Labor Supply, Investments in Housing, and Portfolio Choice: An Empirical Analysis using the HRS

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Summary

In this paper I analyze the relationship between labor supply and housing investments by utility-maximizing individuals in a theoretical and empirical setting. Researchers have emphasized the importance of considering owner-occupied housing as a potentially risky investment and at the same time as a durable consumption good. The emphasis has been on studying its effects on portfolio choice, but not on its connection with labor supply decisions. Only if we understand the role that investments in housing play on households' portfolios can we appropriately characterize the full set of choices that households face when making retirement decisions, retirement plans, and deaccumulation decisions. Furthermore, for older individuals these issues should not be analyzed in isolation from the incentive effects created by social insurance programs and private pensions, and viceversa.

1 Introduction and Motivation

The purpose of this research is to analyze the relationship between labor supply and housing investments in an empirical model where utility maximizing individuals take into account the fact that housing provides a continuous stream of consumption but at the same time represents, in most cases, a substantial portion of a household financial assets. I will be using the Health and Retirement Study (HRS) to study the full set of portfolio decisions of individuals and the implications of the theoretical model, paying particular attention to investments in housing and real state and their relationship with more traditional portfolio investments. For older individuals these issues cannot be analyzed in isolation from the incentives created by social insurance programs and private pensions. In fact, only if we understand the role that investments in housing have on a household portfolio can we appropriately characterize the full set of choices that households face when making retirement decisions, retirement plans, and deaccumulation decisions.

The growing literature on the role of housing investments has concentrated in understanding its effect on the portfolio decisions of individuals, but has not considered its connection with labor supply. In Benítez-Silva (2003) I find that there is an empirical relationship between labor supply and investments in risky assets, as the work by Bodie and Samuelson (1989), Bodie, Merton, and Samuelson (1992), and Benítez-Silva (2002) predicts. At the same time there is a growing literature highlighting the importance that housing investments have on the demand for risky assets. In fact, the work of Flavin and Yamashita (1998), and more recent work by, Hu (2002), and Nichols (2003) show how relevant is to understand housing investments in order to provide an appropriate characterization of households' portfolio decisions over the life cycle. Investments in housing have a strong effect over the age-profile of the holdings of risky assets, and can provide substantial hedging against the fluctuations in the returns of traditional risky assets.

Therefore, the connection between labor supply and housing investments is a natural and essential extension of these literatures, and a way of providing a framework to connect the traditional retirement models, which do not model consumption of durable goods and rarely characterize the full set of investment opportunities of individuals, with a model that includes the decision to own a home as part of both the consumption bundle and the portfolio of individuals.

The role of housing in the decisions of older individuals is in itself a very active literature, which has focused on living arrangements, utilization of products that provide potentially advantageous liquidity to older homeowners, moving behavior and how it is affected by health shocks and other major life events, the connection between housing, consumption, and bequests later in life, and even the broad effects of the demographics trends in developed countries. Examples of this research work are Venti and Wise (1989, 1990a, 1990b, 2000, and 2001), Feinstein and McFadden (1989), Stahl (1989), Mankiw and Weil (1989),

Ai, Feinstein, McFadden, and Pollakowski (1990), Sheiner and Weil (1992), Feinstein (1993), Hoynes and McFadden (1994), Green and Hendershott (1996), and Ermisch (1996). The broad conclusions of this literature indicate that older Americans are not likely to sell their homes (or exploit the availability of financial products that would allow them to increase current consumption by reducing housing equity) unless a major life event affecting, for example, their health or their family's health, forces them to; they are likely to leave houses as bequests, but they do react to housing prices in terms of utilization of equity lines of credit and the probability of selling their properties. The overall demographic trends might push housing prices down in the long run, but the last decade has seen an impressive strengthening of the housing market. Relatively little is known, however, about the role of housing on older Americans' portfolio decisions, on how they prepare for retirement, and the connection with labor supply.

2 Data and Summary Statistics

The Health and Retirement Study is an excellent source of information regarding the portfolio investments of American households, including their investments in housing.[1] And it is the data set of choice for any analysis that studies directly or indirectly the labor supply decisions of older Americans Furthermore, the use of the HRS allows us to tackle these issues for a group of individuals who hold a high percentage of the economy's financial and non-financial assets.

