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December 2003

NATIONAL ASSOCIATION OF REALTORS®
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HOUSING: AN INVESTMENT AND A PIGGYBANK FOR SPENDING

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We are grateful to the National Association of Realtors® for research support and to Assen Assenov, Paul Bishop, Don Jud and Peter Bearse for their helpful comments and suggestions.

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Abstract

The representative household in the United States concentrates its wealth in a house and a retirement account, both of which are illiquid. It holds only negligible financial assets such as stocks and bonds. To fund consumption based on wealth, households use their illiquid assets indirectly by borrowing against them.

This paper develops an intertemporal model of consumption to distinguish between two alternative definitions of wealth: 1) the household's total balance sheet based on assets and liabilities and 2) net equity. An optimal household model of wealth accumulation is developed with empirically testable hypotheses to distinguish between these competing definitions. The equilibrium conditions yield testable marginal propensities to consume from physical (housing) and financial assets. Empirical results for aggregate U.S. data for 1952:2-2001:4 support the total balance sheet definition of wealth as opposed to the net equity specification. Consumption is increasing in mortgage debt with a higher coefficient for financial assets. Borrowing based on the value of residential housing allows households to smooth their consumption and therefore smooth the national consumption cycle.

Keywords: residential housing, wealth, illiquid assets, consumption, household balance sheet, mortgage refinancing, consumption smoothing

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1. Introduction

In the theory of finance, the household as an investor chooses among risky assets with liquid markets and typically without taxable implications. If that household is representative, its financial decision-making influences the sequence of consumption and investment for the entire economy. Further, under appropriate parameter restrictions the relationship between consumption and financial wealth is linear. An additional dollar of wealth, or net equity, has been estimated to increase consumption by 3 to 5 cents per year thereby linking financial markets and the real economy.

While providing a powerful rationale for financial markets, there remain nagging concerns about how liquid and flexible the representative household is with regard to changing wealth and consumption. Household data show that the holding of liquid financial assets is confined to the very wealthy. From the 2001 *Survey of Consumer Finances* (SCF) of the Board of Governors of the Federal Reserve System, households in the top 5 percent of the income distribution hold 57 percent of all wealth, and only in this group are there substantial liquid financial assets.[1] Households have instead chosen retirement accounts with limited liquidity as well as housing that cannot be sold in divisible quantities. More than 67 percent of households are homeowners.

The linkage of household assets and liabilities to consumption under retirement and housing wealth liquidity restrictions is indirect. Households borrow to consume based on their entire balance sheet. They borrow against their house or retirement account, placing the funds received into liquid accounts as assets from which consumption occurs. Household borrowing against illiquid assets contrasts with household consumption from net equity (the difference between assets and liabilities). Between 1989 and 1998 in the *SCF*, median total household wealth increased from $58,800 to $61,000 in 1998 dollars (an increase of only $2,200), but financial assets increased by $5,500 and physical assets (housing) by $8,500. Thus, household debt rose by $11,800 ($5,500 + $8,500 - $2,200). In percentage terms, 84 percent of the increase in the size of the median household's balance sheet was from debt accumulation while equity or net wealth accounted for only 16 percent.

[1] Laitner (2002) discusses this concentration of wealth, and Deaton (1991) estimates the low median financial holding at less than $1,000. Bertaut (1998) using the *Survey of Consumer Finances* of the Board of Governors of the Federal Reserve System finds relatively low stock ownership even among the relatively few households with high levels of liquid assets. Among households with more than $60,000 in liquid assets in 1992, ranking them in the top 10 percent of the financial wealth distribution, more than one-quarter held no equities, in stocks or mutual funds, even in retirement or pension accounts.

Does residential housing ownership smooth the national consumption cycle so as to provide positive social outcomes for individuals, households, and society? Two-thirds of households are homeowners, and at least 60 percent have been since the early 1970s. More households own houses than own stocks and bonds.

Individual households use both the housing and mortgage markets to smooth their consumption in several ways. First, when real interest rates decline during recessions owing to a slowdown in business loan demand, the presence of a complete secondary mortgage market allows lenders to continue funding. Second, existing homeowners tend to be locked in with their homes, given the transaction costs of trading. Facing liquidity squeezes and reduced employment during downturns, they spend more time at home, consuming more housing services.

Third, and possibly most significant for smoothing consumption, home ownership can be used to fund non-housing expenditures. Existing and new homeowners use lower interest rates to increase the amount of their home loan and the size of their homes because real estate becomes more affordable in real terms. By increasing the size of their mortgage balances over and above amortization with cash-out refinancing, households obtain added resources for spending. Second mortgages and home-equity lines of credit also provide additional funds. The cash received from increasing the mortgage balance can be allocated to investment in more housing or to purchasing financial assets or to supporting greater consumption. During the recent 2001 recession, homeowners refinanced and used proceeds for college tuition, furniture, credit card debt reduction, vacations, cars, and other personal consumption. Thus, the housing market tends to operate by increasing consumption counter-cyclically, potentially offsetting pro-cyclical variations in income and the valuation of financial assets.

Fourth, a borrower increases mortgage debt by issuing a bond to the lender. If that bond is bought domestically and both borrowers and bondholders have similar preferences, there is a saving offset. All the mortgagors are domestic, but some of the lenders may be foreign. In the United States, the foreign share in mortgage bondholding is almost half. By refinancing, domestic borrowers receive a savings through a lower interest rate at the expense of foreign savers. If the borrower has a higher marginal propensity to consume than the lender, there is an additional stimulus.

