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The Impact of Cost-Sharing on Hospital Expenditure in China: A Regression Discontinuity Approach*

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The Impact of Cost-Sharing on Hospital Inpatient Expenditure in China: A Regression Discontinuity Approach

Abstract

This paper uses a unique dataset of seriously ill patients in China across the retirement window to analyse the impact of a change in the co-pay ratio at retirement on inpatient expenditures. We find that a decrease in the co-pay ratio (that is, a lower proportion of cost borne by the user) leads to an increase in medical insurance spending. Surprisingly, out-of-pocket spending also increases. Individuals' Medical Saving Account (MSA) balances are associated with higher inpatient expenditures. Results indicate that cost-sharing arrangements in China are very sensitive to changes in the co-pay ratio, an effect which appears to be magnified by significant MSA balances. The reduction in the co-pay at retirement leads to substantial increases in medical expenditures at that time. If policy reform is aimed at containing aggregate health expenditures, the retirement age change in the co-pay rate should be re-visited.

JEL Classification Numbers: I13, I14, I15

Keywords: health policy, co-pay; cost-sharing, medical savings accounts, medical expenditure

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1. Introduction

The design of healthcare financing and insurance represents an enduring challenge for governments worldwide. To limit both utilisation and public cost, some form of cost-sharing between government or insurer and the consumer is frequently implemented. Outcomes of alternative approaches have been frequently analysed in a developed country context, but in less prosperous countries, research coverage is less consistent.

This paper contributes to an emerging literature focused on healthcare policy in China. China's major policy, as measured by resources provided, is the Urban Employee Medical Insurance Scheme (UEMIS). While the UEMIS covers only 24% of the population, it absorbs some 60% of healthcare utilisation nationally.[1] Thus, Healthcare utilisation by fund members is very important; this is our empirical focus.

The UEMIS provides its members with hospital care, subject to a co-pay ratio which varies by hospital grades and age. At age 60, the male retirement age, the co-pay ratio declines markedly (exact parameters depend on local jurisdictions). In addition, members are required to contribute to a compulsory medical savings account, or MSA[2], which may be drawn on only for health-related expenses –the co-pay or to cover either clinic or inpatient expenditures.[3] Contributions to this plan are made from labour earnings during a person's working life; retirees are entitled to the insurance benefit if they meet the vesting requirements.

We examine the impact of co-pay ratios in China using a unique dataset of patients in the city of Qingdao who, a year later, were admitted to long-term care facilities. These patients therefore consume a relatively high quantity of medical services, and the impact of co-pay ratios on their consumption of medical services has a large impact on overall spending. Moreover, their high consumption of medical services results in a high statistical power, enabling us to identify the impact of co-pay ratios. Another advantage of the dataset is that it offers information not only about services covered by medical insurance but also about out-of-pocket healthcare spending that is not covered by insurance.

The patients in the dataset have employee insurance in which the co-pay ratio for services provided by "high-grade" hospitals drops from 14% prior to retirement age to 7% post retirement. We focus our analysis on males who face an official retirement age of 60. We use a regression discontinuity design to identify the impact of this change.

We find that the seven percentage point drop in the co-pay ratio is associated with a 38% increase in overall spending on inpatient services, including a 40% increase in spending on services covered by insurance, and a 33% increase in out-of-pocket spending by patients. Examining medical spending in the year before retirement, we are able to rule out the possibility that patients are simply postponing consumption of health services from shortly before to shortly after retirement. The

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[1] *The China Bureau of Statistics website reports that in 2018 UEMIS membership totaled 316. 8 million, covering about a quarter of the total population. Overall UEMIS membership expenditure was RMB 1071 billion, about 60% of total national health expenditure. See http://data.stats.gov.cn/easyquery.htm?cn=C01,*

[2] *MSA is often labeled as an innovative design of health financing instruments (Prescott 1998)*

[3] *Individual accounts cannot be used to pay for medical expenses not covered under the insurance plan; however, in recent policy reforms, some local governments allow a certain percentage of the individual account to be released*

increase in consumption appears to represent new spending that would not have occurred if the co-pay ratio had remained at its pre-retirement level. We also provide additional evidence suggesting that this impact is reinforced by the existence of the MSAs. Results suggest that within UEMIS memberships, there are considerable disparities in healthcare utilisation induced by financial incentives, and that alternative policy structures may generate different, and potentially more socially efficient, utilisation patterns.

To our knowledge, this is the first paper to examine the effect of changing co-pays on the overall health care outlays, capturing all three elements – insurance payments, co-pays, and out-of-pocket expenditures, in a policy setting where MSA funds can be used to finance co-pays.

