

Early Life Exposure to Disaster and Financial Risk Attitude

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Abstract

We use China's 1959-1961 famine as a natural experiment to quantify the importance of early-life exposure to disaster in financial risk attitude formation. Using observed portfolio choices to proxy for financial risk attitude, we study the roles of common traumatic experience of the famine and idiosyncratic experience. With a difference-in-differences method, our estimates show that on average, individuals with a 10% severer famine experience during the psychological formative period are more risk averse, including a 9.70%-15.06% lower risky assets markets participation rate, and a 32.03%-44.71% lower portfolio share in risky assets (conditional on participating).

Key words: famine, formative experiences, household finance, natural disaster, risk attitude.

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“Although high savings rates can be found across Asia, the Chinese propensity to save is rooted in deep-seated memories of scarcity.”

In Andrew Jacob, “China’s Economy, in Need of Jump Start, Waits for Citizens’ Fist to Loosen”

New York Times, Dec. 3, 2008

I. Introduction

Risk attitude plays a fundamental role in finance theories. Traditional theories assume that individual risk attitude is stable over time and exogenous to personal experiences. In contrast, behavioral and experimental investigations relate heterogeneity in risk attitude to personal early life history, demographic characteristics, and trust in institutions (e.g., Guiso and Paiella (2008), Dohmen et al. (2011), Dohmen et al. (2012), Malmendier and Nagel (2011)). Recently, a growing body of literature links a higher degree of financial risk aversion with negative experience during the psychological formative period (e.g., Bucciol and Zarri (2013), Bernile et al. (2014)). Despite above findings, convincing causal factors of risk attitude formation still requires much further investigation.

In this paper, we attempt to identify and quantify the importance of disaster experience during the psychological formative period in individual financial risk attitude formation. We examine empirically whether individual differs in financial risk attitude depending on the exposure to disaster experience. Using the nationwide great famine in China during 1959-1961 as a natural experiment to achieve identification, we test whether individuals who experienced a more severe famine express a lower willingness to take financial risk, are less likely to participate in the risky assets markets, and invest less in risky assets.

We use household portfolio, migration, education, and occupation records from China Family Panel Survey (CFPS) in 2010 and 2012 to construct variables on financial risk attitude and its contributors; population records from China 1% Population Sampling Survey in 1982 to construct variables on famine intensity. Following standard literature, our focus in this paper is individual risk attitude towards financial decisions; hence we use household financial portfolio choices to proxy for risk attitude. We exploit the differences in portfolio choices both across regions (i.e., provinces stricken by the famine at different levels) and across cohorts (i.e., cohorts that experience famine during the psychological formative period and those not), a difference-in-differences (DID) approach.

Our work contributes to the literature in 2 dimensions. First, to our knowledge, we are the first to make causality inference between early-life exposure to disaster and financial risk attitude. Second, we study both the common disaster experience of famine and idiosyncratic life experience, giving a more comprehensive understanding of risk attitude formation.

The rest of the paper proceeds as follows. Section II presents related literature review. Section III provides a profile of the great famine, China's household financial portfolio and our testable hypotheses. Section IV describes the data and summary statistics. Section V discusses our main empirical results. Section VI documents robustness checks. Section VII concludes.

II. Literature Review

Our work contributes to a growing literature that attempts to quantify the importance of early life experiences for explaining individual financial risk attitude heterogeneity.

II.1. Risk Attitude and Household Financial Portfolio Choices

Portfolio theories suggest that an investor's risk preference influences both the likelihood of one's holding of a risky asset and its portfolio share (conditional on holding). If Two Fund Separation Theorem works, the differences between portfolio choices lie in heterogeneity in risk preference (Levy and Sarnat (1984)). Based on the underlying theory, the holding of risky assets and their portfolio shares are widely adopted to infer risk attitudes. Friend and Blume (1975) use more than 2000 household portfolio (including financial, real estate, and human capital assets) observations, and confirm that investors express relative risk aversion; Cohn et al. (1975) employ the transaction records of individual investors in broker companies during 1964-1970, and contend that investors express diminishing relative risk aversion; Morin and Suarez (1983) and Riley and Chow (1992) use the same empirical strategy and find the diminishing magnitude of relative risk aversion is statistically and economically significant among high income households. Following the preceding literature, our focus in this paper is individual risk attitude towards financial decisions; hence we use household financial portfolio choices to proxy for risk attitude.

II.2. The Persistent Impact of Disaster Experience: Evidence from Biological and Psychological Studies

Biological and psychological studies document the persistent impact of traumatic experience in early life, especially psychological formative period (mainly refers to 3-18 years old).

First, early-life trauma is proved to have biological effects on brain and genome, which is the physical basis of the aforementioned persistent impact. Adverse experiences are proved to have changed individual nervous tissue and in turn one's emotion and risk attitude when making financial decisions (e.g., Kuhnen and Knutson, (2005); Knutson et al. (2008), Kuhnen and

Knutson, (2011), Guiso et al. (2011)). Empirically, Lyoo et al. (2011) utilize a sample of survivors from a South Korean subway disaster and show that disaster stricken individuals have higher dorsolateral prefrontal cortical thickness compared with the control group 1.42 years after the disaster. Dorsolateral prefrontal cortical controls stress disorder symptom reduction. Furthermore, evidence shows that early-life trauma causes epigenetic changes in the promoters of hippocampal neuron genes (e.g., Labont et al. (2012), Mehta et al. (2013)).

