Effects of Universal Health Insurance on Health Care Utilization, Supply-Side Responses and Mortality Rates: Evidence from Japan*

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Abstract

We investigate the effects of a massive expansion in health insurance coverage on health care utilization and health by examining the introduction of universal health insurance in Japan in 1961. There are three major findings. First, health care utilization increases more than would be expected from previous estimates of the elasticities of individual-level changes in health insurance status. Second, increases in the supply of health care services tend to be smaller than increases in the demand for these services. The size of the supply response differs across types of services: while the number of bed increases, effects on the numbers of medical institutions, physicians and nurses are negligible or inconclusive. Third, we do not find evidence of reduced mortality rates at least in the short run. Our results suggest two lessons for countries planning a large expansion in health insurance coverage: first, it requires financial resources for the surge in health care expenditures, which is likely to be much larger than predicted from individual-level changes in insurance status; second, the slow supply-side response may constrain the ability of the health care system to meet increased demand.

Keywords: universal health insurance, health care utilization, mortality rates, supply-side response, Japan

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1 Introduction

Most developed countries have implemented some form of universal public health insurance to ensure that their entire population has access to health care.[1] Even the United States, which has been a rare exception, is moving towards near-universal coverage through health care reform; the Patient Protection and Affordable Care Act passed in March 2010 imposes a mandate for individuals to obtain coverage. Despite the prevalence of universal health care, most studies on the impact of the health insurance coverage have been limited to specific subpopulations, such as infants and children (Currie and Gruber 1996a, 1996b; Hanratty 1996; Chou et al. 2010), the elderly (Finkelstein 2007; Card, Dobkin, and Maestas 2008, 2009; Chay, Kim, and Swaminathan 2010) or the poor (Finkelstein et al. 2011). An important exception is Kolstad and Kowalski (2010) who examined the impact of the introduction of universal health insurance in Massachusetts in 2006; however, they are unable to explore the long-run effect because their data covers only three years after the policy change. Since the effects incurred by such a large policy change may emerge with lags, it is important to examine the long-term impact to capture the overall implication of a large policy change.

This paper studies the impact of a large expansion in health insurance coverage by examining the case of Japan, which achieved universal coverage for its entire population. Since the universal health insurance is achieved as early as 1961 in Japan, we can examine long term impacts of the health insurance expansion. We identify the effect of universal health insurance by exploiting regional variation in health insurance coverage prior to the full enforcement of universal coverage. Specifically, we use the variation across prefectures in 1956, the year before the enactment of the Four-year Plan to achieve universal health insurance by 1961. In 1956, roughly one-third of the population was not covered by any form of health insurance, and the fraction of the population who were uninsured ranged from almost zero to almost half across prefectures. An important source of this regional variation is the fact that the decision to join the National Health Insurance system (hereafter NHI), a residential-based system that covered people without employment-based health insurance, was left to each municipality until the mid-1950s. Thus, prefectures with fewer

[1] The only G7 country without a universal health insurance program is the United States (Cutler, 2002).

municipalities joining the NHI were more affected by the implementation of universal health insurance. Our empirical strategy identifies changes in the outcome variable in a prefecture in which the enforcement of universal coverage had a larger impact relative to a prefecture in which the impact was smaller. Our findings are threefold.

First, we find that the expansion of health insurance coverage resulted in large increases in health care utilization, as measured by admissions, inpatient days, and outpatient visits to hospitals. For example, our estimates imply that the introduction of universal health insurance increased impatient days by 9.4 -12.3 percent and outpatient visits by 7.9 -11.3 percent from 1956 to 1961. The long-run impact is even larger; the estimated increases in inpatient days and outpatient visits from 1956 to 1966 are 12.3-20.3 percent and 11.3-18.5 percent, respectively. Our estimate of the effect on outpatient visits is roughly five or six times larger than the estimate from the RAND Health Insurance Experiment (HIE; Manning et al. 1987; Newhouse 1993), which explores the effects of individual-level changes in insurance status.

Second, we find that supply-side responses to demand shocks differ across the types of services supplied. While the expansion of health insurance coverage did not increase the numbers of clinics and nurses even in the long run, the number of beds increased in response to the expansion of the health insurance coverage. Our results on the numbers of hospitals and physicians are mixed and sensitive to the way we control for regional time trends. It is not surprising that we observe a robust positive effect only on the number of beds because it is less costly for existing hospitals to add beds than for new hospitals and clinics to enter the market by paying large fixed costs. Also, the total supply of physicians and nurses was limited by the capacity of medical and nursing schools. Furthermore, we find that even the number of beds increased at a slower rate than the increases in health care utilization. These results imply that a slow supply-side response can constrain attempts to meet the demand increases induced by large policy changes.

Third, despite the massive increases in utilization, we find rather mixed evidence that the implementation of universal coverage affected health outcomes measured by the age-specific mortality. Only when we control for prefecture-specific linear trends, in addition to region-specific year effects and prefecture-fixed effects, we observe lagged negative effects on mortality rates in the late

1960s. This lack of short-term effects may be because that individuals with acute, life-threatening and treatable health conditions had already sought care at hospitals despite the lack of health insurance. That is, the marginal patients who used health care services were less sick and thus irrelevant to the mortality rate. As suggestive evidence, we find no change in the number of deaths by treatable diseases at that time such as pneumonia, which should have fallen if universal health insurance coverage had made it possible for some formerly untreated patients to have an access to hospitals.

This paper relates to and builds on two strands of literature. The first consists of studies of the effect of health insurance on health care utilization and expenditure. The pioneering work of the RAND HIE (Manning et al. 1987; Newhouse 1992) typically finds modest effects of individual-level changes in health insurance on health care utilization and expenditure. In contrast, Finkelstein (2007) examines the impact of the introduction of Medicare in 1965 and finds a much larger effect on aggregate spending than individual-level changes in health insurance would have predicted. Finkelstein attributes this larger effect to general-equilibrium effects induced by market-wide changes in demand, which alter the supply of health care and the behaviors of people who have already been covered by health insurance.

The second relevant research thread consists of studies that examine whether health insurance indeed improves health outcomes. The existing studies show evidence for positive effects of health insurance coverage for infants' health in Canada (Hanratty 1996), in low income households in the United States (Currie and Gruber 1996b), and in farm households in Taiwan (Chou et al 2011). Studies on Medicare also tend to show that Medicare eligibility has a modest positive effect on the health of the elderly (Chay, Kim, and Swaminathan 2010, Card, Dobkin, and Maestas 2009).[2]

This paper makes three contributions to the literature. First, unlike past studies we can assess more general impacts from the expansion of health insurance coverage because our data cover the entire population for twenty years. For example, estimates from a policy focusing on the elderly (e.g. Medicare) may be different from the average impact of health insurance for the entire

[2] Although Finkelstein and McKnight (2008) find no discernible impact of Medicare expansion on elderly mortality, this is probably because the effect of Medicare is not strong enough to be identified with the state-level aggregate data used by them but detectable with the regression discontinuity design employed by Chay, et al (2010) and Card et al (2009).

population if the health care utilization of the elderly responds to price changes differently from the younger population. Also, the long duration of data allows us to examine the long-term effects that may emerge with lags. Second, we provide a more detailed analysis of supply-side responses to large demand shocks by investigating the several outcomes that have not been explored extensively in the previous studies, such as the number of physicians.[3] Third, we offer evidence in the developing country setting. Japan's per capita gross domestic product in 1956 was about one-quarter of that of the United States at that time,[4] and Japan's average life expectancy was 66, whereas that of the United States was 70. Thus, our estimates are more relevant to developing countries currently considering introducing universal health insurance, such as Mexico, than those of existing studies on developed countries such as the United States.[5]

The rest of the paper is organized as follows. Section 2 describes the institutional background for the implementation of universal health insurance in Japan. Section 3 describes the data, and Section 4 presents the identification strategy. Section 5 shows the main results for utilization. Section 6 analyzes the supply-side responses to the changes in demand, and Section 7 examines health outcomes. Section 8 concludes the paper.

2 Background

This section briefly reviews the history of Japan's universal health insurance system up to the 1960s.[6] Japan's public health insurance system consists of two parallel subsystems: employment-based health insurance and the NHI. Combining the two subsystems, Japan's health insurance program is one of the largest in the world today, covering nearly 120 million people. This is about three times as large as Medicare in the United States, which covers 43 million people (The Centers for Medicare & Medicaid Services 2011).

[3] Finkelstein (2005, 2007) finds a large increase in hospital employment in response to the introduction of Medicare in the United States, but her data do not include most of physicians, because physicians in the United States are not directly employed by the hospital. On the other hand, our data cover all physicians who were working at hospitals in Japan.

[4] Countries whose per capita GDP is about one-quarter of the United States today include, for example, Chile and Turkey.

[5] Of course, the technology available at that time was quite different from that available now. However, the major causes of death in Japan around this time were not much different from the causes of death of individuals in developing countries now (e.g., pneumonia, bronchitis, gastritis, and duodenitis).

[6] The discussion in this section draws heavily from Yoshihara and Wada (1999).

Employment-based health insurance is further divided into two forms; employees of large firms and government employees are covered by union-based health insurance, whereas employees of small firms are covered by government-administered health insurance. In both cases, employers have to contribute about half of the insurance premiums, and the other half is deducted from the salary. Enrolment to the government-administered health insurance program was legally mandated to all employers with five or more employees unless the employer has its own union-based health insurance program. If the household head enrolls to an employment-based health insurance program, his dependent spouse and children are also covered, although higher coinsurance rates are applied to these family members.

The NHI is a residential-based system that covers anyone who lives in the covered area and does not have employment-based health insurance. Therefore, the NHI mainly covers employees of small firms (with less than five employees), self-employed workers in the agricultural and retail/service sectors and their families, the unemployed, and the retired elderly. An important feature for our identification strategy is that the decision to join the NHI system is left to municipalities, not individuals, and there is no option for individuals living in covered municipalities to opt out. Unlike the case of employment-based insurance, in the NHI, each household member is counted as an insured enrollee.

Coinsurance rates varied with the type of insurance and changed differentially for several times. When universal health insurance was achieved in 1961, the coinsurance rate of the NHI was 50 percent for everyone, and that of employment-based insurance was nearly zero for employees and 50 percent for family members. Then, the coinsurance rate of the NHI for household head was reduced to 30 percent in 1963, and then that for other NHI enrollees was reduced to the same rate in 1968. In 1973, the coinsurance rate of employment-based insurance for family members was reduced to 30 percent in 1973 (Yoshihara and Wada, 1999). In the robustness check, we control for the changes in the coinsurance rates during our sample period. The maximum limit on out-of-pocket expenditure had not been set until 1973.

The history of Japan's public health insurance system goes back to the 1920s. First, in 1922, enrolment to employment-based health insurance was mandated to blue collar workers in establishments with ten or more employees. In 1934, the mandatory enrolment was expanded to workers in establishments with five or more employees, and voluntary enrollment by workers in smaller firms is also encouraged. Then, to redress the lack of health insurance among people who were left out from employment-based insurance, the NHI was introduced in 1938.

During World War II, the wartime government rapidly expanded the NHI, and by 1944, universal health insurance was ostensibly achieved. However, in reality, coverage was far from universal because the medical system was not functioning due to war. Furthermore, after defeat in the war, hyperinflation and other disruptions caused a serious breakdown in the health insurance system.

The Japanese government, with the support of General Headquarters, started to restore the health insurance system right after the end of the war. However, even in 1956, roughly one-third of the population (30 million people)—mainly the self-employed, employees of small firms, the unemployed, and the retired elderly—were still not covered by any form of health insurance. This lack of coverage is partly because a non-negligible number of municipalities had not yet rejoined the NHI system. Therefore, in 1956, the Advisory Council on Social Security made a recommendation that all municipalities should join the NHI system. Given this recommendation, the Four-year Plan to achieve the universal coverage by 1961 was proposed by the Ministry of Health and Welfare in 1957. In 1959, an amendment to the National Health Insurance Act legally implemented the mandatory participation to the NHI by April 1961 by all municipalities.

Figure 1 shows the time series of health insurance coverage by the NHI, employer-based insurance, and all types of insurance combined. The figure also includes a linear trend fitted by data prior to 1956. Two vertical lines indicate 1956, which is the reference year, and 1961, which is the year in which universal health insurance was achieved. The number of individuals covered by both employer-based insurance and the NHI gradually increased until the mid-1950s, and there was a sharp increase, especially for the NHI, in the late 1950s. During the last 4 years before the achievement of universal health insurance, around 30 percent of the total population became newly covered by health insurance. By 1961, all municipalities had joined the NHI, and universal health insurance was achieved.

Crowding-out from employment-base insurance by the introduction of NHI seems to have been negligible. The insured are likely to have preferred employment-based insurance because of lower coinsurance rates and the employer's contribution to the premium. In theory, the NHI could also increase self-employed workers by making health insurance available for them even if they are not eligible for employment-based one. Another possibility of crowding out is that the introduction of the NHI could induce firms to reduce its size to less than five employees and get exempt from the contribution to employment-based insurance. Appendix Section A1 assesses both possibilities. Basically, the proportion of self-employed workers in the labor force declined in the same speed in prefectures that experienced a large expansion in the NHI and the others. Also the changes in the fraction of establishments with less than 5 employees do not seem to be systematically correlated with the NHI coverage in 1956. Therefore, the crowding-out effect of the NHI expansion is likely to be negligible.

An important institutional feature of Japan's health insurance system is that detailed fee schedules are set by centralized administration,[7] and the reimbursement from the health insurance system to medical providers strictly follows these schedules. Until 1963, each medical institution was able to choose one schedule from two options, but they had to apply the same schedule for all patients. Thus, there was little room for each hospital or physician to charge differential fees for specific types of patients like the case of the United States. Furthermore, from 1963, fee schedules are integrated into a unified schedule applied nationwide. This stringent fee control is considered to be one of the primary reasons why Japan was able to keep a relatively low share of total medical expenditures to GDP (Ikegami and Campbell 1995). [8]

Note also that, before the full implementation of the universal health insurance, physicians could have charged different prices for uninsured patients. Furthermore, there was no effective legal obligation for physicians or hospitals to provide cares to uninsured patients.[9] Public aid

[7] According to Ikegami (1991, 1992) and Ikegami and Campbell (1995), the national schedule is usually revised biennially by the Ministry of Health, Labor and Welfare (MHLW) through negotiation with the Central Social Insurance Medical Council (CSIMC), which includes representatives of the public, payers, and providers. See also Cutler (2002) for international comparison of the medical systems among G7 countries.

[8] The ratio of total medical expenditures to GDP had been slightly above 3% throughout the 1950s. Although it gradually increased during the early 1960s, it leveled off at around 4% in the mid 1960s until 1973, when healthcare services were made free for elderly. There is no trend break in per-capita medical expenditures until 1973, either.

[9] Although Article 19 of the Medical Practitioners Act stipulates that a physician cannot refuse to diagnosis and treatment without legitimate reason, it was not very effective because of the qualification "without legitimate reason," which could include the lack of ability to pay the fee. At least there was no legal obligation equivalent to the Emergency Medical Treatment and Labor Act in today's United States, which mandates hospitals to provide

for uninsured is limited to patients quarantined with Tuberculosis and other diseases specified in Infectious Deceases Prevention Act and those who live on welfare.

In contrast to the strict price control, entry and expansion of private hospitals had been left virtually free until the upper limit of the number of beds in each region was introduced in 1985. In the 1950s and 60s, the government tried to increase the supply of medical institutions in regions with short supply, but its effect seemed to be limited. Construction of public institutions is of course guided by the government, but its impact is small compared to the increase in private hospitals.[10] Regarding the private institutions, Medical Care Facilities Financing Corporation was founded in 1960 to facilitate the financing of private medical institutions. This alleviates the credit constraint of potential entrants, but whether to enter or expand and where to build hospitals are left voluntary.

