The Power of Public Insurance for the Poor: Evidence from China's New Cooperative Medical Scheme

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Abstract

Low-income people, especially the rural poor in low- and middle-income countries (LMICs), have limited access to healthcare when they are sick. To address this issue, the governments of LMICs have initiated health insurance programs that target these poor populations. However, the health benefits these programs provide are often limited due to resource constraints in LMICs. In this paper, we study the New Cooperative Medical Scheme (NCMS), a limited coverage insurance program for rural residents in China, to explore its effectiveness, and the mechanisms that contribute to its successes, if any. We exploit a plausibly random design to identify the causal effects using data on NCMS enrollment and detailed information extracted from China's yearbooks on healthcare and mortality. Our identification relies on the within-province variation in NCMS enrollment over the 2004-2011 period in a province-year panel. We find that although the insurance coverage the NCMS offered is limited, inpatient care use increases significantly over the study period, and that this increase is mainly driven by the use of inpatient care delivered through primary care providers, for which the reimbursement rates are the most generous. In addition, we show that half of the increase in outpatient use is attributable to the NCMS' investment in the healthcare supply in rural areas. We also find that rural residents substitute the healthcare services and providers they use in response to the differential payment design of the NCMS, largely by using more primary care services that are reimbursed at higher rates. Lastly, our results indicate that the introduction of the NCMS does not lead to increases in out-of-pocket medical expense and does not reduce all-cause mortality rates among rural residents, but does reduce mortality for specific deaseases such as AIDS and infectious disease.

Keywords: Healthcare Utilization, NCMS, Health Insurance, Poor Populations

JEL classification: H51, I12, I13, I18

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1 Introduction

Low-income people, and especially the rural poor in low- and middle-income countries (LMICs), are less likely than people with higher incomes to seek treatment when they get ill (WHO et al. 2012). The limited access to healthcare services among poor populations has long-term consequences, including persistent poverty, constraints on economic growth, and high rates of crime and social violence (Smith 1999; Wagstaff 2002; Thoa et al. 2013; Bondurant et al. 2018; Deza et al. 2022). To encourage poor individuals who are sick to seek healthcare, governments in LMICs have been expanding health insurance coverage to the uninsured in rural areas since the 1990s.[1] However, the health benefits such insurances provide are often limited due to the insufficient fiscal resources of these LMICs (Dong et al. 2003; Asgary et al. 2004; Mataria et al. 2004; Yi et al. 2009; Pavel et al. 2015), which leaves the rural poor covered by these programs with much higher out-of-pocket (OOP) payments than people in OECD countries typically face.[2] How effective are such health insurance programs with limited benefits in increasing access to healthcare among the rural poor in LMICs? In this paper, we study the New Cooperative Medical Scheme (NCMS), a limited coverage insurance program for rural residents in China, to explore its effectiveness as measured by healthcare use, OOP medical expenses, and health outcomes. We also examine the mechanisms behind the NCMS' successes, if any.

As a response to the financial burdens on the rural poor due to increasing medical OOP cost, the Chinese government launched the NCMS as a pilot program in certain counties in 2003, and expanded it nationally starting in 2004.[3] The NCMS is similar to other health insurance programs designed to fully cover poor individuals that were

[1] For example, expansions of national insurance programs to cover poor residents were initiated in Colombia in 1993; in Ghana, Vietnam, and China in 2003; in Mexico in 2005; in Georgia in 2006; and in Nicaragua in 2007. See Acharya et al. (2013) for a detailed review of these programs.

[2] In 2014, on average, 36.26% of medical spending was out-of-pocket in LMICs, while only 13.63% of medical spending was out-of-pocket in OECD countries. See the WHO Global health expenditure database at https://apps.who.int/nha/database for more details.

[3] In 2003, 303 counties out of 1,642 counties were selected for the pilot program.

launched in LMICs prior to 2010.[4] To make healthcare affordable and accessible, the NCMS program increased levels of investment in the healthcare supply in rural areas of China. In these areas, healthcare resources, such as medical staff, hospital beds, and medical equipment, expanded in tandem with NCMS enrollment. As is the case for the programs in most other LMICs, the benefits the NCMS provides are restricted: i.e., while all counties provide coverage for inpatient services, the inpatient reimbursement rate is limited; and the coverage for outpatient services is unsatisfactory, as most counties do not cover outpatient visits (Yi et al. 2009; Zhang et al. 2017).[5] Given that the NCMS fully covers the rural population of China, but provides only limited insurance benefits, we investigate how rural residents in China respond to the NCMS, as measured by their healthcare use, OOP medical expenditures, and mortality, between 2004 and 2011.

To identify the causal effects of the NCMS, we use information on NCMS enrollment provided in a report by Chen and Zhang (2013), and detailed information on healthcare use and mortality provided by China's yearbooks in a plausibly random design. Our identification relies on the within-province variation in NCMS enrollment in a province-year panel for the period of 2004 to 2011. Since the NCMS program was phased in gradually and achieved full enrollment by 2010, there are fewer self-selection issues in the later years of our study period. However, endogeneity issues might arise in the earlier years, when the provincial governments were rolling out their NCMS programs at different speeds. The results of a battery of tests suggest that the within-province variation in NCMS enrollment was not correlated with the urbanization or economic development that occurred in parallel with the rollout of the NCMS, and that the initial NCMS enrollment level in 2004 was not anticipated by rural residents, and it was not predicted by the demographic and economic changes in each province. In addition, our estimates are robust

[4]For example, countries in the Caribbean area have adopted the British national health system model, or the models of socialist countries such as Cuba, China, and Vietnam. The rapid increase in NCMS enrollment presumably occurred because the funding provided by the central government to local governments was determined by the enrollment level (Vilcu et al. 2016). See section 2 for more details.

[5]Yi et al. (2009) find that individuals using inpatient care were reimbursed for 15% of their expenditures between 2004 and 2007.

across different specifications, and by an event study design that utilizes data from the period before the introduction of the NCMS in 1996-2003.

First, we find that over our study period, the NCMS significantly increases inpatient care use on a nationwide scale, despite the limited insurance coverage it offered. Specifically, our estimates show that a one-percentage-point increase in the NCMS enrollment rate increases the use of inpatient services by 0.1 percent (about 0.5 hospital stays per 10,000 people). The results of our detailed analysis by provider show that the increased levels of inpatient care are mainly delivered by primary care providers at community health centers (1.6 percent) and township health centers (0.4 percent), as these forms of care are reimbursed at the most generous rates; and, to a lesser extent, by county hospitals (0.1 percent), for which the reimbursement is less generous. Our event study estimates indicate that the effects on inpatient service use are mainly driven by the large increases during the period (2007-2009) when the NCMS rollout was nearly complete, and are weaker after 2009.

To understand the effects of the NCMS' supply-side policy on the use of inpatient care, we conduct an intermediate analysis. We find that after controlling for healthcare resources, such as the number of hospital beds, the number of healthcare institutions, and the number of medical staff, the magnitude of this effect is reduced by half. Our findings further indicate that half of the NCMS' success in increasing inpatient care use among rural residents in China can be attributed to the policy of investing in the healthcare supply, which leads to increases in both the quantity and the quality of healthcare services in rural China.

Second, our results show that the rural residents are price-sensitive, as they substitute healthcare services and providers in response to the differential reimbursement scheme of the NCMS. In particular, we find that the implementation of the NCMS leads to a statistically insignificant reduction in outpatient care use by rural residents, which is mainly driven by a decline in outpatient visits at city hospitals and community health centers. When we analyze the effects of the NCMS by hospital outpatient department, we find that the reduced NCMS effect on hospital outpatient visits come from outpatient use at general (with

statistical significance), preventive care, and rehabilitation departments. To provide more evidence for the possibility that rural residents shift from city hospitals to primary care providers for outpatient care, we further examine the effects of the NCMS on outpatient services interacted with inpatient services delivered by primary providers at township health centers and community health centers that are reimbursed at more generous rates. We find that the effects of the NCMS on outpatient care use are stronger in provinces with larger volume of inpatient stays and outpatient visits offered by primare care providers. Overall, these results suggest that rural residents substitute outpatient services in city hospitals that are reimbursed less generously by the NCMS with both outpatient and inpatient services delivered by primary care providers that are reimbursed more generously by the NCMS.

Third, we find that the introduction of the NCMS does not lead to increases in OOP medical cost as healthcare utilization rises. In addition, we show that the rollout of the NCMS has no effect on the all-cause mortality rates among rural residents in China. These close-to-null estimates are shown to be robust across specifications. However, our analysis of mortality rate by disease show that the NCMS has significantly reduced the incidence of mortality of infectious disease on the extensive margin, and significantly reduced mortality rate of AIDS on the intensive margin.

Our findings contribute to several branches of literature. First, our paper is directly related to several empirical papers that estimate the effects of the NCMS, which generate conflicting findings. Some of these studies find that the effects of the NCMS on healthcare utilization are very small or close to null. In particular, Lei and Lin (2009) analyze the 2000, 2004, and 2006 data from the longitudinal China Health and Nutrition Survey (CHNS) using multiple research designs, such as fixed effects, instruments, and difference-in-difference (DID) approaches, to correct the endogeneity of participation in the NCMS. They find that while the introduction of the NCMS has led to increases in preventive care use, and particularly in the number of general physical examinations, it has little effect on the numbers of inpatient stays or outpatient visits, OOP expense, and health improvement. Yip et al.

(2008) conduct a longitudinal survey in 2002 and 2005, and employ a DID method to show that the introduction of the NCMS does not result in an increase in outpatient visits. Babiarz et al. (2012) also estimate a DID model using two waves of survey data for five provinces in China in 2005 and 2008, and find little evidence that being enrolled in the NCMS makes sick people more likely to visit healthcare providers.[6]

In contrast, other studies find that the implementation of the NCMS significantly increases healthcare utilization. For example, An analysis by Wagstaff et al. (2009) of data from the National Health Service Survey (NHSS) for 2003 and 2005 in 15 counties for 12 provinces and of healthcare facility data using a DID design shows that the rollout of the NCMS increases the utilization in inpatient and outpatient visits, while has no effect on OOP payment. They also show that the effects occur mainly in THCs. An analysis by Liu (2016) of data from the CHNS for 1993 to 2011 using a DID design shows that the NCMS has been effective in insuring households against health shocks, and in helping them invest in their children's education. Of the studies that examine the effects of the NCMS on medical OOP spending, some find that it decreases expense to a limited extent only (Lei and Lin 2009; Wagstaff et al. 2009; You and Kobayashi 2009; Cheng and Zhang 2012; Cheng et al. 2015), while others show that the NCMS is effective in reducing OOP spending (Babiarz et al. 2012).

There are several potential explanations for these mixed findings. First, as the effects of the NCMS may have been heterogeneous across regions, studies that use samples from different local areas have inconsistent findings. Second, the NCMS evolved as the program was rolled out. For example, the enrollment increases rapidly and the reimbursement rates for healthcare services improve as the program developes. Thus, studies that focus on different phases of the implementation of the NCMS may have yielded conflicting findings. For example, studies that explore the effects of the NCMS in the years immediately after its introduction (2004-2006), when the NCMS has low reimbursement rates and moderate

[6]The five provinces are Jiangsu, Sichuan, Shaanxi, Jilin, and Hebei.

enrollment levels, are very likely to find small or close-to-null estimates of changes in healthcare utilization; whereas studies that focus on the later stages of the NCMS rollout are more likely to produce significant findings. In contrast to the previous literature on the NCMS, our paper draws on a national sample that spans an eight-year period after the program was expanded in 2004, employs a random design utilizing variation in the NCMS enrollment levels over time, examines a broader range of the effects of the NCMS on healthcare use by provider and service type, and explores the mechanisms through which the NCMS increases healthcare access among rural residents in China.

Our findings are also related to the branch of literature on the effectiveness of health insurance. Studies conducted in developed countries have shown that the expansion of health insurance coverage increases healthcare use (Currie and Gruber 1996a; 2001; Finkelstein 2007; Card et al. 2008; 2009; Chay et al. 2010; Finkelstein et al. 2012; Kolstad and Kowalski 2012; Sommers et al. 2012), protects against catastrophic health expenditure (Finkelstein et al. 2012), and significantly reduces mortality (Currie and Gruber 1996a;b; Hanratty 1996; Card et al. 2009; Chay et al. 2010; Miller et al. 2021; Finkelstein et al. 2012; Sommers et al. 2012; Chou et al. 2014; Goodman-Bacon 2018; Swaminathan et al. 2018; Khatana et al. 2019; Borgschulte and Vogler 2020; Goldin et al. 2021). The conclusions of these studies apply to both poor and non-poor populations. Among the studies that focus on non-poor populations are papers that examine the impact of health insurance on Medicare beneficiaries (Finkelstein 2007; Card et al. 2008; 2009; Chay et al. 2010), on patients with specific diseases such as end-stage renal disease (Swaminathan et al. 2018) or cardiovascular disease (Khatana et al. 2019), and on the general public (Kolstad and Kowalski 2012). The studies that focus poor populations include Currie and Gruber (1996a;b); Hanratty (1996); Chou et al. (2014); Currie and Gruber (2001); Goodman-Bacon (2018), which look at the effects of health insurance low-income mothers and children, and Finkelstein et al. (2012); Sommers et al. (2012); Borgschulte and Vogler (2020); Goldin et al. (2021); Miller et al. (2021), which examine the impact of health insurance on poor adults. Utilizing Medicaid

expansion as a natural experiment that allows for a rigorous empirical design, these studies focus on poor populations in developed countries (especially the United States). They all find that the expansion of insurance coverage has led to increases in healthcare use and improvements in mortality.

In contrast, the research findings on the effects of insurance expansion on healthcare use in developing countries are mixed. For example, studies that examine the impact of the Subsidized Regime in Columbia find that the program increases the use of preventive services and curative care (Miller et al. 2013; Trujillo et al. 2005; Giedion et al. 2009; Gaviria et al. 2006). However, a number of studies that look at the impact of insurance programs in other developing countries find only limited effects. For example, a study on the impact of an insurance program in Ghana find that the program has led to an increase in the use of pregnancy care (Mensah et al. 2010), but also that it has no significant effect on OOP expenditure once self-selection is controlled for (Brugiavini and Pace 2016). King et al. (2009) finds that the Seguro Popular program in Mexico does not lead to increases in the utilization of healthcare, whereas Sosa-Rubí et al. (2009) report that it has led to increases in diabetic care use. Other studies find that health insurance for the poor does not result in increases in the use of healthcare or lower OOP medical cost in Nicaragua (Thornton et al. 2010), in Georgia (Bauhoff et al. 2011), or in India (Karan et al. 2017). Assessments of the impact of the Health Care Funds for the Poor program in Vietnam have also been mixed: Wagstaff (2007) finds that the use of inpatient and outpatient care increases, Axelson et al. (2009) report a small increase in the overall use of healthcare, and Wagstaff (2010) finds a null effect of this program on healthcare utilization.[7] We extend this literature by investigating the effects on healthcare utilization of the NCMS, one of the biggest insurance programs for the rural poor in China. More importantly, we explore the mechanisms behind its effectiveness, from which we derive some policy implications for the design and implementation of large-scale insurance programs in LMICs.

[7]See Acharya et al. (2013) for a comprehensive review.

The paper is organized as follows. Section 2 introduces the institutional background of the NCMS. Section 3 describes the data, explains some key dependent variables, and presents summary statistics. Section 4 introduces the empirical models and potential threats to our identification. Sections 5 to 7 report the NCMS effects on healthcare utilization, explore mechanisms, investigate heterogeneous effects, and present robustness checks. Section 8 show the NCMS estimates on medical expense and mortality. Section 9 concludes.

2 Institutional Background

2.1 The Healthcare System in Rural China

China's rural healthcare system is a three-tiered medical system (Wang 2004; Babiarz et al. 2012). Village health clinics are the first level of contact, which provides outpatient services only. Township health centers (THCs) serve as the middle tier, which provides basic inpatient and outpatient healthcare. In some urbanized provinces such as Zhejiang and Jiangsu, rural residents can visit community health centers (CHCs), which typically serve urban residents in neighboring communities and function similarly to that of the THCs in rural areas. The top tier of the rural healthcare system consists of county hospitals that provide relatively specialized and better quality care. Patients with complicated conditions can be referred to city hospitals. THCs play an important role in mediating between village clinics and county hospitals in this three-tier rural medical system. The common services delivered at THCs include preventive healthcare, basic medical care, health surveillance, health education, rehabilitation, and family planning (Wang 2004). Although city hospitals are technically not part of the rural healthcare system, rural residents (especially those living in the areas adjacent to cities) often go to city hospitals for treatment because they have much better staff and equipment than other healthcare facilities. Rural residents may go to a nearby city hospital for better-quality services, or for that their conditions cannot be

treated in THCs or county hospitals.[8]

2.2 The New Cooperative Medical Scheme (NCMS)

Unlike the poor in developed countries mainly live in cities, poor people in China tend to be concentrated in rural areas, and especially in remote and mountainous rural areas far away from cities. However, in the 1990s, only 20% of China's rural population, which accounted for about 70% of the country's total population, had any form of health insurance (MHCHSI 2004). Rural Chinese who lacked health insurance had to pay the full amount for medical care OOP. To reduce the financial burden associated with healthcare use, the Chinese government initiated one of the largest health insurance programs in history in 2002, the New Cooperative Medical Scheme (NCMS), which was designed to cover the 640 million otherwise uninsured rural residents, and to provide full coverage of this population by 2008. The program was rolled out on a staggered basis, first through a pilot program in 300 counties in 2003, and then through an expansion to over 600 counties by 2005 (Liu 2004).[9] In 2003, each provincial government had to choose at least two to three counties for the pilot program based on the financial conditions of the county government, the needs of the local rural population, and the status of the delivery system. Thus, a small number of counties with better economic conditions were chosen to participate in the pilot stage, and the program was expanded to the majority of counties later on. All provinces achieved full coverage of their rural residents by 2008. Appendix Table A1 summarizes the year when each province fully covered its rural population, and the number of counties participating in the pilot stage of the NCMS.

