Front. Econ. China 2021, 16(1): 105–123
DOI 10.3868/s060-013-021-0005-8

RESEARCH ARTICLE

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Can Health Savings Accounts Reduce Health Spending? Evidence from China

Abstract Health care costs are high and continue to rise in most major economies, and the health savings account (HSA) is often viewed as an appealing way to contain health care costs because it can potentially solve the moral hazard spending caused by traditional health insurance. This study uses data from the China Household Finance Survey (CHFS) to empirically examine the effectiveness of HSAs in containing medical expenses and reducing moral hazard. The findings show that HSAs that restrict the use of funds may lead enrollees to discount the value and thus spend more on health care. In addition, the positive effect of HSAs on medical expenses is larger for the relatively healthier group, which may suggest that moral hazard exists regarding the use of HSA funds. The empirical estimates of the HSA effect on medical expenses are robust when a set of covariates are controlled, and HSA balances are instrumented using housing savings account balances.

Keywords health savings accounts (HSAs), medical expenses, risk behavior, China
JEL Classification I13, I12, I18, I14, J1

1 Introduction

It is common knowledge that health care costs in most major economies are high and have been rising over time.[1] Economists have long argued that an important cause of the high and rising health care costs is increased health insurance coverage, which reduces the implicit price of health care facing insured

[1] For example, see An et al. (2016).

Received May 14, 2020

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individuals, and thus encourages them to overuse health care.[2] The traditional theory of "moral hazard" suggests that patients with health insurance only need to pay a part of their health cost and see the health services they receive as "cheaper," and therefore overuse them, causing health care costs to rise. Some research has suggested that health savings accounts (HSAs) can potentially solve this "moral hazard" problem in the traditional health insurance, and thus lower medical expenses (Dixon, 2002; Prescott and Nichols, 1998; Schieber, 1997). When patients need to pay for health care out of their own private health saving accounts, they will probably reduce their demand for health services and look for competitive prices among health care providers, thereby lowering health care costs. Policy makers also expect HSAs to contain health care costs and serve as an efficient cost-saving instrument. A large body of work suggests that HSAs can improve the efficiency of insurance, increase consumer choice, and reduce health care expenditure (Buttler, 1999; Goodman and Musgrave, 1992; Pauly et al., 1995; Porter, 1999; Ramsay, 1998; Sharma, 1998; Yu-Tzu, 1999). However, some HSA critics have argued that HSAs could cause adverse selection, reduce equity, result in cost inflation, and deter necessary utilization (Hurley, 2001; Manitoba Centre for Health Policy, 2000; Moon et al., 1997).

Do HSAs really lower medical expenses? What are their empirical effects? There are only a few empirical studies that address these questions. Barr (2001) finds no evidence of HSAs restraining health costs in Singapore, and Fan et al. (2016) find that HSAs have a positive effect on medical expenses in the 30s' age group. Generally, there are limited studies that investigate the effect of HSAs on containing health care costs, especially in developing countries.

This study empirically examines the HSA effect on health spending behaviors using data from the China Household Finance Survey (CHFS). The results show that HSA enrollees in China generally incur approximately 16 yuan more medical expenses per 1,000 yuan increase in their HSA balances; whereas, there is no significant after-tax income effect on medical expenses. The findings suggest that individuals may discount their assets in the HSAs and then tend to spend more on medical services. This result is robust when covariates are added, when HSA balances are instrumented using housing savings account balances, and when the difference in differences (DID) estimation is used. The effect is most pronounced for individuals with the highest income, relatively better health

[2] Finkelstein (2007), Zhao (2014), and among others.

status, and higher risk-aversion. In addition, the study finds that individuals' preferences towards risks is an important factor that influences their medical spending behaviors. The study uses three types of risk behaviors as proxies: wearing seat belts, obeying traffic signals, and investing in risky projects in a hypothetical scenario. Always using a seat belt and obeying traffic signals are associated with 16% and 22% higher medical expenses, respectively.

