Portfolio Allocation and Borrowing Constraints

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Overview

1. Background
2. Theoretical Model
3. Empirical Approach
4. Conclusion

Background

- Borrowing constraints can play a significant role in shaping economic behaviour and influencing economic outcomes.
- Since the early 1990s, the United States has witnessed increased efforts to provide additional borrowing opportunities for households that were traditionally constrained by credit markets.
- In the fourth quarter of 2018, over sixty million US adults were unlikely to access credit at choice.
- Inability to borrow exacerbates social inequalities and has implications for household consumption smoothing.
- We investigate the role that borrowing constraints play in determining the composition of US households' financial portfolios.

Literature

- Borrowing constraints have implications for the sustainability of government deficits (Wilcox, 1989), the behavior of output and prices (Scheinkman and Weiss, 1986), and consumption behavior (Carroll, 2001).
- Borrowing constraints and the composition of a household's financial portfolio (Haliassos and Hassapis, 1999; Bucciol et al., 2017; and Guiso et al., 1996; Jappelli, 1990; Jappelli et al., 1998; Toussaint, 2021; Carroll, 2021).
- Effects of background risks on portfolio allocations (Bertaut, 1998; Haliassos and Bertaut, 1995; Fratantoni, 2001; Palia et al. 2014)

Model

- Based on Markowitz (1952), and is a variant of Eichner and Wagener (2012), who analyse risk-taking behaviour in a linear portfolio selection problem with non-tradable background wealth.
- Assume that households face a linear portfolio choice problem such that the final wealth of a household is given by:

$$W = q_L L + q_M M + q_H H + \lambda B, \tag{1}$$

where L (low risk), M (medium risk) and H (high risk) are random variables representing the return from allocating all of wealth to these tradable assets.

Model

- The weights that households choose to allocate to these assets are denoted q_i, $i \in \{L, M, H\}$, such that $\Sigma q_i = 1$.
- B denotes non-tradable background wealth which can be viewed as the stream of household income arising due to labour or entrepreneurial activity, human capital, and government transfers
- $\lambda \geq 0$ is used to scale background wealth B up or down; the non-negativity constraint on background wealth
- Our model is also characterised by restrictions on short-selling which lead to the portfolio weights of the household's tradable assets being subject to non-negativity constraints.

Model

- The expected return on total wealth, W, is given by

$$\mu_W = q_L\mu_L + q_M\mu_M + q_H\mu_H + \lambda\mu_B \tag{2}$$

  where μ_J is the mean of variable $J \in \{W, L, M, H, B\}$.

- The corresponding variance, υ_W, is given by

$$\upsilon_W = \begin{bmatrix} q_L^2\upsilon_L + q_M^2\upsilon_M + q_H^2\upsilon_H + \lambda^2\upsilon_B \\ +2q_Lq_M Cov(L,M) + 2q_Lq_H Cov(L,H) + 2q_Mq_H Cov(M,H) \\ +2q_L\lambda Cov(L,B) + 2q_M\lambda Cov(M,B) + 2q_H\lambda Cov(H,B) \end{bmatrix}. \tag{3}$$

- We assume that the tradable assets are not correlated with each other.

Model: Claims

- In the absence of short-sale constraints, the optimal shares of the tradable assets are related to μ_W on the efficient frontier according to

$$\frac{\partial q_L^*}{\partial \mu_W} < 0; \ \frac{\partial q_M^*}{\partial \mu_W} \lesseqgtr 0; \ \frac{\partial q_H^*}{\partial \mu_W} > 0, \tag{4}$$

  where q_L^*, q_M^*, and q_H^* denote the variance minimizing shares for low, medium and high-risk assets.
- On the efficient frontier, a higher expected portfolio return μ_W is associated with an increase (decrease) in the share of assets in the high-risk (low-risk) category.
- For the medium-risk asset, the direction of this effect on q_M^* is ambiguous.

