for all recessions, except for the 2001 recession (see Figure 4.8). The 1973 recession and 2007 recessions were extraordinary in the severity of their impact on sales: both hit low points much later than usual, at 13 periods for the 1973 recession, and 14 for the 2007 recession. This may be due to the unusually long durations of the 1973 and 2007 recessions: 16 months and 18 months, respectively, much longer than the average length of 11.3 months. The 2007 recession coincided with an unusually dramatic decline in new home sales, with sales falling 72% in the 24 months prior to the recession. In contrast

---

[12]Note that new and existing home sales are defined differently. The Census considers a new home sold when either a sales contract has been signed, or a deposit has been accepted. A sale can occur even if construction has not yet started on the home. New home sales transactions are not followed through to closing, so transactions that fall through after the contract signing or deposit acceptance will continue to be included in the series as homes that are sold. Any sustained increase in the rate of new home sales cancellations would affect the trend of new home sales. Existing home sales are recorded once a sale has closed, so would not be subject to the same error from contract modifications or cancellations.

to the 1973 and 2007 recessions, the 2001 recession was marked by its unusually light impact on sales. Sales actually rose (by approximately 8%) in the 24 months prior to the 2001 recession, and continued to rise once the recession began.

Existing home sales follow a similar procyclical pattern as new home sales, but are much less variable. On average, existing home sales fall by approximately 10% in the 24 months prior to a business cycle peak, compared to a decline of almost 30% for new home sales over the same period. Existing home sales have significantly less variance than new home sales in the periods surrounding all business cycle peaks except the ones occurring in 1969 and 1981.

The difference in volatility between sales of new and existing homes is mirrored in autocorrelations of each of the two series. Autocorrelations begin very high, at 0.97 for one month lag of new homes, and 0.98 for one month lag of existing homes. However, the autocorrelation of new homes dies out much more quickly than existing homes, at 0.18 at 40 lags, versus 0.49 for existing homes. The difference in persistence of the two series can be explained by the "multiplier effect" for existing homes.

The procyclical behavior of home sales and relatively acyclical behavior of home prices support Leamer's (2007) assertion that housing has a "volume cycle, not a price cycle." Additionally, the higher volatility of new home sales makes it a stronger indicator of housing market movements than existing home sales.

### 4.2.5 Inventories, Starts, and the Inventory-Sales Ratio

#### 4.2.5.1 Theory

Residential investment is important due to its role in signalling expectations for the housing market, and (more importantly) due to its importance as a key component in aggregate macroeconomic investment. Macroeconomic interest in aggregate inventory investment is driven by its key role in business cycles, particularly in economic downturns. As noted by Ramey and West (1999), declines in inventory investment comprise, on average, 49% of the decline in GDP during the typical U.S. post-WWII recession. It appears that housing investment in particular plays a pivotal role in driving economic downturns: as explored by by Leamer (2007), declines in residential investment drove GDP weakness in eight of the 10 most recent recessions (despite a generally meager effect on GDP growth overall).

The baseline model developed by Poterba predicts that housing starts should rise in conjunction with actual or anticipated home prices. Housing starts in his model are dependent upon the relationship between home prices and construction costs: any actual or anticipated increase in home prices leads to an increase in construction. Poterba's model offers no role for inventories of unsold homes or the inventory-sales ratio in determining housing starts.

More general macroeconomic literature, however, does offer predictions for the dynamics of inventories, starts, and the inventory-sales ratio. General equilibrium neoclassical

sticky price models predict that production of flexibly-priced durable goods should fall during monetary expansions, as increased demand causes costs to rise more than output prices.[13] Similarly, production of those goods should expand during periods of monetary contraction.

Bils and Kahn (2000) link the inventory-sales ratio and inventory investment. If increases in demand cause marginal costs to rise, then any additional inventories would result in lower profits when they are eventually sold. This decrease in expected profit from future sales would cause inventories to fall (or rise at a lower pace than sales) even as an economy continues to expand and sales rise. In this scenario, inventory investment would occur prior to any increase in demand. There is at evidence that at least some home builders follow this strategy: In its annual SEC filing, high-end residential housing developer Toll Brothers notes that other builders, as part of their business strategy, were building homes in anticipation of capturing additional sales in a demand-driven market (Toll Brothers 2009).

### 4.2.5.2 Starts

Housing starts have risen somewhat over time, averaging just under 91,000 each month over the period 1963-present, rising to just under 95,000 each month over the period 1982 to present. Figure 4.9 shows that residential investment tends to be bunched during economic upswings. This is similar to what is observed in aggregate macroeconomic

---

[13]Because some prices are sticky, the monetary expansion causes demand to increase. Increases in production and factor demands cause marginal costs to rise, assuming upward-sloping supply curves.

data (Ramey and West 1999, Bils and Kahn 2000, Barsky, House, and Kimball 2003). New construction starts tend to lead the business cycle, falling well in advance of a recession. This contrasts with the behavior of prices, which tend to lag the business cycle (4.4).

Starts decline sharply around the period of business cycle peaks. On average, starts decline by 28% over the 7 recessions studied, reaching their low point approximately one year following the business cycle peak. In almost all recessions, the pace of the decline in starts increases dramatically in the 4 months prior to the recession. As shown in Figure 4.10, 2007 showed a steeper pre-peak decline (68%), while 2001 showed a lower decline (only 12%). 1960, 1981, and 1990 were marked by recoveries that occurred earlier than average.[14]

### 4.2.5.3  New home inventories

The behavior of starts directly affect the behavior of inventories. New home inventories also show procyclical movements, and lead the business cycle by approximately 6 months. Recessionary inventory movements are shown in Figure 4.5. Average behavior over the 7 recessions studied shows inventories rising by 6% in the 24 months prior to a business cycle peak, declining for up to 18 months after the recession begins, for a total recession decline of 19%. Measured relative to its own cycle, the decline and fall in new home inventories is more dramatic: inventories rise on average 12% to their pre-peak

---

[14]Though brief, it should be noted that the 1981 recession followed only one year after the 1980 recession.

69

apex, and then fall by approximately 22% to their post-peak nadir.

Three significant exceptions to this pattern exist: the periods surrounding the 1981, 2001, and 2007 business cycle peaks (see Figure 4.6). In 1981, inventories declined throughout the 24-month periods before and after the business cycle peak, failing to show any sort of business cycle-like increase. This could be caused by two (related) factors: the unusual length of the 1981 recession (16 months, vs. an average of 11 months for all recessions in the 1963-2006 time period), as well as the timing of the 1981 recession, occurring only one year after the end of the 1980 recession. The 2007 recession also presented a persistent decline, with new home inventories peaking 17 periods prior to the 2007 business cycle peak, and declining for at least the next 41 periods, for a total decline of 55%. As this decline in inventories was driven by starts, rather than sales, it shows that the 2007 recession may have been anticipated by new home builders. Unlike other recessions, for which inventories were a leading procyclical indicator, inventories appear countercyclical in the 2001 recession. 2001 showed an unusually early peak in home inventories, peaking almost a full year prior to the business cycle and then declining 7% before the start of the recession. Similarly, inventories started an unusually early increase, beginning to climb as soon as the recession began.

Despite the 2001 and 2007 exceptions, the mean pattern over the 1989-2007 recessions remains similar as to the total period- inventories peak prior to the recession, and fall to a low approximately 18 periods after the recession begins.

#### 4.2.5.4 Existing home inventories

Due to the importance of inventory investment during periods of declining GDP, much of the research on residential inventories has focused on inventories of new homes. However, existing home inventories also merit attention. Presumably, new home builders must compete with owners of existing homes for purchasers of their products.

Housing models offer little in the way of predictions for existing home inventories. Wheaton's (1990) model, which assumes that households must first buy a new house before selling their original house, predicts structural vacancy- a minimal level of existing home inventories. Any shock that might cause homeowners to change their desired housing consumption would lead to an increased number of homes for sale (Wheaton 1990, Capozza, Hendershott, and Mack 2004).

Unlike new homes, the inventory of existing homes for sale is not conditional on a typical production function that has skilled labor and raw materials as inputs. Furthermore, there is very little time required to add to the stock of existing home inventories. Existing home owners need simply to list their home for sale and make their home available to prospective buyers- a process that can be done in just a few days. Equivalently, the cost of not selling a home in inventory is very different for home builders and existing home owners. The true economic cost of failing to sell one's primary residence would actually be the difference in user cost less consumption value between the actual home and the desired future primary residence (plus some value to represent the stress of keeping the house in good condition for showings.) New home builders, on the other hand, must

bear the burden of the full user cost.

As shown in Table 4.1, existing home inventories of unsold homes average over 6.6 times those of new homes [15].

As one might expect based on their different inventory supply functions, we find that inventory behavior differs between new and existing homes. Existing home inventories lack the consistent business cycle pattern shown by new home inventories. Data for existing single-family homes are available from 1982 onwards, allowing analysis of the periods surrounding the 1990, 2001, and 2007 business cycle peaks. On average, inventory behavior of existing single-family homes is acyclical. Examination of individual recession-specific graphs reveals one exception- the periods surrounding the 2007 business cycle peak. Inventories exhibit strong procyclical behavior surrounding this business cycle peak, rising approximately 22% in the 24 months prior to the peak, and falling by almost the same amount in the 16 periods following the peak. The inventory-sales ratio of existing homes tends to be greater than that for new homes, which may reflect the relative ease with which existing homes can enter the unsold inventory.