The supply of physicians and nurses is constrained by the capacity of medical schools and nursing schools. However, their mobility was not controlled by the national government. Although medical schools had some power to control the choice of hospitals at which their alumnus work, there did not seem to be a coordinated system to allocate physicians or nurses across prefectures.

Lastly, it is worth emphasizing that Japan was experiencing rapid economic growth during the period we study. The average real GDP growth rate during the period of 1956-70 is as high as 9.7 percent. As people became richer, their nutrition and sanitary conditions improved. Also, Tuberculosis Prevention Act enacted in 1951 effectively suppressed tuberculosis, which had been one of the main causes of deaths until the early 1950s in Japan. Therefore, although the life expectancy increased drastically – from 60 years for the cohort born in 1950 to 72 years for the cohort born in 1970, there were many factors that could have improved health outcome of Japanese people other than the introduction of universal health insurance. Hence, it is essential to control for these confounding factors by including region-year dummies, as explained in Section 4.

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stabilizing care and examination to people who arrive in the emergency room for an emergency condition without considering whether a person is insured or their ability to pay.

[10] The share of public hospitals in the total number of hospitals was 33% in 1956, and the number of public hospitals increased only by 6% by 1965, whereas that of private hospitals increased by 48%. Consequently, the share of public hospitals fell to 27% in 1965. Admittedly, however, since public hospitals tend to be larger than private ones, the share in terms of the number of beds was larger: 55% in 1956. Nonetheless, the speed of expansion was faster in private hospitals. The number of beds in public hospitals increased by 34% during the period of 1956-65, whereas that in private hospitals increased by more than 100%. Since we are not aware of any prefecture level data on the number of hospitals by ownership, we are not unable to examine the effect by ownership type separately.

3 Data

Our data come from various sources with hard-copy documentation. Although the decision to join the NHI was made at the municipality level, municipality level data are not available for most of the outcome and explanatory variables. Thus, our unit of observation is the prefecture-year.[11] We mainly focus on the period of 1950–1970, although some specifications use the shorter time period due to the limited availability of variables of interest.[12] Appendix Table A1 describes the definition, data sources, and available periods for each variable. All expenditure variables are converted to real terms at 1980 price levels using the GDP deflator.

3.1 Health Insurance Coverage Rate

We construct the rate of health insurance coverage for each prefecture as follows. First, the population covered by the NHI in prefecture p in year t (NHI_{pt}) is obtained from the Social Security Year Book. Second, the population covered by employment-based insurance is imputed from nationwide, industry-level coverage rates and the industry composition of each prefecture's workforce. Note that, owing to data limitations[13], we have to assume that the coverage rate within each industry does not vary across prefectures (i.e., the variation across prefectures is solely attributable to the variation in industry compositions).[14] Then, for each year and prefecture, the coverage rate of each industry is weighted with the ratio of household heads in the industry. We use this weighted sum of industry-level coverage rates as the coverage rate of employment-based programs in each prefecture.

Specifically, let E_CovR_{jt} denote the ratio of households covered by employment-based insurance, among those with a household head working in industry j, in year t. Let denote W_{pjt} the population living in prefecture p with a household head working in industry j in year t. Then,

[11] There are 46 prefectures excluding Okinawa, which returned to Japan in 1973.

[12] We do not extend our data beyond 1970 because some prefectures started to provide free care for the elderly in the early 1970s, which may confound our results. See Shigeoka (2011) for detail on provision of free care for the elderly.

[13] Although some prefecture-level tables of employment-based insurance are published, most of these tables show the location of *employers*, not the residence of employees.

[14] A potential bias arising from omitting heterogeneity in the coverage rate within each industry across prefectures is that the ratio of population without health insurance may be overestimated for prefectures that have larger firms. Larger firms are much more likely to offer employment-based health insurance, and they tend to locate in Tokyo or Osaka. Thus, as a robustness check, we estimate the same models excluding Tokyo and Osaka from the sample.

the imputed population covered by employment-based insurance in year t in prefecture p can be written as $\sum_j W_{pjt} * E\_CovR_{jt}$. E_CovR_{jt} is available from the Comprehensive Survey of the People on Health and Welfare for 1955–1959.[15] W_{pjt} is calculated from Census 1955 and 1960 and linear interpolation for the inter-census years.

Lastly, the total population of each prefecture, pop_{pt}, is taken from the Statistical Bureau's website.[16] Then $CovR_{pt}$, the ratio of prefecture p's population who were covered by any kind of health insurance in year t, is estimated as follows:

$$CovR_{pt} = [NHI_{pt} + \sum_j W_{pjt} * E\_CovR_{jt}]/pop_{pt} \tag{1}$$

We define the impact of the health insurance expansion, $impact_{pt}$, as the proportion of the population *without* health insurance in prefecture p at time t. Thus, $impact_{pt}$ can be defined as follows:

$$impact_{pt} = 1 - CovR_{pt} \tag{2}$$

Figure 2 shows the regional pattern of the proportion of people without health insurance in 1956, one year before the implementation of the Four-year plan. The figure shows substantial regional variation in the health insurance coverage rate. Most of the variation in this coverage rate comes from the variation in the coverage rate of the NHI. Indeed, the coverage rate of employment-based insurance tend to be high in prefectures with a low total coverage rate, thus the coverage rate of the NHI varies more than the sum of employment-based insurance and the NHI.[17]

[15] Note that the Comprehensive Survey of the People on Health and Welfare classifies a household as being covered by an employment-based program if at least one of the household members is covered by an employment-based program. Although this is a sensible approach given that most employment-based insurance also cover spouses and children, it may also overstate the coverage rate of employment-based programs if some of the other household members are covered by the national program. Thus, as a robustness check, we tried replacing with zero the coverage rate of employment-based program for households in the agricultural sector. The result did not change much.

[16] These data seem to be interpolated from the Population Census by the Statistics Bureau. We additionally take the average of year $t-1$ and year t so that we have the population as of April 1 in year t.

[17] We can decompose $Var(CovR_{pt})$ into the variances of the coverage rates by the NHI and by employment-based insurance, and covariance between them. The variance of NHI coverage rate was 0.037, which is larger than

The proportion of the population without health insurance coverage ranged from almost zero in some of the northeast prefectures to a high of 49 percent in Kagoshima. The proportion of the population without health insurance is relatively high in southwest prefectures and low in northeast prefectures. Additionally, prefectures with large populations, such as Tokyo and Osaka, tend to have low coverage rates because of the additional time needed to build a health insurance tax-collection system and to reach agreements between the local governments and medical providers in cities with a larger number of physicians (Yoshihara and Wada 1999).

It is difficult to know *a priori* whether the average income is positively or negatively correlated with the initial health coverage rate. On the one hand, rich prefectures tend to have a high rate of employer-based insurance coverage. On the other hand, poor prefectures may have tried to restore the NHI earlier to insure the poor. Figure 2 suggests that the latter effect dominated the former given that the northeast part of Japan is on average poorer than the southwest. Because the distribution of the initial health insurance coverage rate is not completely random, we control for unobserved prefecture-specific components by including prefecture fixed effects and region-specific year effects.

3.2 Outcome and Explanatory Variables

Our main outcome variables are divided into three categories: health care utilization, capital and labor inputs as the supply-side response, and mortality rates. The three measures for utilization are admissions, inpatient days, and outpatient visits. Admissions represent the number of admissions to hospitals in each prefecture per calendar year. Inpatient days are the sum of the days of hospital stays of all inpatients. Outpatient visits are visits to hospitals for non-hospitalization reasons. Note that these variables are limited to utilization of hospitals (medical institutions with 20 or more beds), because clinics (institutions with no more than 19 beds) are excluded from the survey.

From several different sources, we also obtain the numbers of hospitals, clinics, beds, physicians, and nurses to explore the supply-side responses to the expansion of health insurance coverage. As a measure of health outcomes, we compute the age-group-specific mortality rate (number of deaths

$Var(CovR_{pt}) = 0.031$. The variance of employment-based insurance is as small as 0.004, and the covariance between coverage rates of two types was -0.005.

per 1000 population) for age groups 0–4, 5–9, 50–54, 55—59, and 60–64 years old. We do not examine the age group of 10-49 years old because the mortality rate is too low for this group. We exclude elderly individuals more than 65 years old to prevent our results from being confounded by the welfare benefits for the elderly without employment-based pension plan, which was introduced in 1961 as a part of the National Pension Plan.[18]

Figures 3–5 present the time-series patterns for each outcome variable used in this study, and compare prefectures whose ratio of uninsured population was greater than 20% in 1956 (high impact prefectures) and the others (low impact prefectures). 20% is about the median of the uninsured ratio in 1956. Figure 3 describes the utilization measures (admission, inpatients, and outpatients) normalized by the population. Health care utilization in high impact prefectures seems to have started rising after the introduction of universal health insurance, but the pattern is not very clear. Rather, the figure invokes the importance of controls for time trends since health care utilization had been increasing rapidly even before 1956. Figure 4 shows the supply-side variables (hospitals, clinics, beds, bed occupation rates, physicians, and nurses). Like Figure 3, all variables except for the bed occupancy ratio are increasing. The bed occupancy rate declined in the late 1950s and increased in the 1960s after the achievement of universal health insurance, probably due to the increase in inpatients. Also, high impact prefectures on average had more hospitals, clinics and physicians before 1956. Thus it is very important to control for pre-existing differences across prefectures. Figure 5 plots age-specific mortality rates. All age and gender groups experienced a substantial decline in mortality rate over the study period. From the graphs, it is difficult to see clear trend break at the full implementation of universal health insurance. Also, low impact prefectures on average had higher mortality rates.

As mentioned earlier, Japan was experiencing a rapid economic growth during the period we study, and the figures reflect this rapid growth. Also the speed and timing of such economic growth may have been different across prefectures. Hence, it is crucial to control for this rapid

[18] This benefit was a bail-out measure for those who were already old when the National Pension Plan was enacted. The benefit was paid for disabled people 65 or older and non-disabled people 70 or more years old and funded by national taxes, not the pension premiums. This benefit was not paid for people who have other income source including employment-based pension benefit. Given that employment-based pension often provided with employment-based health insurance, the impact of this welfare benefit is likely to be correlated with our measure of the impact of universal health insurance.

economic growth allowing regional variations. As described in the next section, we do so by dividing the country into ten regions and including region-year dummies, assuming that within-region variation of the health insurance coverage rate is independent from the growth rate of each prefecture. Furthermore, we add prefecture-specific linear trends to check the robustness.

Table 1 reports the summary statistics of all outcome variables. The mean represents the weighted average of outcomes when populations are used as weights, as in the regression analysis. We also show the mean for 1956, the reference year, and that of five prefectures whose health insurance coverage rates were highest and lowest in 1956. As anticipated from Figure 2, prefectures whose initial coverage rates are higher tend to be poorer. The top five prefectures tend to have a smaller population than the national average, a higher mortality rate, and lower gross national product (GNP) per capita. Even after taking into account the population size, people in these prefectures go to hospitals less often than the national average, and there are fewer physicians and hospitals per population. The characteristics of bottom five prefectures are, on average, similar to the national average. The numbers of most variables tend to be slightly larger than the national average because the bottom-five group includes Osaka, the second largest prefecture in Japan. Because the top five prefectures tend to have lower initial health care utilization, any bias on the estimated positive effects of health insurance expansion is likely be *downward.*

4 Identification Strategy

Our identification strategy is very similar to that of Finkelstein (2007). We exploit the variation in health insurance coverage rates across prefectures in 1956, one year prior to the start of the Four-year plan to achieve the universal coverage by 1961. The basic idea is to compare changes in outcomes in prefectures where the implementation of universal coverage led to a larger increase in the health insurance coverage rate to prefectures where it had a smaller effect.

Health insurance coverage before universal health insurance may not be random. For example, differences in income levels in 1956 can explain some portion of the variation in the health insurance coverage ratio. Also, as shown in Figure 2, the ratio of uninsured population tend to be higher in southwest regions than north-east regions. Therefore, it is essential to control for unobserved components that are correlated with the initial coverage rate of health insurance and may affect the prefecture's healthcare utilization and health outcomes. We control for differences in the levels of the outcome variables by controlling for prefecture fixed effects. Furthermore, we divide the 46 prefectures into 10 regions and control for region-year effects. The identifying assumption is that trends in the outcome variables would have been the same across prefectures within the same region in the absence of the enforcement of universal coverage, although we relax this assumption later.

The basic estimation equation is as follows:

$$Y_{pt} = \alpha_p * 1(pref_p) + \delta_{rt} * 1(year_t) * 1(pref_p \in region_r) + \sum_{t \neq 1956} \lambda_t (impact_{p,1956}) * 1(year_t) + X_{pt}\beta + \varepsilon_{pt} \tag{3}$$

Subscript p indicates prefecture and t indicates year. α_p represents a prefecture fixed effect; δ_{rt} represents region-specific year effects; and $impact_{p,1956}$ is the percentage of the population in prefecture p without health insurance in 1956, as defined in (2).[19]

Next, we further relax the assumption that trends in the outcome variables would have been the same across prefectures within the same region in the absence of the enforcement of universal coverage by including prefecture-specific linear trends:

$$\begin{aligned} Y_{pt} \;=\; & \alpha_p * 1(pref_p) + \delta_{rt} * 1(year_t) * 1(pref_p \in region_r) + \gamma_p t * 1(pref_p) \\ & + \sum_{t \neq 1956} \lambda_t (impact_{p,1956}) * 1(year_t) + X_{pt}\beta + \varepsilon_{pt} \end{aligned} \tag{4}$$

[19] Alternatively, we could regress the outcome variables on the time-varying rate of the population without health insurance in each prefecture. However, we did not use this method for the following three reasons. First, information on the ratio of households covered by employment-based insurance in each industry is only available for 1956–1959, and thus would have a substantially shorter sample period. Second, we have to interpolate the industry composition from the Census in 1955 and 1960, which implicitly impose the assumption that the industry composition changes linearly, in addition to the assumption that the coverage rate within each industry does not vary across prefectures. Thus, adding the time dimension would produce additional measurement errors and make the estimated coefficient even less precise. Third, for unknown reasons, the numbers of NHI enrollees in 1957 and 1961 are not published.

γ_p is the coefficient of the interaction term of prefecture dummy and linear time trend.

We present results from both (3) and (4). If the number of years before the base year was large enough to estimate pre-exisiting trend precisely, (4) would be a better specification because it imposes less assumption regarding the different pre-existing trends across prefectures. However, if the number of observations before the base year was small, the estimated prefecture-specific linear trend might be overfitted; i.e. it might pick up part of the effect of the policy change of interest. In our case, pre-1956 data are available at most six years, and for some variables such as the number of physicians, pre-1956 data are available only for a few years. Furthermore, the change in health insurance coverage rates was gradual and took four years. This gradual change may aggravate the overfitting because the effects also emerge gradually. Given this possibility of overfitting, we present results both with and without prefecture-specific linear trends.

Our parameters of interest are the λ_t's, which represent the coefficients of the interaction terms between year dummies and the percentage of the population without health insurance in 1956. A plot of λ_t's over t shows the flexibly estimated pattern over time in the changes in Y in prefectures where the enforcement of universal coverage had a larger impact on the insurance coverage rate relative to prefectures where it had a smaller impact. If the trend of these λ_t's changes around the period of 1957–1961, the phase-in period of universal coverage, such a change in trend is likely to be attributable to the expansion of health insurance. It is important to note that the equations (3) or (4) does not make any *ex-ante* restrictions on the timing of the structural trend break, so the trend break can occur with a lag of a few years.

The covariate X_{pt} controls for potential confounding factors that might have been changing differentially over time across different prefectures. In our basic regression over the period of 1950–1970, only the log of the total population and the ratio of population over 65 are included, because many of the other control variables are not available for the years prior to 1956. As a robustness check, we restrict the sample to the period of 1956–1970 and include the log of the population, log of real GNP per capita, local governments' revenue to expenditure ratio, and the log of local governments' per capita real expenditure on health and sanitation. Also, to control for the changes in coinsurance rates applied only to the NHI in 1963 and 1968, we add interaction terms between the ratio of population covered by the NHI in the year prior to these changes and dummy variables indicating after these changes.