Section 2 offers some background on China's health system and discusses relevant literature. Section 3 introduces data and background on the healthcare plan in Qingdao and section 4 discusses our regression discontinuity design. Section 5 presents the results and section 6 concludes with a discussion of policy implications.

2. Background and related literature

The impact of cost-sharing on healthcare expenditure has been extensively researched. In general, the conclusion is that co-pays matter (Yip & Hsiao, 1997; Schreyögg & Kin, 2004). At the individual level, the best known cost-sharing experiment is the Rand study in the 1970s, which involved a randomized trial that allocated people into several health insurance policies with different co-pay ratios as well as a maximum dollar upper limit (Manning et al. 1987). Using the outcomes from these trials, Manning et al. (1987) suggested that outpatient expenses on the free health insurance plan were 67 percent higher than those on the 95 percent plan, while outpatient visit rates were 66 percent higher. However, this study does not cover in-patient utilisation. There have been many studies since, focused on more specific aspects of health care. For example, Goldman et al. (2007) conducted a review of 132 cost-sharing studies and found that for each 10% increase in cost-sharing, prescription drug spending decreases by between 2% and 6%. As for hospital expenditure, Siu and Sonnenberg (1986), using a randomized trial method, found that while many admissions and hospital days were judged inappropriate, cost sharing made little difference. They conclude that alternative mechanisms for efficient allocation of hospitalisation were required.

Very few of these studies examine the impact of varying co-pays on insured utilisation where an MSA could be used to meet the co-pay liability. Neither, in general, do they track uninsured out-of-pocket expenditures. China is one of the few countries that have both co-pay ratios as well as medical savings account arrangements in their major healthcare scheme.

But in the US, MSAs are increasingly being introduced through High Deductible Health Plan (HDHP) programs, and our study is directly relevant in this context. The United States has the highest health expenditure in the OECD with spending taking up an increasingly large proportion of GDP From 1998 to 2015, health insurance premiums almost tripled, while average household income only increased by about 58%.[4] As a result, employers have increasingly sought to limit insurance costs by switching to plans that give consumers incentives to control their spending. Typical plans combine high deductibles (a minimum of $1,300 in 2015) with tax-preferred savings accounts which workers and their families can use for out-of-pocket charges (Pauly & Goodman 1995a,b; Fronstin & Elmlinger, 2015; and Agarwal et al., 2017). Brot-Goldberg et al. (2015) find that switching to this HDHP reduced firm-wide health spending by between 11.8% and 13.8%, this being entirely due to a reduction in the

[4] *Information from http://www.allhealthpolicy.org/sourcebook/private-coverage//*

number of services consumed. Keehan et al. (2015) also found that U.S. recent medical expenditure growth "was somewhat moderated by the increased prevalence of employer-sponsored private health insurance plans with high cost-sharing requirements" (p. 1410).

There is also an emerging literature on financial incentives to limit health care utilisation in China, where medical insurance arrangements are in flux. Examples include Blumenthal & Hsiao (2005, 2015); Hu et al., 2008; and Fu et al., 2014. Recently, Yu et al. (2017) found that patients with more generous health insurance coverage have longer hospital stays, higher total costs, higher medication costs, and a higher ratio of medication to total cost, as well as a higher number of and likelihood of specific procedures. Zhou et al. (2016) studied the healthcare utilization of different income groups and concluded that reimbursement participants, those who are financially constrained, are more likely to reduce their healthcare needs. Another paper (Zhang et al., 2018), which studied the causal effect of retirement on healthcare utilization in China, found that retirement increases healthcare utilization, which is contrary to findings from developed countries. However, the paper did not mention cost sharing. Given the fact that cost-sharing ratios change at retirement in China, a link between this financing specification and utilisation is suggestive.

A relevant recent paper by Jin et al. (2019), found that cost-sharing significantly increased the elder's hospital utilisation. They also estimated that the price elasticity is -0.67 for inpatient admission, using Shanghai administrative data. But the role of MSAs, and changes in associated out-of-pocket expenditures, were not examined.