This study provides empirical evidences of the efficiency of the HSAs to the existing literature. These findings suggest that HSAs may not be a good solution to the social health care expenditure crisis and moral hazard problems. They also suggest that policy makers should be cautious when their main purpose for introducing HSAs is to contain medical expenses.

This study also contributes to the literature on the relationship between risk type and health insurance choices. The conventional wisdom says that high risk individuals are more likely to purchase insurance because they expect to have higher medical expenses. This correlation between risk and insurance coverage is typically called "adverse selection." However, some studies argue that there may be a reversed relationship between risk type and insurance coverage if individuals with higher risk-aversion are more likely to purchase insurance and simultaneously they are less likely to engage in risky behavior and thus have fewer medical expenses.[3] This reversed relationship is often referred to as advantageous selection.[4] An important assumption required in the theory of advantageous selection is that individuals with higher risk aversion face lower medical expense risks. This study presents empirical evidence from China under the HSA scheme that risk-averse individuals can even have higher medical expenses. This is probably because China's HSAs are mandatory, and individuals with higher income will have more assets in their HSAs and are likely to spend more out of it. In addition, based on the findings involving risk attitudes, it is

[3] Hemenway (1990, 1992), de Meza and Webb (2001), and Jullien et al. (2006), among others.

[4] There are a significant number of studies examining the importance of advantageous selection in various insurance markets. Finkelstein and McGarry (2006) find that consumers may purchase insurance for reasons related to preferences and that individuals with long-term health care insurance are more likely to engage in preventive behaviors. Cutler et al. (2006) discover that individuals who engage in risk behaviors or who do not take measures to reduce risk are systematically less likely to hold insurance products. Fang et al. (2008) show that advantageous selection exists in the Medigap market in the United States and suggest that advantageous selection could be driven by multiple factors. Buchmueller et al. (2013) study the private health insurance market in Australia and find no evidence of a positive correlation between risk and the level of insurance coverage.

likely because risk-averse individuals are likely to use more preventive health care services under HSA schemes.

2 HSAs in China

The Chinese government adopted the Singaporean HSA model for its urban areas in the 1990s as a major tool to finance health care in these areas. China's health insurance system features individual HSAs and a Social Risk-Pooling (SRP) fund financed by joint contributions from employers and employees (Liu et al., 2002). Whereas there are certain minor variations in policy design across different areas, the whole country shares common key features regarding health insurance policies that are established by government guidelines.

China's general HSA structure is illustrated in Figure 1. The employer and employee jointly contribute a fixed percentage (3.8%) of the employee's wage to the employee's personal HSA. In addition, 4.2% of the wage goes into the SRP fund, which is used to cover large medical expenses including inpatient hospital costs. The fixed contribution ratios are universal to all employees, and the mandatory contributions are deducted directly from the payroll. HSA funds earn the same interest as bank savings accounts but is restricted to cover the employee's own medical expenses. In addition, they cannot be cashed out.

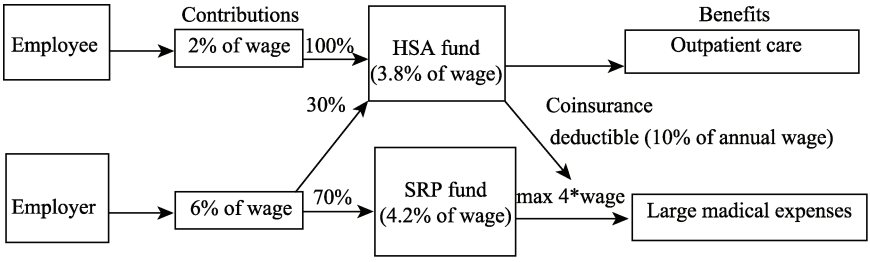

Figure 1 China's General HSA Structure

Enrollees are expected to use their HSA funds to pay all outpatient medical expenses until the funds are depleted.

3 Data

This study uses individual-level data from the CHFS, a nationally representative survey in China with detailed information on housing, assets, income,

expenditures, and social and commercial health insurance. Specifically, the first wave of the CHFS survey conducted in the summer of 2011 was used. The survey meets all appropriate ethical guidelines.