Our primary hypothesis is that financial flexibility provided by refinancing of home mortgages or by new mortgage originations allows for consumption smoothing. Housing consumption is therefore countercyclical and of benefit to the US economy.

This paper presents an intertemporal model of consumption and investment under two alternative definitions of wealth. The first definition of wealth is total balance sheet holdings and the second is defined as net equity. An optimal household model of wealth accumulation is developed with empirically testable hypotheses to distinguish between these competing definitions. Section 2 reports summary data on the representative household portfolio comprised of housing, retirement and financial assets as well as some prior research on consumption smoothing. In the model of Section 3, the household takes account of liquidity restrictions on the premature withdrawal of funds from restricted accounts, the transaction costs of selling a house, and any borrowing constraints in the mortgage market. From these household decisions emerge a reduced form where consumption depends on either the total balance sheet or net equity. Empirically testable reduced forms are derived for both. Under restrictions on the utility function, consumption is linear in the wealth definition and in the marginal propensity to consume.

Section 4 presents empirical results for aggregate quarterly United States data for 1952:2-2001:4. We find consumption to be increasing in mortgage debt with a higher coefficient than that for financial assets. The intertemporal financial decision, therefore, is based on the total balance sheet rather than on net equity. These results are robust to specification, and indicate that for making consumption decisions households define their wealth by their total balance sheet and not by their net equity.

Various specifications are tested with financial and physical (housing) assets. When wealth includes only financial assets, the marginal propensity to consume is 3 to 5 cents per additional dollar annually. When house equity and the mortgage are added to the portfolio, the marginal propensity to consume from financial assets declines to between 1 and 1.5 cents.

2. Do Mortgages Finance Consumption?

Data on savings and housing leverage are indicated in Table 1. The first column reports the aggregate savings rate from 1955-2001. The savings rate increased from 7.1 percent in 1955 to 10.6 percent in 1980, but since 2000 has declined to almost zero. While households have reduced their saving, they have increased the leverage on their houses. The loan-to-value ratio (LTV) was 21 percent in 1955, and fluctuated without trend until 1985 when it was 28 percent. Since 1990 the LTV has increased rapidly, from 34 percent in 1990 to more than 40 percent by 2000. Households have been reducing their saving and also increasing the debt on their houses relative to the value of their homes. Consumption has been sustained by this reduction in household saving and by the increased borrowing against their homes. In fact, the debt on housing has been increasing faster than the value of the houses themselves.

The third and fourth columns show holdings of financial wealth and housing wealth relative to income. Financial wealth is the sum of holdings of stocks, bonds, mutual funds, and deposits in banks along with certificates of deposits. Housing equity is the value of single-family houses less mortgage debt. Both are divided by personal disposable income. The ratio of financial wealth to personal disposable income declined during the period from 1955 to 1970 from 3.8 to 3.6. During the stock market boom of the 1990s which peaked in 2000, the ratio increased to 4.7 before declining to 4.4 in 2001. The ratio of housing equity to personal disposable income declined from 1955-1975 and increased during the 1980s. The ratio hit a low point in 1995, and subsequently increased to 1.05 in 2001.

Table 1. U.S. Savings, LTV, Financial Wealth and Housing Equity 1955-2001

	Savings ratio	Loan-to-value ratio (LTV)	Financial wealth-income ratio	House equity-income ratio
1955	7.1%	21%	3.803	1.128
1960	7.1%	26%	3.948	1.107
1965	8.6%	31%	3.975	0.927
1970	9.9%	28%	3.614	0.978
1975	10.0%	28%	3.257	0.999
1980	10.6%	27%	3.346	1.175
1985	8.7%	28%	3.307	1.198
1990	7.8%	34%	3.555	1.119
1995	5.2%	40%	4.024	0.916
2000	1.0%	40%	4.724	1.021
2001	0.4%	41%	4.369	1.054

Sources: Savings, consumption and personal disposable income, U.S. Department of Commerce, Bureau of Economic Analysis, *National Income and Product Accounts*.
Financial wealth, housing wealth and mortgage debt, Board of Governors of the Federal Reserve System, *Flow of Funds Accounts*.

The qualitative results in Table 1 suggest that households have been reducing saving and increasing housing debt over time. In particular, the lower savings and increased relative mortgage borrowing occurred during downturns in the economy. In 2001, a recession year, the savings rate declined from a very low 1 percent of personal disposable income to an even smaller 0.4 percent. That savings decline was not in response to a wealth effect from increased financial assets, since the stock market declined sharply in 2001. Homeowners increased their loan-to-value ratio overall to 41 percent, a record high since World War II, from 40 percent a year earlier. In the previous recession in 1980 the same qualitative changes occurred. The savings rate declined from 10.6 percent in 1980 to 8.7 percent by 1985, and the LTV of homeowners increased from 27 percent to 28 percent. During 1970-1975, the period that included the 1973-74 recession, the savings rate and the loan-to-value ratio remained constant. That was during a rapid inflationary period indicating that borrowing increased more or less in line with the rapid increase in home prices. That same situation occurred during the period from 1997-2001 when house prices once again began to increase at a rate higher than prices in general.

The data suggest that when there is a downturn in the economy households reduce savings and increase borrowing against their house. This is phenomenon has been described as consumption smoothing. The volatility of consumption is reduced by increasing the volatility in savings and mortgage debt. In effect, households are using their houses to maintain their standard of living.