Differential business cycle impacts on new and existing homes are also evident by cor-

[15]Inventory data for new and existing homes differ in several ways. Inventories of unsold existing homes reflect actual, existing homes listed for sale on local "multiple listing service" (MLS) systems. These typically list all homes which offered by realtors. Homes listed for sale by owner, however, are only included in this listing if the owner/seller chooses to list the home (and pay the associated fee). Inventories of new unsold homes, on the other hand, may include homes for which construction has not yet started. New home inventories include homes for which a building permit has been issued (or work has begun on the foundation of the home, in non-permitting areas) and a contract has not been signed and no deposit has been accepted. Inventories of new and existing homes also differ in terms of seasonality. Census presents seasonally adjusted inventory data, while NAR data is not seasonally adjusted. To make the two series more comparable, I use the Census X12-ARIMA program (used to seasonally adjust new home inventories) to seasonally adjust existing home inventories.

relation analysis. New home inventories are strongly correlated with lagged new home sales, with a correlation of 0.67 for a one-year-lag of sales. The correlation dies out over time, falling to 0.5 for the contemporaneous correlation and 0.2 for a 12-month lead of new home sales. Existing home inventories, however, show a much lower correlation with lagged sales, with a correlation of only 0.23 for a one-year-lag of sales, and 0.11 for a contemporaneous correlation.

Behavior of housing starts is similar to patterns in aggregate macroeconomic data- inventory investment is procyclical, with firms bunching production during economic upswings (Ramey and West 1999, Bils and Kahn 2000, Barsky, House, and Kimball 2003).

#### 4.2.5.5 Inventory-sales ratio

Despite the differing behavior of inventories across new and existing homes, the behavior of the inventory-sales ratio across the two series is surprisingly similar.

The inventory-sales ratio of new homes averages 6.1 months for new homes over the 1963-2010 (see Table 4.1). This comports with the average of 6 months found by Falk and Lee (2004). It falls slightly to 5.2 over the period 1982 to 2010, and is lower than the average of 7.2 months for existing homes over that same period. As noted by Falk and Lee (2004), the average inventory-sales ratios for residential housing are much higher than those for the durable goods sector of the U.S. economy (1.5).

Overall, the inventory-sales ratio moves almost directly opposite of sales. The pattern

exhibited by new and existing homes is quite similar, with existing homes leading new homes by about 2 months. This lead time corresponds to differences in definitions of a sale of new and existing homes. The level of months supply of existing homes is, on general, about one month higher than that of new homes.

The inventory-sales ratio is the most strongly procyclical indicator that we examine, peaking, on average, within one quarter after the overall economy (see Figure 4.11). Months supply typically rises above its long-term averages approximately 10 months prior to a business cycle peak, and falls back to average levels sometime after the ensuing business cycle trough.

As both inventories (see Figure 4.5) and sales (4.7) decline prior to the business cycle peak, increasing inventory-sales ratios indicates that the rate of inventory investment (for new homes) or homeowners choosing to list their homes for sale (for existing homes) decline by less than sales during the pre-peak period.

The procyclical behavior of the residential inventory-sales ratio contrasts with that of aggregate data for the durable goods sector. As noted by Falk and Lee (2004) and Bils and Kahn (2000), the aggregate inventory-sales ratio tends to move in a counter-cyclical fashion.

In the 24 months prior to a business cycle peak, the inventory-sales ratio for existing homes rises, on average, from 5.9 months to 8.1 months (37%). The ratio for new homes increases from 5.2 months to 7.7 months (48%) over the same period. New home Inventories tend to rise at a greater rate than sales in the pre-peak period, as the

inventory-sales ratio rises even after inventory investment (Figure 4.9) and new home sales (Figure 4.7) decline. The inventory-sales ratio of existing homes reaches its peak of 8.4 just 1 month after the business cycle peak, while the ratio for new homes reaches its peak of 8.9 3 months after the business cycle peak. The ratios for both new and existing homes tend to decline throughout recessionary periods.

As with other variables, the 2007 recession had an outsized impact on the inventory-sales ratio of both new and existing homes, with values for both new and existing homes doubling in the 24 month period leading into the recession (see 4.12). The effect of the 2001 recession is weak, with inventory-sales ratios for both series actually decreasing in the 24 month period leading into the recession, and remaining well below long-term averages for the entire 48-month period spanning the 2001 business cycle peak.

Correlation analysis of all periods (not restricted to recessions) indicates that the inventory-sales ratio leads inventories, with the highest correlation occurring at 16 lags of inventories for new homes (0.55) and 6 lags of inventories for existing homes (0.59). However, the inventory-sales ratio lags sales, with the highest correlations occurring at 3 lags of months supply for new homes (-0.61) and at 5 lags for existing homes (-0.70).

#### 4.2.5.6 The relationship between starts, prices, and the inventory-sales ratio

Graphical analysis of starts, inventories, and the inventory-sales ratio indicates that starts tend to decline well in advance of a business cycle peak, though resulting inventories- and the inventory-sales ratio- continue to rise. However, prices typically do not fall

much, and when they do it tends to occur much later in the business cycle. These results, which contrast with the predictions of Poterba (1984) model, prompt further investigation into the determinants of housing starts, their relationship with other housing variables.

Prior empirical research has shown that residential construction does appear to respond to changes in home prices. In a study of MSA-level supply elasticities, Green, Malpezzi, and Mayo (2005) find that MSA-specific supply elasticities range from zero to approximately 20, with high elasticities occurring in cities with lower zoning and other regulatory barriers. Topel and Rosen (1988) examine national data on new homes, and find that residential construction has a short-run supply elasticity of 1.0, and a long-run price elasticity of 3.0. However, Topel and Rosen's (1988) research also yields a surprising result- that prices are not the only determinant of housing starts. They find that the inventory-sales ratio is a strong, negative predictor of housing starts.

Following the work of Topel and Rosen (1988), I use an instrumental variables regression of housing starts $s$ on new home prices $Z$, construction costs $c$, the Federal Funds rate $r$, inflation $\pi$, and months supply of new homes $\frac{i_t}{s_t}$ to examine the determinants of residential inventory investment.

$$s_t = \alpha + \beta_1 Z_t + \beta_2 c_t + \beta_3 r_t + \beta_4 \pi_t + \beta_5 \frac{i_t}{s_t} + \epsilon_t$$

To control for endogeneity between new home prices and housing starts, the first stage of the regression regresses new home prices $Z$ on demand variables including personal

consumption expenditures $x$ (lagged and current), the 30 year fixed mortgage rate $i$ (lagged and current), and gas prices $g$. All variables except the interest rate are in logs.

$$Z_t = \gamma + \beta_1 x_t + \Pi_2 x_{t-1} + \Pi_3 i_t + \Pi_4 i_{t-1} + \Pi_5 g_t + u_t$$

Results of the instrumental variables regression are reported in Table 4.2. First-stage results are reported in Table 4.3. Regression [1] reports results for the regression described above. Regression [2] uses a one-step-ahead prediction of the Federal Funds rate in lieu of the actual Fed Funds rate. Regression [3] once again uses the actual fed funds rate, but substitutes "time on market" (median number of months that new, unsold homes have been on the market) for the months' supply variable. Regression [4] uses both the predicted Fed Funds rate and the time on market variable.

In three of the four regressions, housing starts have strong, statistically significant responses to new home prices. Regressions [1], [2], and [4] suggest that a 1% increase in prices is associated with a 2.1%-2.7% increase in starts. Construction costs appear to have very little impact on starts, though results from the first stage of the regression suggests that a 1% increase in construction costs is associated with over a 1% increase in prices. First stage results also show a strong negative relationship between energy prices (as proxied by the gas price index) and lagged mortgage rates. We also find that the inventory-sales ratio has a strong impact on starts. A one-month increase in months' supply is associated with a 12%-13% decrease in housing starts. The impact is virtually

unchanged when we substitute "time on market" for the months' supply variable.

One interesting result is that the coefficient on price loses its statistical significance in the model that uses both the actual Federal Funds rate and time on market. The only other coefficient that changes in a material way is the inflation rate.These results suggest that using the predicted Fed Funds rate, rather than the actual, is a useful exercise, particularly when using the time on market variable. It is unclear why this only has an impact for the time on market variable- perhaps time on market and months' supply tend to diverge in periods with high inflation.

The 10% decrease in housing starts resulting from a one-month increase in months' supply is very similar to Topel and Rosen's (1988) incidental finding that a one-month increase on time on market is associated with a 30% decrease in quarterly housing starts. However, it should be noted that both of these coefficients are much higher than one might expect. As noted by Topel and Rosen, the cost of an additional months supply of inventory to a builder would be the opportunity cost of capital tied up in that inventory. This would yield a coefficient that is equal to the interest rate. However, the coefficients yielded by these regressions far exceed the real interest rate. Months supply may be playing another role, possibly as an indicator of demand trends. One key difference between these results and those of Topel and Rosen is the role of prices in determining starts. While Topel and Rosen find strong evidence of an upward-sloping supply curve, only one of the four specifications analyzed yields evidence of an upward-sloping supply curve.

### 4.2.6   Time on Market

Time on market is the time (typically in days or months) that a property has been listed for sale. It is a statistic that is commonly used by real estate practitioners and observers as an indicator of housing market liquidity and momentum.

At an individual house level, research has shown that higher home list prices lead to longer periods on the market.  Knight (2002) demonstrates that home prices with a higher mark-up (original list price/ selling price) take longer to sell, and eventually sell for lower prices than other homes.  In a falling market, in which sellers rely on old or incomplete information to set prices, list prices are more likely to be too high, causing longer market times.  For this reason, one might expect the time on the market to rise before homes begin to sell for lower prices and prices fall.

Increasing market times are generally considered indicators of weakening real estate markets. Anglin, Rutherford, and Springer (2003) develop a model that shows a positive relationship between individual overpricing of a property and market time. Applied to a market overall, this model indicates that a combination of backward-looking price setting and a declining market could result in a higher degree of overpricing and longer time on market.

Over time, months' supply should be equal to the average time on market.  Let the total inventory of homes for sale be equal to $N$.  Suppose the number of sales each month follows the Poisson distribution with a rate parameter of $\lambda$.  Then the average proportion of homes sold each month is $\lambda$, and the average wait time (in months) is $\frac{1}{\lambda}$.