The sample size is 29,324 individuals and 8,438 households. Table 1 presents the key summary statistics. The variables include monthly medical expenditure, monthly income, health insurance, health savings accounts, measure of risk behavior, self-reported health status, and other demographic variables. This sample includes 25 provinces (municipalities, autonomous regions), and the sample distribution is presented in Table 2. Among the 25 provinces (municipalities, autonomous regions), there are some variations in the observations for each province, but generally speaking, there is very few

Table 1 Summary Statistics of the 2011 Sample

Variable	2011
Average age (years)	38
Male	51%
Married	77%
Average self-reported health status (1–5)	2.64
Participants with HSA	60%
Medical expenses (yuan)	
Average HSA balance	1,322.11
Average monthly OOP medical expenses	216.68
Average monthly after-tax income	2,171.77
Average monthly personal care expenses (not covered by insurance)	119.70
Behavior	
Percentage of car drivers	30%
Percentage of car drivers always using a seat belt	60%
Percentage always obeying traffic lights	80%
Percentage choosing to undertake no risky investments	41%
Percentage choosing to invest in the riskiest projects	7%
N	29,324

Note: Self-reported health status is a categorical variable that takes a value from 1 to 5 that indicates an individual's self-reported physical condition compared with peers. A very good condition is rated 1 and a very poor condition is rated 5. Personal care expenses are individual spending on personal care not covered by insurance (e.g., dietary supplements and massages).
Source: CHFS.

Table 2 Distribution of the Provinces/Municipalities/Autonomous Regions of the 2011 Sample

Province/Municipality/ Autonomous Region	Obs.	Percent	Province/Municipality/ Autonomous Region	Obs.	Percent
Beijing	1,004	3.42	Henan	2,468	8.42
Tianjin	548	1.87	Hubei	2,340	7.98
Hebei	1,331	4.54	Hunan	1,829	6.24
Shanxi	753	2.57	Guangdong	3,031	10.34
Liaoning	930	3.17	Guangxi	324	1.1
Jilin	942	3.21	Chongqing	642	2.19
Heilongjiang	1,262	4.3	Sichuan	995	3.39
Shanghai	1,484	5.06	Guizhou	332	1.13
Jiangsu	1,503	5.13	Yunnan	899	3.07
Zhejiang	1,812	6.18	Shaanxi	341	1.16
Anhui	1,369	4.67	Gansu	830	2.83
Jiangxi	695	2.37	Qinghai	315	1.07
Shandong	1,345	4.59	Total	29,324	100

Source: CHFS.

observations for outlying province. To examine how risk preference is related to medical expenditure, three measures of risk behaviors that are likely to capture individual risk aversion are used as proxies for risk tolerance: (1) seat belt use, (2) traffic signal obeyance, and (3) attitude toward investing in risky projects. Regarding (3), the respondents are asked a hypothetical question: If they are given an asset, which investment would they choose from five different risk levels? The attitude toward risky investment is a categorical variable that takes a value from 1 to 5, indicating the increasing risk and return of the investment. The dependent variable is monthly out-of-pocket (OOP) medical expenditure, defined as the total medical expenditure minus the portion covered by private health insurance plans.[5] OOP medical expenditure is the cost that consumers are most concerned with and must pay from either their HSAs or after-tax income. Table 1 shows that, on average, 30% of people drive cars, 60% of these drivers report always wearing a seat belt, and 80% report always obeying traffic signals. Further, 41% of people choose not to invest in risky projects, and 7% choose to

[5] Private health insurance plans are not common in China. Only 476 individuals in the sample have such plans.

invest in the riskiest projects.

4 Method

First, I estimate the following equation to study how HSAs affect OOP spending on medical care:

$$OOP\_Medical\_Expense_i = \beta_1 + \beta_2 HSAbalance_i + \beta_3 X_i + \varepsilon_i, \quad (1)$$

where *OOP_Medical_Expense* is the cost of the medical services that an individual must pay from either his HSA or after-tax income. *HSAbalance* is the balance in the individual's HSA. *X* is a set of control variables, which include the individual's after-tax income, self-reported health status, and other demographic variables such as age, education level, marital status, and gender. In addition, spending behaviors are analyzed using different income and self-reported health status subgroups.

