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Study of the Nonlinear Effect of Debt Leverage on Household Financial Asset Allocation

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Abstract: Using data from the China Household Finance Survey (CHFS), this paper investigates whether there is a nonlinear effect of debt leverage on households' financial asset allocation. The study shows that debt leverage affects households' motivation to participate in the financial market and leads to a reduction in the efficiency of financial asset allocation, with a certain nonlinear effect on low-debt households. Further, this paper provides policy recommendations to address the issue of reducing the impact of debt risk on residents' asset allocation, which is important for realizing the growth of household wealth.

Keywords: Debt leverage; Household financial asset allocation; Nonlinear effects.

1. Introduction

The realization of common prosperity requires the continuous creation of more family asset income, and the promotion of the optimization of the structure of family financial asset portfolios can effectively enhance family asset income and wealth appreciation, thereby promoting the optimization of the asset management model. However, according to the data of China's household finance survey, China's households have a low degree of participation in the financial market, with only 4.4% of households holding stocks, and less than 2% of households participating in fund and bond market investments. At the same time, as many as 70% of the families involved in financial market investment hold only one kind of financial assets, and there is the problem of homogenization in the choice of their financial asset portfolio. This "limited participation" in the financial market has resulted in households not being able to fully reap the dividends of the development and reform of the financial market, and their asset-based income and investment efficiency have not been accurately enhanced.

At the same time, the level of indebtedness resulting from the rigid consumption needs of households has been increasing. Excessive debt leverage has caused repayment pressures to climb, forcing households to tighten their liquidity in the short term and thus weakening their freedom of choice of financial assets. Among other things, the liquidity constraint effect and debt-servicing risk arising from reduced cash flows have led to lower household demand for financial assets, thereby weakening the positive effect of financial asset holdings on enhancing the efficiency of household financial asset allocation and further affecting the structure of household financial assets. A monolithic portfolio will seriously affect the appreciation and preservation of household financial wealth and income, and will also have a certain negative impact on the development of financial markets and social welfare. Therefore, it is of great significance to study how to reduce the negative impact of debt risk on the efficiency of household financial asset allocation, and to enhance the enthusiasm of resident households to participate in financial market investment and the efficiency of household financial asset allocation, in order to increase the asset-based income of the population, realize the value-added and preservation of wealth, and thus realize common prosperity.

This paper uses survey data from the 2019 China Household Finance Survey and Research Center (CHFS) to study the role of debt leverage in influencing households' financial asset allocation. It is found that debt leverage will affect the degree of active participation in the financial market by resident households, and lead to a reduction in the efficiency of these households' financial asset allocation. However, at the same time, there is a non-linear effect of the level of household debt bearing on the efficiency of financial asset allocation.

2. Theoretical Analysis and Research Hypothesis

The study of micro-family financial asset allocation is currently one of the important research hotspots in the field of finance at home and abroad, and most of the literature has developed its own research and analysis of the literature from the perspectives of economic class characteristics such as household income, real assets and household debt; background characteristics such as social interaction, social network and health risk; and household demographic characteristics such as age, gender, family size and education level [1, 2]. Among them, in the study of the impact of household liabilities on the allocation of financial assets, most scholars believe that reasonable household liabilities will help families smooth consumption, such as participating in the stock market, buying a house and starting a business to promote the economic growth of the family, but too high a level of debt will seriously increase the debt leverage ratio of the family, which will lead to a lower demand for financial assets or even non-participation in financial activities; too much debt leverage will also bring about a household Chetty and Szeidl and Fougère and Poulhes study the more pronounced "crowding out" effect of housing loans on households' financial asset allocations, i.e., housing loans reduce the household's demand for The "crowding out" effect is more pronounced in the case of the United States and France. At the same time, an increase in debt leverage not only affects the household's demand for financial investment, but also changes the number of financial asset holdings,

which affects the household's choice of financial assets. Accordingly, this paper proposes the hypothesis:

H: Debt leverage affects residents' motivation to participate in financial markets and has a nonlinear effect on household financial asset allocation.