3. Consumption Smoothing

There has been a spate of research on the excess smoothness of consumption (for example, see Caballero (1995), Deaton (1987), Campbell and Deaton (1989)). These research findings are generally accepted: 1) changes in consumption are smoother or stickier with greater serial correlation than would be supported by changes in income; and 2) the volatility of consumption is lower than the volatility of income. A number of explanations have been offered for this apparent divergence from the permanent income hypothesis (PIH) and other theories that stress the interdependence between consumption and income. Flavin (1981), Hayashi (1982), Campbell and Mankiw (1989), Clarida (1991), Deaton (1991), Galf (1991), Gali (1991), Hubbard, Skinner, and Zeldes (1995), Engelhardt (1996), Carroll (1997), and more recently, Storesletten, Telmer, and Yaron (2000), Gourinchas and Parker (2002), Hurd and Rohwedder (2003), and Stephens (2003) are among many researchers who develop models, simulations, and tests that show the effects of liquidity constraints (capital markets and others), saving changes (buffer stocks), governmental benefits, or life cycle changes (job market entry, job loss, and retirement) that, in turn, result in changes in intertemporal consumption.[2] Much of this literature is reviewed by Browning and Lusardi (1996) and Deaton (1992).

We offer a new explanation for the apparent smoothness of consumption. The housing market, particularly through mortgage re-financing, acts to stabilize consumption. This rationale for consumption smoothing and stabilization has not been previously offered in the literature. Some researchers have examined the role of automobile loans and changes in state borrowing (Ostergaard, Sorensen, and Yosha, 2002) in smoothing consumption. Our rationale contrasts with Ludvigson (1998) who shows that credit for automobile loans may act to restrain consumption during periods of tight money supply.

4. A Model of Household Wealth Accumulation

The household has two principal assets, a retirement account or series of them and a house with a mortgage. The retirement account is invested in q_f units of a composite financial asset. The family owns a house of quality q_h on which there is a mortgage with balance q_m. Prices of both assets and the mortgage liability are $p_j, j = f, h, m$. Expectations of the mean and the standard deviation of the return for a given asset or liability are $(\hat{\alpha}_j, \hat{\sigma}_j), j = f, h, m$.[3] If the rates of price change follow a Wiener process with noise dz_{jt} then

[2] Browning and Lusardi (1996) make an interesting comment regarding Deaton (1991). They suggest that Deaton's results show that small amounts of assets can protect individuals from income fluctuations and, thus, considerable smoothing of consumption results. Our primary hypothesis is that financial flexibility provided by refinancing of house mortgages (or new mortgage originations) allows for the same result – consumption smoothing.

[3] Covariance terms could be included, but Goetzmann and Siegel (2000) have shown zero betas for excess housing returns against the Standard and Poor's 500 for 20 separate U.S. cities, using quarterly repeat sales

(1) $$\frac{dp_{jt}}{p_{jt}} = \hat{\alpha}_j dt + \hat{\sigma}_j dz_{jt} \qquad j = f, h, m.$$

Once housing is acquired and retirement accounts are established, there are tax and liquidity restrictions on selling houses or moving funds from retirement accounts. These lead to a liquidity adjustment $\lambda_j \le 1$. The liquidity adjustment for the mortgage is unity. At market prices, the household's balance sheet contains on the asset side a retirement account worth $p_f \lambda_f q_f$ and a house worth $p_h \lambda_h q_h$. On the liability side the market value of the mortgage balance is $p_m q_m$.

In the conventional specification, consumption is based on wealth defined as net equity $p_f \lambda_f q_f + p_h \lambda_h q_h - p_m q_m$. An increase in the value of the house or financial assets increases consumption. An increase in the mortgage balance ultimately decreases consumption by reducing wealth.

This specification, however, does not take into account the restrictions on the sale of a house or the penalties for withdrawing from a retirement account. With these restrictions, households borrow against their assets. Households raise consumption by increasing their debt burden. They regard their entire balance sheet $p_f \lambda_f q_f + p_h \lambda_h q_h + p_m q_m$ as relevant, subject to a solvency constraint on house equity $p_h \lambda_h q_h - \theta p_m q_m > 0$. As the mortgage balance increases, a double-entry offset increases the balance in a liquid asset account to fund consumption. Here θ is a market limit on the ratio the house value to mortgage debt. If the limit on mortgage debt to house value is 80 percent, then the solvency constraint requires that the house value less 1.2 times the mortgage be positive.

Denoting as w the variable on which consumption is based

(2) $$w = p_f \lambda_f q_f + p_h \lambda_h q_h + a p_m q_m \qquad p_h \lambda_h q_h - \theta p_m q_m > 0.$$

Within this specification, consumption can be based on either net wealth or the total balance sheet. In Table 1 the median household owns a house valued at \$66,200. The capital structure of this house is such that there is a mortgage of \$22,500 and equity of \$43,700. The household has \$20,800 of financial assets, with \$16,000 in pension and retirement accounts and \$4,800 in unrestricted accounts. If the household consumes from net wealth, then $a = -1$. Total wealth, defined as net equity, is \$64,500, of which 68 percent is in housing and 25 percent in restricted financial assets. The remaining 7 percent is in unrestricted financial assets.

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data over 1980-1999. There may be a nonzero covariance between mortgages and financial assets. However, the financial assets are in restricted accounts, and the mortgage is more subject to separate timing issues on refinancing.