Model: Claims

- In the presence of both correlated background risk and short-sale constraints $q_L^* \geq 0$, $q_M^* \geq 0$, and $q_H^* \geq 0$, the domain of the non-binding risk-return space will also be a function of background risk.
- More generally, the findings reported above are consistent with Arrondel and Calvo-Pardo (2002) who find that "...the sign and magnitude of the correlation may exacerbate or counterbalance the optimal portfolio response to the introduction of a background risk.

Model: Numerical Representation

- For the tradable assets, we choose parameterisations based on historical data.
- Our parameterisations are: $\mu_L = 2.36$, $\sigma_L = 2.25$ (average effective fed funds rate); $\mu_M = 5.43$, $\sigma_M = 4.96$ (the Bloomberg Barclays Municipal Bond Index); and $\mu_H = 11.89$, $\sigma_H = 18.44$ (the SP 500).
- Background wealth B: $\mu_B = 4$ and $\lambda = 1$, and consider two scenarios:
  Without background risk ($\sigma_H = 0$)
  With background risk positively correlated with the high-risk asset ($\sigma_B = 5, \rho_{LB} = \rho_{MB} = 0$, $\rho_{HB} = 0.4$)
- Household preferences are given by the mean-variance utility function

$$G(\mu_W, \upsilon_W) = \mu_W - \gamma \upsilon_W, \tag{5}$$

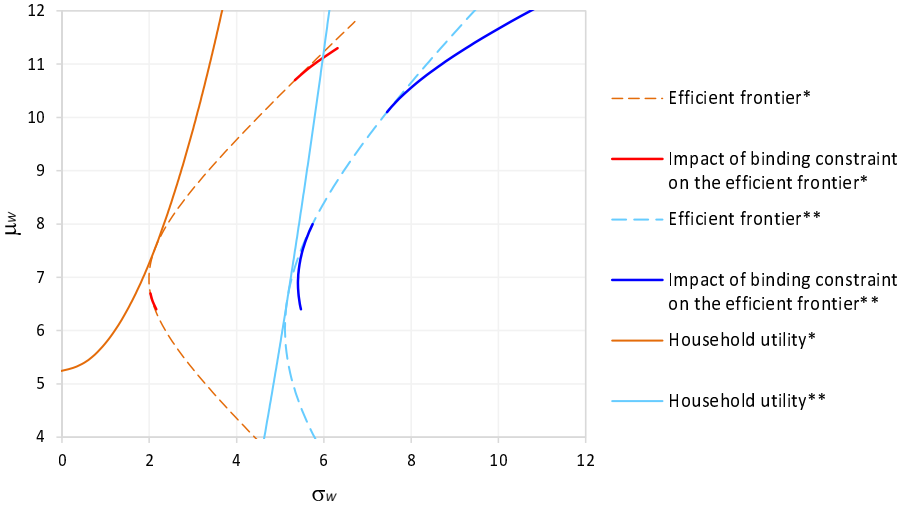
  where $\gamma > 0$ is a risk aversion parameter such that greater values imply lower levels of risk tolerance, and set $\gamma = 0.5$.

Numerical Representation

Table: Optimal portfolio composition predicted by the model under alternative background risk scenarios

Background risk scenarios	Optimal portfolio composition q_L^*	q_M^*	q_H^*	Welfare
No background risk ($\sigma_B = 0$)	0.694	0.268	0.038	5.191
Positive correlation (ρ_{LB}=ρ_{MB}=0; ρ_{HB}=0.4)	0.726	0.274	0	−6.749
Independent background risk (ρ_{LB}=ρ_{MB}=ρ_{HB}=0)	0.694	0.268	0.038	−7.309
Negative correlation (ρ_{LB}=ρ_{MB}=0; ρ_{HB}=−0.4)	0.605	0.249	0.146	−3.917