Furthermore, following Finkelstein (2007), we take the following two approaches to account for the pre-existing trends. First, we calculate the changes in λ_t during the first 5 years since 1956, the year when the Four-year plan started, and take the differences with the changes in λ_t in the 5 years prior to 1956. That is, we calculate $(\lambda_{61} - \lambda_{56}) - (\lambda_{56} - \lambda_{51})$ and their estimated standard errors to see whether they are statistically significantly distinct from zero. We also estimate and $(\lambda_{66} - \lambda_{61}) - (\lambda_{56} - \lambda_{51})$, i.e. we repeat the same exercise for the period of 1961-66, the second 5 years after the expansion.

Second, we estimate the following deviation-from-trend model:

$$\begin{aligned} Y_{pt} &= \alpha_p * 1(pref_p) + \delta_{rt} * 1(year_t) * 1(pref_p \in region_r) + \gamma_{pre} * year_t * impact_{p,1956} \\ &+ \gamma_{mid} * 1(year_t \geq 1956) * (year_t - 1956) * impact_{p,1956} \\ &+ \gamma_{after} * 1(year_t \geq 1961) * (year_t - 1961) * impact_{p,1956} + X_{pt}\beta + \varepsilon_{pt} \end{aligned} \quad (5)$$

γ_{pre} captures any pre-existing trends that are correlated with health insurance coverage rates in 1956. γ_{mid} represents any trend breaks caused by the massive expansion in health insurance that started in 1956, and γ_{after} is meant to capture further trend breaks after the achievement of universal coverage. A disadvantage of this approach is that we have to impose ex-ante restricts on the timing of trend breaks.

We use the population by prefecture as weights in all regressions to account for the substantial variation in the size of population. We also cluster the standard errors at the prefecture level to allow for possible serial correlation over time within prefectures.

Lastly, it is important to clarify how much and to which direction migration could bias our results. First, during the period of 1950-1970, there was substantial inflow of working-age population to industrialized cities, especially Tokyo and Osaka, from rural areas. Since large cities tend to have low coverage rate in 1956, prefectures that had a large increase in insurance coverage from 1956 to 1961 also had an increase of younger population during the same period. Given that younger population less likely to use healthcare services, the bias caused by inter-prefecture migration would be, if there is any, towards zero. Furthermore, as a robustness check, we present results excluding Tokyo and Osaka from the sample. If inter-prefecture migration caused substantial biases, the results excluding Tokyo and Osaka should be different from the results including them. However, as presented in next section, excluding Tokyo and Osaka does not change the results much. Second, it is possible that sicker people migrate from a municipality without NHI to one with NHI within the same prefecture. If so, our estimates put more weights on changes in healthier people's insurance status.

5 Results on Utilization

5.1 Basic Results

Figure 6a plots the estimated λ's from equation (3) without prefecture-specific linear trends for the following three dependent variables as the measures of health care utilization: log of admissions, inpatient days, and outpatient visits. Because 1956 is the reference year, the 1956 is set to zero by definition. Therefore, the coefficient in each year can be interpreted as the relative change in outcomes from 1956 that would have resulted if the expansion of health insurance had increased the coverage ratio by 100 percent, compared to a prefecture where the coverage ratio did not change.

The upper left graph in Figure 6 shows the results for hospital admissions. There is no pre-existing trend in the λ's until 1956, and then the number of admissions started to grow faster in the area in which health insurance expansion had a larger impact. The estimated λ_{1961} and λ_{1966} are 0.264 and 0.296, respectively.[20] Given that roughly 28 percent of the total population did not have any health insurance as of 1956, these estimates imply that the admissions increased by 7.6 percent ($= exp[0.264 * 0.28] - 1$) in 5 years and 9.3 percent in 10 years due to the enforcement of universal health insurance. Inpatient days and outpatient visits show very similar trends to admissions. There is no pre-existing trend in the early 1950s, but both graphs increase sharply in

[20] Hereafter, we mainly focus on λ_{1961}, i.e. the change up to the full achievement of universal health insurance, and λ_{1966}, i.e .the changes in 10 years from the reference year. The estimated coefficients and standard errors for 1950–1970 are available from the authors upon request.

the late 1950s and stay high until the late 1960s. The magnitudes are larger for inpatient days and outpatient visits than admissions. The estimated λ_{1961} and λ_{1966} imply that 9.4 and 8.2 percent increases for inpatients days and 12.2 and 15.2 percent increases for outpatient visits by 1961 and by 1966, respectively, due to the enforcement of universal health insurance.

Figure 6b shows the estimated λ's from equation (4), i.e. the results with controls for prefecture-specific linear trends. The estimated λ's tend to be larger and standard errors are smaller than those in Figure 6a. The estimated and imply that 12.3 and 20.3 percent increases for inpatients days and 11.3 and 18.5 percent increases for outpatient visits by 1961 and by 1966, respectively, due to the enforcement of universal health insurance.

It is informative to compare our estimates with those from the RAND HIE, although we need to pay considerable attention to differences in the coinsurance systems and other relevant factors between Japan in the 1950s and the United States in the 1970s.[21] Given that the coinsurance rate of the NHI in Japan was 50 percent at that time, the most comparable case in the RAND experiment is the change in the coinsurance rate from 95 to 50 percent. Manning et al. (1987) showed that an individual who moved from 95 to 50 percent coinsurance would increase his or her annual number of face-to-face visits by 11 percent (from 2.73 to 3.03 visits).[22] Therefore, the RAND HIE suggests that the effect of moving 28 percent of the population from no insurance to universal health insurance is to increase outpatient visits (i.e., face-to-face visits in hospitals) by 3.1 percent (11*0.28). Our estimates show that outpatient visits increased by 15.2-18.5 percent in the 10 years since 1956. Thus, our estimates are about five times larger than what individual-level changes in health insurance would have predicted.

5.2 Robustness Checks

Table 2 presents robustness checks of our utilization results. To save space, we only report coefficients estimated for the interaction terms of 1961 and 1966. To make the results comparable with

[21] An important difference is that the RAND experiment set limits on the maximum out-of-pocket expenditures (MDE) or stop-loss that the individual should pay, whereas there was no limit on MDE in our case. Since this limit on maximum payment should cause medical utilization to be higher than would be the case otherwise, the estimates from RAND HIE may overestimate the size of the medical expenditures compared to our case.

[22] These figures are taken from Table 2 of Manning et al. (1987). The same figures are presented in Table 3.2 in Newhouse et al. (1993).

our basic results, rows 1 and 4 repeat the results from the basic specification.

First, to check whether our results are driven by the prefectures with large populations, we exclude Tokyo and Osaka, the two largest prefectures, which comprised 15 percent of the total population in 1956. Rows 2 and 5 indicate that our results are not driven by these prefectures. Moreover, dropping these prefectures makes lambda_66 statistically significant. Second, to control for other confounding factors that may affect the outcomes, we add the following time-varying variables: the log of the real GNP per capita converted to 1980 yen, the ratio of local governments revenue to expenditure, local governments per capita real expenditure on health and sanitation, and the ratio of the population more than 65 years old. Also, to control for the changes in coinsurance rates applied only to the NHI in 1963 and 1968, we add interaction terms between the ratio of population covered by the NHI in the year prior to these changes and dummy variables indicating after these changes. Because most of our additional control variables are available only after 1956, we limit the sample to 1956-1970 in this specification.[23] Due to the lack of observation before 1956, this robustness check is done only for the specification without prefecture-specific linear trends. As seen in rows 3 and 6, adding these controls does not significantly change the estimated coefficients.

Furthermore, to check the robustness to pre-existing trends, we compare changes in λ_t during a fixed length of time after the expansion of the health insurance coverage relative to change in λ_t during the same length of time before the expansion. In the first row of Table 3, we take a five year difference in change in the outcome. Although the coefficient on admission is no longer statistically significant, the point estimates for all three utilization outcomes is almost identical to the basic specification reported in row 1 in Table 3. The second row in Table 3 repeats the same five-year test for 1961–1966, the next five-year period, using the same reference period (1951-1956). None of the coefficients are statistically significant. This result is consistent with the leveling off of all utilization measures after 1961 shown in Figure 6. These results indicate that the effect of the expansion of health insurance on utilization is concentrated only during the period when the health insurance coverage was expanding and also that it remained flat after the universal coverage

[23] Limiting the sample to 1956—1970 itself has no impact on the estimated coefficients.

was achieved.

A drawback of this approach is, however, that it relies on only three years of the data, and thus the results can vary depending on which year we pick for point-to-point comparison. To efficiently utilize all available information, we also estimate deviation-from-trend model as in equation (5). We allow the slope to differ during the expansion period (1956-1961) and the lagged period (1961-1970). The rows 3 and 4 in Table 3 show the estimated coefficients of these two slopes in the deviation-from-trend model. The coefficients for the first slopes (row 3) are positive for all three utilization measure and indicated changes are in the same order of the estimates from other specifications, although the estimates for admissions and out patient visits are not statistically significant. For example, the coefficient on the first slope for the admissions is interpreted as an increase of 11.2 percent($= exp[0.076*5*0.28]-1$) by 1961.[24] In contrast, the estimated coefficients for the second slopes are all negative but, except for the case of outpatient visits, the magnitude is smaller than the absolute value of the first slopes, which is consistent with positive but flatter slopes after 1961 in Figure 6.

6 Results on Supply-Side Response

Given the increase in utilization in response to the expansion of health insurance coverage, the next question is whether the supply side can adequately accommodate the drastic increase in the demand for health care. Understanding this supply side response is particularly important since one of the major concerns for the massive health insurance expansion, such as the Patient Protection and Affordable Care Act in the United States, is the shortage of physicians (Association of American Medical College 2010).

The supply-side response is also interesting from a theoretical perspective. Finkelstein (2007) argues that a market-wide change in health insurance coverage may have larger effects than implied by individual-level changes in health insurance coverage, because market-wide changes can fundamentally alter the nature and character of medical practice in ways that small-scale changes

[24] Note that the estimated coefficient only gives a one year effect, and roughly 28 percent of the total population did not have any health insurance coverage as of 1956.

will not, and thus generate additional general-equilibrium effects through the increased supply capacity.[25] That is, if the expansion of health insurance coverage sufficiently increases the aggregate demand for health care services, it may induce medical providers to incur the fixed costs to build new institutions.[26]

Thus we begin by testing this hypothesis by estimating the effects of health insurance expansion on the number of medical institutions. It is important to note that our analyses at the prefecture level can capture the effects thorough induced hospital entry, unlike studies using hospital-level data.

The upper-left graph of Figure 7 plots estimated λ's in equations (3) (4) with the log of the number of hospitals as the dependent variable. Like Figure 6, Figure 7a presents estimates without controls for prefecture-specific linear trends, and Figure 7b presents estimates with controls for prefecture-specific linear trends. Without controls for prefecture-specific linear trends, the estimated coefficients for 1961 and 1966 are 0.191 and 0.411, respectively, and both are statistically significant. Therefore, this graph may read as if the hospitals have increased in the areas where utilization indeed increased. As shown in Table 4, the estimates do not change much when we drop Tokyo and Osaka or add more controls.

However, the graph also shows a strong pre-existing trend before 1956. Indeed, as shown in Table 7b, once prefecture-specific linear trends are included, the estimated coefficients are no longer significantly positive. Table 5 also reports that the positive effects on the number of hospitals disappear when pre-existing trends are controlled. Therefore, the positive association between the increase in health insurance coverage and the number of the hospitals does not seem to be a causal link.

We repeat the same analysis for clinics; the results are shown in the upper-right graph in

[25] Finkelstein (2007) found a six-fold increase in medical expenditures compared to that of the RAND HIE unlike our case of three times. There may be numerous reasons why the estimated effect is different between Finkelstein (2007) and ours due to the institutional differences. We mention one possibility here. The major difference between the situation in Japan and Medicare in the United States is that Medicare covers only the elderly whereas the universal health insurance in Japan covers the entire population. If the elderly are more price-sensitive because they are poorer and have less available credit, the estimates for Medicare expenditures may be larger.

[26] Finkelstein (2007) also pointed out the possibility of the spillover effects, another kind of general equilibrium effects. The basic idea is that changes in insurance for one group of patients can have spillover effects on the treatment intensity or frequency of visits of another group of patients. Appendix Section A2 presents suggestive evidence that is consistent with this spillover hypothesis, although we need to view these results with caution because we cannot distinguish those who were already covered and newly covered due to the data limitation.

Figures 7a and 7b, and the second column in Tables 4 and 5. As shown in the graphs, λ's are not estimated very precisely. Moreover, none of the estimates presented in Tables 4 and 5 are statistically significant. Overall, the response of the number of clinics is small.

Next, we explore the other supply-side response measured by the supply of beds, physicians and nurses. The rest of the Figure 7 shows the estimated λ's for the following four outcomes: log of the number of beds, bed occupancy rate, log of the number of physicians, and that of nurses.[27]

The graphs in the middle row of Figure 7a show that the number of beds started to increase in the mid-1950s. Compared to 1956, the expansion of health insurance increased the number of beds by 3.6 percent by 1961 and 6.6 percent by 1966.[28] The bed occupancy rate also increased substantially in the late 1950s and then declined in the early 1960s. This pattern suggests that, although the number of beds increased in response to the expansion of health insurance coverage, the surge in the number of patients exceeded the increase in the supply of beds. Unlike the case of the number of hospitals and clinics, we do not see particularly discernible pre-existing trend for the number of beds. Figure 7b and the third column in Tables 4 and 5 confirm this observation.

The bottom two graphs in Figure 7 show the estimated λ's for the number of physicians and nurses. The graph of the number of physicians in Figure 7a shows an increase at a slightly slower pace than that of beds, although the estimated λ's are not always statistically significant. The corresponding graph in Figure 7b and the fourth column of Table 5 shows that controlling for pre-existing trends makes the estimated impact on the number of physicians larger, but this may be because of the declining trend during the period of 1953-1956, which may be too short to estimate the pre-existing trends. The response of the number of nurses is noisier and apparently weak.

To recapitulate our results, we do not find robust evidence for increases in the number of the hospitals and clinics in response to the expansion of health insurance, while we find evidence for increases in the number of beds. The effect on the number of physicians is sensitive to the way we

[27] Because data for admissions, inpatient days, and outpatient visits cover hospitals only, we use the number of beds, physicians and nurses working in hospitals for the sake of consistency. We have confirmed that the results do not change much if we expand our data to all beds, physicians and nurses in hospitals and clinics.

[28] Note that the increase in the number of beds at that time was mainly driven by the entry and expansion of private hospitals. It is true that public hospitals also increased its supply of beds by 48% during the period of 1956-1965; yet, the increase rate of beds in private hospitals was more than 100% in the same period. As pointed by Ikegami (1992), there had been no restrictions on capital development of private hospitals until 1985, when the ceiling on the number of hospital beds by region was imposed. In contrast, the supply of physicians and nurses are inevitably constrained by the capacity of medical and nursing schools.

control for the regional trends, and that on the number of nurses is negligible. These contrasting results are plausible since it is less costly for existing hospitals to increase the capacity by adding beds than for new hospitals to enter the market by paying the large fixed costs. It is not surprising either that increasing physicians and nurses are not as easy as adding beds because the total supply of physicians and nurses are constrained by the capacity of medical and nursing schools.[29]

7 Results on Mortality Rates

To complete the picture of the impact of universal health insurance, this section explores whether health insurance indeed benefited insured people. On the one hand, cheaper access to health care services may improve health outcomes.[30] On the other hand, if the marginal people receiving medical care because of the expansion of health insurance are not severely ill or if the expansion of health insurance increases the unnecessary treatments (i.e., *ex-post* moral hazard), there may be no positive effects on health outcomes. Therefore, although an improvement in health outcomes can be an important benefit of health insurance, the impact of health insurance on health outcomes is *a priori* ambiguous. As the measure of health outcomes, we use age-specific mortality rates and the morbidity rates of tooth cavities among children.