With housing and the retirement account restricted, the household consumes from the gross balance sheet. In this double-entry transaction, the household increases assets available to fund consumption by increasing liabilities, principally mortgage debt. The increase in mortgage debt is offset by an equal increase in the amount of unrestricted financial assets from which consumption occurs. The only two sources available for consumption are from the 7 percent in unrestricted financial assets and from borrowing against the house through a mortgage. In a double-entry context, the 7 percent held in unrestricted financial assets is likely to be the offset from increasing the size of debt. The household borrows against its house, increasing the balance on its mortgage. Those funds are deposited by increasing the cash balance or by purchasing liquid investments, making those funds available for consumption. Consumption is determined by the size of the balance sheet and not the difference between assets and liabilities, or $a = +1$. For the median household, the mortgage balance is what allows it to consume. It is effectively consuming from its mortgage, and consumes from the total balance sheet or $109,500.

The economy aggregates over a representative household with consumption per capita c_t at time t. Consumption and other variables are defined relative to income. Consumption is an aggregate of housing and other goods and services. The planning horizon is from initial date 0 to time T. The utility function at time $t, 0 \le t \le T$ is $u(c_t)$ and is increasing and concave in consumption.[4] The rate of time preference at the initial date is r. Maximizing over discounted expected utility yields the indirect utility function

$$(3) \qquad v(w_0) = E_0 \int_0^T u(c_t) e^{-rt} dt$$

where E_0 is the expectation operator at the initial time 0. By duality, indirect or maximized utility v is increasing and concave in initial resources w_0.

Expected cash flow and returns come from financial assets and housing, less the mortgage payment, any consumption expenditures, and the net debt paydown. The flow yield is

$$(4) \qquad dw = (\hat{\alpha}_f \lambda_f q_f + \hat{\alpha}_h \lambda_h q_h - \hat{\alpha}_m q_m - c - b q_m) dt + (\hat{\sigma}_f \lambda_f q_f + \hat{\sigma}_h \lambda_h q_h + \hat{\sigma}_m q_m) dz \, .$$

On its retirement account, the household earns a liquidity-adjusted return of $\hat{\alpha}_f \lambda_f q_f$. Here f is a subscript that applies to financial assets and h applies to housing. For the real

[4] Utility can exhibit non-additive separability in consumption. For one specification as in Sundaresan (1989), consumption is relative to a reference level $\overline{c}_t(c_{t-1}, \ldots, c_0)$ depending on the past sequence. At the current date, utility is $u(c_t - \overline{c}_t)$, a supernumerary level analogous to the Stone-Geary form of demand functions. In equilibrium, consumption is not homothetic in wealth. Consumption remains linear in wealth, the underlying structure required for estimating the wealth effect.

estate itself, returns come from capital gains and equivalent rent after operating expenses of $\hat{\alpha}_h \lambda_h q_h$. The mortgage payment is $-\hat{\alpha}_m q_m$. The fraction of the loan q_m paid down by added payments is b. If b is negative then the household is a net borrower from housing, such as from cashout refinancing, second mortgages and home equity loans.[5] The retirement account and housing have respective volatility $\hat{\sigma}_f \lambda_f q_f$ and $\hat{\sigma}_h \lambda_h q_h$. The volatility on the mortgage is $\hat{\sigma}_m q_m$.

Maximization for the household yields the recursive structure

$$(5) \qquad v(w,t) = \max_{c,q}\left[u(c,t) + \frac{E(v+dv)dt}{1+k}\right]$$
$$= \max_{c,q}\left[v + \left[\begin{array}{l} u(c) - kv + (\hat{\alpha}_f \lambda_f q_f + \hat{\alpha}_h \lambda_h q_h + \hat{\alpha}_m q_m - c - bq_m)v_w \\ +v_t + \frac{1}{2}(\hat{\sigma}_f^2 \lambda_f^2 q_f^2 + \hat{\sigma}_h^2 \lambda_h^2 q_h^2 + \hat{\sigma}_m^2 q_m^2)v_{ww} \end{array}\right]dt\right].$$

The household selects the program of consumption c and investment in the retirement and house assets and the mortgage liability q to maximize intertemporal utility. Optimal consumption and investment in the retirement account, housing and mortgage satisfy

$$(6) \qquad \begin{cases} v_w = u_c & & (consumption) \\ q_j = -\dfrac{\hat{\alpha}_j v_w}{\hat{\sigma}_j^2 \lambda_j v_{ww}} > 0 & j = f,h & (assets) \\ q_m = \dfrac{(\hat{\alpha}_m - b)v_w}{\hat{\sigma}_m^2 v_{ww}} < 0 & & (liability) \end{cases}$$

With the balance sheet defined as wealth, the mortgage liability is measured as a negative asset.

As represented in equation (6), the marginal utility of consumption is equal to the marginal utility of wealth. Investments in the retirement plan or housing increase in $\frac{\hat{\alpha}}{\hat{\sigma}}$. Asset holdings rise in the ratio of the marginal utility of wealth to its second derivative $-\frac{v_w}{v_{ww}} > 0$, where $v_{ww} < 0$ by the concavity of the indirect utility function $v(w,t)$. Asset holdings decrease in their risk $\hat{\sigma}_j$. An increase in liquidity λ

[5] The constraint is that the mortgage cannot exceed the value of the house. In the U.S. there are other institutional restrictions on mortgage borrowing. When the mortgage loan exceeds 80 percent of the value of the house, the borrower pays an effective interest rate premium for default insurance.

reduces the return. With liquidity constraints on consumption, the household has an incentive to use the mortgage balance to fund expenditures.