Model: Graphical Representation



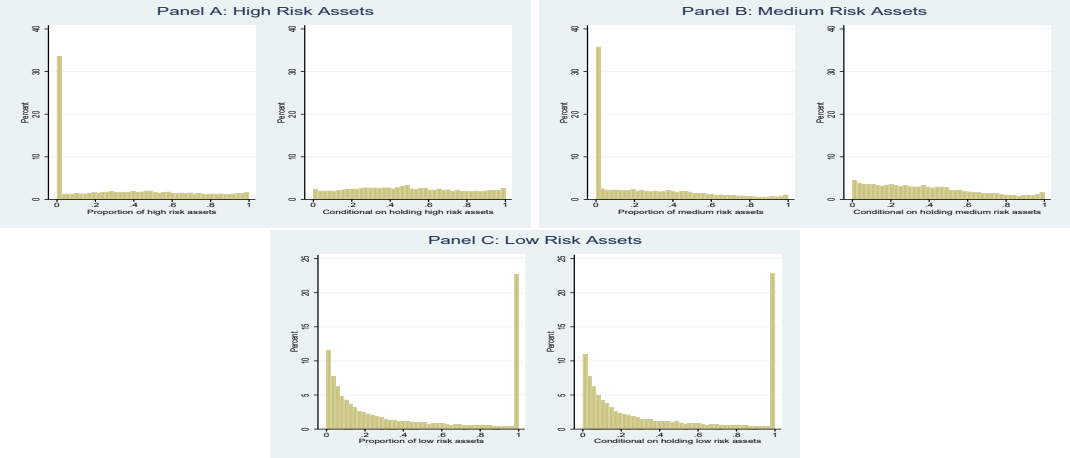
Data

- We exploit data from the 1995 – 2019 waves of the Survey of Consumer Finance.
- The SCF is a repeated cross-sectional triennial survey of US households.
- Uses multiple imputation to account for non-response - Use Rubin Repeated Inference.
- The SCF contains detailed information on household assets and liabilities, in addition to a range of income, socioeconomic and demographic characteristics.

Dependent Variables

- We allocate assets into three distinct risk-based categories: high-risk; medium-risk; and low-risk.
- High-risk assets that comprises of both direct and indirect risky asset holding, through for example, retirement accounts.
- Low-risk assets include, for example, checking accounts and certificates of deposit
- Medium-risk assets include for example, non-risky pension accounts, tax mutual funds and tax free bonds.

Dependent Variables



Notice that the variable are bounded between 0 and 1.

Econometric Methodology

- A household can allocate their financial assets to three distinct categories based on their risk exposure, namely, high, medium and low.
- Our interest lies in modelling the share of the household's financial portfolio allocated to each type of financial asset and the partial effects of observed covariates on these.
- We employ the ordered fractional model of Kawasaki and Lichtenberg (2014).
- This approach provides a means of modelling the household's portfolio allocations, which takes into account the inherent risk ordering of the asset categories.

Econometric Methodology

- What is required is the effect of covariates on

$$E\left(s_{ij}\left|\mathbf{x}_i\right.\right), j = 0, 1, 2 \tag{6}$$

  where E denotes the expected value of the term in parentheses.
- The likelihood function as in Kawasaki and Lichtenberg (2014):

$$\ell_i = \prod_j \left(\Phi\left[\mu_0 - \mathbf{x}_i'\beta\right]\right)^{s_{i,j=0}} \left(\left[\Phi\left(\mu_1 - \mathbf{x}_i'\beta\right) - \Phi\left(\mu_0 - \mathbf{x}_i'\beta\right)\right]\right)^{s_{i,j=1}} \left(1 - \Phi\left(\mu_1 - \mathbf{x}_i'\beta\right)\right)^{s_{i,j=2}}. \tag{7}$$

- Note that here the OF model is consistent with the inherent ordering, in risk, of the asset bundles (and not of the value of the shares themselves).

Econometric Methodology

- This allocation equation is now characterised by

$$
\begin{aligned}
E\left(s_{i,j=0}\,|\mathbf{x}_i\right) &= \Phi\left(\mu_0 - \mathbf{x}_i'\beta\right) \\
E\left(s_{i,j=1}\,|\mathbf{x}_i\right) &= \Phi\left(\mu_1 - \mathbf{x}_i'\beta\right) - \Phi\left(\mu_0 - \mathbf{x}_i'\beta\right) \\
E\left(s_{i,j=2}\,|\mathbf{x}_i\right) &= 1 - \Phi\left(\mu_1 - \mathbf{x}_i'\beta\right)
\end{aligned}
\tag{8}
$$

  which by construction satisfy $0 \leq E\left(s_{i,j}\,|\mathbf{x}_i\right) \leq 1$, and are consistent with the risk ordering of the j asset bundles in the household's portfolio.