In addition to the preceding physical alternations, evidence suggests that early-life adverse experiences have probably the most prominent and persistent effects on individual behaviors. Using a sample of adult victims of childhood incest, Vietnam War veterans, and residents of two southern California communities devastated by fire, Holman and Silver (1998) argue that a tendency to focus on previous experiences is associated with high stress levels long after the trauma. Elder (1999) claims that individuals are most affected by seismic events in the early life.

Based upon literature reviews in this section, we conjure that early-life exposure to disasters have long-term prominent effects on one's psyche, neuron, and thus financial decision making.

II.3. Early-Life Exposure to Natural Disaster and Financial Decision

A growing body of literature investigates whether early-life experience shapes individual risk attitude. There are mainly two streams of literature, focusing on household investment decision and CEOs' financial strategy respectively.

The first strand of research on household investment decisions finds that past traumatic events lead to a more conservative risk attitude. Malmendier and Nagel (2011) use data from Survey of Consumer Finance during 1960-2007, and confirm that individuals who recently experienced a great depression express a low willingness to take financial risks (measured by the binary

variables of holding stocks or bonds). Bucciol and Zarri (2013) use data containing 4461 observations from the U.S. Health and Retirement Survey, and confirm the correlation between adverse experience and a higher degree of risk aversion as proxied by the likelihood of holding risky assets and share of wealth invested in the risky assets. In incentivized risk game experiments, residents with natural disaster experience are less likely to take financial risks than those without such experience; the effect persists long, especially when the disaster is severe (e.g., Cameron and Shah (2012)).

The second strand of research on CEO's financial strategy confirms the existence of CEO fixed effect. CEOs growing up and/or having career experience under an economic depression behave more conservatively, including lower book leverage, more cash assets, higher stock price volatility, more acquisitions and merges (e.g., Malmendier et al. (2011), Bernile et al. (2014)).

III. Background Information and Testable Hypothesis

III.1. The 1959-1961 Famine

Radical “socialism transformation”, including industrial nationalization and agricultural collectivization, was initiated after the foundation of People's Republic of China (P.R.C.) in the 1950s. During the transition, laborers worked in groups and were identically compensated regardless of production outcome. Also, production factors were allocated under central planning. During 1949-1958, gross agricultural production increased from 113.18 million tons to 197.66 million tons, with an annual growth rate of 6.4%²

² Source: Chinese Statistical Yearbook.

Unfortunately, the famine happened, caused by a broad set of coincident factors, including extreme climate, excessive government grain procurement, a tardy response to food shortage, weakened working incentives, and distorted factor allocation between industrial and agricultural sectors (e.g., Ashton et al. (1984), Peng (1987), Lin (1990), Lin and Yang (2000), Kung and Lin (2003)). The consequences of the famine hence are huge since all Chinese residents born before 1959 have experienced this famine:

The short-term effect of the famine is the change of households' investment-consumption decisions. Households squeeze their consumption and make more savings for the potential need of consumption smoothing. As Kane (1988) points out, propaganda of precautionary thoughts like "Dig Deep Cellar and Accumulate Grain" and "For the People: Prepare for War, Prepare for Famine" has profoundly influenced households' decisions. Compared to 1958, households' consumption dropped by 13.2% in 1960 and by 18.6% in 1961 after adjusted for inflation, which is shown in Figure 1.

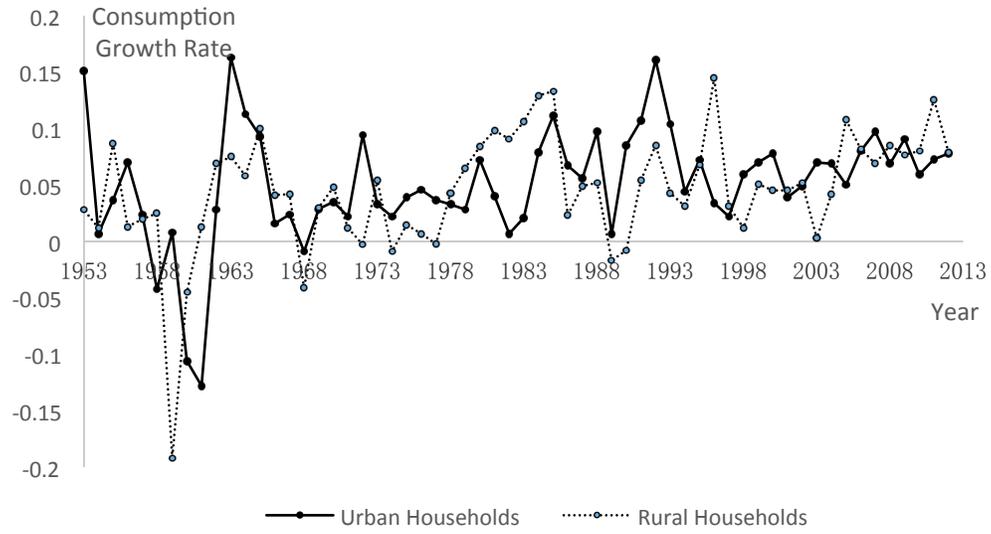
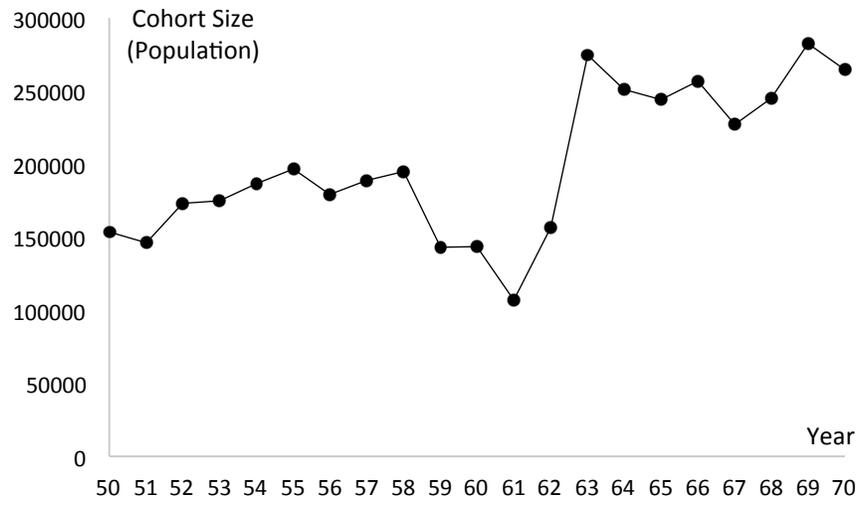