Although participation in the NCMS was voluntary for rural residents, the program offered sufficient incentives to ensure full enrollment. In establishing the premium payments,

[8] In addition, some rural patients with chronic or rare diseases may go to city hospitals outside of their home province for treatment.

[9] For example, Beijing had 13 pilot counties, Shanghai have 10 pilot counties, Zhejiang has 27 pilot counties, Jiangsu has 10 pilot counties, and Shangdong has 26 counties. More details on each province can be found in Appendix Table A1.

the central government set a minimum contribution for participants and a minimum subsidy for local governments every year.[10] As a result, participants paid only around one-fifth of total premiums, with local and central governments subsidizing the rest. For example, an enrollee paid a minimum contribution of 10 to 80 yuan in the 2004-2011 period. In addition, the central government's budget transfers to local governments were conditional upon achieving a target enrollment rate and enrollment levels were tied to promotions for government officials (Vilcu et al. 2016). Thus, local governments put great efforts into promoting enrollment. For example, village leaders visited the non-participating households in person and provided assistance to ensure that they were enrolled. The rapid increase in NCMS enrollment was largely incentivized to local governments from the central government in that the funding transfers were determined by the enrollment rates (Vilcu et al. 2016). As a result of the heavily subsidized premiums and the extensive promotion efforts by local governments, rural residents responded positively to the NCMS, as shown in Figure 1. The program expanded rapidly from 2004 to 2007, with the NCMS enrollment rate increasing from 18 percent to 86 percent over this period. The coverage rate rose to over 95 percent in 2008, flattened in 2009, and reached full coverage in 2010 and 2011.

As the NCMS is implemented at the county level, local governments have discretion in choosing the benefit packages and the administrative arrangements offered in their areas. Thus, the deductibles, coinsurance rates, and ceilings of the scheme can vary across counties (You and Kobayashi 2009). However, the benefit designs of the NCMS programs in different counties have some similar features. First, the NCMS provides more generous benefits for inpatient care than for outpatient care: all counties cover inpatient care, while only a quarter of counties cover outpatient care on a pooling basis (Wagstaff et al. 2009). Second, to control medical expenses, the NCMS generally adopts a hierarchical reimbursement scheme that offers more generous benefits for care delivered by lower-level providers, but less generous reimbursements for care delivered by higher-level providers. In 2011, the highest coverage

[10] In particular, the minimum contribution set by the central government was 10 yuan in 2006, 20 yuan in 2007, 30 yuan in 2008, 50 yuan in 2009, 60 yuan in 2010, and 80 yuan in 2011.

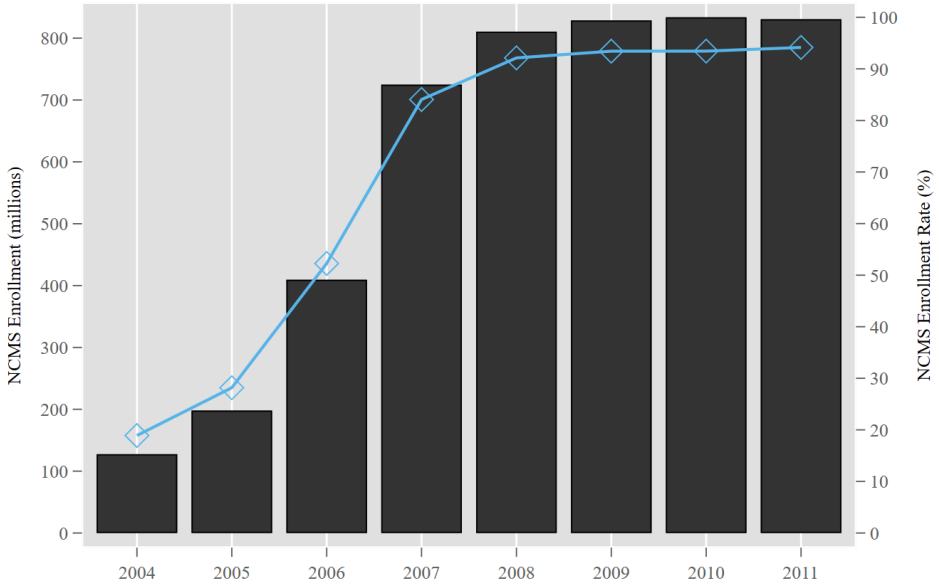

Figure 1: Enrollment in the NCMS over Time

Notes: The data source is the NCMS development report by Chen and Zhang (2013). The y-axis on the left is the number of enrollees and the y-axis on the right is the enrollment rate, which is calculated by dividing the rural population by the number of enrollees over the period from 2004 to 2011.

rates (at 65 percent to 90 percent) were for care delivered by primary care providers, such as THCs and CHCs; the second-highest coverage rates (at 60 percent to 80 percent) were for care provided by county hospitals; and the lowest coverage rates (at 45 percent to 70 percent) were for care provided by city hospitals (Zeng et al. 2019). Third, the range of benefits offered by the NCMS have improved since its initial implementation in 2003. More infectious diseases and catastrophic diseases such as congenital heart disease, leukemia, and cancer, are covered. Since 2007, outpatient services associated with chronic diseases such as kidney dialysis and diabetes have also been reimbursed.[11]

On the supply side, while the NCMS does not determine provider payment rates[12],

[11]The co-payment for the treatment of such diseases is about 10 percent, and is fully reimbursed for some poor households.

[12]Although county governments have some discretion in setting premium and reimbursement levels, they do not negotiate with healthcare providers. The payment rates for healthcare providers are based on the payment design of the local public insurance for employees, which is, in turn, based on the standard set up by the national bureau of health insurance.

another feature of the program expansion is the increasing investments in medical resources of rural areas, which is in parallel with the introduction of the program. From 2004 to 2011, the number of hospital beds at county hospitals grew quickly, while the number of hospital beds at CHCs and THCs remained stable (Appendix Figure A1). In addition, more healthcare providers have been established: the number of CHCs increased significantly and the number of county hospitals expanded rapidly starting in 2010, while the number of THCs decreased from 2004 to 2011 (Appendix Figure A2). Appendix Figure A3 further plots the changes in medical staff in rural areas over time. The number of personnel in hospitals began to increase rapidly starting in 2009. This pattern might be driven by the reform that required doctors in city hospitals to practice in rural institutions for one year to be promoted, and newly graduated medical students who are employed by city hospitals to practice for one year at rural healthcare providers. Overall, the quality of the medical staff in rural areas has improved as a result of the NCMS program.

3 Data

To explore the effects of the NCMS, we rely on three sources of data with annual information on each province of China. Our healthcare utilization and health resources data are collected from the annual China Health Statistical Yearbook (CHSY) for the period from 2004 to 2011. The CHSY is a national yearbook published by the Health Department of China that reports detailed information on the health of the residents of all Chinese provinces. First, the CHSY provides the total numbers of outpatient and inpatient visits at all hospitals, and the corresponding numbers of health services delivered by each provider at city hospitals, county hospitals, community health centers (CHCs), and township health centers (THCs). In addition, the CHSY includes data on outpatient visits at hospitals by specialty from 2007 to 2011, which we use to explore the impact of the NCMS on substitution behavior across services and providers among rural residents. Second, the CHSY provides detailed

information on household consumption and medical expense in rural and urban areas of a province, which allows us to estimate the impact of the NCMS on OOP costs, and to test our identification strategy in section 4.[13] Third, the CHSY contains detailed information on the health resources across the provinces. We use three dimensions of health resources to explore the mechanisms of the effects of the NCMS in our paper: the number of providers; the number of beds offered by providers at different levels, such as city hospitals, county hospitals, CHCs, and THCs; and the number of medical staff in rural areas in each province.

The second data source is the annual China Statistical Yearbook (CSY) from 1996 to 2011. The CSY contains demographic information for each province, including information on the total population; the rural population; the share of married individuals; the share of female individuals; the share of individuals with different levels of education, such as high school and college; the share of individuals belonging to different age groups, such as the proportion of people aged 14 and above and the proportion of older people aged 64 and above; and the ratio of dependent people (children and old parents) in a household.[14] In addition, the CSY contains detailed information on the economic characteristics of each province, including the gross domestic product (GDP) per capita, the unemployment rate, the average income in rural areas, and the household disposable income in cities. These variables are exploited as controls in our estimation model, and are used to test our identification strategy in section 4. The CSY also provides information on mortality (deaths per 1,000 people) in each province, which allows us to estimate the health effects of the NCMS.

Our data on the NCMS policy are derived from the report of the NCMS development by Chen and Zhang (2013). The report presents information on enrollment in the NCMS, NCMS beneficiaries, and the NCMS' reimbursements for inpatients in graphs for each province from 2004 to 2011. While the report explicitly provides the values of these variables for some years, it shows the specific values for other years only in graphs. Therefore, we impute the values

[13]The medical expense includes payment on medical equipment, medications, hospital bills, and doctors' consultation services (Zeng et al. 2019).

[14]The population is based on *hukou* status, China's household registration system: if one's *hukou* is registered in rural areas, one is counted as rural population.

for the years not specified in the graphs based on the numbers given for other years in the report. For example, the report provides specific NCMS enrollment numbers for Beijing in 2004, 2005, 2006, and 2011. For the rest of the years, the corresponding numbers are plotted from 2004 to 2011 in a scattered graph. We use the y-scale information and a software tool to proportionately calculate the NCMS enrollment in all years from 2004 to 2011.[15] The main independent variable of interest is the NCMS enrollment rate constructed by the ratio of NCMS enrollment and the rural population in each province over the years 2004 to 2011.

We also supplement these data with another data source, the China Health Yearbook (CHY) from 1996 to 2003, to test our identification strategy. The CHY provides information on healthcare in the years prior to the NCMS implementation.[16] The variables of interest in the CHY are the number of healthcare providers, the number of hospital beds, the numbers of outpatient visits and emergency visits, the number of medical staff, and healthcare spending across the provinces. We employ the supplemental data in section 4 to test the parallel trend assumption in a framework with a continuous treatment variable.

3.1 Key Dependent Variables

The first set of outcomes is on healthcare use by service and by provider. We construct the total number of outpatient visits per 10,000 people and the total number of inpatient visits per 10,000 people using the information on the population in each province from 2004 to 2011. We then calculate the healthcare use in the form of outpatient and inpatient visits by provider at city hospitals, county hospitals, CHCs, and THCs in order to investigate how the NCMS affected the healthcare-seeking behavior across healthcare providers with different levels of quality. We also combine the information on outpatient visits by department, which allows us to investigate the substitution behavior among rural residents. All of these outcomes are scaled at per 10,000 people.

[15] We use CorelDRAW, which is a powerful graphics tool for vector illustration, layout, and editing. More information about CorelDRAW can be accessed on its website.

[16] The annual CHY reports are available in a scanned version, and we manually collected the data for each province in the reports. The cleaned data are available upon request.

The second set of outcomes is on medical expenses in rural areas. The average medical expenditures of rural residents are inflation-adjusted (2014 yuan). The share of medical expenses is defined by dividing the medical expenses (2014 yuan) by the total consumption expenses (2014 yuan) in rural areas.

The third set of outcomes is on rural healthcare resources by provider, which we exploit to explore the mechanisms of the impact of the NCMS on the healthcare use of rural residents. We examine three types of healthcare resources: hospital beds, hospitals, and medical staff. For the first two dimensions, we calculate the number of hospital beds per 10,000 people and the number of hospitals per 10,000 people for city hospitals, county hospitals, CHCs, and THCs, respectively. For medical staff, we do not have information on each provider. Thus, we use the total numbers of medical staff, doctors, nurses, and assistant physicians at all providers in rural areas.

The fourth set of outcomes is on the NCMS beneficiaries and the reimbursement rates for inpatient care use. We calculate the share of NCMS users as the ratio of NCMS beneficiaries and enrollment levels for each province in each year. The reimbursement rates for inpatient care use are drawn directly from the report, and do not distinguish between providers at different types of hospitals.

3.2 Sample Statistics

Table 1 presents the summary statistics of the main variables used in the paper: the NCMS policy variables, the healthcare utilization dependent variables, the health resources, and the controls of demographic characteristics and economic conditions. On average, 70 percent of rural residents are covered by the NCMS, and the first-year coverage rate in 2004 is about 19 percent. Over the period from 2004 to 2011, the average increase in the NCMS enrollment rate is approximately 75 percent.[17] The average times of being reimbursed per rural resident

[17]Some provinces have a maximum NCMS enrollment rate that is higher than one. This is mainly driven by the urbanization process: as some rural residents turn into urban residents, the size of the rural population (the denominator for calculating the enrollment rate) decreases even through these people are still covered

is about one, indicating that an average enrollee uses the NCMS at least once during our sample period. In terms of healthcare utilization, rural residents visit a doctor twice a year on average, and about eight out of 100 people has used inpatient services. Across providers, city hospitals rank first in both outpatient and inpatient use. THCs rank second in outpatient visits and third in inpatient stays. The CHCs are used much less frequently for inpatient services than other providers, which is reasonable given that CHCs mainly offer outpatient services. The average healthcare expense in the cities is about 856 yuan (2014 yuan), accounting for about seven percent of total consumption. The average disposable income in cities is close to 17,000 yuan (2014 yuan), while the average income in rural areas is around 6,000 yuan (2014 yuan).

4 Estimation Model

In this section, we describe our identification strategy to estimate the effects of the NCMS in a two-way fixed effect (TWFE) framework and a flexible event-study specification, as well as possible identification threats. The TWFE model uses a continuous NCMS enrollment rate across provinces over years as the key independent variable and exploits the within-province variation in the NCMS enrollment rate over time to quantify the effects on potential outcomes of interest. The event-study design utilizes a continuous value of the initial NCMS enrollment rate in 2004 across provinces as the treatment variable and compares province-level outcomes after 2004 between provinces with higher and lower NCMS expansion rates.

4.1 TWFE Specification

$$ln(Y_{pt}) = \beta_0 + \delta NCMS_{pt} + \eta_p + \mu_{rt} + X_{pt}^{'}\beta + \epsilon_{pt} \tag{1}$$

where Y_{pt} is the potential outcome in province p in year t: healthcare use by service and by provider, rural medical expense, and mortality rate. Without specific notification, all

by the NCMS.

Table 1: Summary Statistics

	Mean	S.D.	Min.	Max.	N
NCMS Variables					
NCMS enrollment rate	0.70	0.35	0.02	1.27	232
Initial NCMS rate in 2004	0.19	0.24	0.02	0.93	232
NCMS enrollment gain (2004-2011)	0.75	0.25	0.04	1.04	232
Ratio of NCMS beneficiaries to enrollment	1.04	1.55	0.02	13.21	232
Inpatient reimbursement rate	0.37	0.10	0.16	0.57	222
Healthcare Utilization (per 10,000 people)					
Total number of outpatient visits	24150	20474	7558	133000	232
Outpatient visits at city hospitals	10955	14504	1580	79485	232
Outpatient visits at county hospitals	4416	2247	579	16810	232
Outpatient visits at CHCs	3184	7534	56	52484	232
Outpatient visits at THCs	5743	2257	335	15388	226
Total number of inpatient stays	807	274	310	1771	217
Inpatient stays at city hospitals	344	256	80	1565	232
Inpatient stays at county hospitals	248	138	24	1039	232
Inpatient stays at CHCs	10	18	0	111	217
Inpatient stays at THCs	191	112	2	551	226
Health Resources (per 10,000 people)					
Beds at city hospitals	16	13	5	67	232
Beds at county hospitals	9	4	1	30	232
Beds at CHCs	1	2	0	13	232
Beds at THCs	6	2	0	11	232
Number of city hospitals	0.10	0.07	0.04	0.44	232
Number of county hospitals	0.08	0.05	0.01	0.28	232
Number of CHCs	0.22	0.26	0.02	1.36	232
Number of THCs	0.32	0.16	0.00	0.83	232
Number of medical staff in rural areas	24	9	4	54	232
Number of doctors in rural areas	5	2	1	13	232
Number of nurses in rural areas	4	2	1	15	232
Number of assistant doctors in rural areas	2	1	0	4	232
Demographics					
Population (10,000)	4469	2671	499	10922	232
Married	0.73	0.03	0.64	0.78	232
Female	0.49	0.01	0.46	0.51	232
Education with college degree	0.08	0.05	0.03	0.34	232
Education with high school and above	0.14	0.04	0.06	0.28	232
Aged 65 and above	0.09	0.02	0.05	0.15	232
Aged 15 to 64	0.73	0.04	0.63	0.84	232
Gross dependency ratio	37.09	7.02	19.27	57.58	232
Economic Variables					
Medical expenses in cities (2014 yuan)	856.05	254.61	353.42	1810.81	232
Share of medical expenses in cities (2014 yuan)	0.07	0.01	0.04	0.10	232
Consumption expenses in cities (2014 yuan)	12166	3817	6979	27005	232
GDP per capita (2014 yuan)	27800	17593	5610	91443	232
Income in cities (2014 yuan)	16786	5669	9515	38977	232
Income in rural areas (2014 yuan)	5867	2785	2350	17223	232
Unemployment rate (%)	3.74	0.65	1.30	6.50	231

Notes: The data used are from the CHSY and the CSY from 2004 to 2011. See the texts for details on each variable.

dependent variables are in natural logarithmic form. $NCMS_{pt}$ is the continuous NCMS enrollment rate in province p in year t. η_p, the province fixed effect, controls for unobserved time-invariant province characteristics, such as the political environment for promoting the NCMS and some unobserved preferences for healthcare use among the residents in each province. μ_{rt}, the region-by-year fixed effect, controls for common shocks across regions and convergence in outcomes across regions uncorrelated with the NCMS (Stephens Jr and Yang 2014; Goodman-Bacon 2021).[18] X_{pt} is a vector of covariates that includes the province-level demographic characteristics, such as population size, age structure, education levels, percentage married and female, and the ratio of dependent persons in a household and a vector of economic controls that include the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and urban areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan). The demographic controls are our basic controls. The full controls include both demographic and economic variables. ϵ_{pt} is the standard errors, which are clustered by province. All regressions are weighted by the rural population in 2003 to remove the endogenous urbanization process across provinces from 2004 to 2011.