Next, this study examines whether risk preference influences medical spending. Risk tolerance is proxied using three behaviors that are likely to capture individual risk aversion: seat belt use, traffic signal obeyance, and attitude toward investment in risky projects. The following equation is estimated to examine the relationship between risk behaviors and medical expenses:

$$OOP\_Medical\_Expense_i = \beta_1 + \beta_2 Behavior_i + \beta_3 X_i + \varepsilon_i, \quad (2)$$

where *OOP_Medical_Expense* is the cost of the medical services that an individual must pay from either his HSA or after-tax income. *Behavior* measures risk tolerance and refers to one of the three risk behaviors. *X* represents the covariates, which include the individual's after-tax income, self-reported health status, and other demographic variables.

In the sample, approximately 40% of individuals are without an HSA, probably because their employers did not set up an HSA for them,[6] they are unemployed, or they reside in rural areas. To investigate whether HSAs affect medical expenses differently for individuals with heterogeneous preference, the DID method is employed:

$$OOP\_Medical\_Expense_i = \beta_1 + \beta_2 Behavior_i + \beta_3 HSA_i + \beta_4 (Behavior * HSA)_i + \beta_5 X_i + \varepsilon_i, \quad (3)$$

[6] The Chinese government has been extending HSAs to all urban employers including the self-employed and private business owners in selected pilot urban areas since 2007.

where *OOP_Medical_Expense* is the cost of the medical services that an individual must pay from either his HSA or after-tax income. *Behavior* is a measure of risk tolerance and refers to one of the three risk behaviors. *HSA* is a dummy variable that identifies individuals with or without HSAs. *X* represents covariates, which include the individual's after-tax income, self-reported health status, and other demographic variables.

5 Results

5.1 Real Medical Expenses under the HSA Scheme

This study examines how HSA balances affect OOP spending on health care when controlling for a set of covariates including after-tax incomes. Table 3 reports results from the OLS regression (equation 1) for HSA enrollees. The dependent variable is OOP medical expenditure, and the key independent variable is HSA balance. In addition, after-tax income, self-reported health status, gender, age, marital status, education level, and ethnicity are controlled in the regressions.

In column (1) of Table 3, I find that HSA enrollees incur approximately 16 yuan more medical expenses per 1,000 yuan increase in their HSA balances; whereas, there is no significant after-tax income effect on medical expenses. It is important to note that HSA balance has a larger and more significant effect on medical expenses than income. This result suggests that enrollees may discount their funds in HSAs and tend to overspend on medical services using their HSA funds.

Column (2) of Table 3, adds self-reported health status to control for individual health characteristics. Without controlling for individual health status, the empirical specification suffers the endogeneity problem because individual health characteristics could be correlated with both medical expenses and HSA balances. However, the HSA balance effect remains similar after including self-reported health status as a control variable. This can be because self-reported health status does not capture individual health characteristics well. It is well known that using self-reported health status to measure health status, raises questions about whether it is categorical and subjective.[7]

[7] Hosseini et al. (2019a, 2019b) discuss the potential issues with regard to self-reported health status as a measure of health.

Table 3 Impacts of HSA Balance and After-Tax Income on OOP Medical Expenses

Variable	(1)	(2)	(3)	(4)	(5)
HSA balance	0.016*	0.017*	0.017*	0.017*	0.016*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
After-tax income	0.0009	–0.0008	–0.0008	–0.0008	–0.0010
	(0.0007)	(0.0007)	(0.0006)	(0.0007)	(0.0015)
Gender	25.942	20.320	20.196	20.070	25.296
	(28.375)	(27.006)	(26.358)	(26.611)	(31.067)
Age	0.926	0.112	0.129	0.103	0.245
	(1.011)	(1.221)	(1.145)	(1.150)	(2.05)
Marital status	5.716	5.360	5.357	5.737	3.089
	(18.670)	(18.602)	(18.608)	(18.608)	(15.039)
Education level	–14.995	–15.405	–15.642	–15.639	–25.541
	(9.999)	(10.034)	(9.572)	(9.821)	(15.520)
Ethnicity	–0.254	–0.233	–0.249	–0.207	–0.893
	(1.256)	(1.228)	(1.314)	(1.372)	(1.583)
Self-reported health status		43.975*	44.074*	44.401*	40.530**
		(23.122)	(23.612)	(23.691)	(16.893)
Consumption attitude			–2.523	–2.560	–2.238
			(1.892)	(1.912)	(2.019)
Personal care expenses				–0.002	–0.001
				(0.003)	(0.004)
IV for HSA balance	No	No	No	No	Yes
Province effect	Yes	Yes	Yes	Yes	Yes