Figure 1: Consumption Decrease during Famine
 Data Source: Chinese Statistical Yearbook



*Figure 2: Cohort size by year of birth in China, 1950-1970
Data Source: China 1% Population Sample Survey (1982)*

Also, there are about 20-30 million excess deaths and 30 million lost/postponed births (e.g., Ashton et al. (1984)), causing population to decline drastically. All disasters, preceding or succeeding, pale when compared to the famine. Figure 2 depicts the population of famine cohorts (born in 1959-1961) and that of earlier and later cohorts (born in 1950-1958, 1962-1970) in China.

Despite those short-term effects, there are some long-term effects. First, the famine cohorts present socioeconomic characteristics of less satisfactory, including a shorter height, poorer literacy, lower labor market status, less wealth, worse marriage market outcomes (e.g., Chen and Zhou (2007), Almond et al. (2007)) even 40 years after the famine. Second, famine does affect household financial decisions. Harbaugh (2004) and Cheng and Zhang (2011) confirm that excess investing/saving motive greatly varies across cohorts: cohorts with famine experience in childhood tend to hold relatively more cash and deposits; the effect is more significant when famine is more severe. For instance, it is quite common for a famine stricken household to refuse to bear any potential risk³.

III.2. Financial Market and Household Finance in China

There are mainly two differences between Chinese and U.S financial markets. First, unlike retirement accounts in the U.S., retired individuals cannot choose the investment scheme of their own retirement accounts. The accounts are managed by government with strict regulation from the sovereign organ of China National People's Congress, providing retired individuals with quasi-fixed payments in their saving accounts. Thus wealth in retirement accounts is classified as

³ An example is given by the article mentioned in the introductory quote: Mr. Dang and his wife Zhang Fengxia, aged 52 (in 2008), set aside everything for potential medical costs. Asked whether Ms. Zhang would use a credit card if one were issued to her, she looked confused. 'What's a credit card?' she asked, adding, 'We have everything we need'.

a form of risk free deposit in most Chinese microeconomic survey datasets.

Second, Chinese bond market is underdeveloped. The risk of bonds is much lower than stocks that no default had ever happened till when the data used in our study was collected. Also, most bond transactions (corporate bonds, T-bills, CDS) are made by institutional investors. Gan et al. (2014) show that Chinese household bond market participation rate (0.77%) is far lower than that of stock market (8.84%). In CFPS, only 54 out of 15000 households have bought bonds. Table 1 presents a profile of household financial assets holding in China.

Table 1. Household financial portfolio Choice, A Comparison

	U.S.			China	
	2004	2007	2010	2010	
				Urban	Rural
Deposit and Saving Bonds	17.3	15.3	14.5	64.7	87.6
Bonds	5.3	4.1	4.4	na	na
Stocks	17.5	17.8	14.0	26.0	9.9
Pooled investment funds	14.6	15.8	15.0	9.3	2.5

Data Source: U.S. data from Bricker et al. (2012), Chinese data from CFPS calculated by author, household bond position is unavailable.

III.3. Testable Hypothesis

Based on the above analysis, we postulate that cohorts with famine experience in psychological formative period (famine cohort) will have a more conservative household financial decision. The testable hypotheses are, compared to other households, households whose heads experienced the famine during the psychological formative period have: (1) lower likelihood to participate in hold risky assets transaction; (2) lower share of risky assets in household financial portfolio conditional on participating; (3) the financial risk attitude divergence between famine stricken cohorts and other cohorts is larger when regional famine intensity is larger.

IV. Data and Empirical Strategies

IV.1. Data

We adopt data from China Family Panel Survey (CFPS) in 2010 and 2012 to construct variables on financial risk attitude and its contributors; population records from China 1% Population Sampling Survey in 1982 to construct variables on famine intensity.

The former dataset, CFPS, is a nationally representative longitudinal survey of Chinese households launched in 2010 by Peking University, China. The CFPS collects information biennially and focuses on financial assets, economic activities, education outcomes, family dynamics, migration, and demographic characteristics. In the 2010 survey, CFPS interviewed around 15,000 households and over 40,000 corresponding household members. Through a multi-stage probability sampling with implicit stratification, each subsample in the CFPS study is drawn through three stages: county level, then village level, then household.

During the follow-up survey in 2012, 85% of the families were successfully interviewed and an

individual level follow up rate of 82% were achieved. Considering that most rural households have limited access to financial institutions (rural credit collectives only) and have high transaction costs to invest in risky assets, we restrict our sample to urban households in the following econometric analysis.

The latter dataset, China 1% Population Sample Survey (1982), is launched by the State Council of China for timely documentation of demographic changes between two population censuses. The dataset covers 10 million observations. We then use this dataset to calculate the relevant severity of famine in each province.