3. Data and healthcare plan background

In China, most members enrolled in an Urban Employee Medical Insurance Scheme (UEMIS) have quite comprehensive healthcare services with a pooled social insurance account and a medical savings account (MSA), also known as an individual account. Each city sets its own UEMIS contribution rates and medical reimbursement regulations—different cities have different rates. The contribution to the social pooling account varies by region from about 5-12% of local wage standards. An employee's individual account is usually funded by a contribution of 2-3% of that employee's wage. The UEMIS is mostly managed in city jurisdictions. For example, the contribution in Shenzhen city is 5.2% plus 2% MSA, while in Shanghai, it is 10% plus 2% MSA. Retired employees do not need to contribute, but about 3-5% of the average wage amount is credited to their MSA by the UEMIS fund.[5] Medical expenditure for an inpatient enrolled in UEMIS comes from three sources: the UEMIS fund, the co-pay from the MSA (if the balance is sufficient), and the co-pay by the patient as out-of-pocket expenses (if the MSA balance is insufficient or if the service or drug is not covered by medical insurance). In the case of the first two payments, the hospitals are reimbursed by social insurance operators—we refer to this as *medical insurance expenditure* (MIE). We refer to the patient's own spending as *out-of-pocket expenditure* (OPE).

In Qingdao, the contribution is 9% and 2% respectively to the social pooling and individual accounts. The reimbursement rate to current employees for a top- and second-grade hospital is 86% and 88% (the higher the grade, the higher the quality of service). However, for retired employees, who join the same medical insurance, the reimbursement rates increase to 93% and 94% respectively. Thus, the share paid by a patient in a top-grade hospital (the co-pay ratio) is 14% before the official retirement age and 7% thereafter, with the age set at 60 for males. As patients primarily visit top-grade hospitals, this is the rate we assume in our paper.

[5] *Calculated by authors using information from "2017 China Human Resources and Social Security Development Statistics Report", accessed on August 16, 2018, via http://www.mohrss.gov.cn/SYrlzyhshbzb/zwgk/szrs/tjgb/201805/W020180521567611022649.pdf*

Our data include whole beneficiary recipients of the long-term care insurance program from 2013-14 in the city of Qingdao, China. The dataset consists of all individual health expenditure records (N=17,005) one year before being admitted to its long-term care program. This group is characterised by a high level of disability and heavy treatment demands. Most of the patients are employee medical insurance members. As most of the patients are at the cusp of entering long-term care, they are relatively old, aged 50 to 100. Individual information consists of age, gender, Activity of Daily Living (ADL) score (based on the Barthel Index: totally independent is 100 and totally dependent is zero). The data also report medical insurance expenditure (MIE) and OPE. Annex 1 provides general statistics about patients' medical expenditure in 2014. The cash ratios reported do not indicate the actual co-pay ratios as these are a combination of the gap between the co-pay required and the balance in the MSA (if positive), and the cash for services outside the insurance coverage items. The data set does not provide specific individual account payments.

The total health expenditure per capita is more than RMB 67,000 for the year under observation, which indicates the severity of disease in this group.[6] Of the total expenditure, 73% is paid by the medical insurance, with the balance paid out of pocket. Eighty per cent of these outlays are attributable to inpatient costs.[7] We focus on the inpatient expenditure in our analysis.

4. Regression Discontinuity Approach

This section explores the impact of cost sharing, in terms of co-pay ratios determined by the policy to the impact of healthcare expenditure. We use a regression discontinuity approach to measure the causal impact of the co-pay ratio to healthcare cost. In our data, the co-pay ratio halves from 14% to 7% when workers reach retirement (For male workers, retirement occurs at age 60, giving us an excellent instrument for a regression discontinuity design for testing the causal impact of the co-pay ratio on medical expenditures: total inpatient cost to the insurance fund, as well as individuals' out-of-pocket expenditure. The retirement age is a commonly used instrument in regression discontinuity studies in health economics (Battistin et al., 2009; Li & Wu, 2015; Feng & Zhang, 2018; Chen et al., 2017; and Müller & Shaikh, (2018).[8] For example, Card et al. (2008) examine the health utility before and after the Medicare eligibility at age 65 for the U.S. population. The key identifying assumption is that changes in medical spending as a result of reaching retirement age are due to the halving of the co-pay ratio.

We focus our analysis on males, whose retirement age is set at 60[9] in China, looking specifically at inpatients in a 12-month period from 2013-2014. The selected sample for this empirical analysis is aged from 50 to 70. Our dependent variables are the medical insurance expenditure (MIE) and the patient's own out-of-pocket expenditure (OPE). The key independent variable is the cash ratio (co-share ratios). Controls include age, ADL score, and gender in regressions, which include both males and females. We estimate the average treatment effect based on the propensity scores matching method (Rosenbaum & Rubin, 1983; Nichols, 2007; Becker & Ichino, 2002).