- This framework characterises the theoretical model - three assets which are ordered in their risk exposure.

Borrowing Constraints

- The SCF includes information which enables us to directly observe constrained households
- We use information on whether households have been turned down for credit at a financial institution or if they did not apply because they believed they would be turned down for credit in order to define a range of borrowing constraint measures.
- These measures are in the spirit of Jappelli (1990).
- We restrict our analysis to the sample of households who have made, or thought about making, a credit application in recent years.
- We argue that, if a household has not applied for credit, then we do not observe whether they are constrained or not.
- This results in a sample of $27,618$ households across the time period 1995-2019.

Borrowing Constraints

Panel A: The questions used in constructing the borrowing constraint measures
(1): In the past twelve months, has a particular lender or creditor turned down any request you or your (husband/wife/partner) made for credit, or not given you as much credit as you applied for? (2): Were you later able to obtain the full amount you requested by reapplying to the same institution or by applying elsewhere? (3): Was there any time in the past twelve months that you (or your husband/wife/partner) thought of applying for credit at a particular place, but changed your mind because you thought you might be turned down?

Panel B: Borrowing constraint measures definitions	
Constraint 1	= 1 if the household did not apply for credit due to a belief that the application would be rejected, 0 otherwise
Constraint 2	= 1 if the household responds they were turned down or did not obtain the full amount of credit applied for, 0 otherwise
Constraint 3	= 1 if the household responds they were turned down or did not obtain the full amount of credit applied for and they did not reapply or were able to obtain credit elsewhere, 0 otherwise
Constraint 4	= 1 if constraint 1 or constraint 2 are satisfied, 0 otherwise
Constraint 5	= 1 if constraint 1 and constraint 3 is satisfied, 0 otherwise.

Borrowing Constraints

Borrowing Constraints

	Mean	Std. Dev
Constraint 1	0.141	(0.002)
Constraint 2	0.254	(0.003)
Constraint 3	0.158	(0.002)
Constraint 4	0.293	(0.003)
Constraint 5	0.197	(0.002)

Background Risks

- We include risks associated with income, health, expenditure, business ownership, wealth shocks associated with future inheritance and whether there are a multiple earners in the household.

Background Risks: Summary Statistics

	Mean	Std. Dev
Business Own.	0.282	(0.003)
Multi Earners	0.389	(0.003)
Major Fin. Exp.	0.596	(0.003)
No Health insur.	0.083	(0.002)
Inheritance	0.174	(0.002)
Know Income	0.706	(0.003)
Income Above Norm.	1.396	(0.024)
Income Below Norm.	-1.746	(0.025)