Specifically, debt leverage affects the allocation of household financial assets mainly through the following three paths. First, the rapid accumulation of household liabilities contributes to a continuous rise in household debt leverage, which in turn brings about a reduction in the liquidity of financial assets, as funds are subject to liquidity constraints that make it impossible for residents to reasonably allocate their assets, thereby affecting the structure of financial asset allocation [3, 4,5]. Secondly, some of the loans in the high debt leverage ratio, such as housing loans with excessive amounts and long cycles, will have a "crowding-out effect" on the choice of financial asset portfolios of households [6]. That is, households with high levels of indebtedness incur debt that is beyond their capacity to absorb, and are constrained by the need to maintain a certain level of asset liquidity, which reduces the need for investment in financial assets, ultimately leading to a homogenization of financial asset choices and inefficiencies. Finally, households facing high debt burdens have a higher degree of financial risk aversion and a lower risk tolerance than households with low debt leverage, and are more willing to hold low-risk assets [7,8].

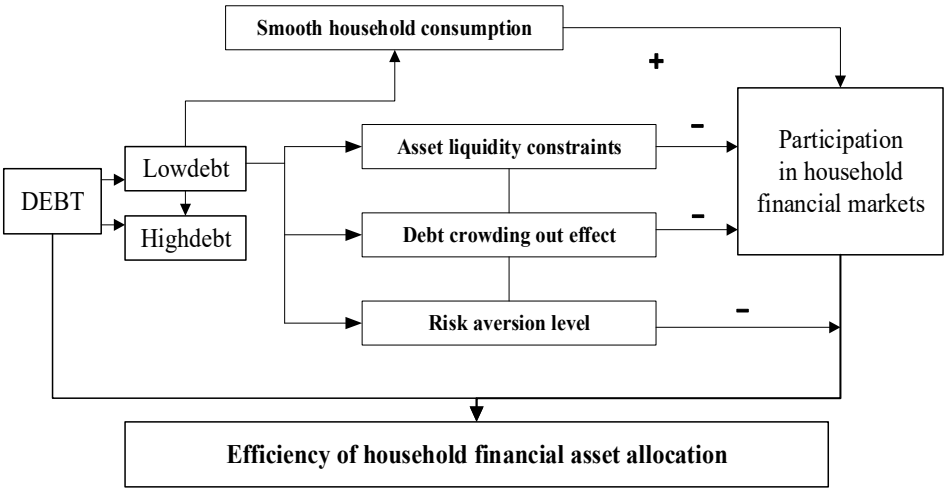

Figure 1. Mechanisms by which debt leverage affects household financial asset allocation

3. Research Design

3.1. Data Sources

The data in this paper comes from the China Household Finance Survey (CHFS) conducted nationwide by Southwestern University of Finance and Economics (SWUFE) in 2019.The CHFS mainly covers financial information related to household holdings of financial and non-financial assets, debt expenditure such as housing liabilities and medical liabilities, household income and household insurance, and so on. Basic information also covers financial information on the utilization of various types of financial assets by households, such as deposits, stocks, bonds, financial products, gold and foreign exchange, and other types of financial assets. At the same time, it also includes a full range of information on the financial literacy of each member of the family and the possible economic behaviors, which provides good data support for the research of this paper. In this paper, in the treatment of data, excluding the family head of household age less than 16 years old, the missing value data reorganization and the data before and after 1% of the data after shrinking the tail to get the sample size of this paper 17094.