Then inventory=$N$, sales= $\lambda N$ and the inventory/sales ratio (months' supply) = $\frac{1}{\lambda}$, just as average time on market

We obtain time on market data showing the median number of months that completed new homes have been on the market (not the time between listing and sale for homes that are sold). This statistic refers solely to completed homes- those sold prior to completion are not included. This statistic is only available nationally for new homes.

On average, the median number of months that a new home was on the market until sale is about one-half month shorter than months supply (see Table 1).

Time on Market is shown in Figure 4.13. Median time on market for new homes rises significantly in the 24 months prior to a business cycle peak, rising on average 25% in the periods preceding the 1980, 1981, 1990, 2001, and 2007 recessions. The number of months on market rises most significantly in the period prior to the 2007 recession, rising by over 50%. The 1980 and 2001 recessions were unusual in that they did not involve a sustained increase in time on market.

As expected, time on market and months supply show similar patterns. However, the two series do not track each other exactly. Figure 7 compares the two series. Months supply tends to start out higher than time on market in the months leading up to, and starting in, a recession. Time on market appears to lag months supply, and the two lines cross some number of periods into each recession. Interestingly, the timing of this cross frequently occurs at about the time that the business cycle hits a trough and the recession ends, suggesting that this may be a good indicator of renewed economic growth.

More investigation into the dynamics of months supply and time on market is necessary in order to draw stronger conclusions about the relationship between the two. One explanation may be found in sales of unfinished homes. Unfinished homes are not included in the time on market indicator, but are included in the inventory of unsold homes. Consequently, a change in the composition of new home sales could affect the relation between the two indicators.

Anecdotal evidence suggests that buyers should be reluctant to commit to unfinished homes in recessions, which would cause the inventory-sales ratio to rise more than time on market[16].

In times of economic uncertainty, potential homebuyers may be more likely to purchase finished homes. Once the economy starts to recover, however, homebuyers may be more optimistic and willing to commit to an unfinished home. An increase in sales of unfinished homes (relative to finished homes) would, all else equal, have no effect on time on market- but would cause the inventory-sales ratio to fall.

## 4.3 Conclusions

The relative movements of home prices, versus other indicators, suggest that home prices are not good business cycle indicators. In fact, movements in home prices may

---

[16]A 2009 article in the New York Times describes an outcome that would inspire fear in purchasers of unfinished properties, noting that "many buyers who signed preconstruction contracts two years ago now find themselves obligated to pay much more for their units than they are worth in todays market" (Gill 2009). Purchasers of finished homes, on the other hand, face no uncertainty about construction timelines, and may view the builders inventory as being more negotiable on price. And, should prices fall, any economic (capital) losses would be partially offset by the buyers enjoyment of living in his or her new home.

not be the best way to gauge trends in the overall housing market, as prices tend to move later than other indicators. This is a theme that has been visited regularly by media outlets in the past five years, as speculation about the sustainability of housings largest post-war boom was called into question:

> If inventory is your gauge, the market is slackening. If prices are your prism, its still going strong... Prices are still in the clouds, but inventory is expanding and bidding wars, once commonplace, are increasingly rare. (Foderaro 2006)

Other variables, such as new and existing home sales, new home inventories, months supply, time on market, and construction starts are better indicators of business cycles and housing market movements. Overall, months supply of both new and existing homes appears to be the housing market indicator that moves most dramatically with the business cycle, while supply-side movements in starts, and in new home inventories, are good leading indicators of recessions. Business cycle troughs may be identified by the relative movements of months supply of new homes, and time on market of new homes. Sales of both new and existing homes are strongly procyclical and lead business cycles, with both series falling before prices and beginning their recovery shortly after the recession begins.

Finally, series for both new and existing homes tend to move in a similar fashion for all series except inventories. This indicates that, apart from the production function for each series and its effect on inventories, the two markets operate as one market.

Additionally, studies performed on either new or existing homes may be relevant for the housing market overall.

Housing market variables may also help inform studies of inventory behavior. The strongly procyclical movement of the inventory-sales ratio and its departure from other durable goods sectors in the face of evidence of rising marginal costs suggests room for further exploration of inventory models.

The impact of a recession on the housing market varies across recessions. The discussion above repeatedly notes the unusual severity of the 2007 recession's effects on the housing market, and the atypical weak impact of the 2001 recession. Additionally, the close timing of the 1980 and 1981 recessions causes the two to behave as one combined, long recession in certain series, such as prices, inventories, and starts.

Is the 2007 recession different than previous recessions? A review of the variables we have studied suggests yes. Firm-level statements by developers of new homes lend additional support to that answer. Every publicly traded company is required to issue an annual report about its business. Every annual report includes a discussion of the major risks facing the business. In a pattern similar to those of its competitors, Hovnanian Brothers, a developer of single family homes, attached townhomes, and condominiums, shows a dramatic shift in the risk factors that it publicizes in its annual reports to the SEC. Hovnanian Bros. begins its 2009 10-K with the caveat that the housing market is cyclical and is significantly affected by changes in general and local economic conditions. It goes on to list particular risk factors, such as employment levels and job

growth, availability of financing for home buyers, interest rates, foreclosure rates, infla-tion, adverse changes in tax laws, consumer confidence, housing demand, and popula-tion growth. Later in its report, Hovnanian also details the primary market risk facing the business of interest rate risk on its long term debt. (Hovnanian Brothers 2009) Con-versely, the same company lists only interest rate risk in its discussion of risk factors. In other areas, the 10-K refers to the risk that they might be unable to receive required governmental approvals for a particular community, or that build-up of inventory of un-sold homes would lead to costs of maintaining and carrying that inventory. The 2004 10-K makes no references to macroeconomic factors such as employment, job growth, consumer confidence, or housing demand.

## 4.4 Tables

---

[17]Time on market series begins in January 1975. 423 observations total. Standard errors in parentheses. Rent-to-price ratios can only be calculated from January 1981 onwards due to availability of the rent index.

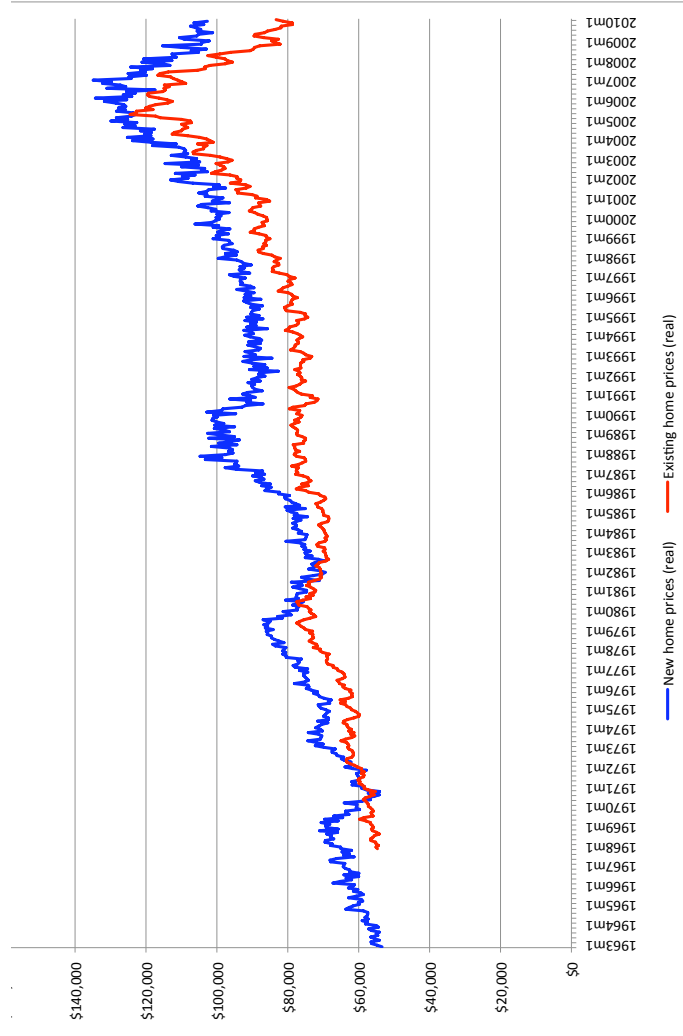Figure 4.1: New and Existing Home Prices (Real)

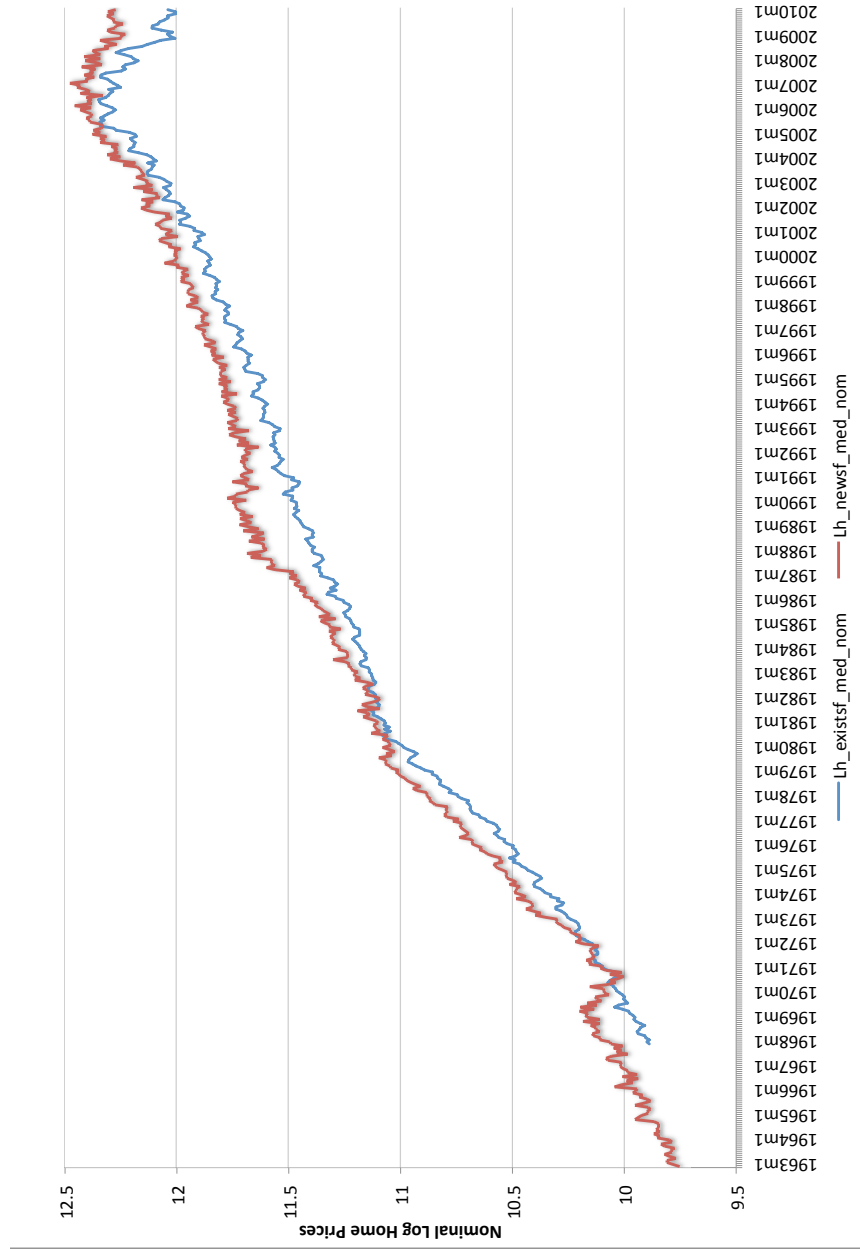Figure 4.2: New and Existing Home Prices (Nominal)

