Housing Collateral, Consumption Insurance, and Risk Premia: An Empirical Perspective (JF, 2005)

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Introduction

- Housing is an important factor in US households' portfolios.
- Collateral restrictions are tied to house prices (e.g. through home equity loans).
- Decreases in house prices lead to:
  - decrease in risk-sharing among households
  - associated increase in consumption growth inequality
- Nonseparability between consumption and housing services leads to hedging motive.
- Both of these channels impact risk premia.

Model - Endowments and Preferences

- Continuum of agents with stochastic labor income that consume nondurable consumption and housing services.
- History of events captured by $s^t = (y^t, z^t)$, where y^t are idiosyncratic events and z^t are aggregate events.
- Evolution of non-housing/housing expenditure governed by $r_t(z^t) = \frac{c_t^a(z^t)}{\rho_t(z^t)h_t^a(z^t)}$.
- Preferences are given by:

$$U(c,h) = E_0 \sum_{t=0}^{\infty} \delta^t u(c_t, h_t)$$

$$u(c_t, h_t) = \frac{1}{1-\gamma}\left[c_t^{\frac{\epsilon-1}{\epsilon}} + \psi h_t^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{(1-\gamma)\epsilon}{\epsilon-1}}$$

Model - Markets

- Housing markets are frictionless.
- Agents can trade a complete set of contingent securities subject to a solvency constraint:

$$\Pi_{s^t}\left[c_t(s^t) + \rho_t(z^t)h_t(s^t)\right] \geq \Pi_{s^t}\left[\eta_t(s^t)\right]$$

- Tightness of this constraint is governed by collateral ratio *my*:

$$my_t(z^t) = \frac{\Pi_{z^t}\left[\rho h^a\right]}{\Pi_{z^t}\left[c^a\right]}$$

- Model is interesting because empirically this has large and persistent swings.

Model - Equilibrium Consumption

- Consumption share always decreasing, except when constraint is binding, in which case it jumps.
- Consumption of nondurables and housing services governed by shares $\tilde{\omega}_t(\omega, s^t)$:

$$c_t(\omega, s^t) = \frac{\tilde{\omega}_t(\omega, s^t)}{\xi_t^a(z^t)} c_t^a(z^t) \text{ and } h_t(\omega, s^t) = \frac{\tilde{\omega}_t(\omega, s^t)}{\xi_t^a(z^t)} h_t^a(z^t)$$

- Absent of collateral ($my_t = 0$), consumption share is set to labor income share: $\frac{\omega_t(\omega, s^t)}{\xi_t^a(z^t)} = \hat{\eta}(y_t, z_t)$

Market Price of Aggregate Risk - Nonseparable Case

- Unconstrained household will have stochastic discount factor: $m_{t+1} = m^a_{t+1} g^{\gamma}_{t+1}$.
- Here, the first factor is given by:

$$m^a_{t+1} = \delta \left(\frac{c^a_{t+1}}{c^a_t} \right)^{-\gamma} \left(\frac{\alpha_{t+1}}{\alpha_t} \right)^{\frac{\epsilon - \frac{1}{\gamma}}{\frac{1}{\gamma}(\epsilon - 1)}}$$

- α_t is the nonhousing expenditure share.
- This risk turns out to be small: unrealistic level of rent growth volatility needed to make SDF large.

Market Price of Aggregate Risk - Separable Case

- Focus on the separable case to highlight the role of the liquidity factor.

$$m_{t+1} = \delta \left(\frac{c^a_{t+1}}{c^a_t} \right)^{-\gamma} g^{\gamma}_{t+1}$$

- Liquidity factor needs to be negatively correlated with consumption growth.
- It is, since when consumption growth is low, we have empirically:
    1. Increase in cross-sectional dispersion of labor income shocks
    2. Decrease in amount of collateral
- This will amplify the effect of time varying consumption growth on asset prices.

Time Series Evidence - Measuring Collateral Ratio

- In the model, only aggregate collateral available matters, not its distribution.
- Housing wealth is measured in three ways:
  - Value of oustanding home mortgages (*mo*)
  - Market value of residential real estate wealth (*rw*)
  - Net stock current cost value of owner-occupied and tenant-occupied residential fixed assets (*fa*)
- Housing collateral ratio is estimated as cointegrating residual of labor income and housing wealth.