[6] *This is in contrast to the average basic medical insurance cost in urban in China which was RMB 1361 in 2014.*

[7] *According to China Health Year Book 2019, the average inpatient cost in 2018 in China was RMB 9976.*

[8] *For regression discontinuity design in general, see Lee & Lemieux, 2010; Black Galdo & Smith, 2007; Rosenbaum & Rubin, 1983; Austin, 2007; Becker & Ichino, 2002; and Battistin, 2009.*

[9] *Women's retirement age is 50 for blue-collar workers and 55 for white-collar employees. Most of our sample inpatients seek service in top-grade hospitals.*

4.1 Regression Discontinuity Model

We follow the RD Model by Battistin et al. (2009). Here y stands for MIE and OPE.

$$y = \beta_0 + \beta_1 T_i + \beta_3 x_i + \varepsilon_i$$

*T*i = 1 if subject *i* received treatment (retired) and *Ti* = 0 otherwise.

$$y = \beta_0 + \beta_1 T_i + \beta_3 (x_i - c) + \varepsilon_i$$

The treatment effect is given by β_1.

E[Y /T = 1; X = c] =β_0 +β_1 and *E[Y /T = 0;X = c]* = 0.

E [Y /T = 1; X = c] - *E [Y /T = 0; X = c]* = β_1

causal effect of treatment for treated *i* is *Yi (1) -Yi (0);*

*A*verage treatment effect is *E [Yi (1) -Yi (0)].* We use retirement age 60 as the instrument dummy and estimate the local average treatment effect on the treated (ATT). We use the Kernel Triangle propensity score matching (PSM) method for smoothing.

4.2 Checks and tests

As part of the validity checks, we also do the same for female patients with the same methods. A robustness check (Jacob et al., 2012) is conducted by excluding the outermost 5% and 10% of data points with the highest and lowest rating values. The result confirms our confidence in the choice of model.

Over-identification tests are conducted using ADL scores and co-pay ratios as variables. Both have no significant discontinuity around the age 60 cut-off point (see results in Annex 2).

As stated, we use age 60 as the instrument and choose the 50-70 age range for male inpatients.

Bandwidth selection is the default bandwidth from Imbens and Kalyanaraman (2009), which is designed to minimize standard errors, or squared bias plus variance, in a sharp RD design in STATA. Detailed analysis is in the Results section. We also applied an F-test to check optimal bin width (Jacob et al., 2012), and the one-year age bin passes the significant test for both MIE and OPE.

5. Results

The final sample size for male inpatients aged between 50-70 is 891. The sample size is 1438, including the female sample for that age cohort. Figure 1 shows the mean (log) medical insurance expenditure (MIE) for males and females aged 50-70. Figure 2 shows the corresponding figures for out-of-pocket expenditure (OPE). For males, there is a clear break at age 60, with a jump in both MIE and OPE. This break aligns with the drop in the co-pay ratio at retirement when the co-pay ratio drops from 14% to 7%. The corresponding results for females show no such break at 60. This is consistent with the hypothesis that the change in spending is caused by the change in co-pay. Since females do not retire at 60, no particular change in spending is expected.