Figures 8a-d presents the estimated λ's in equation (3) with the mortality rates of five age-groups as the dependent variables, separately for male and female and without and with controls for prefecture-specific linear trends. Without controls for prefecture-specific linear trends, as shown in Figures 8a and 8c, the expansion of health insurance coverage do not reduce the mortality rate for any of the age groups we study. As shown in Table 6, this conclusion is robust to adding more controls.

However, as shown in Figures 8b and 8d, when prefecture-specific linear trends are controlled, statistically significant negative effects emerges in the late 1960s except for female adults. Table

[29] In theory, it is also possible that there was excess capacity before the expansion of health insurance coverage, or the economics of scale enhanced the efficiency in the provision of medical services, and hence it was not necessary to build new institutions or hire new physicians and nurses.

[30] Another potential benefit to patients is the lower risk of unexpected, high out-of-pocket medical spending, which results in an evening out of healthcare expenditures. However, we cannot explore this kind of benefit because the variance in individual household healthcare expenditure is not available. Nevertheless, as shown in Appendix Section A3, the introduction of universal health insurance did not affect the average out-of-pocket expenditures.

7 also shows that controlling for the pre-existing trends makes the coefficient for male aged 50-54 in 1965 statistically significantly negative.

This lack of decline in mortality in the short run may be because individuals with acute, life-threatening, treatable health conditions previously sought care at hospitals even if they lacked health insurance. That is, those who suffer from the diseases that could be cured with medical treatment available at that time had already gone to hospitals at their own expense. Even though there was no public aid for uninsured, mutual aid from blood relatives and local community could have supported poor uninsured patients.

To examine such possibility, we examine the cause-specific mortality of diseases that were viewed as treatable at that time, such as pneumonia, bronchitis, gastritis, and duodenitis.[31] If those who could have been saved with appropriate treatment did not have access to care because of the lack of the health insurance, the mortality rates of these treatable diseases should have fallen more in the prefectures that are more affected by the health insurance expansion. However, as shown in Tables 8 and 9, we do not find any statistically significant reduction in the number of deaths by these treatable diseases.[32] Our results are consistent with Almond et al. (2007) and Finkelstein and McKnight (2008), who show that the mortality effects are observed only among those who had not had legal access to the hospitals before the passage of Title VI of the 1964 Civil Rights Act, which mandated desegregation in institutions receiving federal funds. In Japan, such discrimination to limit the access to the health care was not present.

Another possibility is that the sudden increase in demand lowered the quality of health care services. Because health care utilization increased dramatically whereas the number of physicians did not catch up fully, the expansion of health insurance might have reduced the number of physicians per patient. Although we cannot directly measure the quality of medical treatment, this overcrowding may have lowered the quality of health care services.

Nonetheless, our results with controls for prefecture-specific linear trends imply that there may be some lagged improvement on health outcomes. [add more later!]

[31] At that time hospitals could only effectively treat these short-term acute illness rather than chronic illness such as cancer, and cardiovascular diseases.

[32] We also tried to estimate equation(3) and found that most of the λ's are statistically insignificant and close to zero.

8 Conclusion

We have estimated the impact of the massive expansion of health insurance program in Japan on health care utilization and health outcomes. We find substantial increases in health care utilization, which are much larger than what would be implied by the individual-level effect estimated by Manning et al. (1987) and Newhouse (1993). Regarding why we find such larger effects, we find mixed evidence regarding the supply-side responses argued in Finkelstein (2005, 2007). On the one hand, we do not find that the expansion of health insurance increases the number of hospitals and clinics. On the other hand, we find increases in the number of beds in response to the expansion of health insurance coverage. However, even beds increase at a slower rate than the increase in health care utilization. This slow supply-side response may constrain the ability of the health care system to meet increased demand resulting from expansions in coverage.

Despite the increase in health care utilization, we do not find strong evidence for improved health outcomes, at least in the short run. Admittedly, our results on health outcomes are limited to mortality, and thus it is possible that the introduction of universal health insurance reduced the morbidity rates of non-fatal diseases that more severely limit physical function. Nonetheless, universal health insurance is unlikely to be the main factor explaining Japan's drastic improvement in life expectancy in the 1960s at least in the short-run.

Finally, we emphasize that we cannot conclude from our results that universal health insurance does not improve social welfare. Our limited data does not allow us to explore the decline in the risk of sudden out-of-pocket health care expenditures, which is another important benefit from health insurance. Rather, the takeaway from our empirical results is that a large expansion in health insurance coverage will increase health care utilization regardless of whether it improves the health outcome, and the magnitude of the effect will be much larger than predicted from individual-level changes in insurance status. Therefore, countries planning to introduce the universal health insurance need to prepare enough financial resources for the anticipated surge in health care expenditures.

A Appendix

A.1 Evidence against Crowding Out of Employment-based Insurance by the NHI

As explained in Section 2, there are two potential channels through which the expansion of the NHI crowds out employment-based insurance. First, the NHI could increase self-employed workers by reducing the penalty of being ineligible for employment-based insurance. Second, the introduction of the NHI could induce firms to reduce its size to less than five employees and get exempt from the financial contribution to employment-based insurance.

To assess the first possibility, we calculate the ratio of self-employed in employed labor force from Population Census 1950, 1955, and 1960. This self-employment ratio is the sum of the numbers of business owners without paid employees and family workers divided by the number of all employed people 15 or more years old (14 for 1950). We exclude the owners with paid employees because they might be eligible for employment-based insurance. Then, we regressed the changes of this ratio from 1955 to 1960 on the ratio of uninsured in 1956, i.e. impact. As shown in Table A2, the ratio of uninsured people does not have any effect on the ratio of self-employment. Thus, we conclude that the first kind of crowding-out did not occur in the case of Japan in the 1950s.

Regarding the second possibility, we obtain data of the number of establishments by size from the Establishment Census (jigyosho toukei). This survey was conducted every three years, this we use data for 1951, 54, 57, 60, 63 and 66 and estimated equation (3) except that the base year (i.e. year with lambda=0) is 1957. The estimated lambda is shown in Table A3.

If the expansion of NHI induced some firms to reduce the size and get exempt from employment-based insurance, the number of establishments with 1-4 employees should have increased during the period of 1956-1960. Also, the number of establishments with 5-9 employees should have decreased during the same period. Columns (1) and (2) of Table A3a shows that the number of establishments with 1-4 employees did not increase in response to the expansion of NHI, although the number of establishments with 5-9 employees decreased slightly. Columns (4) and (5) further shows that, when looking at the ratio instead of the number, establishments with 1-4 employees increased in the mid 1960s rather than in the late 1950s. Yet, this positively significant lambda 63 and 66 seem to be driven solely by Tokyo and Osaka. As shown in Table A3b, when we exclude Tokyo and Osaka, no lambda remain statistically significant. Thus, Column (4) of Table A3a probably reflects the fact that Tokyo experienced a fall in the ratio of small establishments in the 1950s and already reached to a much lower ratio than other prefectures by 1960, rather than lagged response to the NHI expansion.

A.2 Evidence for Spill-over Hypothesis: Expenditures and Medical Claims by the NHI Recipients

The spillover hypothesis implies that changes in insurance for one group of patients can have spillover effects on the treatment intensity or frequency of visits of another group of patients. (Baker 1997; Glied and Zivin 2002). These spillovers can arise from changes in physician/hospital practice norms, from the joint costs of the production of health care services, or simply from demand inducement.

Ideally, we would like to estimate the impact of universal health insurance on the total medical expenditures of those who already had some sort of health insurance, to explore the possibility of spillover. However, due to the non-prefecture structure of employment-based insurance, payment records at the year-prefecture level are only available for NHI beneficiaries. Admittedly, those who were covered by the NHI are a non-randomly selected part of the population, namely, those not covered by employment-based health insurance. Nonetheless, individuals in the NHI represented about half of those in health insurance programs in the 1950s and 1960s, which we believe is a substantial share.

Our data source is the payment record from the NHI to medical providers from 1957 to 1970 at the year-prefecture level. Specifically, we examine the effects on the per-person expenditure and the per-person number of medical claims.

Another issue in using this payment record is that, because the coverage of the NHI expanded drastically during 1956–1961, the composition of the population insured by the NHI might have also changed substantially. Because our per-person medical expenditure does not distinguish those who became newly covered, the composition effect can generate spurious changes in per-person medical expenditures, even in the absence of a change in the per-person medical expenditure of those who were covered already. Nevertheless, we believe that such a composition effect, if it existed, would have biased the estimated impact downward, because newly insured people tend to be healthier. The reasons are as follows. First, mandatory health insurance was implemented at the municipality level, not the individual level, and so the composition effects were at the municipality level and thus likely to be less severe than would be true with individual selection. Furthermore, as documented by Yoshihara and Wada (1999), the areas newly covered by the NHI in the late 1950s tended to be urban cities with many self-employed and family employees in the retail and service sectors, whereas the majority of those who were already covered in the mid-1950s were farmers. According to the Vital Statistics and the Census, the mortality rate of workers in the retail sector was less than one-half of that of farmers in 1960.

Figure A1 plots the corresponding λ's in equation (3) on the per-person expenditures and per-person medical claims for those covered by the NHI. The left graph shows that the expenditure per person increased substantially as the coverage rate of health insurance in the population increased. That is, the population coverage-rate increase raised the level of medical expenditures that people would have made if covered by the NHI. The right graph shows that two-thirds of this increase was attributable to the increase in the number of benefit claims, that is, the frequency of visits to medical institutions. This implies that the increase in medical expenditure may have been driven by an increase in the number of visits rather than the price per visit. These results are consistent with the RAND experiments in that the coinsurance rate only affects the frequency of visits rather than the intensity of treatment (Manning et al. 1987). Table A2 shows that our estimates are quite robust to alternative specifications, similar to the utilization measures.

A.3 The Impact on Household Out-of-Pocket Healthcare Expenditures

Even if there is no improvement in health outcomes, health insurance may benefit insured individuals by reducing the risk of sudden out-of-pocket spending and helping to smooth consumption (Finkelstein and McKnight 2008). To investigate whether, and to what extent, health insurance can reduce this risk, we need data regarding the distribution of out-of-pocket spending at the individual level. However, such data are not available. Thus, in this section, we instead explore the effect on *average* out-of-pocket medical expenditures.

Household medical out-of-pocket expenditures are taken from the National Survey of Family Income and Expenditures, which has been conducted every 5 years since 1959. This survey is nationally representative in that both insured and non-insured individuals are included. Each surveyed household is asked to keep track of its household budget. Therefore, the data on medical expenditures consists only of out-of-pocket medical expenditures by the household and do not include payments made directly from the insurance system to medical providers. In addition, medical expenditures may include the purchase of nonprescription medication at drugstores. Medical spending by household in 1959, 2 years before the achievement of universal health insurance, was 2,206 yen (in 1980 prices) per month, representing 1.8 percent of the total household income.

We examine the difference between 1959 and 1964 to estimate the impact of health insurance on out-of-pocket expenditures, as well as the difference between 1959 and 1969, to see longer-term effects. Specifically, we estimate the following first-difference regression:

$$dY = \beta_0 + \beta_1 \% insured_{p,1958} + \beta_2' dX + \varepsilon_p$$

where X includes the same set of control variables added in Table 2.

As dependent variables, we use both the ratio of out-of-pocket medical expenditures to the total household expenditures and the log of out-of-pocket medical expenditures. Table A3 presents the results. The estimated coefficients are small and not statistically significant. This result means that the growth of household out-of-pocket medical expenditures did not vary with the proportion of people newly covered by health insurance because of the introduction of universal health insurance.

The fact that health insurance had almost no impact on out-of-pocket medical expenditures is in stark contrast to studies of health insurance effects in the United States. For example, Finkelstein and McKnight (2008) found that the introduction of Medicare produced a 25 percent decline in the out-of-pocket medical expenditures. This difference may be attributable to the difference in the coinsurance rate: in the case of Japan, newly covered NHI recipients still had to pay for 50 percent of their own healthcare costs, whereas the introduction of Medicare reduced consumer costs to almost zero, except for a small deductible. At the same time, this difference may reflect other institutional variation. For example, in Japan, health insurance covers prescription drugs as well as hospital and physician expenses, whereas the Part D prescription-drug benefit was recently added to the Medicare program in 2003 in the United States (The Medicare Modernization Act of 2003).