4.2 Event-Study Specification

$$ln(Y_{pt}) = \alpha_0 + NCMS_p^{2004} \times \left[\sum_{y=2004}^{2011} \theta_y \mathbf{1}\{t - 2004 = y\} \right] + \eta_p + \mu_{rt} + X_{pt}^{'}\beta + \epsilon_{pt} \quad (2)$$

where $NCMS_p^{2004}$ is the continuous NCMS enrollment rate in 2004 in province p. To better interpret our results, we re-define the treatment variable as the differences between the NCMS enrollment rate in 2011 and the NCMS enrollment rate in 2004, which captures the possible differential effects of NCMS enrollment accumulation on health service utilization across provinces.[19] The larger the value of this treatment variable, the greater the accumulated

[18] China's 31 provinces are divided into five regions according to geographical location and economic condition: eastern region, northern region, middle region, sourthern region, and western region.

[19] The results are almost identical when using the alternative differences between 100 percent coverage and the initial NCMS enrollment rate in 2004. The treatment variable also reflects the possible timing effect of

increase in the NCMS enrollment rate. The event-year dummies $\mathbf{1}\{t - 2004 = y\}$, are equal to 1 when the year of observations is $y = 2005 \ldots, 2007, \ldots, 2010, 2011$,respectively. We use 2004, the beginning year of our study period, as the reference year and is thus omitted in our model. Based on the characteristics of the NCMS implementation outlined in section 2, we group the years 2005 to 2006 as the rapid expansion stage of the program, 2007 to 2009 as the close-to-full coverage stage with flattening enrollment rates, and 2010 to 2011 as the full coverage stage. All other variables are the same as those in equation 1. The NCMS effect estimates of interest are the coefficients on the interaction terms between $NCMS_p^{2004}$ and event-year dummies, θ_y, which capture the differences in outcome Y in year y as compared to 2004 between provinces with larger NCMS enrollment gains (smaller initial $NCMS_p^{2004}$) and provinces with lower NCMS enrollment gains (higher initial $NCMS_p^{2004}$) over the periods 2005 to 2011 when the NCMS was rolled out.

4.3 Identification Threats

Outcomes of Interest in Aggregate Levels: In this paper, we are interested in estimating the treatment effects of the NCMS on the healthcare utilization of rural residents. The ideal measures for healthcare use by rural residents would be the number of outpatient visits and inpatient stays used by rural residents. However, because of data limitation, we use healthcare use of the total population as our outcome variables in our estimation model. To make our estimates reflect the treatment effects on the treated, the implicit assumption in the identification strategy is that the healthcare utilization behavior of urban residents can be perfectly absorbed by the city-level controls, such as medical expenditures, consumption, the average disposable income of city residents, and region-by-year fixed effects. If the healthcare use patterns in cities or the effects of insurance on urban residents converge at the region level, the region-by-year fixed effect can do a good job of capturing those differential time trend across regions. Nevertheless, one could be concerned that unobservable characteristics

the NCMS, if there is any.

of city residents might drive our results. We employ as many flexible forms of city-level controls as possible to check the sensitivity of our results. Table 2 shows the results of the NCMS effects on total outpatient and inpatient services utilization with flexible controls in quadratic and cubic forms, as well as with flexible lagged controls. All of the results are quite robust across specifications which alleviates the concern about using outcomes at the total population level as proxies for outcomes of rural residents.

Table 2: Effects of the NCMS on Healthcare Use with Flexible City Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Panel A. Total Outpatient Service Utilization									
NCMS rate	-0.060	-0.063	-0.075	-0.077	-0.046	-0.074	-0.056	-0.064	-0.078	-0.079
	(0.050)	(0.049)	(0.057)	(0.056)	(0.054)	(0.052)	(0.057)	(0.054)	(0.054)	(0.056)
Mean	15293	15293	15293	15293	15293	15293	15293	15293	15293	15293
Observations	231	231	201	201	231	202	202	231	202	202
R-squared	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994	0.994
	Panel B. Total Inpatient Service Utilization									
NCMS rate	0.114*	0.112	0.128**	0.123**	0.090	0.117*	0.095	0.125*	0.116*	0.125*
	(0.065)	(0.068)	(0.060)	(0.059)	(0.069)	(0.058)	(0.060)	(0.068)	(0.059)	(0.063)
Mean	479.4	479.4	479.4	479.4	479.4	479.4	479.4	479.4	479.4	479.4
Observations	216	216	188	188	216	189	189	216	189	189
R-squared	0.979	0.979	0.981	0.981	0.980	0.981	0.981	0.980	0.980	0.981
Flexible unemployment		Y		Y						
Flexible lag unemployment			Y	Y						
Flexible GDP					Y		Y			
Flexible lag GDP						Y	Y			
Flexible city medical expenses								Y		Y
Flexible lag city medical expenses									Y	Y

Notes: Each cell reports an estimate of the NCMS on total outpatient visits (Panel A) and total inpatient use (Panel B) per 10,000 people from different specifications in each column using equation 1. The first column reports the estimates using our baseline model which includes full controls, region-by-year fixed effects, and province fixed effects. Column 2 adds in flexible forms of the unemployment rate including both quadratic and cubic terms. Column 3 adds in flexible forms of the unemployment rate lagged one year for both quadratic and cubic terms. Column 4 adds both flexible controls of the unemployment rate in columns 2 and 3. Columns 5 to 7 test the results using flexible GDP per capita and follow the form as the unemployment rate. Columns 8 to 10 test the results using flexible medical expenses of city residents as above. Standard errors are clustered by province and are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Parallel Trend Assumption: Although there is no consensus on methods testing the parallel trend assumption in a model with a continuous treatment in the literature, we use two strategies in our context to address this issue. First, we estimate an event study model and show the results for years before the NCMS program. Specifically, we regress outcomes of interest for the period in 1996-2003 on the 2004 NCMS enrollment rate, employing the specification in 2.[20] The treatment intensity at the beginning of the NCMS program might more likely to be path dependent on the healthcare utilization and health resources in each province, which can cause severe selection issues. Figure 2 shows the estimates of the NCMS effects on outpatient visits, emergency visits, inpatient services, and hospital discharges, respectively, in years 1996-2003 (2003 is the omitted year). All the estimates lie around the zero line and are statistically insignificant, which presents convincing evidence that the parallel trend assumption is valid. Appendix Figures A5 to A7 further show the NCMS estimates on healthcare staff, healthcare resources, and healthcare spending and demonstrate more evidence to support the parallel trend assumption.

Second, we follow the methods used in Bailey and Goodman-Bacon (2015); Goodman-Bacon (2018) and estimate the effect of the NCMS enrollment rate gains from 2004 to 2011 on a range of demographic and economic variables in 1996 to 2004.[21]

$$y_{pt} = \alpha + \beta_0 NCMS_p^{2004} + \beta_1 NCMS_p^{2004} \times (y - y^{2004}) + \xi_{pt} \tag{3}$$

where y is the dependent variables to be tested against the NCMS enrollment rate in 2004 when the program expansion began. We test for balance both in levels ($H_0 : \beta_0 = 0$) in 2004 and in linear pre-2004 trends ($H_0 : \beta_1 = 0$).

Table 3 and Table 4 test a battery of potential effects of demographic characteristics,

[20]The data for years 1996-2003 are derived from the CHY. The data for our working sample are from the CHSY in years 2004-2011. Although the CHY and the CHSY both document the healthcare outcomes of interest, there might be some inconsistencies between the two data sources. To be conservative, we do not combine the data to plot parallel trend figures. See section 3 for details of the description on each data source.

[21]As discussed, the results of the NCMS enrollment gains from 2004 to 2011 are almost identical to the results of the NCMS enrollment rate in 2004. Results are available upon request.

Table 3: Balance Test: Relationship Between the NCMS Enrollment Rate in 2004 and Pre-Expansion Characteristics in Levels and Trends

Dependent Variable	Mean in 1996	Level ($NCMS_p^{2004}$)	Trend ($NCMS_p^{2004} \times Year$)
		Panel A. Demographics (1996-2004)	
Female (%)	49.09	0.167	0.085
		(0.529)	(0.054)
Sex ratio (100)	103.8	-0.674	-0.342
		(2.171)	(0.208)
Three person household (%)	27.26	4.712	0.238
		(5.730)	(0.315)
Four person household (%)	26.80	5.271	-0.009
		(3.406)	(0.309)
Old dependency ratio (%)	10.24	-1.866	0.047
		(1.664)	(0.169)
Child dependency ratio (%)	39.47	-1.698	-0.451
		(6.588)	(0.344)
Population aged 15 to 64 (%)	66.91	1.625	0.239
		(2.679)	(0.175)
Population aged 65+ (%)	6.84	-1.209	0.038
		(1.466)	(0.105)
Primary school (%)	41.98	0.395	-0.361
		(4.420)	(0.269)
High school education (%)	8.93	-2.302	0.156
		(1.645)	(0.209)
College and above (%)	1.97	-1.755	0.017
		(1.402)	(0.178)
Birth rate (%)	14.83	-1.952	-0.267
		(1.893)	(0.268)
Population growth rate (%)	7.88	-2.798	-0.340
		(1.864)	(0.328)
		Panel B. Economic Conditions (1996-2004)	
Rural income (2014 yuan)	2,811	-4,016***	-140
		(1317)	(108)
Food consumption share in rural areas (%)	57.32	1.617	-0.751*
		(5.959)	(0.414)
Food consumption share in urban areas (%)	48.95	-0.225	0.036
		(1.833)	(0.246)
Share of medical expenses in rural areas (%)	3.66	0.203	0.053
		(1.300)	(0.102)
Share of medical expenses in urban areas (%)	3.63	0.724	0.157
		(1.252)	(0.108)
GDP per capita	7,503	-19,699***	-1,416**
		(6,321)	(550)
Unemployment rate	3.26	0.339	-0.088
		(0.598)	(0.102)

Notes: The data used are from CSY 1996 to 2004. The first column reports the mean of each dependent variable tested in 1996. Columns 2 and 3 estimate the relationship between the NCMS enrollment rate gain and the outcomes from the model weighted using the rural population in 2003: $y_{pt} = \alpha + \beta_0 NCMS_p^{2004} + \beta_1 NCMS_p^{2004} \times (y - y^{2004}) + \xi_{pt}$. Standard errors are clustered at the province level and are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

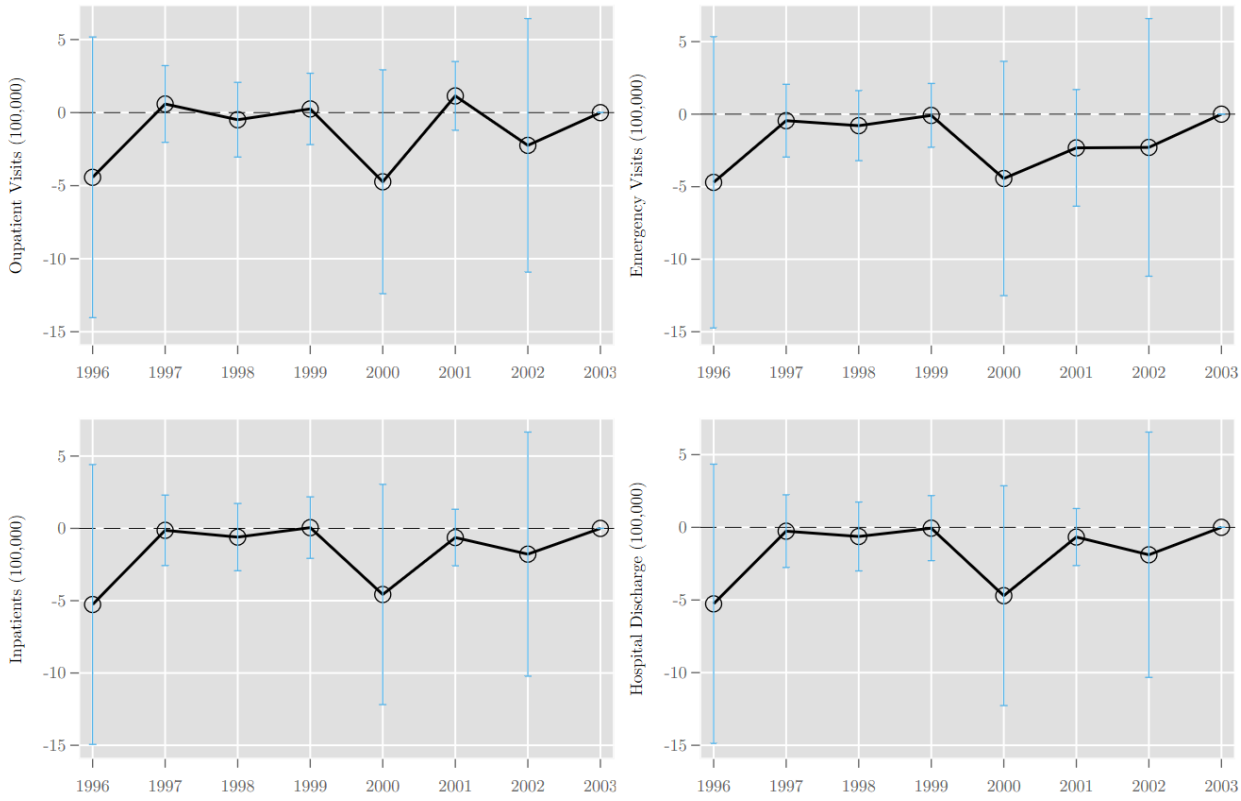

Figure 2: Parallel Trends for the NCMS Effect on the Healthcare Utilization

Notes: The data source is the CHY in 1996-2003. Each figure plots the event study in specification 2 with the baseline estimates. The y-axis is the dependent variable in log form. The interval is the 95% confident interval of each estimate.

economic conditions, and healthcare variables on the NCMS enrollment rate. We find little evidence that there are any relationships between the characteristics of a province from 1996 to 2003 and the NCMS enrollment rate in 2004. Specifically, Panel A of Table 3 shows no evidence that the initial NCMS enrollment rate is correlated with the levels or the trends in demographic characteristics across provinces. Panel B further tests the relationship between the NCMS enrollment rate and the economic conditions of a province. The results imply that provinces with lower initial NCMS enrollment rates have lower incomes. This is not surprising given that the NCMS program targets the rural population with poor resources. Nevertheless, one might be concerned that this selection issue may bias our results. We provide robustness checks controlling for income levels and income trends in

Table 4: Balance Test: Continued

Dependent Variable	Mean in 1996	Level ($NCMS_p^{2004}$)	Trend ($NCMS_p^{2004} \times Year$)
		Panel C. Healthcare (1996-2003)	
Number of institutions (K)	8.30	0.430	-0.615
		(5.437)	(0.587)
Number of hospitals (K)	2.58	-1.024	-0.194
		(1.215)	(0.281)
Number of beds (10K)	13.98	-0.6127	-0.52
		(5.750)	(0.312)
Number of beds at hospitals (10K)	12.07	-1.877	-0.541
		(6.624)	(0.522)
Beds per 1000 people	2.21	-0.826	-0.117
		(0.544)	(0.090)
Outpatient visits (10K)	21.69	-89.325	1.718
		(222.186)	(23.381)
Emergency visits (10K)	1.83	-9.360	-0.200
		(12.787)	(0.979)
Inpatient services (10K)	0.52	-0.772	0.258
		(5.015)	(0.560)
Hospital discharge (10K)	0.51	-0.755	0.257
		(5.015)	(0.561)
Medical staff (K)	233.8	-21.774	-3.154
		(104.775)	(5.563)
Doctors and nurses (K)	189.6	-44.158	-6.919
		(84.052)	(4.076)
Doctors and nurses per 1000 people	3.40	-1.089**	0.001
		(0.527)	(0.062)
Healthcare spending (10K)	0.86	4.464	0.778
		(4.692)	(0.659)
Share of health spending to fiscal resources	3.62	0.438	-0.323
		(4.435)	(0.832)
Medical fixed capital (10K)	15.04	-23.921	-1.449
		(15.051)	(3.246)

Notes: The data used are from CHY 1996 to 2003. The first column reports the mean of each dependent variable tested in 1996. Columns 2 and 3 estimate the relationship between the NCMS enrollment rate gain and the outcomes from the model weighted using the rural population in 2003: $y_{pt} = \alpha + \beta_0 NCMS_p^{2004} + \beta_1 NCMS_p^{2004} \times (y - y^{2004}) + \xi_{pt}$. Standard errors are clustered at the province level and are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

section 7. Panel C of Table 4 estimates the correlation between the NCMS enrollment rates and detailed healthcare resources, such as the number of hospitals, the number of outpatient

visits, the number of inpatient visits, the number of hospital discharges, the number of medical staff including doctors and nurses, and healthcare spending by the governments on fixed capital investment. The results alleviate the concern that the NCMS enrollment rate at the beginning of the period is selected for provinces with differential health resources.