3.2. Definition of Variables

3.2.1. Explained Variables

This paper adopts Sharpe Ratio as a measure of household financial asset allocation efficiency, and the Sharpe Ratio formula is used to measure the efficiency of household financial asset allocation[9]:

$$SharpeRatio_i = \frac{\left[E(R_{pi}) - R_f\right]}{\delta_{ip}}$$

$$E(R_{pi}) = \sum_{j=1}^{m} w_j R_j$$

$$\delta_{ip} = \sqrt{\delta_{ip}^{\ 2}} = \sqrt{\sum_{j=1}^{m}\sum_{k=1}^{m} w_j w_k Cov(R_j, R_k)} \quad (1)$$

In Equation(1), $SharpeRatio_i$ denotes the Sharpe ratio of household i's portfolio of financial assets, $E(R_{pi})$ denotes household i's expected rate of return on its portfolio of financial assets, R_f is the risk-free rate of return (one-year time deposit rate), δ_{ip}denotes the standard deviation of household i's portfolio of financial assets, w_j is the share of various financial assets in the total financial assets, and $Cov(R_j,R_k)$ is the covariance between the returns on each financial asset. Sharpe ratios are denoted by Sharpe throughout the following.

3.2.2. Key Explanatory Variables

The key explanatory variable in this paper is the debt leverage variable Debt. debt leverage is the proportion of total household debt to total household assets.

3.2.3. Other Control Variables

For the selection of control variables,household head characteristics and family characteristics were selected as the main control variables. In the selection of household characteristics variables, personal characteristics such as age, sex, degree, marriage, health and risk are included. The household characteristics variables include family members and lntotal income. this paper argues that both house as well as tech affect the efficiency of indebted households' allocation to financial assets. In addition, fixed effects at the provincial level are controlled for in the empirical analyses in the subsequent sections. Table 2 presents the descriptive statistics of the variables in this paper:

Table 1. Descriptive statistics for variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Sharpe	17094	0.024	0.042	0.000	0.300
Debt	17094	0.075	0.176	0.000	0.790
age	17094	54.759	14.083	24.000	85.000
sex	17094	0.000	0.000	0.000	1.000
degree	17094	3.497	1.698	1.000	9.000
marriage	17094	0.836	0.370	0.000	1.000
health	17094	2.717	1.003	1.000	5.000
risk	17094	3.290	1.688	1.000	5.000
familymembers	17094	3.012	1.468	1.000	7.000
lntotal income	17094	10.311	2.285	0.000	13.308
house	17094	0.883	0.321	0.000	1.000
tech	17094	0.729	0.445	0.000	1.000

3.3. Modeling

3.3.1. Probit Model

This paper investigates whether debt leverage affects households' participation in financial markets for investment, with the explanatory variable Y as a dichotomous variable. Set the value of the explanatory variable for households participating in the financial market for investment as 1, and vice versa as 0. This paper uses the Probit model to study whether the debt leverage of residential households affects the participation of households in the financial market Y. Specifically, the model is set up as follows:

$$Probit(Y_{ip}=1)=\Phi(\beta_0+\beta_1 Debt_{ip}+\beta_2 X+\phi_p)+\varepsilon_{ip} \quad (2)$$

In Equation (2), i and p denote the household and the province, respectively, and Y_{ip} denotes the household's participation in the financial market investment, when Y_{ip}=1 the household is considered to be investing in financial assets (if the household invests in any one or more of the four types of financial assets, namely, deposits, stocks, bonds, or funds, it is considered to be participating in the financial market), otherwise Y_{ip}=0. $Debt_{ip}$ denotes the i of the province p household's debt leverage, X is the other control variables, φ_p is the province fixed effects, and ε_{ip} is the random perturbation term.

3.3.2. OLS Model

To investigate the extent to which debt leverage specifically affects the efficiency of household financial asset allocation. Therefore, the OLS model is used to do the benchmark regression. In Equation (3), i and p denote households and provinces respectively, Sharpe $Ratio_{ip}$ denotes the efficiency of household financial asset allocation of province p for i, $Debt_{ip}$ denotes debt leverage, X is other control variables, φ_p is province fixed effects, and ε_{ip} is a random perturbation term, and the model is set up as follows:

$$Sharpe\ Ratio_{ip}=y_0+y_1 Debt_{ip}+y_2 X+\phi_P+\mu_{ip} \quad (3)$$

3.3.3. Non-linear Effect Model

In order to specifically explore whether there is a certain nonlinear effect of debt leverage on the financial asset allocation of debt households. This paper adds a quadratic term $Debt^2_{ip}$ to the baseline regression model to further extend equation (3). The nonlinear effect of debt leverage on the efficiency of households' financial asset allocation is discussed by calculating the Debt coefficient of equation (4). In addition, the critical level of debt leverage is Debt*, when Debt is lower than Debt* will lead to a decrease in the efficiency of household financial asset allocation, and debt leverage higher than this level will enhance the efficiency of household financial asset allocation, which will be set up in the model as follows:

$$Sharpe\ Ratio_{ip}=y_0+y_1 Debt_{ip}+y_1' Debt_{ip}^{\ 2}+y_2 X+\phi_p+\mu_{ip} \quad (4)$$

4. Empirical Results and Analysis

4.1. Baseline Regression

This paper first empirically tests the relationship between debt leverage and household financial asset allocation. Column (1) in Table 2 presents the results of Probit's marginal effects, and the estimated coefficient of debt leverage is -0.8022 and is significant at the 1% significance level, reflecting the fact that household debt leverage significantly affects households' participation in the financial market. Column (2) presents the results of the baseline linear regression of the effect of debt leverage on the efficiency of household financial asset allocation, with an estimated coefficient of -0.0120, which is also significant at the 1% level. Thus the hypothesis H of this paper is preliminarily tested.

In terms of control variables, the number of family members has a significant negative effect on the efficiency of the household's financial asset allocation, which may be due to the fact that an increase in the number of family members leads to a lack of financial resources, which reduces the demand for financial assets and thus reduces the efficiency of

the household's financial asset portfolio. Households with risk averse attitude will reduce the efficiency of their financial asset allocation to some extent. The coefficient of education level is significantly positive because households with higher education level have a more rational portfolio of financial assets and a more efficient allocation of financial assets. The effect of the health level of the head of the household on the efficiency of financial asset allocation is significantly negative, so that poor health of the investor will also affect the overall financial asset choice of the household. The coefficient of information technology use is significantly positive, indicating that the use of smart information technology by households will increase the effectiveness of asset allocation. The coefficient of income on the efficiency of financial asset allocation is positive, indicating that when household income is higher, the efficiency of financial asset allocation will be enhanced by holding more liquid funds.

Table 2. Base regression analysis

Variable	(1) Probit	(2) Sharpe
Debt	-0.8022*** (-13.09)	-0.0120*** (-6.62)
familymembers	-0.0212*** (-2.62)	-0.0004 (-1.61)
risk	-0.0824*** (-12.17)	-0.0041*** (-20.82)
degree	0.0907*** (12.02)	0.0043*** (19.97)
health	-0.0855*** (-7.87)	-0.0008** (-2.54)
age	0.0001*** (0.00)	0.0003*** (9.20)
marriage	0.0890*** (3.02)	0.0019** (2.11)
house	0.0627* (1.93)	0.0002** (2.07)
tech	0.4808*** (18.04)	0.0094*** (11.40)
lntotalincome	0.0450*** (9.30)	0.0002* (1.71)
Control	-0.4895*** (-4.15)	0.0042 (1.46)
R-sq		0.096
F		181.6176
N	17094	17094

4.2. Non-linear Effects

Second, the impact of debt leverage on households' financial asset allocation is further discussed by categorizing households into those with low debt leverage and those with high debt leverage. From the previous analysis, it can be seen that appropriate debt can help households smooth consumption as well as enhance the incentive to participate in the financial market, but too high a level of debt will affect the liquidity constraint of household assets leading to the inability to set aside sufficient funds to participate in financial activities. Column (1) in Table 4 shows the nonlinear results of debt leverage on financial asset allocation for the full sample of households, but the coefficient of the quadratic term is not significant. Column (2) of the table shows that for low debt leverage households (Debt<=0.149), the increase in debt leverage negatively affects the efficiency of financial assets when the level of debt does not exceed the critical value of 0.09 (0.536/(2*2.982)), and the efficiency of households' allocation of financial assets begins to slowly increase when debt leverage exceeds the critical level of 0.09. From columns (3) and (4) can be seen, when debt leverage continues to increase, climbed to more than 0.149 that is, low-debt households become high-debt households, the debt level of the financial assets of the "crowding out" effect began to play a role in the household's level of risk-taking declined, resulting in the allocation of financial assets to the efficiency of the non-linear effect but rather The efficiency of allocation to financial assets does not have a nonlinear effect, but rather declines. This is consistent with the previous conclusion that a reasonable level of debt plays a role in optimizing the allocation of household assets, and excessive debt leverage has a serious negative impact on the allocation efficiency. So far the hypothesis H of this paper has been fully verified.