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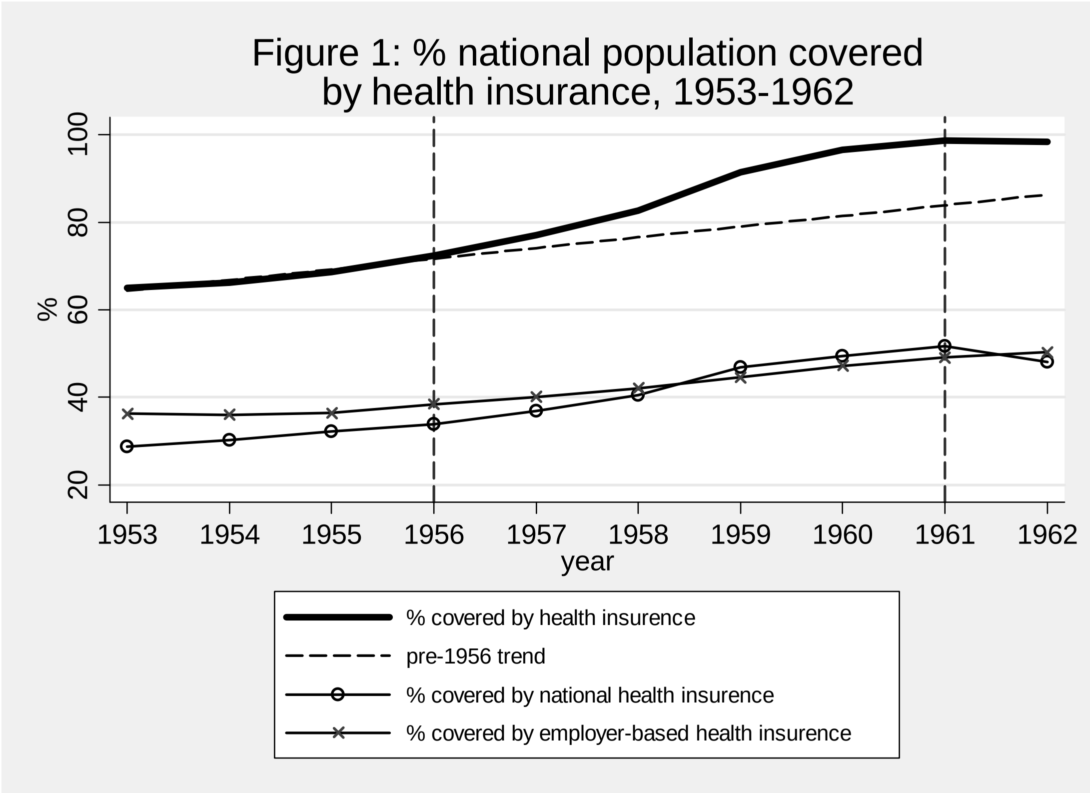
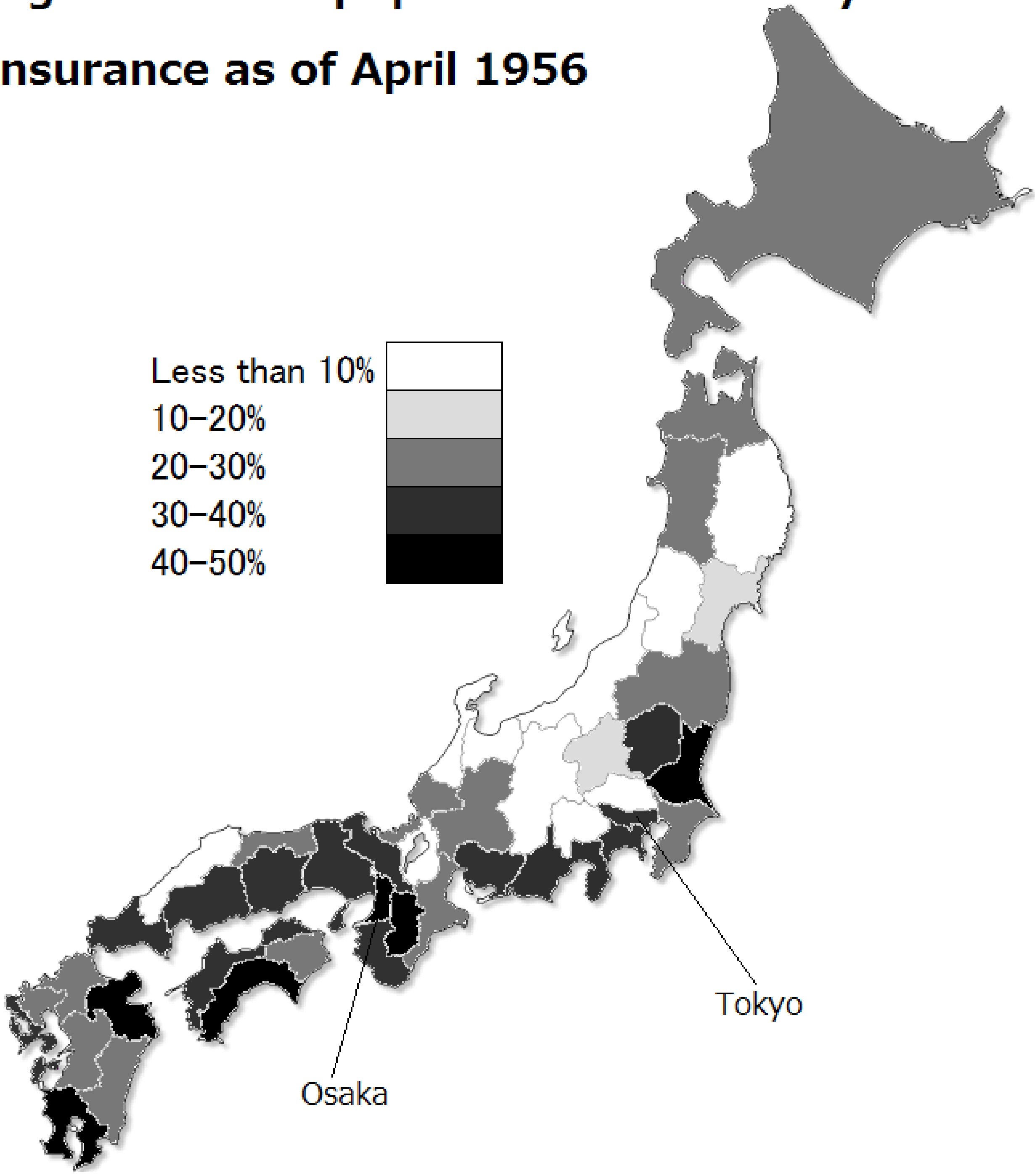
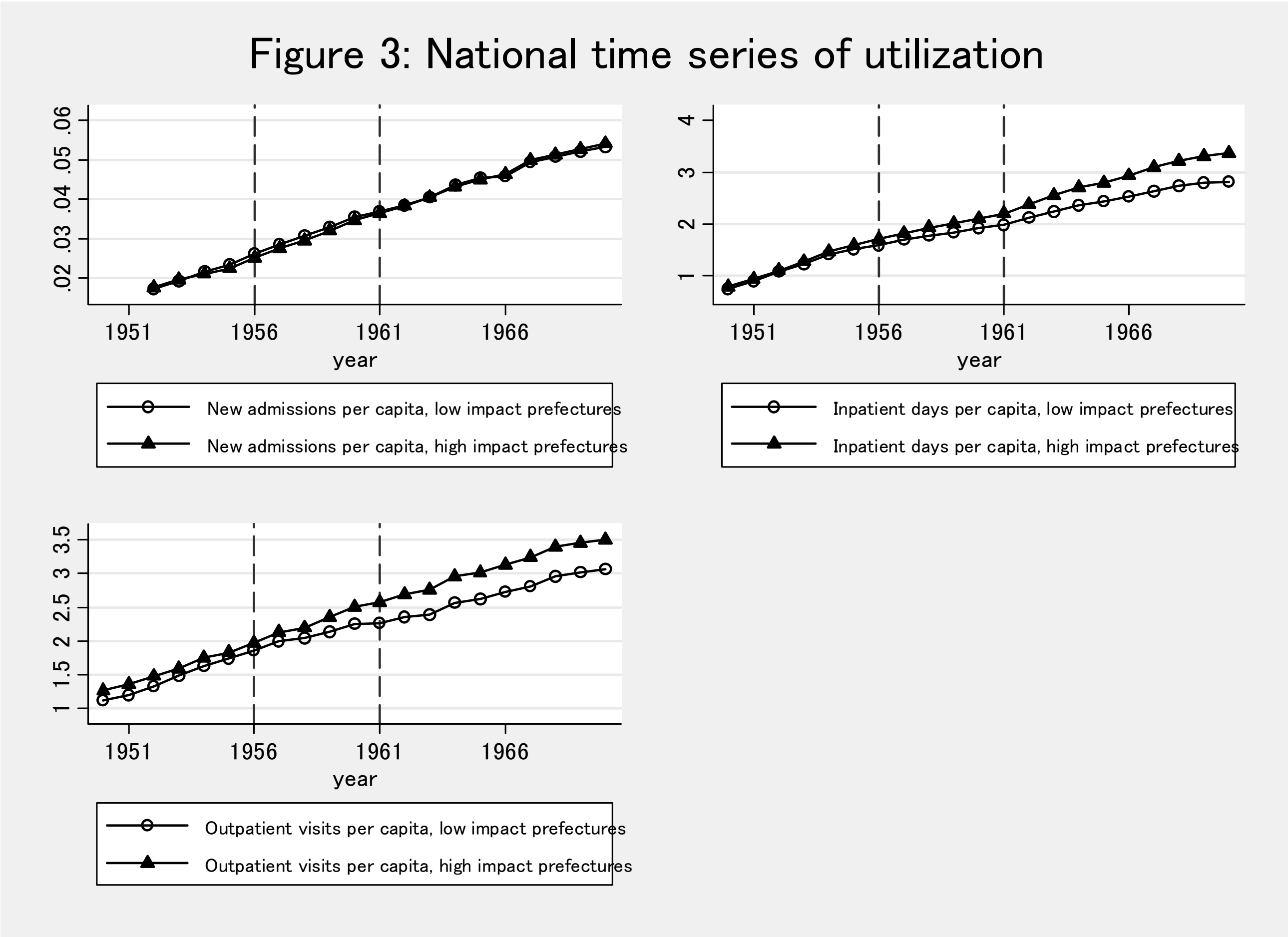


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved.

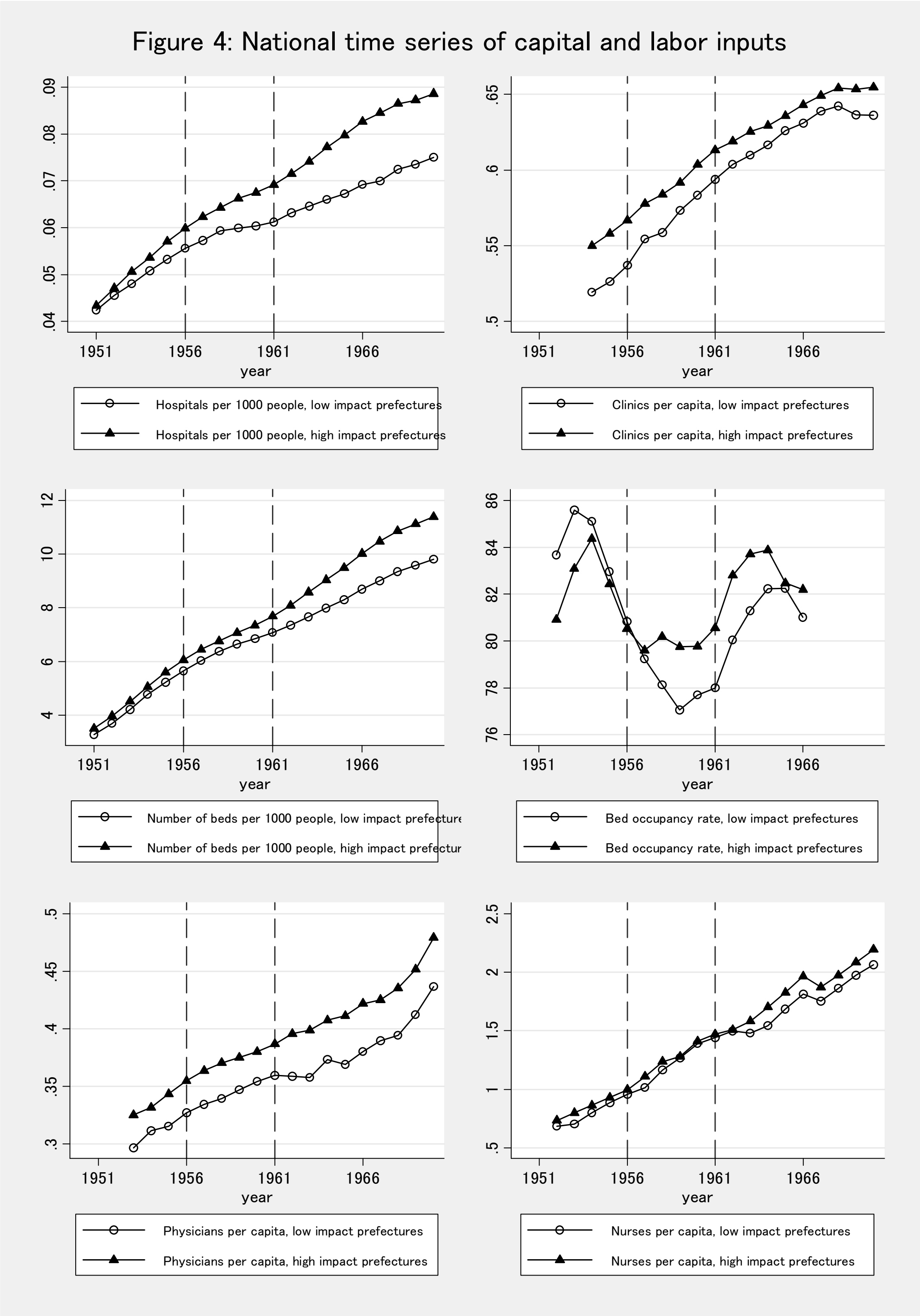
Source: Social Security Year Book (1952-57) and Annual Report on Social Security Statistics (1958-1964).

Figure 2: % of population without any health insurance as of April 1956



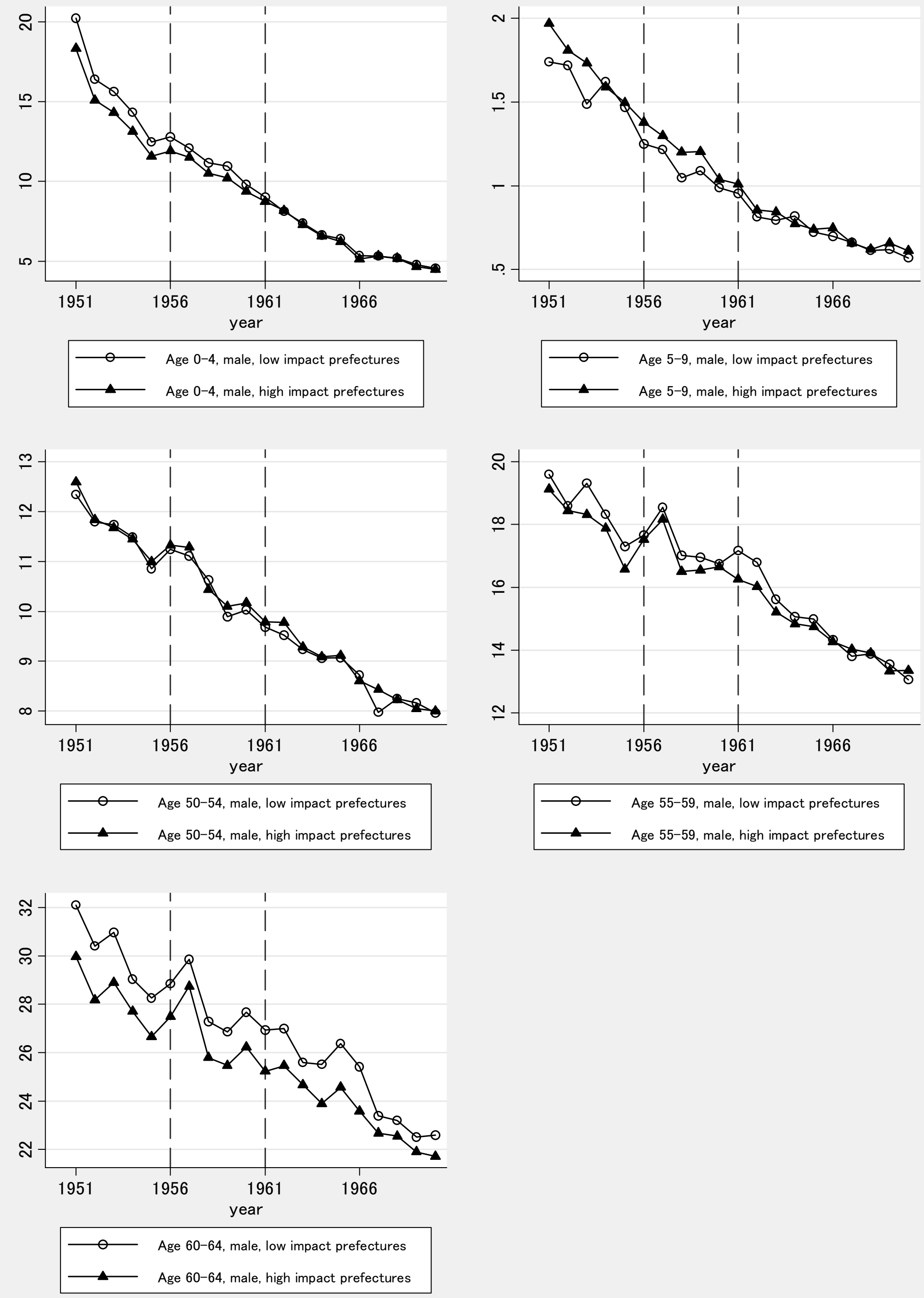


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Low impact prefectures are prefectures whose rate of uninsured population was less than 20% in 1956.