Time Series Evidence - Estimated Collateral Ratio

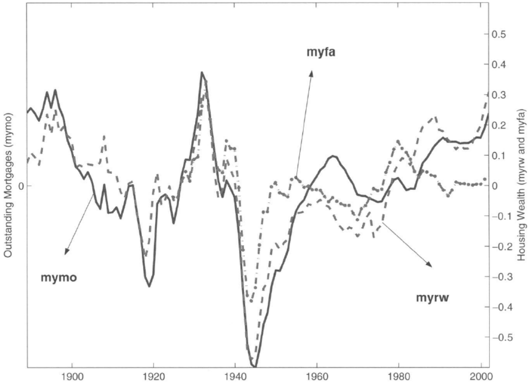


Figure 4. Estimated housing collateral ratio, 1889–2002. Deviation from the cointegration relationship between human wealth (y) and outstanding home mortgages (mo, full line), nonfarm residential wealth (rw, dashed line) and residential fixed asset wealth (fa, dash-dotted line). Data are for 1889–2002.

Time Series Evidence - Stock Return Predictability I

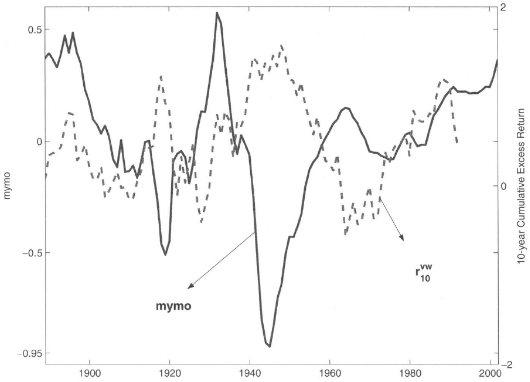


Figure 6. Ten-year excess market return and the housing collateral ratio. The housing collateral ratio is *mymo*, the measure based on outstanding mortgages. We use the cum-dividend return on Standard and Poor's composite stock price index, denoted R_t^{vw}. The market return is expressed in excess of a risk-free rate, the return on 6-month prime commercial paper.

Time Series Evidence - Stock Return Predictability II

Long-Horizon Predictability Regressions

The results are for the regression $r^{e,K}_{t+K,vw} = b_0 + b_{my}\widetilde{my}_t + \epsilon_{t+K}$, where $r^{e,K}_{t+K,vw}$ are cumulative (log) excess returns on the S & P Composite Index over a K-year horizon. Panel A reports results for the full sample 1889–2002; the sample size decreases from 113 observations for $K = 1$–104 years for $K = 10$. Panel B reports the results for 1926–2002; the sample size decreases from 77 observations for $K = 1$–68 years for $K = 10$. The subpanels report the results for the different collateral measures. Subpanel 1 reports results for the mortgage-based collateral measure *mymo*, subpanel 2 for the measure based on residential wealth *myrw*, and subpanel 3 for the measure based on fixed assets *myfa*. The housing collateral ratio is rescaled so that it lies between 0 and 1 and measures collateral scarcity: $\widetilde{my}_t = (\frac{my^{\max} - my_t}{my^{\max} - my^{\min}})$, where $my^{\max}$ and $my^{\min}$ are the maximum and minimum observation in the respective samples. The first row of each subpanel reports least squares estimates for $b = b_{my}$. Newey–West HAC standard errors σ^{nw} are reported in the second row of each subpanel. The standard errors correct for serial correlation of order K, where K is the holding period. The third row reports the R^2 for this OLS regression. The fourth row of each subpanel reports the p-value of the null hypothesis of no predictability, obtained by bootstrap.

Horizon K	1	2	3	4	5	6	7	8	9	10
Panel A: 1889–2002										
Subpanel 1: Collateral Measure: Mortgages *mymo*										
b	0.08	0.19	0.29	0.32	0.48	0.74	1.12	1.65	2.15	2.54
σ^{nw}	0.04	0.07	0.11	0.15	0.19	0.24	0.29	0.33	0.36	0.40
R^2	0.01	0.02	0.02	0.02	0.03	0.06	0.09	0.15	0.22	0.26
$p - val$	0.15	0.12	0.13	0.16	0.11	0.06	0.03	0.01	0.00	0.00
Subpanel 2: Collateral Measure: Residential Wealth *myrw*										
b	0.06	0.09	0.08	0.02	0.08	0.24	0.43	0.71	1.08	1.45
σ^{nw}	0.04	0.08	0.12	0.18	0.24	0.30	0.38	0.46	0.53	0.61
R^2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05	0.08
$p - val$	0.21	0.27	0.34	0.44	0.38	0.27	0.19	0.11	0.05	0.02