Note: 1. Dependent variable: OOP medical expenses. 2. The table reports result from OLS regressions for individuals with HSAs. N = 6,294. The dependent variable is OOP medical expenses, which consumers are concerned with and must pay from their HSA savings or pocket money (unit: yuan). Self-reported health status is a categorical variable that takes a value from 1 to 5 that indicates an individual's self-reported physical condition compared with peers (see the note of Table 1). Consumption attitude is a categorical variable that takes a value from 1 to 5, indicating an individual's willingness to spend more as the value of assets rises. In this regard, 1 denotes "very willing" and 5 "very unwilling." For personal care expenses, see the note of Table A1. Standard errors shown in parentheses for OLS regressions are robust and clustered by province in all specifications. * and ** indicate significance at the 10% and 5% levels, respectively.

Source: CHFS 2011.

Column (3) of Table 3, also controls for consumption attitude. Consumption attitude is treated as a categorical variable ranging from 1 to 5 to indicate an individual's willingness to spend more when the value of an asset rises. The estimation results show that individuals who are very willing to spend tend to have more medical expenses in the HSA context. Column (4) of Table 3, controls for personal care expenses, namely those personal care expenses that insurance does not cover. The estimates suggest that individuals who spend more on personal care have less OOP medical expenses.

It is important to note that the key independent variable, HSA balance, may also suffer from the endogeneity problem. Current balance in HSA contains the roll-over of the remaining balance from the previous year, which may be related to the enrollee's unobserved health characteristics and risk preference. To this end, the balance in the housing savings account is used as the instrumental variable (IV) for the balance in the HSA. Similar to the HSA, a housing savings account is a compulsory form of saving taken from a fixed percentage of an employee's monthly salary to pay for housing needs.[8] Thus, the housing savings account balance is correlated with the HSA balance but uncorrelated with the OOP medical expenses. The IV regression results in column (5) of Table 3 suggest that the estimates regarding the key variable are robust. The standard errors shown in parentheses are robust and clustered at the provincial level in all specifications. In addition, the first stage of IV regression is used to test the weak instrument, and the Cragg Donald *F* statistics is above the critical values from the OLS.[9] The result suggests that the instrument variable is relevant, therefore the hypothesis of weak instruments is actually rejected at the 15% significance level.

Because of the universal fixed contribution rate, individuals with high incomes have to place substantial funds in their HSAs each month. These balances could be too high for them to spend on medical expenses after considering future health care risk. Thus, high-income individuals may spend more from their HSAs as their balances continue to increase. Two methods are used to test the heterogenous effects of income. First, the heterogeneous sample is divided by income level and self-reported health status, and the results are shown in Table 4.

[8] In 2011, employers and employees in Shanghai were required to place 7% of employees' monthly salaries in housing savings accounts.

[9] The weak identification test of the first stage regression shows that the Cragg-Donald Wald *F* statistic is 12.671, and the Stock-Yogo weak ID test critical value at 15% maximal IV size is 8.96.