CFPS 2010 and 2012 have 29117 year-household observations. After deleting household observations in rural area (18048), with no famine severity record (335), with no migration, health and job record (197), we finally have 10537 year-household observations { 5951 in 2010 and 4586 in 2012.

IV.2. Constructions of Variables

IV.2.1. Measure of Financial Risk Attitude

In CFPS, financial assets include deposits, stocks, pooled investment funds, bonds, and derivatives. To avoid measurement error introduced by misclassification of asset classes at different risk levels, we aggregate household financial portfolio information into two main categories: risk free (deposit and government bonds) and risky assets (stocks, funds, derivatives), similar to Bucciol and Zarri (2013). We do not take holding bond as a behavior of risky asset investment for both the rare participation of individual investors and non-existence of default. Following standard literature, we use observed portfolio choices as a proxy of financial risk attitude. Providing individual investors have more access to stocks and know their risk and

returns better compared to other types of risky assets, we follow Bucciol and Zarri (2013), using household stock investment records as another proxy.

We first focus on the act of holding risky assets (see eq.(1)-eq.(2)). We then turn to the share of risky assets in household financial portfolio (see eq.(3)-eq.(4)).

$$I_{\text{stock}} = I\{\text{Stocks} > 0\} \quad (1)$$

$$I_{\text{risky}} = I\{\text{Stocks} > 0 \text{ or } \text{Funds} > 0\} \quad (2)$$

$$\text{Portfolio Share in Stock (SS)} = \frac{\text{Stock}}{\text{Household Financial Wealth}} \quad (3)$$

$$\text{Portfolio Share in Risky Assets (RS)} = \frac{\text{Stock} + \text{Fund}}{\text{Household Financial Wealth}} \quad (4)$$

IV.2.2. Famine Experience

The effect of famine on household financial decisions is mainly through household head (i.e., individual who has final decision power on household financial portfolio choices). Based on household heads' age during famine, we group household heads into three cohorts: pre-psychological formative period, psychological formative period and post-psychological formative period, which is consistent with the existing classification (Cheng and Zhang (2011), Bernile, et al. (2014)). Table 2 presents the classification in detail.

Table 2. Cohort Groups

Cohort	Year of birth	Age during famine	Psychological Period	Proportion in the sample
Cohort 1	-1946	>12	Post formative	14.5%
Cohort 2	1947-1958	3-12	Formative	28.9%
Cohort 3	1958-	<3	Pre formative	56.6%

Table 3 reports all variables used in our analysis. Table 4 lists summary statistics on these variables.

IV.2.3. Measure of Famine Severity

An accurate and comparable measure of disaster intensity is hard to build. Many works use average frequency, fatality or property loss of disasters happening in individual birth place as a proxy of early-life disaster experience. But as Bernile et al. (2014) argues, such measure has measurement error since the stationarity of disaster occurrence may change one's evaluation of the cost of disaster risk⁴. Also, the measure may be subject to endogeneity bias since most studies neglect the existence of migration which is correlated with disaster occurrence. With a detailed record of individual migration, we construct a comparable and more accurate measure of disaster intensity.

Following Huang et al. (2010), we utilize county level demographic information from China 1% Population Sample Survey (1982) to derive a measure of famine severity at provincial level. From the perspective of demographic study, the consequence of the famine can be decomposed into lost and postponed birth, we define demographic reduction ratio (DR) as the average size of famine cohort (born in 1959-1961, $N_{famine} = (N_{1959} + N_{1960} + N_{1961})/3$) to average size of earlier and later cohorts (1956-1958 and 1962-1964, $N_{normal} = (N_{1956} + N_{1957} + N_{1958} + N_{1962} + N_{1963} + N_{1964})/6$) cohort. DR of province s captures the regional disparities in famine intensity. Figure 3 depicts regional demographic reduction ratio, suggesting the considerable regional disparities in famine severity (Cao, 2005; Chen and Zhou, 2007; Lin and Yang, 2000).

$$DR = (N_{normal} - N_{famine})/N_{normal} \quad (5)$$

⁴ For example, when a place is more vulnerable to natural disaster, local residents can cope with disasters more confidently and in turn tend to underestimate the cost of disaster risk and form higher risk tolerance.

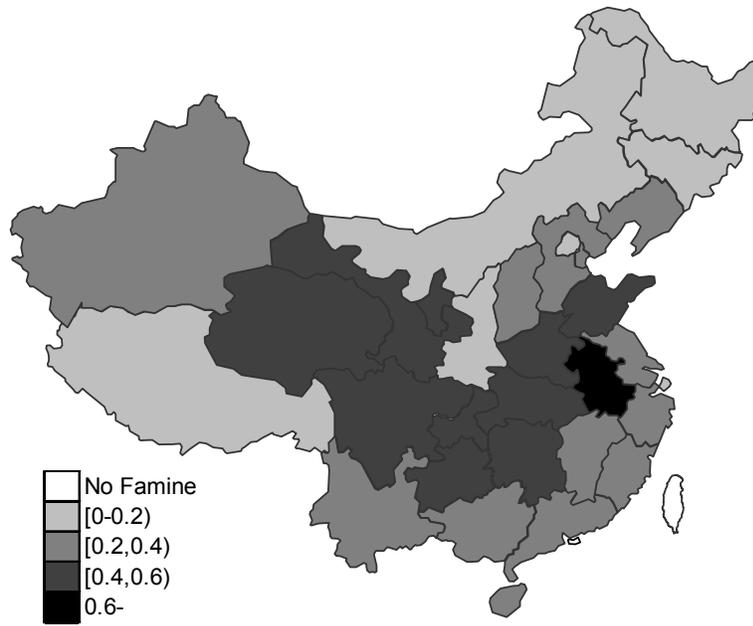


Figure 3: Regional Disparity of Demographic Reduction during Famine
Data Source: China 1% Population Sampling Survey (1982)

IV.3. Descriptive Statistics

Table 3 reports all variables used in our analysis. Table 4 lists summary statistics on these variables.