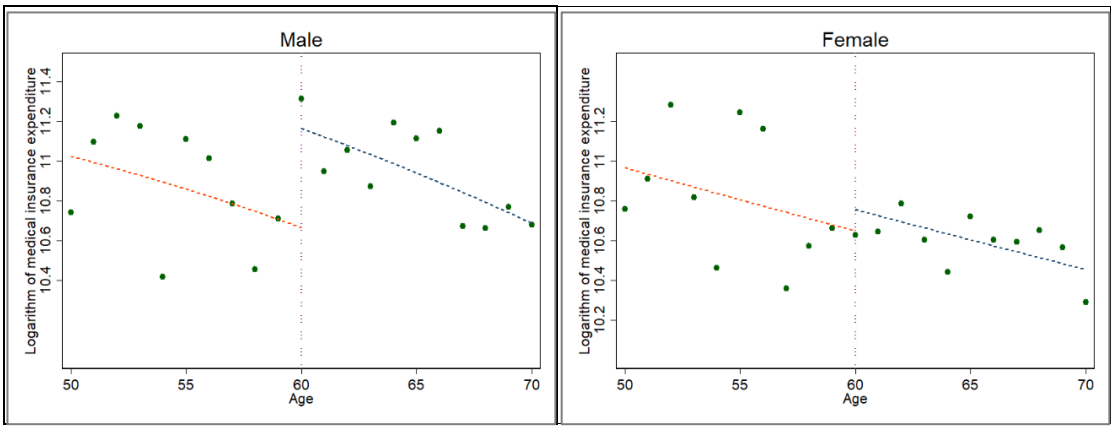

Figure 1: Mean log medical insurance expenditure (MIE) by gender

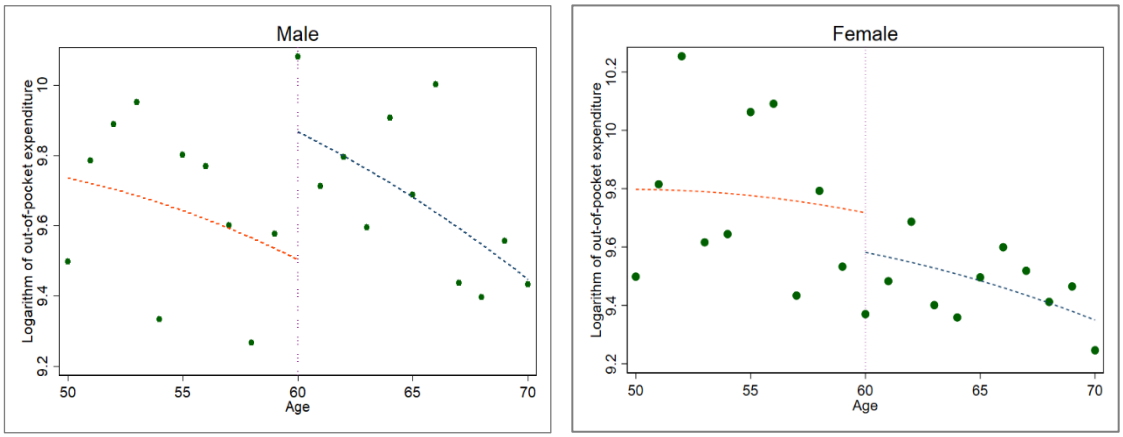

Figure 2: Mean log out-of-pocket expenditure (OPE) by gender

In Table 1, we present the formal test of the hypothesis that the retirement at 60 for males explains the rise in MIE and OPE. Retirement here plays the role of "treatment" in the test of an intervention. The table shows a statistically significant increase in MIE and OPE for males—but not females—at retirement. For males, retirement results in coefficients of 0.50 in MIE and 0.36 in OPE. These results are consistent with bandwidth estimates, which are 0.47 and 0.38 respectively. Age is also statistically significant: apart from the jump at age 60, spending is decreasing with age. This decrease in spending as a function of age is a typical finding for the Chinese medical system.

The retirement treatment effect, according to our model estimates, and converted with linear log function, is equivalent to about a 46% decrease in MIE after retirement and a 33% out-of-pocket (OPE) expenditure reduction at age 60 without the co-pay ratio policy change. These numbers may not be universally applicable as different patient samples in different regions will lead to varying results. However, they do indicate a very significant increase in health costs induced by the 7 percentage point drop the in co-pay ratio in Qingdao.

Table 1: The local treatment effect of retirement on mean log medical insurance expenditure (MIE), out-of-pocket expenditure (OPE) (male and female) and total male expenditure.

	MIE			OPE		
	Male	Male with age 59 dummy	Female	Male	Male with age 59 dummy	Female
Retired	0.499**	0.500*	0.108	0.363**	0.386*	-0.136
Age	-0.041**	-0.041**	-0.031**	-0.033**	-0.034*	-0.016
Age sq2	-0.001	-0.001	0.000	-0.001	-0.001	-0.001
Age59		0.004			0.056	
Constant	10.670***	10.670***	10.650***	9.504***	9.486***	9.717***
R^2	0.256	0.256	0.307	0.224	0.226	0.398

(Note: * p < 0.10, ** p < 0.05, *** p < 0.01), Instrumental variable estimates based on 20 cell mean log values from data. The equation relates expenditure to a dummy (0.1) for reaching age 60. Standard errors are robust to heteroskedasticity.

We also added an age 59 dummy in the male groups to test for the possibility that part of the effect is due to individuals postponing medical treatment till they retire. If postponing were significant, we would expect the coefficient on age 59 to be negative. In fact, the coefficient is slightly positive, suggesting that this concern is misplaced. Judging from these results, the increase in spending post-retirement represents spending that would not have occurred if the co-pay ratio had remained at 14%.

5.1 Robustness check

Table 2 reports the results of a robustness check in which ADL scores are an additional covariate. We estimate both cell values in bins and the individual data by grouping them into discrete 1-year age cohorts (age 59, for example, instead of age 59.2, 58.8 etc.). The coefficients after adding the covariates do not change in statistical significance, but the size of the coefficients is somewhat smaller. This is unsurprising as the health of older patients is likely be worse than that of younger patients. The coefficient for MIE is about 0.45, and for OPE, it is about 0.33. The results for females at age 60 remain insignificant. The coefficients for the bandwidth check are in Annex 3.

