Consumption of Stockholders and Nonstockholders: New Evidence from the PSID

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November 2020

Introduction

- For 35 years, the field of macro/finance has struggled to reconcile estimates of risk aversion and intertemporal substitution with observed behavior of asset prices
- ***The optimality condition that produces the stochastic discount factor that prices an asset holds with equality only for consumers who have nonzero holdings of the asset***
- Until 1999, no single dataset contained reliable individual-level information on the form of wealth-holding as well as a broad measure of consumption
- Long Run Risk (LRR) has emerged as a promising path to resolution of other key puzzles, so we want to continue with this approach

What do we know about stockholder risk aversion?

Mankiw and Zeldes (1991) First contribution to this field

- Exponential utility
- Good-quality household-level asset-holding data from the PSID
- Poor measure of consumption available in PSID —at that time, only available consumption data was food at home plus food away from home.
- They find that stockholders must have a very high level of the CRRA; similar to findings of Mehra-Prescott (1982)

What have we learned since then?

- In the past 20 years, many papers
  - Use EZW preferences combined with long-run risk
  - Combine datasets to get measures of consumption and stockholding
- One of the most widely cited is Malloy et al. (2009)
  - Good-quality household-level consumption data from the Consumer Expenditure Survey (CEX)
  - Low-quality data on asset holdings from the CEX supplemented with prediction of stockholding from Survey of Consumer Finances
  - Estimates of stockholder risk aversion range from -390 to 137, depending on the forecast horizon and the form of the estimating equation

Improvements over prior literature

- PSID data provides a single source for consumption and identification of stockholders
- We show that stockholding is concentrated in "indirect" stockholding via pension funds and retirement accounts not found in the CEX
- Prior attempts to predict stockholding in the CEX using a probit from the Survey of Consumer Finance are problematic:
- We show that predicting stockholding is a difficult econometric problem, even just within the PSID
- Combining surveys not a viable route forward

Who is a stockholder?

- Stocks can be held
  - "Indirectly" —via a pension or retirement account
  - "Directly" —separately from pension or retirement account
- In 1999, about 50% of households held stock in some form, falling to 43% by 2017
- In 1999, 50% of all stockholders held stocks ***only*** indirectly, via a pension or retirement account
- By 2017, 75% of all stockholders held stocks ***only*** indirectly
- Essential to have a dataset that identifies direct and especially ***indirect*** stockholders

Defining stockholder groups

- “Broad” stockholders: hold stocks either “directly” or “indirectly” at the beginning of the two-year period over which consumption growth is calculated.
- “”Both period” stockholders: hold stocks either “directly” or “indirectly” in both of the two waves used to calculate consumption growth.
- “Direct” stockholders: hold stocks directly at the beginning of the period; may also have indirect holdings. ***Direct holdings cannot be unintentional,*** which may be the case for pension or retirement account holdings.
- ”Always” stockholders: hold stocks in some form in every period in which they are in the sample. May be more experienced in trading risky assets.

Comparison groups

Although the Euler equation will hold only for stockholders, for comparison purposes we define some additional groups of households:

- All households in the sample
- Households that never hold stocks
- Groups representing the complements of each of the stockholder groups, e.g., a household that holds stocks neither directly nor indirectly in a given period. This is different from the group of "never" stockholders, since a household can be a stockholder in one period but not a stockholder in another

Predicting stockholding is hard

- Previous literature, notably Malloy et al. (2009) tried to improve identification of stockholders in datasets such as the Consumer Expenditure Survey (CEX) that has data on direct stockholding only, as well as a high non-response rate
- Use detailed asset holding data and family characteristics in the Survey of Consumer Finance (SCF) to estimate a probit for stock ownership; use the predicted values when applied to the CEX to identify CEX stockholders
- In replicating the work of Malloy et al. (2009), we found that this procedure led to very poor fit – the process could not distinguish between wealthy households that did hold stock and wealthy households that did not. Similarly, less-wealthy households that did hold stock were predicted not to be stockholders.