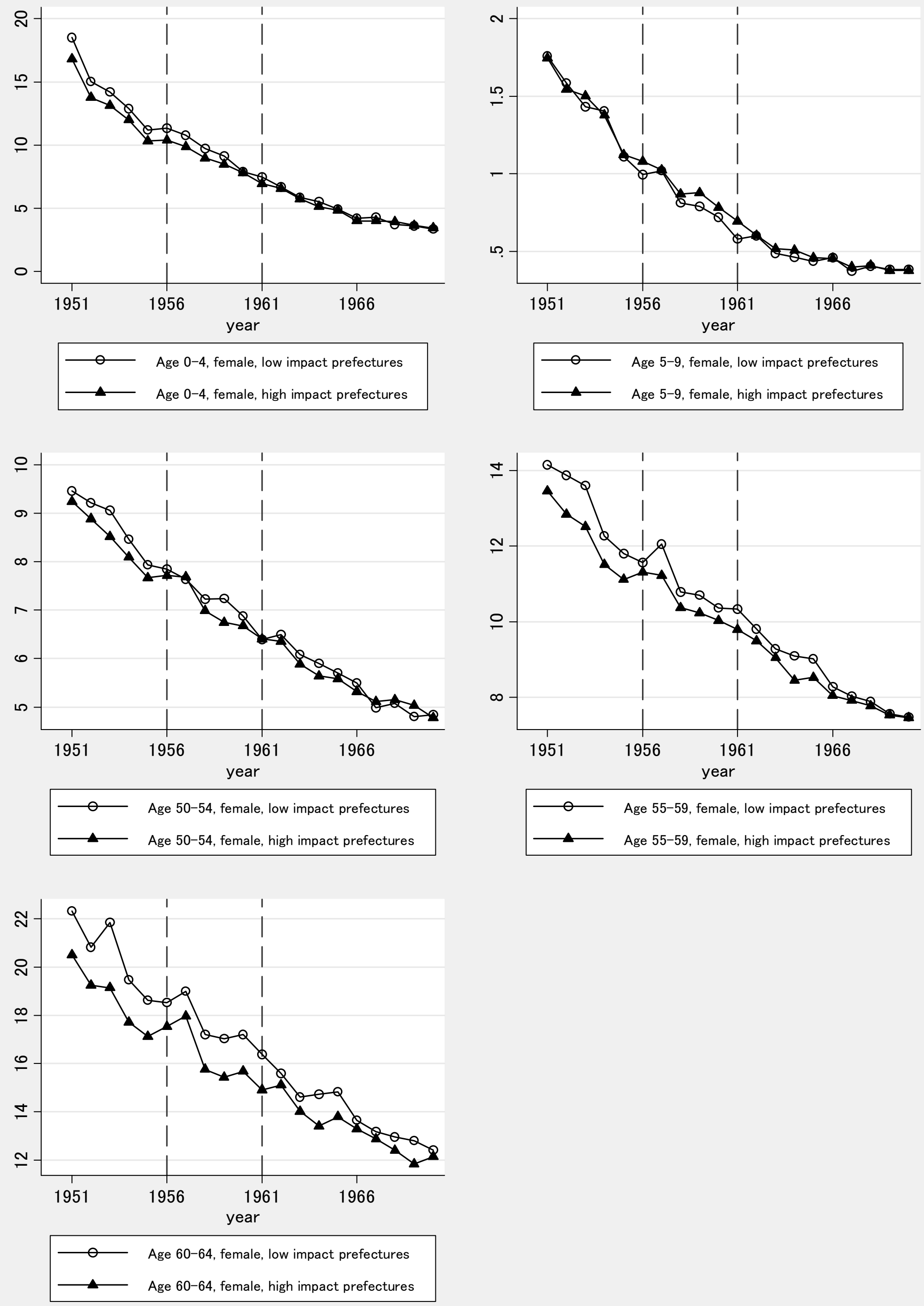
Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Low impact prefectures are prefectures whose rate of uninsured population was less than 20% in 1956.

Figure 5a: National time series of age specific mortality rates, male



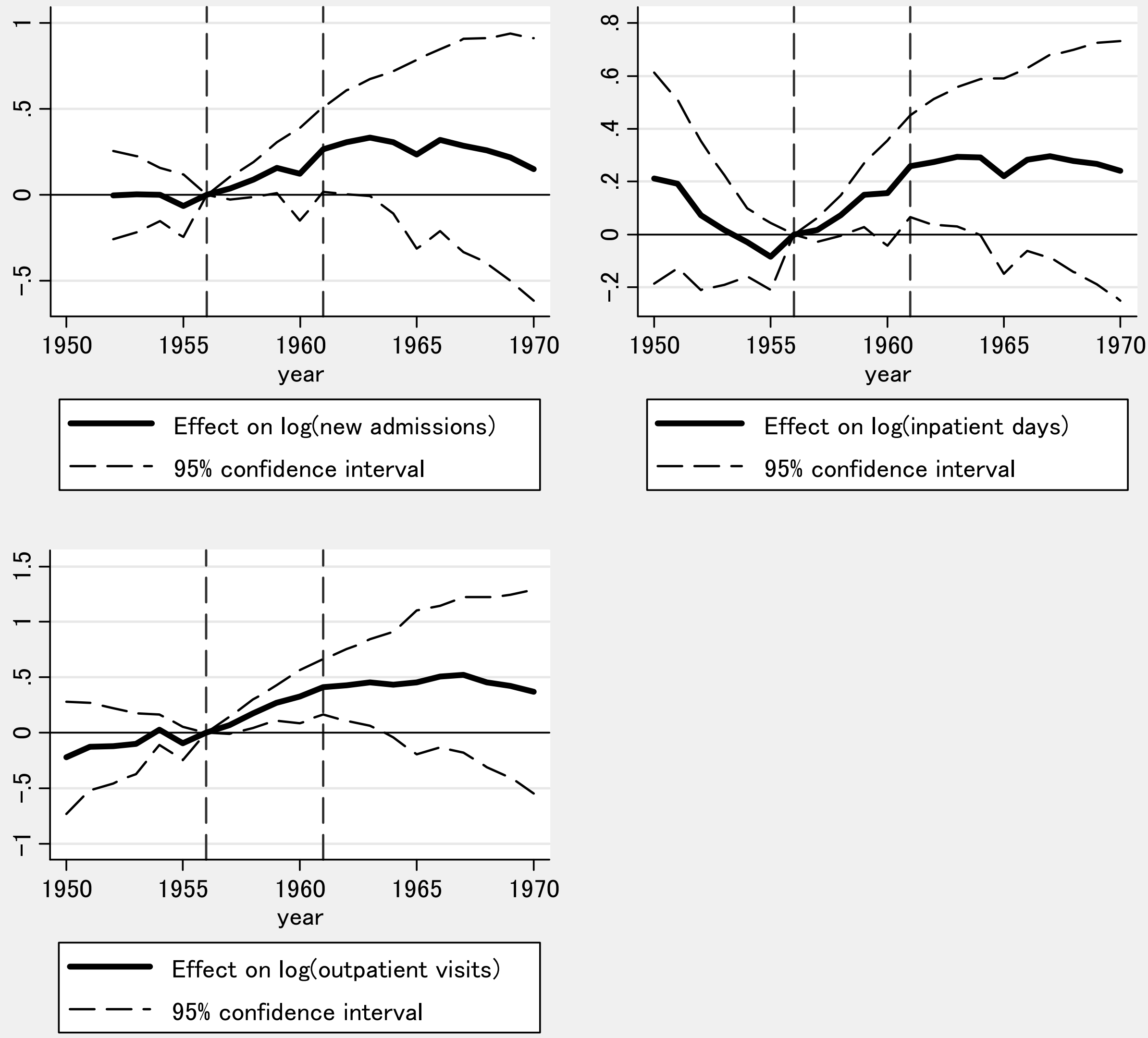
Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Low impact prefectures are prefectures whose rate of uninsured population was less than 20% in 1956.

Figure 5b: National time series of age specific mortality rates, female

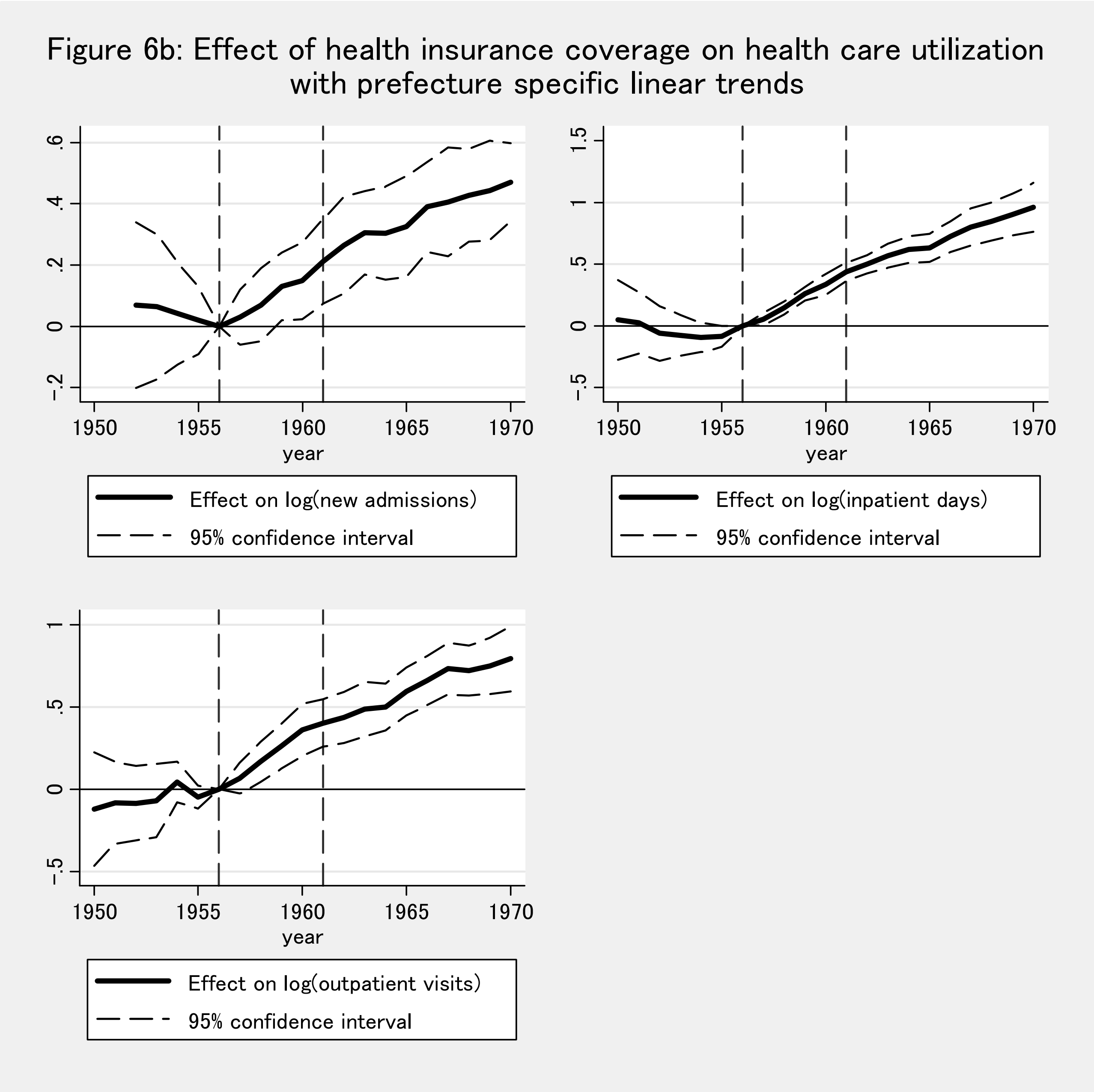


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Low impact prefectures are prefectures whose rate of uninsured population was less than 20% in 1956.

Figure 6a: Effect of health insurance coverage on health care utilization without controls for prefecture specific linear trends

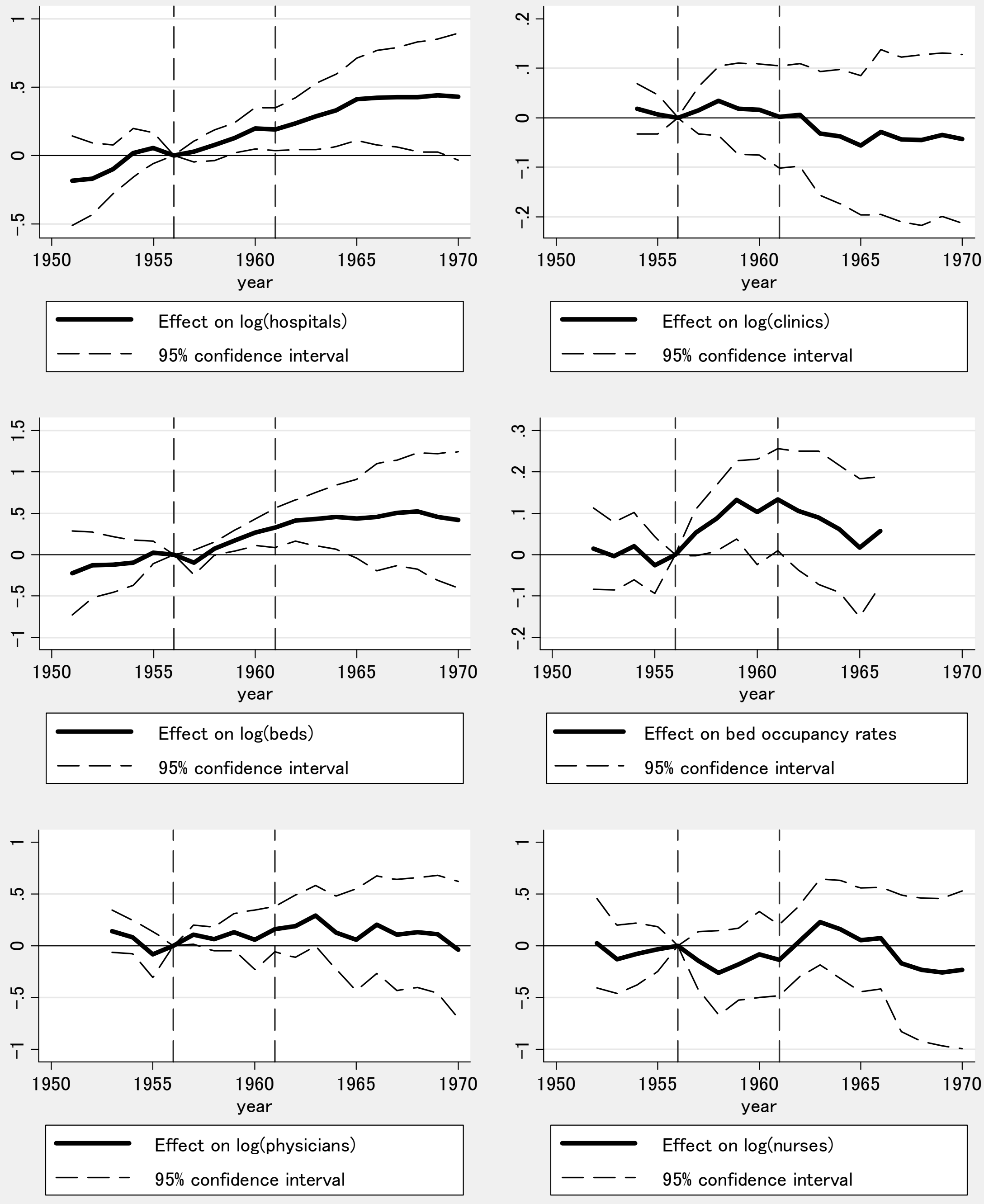


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, log population and the ratio of over 65 in population, but do not include prefecture-specific linear trends.