Second, an interaction term between HSA balance and income is created and the regression results are reported in Table A1 in the Appendix. In addition, to test whether the effect of HSAs on expenses is nonlinear, the Ramsey RESET test using powers of the fitted values of OOP medical expenses is used to test

Table 4 Impacts of HSA Balance on OOP Medical Expenses by Subgroups

	(1)	(2)	(3)
Panel A: By income group			
Bottom 25 quantile	0.0564***	0.0569*	0.0263
	(0.0138)	(0.0291)	(0.0495)
The middle 50 quantile	–0.0063	–0.0060	–0.0063
	(0.0054)	(0.0031)	(0.0120)
Top 25 quantile	0.0154***	0.0171*	0.0614*
	(0.0042)	(0.0094)	(0.0359)
IV for HSA balance	No	No	Yes
Province effect	No	Yes	Yes
Panel B: Self-reported health status	(1)	(2)	(3)
Very good	–0.0582	–0.0582	–0.0612
	(0.1871)	(0.1011)	(0.0440)
Good and normal	0.1279***	0.1279***	0.1315***
	(0.0184)	(0.0413)	(0.0215)
Below average	0.0249***	0.0249***	0.0330*
	(0.0065)	(0.0075)	(0.0188)
IV for HSA balance	No	No	Yes
Province effect	No	Yes	Yes

Note: The table reports results from OLS regressions for individuals with HSAs by income and health subgroup, $N = 6{,}294$. The main effects of HSA balance on OOP medical expenses report the coefficients of HSA balance. Self-reported health status is a categorical variable that takes a value from 1 to 5 that indicates an individual's self-reported physical condition compared with peers (see the note of Table 1). According to the values of the self-reported health status variable, I create three major health groups: The first category refers to individuals with a value of 1, the "good and normal" category refers to individuals with values of 2 and 3, and the "below average" category refers to individuals with values of 4 and 5. Standard errors shown in parentheses for OLS regressions are robust and clustered by province in all specifications. * and *** indicate significance at the 10% and 1% levels, respectively.

whether the model has nonlinearity and no omitted variables. The *F*-test result shows that the null hypothesis of correct specification cannot be rejected at the 5% significance level.

Table 4 reports the estimation of the effect of HSA balances on OOP medical expenses for these heterogeneous subgroups. The regression results suggest that the highest-income group (the top 25 quantile) has the most significant and pronounced effect because it may have more HSA funds waiting to be spent on health care (Panel A of Table 4). The richest individuals incur approximately 61 yuan more medical expenses per 1,000 yuan increase in their HSA balances, more than triple the average effect. In addition, the effects for heterogeneous health groups are reported in Panel B of Table 4. Individuals who reported good to normal health statuses are most likely to overspend from their HSAs. They incur approximately 132 yuan more medical expenses per 1,000 yuan increase in their HSA balances, more than four times the rate of those individuals who report below-average health statuses. However, the estimated coefficient for individuals who have "very good" health statuses is not significant, suggesting that very healthy people do not overspend from their HSAs.

Some researchers believe that HSAs could solve the typical "spending moral hazard" problem by forcing consumers to be responsible for their purchases. However, this study's findings suggest that there could still be an overspending moral hazard in certain HSA markets. In this study, because of compulsory savings and universal contribution rates in China, an HSA becomes a less private or less valuable account than pocket money. Consumers, particularly those with the highest incomes and relatively better health statuses, tend to discount their HSA assets and incur larger medical expenses. This study's results provide some empirical evidence showing that HSAs may not be very effective in containing medical expenses and reducing moral hazard. These findings make policy makers aware of the need for caution in using HSAs to contain medical expenses.

5.2 Risk Behaviors and Medical Expenses

This study then examines whether HSAs affect medical expenses differently for individuals with different risk attitudes, proxied by three risk behaviors. Table 5 presents the results of estimating equation (2) and explores the relationship between risk behaviors and medical expenses. Following Cutler et al. (2008), this

study examines the simple and unconditional relationship between risk behaviors and risk occurrences, before and after controlling for covariates (X).