Table 5: Effects of Province Economic Conditions on the NCMS Enrollment Rate

	(1)	(2)	(3)	(4)	(5)
Unemployment rate	0.057	0.057	-0.050	-0.407	-0.577
	(0.052)	(0.042)	(0.595)	(0.551)	(0.488)
Unemployment rate^2			0.085	0.147	0.194
			(0.149)	(0.145)	(0.126)
Unemployment rate^3			-0.011	-0.014	-0.018*
			(0.012)	(0.012)	(0.010)
GDP per capita (2014 yuan)				-0.054	0.000
				(0.050)	(0.060)
Average income per capita (2014 yuan)				-1.194**	3.477
				(0.504)	(2.181)
Average income per capita^2					-3.582*
					(1.924)
Average income per capita^3					0.100
					(0.068)
Basic demographic controls		Y	Y	Y	Y
Economic controls				Y	Y
Mean NCMS-rate	0.189	0.189	0.189	0.189	0.189
Observations	231	231	231	231	231
Adjusted R-squared	0.913	0.924	0.927	0.937	0.941

Notes: Each cell reports estimates from a separate specification. The unemployment rate, the demographics, and the economic controls for each province are from the CSY yearbooks, and the NCMS policy information is from the report on the development of the NCMS. The basic demographic controls include population, age structure, education, percentage married and female, and the ratio of dependent persons. The Economic controls include the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and city areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan). The GDP per capita, the average income per capita, and its quadratic and cubic form are re-scaled to show non-zero coefficients. All regressions include province and year fixed effects. All statistics are weighted by the rural population in 2003. Standard errors are clustered by province and are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Policy Selection on Economic Conditions: Another possible worry could be that provinces might have chosen to expand the NCMS program based on their economic

conditions, which might also affect the healthcare utilization of their residents. To address this issue, we regress our policy NCMS enrollment rate on province economic variables such as the unemployment rate, GDP per capita (2014 yuan), and the average income per capita (2014 yuan), while controlling for province and year fixed effects in a province-year panel. Table 5 reports the results using flexible forms of these economic controls. Column 1 estimates the simple relationship between the unemployment rate and the NCMS enrollment rate. Column 2 adds the basic demographic controls for each province used in equation 1 such as population, education, age structure, percentage married and female, and the ratio of dependent persons. Column 3 allows for flexible quadratic and cubic forms of the unemployment rate. Column 4 adds other economic conditions in cities, such as consumption, medical expenses, and the average income in 2014 yuan. Column 5 includes all possible economic controls and takes flexible forms of the unemployment rate and the average income per capita (2014 yuan) in rural areas. Overall, the results provide little evidence of any relationships between the NCMS expansion and economic conditions. For example, column 1 estimates that a one percentage point increase in the unemployment rate is correlated with an approximate 0.06 percentage point increase with no significance in the NCMS enrollment rate. The flexible forms in columns 4 and 5 show that there might be a significant relationship between the average income per capita of rural residents and the NCMS enrollment rate. Thus, we include this income control in our baseline model. We will nevertheless address this concern in section 7. For further evidence, Appendix Table A2 shows the estimates of the effects of lagged economic conditions on the NCMS enrollment rate. The estimates show that the lagged economic conditions have little correlation with the NCMS roll-out.

5 NCMS Effects on Outpatient Services Utilization

Although the NCMS provides very restricted coverage for outpatient visits, outpatient care constitutes the fundamental and essential part of healthcare. We thus begin by examining the relationship between the NCMS enrollment rate and outpatient services utilization by rural residents. In addition, we further estimate substitution effects of the program by service provider and visits by department to address the potential bias of using the aggregate data in a province-year panel.

Panel A of Table 6 reports baseline estimates of the model 1 and other estimates of its alternative specifications. The baseline estimate in column 1 suggests that a one percentage point increase in the NCMS enrollment rate leads to a statistically insignificant 0.06 percent decrease in outpatient visits among rural residents (approximately 9 visits per 10,000 people). Column 2 replaces region-year fixed effects with year fixed effects and shows similar results to the baseline estimates. The insensitivity of our results to the removal of region-level time trend suggests that time-varying regional changes, such as changes in socio-economic conditions and the convergence of local policies do not drive our results. One might also be concerned that our results could capture the effects of contemporaneous urbanization, economic development, and health insurance expansion in cities, which could coincide with the NCMS roll-out across provinces over time. Column 3 drops the economic controls, including the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), the disposable income in rural and urban areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan) in the baseline model and yields similar estimates, which alleviates concerns that our results capture the healthcare utilization behavior of urban residents. Column 4 further drops demographic controls and the estimate changes little compared to the baseline estimate. Column 5 without weights shows similar estimates.

The aggregate estimate above might mask the heterogeneous effect of the NCMS across providers of different levels. Assuming that rural residents value both price and proximity when choosing healthcare providers, we hypothesize that the NCMS effects are larger for

Table 6: Estimates of the Effects of the NCMS on Outpatient Services Utilization

	Panel A. Total Outpatient Services Utilization				
	(1)	(2)	(3)	(4)	(5)
	Baseline	No Region-Year FE	No Economic Controls	No Controls	Unweighted Baseline
NCMS rate	-0.060	-0.053	-0.063	-0.078	-0.025
	(0.050)	(0.041)	(0.050)	(0.047)	(0.054)
Mean	15293	15293	15293	15293	15293

	Panel B. Outpatient Services Utilization by Provider Using the Baseline Model			
	(1)	(2)	(3)	(4)
	City hospital	CHC	County hospital	THC
NCMS rate	-0.030	-0.076	0.077	0.070
	(0.040)	(0.433)	(0.056)	(0.149)
Mean	5726	602.4	3599	5365

Notes: Each cell reports estimates from a separate specification. The dependent variable is outpatient visits per 10,000 people. Panel A reports the effects of the NCMS on outpatient visits in all hospitals. Column 1 reports estimates from the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region by year fixed effects. Column 2 replaces region by year fixed effects with year fixed effects. Column 3 removes economic covariates including the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and urban areas (2014 yuan), and consumption and medical expense in cities (2014 yuan). Column 4 further drops demographic covariates including population, age structure, education level, percentage married and female, and the ratio of dependent persons in a household. The estimates in columns 1 to 4 are weighted by the rural population in 2003. Standard errors are clustered by province and are shown in parentheses. Column 5 displays the unweighted results of the baseline specification. Panel B reports the effect of the NCMS on outpatient visits at city hospitals, CHCs, county hospitals, and THCs, respectively using the baseline model 1. The mean of each dependent variable is the average in 2004 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

higher-reimbursed THCs and county hospitals which are closer to rural neighborhoods than that for city hospitals with less generosity in coverage and longer distances. Panel B of Table 6 describes the NCMS effects on outpatient services utilization across healthcare providers: city hospitals, county hospitals, CHCs, and THCs. As expected, the NCMS increases outpatient visits in county hospitals and THCs by 0.08 percent (about 3 visits per 10,000 people) with a one percentage point increment in the enrollment rate while it decreases outpatient use in city hospitals by 0.03 percent and in CHCs by 0.08 percent. This pattern of heterogeneity across providers validates the credibility of our findings. However, all of the coefficients are

statistically insignificant, presumably because of the insufficient incentives to use outpatient services under the restrictive NCMS benefit design for outpatient visits.

To further investigate the dynamic effects of the NCMS, we divide our working period into three stages according to the development of the NCMS: the rapid expansion stage (2005-2006), the close-to-full coverage stage (2007-2009), and the full coverage stage (2010-2011). Figure 3 plots the estimates on total outpatient care utilization from the event-study equation 2. Outpatient visits by rural residents decreased quickly during the rapid expansion stage in reference to 2004, caught up slightly during the close-to-full coverage stage, and continued to decline during the full coverage stage. Figure 4 in detail plots the estimates on outpatient use by healthcare provider. The results indicate that the patterns are similar at city hospitals and CHCs: outpatient visits increase slightly during the close-to-full coverage stage compared to the rapid expansion stage, and continue to decrease during the full coverage stage (however, outpatient visits picked up slightly at CHCs). By contrast, the outpatient visits at THCs increased steadily over the entire period from 2005 to 2011. The rate of increase continued even during the full coverage stage.

Overall, the dynamic patterns shown in Figures 3 and 4 are consistent with the estimates in Table 6 employing the TWFE model in equation 1: While the NCMS seems to increase outpatient visits at THCs and county hospitals, the program reduces the overall number of outpatient visits by rural residents. The reducing effect of the NCMS is mainly driven by the decrease of outpatient visits at city hospitals.

5.1 Mechanism Analysis

In this section, we explore the possible mechanisms that explain our findings: The NCMS increases outpatient visits at THCs and county hospitals, and decreases outpatient visits at city hospitals.

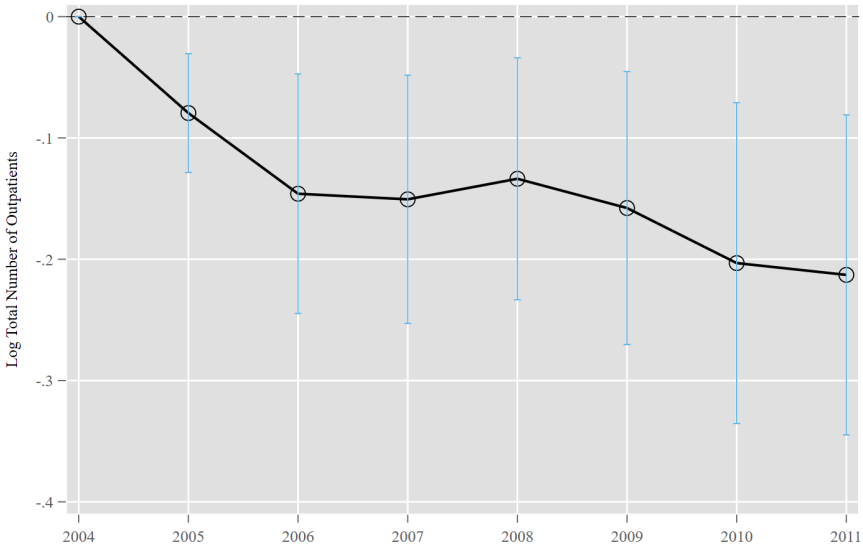

Figure 3: Event Study for the Effects of the NCMS on Total Outpatient Visits

Notes: The dependent variable is total outpatient visits per 10,000 people. The treatment variable is defined as the NCMS enrollment rate differences between 2011 and 2004. The coefficients are weighted event-study estimates from the baseline specification of equation 2. The weights are the rural populations across provinces in 2003. The 95 percent confidence intervals are calculated based on the standard errors clustered by province.

5.1.1 Supply-side Expansion in Healthcare Resources

In this section, we investigate the mechanisms through which the NCMS increases outpatient visits at county hospitals and THCs consistently despite not statistically significant (Panel B of Table 6 and Figure 4). A simple explanation is that the NCMS insurance provides coverage for healthcare services and reduces out-of-pocket medical costs, leading to the increased demand on outpatient visits. The more generosity reimbursed by the NCMS, the more utilization at healthcare providers such as THCs and county hospitals. Nevertheless, the increased use of outpatient visits can also plausibly be explained by the supply-side expansion of healthcare resources in rural areas. A distinct feature of the NCMS program is that it not only expanded insurance coverage for rural residents, it also increased investments in healthcare providers.[22] Therefore, our positive estimates on outpatient use at THCs and county hospitals can come from an increase in both healthcare demand and healthcare supply.

[22]Refer to the policy background section 2 for more details.

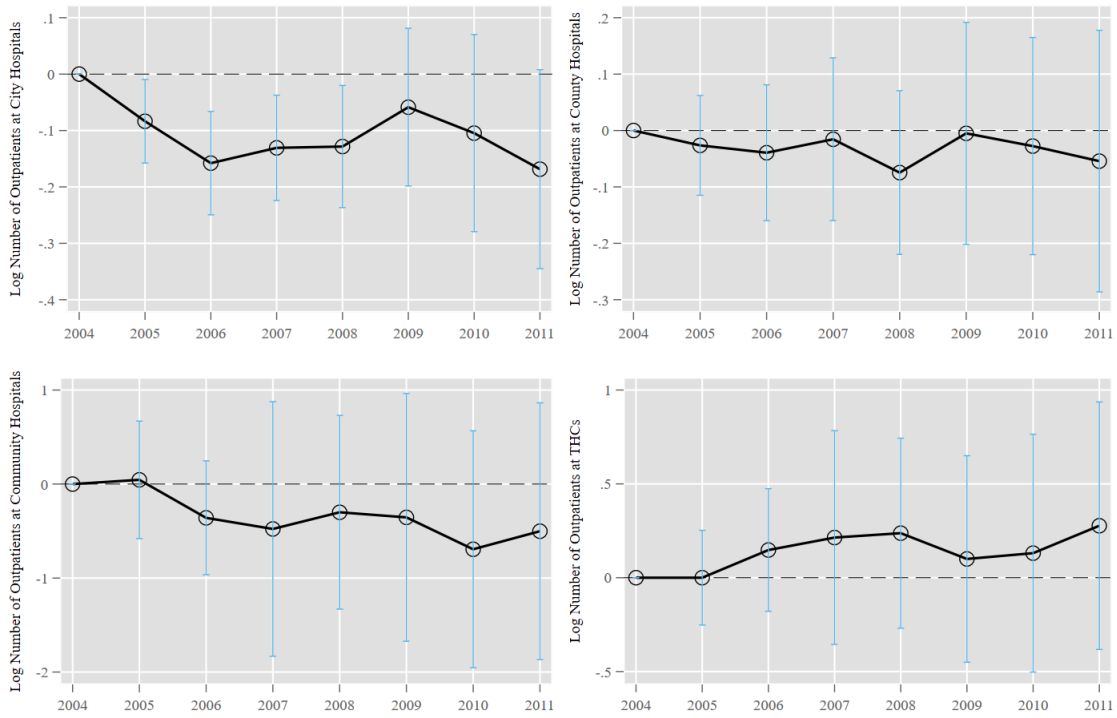

Figure 4: Event Study for the Effects of the NCMS on Outpatient Visits by Provider

Notes: The dependent variable is outpatient visits per 10,000 people. The treatment variable is defined as the NCMS enrollment rate differences between 2011 and 2004. Each figure plots the weighted event-study estimates from the baseline specification of equation 2 at city hospitals, county hospitals, CHCs, and THCs. The weights are the rural populations across provinces in 2003. The 95 percent confidence intervals are calculated based on the standard errors clustered by province.

To disentangle the NCMS effect caused by supply-side changes, we evaluate three dimensions of healthcare resources in rural areas: the number of healthcare providers, the number of beds at hospitals, and the number of medical staff. First, we examine the correlation between the NCMS enrollment rate and the healthcare supply measures in a simple univariate regression. Panel A of Table 7 shows that with a one percentage point increase in the NCMS enrollment rate, the number of CHCs significantly increases by approximately 0.9 percent, while the number of THCs decreases by around 0.3 percent. The number of county hospitals does not change in response to the NCMS. Panel B shows that the number of beds at county hospitals and primary care providers at CHCs and THCs increase significantly in response to the NCMS. Specifically, as the NCMS enrollment rate increases by one percentage point, the number of beds grows by 0.3 percent

(0.02 beds per 10,000 people) at county hospitals, by 3.6 percent (0.004 beds per 10,000 people) at CHCs, and by 0.4 percent (0.02 beds per 10,000 people) at THCs. Panel C shows that the number of medical staff in rural areas is positively correlated with the NCMS enrollment rate: the total number of staff increases by around 0.2 percent (0.04 medical staff per 10,000 people), the number of doctors increases by 0.2 percent (0.007 doctors per 10,000 people), and the number of nurses increases by 0.5 percent (0.01 nurses per 10,000 people). In summary, medical resources in rural areas expand in tandem with increases in NCMS enrollment among rural residents.

Second, we re-estimate the effects of the NCMS on healthcare use after controlling for healthcare resources. Column 1 of Table 8 reports the baseline effects of the NCMS on outpatient visits at county hospitals, and columns 2 to 4 report the estimates after controlling for inpatient beds, the number of providers, and medical staff in rural areas, respectively. The results are in line with our expectations: outpatient services utilization at county hospitals is positively correlated with the number of beds at county hospitals, the number of county hospitals, and the number of rural nurses. After controlling for these medical resources, the magnitude of the baseline effect becomes smaller, which suggests that the increase in outpatient visits at county hospitals can be attributed to the improvement in the rural healthcare supply. In total, column 5 shows that the supply-side health resources account for about half of the baseline effects of the NCMS on outpatient visits at county hospitals.[23]

5.1.2 Substitution of Different Forms of Healthcare Utilization

In this section, we provide two possible explanations for the decreasing effect of the NCMS on outpatient visits at city hospitals. First, rural residents might substitute outpatient care with services that can be provided at the inpatient department given that the NCMS has more generous coverage for inpatient services than outpatient visits.[24] For example, an

[23]The mechanisms are similar for outpatient visits at THCs. Results are available upon request.
[24]See section 2 for more details.

Table 7: Correlation Between the NCMS Expansion and Medical Resources in Rural Areas

	Panel A. Number of Healthcare Providers			
	(1)	(2)	(3)	
	County hospital	CHC	THC	
NCMS rate	-0.007	0.947***	-0.279***	
	(0.078)	(0.182)	(0.076)	
Mean	0.0667	0.105	0.334	
Observations	232	232	226	
Adjusted R-squared	-0.004	0.173	0.060	
	Panel B. Number of Beds at Hospitals			
	(1)	(2)	(3)	
	County hospital	CHC	THC	
NCMS rate	0.273***	3.573***	0.367***	
	(0.072)	(0.373)	(0.055)	
Mean	7.335	0.0976	5.280	
Observations	232	221	226	
Adjusted R-squared	0.070	0.581	0.241	
	Panel C. Number of Medical Staff			
	(1)	(2)	(3)	(4)
	Total	Doctor	Nurse	Assistant physician
NCMS rate	0.175**	0.191*	0.451***	0.050
	(0.074)	(0.093)	(0.081)	(0.129)
Mean	21.12	3.653	2.747	1.552
Observations	232	232	232	232
Adjusted R-squared	0.032	0.022	0.127	-0.003

Notes: Each cell reports estimates from a simple univariate regression of the NCMS enrollment rate on dependent variables per 10,000 people in logarithm form in each panel. The mean of each dependent variable is the average in 2004 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

Table 8: The NCMS Effect on Outpatient Visits at County Hospitals Controlling for Rural Healthcare Resources

	(1)	(2)	(3)	(4)	(5)
NCMS rate	0.077	0.060	0.022	0.058	0.038
	(0.056)	(0.043)	(0.039)	(0.059)	(0.044)
THC beds		-0.059			0.002
		(0.042)			(0.073)
County hospital beds		0.666***			0.474***
		(0.073)			(0.091)
CHC beds		0.001			-0.004
		(0.007)			(0.007)
Number of THCs			0.013		-0.019
			(0.051)		(0.083)
Number of county hospitals			0.419***		0.211***
			(0.062)		(0.067)
Number of CHCs			-0.009		0.013
			(0.016)		(0.015)
Rural staff				-0.046	0.174*
				(0.123)	(0.094)
Rural doctors				-0.049	0.014
				(0.100)	(0.069)
Rural nurses				0.229***	-0.089
				(0.072)	(0.099)
Rural assistant physicians				-0.071	-0.080**
				(0.053)	(0.038)
Mean	3599	3599	3599	3599	3599

Notes: Each cell reports estimates of the effects of the NCMS on outpatient visits at county hospitals after controlling for each set of healthcare resources: hospital beds, number of providers, and number of medical staff in rural areas using the baseline model 1. The mean of the dependent variable is the average of outpatient visits in 2004 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

ultrasound guided puncture procedure could be performed at both outpatient and inpatient departments. Thus a rural resident who could have received outpatient care for the procedure without the NCMS may have chosen to get treated at an inpatient department with lower out-of-pocket costs. We propose two hypotheses regarding this substitution: the negative effects of the NCMS on outpatient services that are more substituted may have been larger; the negative effects of the NCMS on the substitution of outpatient services may have been greater in provinces with more inpatient care use. Tables 9 and 10 show preliminary evidence

to support our hypotheses.