Substituting the equilibrium conditions

$$(7) \qquad u(c) - kv - c + v_t + \frac{1}{2} v_w \left[\hat{\alpha}_f \lambda_f q_f + \hat{\alpha}_h \lambda_h q_h - (\hat{\alpha}_m - b) q_m \right] = 0 .$$

This partial differential equation of the representative household's initial wealth includes the liquidity discounts on housing and retirement accounts λ_h, λ_s and the relatively costless capability b of modifying the mortgage balance.

An explicit solution requires the specification of a utility function $u(c)$, the units of housing q_h, the mortgage q_m, and the retirement account q_f. Once two of the principal assets and liability are specified, the third is obtained from the resource definition (2). If the utility function exhibits constant relative risk aversion with parameter γ, solving for optimal consumption

$$(8) \qquad u(c) = \frac{c^{1-\gamma}}{1-\gamma} \qquad u_c = c^{-\gamma} = v_w \qquad c = v_w^{-\frac{1}{\gamma}} .$$

The household's financial wealth has two components. One is for restricted accounts such as retirement and insurance funds. This component accounts for the large majority of financial wealth for the median household. The other is for unrestricted accounts including cash, savings and checking accounts, certificates of deposits, stocks, bonds and mutual funds. The parameter κ summarizes net contributions to these accounts. The cumulative size of financial accounts is $s(\kappa, p_f)$ based on the contribution rate and the financial asset price process. The household's retirement account is therefore exogenous. Over its financial planning period, the household remains in the same house h and accumulates positive housing equity, so $h - q_m > 0$. With its retirement account and house predetermined, net equity is determined by the level of household liabilities. The allocation is

$$(9) \qquad p_f q_f = s(\kappa, p_f) \qquad p_h q_h = h \qquad q_m = \frac{w - \lambda_f s - \lambda_h h}{a} .$$

Any discretionary consumption is funded by the adjustment of the mortgage balance (borrowing, refinancing, etc.). Substituting (8)-(9) into (7) yields

$$(10) \qquad -\frac{\gamma v_w^{\frac{\gamma-1}{\gamma}}}{\gamma - 1} - kv - c + v_t + \frac{1}{2} v_w \left[\hat{\alpha}_f \lambda_f s + \hat{\alpha}_h \lambda_h h - \frac{\hat{\alpha}_m - b}{a} \left[w - \lambda_f g - \lambda_h h \right] \right] = 0 .$$

The indirect and direct utility functions v and u have the same functional form by duality, or

$$(11) \qquad v(w,t) = e^{kt}\frac{w^{1-\omega}}{1-\omega} \qquad v_w = e^{kt}w^{-\omega} \qquad v_t = ke^{kt}\frac{w^{1-\omega}}{1-\omega}.$$

Here ω is the coefficient of relative risk aversion in indirect utility. Its inverse is the marginal rate of intertemporal substitution in wealth. Substitution for v, v_w and v_{ww} solves for (10) in resources w given boundary conditions and estimates of the parameters. Under constant relative risk aversion in (11), the optimal mortgage in (6) is linear in wealth, or

$$(12) \qquad q_m = -\frac{\hat{\alpha}_m w}{\hat{\sigma}_m^2 \omega} < 0 \qquad .$$

The dollar balance of the mortgage increases in its price of risk $\frac{\hat{\alpha}_m}{\hat{\sigma}_m}$ but decreases in its volatility $\hat{\sigma}_m$ and in the degree of risk aversion ω. Also from (8) and (9) the relationship between consumption and asset holdings is

$$(13) \qquad c = e^{-\frac{kt}{\gamma}}\left[\lambda_f s + \lambda_h h + aq_m\right]^{\frac{\omega}{\gamma}} \qquad .$$

4. Data and Model Specification

Given the aggregation conditions for the representative household, the data are quarterly observations on United States macroeconomic variables for the period from 1952:4 through 2001:4. For the model, the relevant data are consumption and holdings of financial and physical assets, along with liabilities. These data are normalized by income from human wealth to be consistent with life-cycle accumulation, requiring a distinction between labor and property income. Income variables are from the *National Income and Product Accounts* of the Bureau of Economic Analysis of the U.S. Department of Commerce. Property income includes corporate dividends, net interest, rental income, and proprietors' income. Total property income is subtracted from total disposable income to obtain an estimate of labor income. Labor income plus transfer income, *Y*, is the definition of income used in the analysis.

For personal consumption expenditure, C, the consumption-income ratio is $c \equiv \frac{C}{Y}$. The other variables in wealth–financial holdings, housing and mortgages–are similarly defined relative to income. Data on personal consumption expenditure is from the *NIPA* quarterly series.