Predicting stockholding in the PSID

As in Malloy et al. (2009), we ran a probit of stockholding status on:

- age and age squared
- high school degree but not an advanced degree
- college degree or higher
- indicator for non-white race
- log of household real pre-tax income
- log of real dollar assets in checking or saving accounts (zero if none held)
- indicator for no checking or saving accounts
- dummy variables for the interview years

Probit estimates

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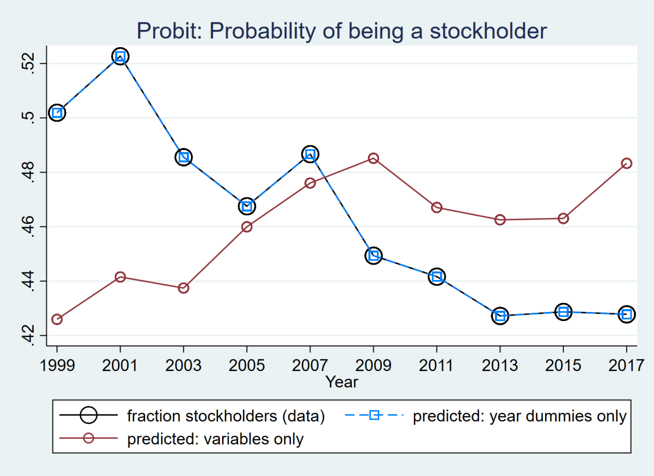
Probit regression                               Number of obs     =     48,522
                                                Wald chi2(17)     =    6110.82
                                                Prob > chi2       =     0.0000
Log pseudolikelihood = -25668.718               Pseudo R2         =     0.2334