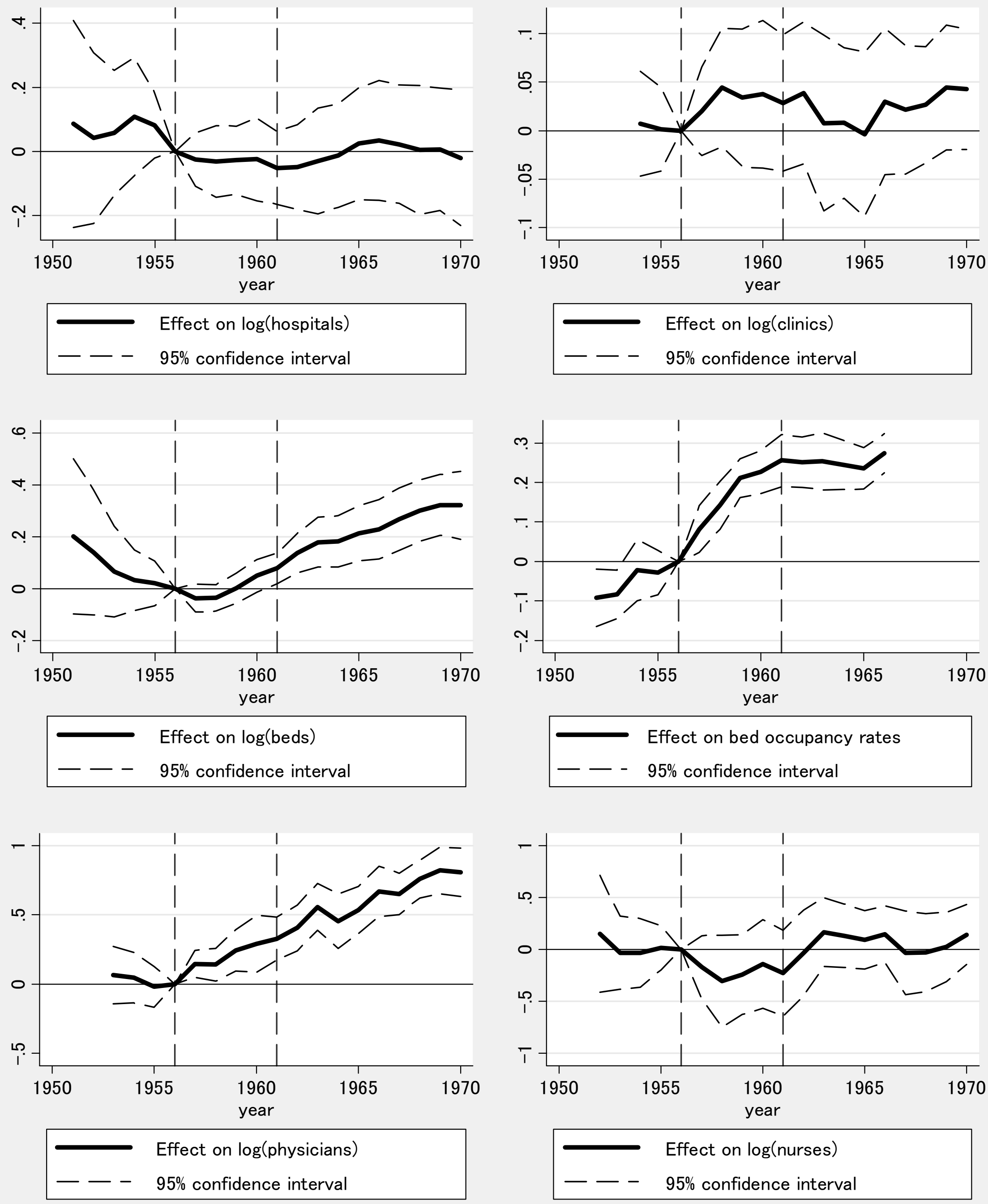
Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, prefecture-specific linear trends, log population and the ratio of over 65 in population.

Figure 7a: Effect of health insurance coverage on supply of health care without controls for prefecture specific linear trends

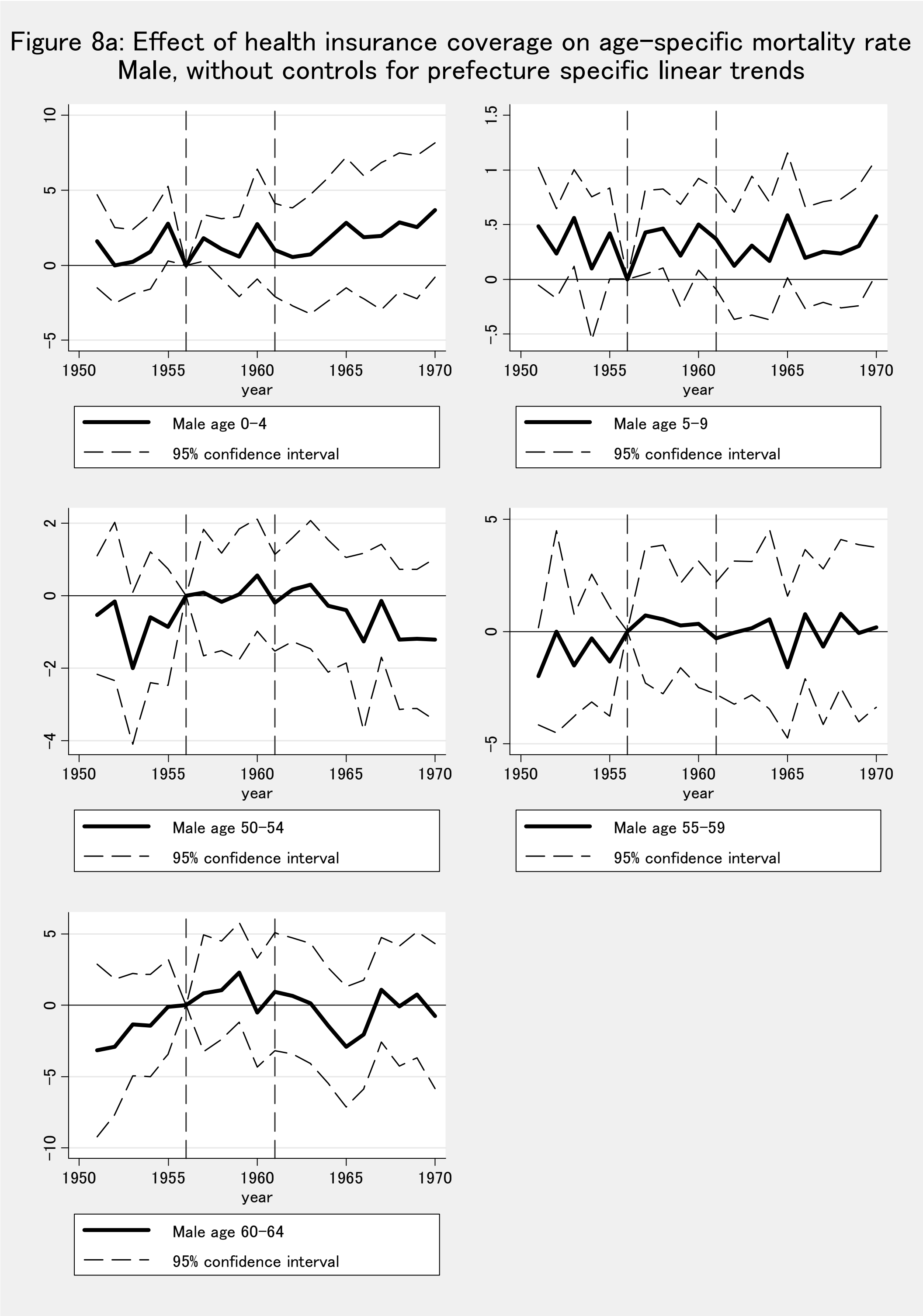


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, log population and the ratio of over 65 in population, but do not include prefecture-specific linear trends.

Figure 7b: Effect of health insurance coverage on supply of health care with prefecture specific linear trends

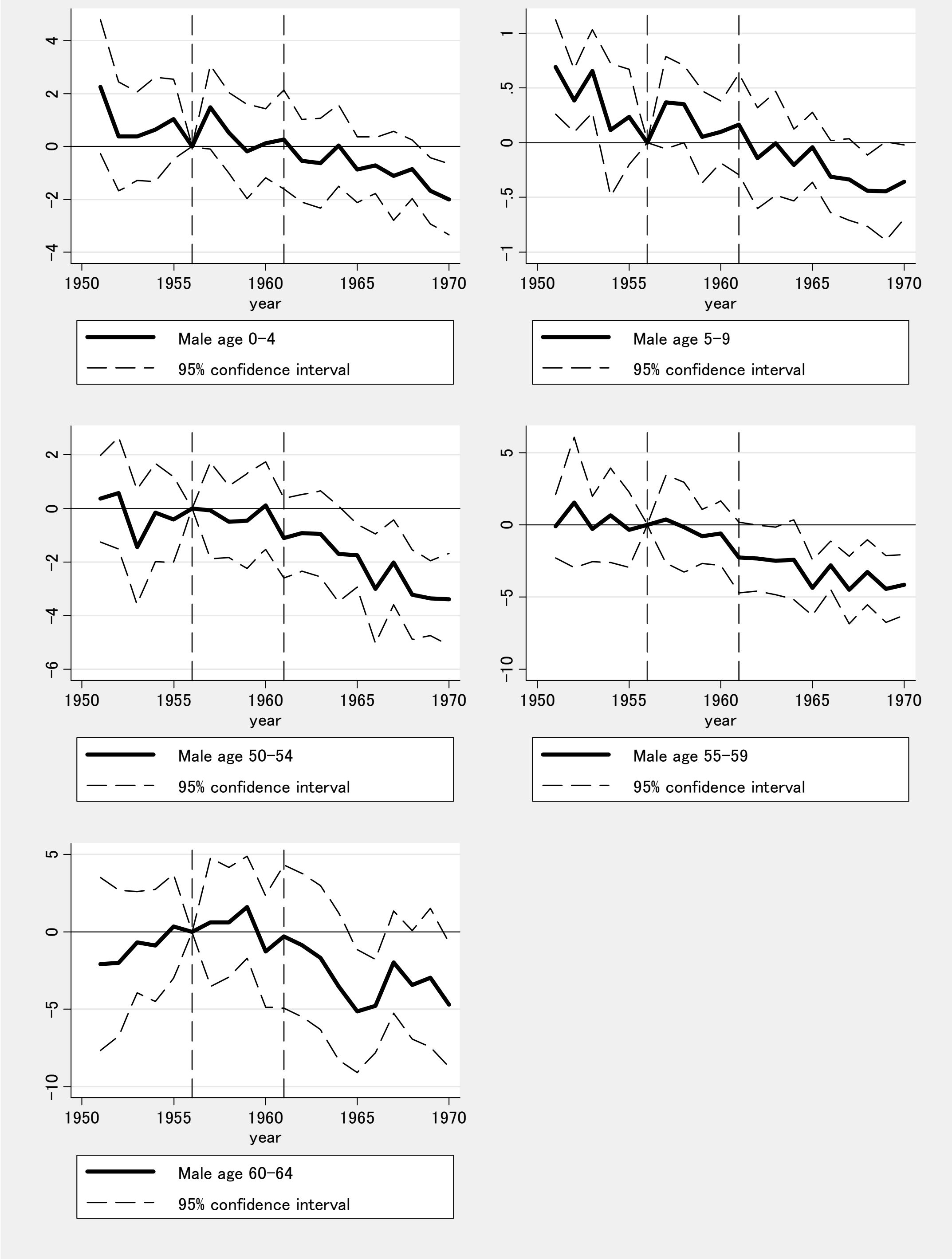


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, prefecture-specific linear trends, log population and the ratio of over 65 in population.

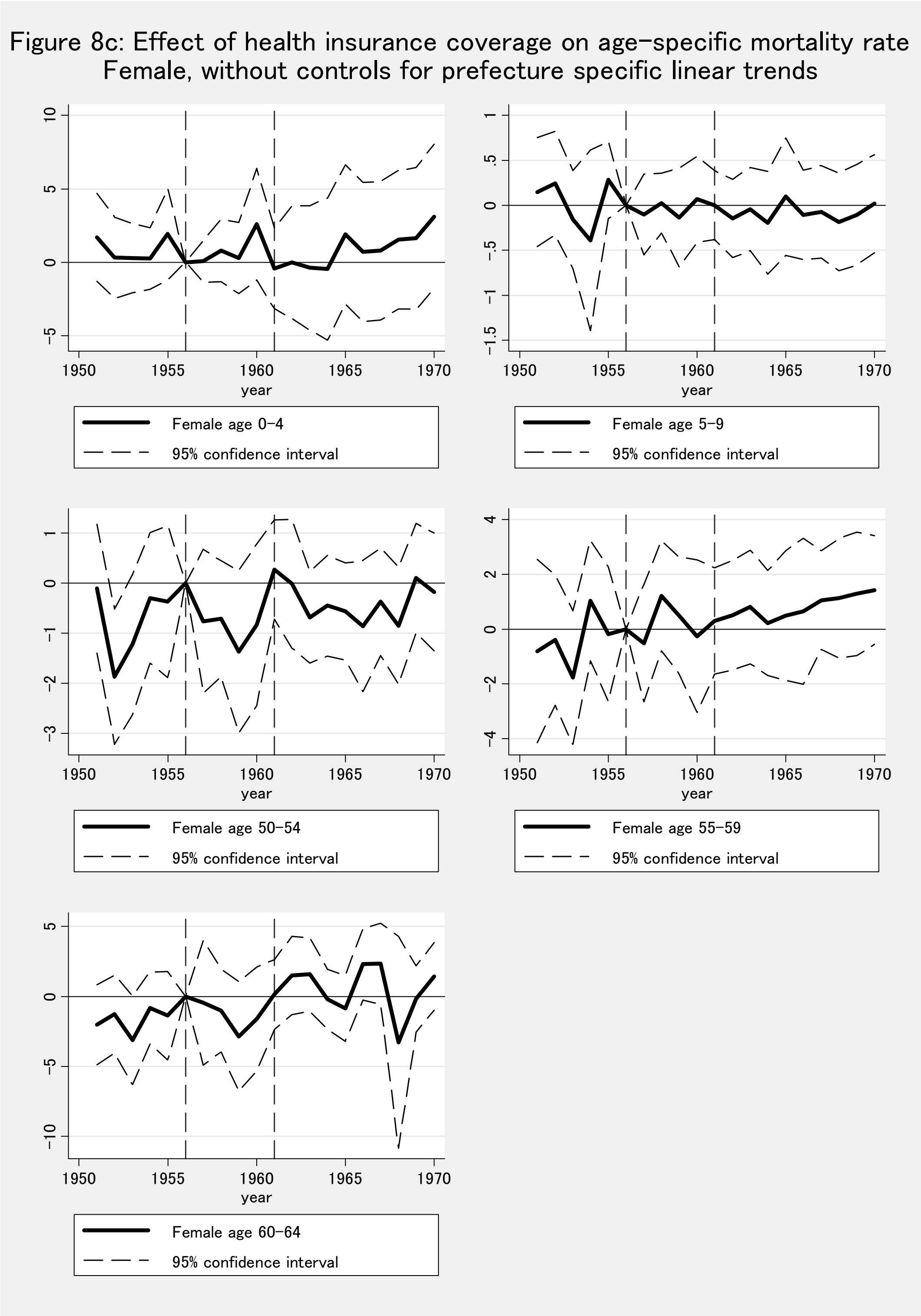


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, log population and the ratio of over 65 in population, but do not include prefecture-specific linear trends.