Time Series Evidence - Cross-sectional differences

Long-Horizon Predictability Regressions

The results are for the regression $r_{t+K}^{sp_{i,j}} = b_0 + b_{my}\widetilde{my}_t + \epsilon_{t+K}$, where $r_{t+K}^{sp_{i,j},K}$ is the spread in log K-period holding returns for two extremum portfolios i and j formed on the basis of the six Fama–French benchmark portfolios (two independent sorts, two by size and three by book-to-market). Panel A reports results for the mortgage-based collateral measure *mymo*, Panel B for the measure based on residential wealth *myrw* and Panel C for the measure based on fixed assets *myfa*. The housing collateral ratio is rescaled so that it lies between 0 and 1 and measures collateral scarcity. The first row of each panel reports least-squares estimates for $b = b_{my}$. Newey–West HAC standard errors σ^{nw} are reported in the second row of each panel. The standard errors correct for serial correlation of order K, where K is the holding period. The third row reports the R^2 for this OLS regression. The fourth row of each panel reports the p-value of the null hypothesis of no predictability, obtained by bootstrap. The estimation results are for 1927–2002.

Horizon K	1	2	3	4	5	6	7	8	9	10
Panel A: Collateral Measure: Mortgages *mymo*										
Spread: Small Value Minus Small Growth										
b	0.32	0.56	0.75	0.93	1.04	1.10	1.07	0.99	0.84	0.69
σ^{nw}	0.03	0.06	0.09	0.13	0.16	0.19	0.22	0.24	0.26	0.28
R^2	0.12	0.14	0.14	0.18	0.16	0.14	0.12	0.09	0.06	0.04
$p-val$	0.00	0.01	0.02	0.02	0.03	0.04	0.06	0.08	0.14	0.19
Spread: Big Value Minus Big Growth										
b	0.21	0.42	0.61	0.73	0.79	0.86	0.93	0.90	0.77	0.57
σ^{nw}	0.03	0.06	0.10	0.14	0.17	0.21	0.25	0.29	0.33	0.37
R^2	0.05	0.09	0.12	0.11	0.10	0.10	0.10	0.08	0.05	0.02
$p-val$	0.03	0.02	0.03	0.04	0.06	0.06	0.08	0.10	0.15	0.22

Cross-sectional Evidence - Estimation Strategy

- Need to approximate liquidity factor since agents have to forecast aggregate consumption weight growth.

$$\log(g_t(z_t^\infty, my_0)) \simeq \phi(F_t^a, ...F_{t-k}^a; my_t), \text{ where } F_t^a = (\Delta \log(c_t^a), \Delta \log(\alpha_t))$$

- Then GMM can be used to identify the function ϕ as well as the structural parameters via moment conditions of the form:

$$E_t \left[m_{t+1}^a \exp(\gamma * \phi(F_t^a, ...F_{t-k}^a; my_t)) R_{t+1}^j \right] = 1$$

- Additional inequality constraints that follow from model are also used as overidentifying restrictions, including Kuhn Tucker restrictions of the form:

$$\lambda(\theta) E[m_{t+1}^a R_{t+1}^j - 1] = 0$$

Cross-sectional Evidence - Results with Seven Test Assets

Table VII

Cross-Sectional Results Collateral Model: Seven Assets

Shown here are GMM parameter estimates for the collateral model for 1926–2002. The estimates minimize the pricing errors on the market return, the T-bill return, a 10-year bond, and the four extremum size and value portfolios. The estimation also imposes seven inequality conditions. The left panel imposes separability by fixing ϵ at 0, while the left panel fixes ϵ at 0.85. In columns 1 and 4, $\tilde{\phi}(\cdot)$ is a first-order, in columns 2 and 5, it is a second-order, and in columns 3 and 6, it is a third-order Tchebychev polynomial. The penalty parameter c is 100 (columns 1), 12 (column 2), 11 (column 3), 300 (column 4), 2 (columns 5 and 6). The time discount factor δ is fixed at 0.95 in the estimation. The identity weighting matrix is used in the first stage, and the Newey–West matrix with lag length 3 is used to compute standard errors.