In Table 1, in the Appendix, we provide summary statistics of some of the housing investments and portfolio measures using the first five waves of the HRS. We include in the sample only the financially knowledgeable respondent in the household. A number of interesting relationships emerge from this exploratory analysis. From 1992 to 2000 the homeownership rate has been fairly stable, with the exception of a decline from the 1992 levels, while the average and median housing values (both gross values and net values) increased in the last four years of the decade after a hump shape pattern in the beginning of the 1990s. During the same period the stock ownership rate, and the real estate ownership rate have declined. The pattern of stock ownership is very different for homeowners and renters, while between 25% and 37% of those that own a home own stocks during the 1990s, only between 4% and 10% of the renters own stocks in the same period. The pattern is qualitatively similar for investments in real estate. Everyone that hold risky assets, however, seemed to have benefited from the bull market of the mid to late 1990s, but by noticing the difference between average and median values of the risky assets we can see that some individuals benefited

[1] Hurd (2002) analyzes the portfolio decisions using the AHEAD, his emphasis is on participation in the market for risky assets. Ameriks and Zeldes (2001) use the Survey of Consumer Finances and data from TIAA-CREF, but do not focus on investments in housing.

a lot more than others.

These results confirm some earlier findings by Tracy, Schneider, and Chan (1999), and by Tracy and Schneider (2001), and some more recent ones by Benítez-Silva (2003). The latter work shows that during the late 1990s, other things equal, stock ownership was not on the rise among older Americans, and although some individuals saw their portfolios reached very high levels, many individuals maintained a fairly small amount of wealth on equities.

Finally, the last rows of the table provide some support for the findings in a number of recent studies that analyze the relationship between homeownership and investments in risky assets. Non homeowners have a much larger percentage of their net wealth in risky assets, in some years almost twice as large. Notice this is only computed for those that own stocks, since as we saw above, homeownership actually drives down the likelihood of owning stocks and real estate.

3 Investments in Housing and Portfolio Decisions

It is then important to appropriately characterize the role of investments in housing in the portfolio and consumption decisions of individuals and/or households. The fact that individuals (households) demand housing investments in order to actually live in them, but at the same time make out a large proportion of the assets that a family owns, complicates its modeling considerably. On the other hand, as we saw above individuals invest in real state even beyond the investment in their homes, a fact that might allow us to test some of the assumptions regarding the over or underinvestment arguments that some researchers have provided. It is also important to consider that housing prices do fluctuate, even if in the last few years the movement has been mainly upwards. This is important because most homeowners are likely to move and then try to recover the equity in their homes to purchase new homes, or modify their living arrangements, or might use the equity to finance additional consumption. Microeconomic empirical evidence from the 1980s (Engelhardt 1995) indicates that the marginal propensity to consume out of real housing capital gains is non-trivial. Aggregate results from Case, Quigley and Shiller (2001) seem to support that finding.

The connection between portfolio decisions and investments in owner-occupied housing has been analyzed by a large number of researchers. Henderson and Ioannides (1983), show that given the nature of the demand for housing it can be rational for households to over-invest in residential housing. Tax distortions, transactions costs and the (almost) non-divisible nature of the durable asset make it very difficult for individuals to match the demand for housing for investment and consumption purposes. Grossman and Laroque (1990) focused on the durable nature of housing investments, and the effect of transaction costs that affect the adjustment of these investments, concluding that owning a house can reduce the holdings of

risky assets as a proportion of wealth. Berkovec and Fullerton (1992) build a general equilibrium model that focuses on the role of taxes, and find that the benefits to owner-occupied housing have less of an effect on homeownership and on the stock of housing than in partial equilibrium models, mainly due to the different behavior of low and high income households. They also conclude that tax factors drive the size of the housing investment but not the tenure choice. Fratantoni (1998) finds that higher expenditures connected with homeownership (for example mortgage payments) cause agents to hold a lower portion of their assets in risky form. Kullmann and Siegel (2002) find that the ratio of a household's house value to its net worth affects negatively the relative share of risky financial assets in the household's total portfolio.

Flavin and Yashmita (1998) using a mean-variance efficiency model show that if considered only from an investment perspective housing investments improve the efficient frontier, meaning that they can be used to hedge against the fluctuations of traditional financial assets and their inclusion into the portfolio can increase the mean return without increasing the variance. This is due to the covariance structure between housing and other investments and the virtual lack of correlation between the returns to housing and risky financial assets. However, returns to housing investment might be potentially correlated with income shocks (house prices can be tied to the local economy), and as Haurin (1991), and Robst, Deitz and McGoldrick (1999) find, this can affect the decision to own a home. When the durable consumption nature of the housing investment is considered it becomes clear that it can affect the life-cycle profile of other financial assets. Flavin and Yashmita (1998) find that young households that own a house have a much smaller proportion of their wealth in risky assets, suggesting that they are constrained to be highly leveraged and with few possibilities of diversification. This constraint is relaxed as households age. The latter evidence could be supported by the fact that a significant number of households in the HRS not only own their homes but have other investments in real estate. The authors, however, do not model the renting vs. owning decision. These results are in line with the findings of Banks, Blundell, and Smith (2002) which exploit the differences between the U.S. and the U.K. to characterize these relationships.