5. Main Conclusions and Recommendations

5.1. Main Conclusions

The rapid accumulation of household debt and the inefficiency of household financial asset allocation caused by it have a negative impact on the value-added preservation of residents' wealth, and may even affect China's macrofinance as well. Based on this, this paper comprehensively examines the impact of debt leverage on household financial asset allocation. The empirical results of this paper show that debt leverage significantly affects the degree of indebted families' participation in the financial market and reduces the efficiency of family financial asset allocation, but it has a

certain non-linear effect on low-debt families, i.e., a certain degree of debt leverage promotes the optimization of the family's financial asset structure and efficiency enhancement. Households with high debt leverage, however, are constrained by liquidity constraints, the "crowding out" effect of household indebtedness and the ability to bear financial risk, and are unable to participate effectively in financial activities and make efficient asset combinations, which reduces the level of wealth and income of households, and incurs a certain loss in terms of social welfare.

Table 3. Analysis of nonlinear effects

Variable	(1) ALL	(2) LowDebt	(3) HighDebt	(4) HighDebt
Debt	-0.1027*** (-5.43)	-0.5363*** (-4.20)	0.0879 (1.27)	-0.0827*** (-6.72)
Debt^2	0.0299 (1.10)	2.9822*** (2.69)	-0.1775** (-2.50)	
familymembers	-0.0174** (-2.21)	-0.0201** (-2.32)	0.0099 (0.52)	0.0090 (0.47)
risk	-0.0822*** (-12.26)	-0.0823*** (-10.97)	-0.0863*** (-5.74)	-0.0863*** (-5.74)
degree	0.0898*** (12.26)	0.0892*** (10.98)	0.0968*** (5.49)	0.0964*** (5.47)
health	-0.0850*** (-7.94)	-0.0887*** (-7.63)	-0.0512* (-1.83)	-0.0516* (-1.85)
age	0.0001 (0.07)	-0.0006 (-0.58)	0.0002 (0.09)	-0.0002 (-0.09)
marriage	0.0920*** (3.15)	0.0913*** (2.90)	0.0864 (1.08)	0.0887 (1.11)
house	0.0480 (1.48)	0.0787** (2.26)	-0.1164 (-1.30)	-0.0763 (-0.87)
tech	0.4680*** (17.76)	0.4661*** (16.49)	0.4685*** (6.17)	0.4743*** (6.26)
lntotalincome	0.0468*** (9.84)	0.0514*** (9.63)	0.0293*** (2.82)	0.0301*** (2.89)
N	17094	14452	2642	2642

5.2. Recommendations

Based on the findings of this paper, the following recommendations are made: first, China's regulatory authorities should accelerate and improve the monitoring of households with excessive debt leverage, so as to avoid debt risks from triggering inappropriate investment choices, or even causing their spillover to the macroeconomy. At present, the debt leverage ratio of households should be gradually reduced and debt risks should be controlled, and the credit rating and risk-bearing level of highly indebted households should be strictly assessed before lending, so as to strictly control the debt leverage ratio of households and the spillover of debt risks. At the same time, financial risk monitoring should be strengthened and risk-bearing mechanisms should be improved for households that grant loans, so as to strictly control the rate of growth of the household sector's debt and reduce the negative impact of non-performing liabilities on the efficiency of the allocation of households' financial assets, in order to solidly promote the process of shared prosperity.

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