Table 5 The Relationship between Risk Behaviors and Medical Expenses

	Dependent variable: OOP medical expenses (yuan)			
	(1)	(2)	(3)	(4)
Panel A: Always wearing a seat belt				
Coefficient	20.557	20.557	35.536*	35.534**
	(20.286)	(14.264)	(21.914)	(14.785)
Controls	No	No	Yes	Yes
Province effect	No	Yes	No	Yes
N	6,633	6,633	6,633	6,633
Panel B: Always obeying traffic signals				
Coefficient	47.378*	47.378*	48.693*	48.693*
	(25.297)	(23.570)	(26.706)	(24.606)
Controls	No	No	Yes	Yes
Province effect	No	Yes	No	Yes
N	10,954	10,954	10,954	10,954
Panel C: Investing in high-risk projects				
Coefficient	47.272	47.272	50.335	50.335*
	(31.753)	(29.138)	(30.281)	(28.928)
Controls	No	No	Yes	Yes
Province effect	No	Yes	No	Yes
N	11,073	11,073	11,073	11,073

Note: The table report results from OLS regressions using data from CHFS 2011. The dependent variable in all regressions is OOP medical expenses (measured in yuan) (see the note of Table 3 for definition). The first row in each panel presents the coefficient estimates of the given risk behavior variable. Investing in high-risk projects (Panel C) is a categorical variable that takes a value from 1 to 5 that indicates the increasing risk and return of the investment that an individual would choose under a hypothetical scenario. Additional controls (coefficient estimates unreported) include demographic variables such as self-reported health status, age, income, education level, marital status, and gender. Robust standard errors for all specifications are in parentheses. In the specifications in columns (2) and (4), they are clustered by province. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

In Table 5, the first row in each risk behavior panel shows the coefficient of that risk behavior variable. Panels A and B present the relationship between risk-reducing behaviors and the occurrence of risk reflected by OOP medical expenses. Given that the average OOP medical expense in the sample is 216.68 yuan, always using a seat belt is associated with 16% higher medical expenses, and obeying traffic signals is associated with 22% higher medical expenses. Panel C shows the relationship between the willingness to invest in risky projects and OOP medical expenses. The estimates show that the willingness to invest in risky projects, if given the necessary amount of money under a hypothetical scenario, is associated with 23% higher medical expenses.

In sum, the results are mixed. Risk-averse individuals who always wear a seat belt or always obey traffic signals tend to have more medical expenses than individuals who do not have these two risk-reducing behaviors. However, risk-loving individuals willing to undertake risky investments tend to have more medical expenses than individuals who avoid risky investments. The differences are probably caused by presenting individuals with the hypothetical scenario of risky investing and giving them money to undertake the investment. Their choices in a hypothetical scenario probably do not reflect their real investment attitudes. In addition, individuals' attitudes toward financial risk may differ from their attitudes toward risk behaviors. Thus, only the first two real risk behaviors are used to reach a conclusion.

Cutler et al. (2008) find that in the medigap market, individuals who always wear a seat belt have fewer medical expenses than individuals who ignore seat belts. However, this study's estimates suggest that individuals who always wear a seat belt tend to have 16% higher medical expenses covered by insurance via HSAs. A likely explanation is that risk-averse individuals may use their HSAs more for preventive and primary health services. Because HSAs mainly cover basic health care expenses, including primary care, non-prescription drugs, and outpatient hospital services, this explanation may account for risk-averse individuals' higher medical expenses.

Next, the DID approach is used to investigate whether compulsory HSAs affect the medical expenses of individuals with different risk attitudes. Table 6 reports the results from the DID estimation of the relationship between risk behaviors and medical expenses for individuals with HSAs (60% of individuals in the sample). The first row in each panel presents the coefficient estimates of

the interaction term between the dummy variable for holding an HSA and the given risk behavior variable. For all three types of behavior—and after controlling for demographic variables such as self-reported health status, age,

Table 6 DID Estimation of the Relationship between Risk Behaviors and Medical Expenses for HSA Holders