Figure 4.3: Log (Real) Prices of New and Existing Single-Family Homes: 1969-2007 Recession Averages
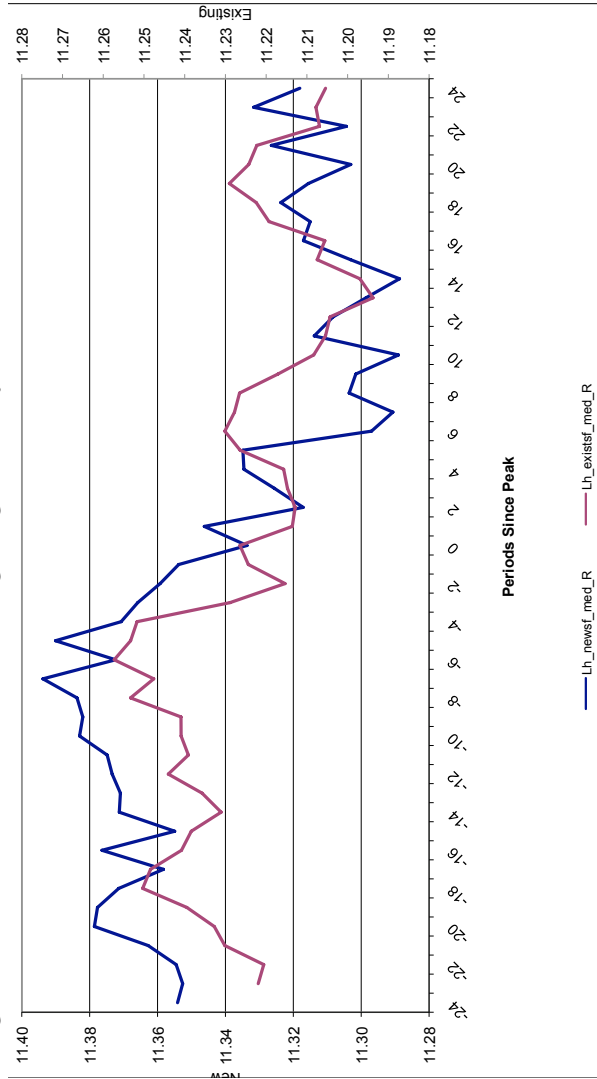
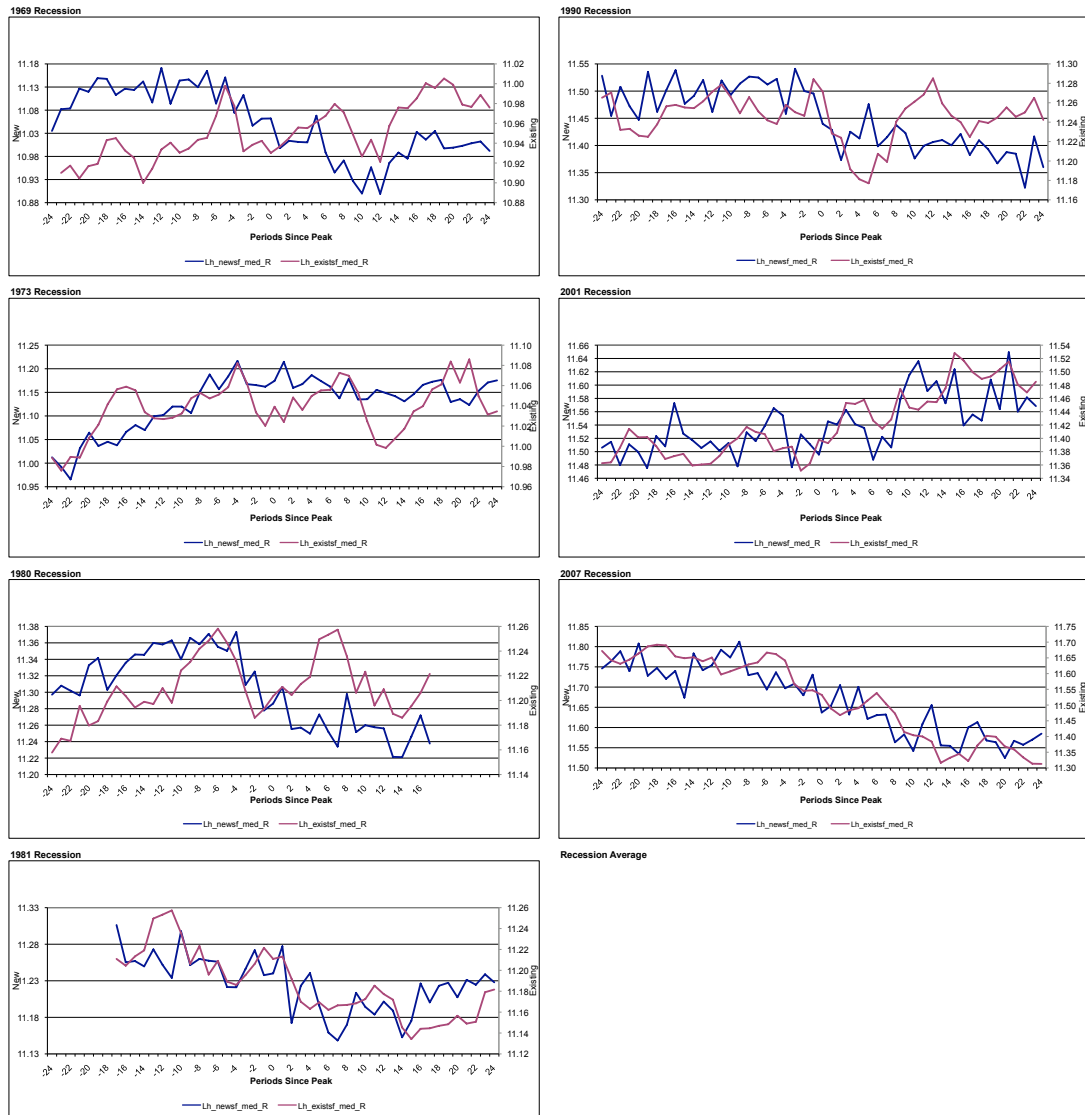Figure 4.4: Log (Real) Prices of New and Existing Single-Family Homes