Table 2. The treatment effect of retirement on log medical insurance expenditure (MIE) and out-of-pocket expenditure (OPE) for males and females using cell n (N=20) value and discrete individual samples (891)

	Male ln(MIE)	Female ln(MIE)	Male ln(OPE)	Female ln(OPE)	Male ln(MIE	Male ln(OPE)
Treatment	0.452**	0.16	0.331*	-0.041	0.496***	0.360***
Age	-0.037**	-0.034**	-0.029*	-0.021	-0.042**	-0.033**
Age square	-0.000	-0.000	-0.001	-0.001	-0.000	-0.000

ADL score	-0.028	-0.017	-0.019	-0.031**	-0.017***	-0.013***
Constant	11.420***	11.120***	10.020***	10.560***	11.08***	9.819***
N	20	20	20	20	891	891
R2	*0.32*	*0.353*	*0.264*	*0.561*	*0.056*	*0.031*

(Note: * p < 0.10, ** p < 0.05, *** p < 0.01)

5.2 Other Evidence

The RDD approach indicates a causal effect of the co-pay ratio on inpatient expenditures. Another method to explore this link is to examine the level of expenditure at different times during the year. In the system used in Qingdao, the amount in the MSA accumulates month by month. The later in the year, the more money there is in the MSA, and the less the person has to pay out of his or her own pocket. Consequently, if health consumption is sensitive to out-of-pocket spending, we would expect higher expenditure in the 4th quarter than in the 1st quarter.

Our inpatient observations are individuals one year prior to becoming eligible for long-term care service, representing a similar level of severity of their health status. We assume there is little seasonal impact. In order to maximise statistical power, we focus on total inpatient expenditure for each quarter. Table 3 reports the results. The 4th quarter total inpatient expenditure is significantly higher than that of the first quarter of the year. This provides further evidence that medical spending is responsive to the amount that individuals pay out-of-pocket. In particular, the regression shows that the amount of money in the individual account works as leverage for medical services. Given the coefficient value and according to the sample statistics, in the final quarter of the year, individuals consume about 16% more medical resources than in the 1st quarter.

Table 3. The relationship between log total inpatient expenditures and the time of year in which the expenditures are incurred. The omitted category is the 1st quarter.

	B	*t*	95% Conf. Interval	
Age	-0.009	(-0.37)	-0.060	0.041
Age Square	0.000	-0.340	0.000	0.000
Female	0.108*	-2.160	0.010	0.205
ADLs Score	-0.003	(-1.47)	-0.006	0.001
Expenditure (first quarter of 2013 as base)				
2nd Quarter	0.047	-0.650	-0.094	0.187
3rd Quarter	0.070	-0.990	-0.069	0.209
4th Quarter	0.175*	-2.520	0.038	0.311
cons	11.510***	-12.180	9.656	13.364
N	1438			
R2	0.043			

6. Policy Implications

Our principal finding is that the drop in the co-pay ratio at retirement results in a substantial increase in both medical insurance expenditure (MIE) and out-of-pocket expenditure (OPE). Generalising from this finding, we conclude that reductions in the co-pay ratio lead to the consumption of more and/or more expensive medical services.

Two principal mechanisms can explain the increase in MIE. The first mechanism is increased demand: individuals seek as much medical care as possible funded by MIE. The reduction in the co-pay implies that a given MSA balance will fund increased services. The second mechanism is increased supply: hospitals seek maximum revenue by maximizing the resources from insurance reimbursement schemes.

Another notable finding is the increase in out-of-pocket expenditure. If patients had continued to consume the same quantity and type of services, their out-of-pocket spending should have dropped following retirement. Instead, it is increasing. This suggests that the increase in the quantity and/or quality of services that patients consume must be very substantial—so much so that the drop in out-of-pocket spending due to the lower co-pay ratio is outweighed by the increase in out-of-pocket spending due to increased consumption of medical services. Given the nature of our sample, it also suggests that seriously ill people tend to spend more if there are not financially constrained.

The empirical findings from our analysis are salient to healthcare reform in China. They have the following policy implications.

Causal effect of cost sharing to medical fund. The most important implication is that the very low or zero co-pay ratio in the current Chinese healthcare delivery system should be revisited.[10] The current change in the co-pay ratio after retirement induces higher healthcare consumption, especially for the seriously ill group in our sample. This also suggests that a deductible ceiling with no co-pay on additional expenditures might not work well to contain the cost. In our sample, the increase in OPE accompanying increased health utilisation after the age of 60 suggests that these individuals are able to afford the health services they need. They consume additional healthcare following the decrease in the co-pay because it is cheaper.