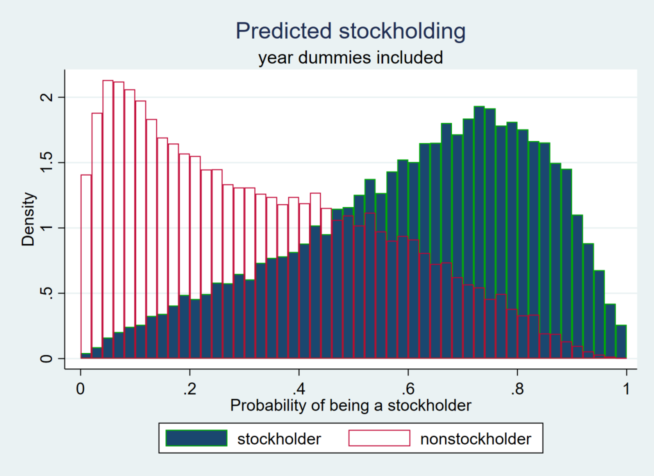
                             (Std. Err. adjusted for 12,333 clusters in UID_person)
```

WI_stckextend	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
UID_wave						
2001	.0128963	.0264032	0.49	0.625	-.0388531	.0646457
2003	-.0962278	.0266724	-3.61	0.000	-.1485047	-.043951
2005	-.2343181	.0275991	-8.49	0.000	-.2884114	-.1802248
2007	-.2234522	.0280346	-7.97	0.000	-.278399	-.1685055
2009	-.3847882	.0282423	-13.62	0.000	-.4401421	-.3294343
2011	-.3522542	.0286987	-12.27	0.000	-.4085025	-.2960058
2013	-.387477	.0288947	-13.41	0.000	-.4441096	-.3308445
2015	-.3837287	.0293771	-13.06	0.000	-.4413069	-.3261506
2017	-.4520018	.0287777	-15.71	0.000	-.508405	-.3955986
age	.0003374	.0063687	0.05	0.958	-.012145	.0128199
agesq	.0001307	.0000731	1.79	0.074	-.0000126	.000274
nonwhite	-.373578	.0204558	-18.26	0.000	-.4136706	-.3334854
highschool	.2151697	.0286364	7.51	0.000	.1590434	.2712961
coll_deg	.28296	.0208965	13.54	0.000	.2420036	.3239163
chksav0	-.2955976	.0419632	-7.04	0.000	-.3778439	-.2133512
log_chck	.1066939	.005009	21.30	0.000	.0968765	.1165112
log_FI	.5346874	.0148995	35.89	0.000	.505485	.5638899
_cons	-6.665584	.1852268	-35.99	0.000	-7.028622	-6.302547

Predicting stockholding



Who is a stockholder?



Discussion

- Difficult to predict stockholding behavior in the time series: economic variables explain little; year dummies explain nearly all observed variation in the population share of stockholders
- Difficult to identify stockholders in the cross section: Predicted probabilities for stockholder/nonstockholder status have considerable overlap
- Bottom line: Essential to have good measures of both stockholding and consumption in the same dataset.

Measuring Consumption

- In the consumption-based asset pricing literature, consumption is usually defined as nondurables or nondurables plus services.
- Ideally we would include the service flow from durable goods, notably housing
- We define two measures of consumption:
  - A broad measure of nondurables and services, including the service flow from housing – this is the "preferred" consumption measure of Aguiar et al. (2020)
  - A narrower measure, excluding the service flow from housing as well as car down payments and car lease expenditures

Nondurables and services in the PSID

Since 1999 the PSID has collected information on the following categories of nondurable and service consumption:

- Food: at home, away from home, and delivered to the home
- Housing: taxes; insurance; utilities; telephone; computers; household repair; furnishings
- Health: doctor visit; insurance; prescriptions; hospital expenses
- Childcare expenses
- Education expenses
- Transportation: insurance; repair; gasoline; parking; taxis; public transportation; "other expenses"

Service flow from durables in the PSID

Since 1999 the PSID has also collected information on the following categories of durable goods purchases or expenditures related to the flow of services from durables:

- Housing: rent (if a renter); value of home (if homeowner)
- Transportation: car down payments; car leases

We impute the value of housing services as

- rent (if the household is a renter), or
- 6% of the value of the home if the household owns their home.

Consumption: data details

- Deflate nominal consumption using the CPI for nondurables (urban consumers, base 1982-1984)
- Family size:
  - Consumption growth can be affected by changes in family size
  - Family size takes on integer values of one through five; family size greater than five is coded as five
  - Remove effect of changes in family size on consumption growth by using residuals from regression of log change in real consumption on log change in family size

Other adjustments (same as Aguiar et al. (2020)):
  - Household head ages 24-64
  - Exclude if consumption, income over \$2,000
  - Exclude if food consumption share less than 5% or greater than 90%