The data on financial assets and liabilities and physical assets are from the *Flow of Funds Accounts* of the Board of Governors of the Federal Reserve System. The *Flow* *of Fund Accounts* report on household holdings of real estate q_h from principal residences and investment property. The holdings of real estate in current dollars at p_h is $h = p_h q_h$. The *Flow of Funds Accounts* report household mortgage debt, yielding q_m in current dollars p_m. The ratio of mortgage debt to house value is $m = \frac{q_m}{h}$, the leverage or loan-to-value ratio. The holding of financial wealth net of debt used for purchase, such as margin accounts is $f = p_s q_s$. These are the variables required for estimating equation (13), all measured relative to personal disposable income. The variables are consumption, financial net assets, housing, mortgage and housing leverage, or $(c_t, f_t, h_t, q_{mt}, m_t)$

Time series due diligence tests for unit roots and cointegration were carried out on data covering the estimation period. As indicated in Tables 1 and 2 of the Appendix, the tests indicate unit roots in levels but stationarity in first differences with no cointegration. The derived estimating equation using $m \equiv \frac{q_m}{h}$ as the ratio of the mortgage loan to house value is

$$(14) \qquad \Delta c_t = e^{-\frac{kt}{\gamma}} \left\{ \lambda_f \Delta f_t + \Delta h_t \left[\lambda_h + a \Delta m_t \right] \right\}^{\frac{\omega}{\gamma}} .$$

If the coefficients of relative risk aversion are identical for consumption and wealth, then $\omega = \gamma$. If the rate of time preference is constant at $k = \rho$, then the marginal propensity to consume from wealth with no liquidity adjustments is $\beta_{\omega=\gamma} \equiv e^{-\frac{\rho t}{\gamma}}$.[6] Under these restrictions, consumption is linear in financial wealth, housing and the mortgage, or $\Delta c_t = \beta \left[\lambda_f \Delta f_t + \lambda_h \Delta h_t + a \Delta q_{mt} \right]$. If $a = 1$ the household takes the piggybank approach to the mortgage as a store of value for consumption. Then from maximum likelihood estimation with $\beta_{as} \equiv \beta\lambda_s, \beta_{ah} \equiv \beta\lambda_h, \beta_{am} \equiv \beta$ in $\Delta c_t = \beta_{as}\Delta f_t + \beta_{ah}\Delta h_t + \beta_{am}\Delta q_{mt}$ the coefficients $(\beta, \lambda_s, \lambda_h)$ can be recovered by invariance under single-valued transforms. The coefficients $(\beta, \lambda_s, \lambda_h)$ are the overall marginal propensity to consume, the liquidity adjustment for financial assets given their placement in restricted accounts and the liquidity adjustment for housing.

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[6] Even without duality, the marginal propensity to consume remains dependent on the time horizon. If utility depends on consumption as $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, and consumption is linear in wealth so that $c_t = \beta w_t$, from iterated expectations $\beta = \frac{1-\phi}{1-\phi^t}$ dependent on t. Here $\phi \equiv \frac{1}{1+r}\left[\frac{1+r}{1+\rho}\right]^{\frac{1}{\gamma}}$ where r is the riskless rate of interest and ρ is the rate of time preference.

If the household operates using net wealth and does not distinguish between liquidity of the house or the mortgage, then $a = -1$ and $\beta\lambda_f = \beta_f, \beta\lambda_h = \beta_h$, where β_f is the marginal propensity to consume from financial wealth. Here β_h is the marginal propensity to consume from housing equity $h - q_f$. A dollar of mortgage debt reduces wealth by a dollar and a dollar increase in the value of the house increases wealth by a dollar. Consumption from net wealth is $\Delta c_t = \beta_f \Delta f_t + \beta_h(\Delta h_t - \Delta q_{mt})$.

When the household makes no distinction between its net wealth, $\beta_{a=-1} \equiv \beta_f \equiv \beta_h$. Here $\beta_{a=-1}$ is the marginal propensity to consume from net wealth, and $\Delta c_t = \beta_{a=-1}(\Delta f_t + \Delta h_t - \Delta q_{mt})$. If it consumes only from financial wealth and ignores its housing equity, $\beta_{a=-1} = \beta_f, \beta_h = 0$. This is the conventional wealth effect on consumption, estimated at 3 to 5 cents per additional dollar in the current year. When consumption depends only on housing and not financial wealth, $\beta_{a=-1} = \beta_h, \beta_f = 0$.

In Table 2, we estimate various marginal propensities to consume with t-statistics shown in parentheses. The marginal propensity to consume from financial assets is as high as 4 cents per additional dollar when housing and mortgages are excluded. With the real estate portfolio included, this marginal propensity declines to 2 cents per additional dollar. Thus, we find consumption to be increasing in mortgage debt with a higher coefficient than that for financial assets. The intertemporal financial decision, therefore, is based on the total balance sheet and not on net equity.

Table 2 reports empirical results. Column (1) has results for the piggybank specification where the household has liquidity constraints on its house and financial assets, and uses the mortgage for consumption. In column (2) consumption is based on net wealth but there are separate propensities for financial assets and net housing equity. In column (3) consumption is from financial assets only.

The two variables that have measurable impact on consumption are financial assets and the mortgage. The housing coefficient is not significant. The mortgage coefficient is 0.06. A change in the mortgage balance by one dollar leads to a change in consumption by six cents. In column (2) households consume from net housing equity and from financial assets and there is no piggybank savings from the mortgage.