Figure 4.5: Log Inventories of New and Existing Single-Family Homes-Recession Averages. New Homes: 1969-2007 Recessions; Existing Homes: 1990-2007 Recessions
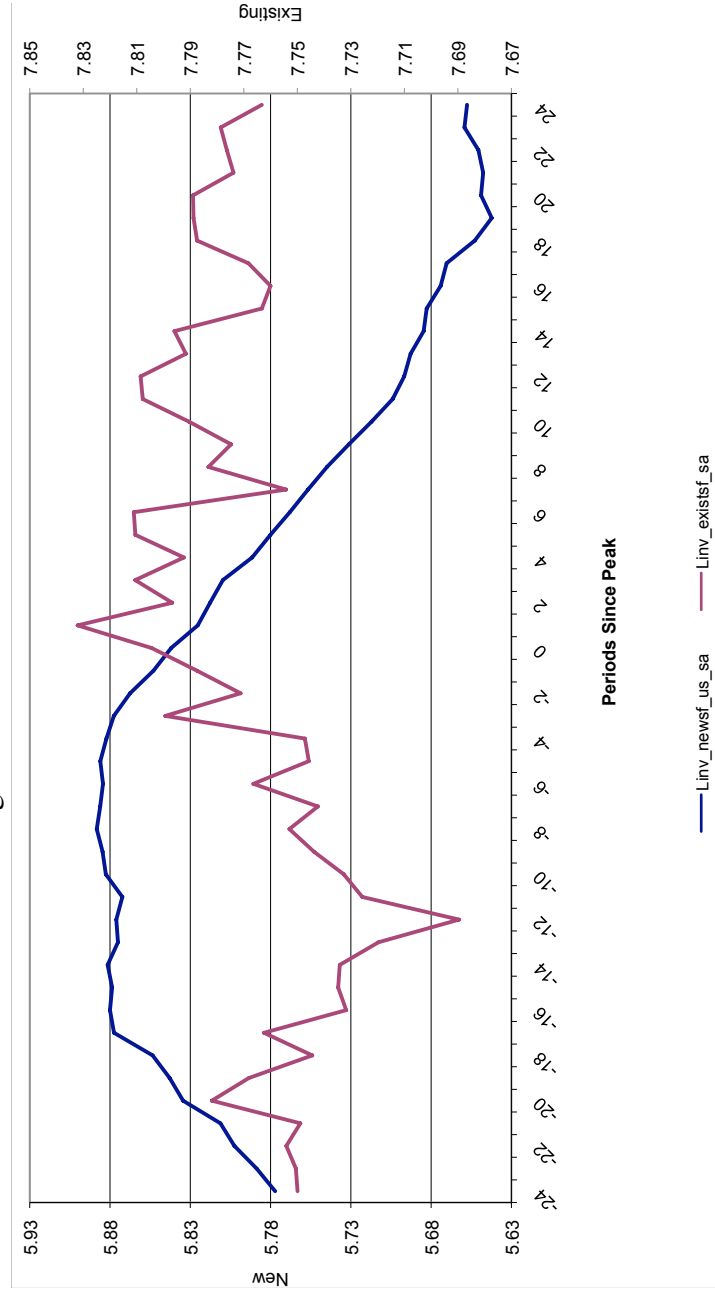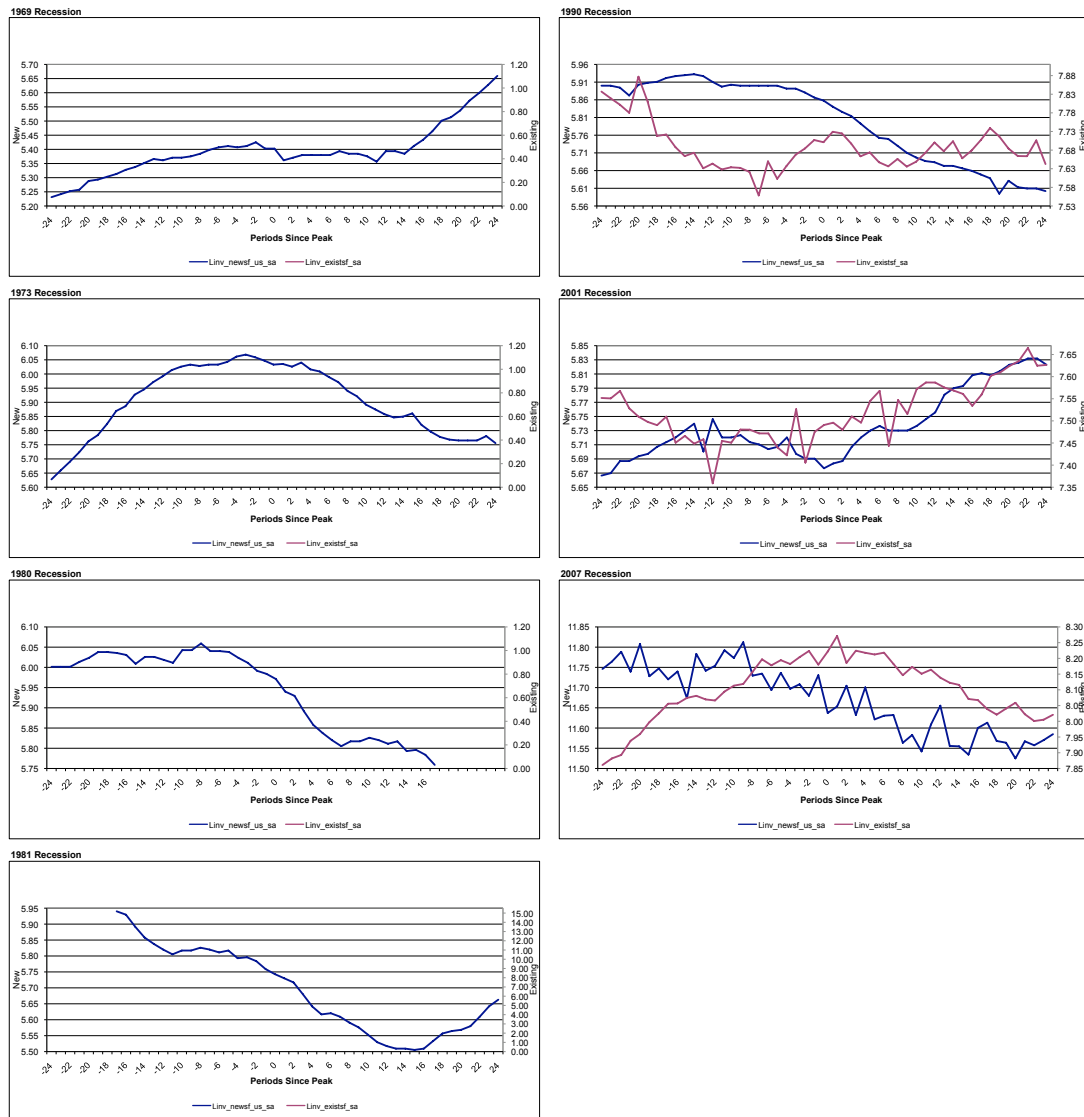
# Figure 4.6: Log Inventories of New and Existing Single-Family Homes



1969 Recession



1990 Recession



1973 Recession



2001 Recession



1980 Recession



2007 Recession



1981 Recession

Figure 4.7: Log Sales of New and Existing Single-Family Homes: 1969-2007 Recession Averages