Table 9 reports the estimates of the effects of the NCMS on common outpatient specialty visits at hospitals. Each estimate is a coefficient from regressing the department visits per 10,000 people on the NCMS enrollment rate using the baseline model 1. The NCMS leads to an insignificant increase in outpatient visits at internal medicine, gynecology, and ophthalmology departments, which are popular among rural residents (with a higher mean) and it leads to an decrease in visits at general (with statistical significance), preventive care, and rehabilitation departments. The services at internal medicine, gynecology, and ophthalmology departments tend to be provided through outpatient visits, while the services at general, preventive care, and rehabilitation departments are not exclusively provided through outpatient visits, and could be preformed at home or at other facilities.[25] This piece of evidence supports that more substituted outpatient services responded more negatively to the introduction of the NCMS.

Table 10 shows the estimates of the effects of the NCMS on department visits including the interactive term between the NCMS enrollment rate and inpatient use in the baseline model 1. Panel A reports the estimates for the interactive term between the NCMS rate and inpatient care use with primary care providers at CHCs and THCs. Panel B shows the results for the interactive term between the NCMS rate and inpatient care use at city and county hospitals. We expect the interaction in Panel A to be negative and the interaction in Panel B to be ambiguous given that outpatient and inpatient services within one provider could substitute or complement each other. Six out of nine interactive estimates in Panel A are negative, which implies that rural residents use inpatient care by primary care providers at CHCs and THCs with generous coverage as a substitute for outpatient visits at city hospitals. Panel B shows that services at general practice and preventive care departments are substitutes for inpatient care, while services at other departments are complements for inpatient use within hospitals. Other than the substitution effect that dominates at general

[25]Rehabilitation can be done at home or in some skilled facilities.

Table 9: Estimates of the Effects of the NCMS on Outpatient Service Utilization by Department

	(1) General	(2) Preventive	(3) Rehabilitation	(4) Pediatrics	(5) Physical	(6) Emergency	(7) Otolaryngology	(8) Oral	(9) Dermatology	(10) Internal	(11) Gynecology	(12) Ophthalmology
NCMS rate	-0.577*	-0.530	-0.321	-0.094	-0.061	-0.052	-0.041	-0.035	-0.009	0.079	0.050	0.015
	(0.307)	(0.428)	(0.259)	(0.067)	(0.074)	(0.188)	(0.064)	(0.105)	(0.099)	(0.074)	(0.081)	(0.069)
Mean	364.5	116.1	94.85	1109	1137	493.7	366.1	372.1	376.3	2640	1122	381.2
Observations	145	145	145	145	145	145	145	145	145	145	145	145
R-squared	0.960	0.950	0.957	0.996	0.994	0.988	0.995	0.992	0.992	0.994	0.996	0.995

Notes: The data on outpatient department visits are from 2007 to 2011. The dependent variable is log outpatient visits per 10,000 people by department. The model used is the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region by year fixed effects, weighted by the rural population in 2003. Standard errors are clustered by province and are shown in parentheses. The mean of each dependent variable is the average from 2007 to 2011 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

and preventive departments shown in Table 9, there might have been spillover effects of inpatient care use on outpatient visits within hospitals, which may have increased the use of outpatient services at some departments.

Second, rural residents might substitute outpatient services across providers. On the one hand, while the ranking of care quality is not straightforward among primary care providers, city hospitals in general provide the best quality care and county hospitals offer better quality care than primary care providers. If budget constraint and distance is not an issue, a city hospital may be seen as providing the best treatment, while a county hospital could be the second-best choice if a city hospital is not easily accessible. On the other hand, the NCMS employs a hierarchical reimbursement scheme. The most generous coverage is for healthcare rendered by primary care providers at CHCs and THCs; while the coverage is lower at county hospitals; and the generosity is even lower at city hospitals. Therefore, for an average rural resident, the county hospital might have been the best option if the person valued better quality care, and the THC could have been the best option if the person valued accessibility combined with affordability. The results of Table 6 support this hypothesis: the decrease in outpatient visits at expensive city hospitals is offset by the increase in outpatient visits at the more affordable county hospitals and THCs.

6 NCMS Effects on Inpatient Services Utilization

As the NCMS reimburses more generously for inpatient care, we hypothesize that the effect of the NCMS on inpatient services utilization is positive. Panel A of Table 11 shows these estimates from the baseline model 1 and its alternative specifications with a format similar to that in Table 6. The baseline estimate in column 1 suggests that a one percentage point increase in the NCMS enrollment rate significantly increases inpatient services use of rural residents by 0.1 percent (about 0.5 hospital stays per 10,000 people). The larger estimate in column 2, 0.16 percent as compared to the baseline estimate of 0.1 percent, implies that

Table 10: Substitution Effects of the NCMS on Healthcare Utilization

	(1) General	(2) Preventive	(3) Rehabilitation	(4) Pediatrics	(5) Physical	(6) Emergency	(7) Otolaryngology	(8) Oral	(9) Dermatology
Panel A. Interacting the NCMS With Inpatient Services in CHCs and THCs									
NCMS*inpatient	-0.028	-0.523	0.149	-0.087	-0.080	-0.404	0.039	-0.210	-0.219
	(0.546)	(0.836)	(0.793)	(0.164)	(0.153)	(0.509)	(0.193)	(0.326)	(0.271)
Panel B. Interacting the NCMS With Inpatient Services in City and County Hospitals									
NCMS*inpatient	-0.398	-0.384	0.218	0.024	0.233	0.400	0.048	0.090	0.014
	(0.954)	(1.152)	(0.857)	(0.256)	(0.163)	(0.450)	(0.182)	(0.334)	(0.305)
Panel C. Interacting the NCMS With Outpatient Services in THCs									
NCMS*outpatient	2.013*	3.638**	1.559	-0.027	0.443	0.388	-0.257	-0.835	-0.093
	(1.080)	(1.735)	(1.100)	(0.380)	(0.352)	(0.842)	(0.348)	(0.718)	(0.516)
Mean	364.5	116.1	94.85	1109	1137	493.7	366.1	372.1	376.3
Observations	145	145	145	145	145	145	145	145	145

Notes: The data on outpatient department visits are from 2007 to 2011. The dependent variable is log outpatient visits per 10,000 people by department. The model used is the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region by year fixed effects, weighted by the rural population in 2003. Standard errors are clustered by province and are shown in parentheses. The mean of each dependent variable is the average from 2007 to 2011 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

omitting region-level characteristics (e.g. the expansion of health insurance among urban residents) might lead to an overestimation of the NCMS effect on inpatient services utilization by around 0.05 percent. Column 3 provides further evidence that omitting economic controls for urban residents leads to an overestimation of the NCMS effect by 0.02 percent. Column 4 indicates that omitting both demographic controls and economic controls leads to an overestimation by about 0.09 percent, which points to the importance of controlling for time-varying demographic and social-economic conditions across provinces and regions. The similar unweighted coefficient presented as the baseline estimate in column 5 implies that the effect of the NCMS on inpatient care is robust to dropping the analytical weights for the rural population in 2003.

Given the hierarchical reimbursement scheme under the NCMS, we hypothesize that the NCMS imposes larger incentives for rural residents to use inpatient services with primary healthcare providers. Panel B of Table 11 shows that the positive effect of the NCMS on inpatient services utilization is mainly produced by increased use of primary care providers at CHCs and THCs. The largest effect is at CHCs with a 1.6 percent increase; followed by THCs with a 0.4 percent increase; at county hospitals with a 0.1 percent increase; and at city hospitals with an increase that is close to null.

Figures 5 and 6 plot the dynamic effects of the NCMS on inpatient services utilization for inpatient services in total and by provider, respectively. Figure 5 shows that during the rapid expansion stage (2005-2006), the decline in total inpatient services utilization was relatively small in the provinces that had experienced a larger NCMS expansion. During the close-to-full coverage stage (2007-2009), inpatient use caught up rapidly in the provinces with a larger NCMS expansion, but this increasing momentum slowed and began to decline during the full coverage stage (2010-2011). The pattern of inpatient care use across providers displayed in Figure 6 indicates that the NCMS significantly increases inpatient stays at county hospitals, CHCs, and THCs. While the NCMS effect on inpatient care at city hospitals fails to achieve statistical significance in Table 11 (column 1 of panel

Table 11: Baseline Estimates of the NCMS Effects on Inpatient Services Utilization

	Panel A. Total Inpatient Services Utilization				
	(1)	(2)	(3)	(4)	(5)
	Baseline	No Region-Year FE	No Economic Controls	No Controls	Unweighted Baseline
NCMS rate	0.114*	0.160**	0.134**	0.200***	0.126**
	(0.065)	(0.073)	(0.065)	(0.058)	(0.046)
Mean	479.4	479.4	479.4	479.4	479.4
	Panel B. Inpatient Service Utilization by Provider				
		(1)	(2)	(3)	(4)
		City hospital	CHC	County hospital	THC
NCMS rate		0.032	1.647*	0.116***	0.360*
		(0.041)	(0.850)	(0.041)	(0.184)
Mean		183.4	0.995	169.1	127.6

Notes: Each cell reports estimates from a separate specification. The dependent variable is inpatient visits per 10,000 people. Panel A reports the effect of the NCMS on inpatient care use in all hospitals. Column 1 reports estimates from the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region by year fixed effects. Column 2 replaces region by year fixed effects with year fixed effects. Column 3 removes economic covariates including the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and urban areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan). Column 4 further drops demographic covariates including population, age structure, education level, percentage of married and female, and the ratio of dependent persons in a household. The estimates of columns 1 to 4 are weighted by the rural population in 2003. Standard errors are clustered by province and are shown in parentheses. Column 5 indicates the unweighted results of the baseline specification. Panel B reports the effect of the NCMS on outpatient visits at city hospitals, CHCs, county hospitals, and THCs, respectively using the baseline model 1. The mean of each dependent variable is the average in 2004 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

B), Figure 6 shows an upward trend. The inconsistency between the event-study estimates of equation 2 and the estimates of equation 1 is due to the intent-to-treat (ITT) estimand defined in the event-study specification. The ITT estimates shown in Figures 5 and 6 are smaller than the average treatment effect on the treated (ATT) shown in the specification 1. Overall, the patterns of these two estimands are consistent.

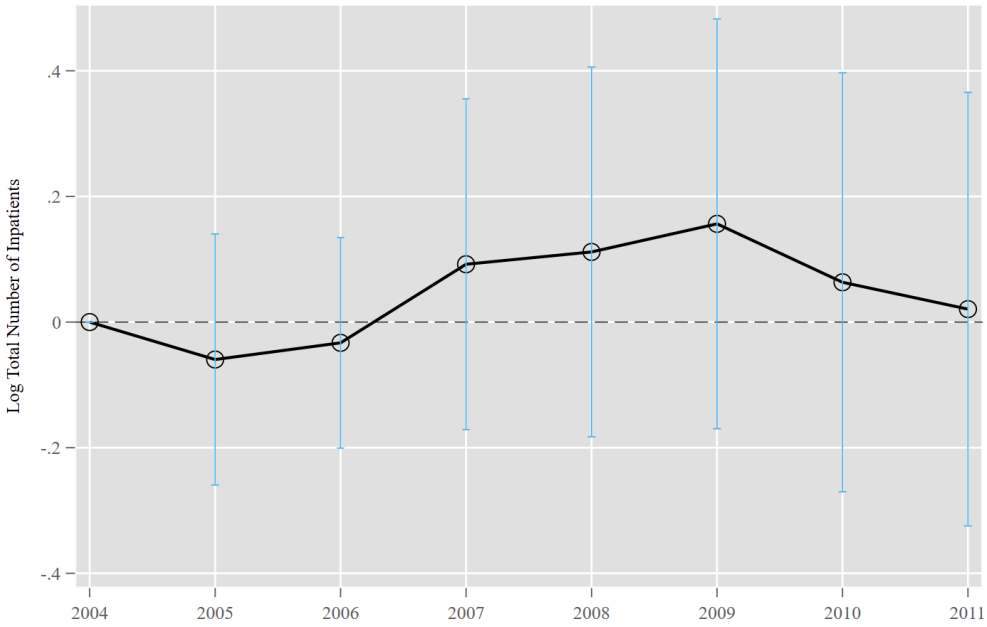

Figure 5: Event Study for the Effects of the NCMS on Total Inpatient Care Use

Notes: The dependent variable is the inpatient care use per 10,000 people. The treatment variable is defined as the NCMS enrollment rate differences between 2011 and 2004. The coefficients are weighted event-study estimates from the baseline specification of equation 2. The weights are the rural population across provinces in 2003. The 95 percent confidence intervals are calculated based on the standard errors clustered by province.

6.1 Mechanism Analysis

Similar to section 5.1, we explore the supply-side mechanism through which the NCMS leads to a significant increase in inpatient services use at county hospitals, CHCs, and THCs (Panel B of Table 11). Table 12 describes the effects of the NCMS on inpatient care utilization after controlling for rural healthcare resources. Panel A shows that controlling for hospitals beds decreases the baseline effects of the NCMS on total inpatient stays by 0.09 percent (0.44 inpatient stays per 10,000 people), 0.33 percent (0.03 inpatient stays per 10,000 people) at CHCs, 0.06 percent (0.1 inpatient stays per 10,000 people) at county hospitals, and 0.48 percent (0.62 inpatient stays per 10,000 people) at THCs, compared to the baseline estimates in Table 11. It is noteworthy that the NCMS effect on inpatient services utilization at THCs is close to null, and becomes insignificant after controlling for hospitals beds (Column 4 of Table 12). This suggest that the baseline effect at THCs is mainly driven by the increase

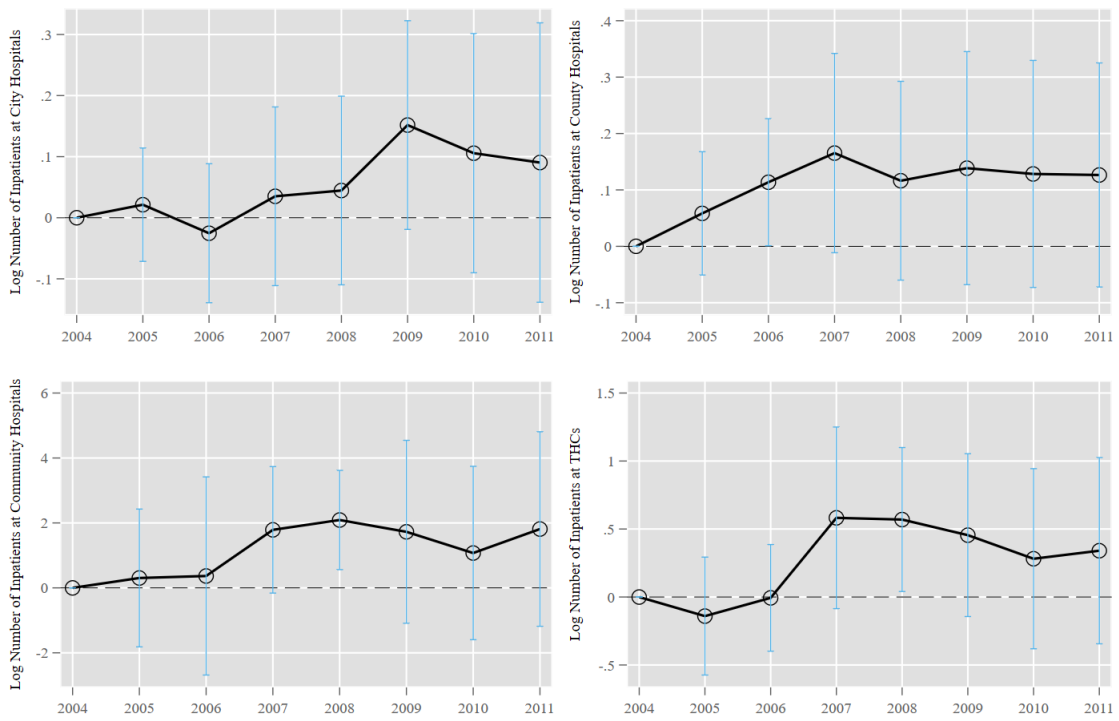

Figure 6: Event Study for the Effects of the NCMS on Inpatient Care Use by Provider

Notes: The dependent variable is the inpatient use per 10,000 people. The treatment variable is defined as the NCMS enrollment rate differences between 2011 and 2004. Each figure plots the weighted event-study estimates from the baseline specification of equation 2 at city hospitals, county hospitals, CHCs, and THCs. The weights are the rural population across provinces in 2003. The 95 percent confidence intervals are calculated based on the standard errors clustered by province.

in hospital beds. Panel B further shows evidence that the number of providers also plays a role in the effects of the NCMS on inpatient care use. We find that these mitigating effects are smaller than those of hospital beds in Panel A of Table 12. This is understandable given that the number of hospital beds directly impacts the capacity of inpatient services utilization. Panel C shows that controlling for medical staff merely changes the magnitudes of our baseline estimates shown in Table 11. Appendix Table A3 reports the NCMS estimates on inpatient use after adding all of the controls of rural healthcare resources from model 1. Compared to the baseline estimates in Table 11, total medical resources account for about 93 percent of the effects of the NCMS on total inpatient services utilization, 57 percent of the NCMS effect at CHCs, and 50 percent of the NCMS effect at county hospitals, and they absorbs all of the NCMS effect at THCs.