	Separability			Nonseparability		
	Polynomial Order			Polynomial Order		
Parameters	1	2	3	1	2	3
$\hat{\gamma}$	4.78	4.96	4.67	2.07	1.35	1.35
SE	[1.72]	[1.68]	[1.58]	[0.32]	[0.19]	[0.20]
$\hat{\theta}_1$	0.37	0.63	−0.31	−0.15	7.31	0.44
SE	[0.31]	[3.15]	[2.77]	[2.43]	[3.96]	[6.78]
$\hat{\theta}_2$	−2.00	−1.93	−6.61	−5.16	−8.14	6.44
SE	[0.92]	[0.85]	[13.46]	[1.78]	[4.87]	[7.40]
$\hat{\theta}_3$		0.33	−0.77	−3.67	3.63	0.23
SE		[4.05]	[3.16]	[8.31]	[28.37]	[10.14]
$\hat{\theta}_4$			−1.69		−0.92	−6.59
SE			[5.26]		[19.73]	[5.83]
$\hat{\theta}_5$					7.56	6.53
SE					[14.21]	[3.13]
$\hat{\theta}_6$						7.53
SE						[7.95]
$\hat{\theta}_7$						−0.70
SE						[13.37]
J	33.68	110.37	56.31	14.18	60.36	54.15
p	0.0000	0.0000	0.0000	0.1671	0.0000	0.0000

Cross-sectional Evidence - Linear Factor Model

Cross-Sectional Results, Linear Factor Model

Shown here is the estimation of the market prices of risk $\tilde{\lambda}$, using the Fama-MacBeth procedure for 1926–2002. The asset-pricing factors are $\Delta\log(c_{t+1})$ in row 1, $\Delta\log(c_{t+1})$ and $\Delta\log(\alpha_{t+1})$ in row 2, $\Delta\log(c_{t+1}), \widetilde{my}_t, \widetilde{my}_t\Delta\log(c_{t+1})$ in rows 3–5, and $\Delta\log(c_{t+1}), \Delta\log(\alpha_{t+1}), \widetilde{my}_t, \widetilde{my}_t\Delta\log(c_{t+1})$, and $\widetilde{my}_t\Delta\log(\alpha_{t+1})$ in rows 6–8. The housing collateral variable is the mortgage-based *mymo* in rows 3 and 6, the residential-wealth-based *myrw* in row 4 and 7, and the fixed-assets-based *myfa* in row 5 and 8. *my* is estimated with data from 1925 to 2002. OLS standard errors are in parentheses, and Shanken-corrected standard errors are in brackets. The last column reports the R^2 and the adjusted R^2 just below it.

Model	$\tilde{\lambda}_0$	$\tilde{\lambda}_c$	$\tilde{\lambda}_\alpha$	$\tilde{\lambda}_{my}$	$\tilde{\lambda}_{my.c}$	$\tilde{\lambda}_{my.\alpha}$	R^2
1	8.87	1.61					**9.4**
CCAPM	(2.55)	(1.01)					5.6
	[2.77]	[1.18]					
2	6.90	0.51	0.55				**37.5**
HCAPM	(2.31)	(0.88)	(0.24)				32.0
	[2.60]	[1.08]	[0.30]				
3	4.22	1.94		−0.03	2.23		**86.5**
Separable Prefs.	(2.29)	(1.05)		(0.06)	(0.79)		84.6
mymo	[3.31]	[1.58]		[0.09]	[1.17]		
4	3.52	2.12		−0.03	1.36		**87.8**
Separable Prefs.	(2.25)	(1.02)		(0.03)	(0.47)		86.1
myrw	[3.33]	[1.58]		[0.05]	[0.72]		
5	2.81	0.97		−0.00	0.66		**73.3**
Separable Prefs.	(2.27)	(0.94)		(0.02)	(0.35)		69.7
myfa	[2.93]	[1.28]		[0.03]	[0.47]		
6	2.87	2.59	0.11	−0.02	2.77	0.05	**87.4**
Nonsep. Prefs.	(2.73)	(0.81)	(0.26)	(0.06)	(0.64)	(0.18)	84.3
mymo	[4.45]	[1.38]	[0.44]	[0.10]	[1.09]	[0.30]	
7	3.62	2.30	0.25	−0.03	1.45	0.11	**88.1**
Nonsep. Prefs.	(2.48)	(0.92)	(0.20)	(0.03)	(0.41)	(0.08)	85.1
myrw	[3.81]	[1.47]	[0.33]	[0.06]	[0.65]	[0.13]	
8	3.20	1.56	−0.05	−0.02	0.94	0.05	**85.4**
Nonsep. Prefs.	(2.44)	(1.01)	(0.21)	(0.02)	(0.38)	(0.06)	81.7
myfa	[4.11]	[1.75]	[0.38]	[0.04]	[0.66]	[0.11]	