MSA and cost containment. We also demonstrate that a balance increase in the individual medical savings account could induce higher medical expenditure. In Qingdao, the medical savings contribution rate, based on wages or pensions, is 3% just before retirement and 4.5% after retirement. The lower co-pay ratio combines with additional balances in individual savings accounts to generate a jump in health care utilisation.

Controlling this increase will require an increased post-retirement-age co-pay ratio, and perhaps modifications to the availability of MSA balances to meet co-pay obligations. A possible policy response would maintain the same reimbursement rate before and after retirement and remove the increased transfer from social pooling to an individual medical savings account after retirement. This could be combined with a capped maximum out-of-pocket amount for approved services. This policy reform could contribute to immediate cost control without compromising the delivery of essential services, and without changing other parameters. In addition, alternative uses for these balances, such as the purchase of catastrophic health insurance, might be permitted, possibly with cover

[10] *China used to have almost zero co-pay schemes for high-rank veterans.*

extending to other family members. Some jurisdictions have already moved in this direction, as we indicate below.[11]

Inequality in healthcare delivery. We have shown that a higher co-pay is associated with lower total healthcare expenditure in the current public health insurance plans. This can also result in inequality in health consumption. Rural and urban residents who are not covered by the UEMIS have high co-pays with less financial resources. As such, they are unlikely to receive equal treatment in hospitals. Our results also indicate that unequal treatment is likely to be induced by the balance of individual accounts not only among different health insurance groups but also within the same employee medical insurance plan. Members with higher individual account balances are more likely to have a higher income, and are more likely to receive better or more expensive medical care services in the pooling accounts. This will distort the purpose of social insurance. Reforming MSAs would therefore likely contribute to a reduction in inequality.

Limitations. One limitation of this study is that we do not have wealth and income data for our sample. Presumably, a person's financial status affects their consumption of healthcare services, and in particular, that person's out-of-pocket expenditure. In terms of universal application, it should be recalled that our sample focuses on severely ill patients, and the sample is not representative of the general population of patients. However, severely ill patients are of particular importance as they are responsible for vastly disproportionate spending on health services. Moreover, since these patients have serious medical problems, their consumption of health services may be less elastic (less responsive to price signals) than that of healthier individuals. If so, the impact of the co-pay ratio on the consumption of health services may be even larger in the general population.

7. Discussion and Concluding remarks

In conclusion, it is of interest to contrast the policy framework in China with that of another country which combines a co-pay based health social health insurance regime with an MSA. Singapore has a successful system which has achieved a high life expectancy, high satisfaction rate and low cost (WHO 2002, Lim 2004). One of the key ingredients in the Singapore system is the use of high co-payments and MSAs.[12]

Although the basic design of the Chinese system is similar to Singapore, the range of China's co-pay ratios is far lower than Singapore's, which range from 20 to 50% based on various factors[13], with well-developed private insurance to cover the remaining risk. However, the Singapore government has monitored the private insurance offerings very closely and has found that zero out-of-pocket co-pay extra insurance schemes greatly increase the total medical expenditure. It has therefore stopped

[11] *A more radical reform would be to abolish the MSA entirely (Shen & Hong 2011).*

[12] *Singapore was ranked at the top in the 2017 UN Health Goals among 188 nations and its health system features a public-private partnership in healthcare financing. Singapore's public subsidy for health care was only about 1.6% of GDP compared to more than 7% in the US and an average of 4% in OECD as a whole in 2015-16.[12](Source from https://edition.cnn.com/2017/09/12/health/un-health-goals-country-ranking-study/index.html and Health at a Glance, via https://www.oecd-ilibrary.org/docserver/health_glance-2017-en.pdf?expires=1526266206&id=id&accname=guest&checksum=D708B8CCDEB328C65626985E8E3B9A6E)*

[13] *Source from: https://www.guidemesingapore.com/business-guides/immigration/get-to-know-singapore/healthcare-in-singapore*

zero-co-pay offerings.[14] For medical savings accounts, Singapore has a risk sharing as well as fee for each service limitation on the individual account balance (Fu & Cheng, 2018).