	Dependent variable: OOP medical expenses (yuan)			
	(1)	(2)	(3)	(4)
Panel A: Always wearing a seat belt				
Interaction coefficient	42.439	42.439	45.424	45.424*
	(37.694)	(32.457)	(33.811)	(27.361)
Controls	No	No	Yes	Yes
Province effect	No	Yes	No	Yes
N	6,633	6,633	6,633	6,633
Panel B: Always obeying traffic signals				
Interaction coefficient	10.714	10.714	10.020	10.019
	(27.387)	(25.1304)	(28.088)	(26.261)
Controls	No	No	Yes	Yes
Province effect	No	Yes	No	Yes
N	10,954	10,954	10,954	10,954
Panel C: Investing in high-risk projects				
Interaction coefficient	35.351	35.351	37.815	37.815*
	(23.705)	(21.085)	(24.116)	(21.491)
Controls	No	No	Yes	Yes
Province effect	No	Yes	No	Yes
N	11,073	11,073	11,073	11,073

Note: The table reports results from OLS regressions using data from CHFS 2011. The dependent variable in all regressions is OOP medical expenses (measured in yuan) (see the note of Table 3 for definition). The first row in each panel presents the coefficient estimates of the interaction term between the dummy variable for holding an HSA and the given risk behavior variable. Investing in high-risk projects (Panel C) is a categorical variable that takes a value from 1 to 5 (see the note of Table 6). Additional controls (coefficient estimates unreported) include demographic variables such as self-reported health status, age, income, education level, marital status, and gender. Robust standard errors for all specifications are in parentheses. In the specifications in columns (2) and (4), they are clustered by province. * indicates significance at the 10% level.

income, education, marital status, and gender—individuals with HSAs are associated with more medical expenses than individuals without HSAs. The results show that compulsory HSAs may cause risk-loving individuals to spend more on medical services. This could be of interest to policy makers for adapting HSAs to contain medical expenditure, as the HSA effect could be different for individuals with different income, health status, and risk attitudes.

6 Conclusion

In sum, this study finds negative results for the effectiveness of HSAs in containing medical expenses and reducing moral hazard. Because of compulsory savings and universal contribution rates, an HSA becomes a less private or valuable account than pocket money. Consumers, particularly those with the highest incomes and relatively better health statuses, tend to spend more as the balances in their HSAs increase. These findings suggest that a compulsory HSA scheme with a universal contribution rate may not be a good solution to the social health care expenditure crisis. In addition, this study's analysis could be considered a critical assessment of the efficiency of the HSA system. In this light, the results, which suggest the need for caution in using HSAs to contain medical expenses, may interest policy makers worldwide.

Acknowledgments The author is very grateful to Kevin Lang, Randall Ellis, and Thomas McGuire for their guidance and support. The author is also thankful to Albert Ma, Charles Becker, Edward Tower, and Kai Zhao for illuminating discussions and helpful suggestions. The author thanks participants at Harvard Medical School Health Economics Seminars for helpful comments. All errors are the author's.

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Appendix

To investigate the heterogenous effects of income and risk attitude on OOP medical expenditure, this study also creates an interaction term between HSA balance and income and Table A1 reports the regression results. Pooling the income subgroups and running a regression using an interaction term between HSA balance and income, shows that the coefficient of the interaction term remains positive, suggesting that individuals with higher income will have a larger effect, though it is not significant.

Table A1 Impacts of HSA Balance on OOP Medical Expenses Using Interaction with Income

	(1)	(2)
HSA balance	0.0128*	0.0128**
	(0.0069)	(0.0052)
After-tax income	0.0001	0.0001
	(0.0003)	(0.0003)
Interaction between HSA balance and income	0.0046	0.0046
	(0.0032)	(0.0030)
IV for HSA balance	Yes	Yes
Province effect	No	Yes

Note: The table reports results from OLS regressions for individuals with HSAs by income and health subgroup. $N = 1{,}850$. The main effects of HSA balance on OOP medical expenses report the coefficients of HSA balance. Self-reported health status is a categorical variable that takes a value from 1 to 5 that indicates an individual's self-reported physical condition compared with peers (see the note of Table 1). According to the values of the self-reported health status variable, I create three major health groups: The first category refers to individuals with a value of 1, the "good and normal" category contains refers to individuals with values of 2 and 3, and the "below average" category refers to individuals with values of 4 and 5. Standard errors shown in parentheses for OLS regressions are robust and clustered by province in all specifications. * and *** indicate significance at the 10% and 1% levels, respectively.