Cross-sectional Evidence - CCAPM vs. Collateral CCAPM

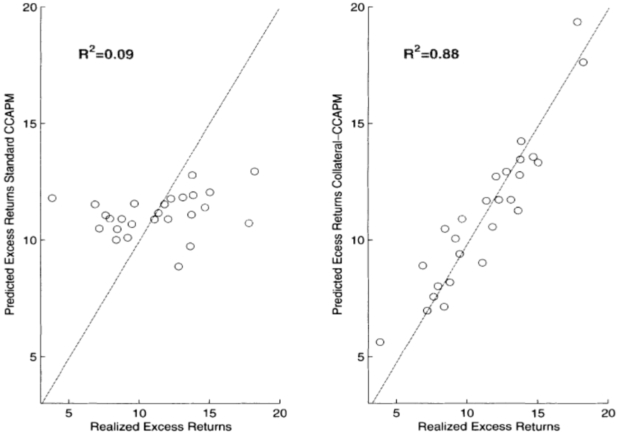


Figure 7. Realized versus predicted returns: The consumption-CAPM and collateral-CAPM. Left panel: Realized average excess returns on 25 Fama–French portfolios and the value-weighted market return against predicted excess returns by standard consumption-CAPM. Right panel: Against predicted returns by collateral-CAPM (under separability).

Quantitative Results - Average Pricing Error Comparison

Average Pricing Errors, Linear Collateral Model

Test Asset	CCAPM	Fama–French	Coll-CCAPM
R^{vw}	2.97	−0.20	0.07
S1B1	7.97	3.96	1.79
S1B2	1.89	2.51	1.23
S1B3	−1.01	−1.08	−0.34
S1B4	−7.10	−2.07	1.53
S1B5	−5.29	−2.78	−0.62
S2B1	4.64	1.94	2.03
S2B2	−0.30	−1.15	−1.27
S2B3	−2.65	−1.23	−0.96
S2B4	−3.31	−0.79	−1.14
S2B5	−3.00	−0.08	−1.72
S3B1	1.99	−1.41	2.00
S3B2	−0.24	−1.12	0.28
S3B3	−0.50	−0.62	−0.55
S3B4	−1.28	0.03	−1.40
S3B5	−1.92	1.58	0.38
S4B1	1.65	−2.54	−1.25
S4B2	0.90	0.70	0.85
S4B3	−0.22	0.24	−2.08
S4B4	−1.18	0.64	0.62
S4B5	−3.90	−0.11	−2.38
S5B1	3.41	−2.52	−0.07
S5B2	3.31	0.73	−0.21
S5B3	2.13	0.46	−0.59
S5B4	1.19	1.96	−0.10
S5B5	−3.95	−0.86	0.10
RMSE	3.27	1.61	1.21
χ^2	72.1***	61.1***	35.1*

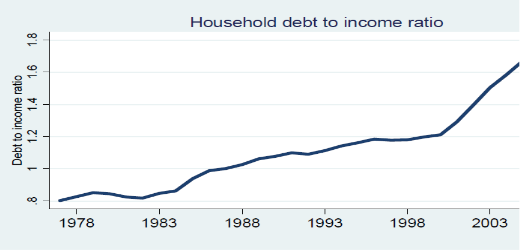
Conclusion

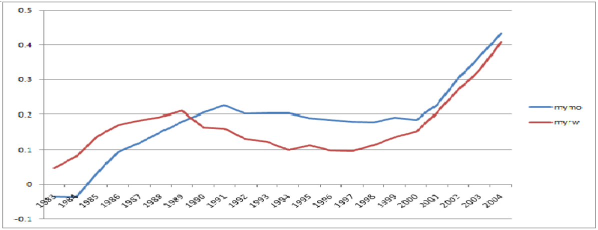
- House price fluctuations impact risk-sharing via the collateral channel
- This has a large quantitative impact on the market price of risk
- Allows us to obtain small pricing errors in the cross section and time series predictability with reasonable risk aversion parameter
- Also highlights role of imperfect risk-sharing, and in particular time-variation in risk-sharing opportunities

Discussion - Cointegration Results

- Authors extract my_t as cointegrating residual of labor income and housing wealth
- What about other forms of wealth?
- Is this the appropriate thing to do because households that are constrained have housing as largest component of wealth?
- What is the aggregate budget constraint or other restriction that ties these together (as in *cay*)?

Discussion - Correlation with Other Measures (Sufi and Mian, 2009)





Discussion - Endogenize Collateral Value

- Where does the change in nonhousing consumption come from?
- Making this exogenous leads to surprisingly good fit (as we saw from last slide).
- However, it would be nice to have fully endogenous decision on how much of collateral is used.
- Also, interaction between credit market conditions and housing collateral likely to be important.