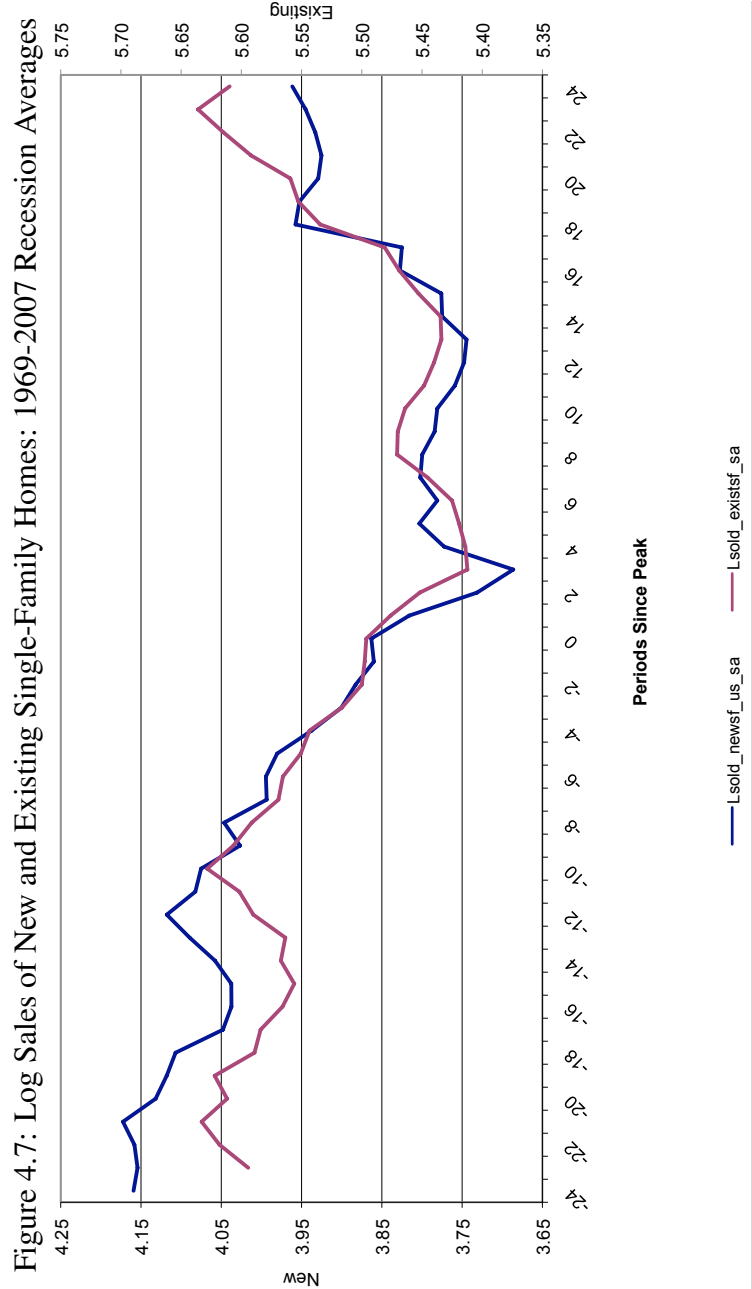

Periods Since Peak

——Lsold_newsf_us_sa ——Lsold_existsf_sa

Figure 4.8: Log Sales of New and Existing Single-Family Homes
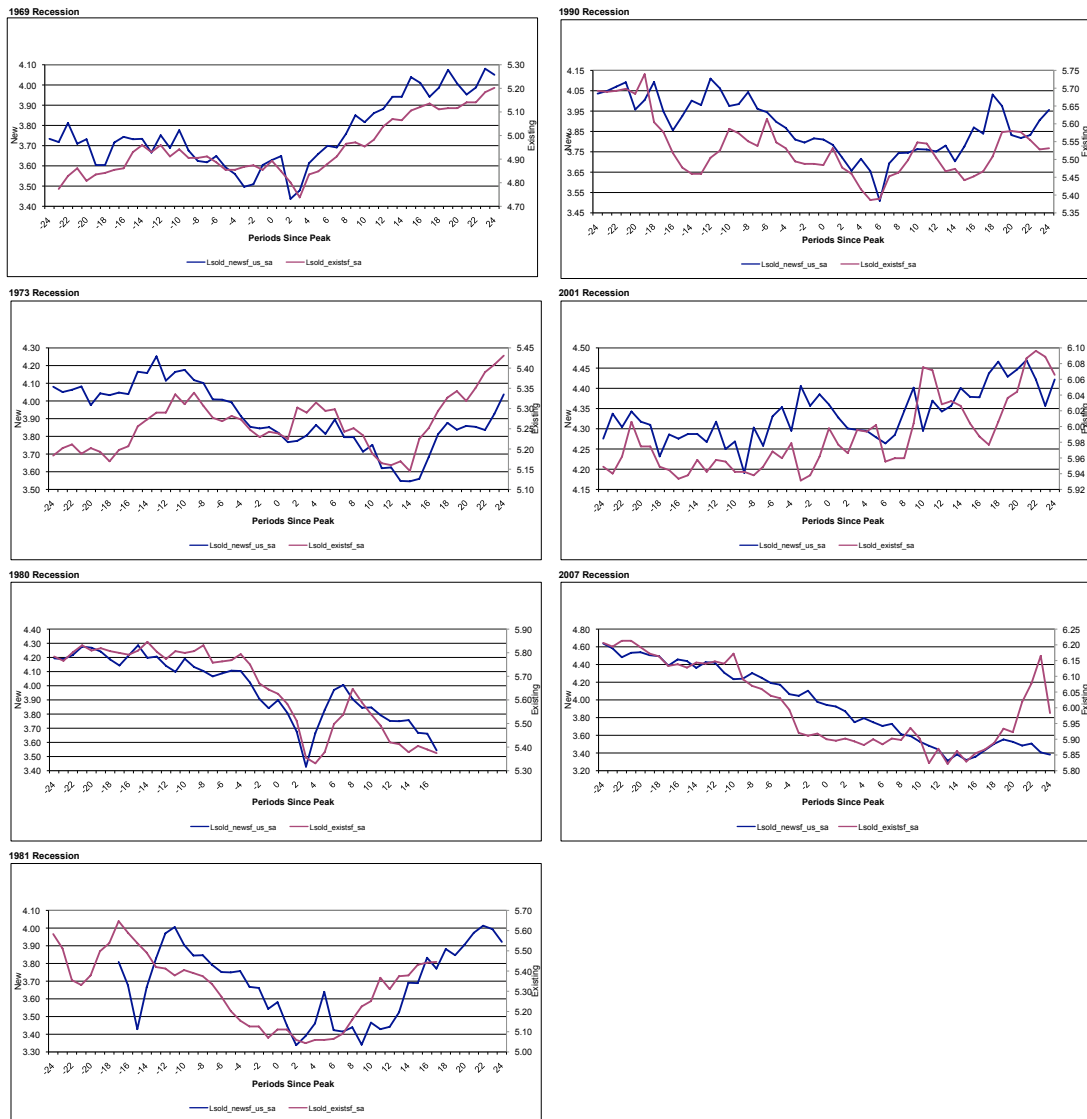
Figure 4.9: Log Starts of New, Single-Family Homes: 1969-2007 Recession Averages

Periods Since Peak

Lstarts_us_sf_sa
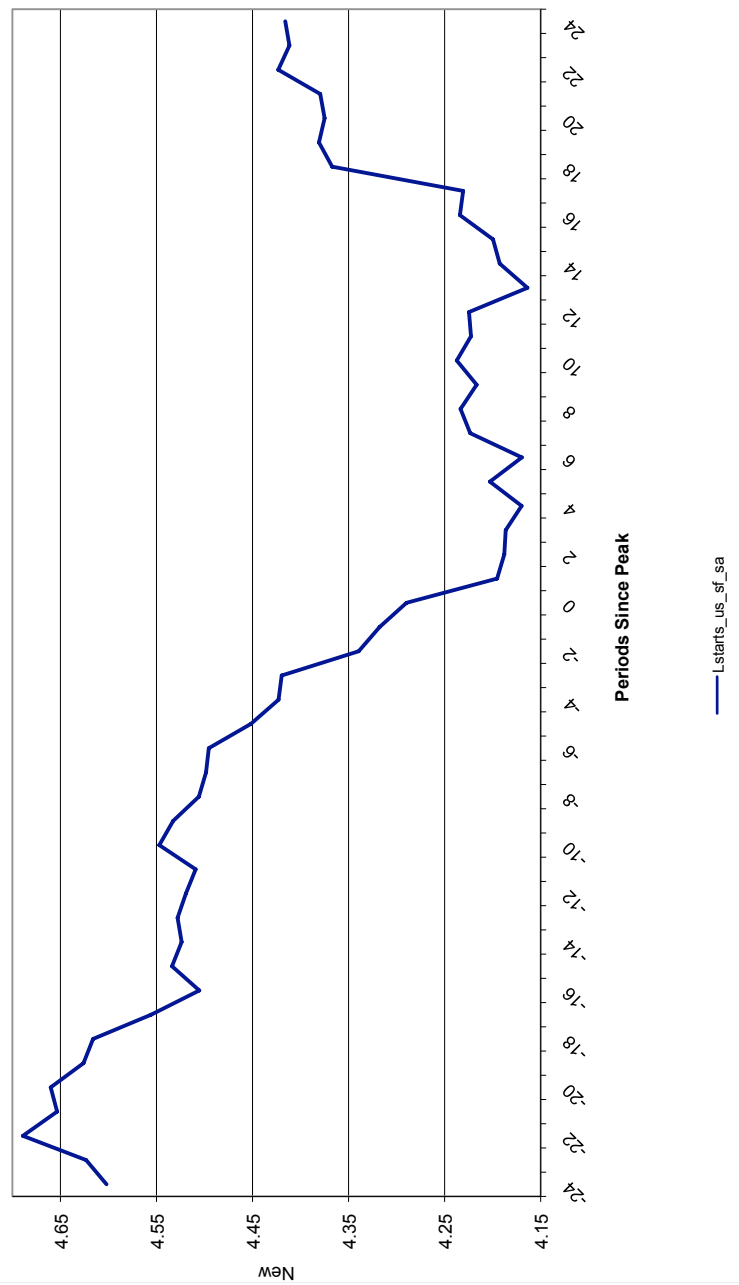
New

Figure 4.10: Log Starts of New, Single-Family Homes

Figure 4.11: Inventory-Sales Ratio (Months' Supply) of New and Existing Single-Family Homes- Recession Averages. New Homes: 1969-2007 Recessions; Existing Homes: 1990-2007 Recessions
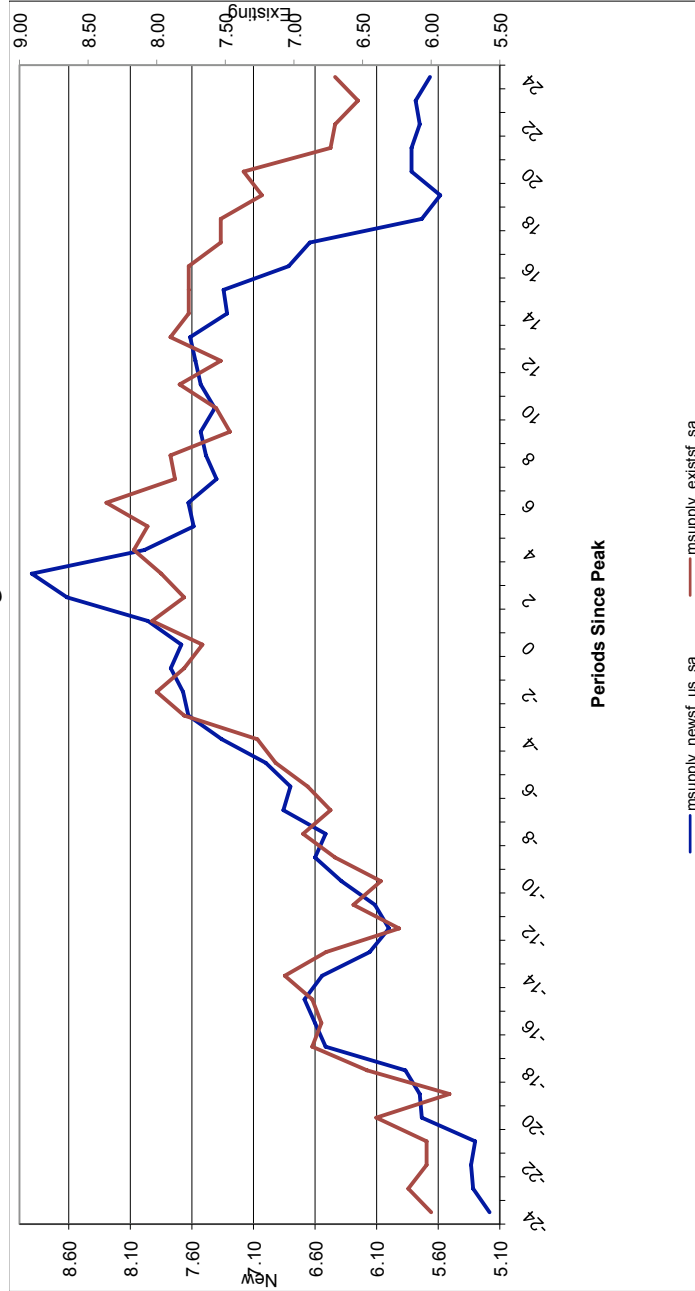
Figure 4.12: Inventory-Sales Ratio (Months' Supply) of New and Existing
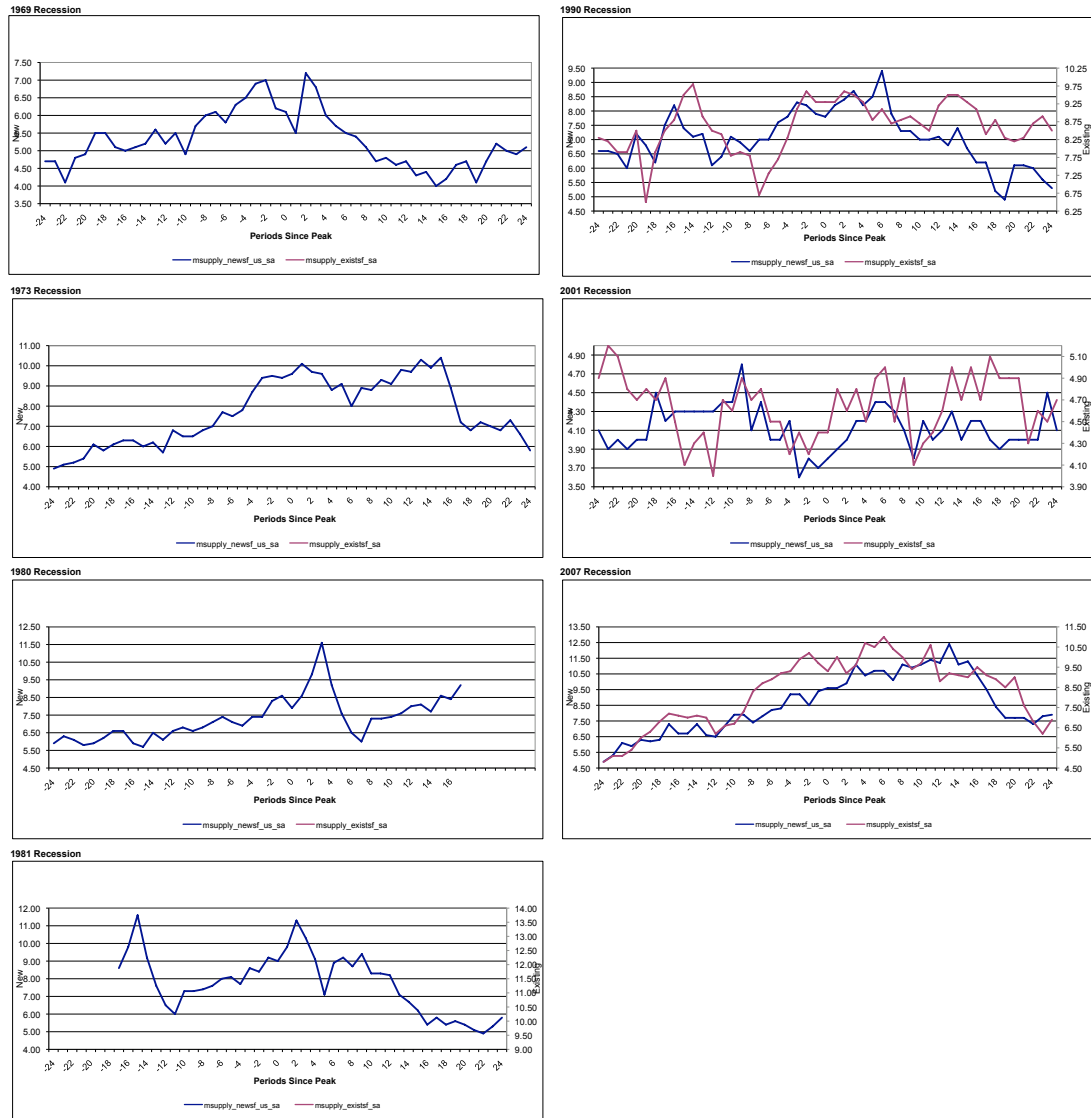Single-Family Homes