Table 3. Definition of Variables

Variable	Definition
Household financial portfolio Choice	
Stock holding (Istock)	Dummy for stock holding
Risky asset holding (Irisky)	Dummy for risky asset holding, including direct (stock) and indirect (fund) investment
Deposit share (DS)	Deposit share in the financial portfolio
Risky asset share (RS)	Share of direct (stock) and indirect (fund) investment in risky asset
Famine experience	
Cohort	Three dummy variables of cohort groups
Demographic reduction ratio (DR)	Famine years population reduction ratio (see eq.(7))
Demographic characteristics and idiosyncratic experience (household head)	
Male	Dummy variable for the gender of Household head, 1 for male, 0 for female
Education	Four dummy variables for college, senior middle school, junior middle school, and elementary school or below
Urban	Dummy variable for registered residence, 1 for urban, 0 for rural
Widowed	Dummy variable for marriage, 1 for widowed, 0 otherwise
Divorced	Dummy variable for marriage, 1 for separated or divorced, 0 otherwise
Self-assessed good health	Dummy for health status, 1 for self-assessed good or very good health status, 0 otherwise
Self-assessed average health	Dummy for health status, 1 for self-assessed average health status, 0 otherwise
Non watch-over time	Duration that parents did not watch over during 4-12 year old (in year)
Unemployment	Dummy for household head current employment, 1 for unemployment, 0 otherwise
Ln(Annual income)	Logarithm of household annual income in RMB
Number of layoffs	Number of family members who have layoff experience

Table 4. Summary Statistics

Variable	2010			2012		
	N	Mean	Std.Dev.	N	Mean	Std.Dev.
Istock	5951	0.089	0.285	4586	0.085	0.278
Irisky	5951	0.118	0.323	4586	0.121	0.326
SS	5480	0.043	0.175	4216	0.030	0.129
RS	5480	0.059	0.207	4216	0.048	0.165
DR	5951	0.318	0.150	4586	0.320	0.149
Cohort1	5951	0.105	0.307	4586	0.102	0.302
Cohort2	5951	0.354	0.478	4586	0.370	0.483
Cohort3	5951	0.541	0.498	4586	0.528	0.499
Male	5951	0.660	0.474	4586	0.667	0.471
Age	5950	50.40	13.41	4586	52.81	13.03
Education: elementary and below (control group)	5951	0.340	0.474	4586	0.353	0.478
Education: Junior Middle School	5951	0.330	0.470	4586	0.335	0.472
Education: Senior High School	5951	0.197	0.397	4586	0.190	0.392
Education: College and above	5951	0.134	0.340	4586	0.122	0.327
Annual income	5951	44490	58730	4586	55814	81934
Widow	5951	0.088	0.284	4586	0.078	0.268
Divorce	5951	0.057	0.232	4586	0.035	0.184
Household size	5951	3.393	1.506	4586	3.178	1.439
Self-assessed health: good	5951	0.441	0.497	4586	0.589	0.492
Self-assessed health: average	5951	0.412	0.492	4586	0.227	0.419
Self-assessed health: bad (control group)	5951	0.147	0.354	4586	0.184	0.388
Number of layoffs	5951	0.030	0.176	4586	0.031	0.179
Home owner	5951	0.777	0.417	4586	0.804	0.397

IV.4. Empirical Strategies

The famine is qualified to be taken as a natural experiment. Both the continuous agricultural production growth in pre-famine era and the rare coincidence of famine contributors make this famine unanticipated by households and hard to cope with for them. Also, provided the extreme special social context during the famine years, there exist little self-selection bias. As Chen and Zhou (2007) argue, the socioeconomic status of citizens were highly equalized after a set of political movement against the wealthier. The consequences of famine found in empirical studies are not supposed to be taken as the result of social economic status during the famine years. The most important, the famine was caused by inadequate policy and extreme climate to a large extent (e.g., Kane (1988)), there is no positive correlation between provincial famine severity and natural endowment (e.g., Meng et al. (2010)), strongly rejecting the alternative explanation either the different disaster occurrence probability or economic endowment divergence across regions leads to variations of individual economic decisions.

To achieve identification, we exploit the differences in portfolio choices both across regions (i.e., provinces stricken by famine at different levels) and across cohorts (i.e., cohorts that experience famine during the psychological formative period and those not). If the hypothesis is true, we expect DID estimator δ_2 (the coefficient of the interaction term between DR_s and cohort dummy of famine experience in the psychological formative period, $cohort_2$) to be significant with direction towards risk aversion ($\delta_2 < 0$). It is identical to say that, after the famine, household heads more intensely stricken by famine tend to make more conservative financial decisions. We set up the regression model as follows:

Based upon above discussions, we set up the regression model as follows:

$$y_{isc} = c + \sum_s \alpha_s dr_s + \sum_c \beta_c cohort_c + \sum_{c,s} \delta_i (cohort_c \times dr_s) + X_i \gamma_i + \epsilon_{isc} \quad (6)$$

where y_{ist} denotes the explained variable corresponding with household i whose head lived in province s during the psychological formative period⁵; DR_s is regional famine severity of province s ; $cohort_i$ is cohort of household head as classified in Table 2; DR_s is the demographic reduction ratio in province s ; X_i is control variables of household i capturing socio-demographic features, idiosyncratic experience that may affect risk attitude; c is interception term and ϵ_{ist} is stochastic disturbance.