Table 2: Marginal Propensities to Consume from Wealth, 1952.1 – 2001.4

		(1) Financial Assets, Housing and Mortgage $\Delta c_t = \beta\left[\lambda_f \Delta s_t + \lambda_h \Delta h_t + a\Delta q_{mt}\right]$	(2) Financial Assets and Net Housing $\Delta c_t = \beta_f \Delta f_t + \beta_h(\Delta h_t - \Delta q_{mt})$	(3) Financial Assets $\Delta c_t = \beta_{a=-1}\Delta s_t$
Dependent Variable				
Δc	Change in consumption			
Independent Variables				
Constant		0.000 (0.42)	0.000 (0.36)	0.000 (0.42)
Δh	Change in house value	0.147 (0.84)		
$\Delta h - \Delta q_m$	Change in house equity		0.142 (0.81)	
Δf	Change in financial assets	0.020 (4.41)	0.021 (4.70)	0.044 (4.38)
Δq_m	Change in mortgage debt	0.060 (2.09)		
AR(1)		-0.304 (-4.20)	-0.329 (-4.62)	-0.357 (-4.69)
Adjusted R^2		0.201	0.187	0.127
LM Test		0.574	0.347	0.238
N		198	198	198

Estimating equation: $\Delta c_t = e^{-\frac{kt}{\gamma}} \left\{\lambda_f \Delta f_t + \Delta h_t \left[\lambda_h + a\Delta m_t\right]\right\}^{\frac{\omega}{\gamma}}$

5. Summary and Conclusions

The representative household in the United States holds as its principal assets a house and a retirement account, both of which are illiquid. It holds negligible financial assets otherwise. Households consume not from these house and retirement account assets directly, but by borrowing against them. Borrowing allows households to replenish liquid assets to finance consumption. Consumption, consequently, is determined by the size of the balance sheet based on total assets and liabilities as opposed to consumption based on net equity. Thus, with household assets constrained, consumption is positively correlated with liabilities.

This paper develops an intertemporal model of consumption to distinguish between these alternative definitions of wealth: 1) balance sheet based on total assets and liabilities or 2) net equity. The equilibrium conditions yield marginal propensities to consume from physical (housing) and financial assets. Empirical results for aggregate U.S. data for 1952:2-2001:4 support the total balance sheet definition of wealth as opposed to the net equity specification.

These findings empirically support an additional rationale for national and local policy makers to support the growth of single-family housing and mortgage credit markets. Residential home ownership and the housing market smooth the national consumption/business cycle. Homeowners use their mortgage balances to fund consumption when there are downturns in income. The ability to increase the mortgage balance comes when interest rates are low, frequently during recessions. Therefore, the housing market offers homeowners the opportunity to stabilize and smooth their consumption over the business cycle.

During the recent 2001 recession, housing remained strong, and coupled with the refinancing of existing mortgages, softened the economic downturn. After refinancing their mortgages, homeowners used these proceeds for college tuition, furniture, debt reduction, vacations, cars, and other personal consumption. This consumption smoothing enabled by residential housing ownership and the mortgage markets provides positive outcomes for individuals, households, and society.

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Appendix. Results on Unit Roots and Cointegration

To determine the appropriate time series specification, tests for unit roots are carried out. For a time series Vx_t, the estimating equation for a unit root is $Vx_t = \alpha + \varsigma t + (\rho - 1)x_{t-1} + \sum_{j=1}^{r} \varphi_r \Delta x_{t-r} + \varepsilon_t$. Here V is the first difference operator, r is the number of augmentation lags, $(\varsigma, \rho, \varphi)$ are parameters and ε_t a disturbance term. The unit root test is for the null hypothesis of $\rho = 1$ against the alternative of $\rho < 1$. If the time series appear to have a trend, time t is included, and the test statistic is denoted v_1. If there is no apparent trend, time is excluded and the resulting test statistic is v_2. The number of augmentation lags r is large enough to eliminate evidence of serial correlation in the residuals from the estimating equations. In all cases, asymptotic critical values are used, since the residuals from the estimating regressions do not appear to be normally distributed.

Unit root test statistics are in column (4) of the upper panel of Table 1 below in the Appendix. Test statistics including a time trend are v_1 and without a time trend are v_2. The data for all time series exhibit unit roots in levels. In the first differences all time series are stationary. Following the procedure developed by Johansen (1995), we conducted a series of cointegration tests using the group of variables listed in Table 1 in the Appendix. The Johansen procedure considers five alternative trend assumptions. The null hypothesis of no cointegration could not be rejected under any of the trend assumptions at either the 5-percent or 1-percent confidence level.

The appropriate specification depends on restrictions for tests for unit roots and cointegration on the time series (c, f, h, m). For a time series Vx_t, the estimating equation is $Vx_t = \alpha + \varsigma t + (\delta - 1)x_{t-1} + \sum_{j=1}^{r} \varphi_r \Delta x_{t-r} + \varepsilon_t$ for r augmentation lags, parameters $(\varsigma, \delta, \varphi)$ and ε_t a disturbance. The unit root test is for the null hypothesis of $\delta = 1$ against the alternative of $\delta < 1$.[7] The cointegration test for a stationary linear combination of variables is a unit root test on the residuals of this estimating equation. The test takes account of multiple cointegrating relationships with the Johansen (1995) rank test.[8]

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[7] If the time series appear to have a trend, time t is included, and the test statistic is denoted v_1. If there is no apparent trend, time is excluded and the resulting test statistic is v_2. The number of augmentation lags r is large enough to eliminate evidence of serial correlation in the residuals from the estimating equations. In all cases, asymptotic critical values are used, since the residuals from the estimating regressions do not appear to be normally distributed.