Results

	Coefficients		High-risk		Medium-risk		Low-risk	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Age	-0.0351***	(0.0026)	0.0123***	(0.0009)	0.0013***	(0.0001)	-0.0135***	(0.001)
White	-0.1295***	(0.015)	0.0453***	(0.0052)	0.0047***	(0.0006)	-0.0500***	(0.0058)
Education								
High School	-0.2400***	(0.0279)	0.0839***	(0.0098)	0.0088***	(0.0011)	-0.0927***	(0.0108)
College Degree	-0.4196***	(0.0281)	0.1467***	(0.0098)	0.0154***	(0.0012)	-0.1621***	(0.0109)
Employment								
Employed	-0.2630***	(0.0262)	0.0920***	(0.0091)	0.0096***	(0.0011)	-0.1016***	(0.0101)
Self-Employed	-0.0160	(0.03)	0.0056	(0.0105)	0.0006	(0.0011)	-0.0062	(0.0116)
Retired	-0.1370***	(0.0308)	0.0479***	(0.0108)	0.0050***	(0.0012)	-0.0529***	(0.0120)
Child	0.0288**	(0.0121)	-0.0101**	(0.0042)	-0.0011**	(0.0004)	0.0111**	(0.0047)
Economic Exp.	-0.0183**	(0.0071)	0.0064**	(0.0025)	0.0007**	(0.0003)	-0.0071**	(0.0027)
Important Period	-0.0285***	(0.0045)	0.0100***	(0.0016)	0.0010***	(0.0002)	-0.0110***	(0.0017)
Risk Attitudes	-0.2046***	(0.0071)	0.0715***	(0.0025)	0.0075***	(0.0004)	-0.0790***	(0.0027)
Total Income	-0.1287***	(0.0057)	0.0450***	(0.0020)	0.0047***	(0.0003)	-0.0497***	(0.0022)
Net Worth	-0.0190***	(0.0009)	0.0067***	(0.0003)	0.0007***	(0.0000)	-0.0073***	(0.0004)
Home owner	-0.1413***	(0.0142)	0.0494***	(0.0050)	0.0052***	(0.0006)	-0.0546***	(0.0055)
Observations	27,618							

Results

	Coefficients		High-risk		Medium-risk		Low-risk	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Background Risk								
Business Owner	0.04***	(0.0154)	-0.014***	(0.0054)	-0.0015***	(0.0006)	0.0155***	(0.006)
Multi Earners	-0.0599***	(0.0136)	0.0209***	(0.0048)	0.0022***	(0.0005)	-0.0231***	(0.0053)
Major Fin. Exp.	-0.0533***	(0.0114)	0.0186***	(0.004)	0.0020***	(0.0004)	-0.0206***	(0.0044)
No Health insur.	0.2823***	(0.0246)	-0.0987***	(0.0086)	-0.0103***	(0.001)	0.109***	(0.0095)
Inheritance	-0.0507***	(0.0135)	0.0177***	(0.0047)	0.0019***	(0.0005)	-0.0196***	(0.0052)
Know Income	-0.0584***	(0.0125)	0.0204***	(0.0044)	0.0021***	(0.0005)	-0.0226***	(0.0048)
Income Above Norm.	0.0012	(0.0014)	-0.0004	(0.0005)	0.0000	(0.0001)	0.0005	(0.0005)
Income Below Norm.	-0.0020	(0.0014)	0.0007	(0.0005)	0.0001	(0.0001)	-0.0008	(0.0005)
Observations	27,618							

Results

	Coefficients		High-risk		Medium-risk		Low-risk	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Borrowing Constraints:								
Constraint 1	0.0318*	(0.0189)	-0.0111*	(0.0066)	-0.0012*	(0.0007)	0.0123*	(0.0073)
Constraint 2	0.0302**	(0.0145)	-0.0106**	(0.0051)	-0.0011**	(0.0005)	0.0117**	(0.0056)
Constraint 3	0.0334*	(0.0175)	-0.0117*	(0.0061)	-0.0012*	(0.0006)	0.0129*	(0.0068)
Constraint 4	0.0358**	(0.0144)	-0.0125**	(0.0051)	-0.0013**	(0.0005)	0.0138**	(0.0056)
Constraint 5	0.0378**	(0.0166)	-0.0132**	(0.0058)	-0.0014**	(0.0006)	0.0146**	(0.0064)
Observations	27,618							

Conclusions

- We developed a tractable theoretical framework with a basis in standard portfolio theory, which is structured around three tradable assets differentiated by increasing rates of risk and return.
- Under non-restrictive assumptions, the behavior of the medium-risk asset was found to be ambiguous.
- The confluence of correlated background risk and borrowing constraints was found to impact on the domain of the non-binding risk-return space, which in turn holds implications for the structure of the household's optimal portfolio.
- US households also shun holding medium-risk assets, which our empirical proxies for borrowing constraints appear to partially explain.
- In this sense, our contribution suggests that further work directed towards accounting for the allocation of medium-risk assets in US households should be considered expedient.

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