Theory: Preferences

Epstein-Zin-Weil (EZW) preferences widely used in consumption-based asset pricing because of separation of the parameter governing the elasticity of intertemporal substitution (EIS) from the coefficient of relative risk aversion (CRRA):

$$V_t = \left\{ (1-\beta) C_t^{\frac{1-\gamma}{\theta}} + \beta \left(E_t \left[V_{t+1}^{1-\gamma} \right] \right)^{1/\theta} \right\}^{\frac{\theta}{1-\gamma}}, \tag{1}$$

where where C_t is consumption, γ is the coefficient of relative risk-aversion, ψ is the elasticity of intertemporal substitution (EIS), $\theta \equiv (1-\gamma)/(1-1/\psi)$, and $0 < \beta < 1$ is the time discount factor.

Intertemporal budget constraint

The individual faces the intertemporal budget constraint given by:

$$W_{t+1} = (1 + R_{w,t+1})(W_t - C_t), \tag{2}$$

where W_t is the individual's total wealth at date t, and $(1 + R_{w,t+1})$ is the gross return on the wealth portfolio from t to $t + 1$.

Euler equation

The individual's Euler equation for asset i is given by the following, under the assumption that all assets are tradable and that wealth captures all sources of wealth, including human wealth:

$$1 = \mathrm{E}_t \left[\left\{ \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\frac{1}{\psi}} \right\}^{\theta} \left\{ \frac{1}{(1 + R_{w,t+1})} \right\}^{1-\theta} (1 + R_{i,t+1}) \right]. \tag{3}$$

Jointly lognormal consumption growth and asset returns

Assume consumption growth and asset returns are jointly lognormal. Letting lowercase letters denote logs, the excess return on asset i over the risk-free rate, $r_{f,t+1}$, is given by:

$$\mathrm{E}_t\left[r_{i,t+1}\right] - r_{f,t+1} + \frac{\sigma_i^2}{2} = \theta \frac{\sigma_{ic}}{\psi} + (1-\theta)\sigma_{iw}. \tag{4}$$

State of the economy

We follow Hansen et al. (2008) in specifying that the state of the economy, the vector x_t, follows a first-order autoregression:

$$x_{t+1} = Gx_t + Hz_{t+1}. \tag{5}$$

where G has eigenvalues with absolute values that are strictly less than one, and the sequence $\{z_{t+1} : t = 0, 1, \ldots\}$ consists of vectors of normal random variables that are independently and identically distributed with mean zero and covariance matrix Σ.

State-dependent consumption growth

The change in the logarithm of consumption is assumed to be a linear function of the state vector:

$$c_{t+1} - c_t = \mu_c + U_c x_t + \lambda_0 z_{t+1}. \tag{6}$$

The process for the evolution of the state vector implies that consumption growth evolves according to a stationary moving average of infinite order:

$$\begin{aligned} c_t - c_{t-1} &= \mu_c + \lambda(L) z_t \\ &= \mu_c + \left(\Sigma_{s=0}^{\infty} \lambda_s L^s\right) z_t \\ &= \mu_c + \Sigma_{s=0}^{\infty} \lambda_s z_{t-s}. \end{aligned} \tag{7}$$

Elasticity of Intertemporal Substitution (EIS)

- The EIS measures consumers' willingness to intertemporally substitute consumption over time
- The EIS is crucially related to the level of the risk-free rate; the "risk-free rate puzzle" restricted its range in power-utility specifications
- With Epstein-Zin preferences, the EIS governs individuals' preferences over the timing of the resolution of risk. If $EIS < 1$ (> 1), individuals prefer later (earlier) resolution of risk.
- $EIS = 1$ is a useful benchmark, utilized in much of the related literature

$EIS = 1$

We focus on the case in which the EIS, ϕ, is equal to 1.

- This case is empirically useful because it obviates the need to measure the return on the wealth portfolio.
- The SDF depends only on consumption growth rates. The rate of risk aversion can therefore be estimated using data on consumption growth rates and asset returns.
- Chen et al. (2013) bolster the results of Malloy et al. (2009) that estimation of relative risk aversion in the cross section is not greatly affected by assuming EIS=1 even if the true EIS is somewhat higher.