Whether young households are over-invested in their homes is in itself rather controversial. If this is the case, they would be interested in reducing the risk of having such a large portion of their wealth in one asset, which can fluctuate considerably in value. Shiller and Weiss (1998) have analyzed the moral hazard problem with modified mortgage contracts that would allow homeowners to trade some of the risk of their investments, and have suggested alternatives that can reduce this problem; Nichols (2003) carefully models one of these contracts in a dynamic setting, the shared equity mortgage which prevents the home-owner from losing all the equity in the home but also prevents him or her from reaping all the benefits from equity increases. He finds that this type of contract does not affect the decisions of individuals in a significant way.

Notice, however, that almost no attention has been paid to the role of labor supply and labor income

into the housing investment decision and its connection with portfolio decisions. Similarly, the retirement literature has rarely modeled housing as a consumption durable good or investment asset. In part this is due to the complications of integrating these aspects in what can be already complex models. This research tries to bridge these gaps providing a theoretical and empirical treatment of these concepts.

4 Modeling Labor Supply, Housing Investments, and Portfolio Decisions

Appropriately accounting for the various motives for housing investment requires a model that allows for consumption and saving decisions under uncertainty regarding investments outcomes. I incorporate labor supply decisions into a, partial equilibrium, dynamic finite horizon portfolio choice model, to account for the possibility of labor supply playing a role to hedge fluctuations in risky investments, including housing, and to understand the role that housing investments play on retirement decisions. I present a model that shares some of the characteristics of Rust, Buchinsky, and Benítez-Silva (2002), van der Klaauw and Wolpin (2002), Benítez-Silva (2002), French (2000), Hu (2002), and Nichols (2003). It is a model that accounts for the durable nature of the investments in housing, includes the household choice between renting and owning a home, models the retirement decision, the incentives from social insurance programs, and the uncertain nature of investments in financial assets (including housing). This model can be thought as an extension of the retirement model presented in Rust, Buchinsky, and Benítez-Silva (2002) by adding the decision to own or rent a home with the corresponding effect on wealth accumulation, but without accounting for the disability application, and the role of health and health insurance. It can also be seen as directly extending the work of Hu (2002) and Nichols (2003) to account for the labor supply decision and the social insurance incentives that affect retirement decisions and retirement planning.

Although solving this model is challenging, by building upon the growing literature on dynamic models it is feasible, and can provide a more complete characterization of the choices and incentives that older individuals face when approaching retirement. Both the dynamic retirement models and the housing models that do not account for labor supply decisions have struggled with matching the wealth accumulation profile over the life cycle. By endogenizing the housing decision in a model that takes into account that individuals are making labor supply decisions over the life cycle we hope to provide a more accurate picture of the important decisions faced by individuals and households. This will ultimately provide a better characterization of the effects that social insurance programs have on individuals, and we will be able to provide valuable policy recommendations regarding Social Security reform, including privatization.

We will briefly describe the model here, but further details can be obtained in the references mentioned. Extending the model in the ways described is relatively straightforward at the theoretical level. The compli-

cation is to solve, simulate, and then possibly estimate such a model. At this time I will solve and simulate this model, and to study and test its implications using the HRS. I will then estimate the model by Maximum Likelihood or by some modified Method of Moments routine, depending on how long it takes to solve the model.

The model has four choice variables: consumption, savings of risky assets, labor supply, and the owning/renting decision. The first two variables are continuous; labor supply can take three values: full time work, part-time work, and no work; and the home owning decision is a dichotomous choice. The computational complications come from the number of state variables in the model. Given the discrete time nature of the problem, age is a state variable which will take 80 values, since we will be solving the model for individuals age 21 to 100. Second, we keep track of the financial non-housing wealth that individuals hold, which is affected by the uncertain return on risky investments. Third, we need to keep track of the value of the home (a continuous variable), which changes due to price movements in the housing market and the value of the mortgage. The latter is our fourth state variable. The fifth state variable is the current home tenure status which can take four values depending on whether the individual stays in the current situation, becomes a renter, becomes an owner, or acquires a new home. Finally, we need to keep track of the average wage in order to appropriately characterize the incentives from the Social Security program. Notice that we will follow Rust, Buchinsky, and Benítez-Silva (2002) in modeling the relationship between wages and average wages, which allows us to save the additional burden of keeping track of wages as a state variable.