Table 12: The NCMS Effect on Inpatient Care Use Controlling for Rural Healthcare Resources

	(1) Total	(2) CHC	(3) County hospital	(4) THC
	Panel A. Number of Beds at Hospitals			
NCMS rate	0.052	0.892**	0.070**	-0.023
	(0.057)	(0.414)	(0.026)	(0.124)
THC beds	0.242	-0.020	0.086	1.162***
	(0.143)	(0.495)	(0.056)	(0.135)
County hospital beds	0.343**	0.120	0.759***	0.324
	(0.150)	(0.840)	(0.077)	(0.272)
CHC beds	-0.005	1.050***	-0.007	0.003
	(0.010)	(0.127)	(0.005)	(0.021)
	Panel B. Number of Healthcare Providers			
NCMS rate	0.096	1.767**	0.075*	0.278
	(0.066)	(0.716)	(0.043)	(0.178)
Number of THCs	0.137	0.720	0.125	1.283***
	(0.118)	(0.607)	(0.098)	(0.165)
Number of county hospitals	0.081	-0.116	0.326***	0.076
	(0.128)	(0.876)	(0.077)	(0.221)
Number of CHCs	0.021	0.645**	0.002	0.060
	(0.022)	(0.314)	(0.014)	(0.054)
	Panel C. Number of Medical Staff			
NCMS rate	0.095	1.731*	0.090**	0.356*
	(0.061)	(0.862)	(0.035)	(0.176)
Rural staff	0.122	1.101	-0.046	0.256
	(0.112)	(1.496)	(0.136)	(0.361)
Rural doctors	-0.199	-0.448	-0.085	-0.073
	(0.125)	(1.218)	(0.120)	(0.235)
Rural nurses	0.268	0.738	0.352***	0.426
	(0.169)	(1.160)	(0.126)	(0.308)
Rural assistant physicians	0.020	-0.049	-0.090**	-0.021
	(0.051)	(0.732)	(0.038)	(0.156)
Mean	479.4	0.995	169.1	127.6

Notes: Each cell reports estimates of the effects of the NCMS on inpatient care use after controlling for each set of healthcare resources: hospital beds, number of providers, and number of medical staff in rural areas using the baseline model 1. Each column corresponds to the estimates of inpatient care at specific hospitals. The mean of the dependent variable is the average of inpatient care use in 2004 per 10,000 people and is weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

6.2 Heterogeneity Analysis

We find that the NCMS led to increases in inpatient care use of by rural residents at CHCs, county hospitals, and THCs, as shown in section 6. However, the overall results might mask some unique patterns in certain provinces. In this section, we analyze the heterogeneous effects of the NCMS on inpatient services by levels of urbanization and NCMS coverage generosity. First, we expect to see that the effects of the NCMS on inpatient care are smaller in more urbanized provinces. For example, rural residents who are covered relatively well in provinces with more established healthcare systems may be less likely to respond to the NCMS. Panel A of Table 13 reports the coefficients of the interaction term between the NCMS enrollment rate and the average of the within-province urbanization rate, which is captured by the share of urban population. Consistent with our hypothesis, rural residents in more urbanized provinces are less likely to use inpatient services in general (column 1). Specifically, we assume that the rollout of the NCMS is less likely to lead to increases in inpatient stays at city hospitals and county hospitals in provinces with higher urbanization rates. This assumption is reasonable given that in the more urbanized provinces, the utilization of inpatient services is already high before the NCMS expansion because they have better economic conditions and local government welfare programs.[26]

Second, we hypothesize that the effects of the NCMS on inpatient care use are positively correlated with the generosity of the benefits for inpatient care. The NCMS' reimbursement rate for inpatient stays determines the out-of-pocket expenses that rural residents pay. We assume that if rural residents are price-sensitive, the provinces with higher levels of NCMS coverage for inpatient care would use more inpatient services. Panel B of Table 13 shows the estimates of the interaction term between the NCMS rate and the generosity of the

[26]For example, in Shanghai, the average urbanization rate from 2004 to 2011 is about 86 percent, and the share of inpatients among the total population in 2004 is about 75 percent; and in Beijing, the urbanization rate is close to 76 percent, and the 2004 share of inpatients is close to 77 percent. In contrast, in Yunnan, the urbanization rate is around 16 percent, and the 2004 share of inpatients is about 11 percent; and in Guizhou, the urbanization rate is approximately 16 percent, and the 2004 share of inpatients is as low as eight percent.

Table 13: Heterogeneous Effects of the NCMS on Inpatient Services Utilization

	(1) Total	(2) City hospital	(3) CHC	(4) County hospital	(5) THC
Panel A. Heterogeneous NCMS Effects by Urbanization					
NCMS rate	0.342**	0.271***	1.264	0.317***	0.392
	(0.138)	(0.067)	(1.440)	(0.096)	(0.363)
NCMS rate*urbanization	-0.007*	-0.007***	0.011	-0.006**	-0.001
	(0.004)	(0.002)	(0.032)	(0.003)	(0.010)
Panel B. Heterogeneous NCMS Effects by Inpatient Reimbursement Rate					
NCMS rate	-0.245	-0.077	3.189	-0.370	0.333
	(0.482)	(0.263)	(2.931)	(0.330)	(1.025)
NCMS rate*reimbursement	0.011	0.003	-0.047	0.014	0.002
	(0.014)	(0.007)	(0.086)	(0.010)	(0.029)
Panel C. Heterogeneous NCMS Effects by Older Population Share					
NCMS rate	-0.244	-0.290**	3.429	0.073	-0.309
	(0.196)	(0.127)	(2.093)	(0.213)	(0.399)
NCMS rate*age 65 percentage	3.887**	3.411**	-17.501	0.639	7.240*
	(1.865)	(1.267)	(18.504)	(2.277)	(3.570)

Notes: Each cell reports estimates from a separate specification using the baseline model 1, with full controls of time-varying demographic covariates and economic covariates for each province, province fixed effects, and region-by-year fixed effects. The dependent variable is inpatient visits per 10,000 people by provider: city hospitals, CHCs, county hospitals, and THCs. Panel A reports the heterogeneous effects of the NCMS on inpatient care use by the average of the within-province urbanization rate, which is captured by the share of urban population. Panel B reports the heterogeneous effects of the NCMS on inpatient visits by the generosity of inpatient reimbursement, measured as the mean of the within-province reimbursement rate from 2004 to 2011. The demographic covariates include population, age structure, education level, percentage married and female, and the ratio of dependent persons in a household. The economic covariates include the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and urban areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan). All estimates are weighted by the rural population in 2003. Standard errors are clustered by province, and are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

inpatient reimbursement rate, measured as the mean of the within-province reimbursement rate from 2004 to 2011. Rural residents use more inpatient services at city hospitals, county hospitals, and THCs with higher inpatient reimbursement rates. However, the differences in the levels of inpatient care use in provinces with higher and with lower reimbursement rates

are statistically insignificant. To explore the reasons why there are no differences in levels of inpatient care use, Appendix Figure A4 plots the distribution of the average inpatient reimbursement rates across provinces, with the rates ranging from 25 to 45 percent. For instance, the average cost of an inpatient stay in 2020 was about 10,600 RMB, which implies that the differences in the out-of-pocket payments are less than 2,200 RMB. Therefore, the NCMS's low levels of coverage of inpatient care does not generate sufficient incentives for residents to use significantly more inpatient services, even in the relatively well-insured provinces.

Third, as is documented in the literature, the elderly uses the majority of inpatient services. Therefore, we expect to see larger effect in provinces with a larger share of people age 65 and above. In Panel C of Table 13, we interact the NCMS effect with the percentage of older group by provider and report positive and significant coefficients on the interacted terms for total hospitalization, hospitalization in city hospital, and THCs. Specifically, provinces with more elderly tend to see larger hospitalizations in city hospitals and THCs, suggesting that rural elderly tend to rely on city hospitals and THCs for inpatient services.

7 Robustness Checks

Our identification asssumption relies on the variation in NCMS enrollment within provinces. As discussed in section 4.3, one of the identification threats is that the NCMS development might be endogenous to economic conditions, which in turn can be correlated with healthcare utilization. The balance tests in Table 3 suggest little evidence on significant relationships between the NCMS enrollment rate and a battery of controls except the GDP per capita variable. To clear this concern, column 2 of Appendix Table A4 reports the estimates after including an interaction term between GDP per capita and time trends in our baseline specification 1. In addition, the endogeneity test shown in Table 5 shows that the rural income might be correlated with our treatment variable. To check the sensitivity of our

results, column 3 of Appendix Table A4 further controls for average rural income in flexible form. Columns 4 to 5 show the results of the NCMS effect on healthcare utilization after controlling for unemployment rate, lagged unemployment rate, GDP per capita, lagged GDP per capita, medical expenses by urban residents, and lagged medical expense by urban residents. These results suggest that our estimates are not sensitive to the demand-side controls, although there is a loss in statistical significance on inpatient services due to larger standard errors, which suggests that these controls might absorb too much variation in the NCMS enrollment rate with a small sample size in our context. Reassuringly, the magnitude of these coefficients is similar to that of our baseline estimates.

8 Effects on Medical Expense and Health Outcome

8.1 Effects of the NCMS on Medical Expense

We find that the NCMS has led to increases in healthcare service utilization among rural residents, which could decrease or increase their out-of-pocket medical expenses, including for both premiums and co-payments. On the one hand, a beneficiary covered by the NCMS might pay less for healthcare, which lower his or her average medical expenditures. On the other hand, the NCMS may cause beneficiaries' average medical expenditures to increase through two channels: by encouraging rural beneficiaries to consume more healthcare, and by requiring previously uninsured rural residents to pay insurance premiums. Therefore, the out-of-pocket medical expenses paid by rural residents are negatively correlated with the generosity of the NCMS benefits, and positively correlated with premiums and with the healthcare utilization of rural residents.

Table 14 shows the estimates of the effects of the NCMS on medical expenditures and on the share of medical expenditures, separately. Column 1 of Panel A shows that the NCMS does not lead to significant changes in the average medical expenditures of rural residents using the baseline specification 1. The estimate is statistically insignificant and

Table 14: Estimates of the NCMS Effect on Medical Expenditure in Rural Areas

	(1) Baseline	(2) No Region-Year FE	(3) No Economic Controls	(4) No Controls	(5) Unweighted Baseline
			Panel A. Medical Expenditure per Capita		
NCMS rate	-0.021	0.013	0.126	0.165	-0.026
	(0.068)	(0.063)	(0.105)	(0.102)	(0.073)
R-squared	0.980	0.976	0.973	0.972	0.976
Mean	173.7	173.7	173.7	173.7	173.7
			Panel B. Ratio of Medical Expenditure to Consumption		
NCMS rate	-0.000	0.002	0.007	0.009	-0.003
	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)
R-squared	0.925	0.916	0.911	0.907	0.913
Mean	0.0578	0.0578	0.0578	0.0578	0.0578

Notes: Each cell reports estimates from a separate specification. Column 1 reports estimates from the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region-by-year fixed effects. Column 2 replaces region-by-year fixed effects with year fixed effects in a standard TWFE specification. Column 3 removes economic covariates, including the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and urban areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan). Column 4 further drops demographic covariates, including population, age structure, education level, percentage married and female, and the ratio of dependent persons in a household. The estimates of columns 1 to 4 are weighted by the rural population in 2003. Standard errors are clustered by province, and are shown in parentheses. Column 5 displays the unweighted results of the baseline specification. The mean of each dependent variable is the average in 2004, weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

robust to replacing region-by-year fixed effects with year fixed effects (column 2), removing city-level controls (column 3), dropping all province-level time-varying covariates (column 4), and dropping weights (column 5). Panel B reports the estimates of the share of medical expenditures in total consumption in rural areas. Consistent with the close-to-null findings on medical expenditures in Panel A, we find that the NCMS does not change the percentage of medical expenses in total consumption among rural residents. This result is quite robust across specifications in columns 2 to 5. In summary, the NCMS does not lead to increases in the financial burdens of rural residents, even though it improves their healthcare utilization.

Table 15: Estimates of the NCMS Effect on Mortality Rate

	(1) Baseline	(2) No Region-Year FE	(3) No Economic Controls	(4) No Controls	(5) Unweighted Baseline
NCMS rate	0.199	0.231	0.111	0.237**	0.091
	(0.161)	(0.149)	(0.109)	(0.114)	(0.135)
R-squared	0.917	0.906	0.913	0.888	0.914
Mean	6.162	6.162	6.162	6.162	6.162
Observations	231	231	232	232	231

Notes: Each cell reports estimates from a separate specification on the dependent variable, mortality rate. Column 1 reports estimates from the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region-by-year fixed effects. Column 2 replaces region-by-year fixed effects with year fixed effects in a standard TWFE specification. Column 3 removes economic covariates, including the unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and urban areas (2014 yuan), and consumption and medical expenses in cities (2014 yuan). Column 4 further drops demographic covariates, including population, age structure, education level, percentage married and female, and the ratio of dependent persons in a household. The estimates of columns 1 to 4 are weighted by the rural population in 2003. Standard errors are clustered by province, and are shown in parentheses. Column 5 displays the unweighted results of the baseline specification. The mean of the dependent variable is the average in 2004, weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

8.2 Effects of the NCMS on Mortality

Table 15 reports the effects of the NCMS on mortality. Overall, the rollout of the insurance program does not substantially affect mortality rates. Column 1 shows that the NCMS has little effect on the mortality of rural residents using the baseline specification 1. The estimate is statistically insignificant and robust to replacing region-by-year fixed effects with year fixed effects (column 2), removing city-level controls (column 3), and dropping weights (column 5). The estimate in column 4 of the specification that drops all controls becomes statistically significant, while the magnitude of the coefficient is similar to that in our baseline model (column 1). This suggests that the omission of variables might overestimate the true effects, and generate an imprecise confidence interval.

The estimates on all-cause mortality rate shown in Table 15 can mask potential benefits from the NCMS on particular diseases. As the program rolled out, it increased coverage for some preventive and highly infectious diseases such as AIDS/HIV, hepatitis,

Table 16: Estimates of the NCMS Effect on Incidence and Mortality Rate by Disease

	Panel A. Incidence Rate by Disease							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Infection	Measles	AIDS	HIV	Tuberculosis	Hepatitis	Dengue fever	Rabies
NCMS rate	-136.087*	5.757	-0.340	0.747	-4.046	-24.071	-0.201	-0.038
	(67.689)	(4.066)	(0.410)	(0.807)	(8.325)	(16.956)	(0.349)	(0.120)
R-squared	0.915	0.464	0.887	0.948	0.950	0.932	0.533	0.870
Mean	522.4	5.699	0.259	1.096	76.86	91.51	0.043	0.239
Observations	231	231	230	231	231	231	110	177

	Panel B. Mortality Rate by Disease						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Infection	Measles	AIDS	HIV	Tuberculosis	Hepatitis	Rabies
NCMS rate	-0.454	-0.010	-0.379*	-0.238	0.062	0.007	-0.038
	(0.439)	(0.011)	(0.199)	(0.277)	(0.041)	(0.033)	(0.120)
R-squared	0.898	0.557	0.847	0.881	0.882	0.820	0.873
Mean	0.773	0.006	0.062	0.003	0.104	0.078	0.239
Observations	231	101	229	197	230	227	177

Notes: Each cell reports estimates from a separate specification on the dependent variable by disease using the baseline equation 1, with full controls of both time-varying demographic covariates and economic covariates for each province, province fixed effects, and region-by-year fixed effects. The detailed incidence rate and mortality rate by disease data is from Chinese Center for Disease Control and Prevention. Panel A reports the estimates on incident rate per 100,000 people and Panel B reports the estimates on mortality rate per 100,100 people. There are not enough observations on mortality rate of Dengue fever. Standard errors are clustered by province, and are shown in parentheses. The mean of the dependent variable is the average in 2004, weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

and catastrophic diseases.[27] We collect information about incidences and deaths by disease of each province from the Chinese Center for Disease Control and Prevention (CDC) to explore further evidence on potential benefits of the NCMS on some conditions. Panel A of Table 16 reports the effects of the NCMS on incidence rates per 100,000 people across diseases. The NCMS significantly reduces the incidence rate of infectious diseases by 0.3 percent with a one percentage point increase in NCMS enrollment rate (Column 1). Columns 2 to 8 show estimates on particular infections such as measles, AIDS/HIV,

[27]Infectious diseases include 57 conditions reported by the Chinese Center for Disease Control and Prevention. Catastrophic diseases include common cancers such as leukemia among children, breast cancer and cervical cancer among women, serious mental illness, and end-stage renal disease, to name a few. These severe diseases place a high risk to put rural residents into poverty.

tuberculosis, hepatitis, dengue fever, and rabies. Overall, the NCMS seems to decrease the incidence rate for most of these infectious diseases while the estimates are imprecise due to the small sample size (Columns 7 and 8). Panel B reports the estimates of the NCMS on mortality rate by disease. The NCMS is effective to reduce AIDS deaths by 6 percent with a mean of 6 deaths per 100,000 people with a one percentage point increase in NCMS enrollment. The magnitudes on mortality rates of all infectious conditions in column 1 is about 0.6 percent with no statistical significance and 79 percent for HIV given a small mortality rate, 0.003 among 100,000 people in column 4. The magnitude of other coefficients is economically small and not statistically significant.

In summary, the introduction of the NCMS does not reduce all-cause mortality rate but it seems to be effective to prevent some infectious diseases such as AIDS/HIV. Some of these estimates should be interpreted as suggestive with less precision due to a small sample size. Nevertheless, they do implicate some potential benefits of the NCMS on reducing the mortality rate on AIDS.

9 Discussion and Conclusion

This paper studies the effect of the NCMS program on healthcare utilization, OOP payment, and mortality of rural residents in China. The NCMS is one of the largest scale insurance expansion program targeting the rural poor among LMICs. Comparing to other insurance programs, the NCMS has achieved full coverage with the assistance of financial subsidies and administrative efforts from governments in China while the benefits of the NCMS are limited due to resources constraint, a common challenge in LMICs. Using a province-year panel dataset covering eight years since the NCMS expanded nationally in 2004, we find that the NCMS is overall powerful in three aspects.