For an EIS different from 1, it is necessary to estimate the VAR for the state variable. Given the length of our sample period, the VAR estimates would have very high standard errors.

Solution for SDF

The log SDF when $EIS = 1$ is:

$$
\begin{aligned}
&s_{t+1} \\
&= \ln\beta - [\mu_c + \lambda(L)z_{t+1}] + (1-\gamma)\lambda(\beta)z_{t+1} - \frac{1}{2}(1-\gamma)^2\lambda(\beta)^2 \\
&= \ln\beta - [c_{t+1} - c_t] + (1-\gamma)\left(\Sigma_{s=0}^{\infty}\lambda_s\beta^s\right) z_{t+1} - \frac{1}{2}(1-\gamma)^2\left(\Sigma_{s=0}^{\infty}\lambda_s\beta^s\right)^2 \\
&\simeq \ln\beta + (1-\gamma)\left[(E_{t+1} - E_t)\,\Sigma_{s=0}^{\infty}\beta^s\left(c_{t+1+s} - c_{t+s}\right)\right] - \frac{1}{2}(1-\gamma)^2\left(\Sigma_{s=0}^{\infty}\lambda_s\beta^s\right)^2
\end{aligned}
\tag{8}
$$

Written in terms of consumption growth rates, the term $\left(\Sigma_{s=0}^{\infty}\lambda_s\beta^s\right) z_{t+1}$ equals $\left(E_{t+1} - E_t\right)\Sigma_{s=0}^{\infty}\beta^s\left(c_{t+1+s} - c_{t+s}\right)$, representing the innovation in expectations about the present value of consumption growth rates, and the term $\left(\Sigma_{s=0}^{\infty}\lambda_s\beta^s\right)^2$ is the variance of this innovation.

Excess returns

$$
\begin{aligned}
&E\left(r^i_{t+1}-r^f_{t+1}\right)+\tfrac{1}{2}V\left(r^i_{t+1}\right)-\tfrac{1}{2}V\left(r^f_{t+1}\right)\\
&=-\operatorname{cov}\left(s_{t+1},r^i_{t+1}-r^f_{t+1}\right)\\
&\simeq(\gamma-1)\operatorname{cov}\left(E_{t+1}\Sigma_{s=0}^{\infty}\beta^s\left(c_{t+1+s}-c_{t+s}\right)-E_t\Sigma_{s=0}^{\infty}\beta^s\left(c_{t+1+s}-c_{t+s}\right),r^i_{t+1}-r^f_{t+1}\right)\\
&=(\gamma-1)\operatorname{cov}\left(\Sigma_{s=0}^{\infty}\beta^s\left(c_{t+1+s}-c_{t+s}\right),r^i_{t+1}-r^f_{t+1}\right)\\
&\quad-(\gamma-1)\operatorname{cov}\left(E_t\left(\Sigma_{s=0}^{\infty}\beta^s\left(c_{t+1+s}-c_{t+s}\right)\right),E_t\left(r^i_{t+1}-r^f_{t+1}\right)\right)
\end{aligned}
\tag{9}
$$

Unconditional Covariances

- The excess return equation holds in both conditional and unconditional form
- Use unconditional covariances due to the difficulty of estimating conditional convariances in a relatively short sample
- The use of unconditional coviances is appropriate if expected excess returns are constant over time and if there is a constant covariance between discounted sums of consumption growth and discounted long-horizon returns.

Unimportance of EIS=1 vs. EIS=1.5 or EIS=2

Malloy et al. (2009), page 2434, provide an excellent intuitive discussion on the EIS and its importance in cross-section estimates of consumption-based asset-pricing models and confirm this intuition in their empirical analysis. They argue as follows:

> *If a higher EIS increases covariances of all stock returns with the log stochastic discount factor by a roughly similar amount, then the risk aversion coefficient identified purely from the cross-section of returns will not be substantially affected by the value of the EIS. We confirm this intuition empirically in Section III. This property of the model suggests that using cross-sectional inference to estimate risk aversion may be particularly useful when there is lack of agreement about the value of the EIS.*

Results: Broad measures of stockholding and consumption

Table 1. Direct and/or indirect stockholding; broad consumption

	2 yrs	4 yrs	6 yrs
γ: stockholders	6.55	5.73	5.76
	(1.14)	(1.04)	(0.90)
constant	0.20	0.19	0.19
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.51	0.51	0.52

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Sensitivity analysis: Broad consumption

Table 2. Stockholders with some direct stockholding

	2 yrs	4 yrs	6 yrs
γ: sdir	9.65	8.03	7.59
	(2.17)	(1.38)	(1.22)
constant	0.22	0.21	0.21
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.40	0.47	0.51

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Sensitivity analysis: broad consumption

Table 3. Households who are always stockholders

	2 yrs	4 yrs	6 yrs
γ: sall	9.57	7.80	7.49
	(1.87)	(1.28)	(1.17)
constant	0.22	0.21	0.21