This model will include several sources of uncertainty: lifetime uncertainty, uncertainty over returns to capital investments, uncertainty over housing prices, and wage uncertainty. We will assume all mortgages are obtained at a fixed interest rate, and that the returns on traditional financial assets are uncorrelated with the returns on housing and wage innovations.[2]

The level of complication of this model comes from the number of continuous state variables that we need to keep track of and the sources of uncertainty. A delicate issue is to decide whether we can reduce the state space, by for example (following Nichols 2003) approximating the state variable that keeps track of the value of the mortgage by mortgage age, which given some initial conditions regarding down payments, initial interest rate, and length of the mortgage can be a fairly good approximation. Finally, given the number of sources of uncertainty we might have to compute multiple integrals for each of the combinations of the state and choice variables, given our experience with a variety of robust methods (see Benítez-Silva et al. 2000) we are confident we can solve this part of the problem relatively fast. It is worth mentioning that the programming of this model is done in Gauss and C, using dynamic libraries, and exploiting the parallel

[2] Campbell and Cocco (2002) analyze the optimal mortgage choice in a finite horizon model that allows for risky labor income and borrowing constraints. They do not model the labor supply or the retirement decision.

capabilities of Linux workstations using the LAM/MPI software.

The within period utility function is assumed to be Isoelastic and Cobb-Douglas between consumption in non-durable goods and housing (which depends on the housing choice, and for homeowners it can be a function of the value of their property), and additive in leisure through a function ϕ, which depends positively on age, and negatively on average wages, to account for the lower disutility of work for higher earners:

$$u(c,l,h_i,\phi) = \frac{(c^{\eta}\, h_i^{1-\eta})^{1-\gamma}}{1-\gamma} + \phi(age, aw) \ * \ \log(l) \ , \tag{1}$$

where γ is the coefficient of *relative risk aversion* and η is the valuation of consumption in non-durables versus consumption of housing. The two types of consumption goods are substitutes or complements depending on the value of γ, analogously to the discussion in Heckman (1974) and Low (1998), but in their cases consumption and leisure were non-separable within periods. We assume that labor is discrete, agents can choose to work full-time, part-time, or not at all. Notice as well that since we are allowing for lifetime uncertainty individuals will be leaving bequests, which will be assumed to depend only on the size of the bequest and we will assume housing is inherited in cash at the current value of the home.

Individuals solve

$$\max_{c_s,l_s,h_{i,s},A_s,c_T,l_T,h_{i,T},A_T} E_t \left[\sum_{s=t}^{T-1} (\tau_s\, \beta^{s-t}\, u(.) + (1-\tau_s)\, K\, \beta^{s-t} u(.)) + \beta^T\, u(.) + K\, \beta^T u(.) \right] \ , \tag{2}$$

where $K \in (0,1)$ is a bequest factor. β is a classic discount factor, and τ_t represents age-specific survival probabilities, which for simplicity will be directly taken from the U.S. Life Tables. Individuals also choose how much to invest in the risky asset. Utilities depend on consumption of non-durables and housing, and leisure, except in the last period (either T or the probabilistic last period of life), when they only depend on family savings including the monetized value of housing. Total family savings, w_t, is the sum of the portion that accumulates at a probabilistic rate of return, $\tilde{r}_1$, the net value of the home next period including price increases $\tilde{r}_h$, and the residual investment in riskless assets at a rate of return r_2:

$$w_{t+1} = \tilde{r}_1\ (A_t) + r_2\ (w_t + \omega\,(1-l) - c - h_i\, P - A_t) + \tilde{r}_h (H_t - M_t), \tag{3}$$

where ω represents wages, H_t is the value of the house, M_t is the value of the mortgage, and P is the cost of the corresponding housing choice (which will include transaction costs for those buying or selling a property, see Martin 2003 for a more detailed discussion of the role of transaction costs), and where we omit the time subscript except on the wealth variables to simplify the notation. Notice that we allow the home equity gains to be part of future wealth, implicitly assuming the gains will not be used to repay the mortgage, for example. Renters will have a value of the house and mortgage of zero, and their consumption

of housing will be equal to the rent they are paying, for owners the implicit rent is lower thanks to the tax incentives, but it can be a function of the value of the house.