First, the NCMS significantly increases inpatient services utilization, which is consistent with the findings in Wagstaff and Lindelow (2008); Yi et al. (2009). In addition, the positive

NCMS effect on inpatient stays mainly come from the services delivered at THCs, CHCs and county hospitals. This result is similar to that in Wagstaff (2007), which finds an increase of the NCMS on inpatient stays at THCs. These effects are conservatively estimated in our context of using the aggregate province-year panel data. Distinctly from previous literature, we find that half of the increase on inpatient care use can be attributed to the supply side policy of increasing investments in rural healthcare resources by the NCMS, which has proved to be essential in reinforcing the effectiveness of insurance expansion program by Kondo and Shigeoka (2013).

For outpatient services, we do not find statistically significant effect, which is consistent with Yip et al. (2008); Lei and Lin (2009); Babiarz et al. (2012). However, the close-to-null estimate may be inefficient by potential limitations of using the aggregate data at the province level. In particular, our estimates might be imprecise due to larger standard errors in a small sample. To address this issue, we further examine the outpatient effect of the NCMS by service providers and by department, we find that the NCMS tends to reduce outpatient visits at city hospitals (by a larger but statistically insignificant magnitude) and that outpatient use of general medicine decreases significantly when the NCMS rolled out, reinforcing the credibility of our finding that NCMS decreases outpatient visits at city hospitals. In addition, we find that rural residents substitute cheaper services for more expensive inpatient services by visiting more at primary care providers.

Third, although the NCMS increases healthcare utilization among rural residents in China, it does not increase OOP medical cost. In addition, we find that the NCMS reduces incidence rates and mortality rates for conditions that are generously covered such as infectious diseases although the all-cause mortality rate is not affected by the NCMS.

References

Acharya, A., Vellakkal, S., Taylor, F., Masset, E., Satija, A., Burke, M., and Ebrahim, S. (2013). The impact of health insurance schemes for the informal sector in low-and middle-income countries: A systematic review. *The World Bank Research Observer*, 28(2):236–266.

Asgary, A., Willis, K., Taghvaei, A. A., and Rafeian, M. (2004). Estimating rural households' willingness to pay for health insurance. *The European Journal of Health Economics*, 5(3):209–215.

Axelson, H., Bales, S., Minh, P. D., Ekman, B., and Gerdtham, U.-G. (2009). Health financing for the poor produces promising short-term effects on utilization and out-of-pocket expenditure: Evidence from Vietnam. *International Journal for Equity in Health*, 8(1):1–17.

Babiarz, K. S., Miller, G., Yi, H., Zhang, L., and Rozelle, S. (2012). China's New Cooperative Medical Scheme improved finances of township health centers but not the number of patients served. *Health Affairs*, 31(5):1065–1074.

Bailey, M. J. and Goodman-Bacon, A. (2015). The war on poverty's experiment in public medicine: Community Health Centers and the mortality of older Americans. *American Economic Review*, 105(3):1067–1104.

Bauhoff, S., Hotchkiss, D. R., and Smith, O. (2011). The impact of medical insurance for the poor in Georgia: A regression discontinuity approach. *Health Economics*, 20(11):1362–1378.

Bondurant, S. R., Lindo, J. M., and Swensen, I. D. (2018). Substance abuse treatment centers and local crime. *Journal of Urban Economics*, 104:124–133.

Borgschulte, M. and Vogler, J. (2020). Did the ACA Medicaid expansion save lives? *Journal of Health Economics*, 72:102333.

Brugiavini, A. and Pace, N. (2016). Extending health insurance in Ghana: Effects of the National Health Insurance Scheme on maternity care. *Health Economics Review*, 6(1):1–10.

Card, D., Dobkin, C., and Maestas, N. (2008). The impact of nearly universal insurance coverage on health care utilization: Evidence from Medicare. *American Economic Review*, 98(5):2242–58.

Card, D., Dobkin, C., and Maestas, N. (2009). Does Medicare save lives? *The Quarterly Journal of Economics*, 124(2):597–636.

Chay, K. Y., Kim, D., and Swaminathan, S. (2010). Medicare, hospital utilization and mortality: Evidence from the program's origins. Technical report, Mimeo.

Chen, Z. and Zhang, M. (2013). The report of China New Cooperative Medical Scheme development (in Chinese).

Cheng, L., Liu, H., Zhang, Y., Shen, K., and Zeng, Y. (2015). The impact of health insurance on health outcomes and spending of the elderly: Evidence from China's New Cooperative Medical Scheme. *Health Economics*, 24(6):672–691.

Cheng, L. and Zhang, Y. (2012). The China's New Cooperative Medical Scheme: Economic performance or health performance. *Economic Research*, 1:120–133 (in Chinese).

Chou, S.-Y., Grossman, M., and Liu, J.-T. (2014). The impact of national health insurance on birth outcomes: A natural experiment in Taiwan. *Journal of Development Economics*, 111:75–91.

Currie, J. and Gruber, J. (1996a). Health insurance eligibility, utilization of medical care, and child health. *The Quarterly Journal of Economics*, 111(2):431–466.

Currie, J. and Gruber, J. (1996b). Saving babies: The efficacy and cost of recent changes in the Medicaid eligibility of pregnant women. *Journal of Political Economy*, 104(6):1263–1296.

Currie, J. and Gruber, J. (2001). Public health insurance and medical treatment: The equalizing impact of the Medicaid expansions. *Journal of Public Economics*, 82(1):63–89.

Deza, M., Maclean, J. C., and Solomon, K. (2022). Local access to mental healthcare and crime. *Journal of Urban Economics*, 129:103410.

Dong, H., Kouyate, B., Cairns, J., Mugisha, F., and Sauerborn, R. (2003). Willingness-to-pay for community-based insurance in Burkina Faso. *Health Economics*, 12(10):849–862.

Finkelstein, A. (2007). The aggregate effects of health insurance: Evidence from the introduction of Medicare. *The Quarterly Journal of Economics*, 122(1):1–37.

Finkelstein, A., Taubman, S., Wright, B., Bernstein, M., Gruber, J., Newhouse, J. P., Allen, H., Baicker, K., and Group, O. H. S. (2012). The Oregon health insurance experiment: Evidence from the first year. *The Quarterly Journal of Economics*, 127(3):1057–1106.

Gaviria, A., Medina, C., Mejía, C., McKenzie, D., and Soares, R. R. (2006). Assessing health reform in Colombia: From theory to practice [with comments]. *Economia*, 7(1):29–72.

Giedion, U., Díaz, B. Y., Alfonso, E. A., and Savedoff, W. D. (2009). The impact of subsidized health insurance on health status and on access to and use of health services. *From Few to Many*, page 47.

Goldin, J., Lurie, I. Z., and McCubbin, J. (2021). Health insurance and mortality: Experimental evidence from taxpayer outreach. *The Quarterly Journal of Economics*, 136(1):1–49.

Goodman-Bacon, A. (2018). Public insurance and mortality: evidence from Medicaid implementation. *Journal of Political Economy*, 126(1):216–262.

Goodman-Bacon, A. (2021). The long-run effects of childhood insurance coverage: Medicaid implementation, adult health, and labor market outcomes. *American Economic Review*, 111(8):2550–93.

Hanratty, M. J. (1996). Canadian national health insurance and infant health. *The American Economic Review*, 86(1):276–284.

Karan, A., Yip, W., and Mahal, A. (2017). Extending health insurance to the poor in [india: An impact evaluation of rashtriya swasthya bima yojana] on out of pocket spending for healthcare. *Social Science & Medicine*, 181:83–92.

Khatana, S. A. M., Bhatla, A., Nathan, A. S., Giri, J., Shen, C., Kazi, D. S., Yeh, R. W., and Groeneveld, P. W. (2019). Association of Medicaid expansion with cardiovascular mortality. *JAMA Cardiology*, 4(7):671–679.

King, G., Gakidou, E., Imai, K., Lakin, J., Moore, R. T., Nall, C., Ravishankar, N., Vargas, M., Téllez-Rojo, M. M., Ávila, J. E. H., et al. (2009). Public policy for the poor? a randomised assessment of the Mexican universal health insurance programme. *The Lancet*, 373(9673):1447–1454.

Kolstad, J. T. and Kowalski, A. E. (2012). The impact of health care reform on hospital and preventive care: Evidence from Massachusetts. *Journal of Public Economics*, 96(11-12):909–929.

Kondo, A. and Shigeoka, H. (2013). Effects of universal health insurance on health care utilization, and supply-side responses: Evidence from japan. *Journal of Public Economics*, 99:1–23.

Lei, X. and Lin, W. (2009). The New Cooperative Medical Scheme in rural China: does more coverage mean more service and better health? *Health Economics*, 18(S2):S25–S46.

Liu, K. (2016). Insuring against health shocks: Health insurance and household choices. *Journal of Health Economics*, 46:16–32.

Liu, Y. (2004). Development of the rural health insurance system in China. *Health Policy and Planning*, 19(3):159–165.

Mataria, A., Donaldson, C., Luchini, S., and Moatti, J.-P. (2004). A stated preference approach to assessing health care-quality improvements in Palestine: from theoretical validity to policy implications. *Journal of Health Economics*, 23(6):1285–1311.

Mensah, J., Oppong, J. R., and Schmidt, C. M. (2010). Ghana's National Health Insurance Scheme in the context of the health mdgs: An empirical evaluation using propensity score matching. *Health Economics*, 19(S1):95–106.

Miller, G., Pinto, D., and Vera-Hernandez, M. (2013). Risk protection, service use, and health outcomes under Colombia's Health Insurance Program for the Poor. *American Economic Journal: Applied Economics*, 5(4):61–91.

Miller, S., Johnson, N., and Wherry, L. R. (2021). Medicaid and mortality: New evidence from linked survey and administrative data. *The Quarterly Journal of Economics*, 136(3):1783–1829.

Ministry of Health Center for Health Statistics and Information (2004). An analysis report of National Health Services Survey in 2003.

Pavel, M. S., Chakrabarty, S., and Gow, J. (2015). Assessing willingness to pay for health care quality improvements. *BMC Health Services Research*, 15(1):1–10.

Smith, J. P. (1999). Healthy bodies and thick wallets: The dual relation between health and economic status. *Journal of Economic Perspectives*, 13(2):145–166.

Sommers, B. D., Baicker, K., and Epstein, A. M. (2012). Mortality and access to care among

adults after state Medicaid expansions. *New England Journal of Medicine*, 367(11):1025–1034.

Sosa-Rubí, S. G., Galárraga, O., and López-Ridaura, R. (2009). Diabetes treatment and control: The effect of public health insurance for the poor in Mexico. *Bulletin of the World Health Organization*, 87(7):512–519.

Stephens Jr, M. and Yang, D.-Y. (2014). Compulsory education and the benefits of schooling. *American Economic Review*, 104(6):1777–92.

Swaminathan, S., Sommers, B. D., Thorsness, R., Mehrotra, R., Lee, Y., and Trivedi, A. N. (2018). Association of Medicaid expansion with 1-year mortality among patients with end-stage renal disease. *JAMA*, 320(21):2242–2250.

Thoa, N. T. M., Thanh, N. X., Chuc, N. T. K., and Lindholm, L. (2013). The impact of economic growth on health care utilization: A longitudinal study in rural Vietnam. *International Journal for Equity in Health*, 12(1):1–6.

Thornton, R. L., Hatt, L. E., Field, E. M., Islam, M., Solís Diaz, F., and González, M. A. (2010). Social security health insurance for the informal sector in Nicaragua: A randomized evaluation. *Health Economics*, 19(S1):181–206.

Trujillo, A. J., Portillo, J. E., and Vernon, J. A. (2005). The impact of subsidized health insurance for the poor: Evaluating the Colombian experience using propensity score matching. *International Journal of Health Care Finance and Economics*, 5(3):211–239.

Vilcu, I., Probst, L., Dorjsuren, B., and Mathauer, I. (2016). Subsidized health insurance coverage of people in the informal sector and vulnerable population groups: Trends in institutional design in Asia. *International Journal for Equity in Health*, 15(1):1–29.

Wagstaff, A. (2002). Poverty and health sector inequalities. *Bulletin of the World Health Organization*, 80:97–105.

Wagstaff, A. (2007). *Health insurance for the poor: initial impacts of Vietnam's Health Care Fund for the Poor*, volume 11. World Bank Publications.

Wagstaff, A. (2010). Estimating health insurance impacts under unobserved heterogeneity: The case of Vietnam's Health Care Fund for the Poor. *Health Economics*, 19(2):189–208.

Wagstaff, A. and Lindelow, M. (2008). Can insurance increase financial risk?: The curious case of health insurance in China. *Journal of Health Economics*, 27(4):990–1005.

Wagstaff, A., Lindelow, M., Jun, G., Ling, X., and Juncheng, Q. (2009). Extending health insurance to the rural population: an impact evaluation of China's New Cooperative Medical Scheme. *Journal of Health Economics*, 28(1):1–19.

Wang, S. (2004). China's health system: from crisis to opportunity. *Yale-China Health Journal*, 3:5–49.

WHO et al. (2012). *Health at a glance: Asia/Pacific 2012*. OECD Publishing.

Yi, H., Zhang, L., Singer, K., Rozelle, S., and Atlas, S. (2009). Health insurance and catastrophic illness: A report on the New Cooperative Medical System in rural China. *Health Economics*, 18(S2):S119–S127.

Yip, W., Wang, H., and Hsiao, W. (2008). The impact of Rural Mutual Health Care on access to care: Evaluation of a social experiment in rural China. *Harvard School of Public Health Working Paper*.

You, X. and Kobayashi, Y. (2009). The New Cooperative Medical Scheme in China. *Health Policy*, 91(1):1–9.

Zeng, Y., Li, J., Yuan, Z., and Fang, Y. (2019). The effect of China's New Cooperative Medical Scheme on health expenditures among the rural elderly. *International Journal for Equity in Health*, 18(1):1–10.

Zhang, A., Nikoloski, Z., and Mossialos, E. (2017). Does health insurance reduce out-of-pocket expenditure? heterogeneity among China's middle-aged and elderly. *Social Science & Medicine*, 190:11–19.

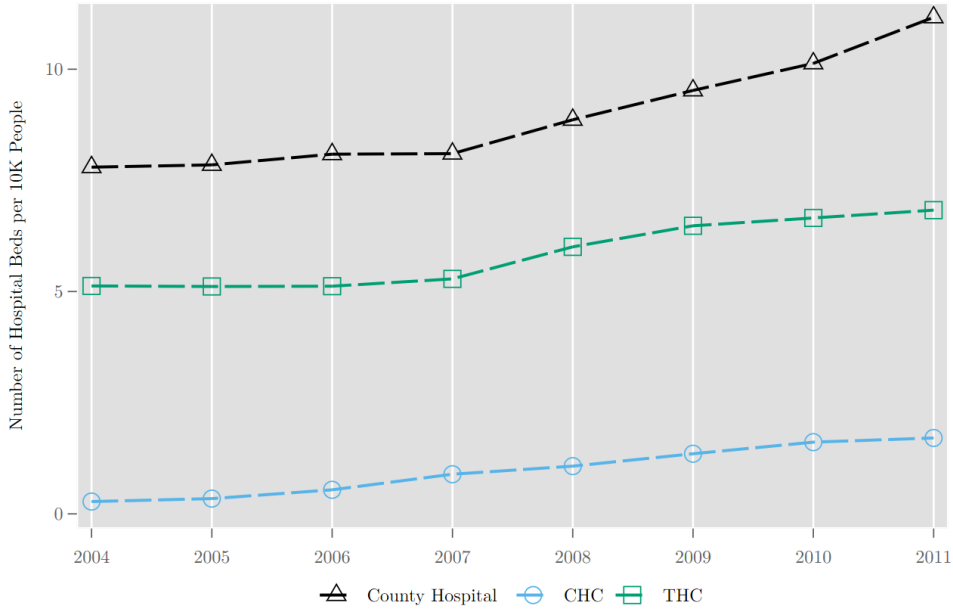

Figure A1: The Number of Hospital Beds Over Time

Notes: The data source is from CHSY 2004 to 2011. The y-axis is the number of hospital beds by provider across the period 2004 to 2011.

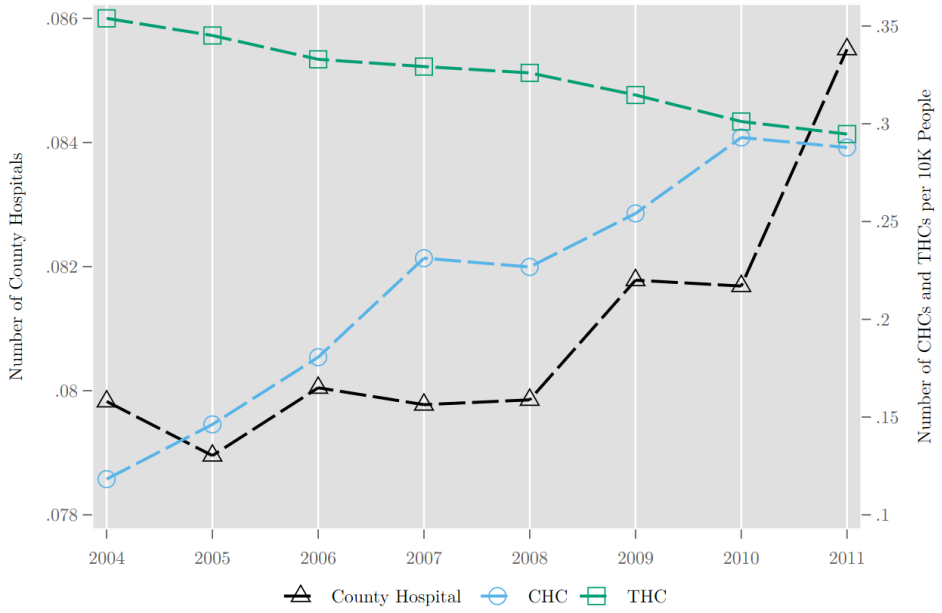

Figure A2: The Number of Institutions Over Time

Notes: The data source is from CHSY 2004 to 2011. The y-axis is the number of institutions by provider across the period 2004 to 2011.