We first look into the famine's impact on the extensive margin using indicator variables $Istock$ and $Irisky$ as explained variables and Probit model to achieve estimation. We then look into the famines' impact on the intensive margin using continuous variables SS and RS as explained variables and Tobit model to achieve estimation since SS and RS are censored at 0. Also, considering the fact that observations within one province may have intra-group correlation, we report provincial level cluster robust standard errors.

⁵ We use household head resident place at 3 in baseline regressions. 85% of household heads do not migrant during psychological formative period. Also, if we use household head resident place at the age of 12 to redo the regression, the result is consistent with what we find.

V. Results

This section reports our main empirical results.

V.1. Baseline Regression

V.1.1. Holding of Risky Assets

Table 5 and Table 6 report the determinant of stocks holding and risky assets holding in household financial portfolio. The results suggest that famine in the psychological formative period depresses the holding probability of individual investors. The samples in the two tables are Cohort2 and Cohort3. Column (1) and column (3) controls only DR, Cohort, and their interaction term. Column (2) and column (4) control a broader set of variables. The coefficient of $\text{cohort2} \times \text{DR}$ is significantly negative, suggesting that famine experience during the psychological formative period depresses household investment in risky assets. The results hold for various household socio-demographic features.

Table 5. Famine Experience and Holding of Stocks

	2010		2012	
	(1)	(2)	(3)	(4)
DR	-0.557 (0.941)	-0.124 (0.725)	-0.622 (0.911)	-0.139 (0.666)
Cohort2	0.230* (0.135)	0.142 (0.149)	0.236 (0.149)	0.235 (0.147)
Cohort2× DR	-1.426*** (0.410)	-1.024** (0.445)	-1.355*** (0.498)	-1.318** (0.517)
Male		-0.207*** (0.064)		-0.272*** (0.058)
Age		0.090** (0.035)		0.047* (0.027)
Age ²		-0.001** (0.000)		-0.000 (0.000)
Education: junior middle School		0.387*** (0.136)		0.518*** (0.079)
Education: Senior high school		0.814*** (0.120)		0.813*** (0.069)
Education: Collage and above		1.128*** (0.123)		1.216*** (0.096)
Ln(annual income)		0.441*** (0.047)		0.448*** (0.030)
Widow		-0.346*** (0.118)		-0.299** (0.130)
Divorce		-0.110 (0.099)		-0.363** (0.153)
Household size		-0.087*** (0.029)		-0.057** (0.028)
Self-assessed health: good		0.035 (0.115)		0.039 (0.070)
Self-assessed health: average		0.185** (0.078)		0.165** (0.073)
Number of layoffs		0.080 (0.161)		-0.140 (0.164)
Home owner		0.005 (0.086)		0.040 (0.074)
Constant	-1.091*** (0.392)	-8.449*** (1.031)	-1.115*** (0.369)	-7.922*** (0.588)
Log-likelihood	-1626.33	-1322.83	-1196.47	-991.23
N	5326	5326	4120	4120

Note: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Holding of Risky Assets

	2010		2012	
	(1)	(2)	(3)	(4)
DR	-0.588 (0.883)	-0.172 (0.680)	-0.583 (0.786)	-0.176 (0.542)
Cohort2	0.248* (0.145)	0.192 (0.129)	0.343*** (0.133)	0.307** (0.131)
Cohort2× DR	-1.499*** (0.408)	-1.019** (0.444)	-1.607*** (0.477)	-1.592*** (0.553)
Male		-0.221*** (0.072)		-0.263*** (0.048)
Age		0.083** (0.036)		0.041** (0.021)
Age ²		-0.001** (0.000)		-0.000 (0.000)
Education: junior middle School		0.455*** (0.088)		0.508*** (0.078)
Education: Senior high school		0.876*** (0.108)		0.820*** (0.098)
Education: Collage and above		1.174*** (0.082)		1.316*** (0.122)
Ln(annual income)		0.495*** (0.047)		0.406*** (0.032)
Widow		-0.313* (0.166)		-0.117 (0.096)
Divorce		-0.102 (0.069)		-0.339* (0.187)
Household size		-0.093*** (0.025)		-0.012 (0.019)
Self-assessed health: good		0.103 (0.099)		0.039 (0.058)
Self-assessed health: average		0.212** (0.083)		0.118** (0.057)
Number of layoffs		0.151 (0.134)		-0.281 (0.202)
Home owner		0.033 (0.087)		0.074 (0.081)
Constant	-0.911** (0.363)	-8.694*** (1.061)	-0.931*** (0.314)	-7.332*** (0.534)
Log-likelihood	-1967.43	-1569.98	-1519.29	-1260.56
N	5326	5326	4120	4120

Note: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

V.1.2. Share of Risky Assets

Table 7 and Table 8 report the determinant of risky assets share in household financial portfolio. The samples in the two tables are Cohort2 and Cohort3. Column (1) and column (3) controls only DR, Cohort, and their interaction term. Column (2) and column (4) control a broader set of variables. The coefficient of cohort2×DR is significantly negative, suggesting that famine experience during the psychological formative period depresses household investment in risky assets. The results hold for various household socio-demographic features.