We solve this dynamic programming problem by backward induction. The following expression,

$$V_T(w, aw, H, M, h) = \max_{(0 \leq c \leq w, l, A, h)} U(c, l, h, \phi) + K\, U(w') \,, \tag{4}$$

is solved by individuals in the last period of life, where labor is chosen among the three possible states, housing is chosen among the four possible states, and consumption and investments in risky assets are chosen optimally considering that households can only leverage through the mortgage. Once we obtain the decision rules numerically we can write the value function in the next to last period:

$$V_{T-1}(w, aw, H, M, h) = \max_{(0 \leq c \leq w', l, A, h)} U(.) + (1 - \tau_{T-1})\, K\, U(w') + \tau_{T-1}\, \beta\, E\, V_T(w', aw', H', M', h') \,. \tag{5}$$

The functions for the earlier periods are obtained recursively. The expectation appearing in the value functions for the different periods can be written as follows:

$$\int_0^{\overline{r}_1} \int_0^{\overline{r}_h} \int_0^{\overline{\omega}} V(w', aw', H', M', h')\, f(\tilde{r}_1) d\tilde{r}_1\, f(\tilde{r}_h) d\tilde{r}_h f(\tilde{\omega}) d\tilde{\omega} \,. \tag{6}$$

The interpolation of the values of the next period value function has to be carried out in multiple dimensions. The integrals are solved by Gaussian quadrature or low-discrepancy integration, and we use iterated integration given the assumptions regarding the independence between returns and wage innovations.[3]

This model can provide an excellent characterization of the choices that individuals face, and the interaction between portfolio decisions, housing decisions and retirement decisions. Policy experimentation and possible recommendations can be grounded on a more realistic model of decision making by utility maximizing individuals. Notice however, that the implications of this model will first be tested using the HRS, analyzing portfolio decisions, housing decisions and retirement patterns.

[3] See Rust (1996) and Judd (1998) for a survey of numerical methods in economics.

Appendix

Table 1: Housing Wealth and Risky Assets in the HRS

	Quantities in $ of 1992				
Variables	Wave 1:1992	Wave 2:1994	Wave 3:1996	Wave 4:1998	Wave 5:2000
Home-ownership rate	78.1%	69.1%	72.2%	72.2%	72.6%
Stock-ownership rate	26.4%	29.3%	20.1%	20.0%	19.9%
Real-Estate Ownership rate	22.9%	23.4%	18.6%	15.4%	15.1%
Average Housing Value	119,207	122,990	107,728	124,788	127,005
Median Housing Value	80,000	85,203	80,478	86,070	89,628
Average Mortgage	31,225	31,733	23,705	25,345	24,268
Median Mortgage	11,000	9,940	0	0	0
Average Net Worth Home Owners	268,704	286,699	226,460	256,558	284,746
Average Net Worth Non H-owners	35,360	44,940	47,030	32,056	42,016
Stock-ownership among H-O.	31.67%	37.61%	25.61%	26.04%	25.75%
Stock-ownership among N. H-O.	7.62%	10.77%	5.99%	4.34%	4.47%
Real-Estate own. among H-O.	27.31%	29.87%	23.13%	19.75%	19.20%
Real-Estate own. among N. H-O.	7.44%	8.92%	6.89%	3.85%	4.36%
Average Stocks H-O.	68,923	88,871	105,544	140,753	180,110
Average Stocks N. H-O.	35,627	44,086	57,290	113,647	131,004
Median Stocks N. H-O.	8,000	12,348	16,096	21,518	20,370
Average Real-Est. H-O.	157,507	144,895	134,020	152,140	160,938
Average Real-Est. N. H-O.	100,890	76,782	150,433	61,040	98,131
Median Real-Est. N. H-O.	20,000	22,378	34,874	25,821	24,444
% of Net Worth in Stocks H-O.	14.51%	16.31%	17.88%	20.44%	21.90%
% of Net Worth in Stocks N. H-O.	29.71%	27.11%	30.88%	125.81%	44.98%
% of Net Worth in Real-Est. H-O.	25.98%	24.57%	26.83%	26.40%	27.72%
% of Net Worth in Real-Est. N. H-O.	56.9%	56.20%	56.92%	36.26%	59.13%
Number of Observations	7,607	7,008	6,771	6,539	6,273

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