[8] The rank test is for Γ in $Vz_t = \alpha_z + \Gamma z_{t-1} + \sum_{j=1}^{m} \vartheta_m \Delta z_{t-m} + \varepsilon_{zt}$. This maximum likelihood procedure is based on the existence of a Gaussian vector autoregressive representation of the variables as $z_t = \alpha_z + \xi_1 z_{t-1} + \xi_2 z_{t-2} + ... + \xi_m z_{t-m} + \upsilon_{zt}$ which is equivalent to the tested specification. The VAR is

Appendix Table 1. Unit Root and Cointegration Tests

1. Unit Root				
(1) Series	(2) Trend	(3) Augmented Lags	(4) Test Statistics	(5) 95% Critical Value
c_t	Yes	4	v_1 = -1.13, -1,18	-3.41
y_t	Yes	4	v_1 = -2.32, -2.33	-3.41
h_t	No	4	v_2 = -1.90, -1.91	-2.86
g_t	Yes	4	v_1 = -1.50, -1.47	-3.41
Vc_t	No	3	v_2 = -7.51, -7.18	-2.86
Vy_t	No	3	v_2 = -5.13, -5.34	-2.86
Vh_t	No	3	v_2 = -5.01, -4.99	-2.86
Vg_t	No	3	v_2 = -6.90, -6.74	-2.86
2.Cointegration				
Rank Test				
(1) Γ Rank, No Cointegration		(3) Γ Rank, Cointegration	(4) Test Statistics	(5) 95% Critical Value
			η_{trace}	
0		1,2,3 or 4	26.19, 31.00	47.18
1		2,3, or 4	7.77, 10.65	29.51
2		3 or 4	2.55, 4.68	15.20
3		4	0.43, 0.71	3.96
			η_{max}	
0		1	18.42, 20.35	27.20
1		2	5.22, 5.97	20.78
2		3	2.13, 3.98	14.04
3		4	0.43, 0.71	3.96
Unit Root Test		1	-3.21,-3.65	-4.16

The data are quarterly observations from 1952:1-2001:4 on aggregate wealth and mortgage debt for the United States from the Board of Governors of the Federal Reserve System's *Flow of Funds Accounts*. Net real estate equity is real estate wealth less mortgage debt. Financial wealth is total net worth minus net real estate wealth.

Data on the various components of disposable personal income and consumption are taken from the quarterly *National Income and Product Accounts* of the Bureau of Economic Analysis of the U.S. Department of Commerce.

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of lag length m with parameters (α_z, γ) and error $\upsilon_t \sim NID(0, \Sigma)$ where Σ is the variance-covariance matrix.

Cointegration tests are in the lower panel of Table 1 in the Appendix. To determine the lag length m, both sequential general-to-specific likelihood ratio tests and the Akaike information criterion are applied. Both these approaches involve setting $m = 5$ including the possibility of a drift in the trend component of z_t. As shown in column (4), there is no cointegration among the variables from the test statistics. The statistics are for η_{trace} and $\eta_{\max}$ the trace and largest eigenvalue of Γ. The Engle-Granger unit root test reported in the last row also shows no cointegration. Here f is the holding of financial assets.

To correct for the autocorrelation of residuals, ARMA terms AR(L) up to lag L are included in the regression models. Serial correlation is tested using the Breusch-Godfrey Lagrange multiplier (LM) test. The null hypothesis of the LM test is that there is no serial correlation up to a lag order k where k is a pre-specified integer. The LM test statistic is asymptotically distributed as χ^2_k, a chi-squared test statistic with k degrees of freedom. There is no evidence of autocorrelation using orders for k as high as 5.

Unit root tests for an alternative specification are in Appendix Table 2.

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[9] If the time series appear to have a trend, time t is included, and the test statistic is denoted v_1. If there is no apparent trend, time is excluded and the resulting test statistic is v_2. The number of augmentation lags r is large enough to eliminate evidence of serial correlation in the residuals from the estimating equations. In all cases, asymptotic critical values are used, since the residuals from the estimating regressions do not appear to be normally distributed.

[10] The rank test is for Γ in $Vz_t = \alpha_z + \Gamma z_{t-1} + \sum_{j=1}^{m} \vartheta_m \Delta_{t-m} + \varepsilon_{zt}$. This maximum likelihood procedure is based on the existence of a Gaussian vector autoregressive representation of the variables as $z_t = \alpha_z + \xi_1 z_{t-1} + \xi_2 z_{t-2} + \ldots + \xi_m z_{t-m} + \upsilon_{zt}$ which is equivalent to the tested specification. The VAR is of lag length m with parameters (α_z, γ) and error $\upsilon_t \sim NID(0, \Sigma)$ where Σ is the variance-covariance matrix.

Appendix Table 2: Unit Root Tests

(1) Series	(2) Trend	(3) Augmented Lags	(4) Test Statistic	(5) 95 % Critical Value
c_i	Yes	4	v_1 = -1.13	-3.43
r_i	Yes	4	v_1 = -2.21	-3.43
rn_i	No	4	v_2 = -1.90	-2.88
m_i	Yes	4	v_1 = -0.89	-3.43
s_i	Yes	4	v_1 = -1.50	-3.43
t_i	Yes	4	v_1 = -2.32	-3.43
Δc_i	No	3	v_2 = -7.51	-2.88
Δr_i	No	3	v_2 = -4.79	-2.88
Δrn_i	No	3	v_2 = -5.01	-2.88
Δm_i	No	3	v_2 = -3.35	-2.88
Δs_i	No	3	v_2 = -6.90	-2.88
Δt_i	No	3	v_2 = -5.13	-2.88

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