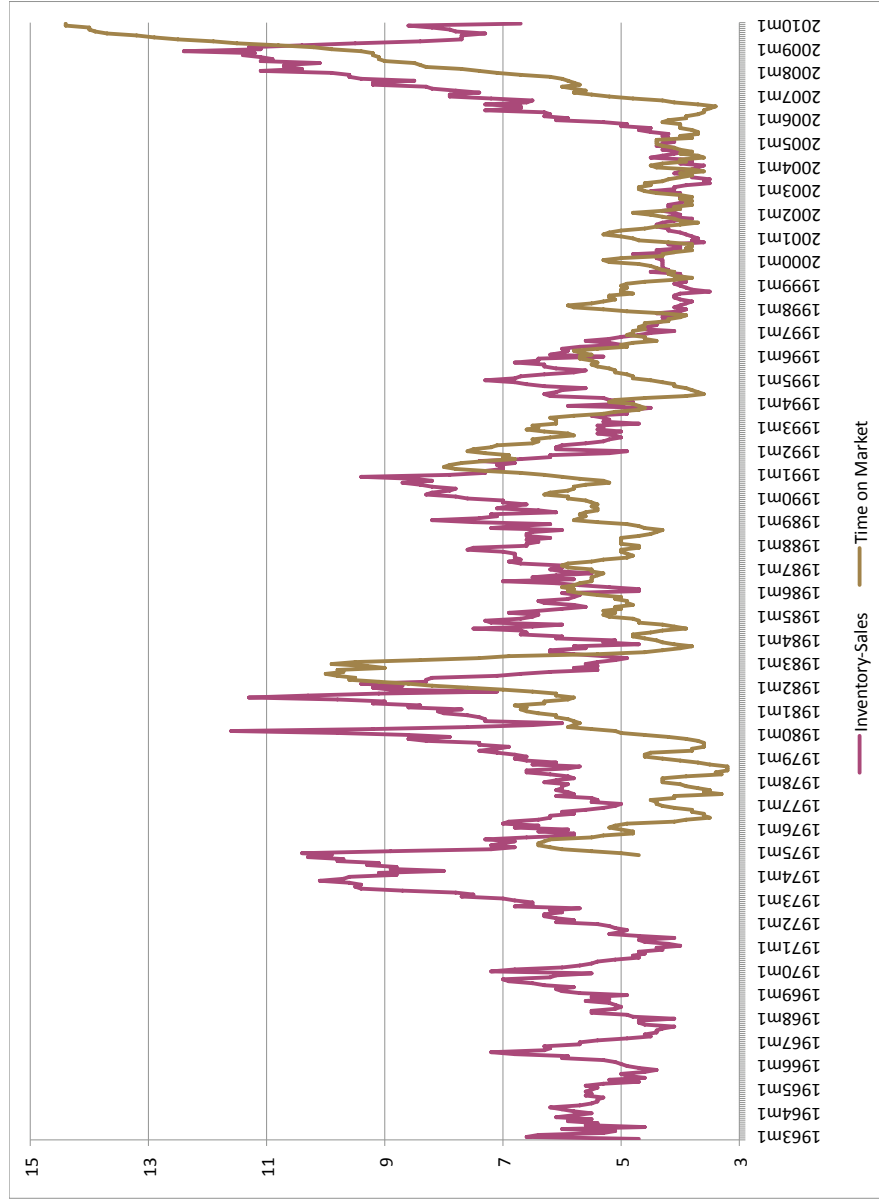Figure 4.13: Inventory Sales Ratio vs. Time on Market

Table 4.1: Summary Statistics: Single-Family Homes

| VARIABLES[17] | 1963.1 mean | 1968.1 mean | 1982.6 mean | Varied mean |
|---|---|---|---|---|
| **Rent to Price Ratio** | | | | |
| New | | | | -6.774 |
| | | | | (0.104) |
| Existing | | | | -6.639 |
| | | | | (0.113) |
| **Median Prices** | | | | |
| New, | 86,069 | 89,131 | 98,271 | |
| | (19,221) | (17,967) | (14,614) | |
| Existing | | 78,461 | 85,528 | |
| | | (15,487) | (13,931) | |
| **Sales, 000's** | | | | |
| New | 57.02 | 58.55 | 63.04 | |
| | (17.47) | (17.75) | (18.68) | |
| Existing | | 294.1 | 335.9 | |
| | | (99.51) | (87.16) | |
| **Inventory, 000's** | | | | |
| New | 327.2 | | 346.0 | |
| | (79.22) | | (74.23) | |
| Existing | | | 2,297 | |
| | | | (543.0) | |
| **Inventory-Sales Ratio** | | | | |
| New | 6.150 | | 5.941 | |
| | (1.729) | | (1.792) | |
| Existing | | 7.229 | | |
| | | (2.303) | | |
| **Other** | | | | |
| New- Time on Market | | | 5.626 | 5.458 |
| | | | (2.046) | (1.923) |
| Housing Starts | 89.91 | | 94.37 | |
| | (22.94) | | (23.84) | |
| Observations | 567 | 507 | 334 | 423 |

Table 4.2: Log New Home Starts is Dependent Variable

| VARIABLES[18] | (1) Starts | (2) Starts | (3) Starts | (4) Starts | (5) mean |
|---|---|---|---|---|---|
| New home price | 2.11*** | 2.74*** | 0.87 | 2.50*** | 11.4 |
| | (0.58) | (0.54) | (0.91) | (0.66) | (0.16) |
| Construction Cost | 0.16 | -0.44 | -0.22 | -2.10*** | 3.84 |
| | (0.75) | (0.67) | (1.00) | (0.63) | (0.065) |
| Ann. Fed Funds r | -0.0037 | | -0.025*** | | |
| | (0.0061) | | (0.0080) | | |
| Pred. Fed Funds r | | 0.0031 | | 0.0041 | -0.0053 |
| | | (0.0024) | | (0.0040) | (1.78) |
| Annualized $\pi$ | -0.0045 | -0.0023 | -0.025*** | -0.0026 | 3.82 |
| | (0.0054) | (0.0016) | (0.0078) | (0.0018) | (4.65) |
| Months' supply | -0.13*** | -0.12*** | | | 6.21 |
| | (0.010) | (0.011) | | | (1.80) |
| trend | -0.0031*** | -0.0037*** | -0.0009 | -0.0019*** | 356 |
| | (0.00047) | (0.0005) | (0.0007) | (0.0006) | (122) |
| Time on market | | | -0.11*** | -0.10*** | 5.46 |
| | | | (0.012) | (0.013) | (1.92) |
| Constant | -18.2*** | -23.0*** | -3.60 | -14.8*** | |
| | (4.04) | (4.02) | (6.72) | (5.30) | |
| Observations | 467 | 467 | 423 | 423 | 423 |
| R-squared | 0.757 | 0.699 | 0.693 | 0.590 | |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

First stage regresses starts on current and lagged personal consumption expenditures, current and lagged 30 year fixed mortgage, and gas prices.

Coefficients on month dummy variables omitted.

New home prices, construction costs, and interest rates are real variables.