Table 7. Famine Experience and Share of Stocks in household financial portfolio

	2010		2012	
	(1)	(2)	(3)	(4)
DR	-0.358 (0.908)	0.065 (0.634)	-0.359 (0.572)	-0.011 (0.394)
Cohort2	0.427*** (0.139)	0.358** (0.151)	0.180* (0.104)	0.199** (0.101)
Cohort2× DR	-2.313*** (0.454)	-1.614*** (0.434)	-0.900** (0.375)	-0.781** (0.359)
Male		-0.198** (0.089)		-0.159*** (0.039)
Age		0.106*** (0.030)		0.030 (0.019)
Age ²		-0.001*** (0.000)		-0.000 (0.000)
Education: junior middle School		0.378** (0.147)		0.311*** (0.070)
Education: Senior high school		0.840*** (0.132)		0.499*** (0.090)
Education: Collage and above		1.058*** (0.116)		0.752*** (0.118)
Ln(annual income)		0.398*** (0.031)		0.278*** (0.034)
Widow		-0.430*** (0.155)		-0.220* (0.128)
Divorce		-0.137 (0.124)		-0.226** (0.102)
Household size		-0.100*** (0.027)		-0.024 (0.020)
Self-assessed health: good		0.055 (0.113)		0.041 (0.048)
Self-assessed health: average		0.154* (0.085)		0.127** (0.055)
Number of layoffs		0.102 (0.153)		-0.128 (0.125)
Home owner		0.067 (0.107)		0.038 (0.057)
Constant	-1.439*** (0.469)	-8.421*** (0.673)	-0.896*** (0.335)	-5.076*** (0.420)
Log-likelihood	-1458.21	-1218.24	-1065.29	-891.17
N	4909	4909	3797	3797

Note: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8. Famine Experience and Share of Risky Assets in Household Financial Portfolio

	2010		2012	
	(1)	(2)	(3)	(4)
DR	-0.405 (0.850)	-0.018 (0.594)	-0.383 (0.536)	-0.052 (0.349)
Cohort2	0.465*** (0.146)	0.407*** (0.126)	0.253** (0.101)	0.210** (0.094)
Cohort2× DR	-2.426*** (0.411)	-1.625*** (0.389)	-1.146*** (0.360)	-0.992*** (0.352)
Male		-0.198*** (0.074)		-0.159*** (0.032)
Age		0.085** (0.034)		0.023* (0.014)
Age2		-0.001** (0.000)		-0.000 (0.000)
Education: junior middle School		0.472*** (0.112)		0.313*** (0.077)
Education: Senior high school		0.887*** (0.133)		0.526*** (0.116)
Education: Collage and above		1.116*** (0.113)		0.844*** (0.138)
Ln(annual income)		0.410*** (0.032)		0.261*** (0.025)
Widow		-0.367* (0.192)		-0.016 (0.074)
Divorce		-0.164* (0.085)		-0.252** (0.109)
Household size		-0.087*** (0.022)		-0.004 (0.016)
Self-assessed health: good		0.085 (0.093)		0.036 (0.040)
Self-assessed health: average		0.158** (0.080)		0.104*** (0.039)
Number of layoffs		0.132 (0.110)		-0.185 (0.142)
Home owner		0.052 (0.096)		0.045 (0.064)
Constant	-1.203*** (0.397)	-7.895*** (0.895)	-0.772*** (0.299)	-4.729*** (0.441)
Log-likelihood	-1814.95	-1498.55	-1394.85	-1165.95
N	4909	4909	3797	3797

Note: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

V.2. Marginal Effects in Nonlinear Models

To quantify the importance of famine experience, we calculate the average marginal effect of famine intensity based on the baseline results: the holding likelihood and portfolio share decrement of risky assets when famine severity (DR) increases 10%.

V.2.1. Holding of Risky Assets

When famine severity increases 10%, the probability decrement of holding risky assets for Cohort2 is:

$$\begin{aligned} E(P(y_{ist}=1)|Cohort_2=1, \bar{X}_i, \overline{DR}_s+10\%) - E(P(y_{ist}=1)|Cohort_2=1, \bar{X}_i, \overline{DR}_s) \\ = \Phi(c + \alpha_s(\overline{DR}_s+10\%) + \beta_2 + \delta_2(\overline{DR}_s+10\%)) + X_i\gamma_i - \Phi(c + \alpha_s\overline{DR}_s + \beta_2 + \delta_2\overline{DR}_s) + \bar{X}_i\gamma_i \end{aligned}$$

Table 9 reports the estimate, standard error, p value of hypothesis test, and percentile change of the marginal effect. For Cohort2, when famine intensity increases 10% at means, the holding likelihood of risky assets decreases 9.70%-15.06%. The results confirm Hypothesis (1) and (3).

Table 9. The Famine's Average Marginal Effects on Stocks Holding and Stocks Share

	2010		2012	
	Stocks	Risky Assets	Stock	Risky Assets
Average Marginal Effects	-0.009	-0.013	-0.009	-0.018
Standard Errors	0.005	0.006	0.003	0.006
P-value (H_0 : Average Marginal Effects=0)	0.116	0.051	0.003	0.001
Participation Rate (whole sample)	0.089	0.118	0.085	0.121
Proportional change =Average Marginal Effects/Participation Rate	9.70%	10.78%	11.7%	15.06%

Table 10. The Famine's Average Marginal Effects on Risky Assets Holding and Risky Assets Share

	2010		2012	
	Stocks	Risky Assets	Stock	Risky Assets
Average Marginal Effects	-0.019	-0.022		-0.010
Standard Errors	0.008	0.008		0.006
P-value (H_0 : Average Marginal Effects=0)	0.025	0.004		0.065
Participation Rate (whole sample)	0.043	0.059		0.030
Proportional change =Average Marginal Effects/Participation Rate	44.71%	37.70%		35.21%

VI. Robustness Check

VI.1. Validity of DID Model

Following Chen and Zhou (2007), we test the validity of DID model. If the effect of famine during formative period (namely the coefficient of “cohort2× DR”) is caused by omitting variable, famine severity will still affect the control group (cohorts born after 1958) though they do not experience the famine.