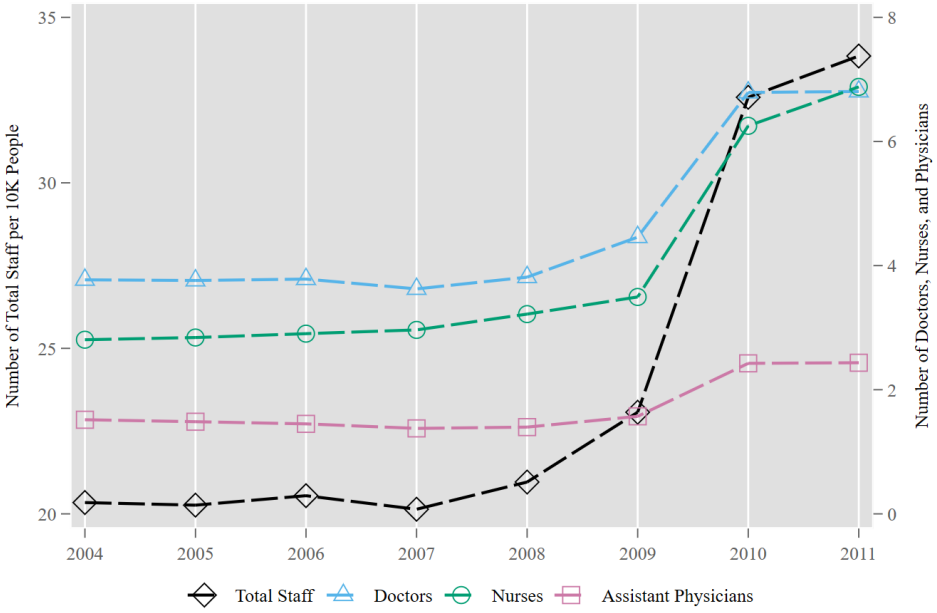

Figure A3: The Number of Medical Staff in Rural Over Time

Notes: The data source is from CHSY 2004 to 2011. The y-axis is the number of medical staff in rural healthcare providers across the period 2004 to 2011.

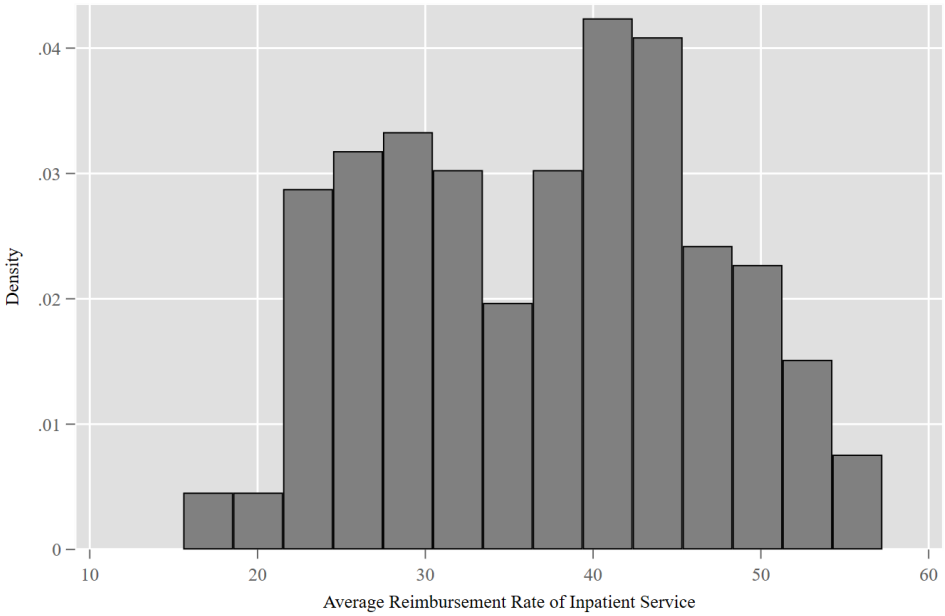

Figure A4: Distribution of the NCMS Reimbursement for Inpatient Service

Notes: The data source is from CHSY 2004 to 2011. The y-axis is the density of the average within-province reimbursement rate across the period 2004 to 2011.

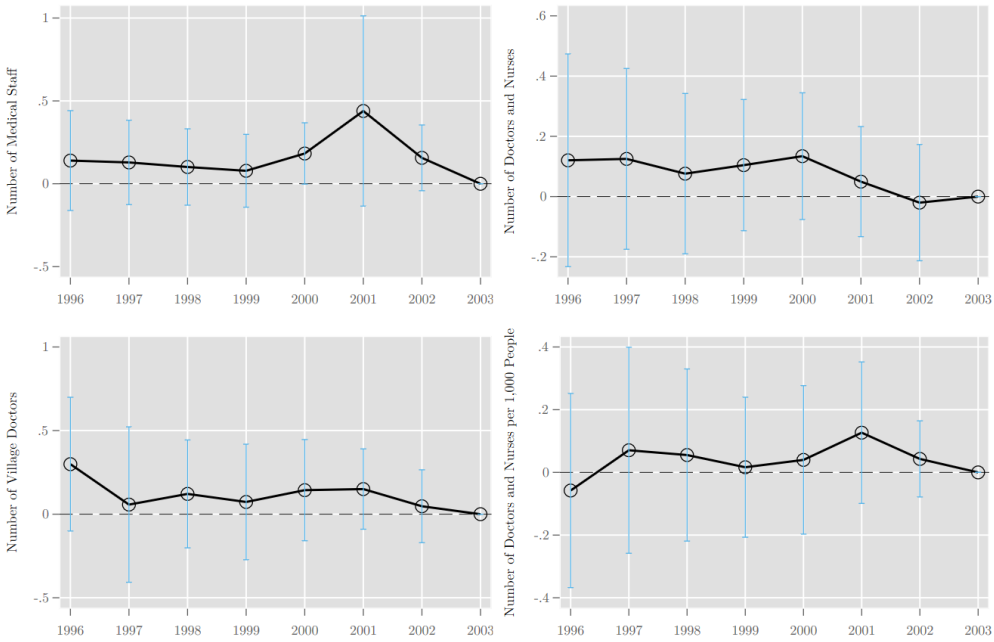

Figure A5: Parallel Trends for the NCMS Effect on Healthcare Staff

Notes: The data source is the CHY in 1996-2003. Each figure plots the event study of the specification 2 with the baseline estimates. The y-axis is the dependent variable in log form. The interval is the 95% confident interval of each estimate.

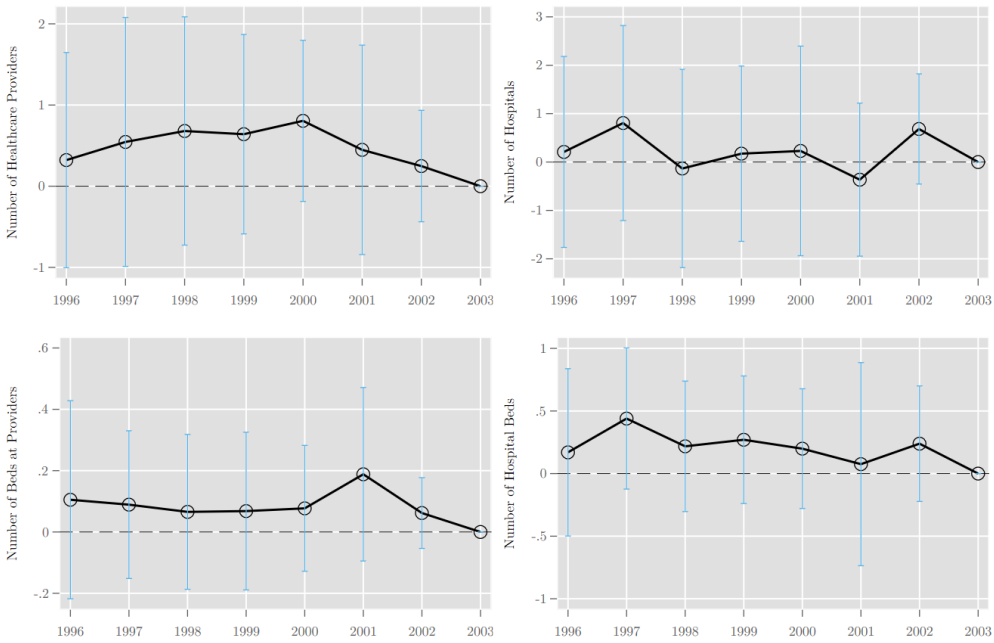

Figure A6: Parallel Trends for the NCMS Effect on Healthcare Resources

Notes: The data source is the CHY in 1996-2003. Each figure plots the baseline estimates in the event study of the specification 2. The y-axis is the dependent variable in log form. The interval is the 95% confident interval of each estimate.

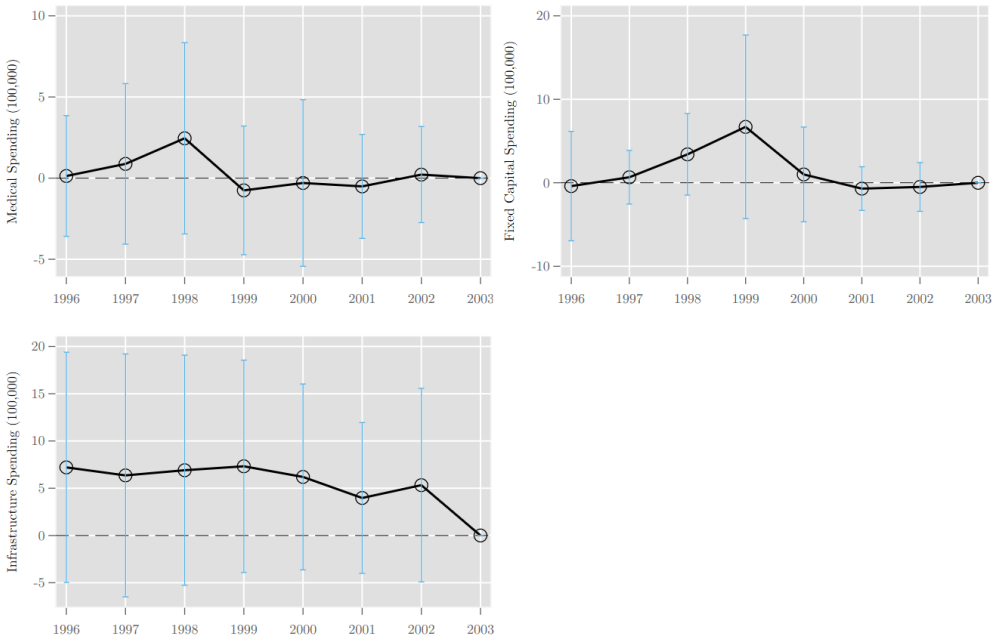

Figure A7: Parallel Trends for the NCMS Effect on Healthcare Spending

Notes: The data source is the CHY in 1996-2003. Each figure plots the baseline estimates in the event study of the specification 2. The y-axis is the dependent variable in log form. The interval is the 95% confident interval of each estimate.

Table A1: NCMS Implementation Across Provinces

	2002	2003	2004	2005	2006	2007	2008
Beijing	Pilot (13)		Full				
Tianjin			Pilot (4)			Full	
Hebei		Pilot (3)					Full
Shanxi			Pilot (15)				Full
Liaoning			Pilot			Full	
Jilin		Pilot (6)				Full	
Heilongjiang			Pilot (5)				Full
Shanghai		Pilot (10)	Full				
Jiangsu		Pilot (10)		Full			
Zhejiang		Pilot (27)			Full		
Anhui		Pilot (10)					Full
Fujian		Pilot (3)				Full	
Jiangxi		Pilot (7)					Full
Shandong		Pilot (26)				Full	
Henan		Pilot (25)					Full
Hubei		Pilot (8)					Full
Hunan		Pilot (5)					Full
Guangdong	Pilot (4)						Full
Guangxi		Pilot (3)					Full
Hainan		Pilot (3)			Full		
Chongqing		Pilot (6)				Full	
Sichuan		Pilot (5)					Full
Guizhou		Pilot (8)				Full	
Yunnan		Pilot (20)				Full	
Shaanxi			Pilot (3)			Full	
Gansu		Pilot (5)					Full
Qinghai		Pilot (8)		Full			
Ningxia		Pilot (2)					Full
Xinjiang		Pilot (5)					Full

Notes: Data source is the NCMS development report from Chen and Zhang (2013). The Full means that the province has covered all rural residents. The Pilot means that the number of counties a province participated in the pilot experiment of the NCMS.

Table A2: Effect of Lagged Province Economic Conditions on NCMS Enrollment Rate

	(1)	(2)	(3)	(4)	(5)
Unemployment rate lag 1	-0.007	-0.017	0.277	0.653	0.673
	(0.047)	(0.046)	(0.526)	(0.480)	(0.453)
Unemployment rate lag 1^2			-0.050	-0.142	-0.147
			(0.137)	(0.115)	(0.110)
Unemployment rate lag 1^3			0.002	0.009	0.010
			(0.011)	(0.009)	(0.008)
GDP per capita (2014 yuan)				-0.065*	-0.021
				(0.037)	(0.053)
Average income per capita (2014 yuan)				-1.608***	2.577
				(0.538)	(2.009)
Average income per capita^2					-2.822
					(1.902)
Average income per capita^3					0.066
					(0.072)
Basic demographic controls		Y	Y	Y	Y
Economic controls				Y	Y
Mean NCMS-rate	0.189	0.189	0.189	0.189	0.189
Observations	202	202	202	202	202
Adjusted R-squared	0.908	0.923	0.923	0.939	0.944

Notes: Each cell reports estimates from a separate specification. The unemployment rate, demographics, and economic controls of each province is from CSY yearbooks, the NCMS policy is from the report of NCMS development. The basic demographic controls include population, age structure, education, percentage of married and female, and ratio of dependent persons. Economic controls include gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and city (2014 yuan), consumption and medical expenses in city (2014 yuan). The GDP per capita, average income per capita, and its quadratic and cubic form are re-scaled to show non-zero coefficients. All regressions include province and year fixed effects. All statistics are weighted by the rural population in 2003. Standard errors are clustered at the province level and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table A3: The NCMS Effect on Inpatient Use Controlling for All Rural Healthcare Resources

	(1) Total	(2) CHC	(3) County hospital	(4) THC
NCMS rate	0.010	1.120**	0.063*	-0.037
	(0.055)	(0.440)	(0.032)	(0.155)
THC beds	0.392***	-1.623*	0.126	1.020***
	(0.120)	(0.891)	(0.081)	(0.225)
County hospital beds	0.306**	0.424	0.794***	0.101
	(0.144)	(1.423)	(0.127)	(0.426)
CHC beds	-0.012	1.064***	-0.009**	0.003
	(0.009)	(0.131)	(0.004)	(0.018)
Number of THCs	-0.288*	1.863**	-0.051	0.248
	(0.164)	(0.791)	(0.106)	(0.259)
Number of county hospitals	-0.010	-0.891	-0.014	0.164
	(0.092)	(1.059)	(0.081)	(0.278)
Number of CHCs	0.030	0.209	0.024**	0.027
	(0.019)	(0.234)	(0.010)	(0.062)
Rural staff	0.308**	1.107	0.104	0.371
	(0.128)	(0.988)	(0.073)	(0.335)
Rural doctors	-0.179*	-1.169	0.037	-0.123
	(0.097)	(0.780)	(0.072)	(0.229)
Rural nurses	0.179	1.606*	0.007	0.190
	(0.111)	(0.894)	(0.081)	(0.230)
Rural assistant physicians	-0.126	-0.026	-0.149***	-0.212
	(0.075)	(0.414)	(0.041)	(0.172)
Mean	479.4	0.995	169.1	127.6

Notes: Each cell reports estimates of the NCMS on inpatient use after controlling for all of the healthcare resources: hospital beds, number of providers, and number of medical staff in rural using the baseline model 1. The mean of dependent variable is the average of inpatient use in 2004 per 10,000 people and weighted by the rural population in 2003. *** p<0.01, ** p<0.05, * p<0.10.

Table A4: Robustness of NCMS Results on Healthcare Utilization to Economic Controls

	(1) Baseline	(2)	(3)	(4)	(5)
	Panel A. Total Outpatient Service Utilization				
NCMS rate	-0.060	-0.066	-0.089	-0.076	-0.078
	(0.050)	(0.051)	(0.058)	(0.056)	(0.055)
Mean	15293	15293	15293	15293	15293
Observations	231	231	231	201	201
	Panel B. Total Inpatient Service Utilization				
NCMS rate	0.114*	0.111	0.107	0.116	0.116
	(0.065)	(0.066)	(0.072)	(0.078)	(0.077)
Mean	479.4	479.4	479.4	479.4	479.4
Observations	216	216	216	188	188
GDP trend		Y	Y	Y	Y
Flexible rural income			Y	Y	Y
Flexible unemployment and GDP				Y	Y
Flexbile medical expense in city					Y

Notes: Each cell reports estimates from a separate specification. The unemployment rate, demographics, and economic controls of each province is from CSY yearbooks, the NCMS policy is from the report of NCMS development. Column 1 is the baseline specification 1 with basic demographic and economic controls. The basic demographic controls include population, age structure, education, percentage of married and female, and ratio of dependent persons. Economic controls include unemployment rate, gross domestic product (GDP) per capita (2014 yuan), disposable income in rural and city (2014 yuan), consumption and medical expenses in city (2014 yuan). The flexible rural income includes average income per capita, its quadratic, and cubic form. The flexible unemployment and GDP and medical expense in city include both flexible form and its lagged flexible form. The mean of each dependent variable is the average in 2004 per 10,000 people and weighted by the rural population in 2003. Standard errors are clustered by province and shown in parentheses. *** p<0.01, ** p<0.05, * p<0.10.