Robust standard errors.

Table 4.3: First Stage Results: Log New Home Price is Dependent Variable

| VARIABLES [19] | (1) Price | (2) Price | (3) Price | (4) Price | (5) mean |
|---|---|---|---|---|---|
| Construct. Costs | 1.39*** | 1.37*** | 1.10*** | 1.12*** | 3.84 |
| | (0.058) | (0.053) | (0.071) | (0.066) | (0.065) |
| Pred. Fed Funds | | -0.0094*** | | -0.0081*** | -0.0053 |
| | | (0.0020) | | (0.0020) | (1.78) |
| Annualized $\pi$ | -0.0006 | 0.0016 | -0.0023 | 0.0006 | 3.82 |
| | (0.0021) | (0.0021) | (0.0022) | (0.0022) | (4.65) |
| Months' Supply | 0.0014 | 0.0015 | | | 6.21 |
| | (0.0025) | (0.0019) | | | (1.80) |
| Time on market | | | -0.0035** | -0.0023 | 5.46 |
| | | | (0.0017) | (0.0015) | (1.92) |
| Trend | 0.0012*** | 0.0012*** | 0.00044*** | 0.0004*** | 356 |
| | (0.00014) | (0.0001) | (0.0002) | (0.0002) | (122) |
| PCE | -0.0000 | -0.0000 | -0.00011 | -0.0001 | 3,295 |
| | (0.0002) | (0.00014) | (0.00015) | (0.0001) | (1,012) |
| L.PCE | -5.4e-06 | -0.000014 | 0.0002 | 0.0001 | |
| | (0.0002) | (0.0001) | (0.00015) | (0.0001) | |
| 30 Year Mort. | -0.0022 | -0.0001 | -0.0050** | -0.0010 | 5.26 |
| | (0.0027) | (0.0020) | (0.0025) | (0.0020) | (4.75) |
| L.30 Year Mort. | -0.0023*** | -0.0048*** | -0.0015** | -0.0040*** | |
| | (0.0006) | (0.0008) | (0.0006) | (0.0008) | |
| Gas Price Index | -0.0032*** | -0.0019** | -0.0025** | -0.0020* | 85.1 |
| | (0.0010) | (0.0009) | (0.0012) | (0.0011) | (20.3) |
| L.gas_R | 0.0013 | -0.0002 | 0.0010 | 0.0002 | |
| | (0.00095) | (0.0009) | (0.0011) | (0.0011) | |
| Fed Funds rate | -0.0012 | | 0.0007 | | |
| | (0.0016) | | (0.0016) | | |
| R-squared | 0.939 | 0.943 | 0.928 | 0.932 | |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

First stage regresses starts on current and lagged personal consumption expenditures, current and lagged 30 year fixed mortgage, and gas prices.

Coefficients omitted for month dummy variables, severe winter of 1979, and constant.

30 year mortgage and Fed Funds rate annualized.

New home prices, construction costs, and interest rates are all real variables.

Price variables in logs.

# Chapter 5

# Conclusion

In this dissertation, I explore several interactions between the housing market and the macroeconomy. In Chapter 2, I develop, calibrate, and empirically test a model of household wealth and consumption decisions that considers the user cost of housing in calculations of net housing wealth. The model demonstrates that changes in user cost cause changes in housing wealth to be smaller than corresponding capital gains, and that this relationship differs across households according to age and mobility. Changes in the annuity value of net housing wealth are generally much smaller than capital gains, and the age and future mobility of a household each have large, distinct impacts on the MPC out of housing gains.

In Chapter 3, I present econometric tests of the model developed in Chapter 2. I use a maximum likelihood Heckman selection model on data from the PSID to estimate household mobility, and use fixed effects regression to examine the MPCs out of stock market and housing gains. I find that the MPC out of stock gains is smaller than that

out of housing, that the MPC out of housing gains increases with age, and that mobility affects the response of consumption to home gains.

In Chapter 4, I explore linkages between the housing market and business cycles, with a focus on housing market dynamics during recessions. It establishes empirical regularities in the markets for both new and existing homes for the following variables: home prices, inventories of unsold homes, sales volumes, the inventory-sales ratio, time on market, and new construction starts. I conclude that home prices are not good leading or contemporaneous indicators of business cycles, and that sales volumes and starts are leading indicators of recessions. I also find that the inventory-sales ratio is the strongest contemporaneous housing market indicator, and that it has predictive power for housing starts. Finally, I find that the markets for new and existing homes move together, apart from the behavior of inventories.

# REFERENCES

ANGLIN, P. M., R. RUTHERFORD, AND T. M. SPRINGER (2003): "The Trade-off Between the Selling Price of Residential Properties and Time-on-the-Market: The Impact of Price Setting," *Journal of Real Estate Finance and Economics*, 26(1), 95–111.

ARIAS, E. (2004): *United States Life Tables, 2002.*, vol. 53 of *National Vital Statistics Reports*. National Center for Health Statistics, Hyattsville, MD.

BARSKY, R., C. L. HOUSE, AND M. S. KIMBALL (2003): "Do Flexible Durable Good Prices Undermine Sticky Price Models?," *NBER Working Paper 9832*.

——— (2007): "Sticky Price Models and Durable Goods," *American Economic Review*, 97(3), 984–998.

BILS, M., AND J. A. KAHN (2000): "What Inventory Behavior Tells Us About Business Cycles," *American Economic Review*, 90(3), 458–481.

BOEHM, T., H. HERZOG, AND A. SCHLOTTMAN (1991): "Intra-Urban Mobility, Migration, and Tenure Choice," *The Review of Economics and Statistics*, 73(1), 59–68.

BOSTIC, R., S. GABRIEL, AND G. PAINTER (2005): "Housing Wealth, Financial Wealth, and Consumption: New Evidence from Micro Data," *Lusk Center for Real Estate Working Paper*, (2004-1005).

BUCKS, B., A. KENNICKELL, T. L. MACH, AND K. B. MOORE (2009): "Changes in U.S. Family Finances from 2004 to 2007: Evidence from the Survey of Consumer Finances," *Federal Reserve Bulletin*.

CAMPBELL, J., AND J. COCCO (2005): "How do house prices affect consumption? Evidence from micro data," *NBER Working Paper*, (11534).

CAPOZZA, D., P. HENDERSHOTT, AND C. MACK (2004): "An Anatomy of Price Dynamics in Illiquid Markets: Analysis and Evidence from Local Housing Markets," *Real Estate Economics*, 32, 1–32.

CASE, K., J. QUIGLEY, AND R. SHILLER (2005): "Comparing Wealth Effects: The Stock Market versus the Housing Market," *Advances in Macroeconomics*, 5(1).

CASE, K., AND R. SHILLER (1989): "The Efficiency of the Market for Single-Family Homes," *American Economic Review*, 79(1), 125–137.

DOUGHERTY, A., AND R. VAN ORDER (1982): "Inflation, Housing Costs, and the Consumer Price Index," *American Economic Review*, 72(1), 154–164.

ENGELHARDT, G. (1996): "House prices and home owner saving behavior," *Regional Science and Urban Economics*, 26, 313–336.

FALK, B., AND B.-S. LEE (2004): "The Inventory-Sales Relationship in the Market for New Single-Family Homes," *Real Estate Economics*, 32(4), 645–672.

FEENBERG, D., AND E. COUTTS (1993): "An Introduction to the Taxsim Model," *Journal of Policy Analysis and Management*, 12(1).

FODERARO, L. (2006): "That Sound You Hear? The Market Coming Down to Earth," *The New York Times*.

GENESOVE, D., AND C. MAYER (2001): "Loss Aversion and Seller Behavior: Evidence from the Housing Market," *Quarterly Journal of Economics*, 87(3), 255–269.

GILL, D. (2009): "A Luxury Home Away From Home, at Reduced Prices," *The New York Times*.

GREEN, R. K., S. MALPEZZI, AND S. K. MAYO (2005): "Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources," *American Economic Review*, 95(2), 334–339.

GREENE, W. H. (2003): *Econometric Analysis*. Prentice Hall, fifth edn.

HOVNANIAN BROTHERS (2009): "Hovnanian Brothers Form 10-K for the fiscal year ended October 31, 2009," .

JUSTER, F. T., J. P. LUPTON, J. P. SMITH, AND F. STAFFORD (2006): "The Decline in Household Saving and the Wealth Effect," *The Review of Economics and Statistics*, 88(1).

KNIGHT, J. R. (2002): "Listing Price, Time on Market, and Ultimate Selling Price: Causes and Effects of Listing Price Changes," *Real Estate Economics*, 30(2), 213–237.

LEAMER, E. (2007): "Housing is the Business Cycle," *Proceedings, Federal Reserve Bank of Kansas City*, pp. 149–233.

LI, W., AND R. YAO (2006): "The Life Cycle Effects of House Price Changes," *forthcoming, Journal of Money, Credit and Banking*.

MORRIS, E. D. (2007): "Wealth Effects from Home Price Appreciation," .

POTERBA, J. (1984): "Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach," *The Quarterly Journal of Economics*, 99(4), 729–752.

RAMEY, V. A., AND K. D. WEST (1999): "Inventories," *Handbook of Macroeconomics*, 1.

SKINNER, J. (1989): "Housing Wealth and Aggregate Saving," *Regional Science and Urban Economics*, (19), 305–324.

TOLL BROTHERS (2004): "Toll Brothers 10-K for the fiscal year ended October 31, 2004," .

——— (2009): "Toll Brothers 10-K for for the fiscal year ended October 31, 2009," .

TOPEL, R., AND S. ROSEN (1988): "Housing Investment in the United States," *The Journal of Political Economy*, 96(4), 718–740.

U.S. CENSUS (2007): http://www.census.gov/const/www/existingvsnewsales.html, accessed on March 22 2007.

WHEATON, W. (1990): "Vacancy, Search and Prices in a Housing Market Matching Model," *The Journal of Political Economy*, 98(6), 1270–1292.