We group the households whose head is born after 1958 into four equal divided cohorts: 1959-1969, 1969-1979 (c70), 1979-1989 (c80), and 1989-1999 (c90, reference group). We redo the regression and the result is in Table 11. It strongly supports the fact that factors correlated with famine experience in early-life but omitted do not affect the control group. The result support the robustness of our DID model.

Table 11. Validity of DID Estimate

	2010				2012			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Istock	Irisky	SS	RS	Istock	Irisky	SS	RS
DR	0.221 (0.834)	0.240 (0.840)	0.567 (0.955)	0.241 (1.006)	-0.172 (1.070)	-0.006 (0.941)	-0.130 (0.648)	-0.198 (0.609)
c70	0.586 (0.363)	0.906*** (0.285)	0.629** (0.293)	0.757*** (0.251)	0.371 (0.313)	0.783** (0.327)	0.180 (0.241)	0.359 (0.276)
c70×DR	-1.120 (0.911)	-0.904 (0.805)	-1.267 (0.994)	-0.746 (0.859)	-0.668 (0.773)	-0.662 (0.808)	-0.174 (0.518)	-0.050 (0.490)
c80	0.025 (0.330)	0.452 (0.283)	0.090 (0.345)	0.348 (0.288)	-0.357 (0.371)	0.133 (0.394)	-0.144 (0.284)	0.041 (0.336)
c80×DR	0.547 (1.063)	0.124 (0.932)	0.373 (1.303)	0.323 (1.092)	1.184 (1.160)	0.546 (0.916)	0.638 (0.715)	0.467 (0.631)
Log-likelihood	-843.41	-995.93	-793.96	-973.40	-602.38	-754.13	-538.78	-701.74
N	3218	3218	2987	2987	2423	2423	2263	2263

Note: This table presents the average marginal effects estimates. Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, We also add the same control variables in the regression. The result is not reported for the space limitation.

VI.2. Total Financial Wealth and Famine Experience

Is it possible that the previous finding is due to famine stricken individuals less actively engaged in financial investing? We redo baseline regression using same explaining variables, excluding zero financial wealth observations.

Table 12. Total Financial Wealth and Famine Experience

	2010				2012			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Istock	Irisky	SS	RS	Istock	Irisky	SS	RS
DR	-0.101 (0.767)	0.084 (0.601)	-0.164 (0.717)	-0.016 (0.550)	-0.139 (0.666)	-0.176 (0.542)	-0.011 (0.394)	-0.052 (0.349)
Cohort2	0.033 (0.165)	0.263* (0.152)	0.075 (0.149)	0.303** (0.131)	0.235 (0.147)	0.307** (0.131)	0.199** (0.101)	0.210** (0.094)
Cohort2×DR	-0.967* (0.507)	- 1.482*** (0.468)	-0.961* (0.540)	- 1.475*** (0.428)	- 1.318** (0.517)	- 1.592*** (0.553)	- 0.781** (0.359)	- 0.992*** (0.352)
Log-likelihood	- 1127.01	-1042.52	- 1296.89	-1251.33	-991.23	-1260.56	-891.17	-1165.95
N	2890	2473	2890	2473	4120	4120	3797	3797

Note: This table presents the average marginal effects estimates. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

VI.3. Measure of Famine Severity

Before Huang et al. (2010), most studies use excess death rate (EDR) provided in Lin and Yang (2000) as the proxy of famine severity. We use it as proxy of famine severity for robustness.

$$\text{EDR} = \text{average death rate (1959-1961)} / \text{average death rate (1956-1958 \& 1962-1964)}$$

The results are in Table 13. It shows that all are consistent with prior findings. Only column (1) is not statistically significant with direction identical to previous findings ($t=-1.47$).

Table 13. Excess Death Rate as Proxy of Famine Severity

	2010				2012			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Istock	Irisky	SS	RS	Istock	Irisky	SS	RS
EDR	-0.026 (0.018)	-0.029* (0.016)	-0.020 (0.016)	-0.022 (0.015)	-0.026 (0.017)	-0.029** (0.014)	-0.016* (0.008)	-0.019** (0.008)
cohort2	-0.034 (0.045)	-0.015 (0.039)	-0.043 (0.052)	-0.025 (0.043)	-0.034 (0.046)	-0.017 (0.031)	-0.021 (0.030)	-0.006 (0.019)
cohort2 ×EDR	-0.025 (0.029)	-0.031 (0.026)	-0.044* (0.023)	-0.047** (0.019)	-0.042* (0.025)	-0.059** (0.025)	-0.025 (0.016)	-0.033** (0.014)
ll	(0.438)	(0.440)	(0.426)	(0.387)	(0.517)	(0.552)	(0.362)	(0.354)
N	-1429.99	-1689.24	-1332.59	-1625.71	-1076.76	-1361.94	-971.45	-1263.50
	5950	5950	5479	5479	4586	4586	4216	4216

*Note: This table reports average marginal effects estimates. Standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. We also add the same control variables in the regression. The result is not reported for the space limitation.*

VII. Conclusion

Using the nationwide great famine in China in 1959-1961 as a natural experiment, we identify the importance of early-life disaster in individual risk attitude heterogeneity. We use household financial portfolio choices as the proxy of household risk attitude. After controlling both common traumatic experience of great famine and individual idiosyncratic experience in early-life, we show that households whose head had famine experience during psychological formative period tend to make a more conservative financial decision. Our results support natural disaster induced risk attitude divergence hypothesis and survive various robustness checks.

VIII. References

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