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.46	0.48	0.53

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Results: Narrow consumption measure

Table 4. Direct and/or indirect stockholding

	2 yrs	4 yrs	6 yrs
γ: sind	11.89	11.41	11.95
	(2.08)	(1.87)	(2.53)
constant	0.21	0.21	0.23
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.50	0.53	0.36

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Summary of results for stockholders

- Risk aversion estimates in the range of
- Not sensitive to forecast horizon
- Slightly lower for "always" stockholders or stockholders with direct holdings
- Not sensitive to broad vs. narrow consumption measures

Estimates for all households, broad consumption

Table 5. All households; broad consumption

	2 yrs	4 yrs	6 yrs
γ: aggr	11.91	9.83	9.14
	(2.35)	(1.55)	(1.51)
constant	0.21	0.20	0.21
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.48	0.54	0.51

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Estimates for all households, narrow consumption

Table 6. All households; narrow consumption

	2 yrs	4 yrs	6 yrs
γ: aggr	12.84	13.35	12.56
	(2.53)	(2.27)	(3.02)
constant	0.22	0.21	0.23
	(0.01)	(0.01)	(0.02)
Adj-R^2	0.45	0.51	0.29

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Table 7. Never stockholders; broad consumption

	2 yrs	4 yrs	6 yrs
γ: nevr	13.30	12.01	10.77
	(2.93)	(2.08)	(2.02)
constant	0.22	0.21	0.22
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.43	0.52	0.42

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Table 8. Never stockholders; narrow consumption

	2 yrs	4 yrs	6 yrs
γ: nevr	11.98	15.45	8.75
	(3.71)	(3.78)	(5.28)
constant	0.24	0.23	0.23
	(0.02)	(0.02)	(0.03)
Adj-R^2	0.23	0.31	0.04

Notes: Columns indicate maximum forecast horizon used in estimation. OLS standard errors in parentheses. Constant is $100 \times \alpha$. p-values $= 0.0$ for all specifications.

Food away from home as a proxy for consumption

- Food away from home is known to be more volatile and cyclically sensitive than food purchased for home consumption –Wachter and Yogo (2010)
- Food away from home is about as volatile as our broad measure of consumption, and more highly correlated with broad consumption than narrow consumption, although quite highly correlated with both
- Food away from home is more highly correlated than either measure of aggregate consumption with returns on the 25 equity portfolios
- Risk aversion estimates using food away from home are in the range of those produced earlier

Food away from home

Broad stockholders

	2 yrs	4 yrs	6 yrs
γ: sind	10.04	7.81	8.51
	(1.39)	(1.07)	(1.75)
constant	0.19	0.19	0.22
	(0.01)	(0.01)	(0.01)
Adj-R^2	0.61	0.62	0.39

Mankiw and Zeldes (1991), revisited

- Mankiw and Zeldes (1991) identified "consumption" in the PSID with food at home plus food away from home (only consumption data available in the PSID at that time)
- Re-do our estimation using "total food" as our measure of consumption
- "Total food" is one-fifth as volatile as broad consumption, and much less correlated with asset returns
- This generates improbable and unstable estimates for risk aversion
- They should have used just food away from home; captures volatility in unmeasured consumption components, notably (but not limited to) service flow from housing and health expenditures

Total food consumption

Broad stockholders

	2 yrs	4 yrs	6 yrs
γ: sind	18.91	29.55	-13.47
	(4.28)	(6.15)	(7.72)
constant	0.20	0.23	0.12
	(0.01)	(0.01)	(0.04)
Adj-R^2	0.41	0.38	0.24

Discussion

- For broad and narrow aggregates of consumption of nondurables plus services, estimates of risk aversion are low and "reasonable," ranging from about 5 to about 12
- These estimates are stable across
  - Definitions of "who is a stockholder"
  - Forecast horizon
- "Food away from home" generates reasonable risk aversion estimates, while total food consumption does not

Previous estimates

Reference

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