A recent development in China's UEMIS policy is to allow the individual account balance to pay for medical expenditures for family members (parents and children) as well as for purchasing additional private healthcare insurance. In 2018, Shenzhen allowed the individual account to be a sharing pool for family members, resulting in improvements in reducing the account balance (Chen & He, 2018). Wu (2018) suggests that individual accounts could be reformed by gradually reducing the credit amount and allowing patients to pay for more options. This would change the nature of the individual account from a personal savings account to a broader risk sharing mechanism.

China's health system, in common with many other national health systems, has many unique aspects. But it also provides some lessons that are applicable elsewhere, including the recent High Deductible Health Plan in the US.[15] The findings in this paper highlight the importance of the combined impact of multiple components of funding arrangements in a health system.

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[14] *Information from https://www.xinjiapo.news/news/23367, translated by authors.*

[15] *The High-Deductible Health Plan (HDHP) has recently been a popular policy for employers when choosing health insurance programs in the US. The adoption rates have been growing since its inception in 2004. As of 2016, HDHPs represented 29% of the total covered workers in the United States (source:* https://www.motivhealth.com/2020/05/25/hdhps-the-influencers-of-healthcare-consumerism/*).*

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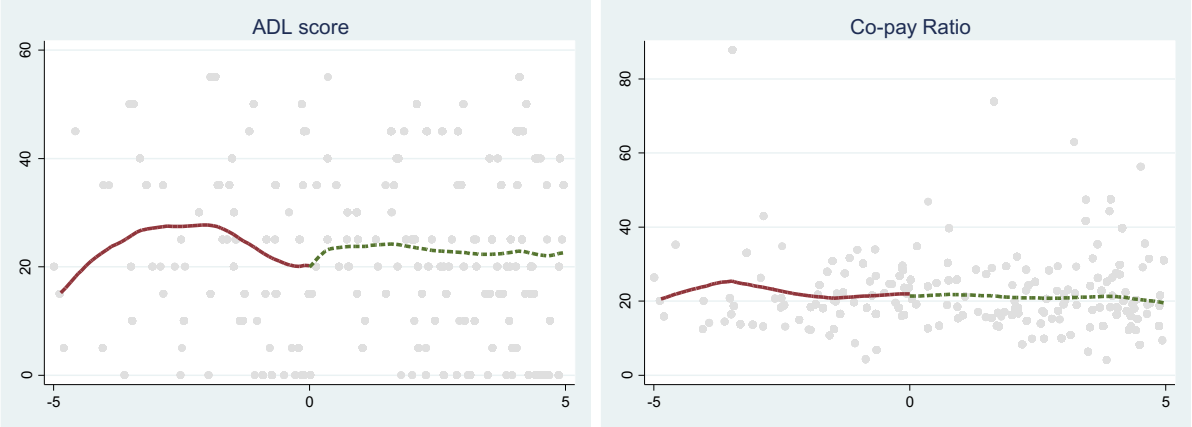
Annex 1. Medical insurance beneficiaries' statistics for total expenditure (TE), inpatient and outpatient expenditures for total and sub sample (age 50-70) inpatients.

	Variables	Observations	Average	Std. Dev.
General	Gender (Female=1)	17,005	0.60	0.49
	Age	17,005	79.65	9.45
	ADL score	17,005	26.39	14.95
Total Healthcare	Total Expenditure	15,872	67,545	139,276
	MIE	15,872	50,861	108,974
	OPE	15,872	16,684	36,768
Inpatient	Total Expenditure	9,684	54,228	126,428
	MIE	9,684	40,531	96,512
	OPE	9,684	13,697	36,101
Out-patient	Total Expenditure	14,746	13,317	37,184
	MIE	14,746	10,330	35,320
	OPE	14,746	2,987	4,885

Sub sample (age 50-70)

Inpatients	Variables	Observations	Average	Std. Dev.
	% Female	1906	0.42	0.49
	Age	1906	63.58	4.89
	ADL score	1906	27.88	15.46
	Total Expenditure	1906	115,749	202,416
	MIE	1906	88,300	162,890
	OPE	1906	27,448	48,483

Annex 2. Over-identification tests



Annex 3. Coefficients of the local Wald Estimate for male medical insurance expenditure (MIE) and out-of-pocket expenditure (OPE) before and after retirement with different bandwidth selections.

	Bandwidth	Model Coefficients			
		MIE	MIE	OPE	OPE
Default	3.479	0.43**	0.465**	0.354*	0.3787*
50%	1.740	0.492	0.533	0.377	0.397
150%	5.219	0.561**	0.613***	0.494**	0.532**
Covariate		No	Yes	No	Yes

$^{*}\ p < 0.10,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$, *Note: MIE refers to medical insurance expenditure and OPE refers to out-of-pocket expenditure.*