Figure 8b: Effect of health insurance coverage on age-specific mortality rate
Male, with controls for prefecture specific linear trends

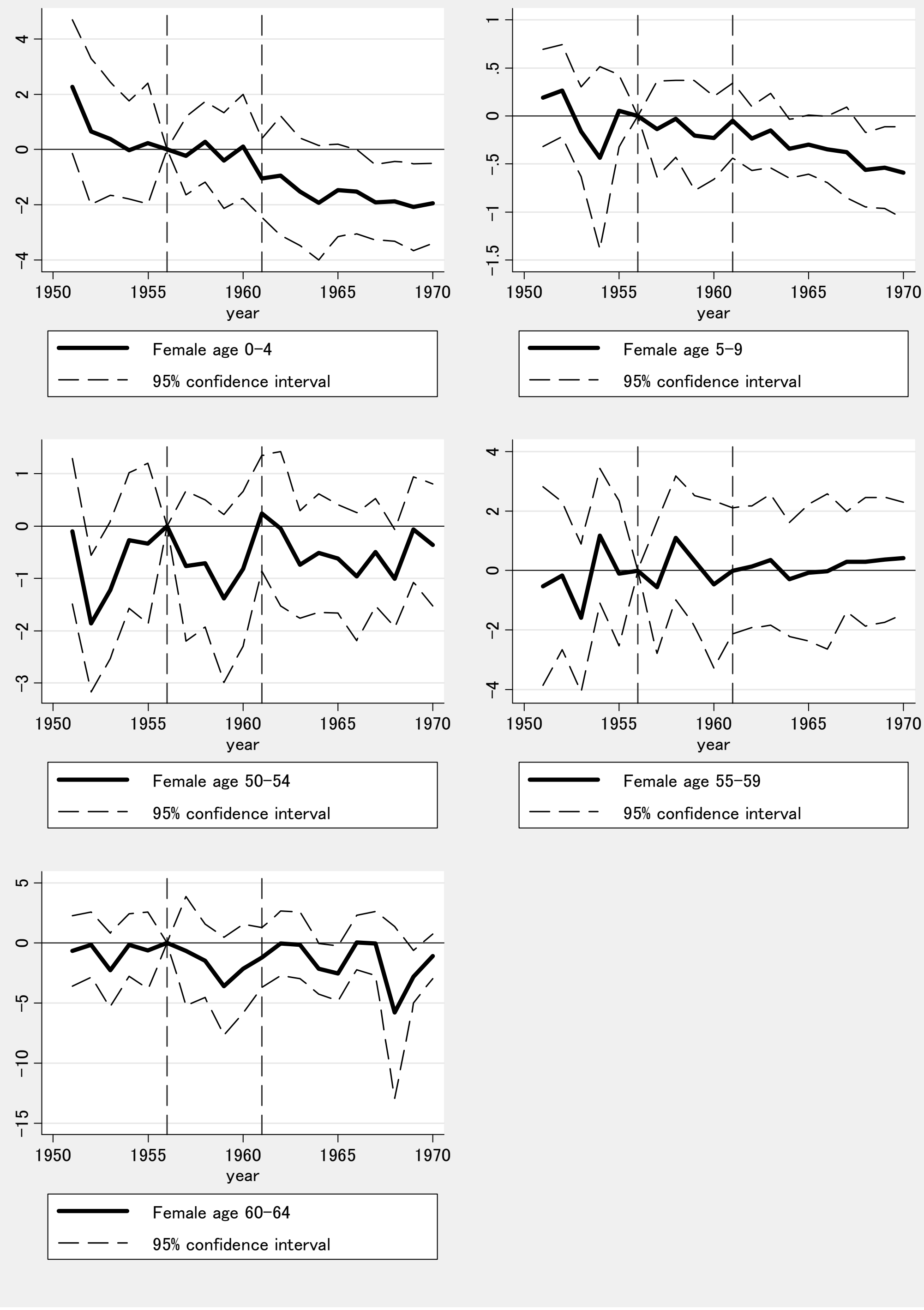


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, prefecture-specific linear trends, log population and the ratio of over 65 in population.



Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, log population and the ratio of over 65 in population, but do not include prefecture-specific linear trends.

Figure 8d: Effect of health insurance coverage on age-specific mortality rate
Female, with controls for prefecture specific linear trends



Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, prefecture-specific linear trends, log population and the ratio of over 65 in population.

Figure A1: Effect of health insurance coverage on NHI expenditures and claims

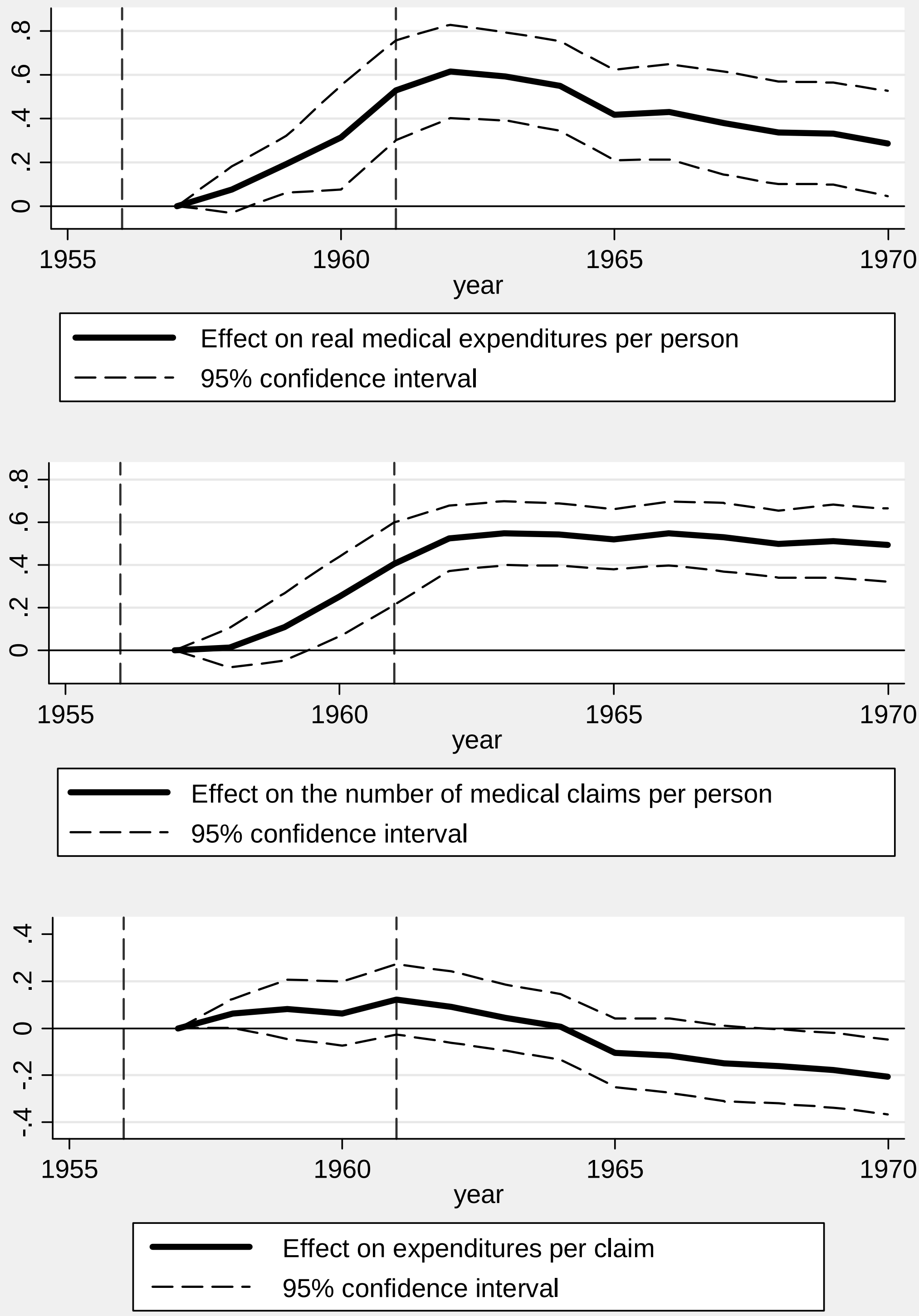


Table 1: Mean of dependent and control variables

Variable	Obs	Available period	Whole period	All prefectures in 1956	Top 5 prefectures In 1956	Bottom 5 prefectures in 1956
Admission (thousands)	874	1952-70	148.5	91.5	44.3	93.6
Inpatient days (thousands)	966	1950-70	7517.1	5610.1	2687.3	6085.6
Outpatient visits (thousands)	966	1950-70	9744.5	7322.9	3300.6	7951.1
Hospitals	920	1951-70	215.4	180.9	74.5	190
Clinics	828	1951, 54-70	2406.4	1911.7	837.2	2168.8
Number of beds in hospitals	828	1951-70	27619.7	19439.1	9131.4	20983.4
Bed occupancy rate (%)	690	1952-66	82.1	81.1	84.8	82.4
Number of physicians in hospitals	828	1953-70	1516	1349.7	526.8	1469.8
Number of nurses in hospitals	874	1952-70	5884.6	3649.9	1697.8	4614.5
Mortality rate: age 0-4 male	506	1955-65	8.8	11.3	13.8	10.9
Mortality rate: age 0-4 female	506	1955-65	7.3	9.9	12.3	9.7
Mortality rate: age 5-9 male	506	1955-65	1	1.3	1.3	1.4
Mortality rate: age 5-9 female	506	1955-65	0.7	1	1	1.1
Mortality rate: age 50-54 male	506	1955-65	10	11.4	11.9	12
Mortality rate: age 50-54 female	506	1955-65	6.7	7.8	7.9	7.8
Mortality rate: age 55-59 male	506	1955-65	16.3	17.6	18.9	18.1
Mortality rate: age 55-59 female	506	1955-65	10	11.4	12	11.4
Population (thousands)	966	1950-70	3325.8	2939.6	1649.5	3064.6
Real GNP per capita (1980 thousand yen)	736	1955-70	700.7	378.9	318.3	387.4
Real local gov. expenditure on health and sanitation (1980 thousand yen)	690	1956-70	5.6	1.8	1.5	2
Local gov. expenditure to revenue ratios	690	1956-70	1.03	1.02	1	1.02
Real medical expenditures per person by NHI (1000 yen in 1980 price)	644	1957-70	20.1	6.7 (in 1957)	7.3 (in 1957)	7 (in 1957)

Note: Top 5 and bottom 5 prefectures are 5 prefectures with highest and lowest health insurance coverage rate in 1956. Top 5: Toyama, Shiga, Iwate, Niigata, Yamagata. Bottom 5: Kagoshima, Nara, Oita, Kochi, and Osaka. Mortality rate is the number of deaths per 1000 population.

Table 2: Robustness checks for utilization outcomes

a. Without prefecture-specific linear trends

		λ in 1961	
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(1) λ shown in Figure 6	0.264**	0.259***	0.412***
	[0.122]	[0.096]	[0.124]
(2) (1) + excluding Tokyo and Osaka	0.296**	0.241**	0.470***
	[0.111]	[0.098]	[0.130]
(3) (1) + more controls	0.156	0.193	0.250**
(sample period: 1956-1970)	[0.145]	[0.115]	[0.123]

		λ in 1966	
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(4) λ shown in Figure 6	0.319	0.283	0.506
	[0.263]	[0.172]	[0.316]
(5) (4) + excluding Tokyo and Osaka	0.468*	0.313*	0.710**
	[0.247]	[0.181]	[0.339]
(6) (4) + more controls	0.430**	0.338**	0.695***
(sample period: 1956-1970)	[0.197]	[0.150]	[0.233]

b. With prefecture-specific linear trends

		λ in 1961	
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(7) λ shown in Figure 6	0.212***	0.441***	0.402***
	[0.069]	[0.037]	[0.071]
(8) (7) + excluding Tokyo and Osaka	0.255***	0.426***	0.421***
	[0.051]	[0.043]	[0.079]

		λ in 1966	
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(9) λ shown in Figure 6	0.390***	0.724***	0.659***
	[0.073]	[0.062]	[0.074]
(10) (9) + excluding Tokyo and Osaka	0.439***	0.709***	0.680***
	[0.069]	[0.072]	[0.092]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 3: Controlling for pre-existing trend: utilization outcomes

Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	0.262	0.450***	0.286*
	[0.216]	[0.134]	[0.153]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	0.052	0.215	-0.031
	[0.240]	[0.152]	[0.237]
(Slope prior to 1956) - (Slope in 1956-1961)	0.076	0.113***	0.060
	[0.049]	[0.031]	[0.036]
(Slope prior to 1961) - (Slope in 1961-1970)	-0.073***	-0.069***	-0.089**
	[0.020]	[0.017]	[0.041]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 4 Robustness checks for the supply of health care

a. Without prefecture-specific linear trends

	λ in 1961				
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
(1) λ shown in Figure 7	0.191**	0.002	0.127**	0.162	-0.136
	[0.078]	[0.051]	[0.063]	[0.110]	[0.170]
(2) (1) + excluding Tokyo and Osaka	0.184**	-0.028	0.113	0.194*	-0.129
	[0.084]	[0.046]	[0.068]	[0.114]	[0.220]
(3) (1) + more controls	0.133*	0.036	0.076	0.039	-0.185
(sample period: 1956-1970)	[0.079]	[0.051]	[0.068]	[0.123]	[0.184]

	λ in 1966				
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
(4) λ shown in Figure 7	0.411***	-0.056	0.229	0.061	0.056
	[0.149]	[0.070]	[0.142]	[0.244]	[0.249]
(5) (4) + excluding Tokyo and Osaka	0.479***	-0.08	0.298*	0.34	0.055
	[0.177]	[0.081]	[0.164]	[0.221]	[0.278]
(6) (4) + more controls	0.518***	-0.03	0.286**	0.253	0.217
(sample period: 1956-1970)	[0.136]	[0.082]	[0.140]	[0.186]	[0.249]

b. With prefecture-specific linear trends

	λ in 1961				
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
(7) λ shown in Figure 7	-0.051	0.028	0.078**	0.327***	-0.228
	[0.056]	[0.035]	[0.029]	[0.077]	[0.205]
(8) (7) + excluding Tokyo and Osaka	-0.008	0.054	0.078**	0.237**	0.029
	[0.065]	[0.034]	[0.035]	[0.094]	[0.236]

	λ in 1966				
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
(9) λ shown in Figure 7	0.035	0.03	0.228***	0.670***	0.149
	[0.093]	[0.037]	[0.057]	[0.091]	[0.136]
(10) (9) + excluding Tokyo and Osaka	0.119	0.076	0.255***	0.487***	0.398**
	[0.100]	[0.046]	[0.066]	[0.123]	[0.190]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5: Controlling for pre-existing trend: the supply of health care

Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	0.005	0.010	0.256*	0.373*	-0.108
	[0.170]	[0.068]	[0.149]	[0.187]	[0.358]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	0.045	-0.022	0.235	0.253*	0.0241
	[0.248]	[0.060]	[0.191]	[0.140]	[0.362]
(Slope prior to 1956) - (Slope in	-0.001	-0.006	0.075**	0.087**	0.078
1956-1961)	[0.031]	[0.016]	[0.034]	[0.038]	[0.074]
(Slope prior to 1961) - (Slope in	-0.011	-0.002	-0.027	-0.058**	-0.067
1961-1970)	[0.034]	[0.009]	[0.023]	[0.029]	[0.055]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 6: Robustness checks for age specific mortality

a. Male, without prefecture specific linear trends

	λ in 1961				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(1) λ shown in Figure 8	1.007	0.369	-0.188	-0.302	0.941
	[1.543]	[0.229]	[0.662]	[1.240]	[2.054]
(2) (1) + excluding Tokyo and Osaka	0.871	0.441*	-0.255	-0.062	2.209
	[1.588]	[0.256]	[0.764]	[1.311]	[2.334]
(3) (1) + more controls	2.232	0.478**	-0.082	-0.248	0.984
(sample period: 1956-1970)	[1.877]	[0.236]	[0.703]	[1.265]	[2.118]

	λ in 1966				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(4) λ shown in Figure 8	1.855	0.196	-1.263	0.779	-2.059
	[2.039]	[0.230]	[1.210]	[1.425]	[1.893]
(5) (4) + excluding Tokyo and Osaka	0.763	0.111	-0.636	1.484	-1.219
	[2.349]	[0.228]	[1.351]	[1.627]	[2.332]
(6) (4) + more controls	1.907	0.162	-0.644	1.371	-1.805
(sample period: 1956-1970)	[1.982]	[0.216]	[1.182]	[1.490]	[1.845]

b. Male, with prefecture specific linear trends

	λ in 1961				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(7) λ shown in Figure 8	0.262	0.166	-1.109	-2.246*	-0.299
	[0.930]	[0.229]	[0.740]	[1.217]	[2.297]
(8) (7) + excluding Tokyo and Osaka	-0.160	0.136	-1.25	-2.151	0.443
	[0.960]	[0.218]	[0.864]	[1.341]	[2.587]

	λ in 1966				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(9) λ shown in Figure 8	-0.709	-0.310*	-2.996***	-2.789***	-4.782***
	[0.529]	[0.163]	[1.013]	[0.832]	[1.495]
(10) (9) + excluding Tokyo and Osaka	-1.522***	-0.508**	-2.595**	-2.566**	-4.713***
	[0.492]	[0.194]	[1.173]	[1.057]	[1.673]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 6: Robustness checks for age specific mortality (continued)

c. Female, without prefecture-specific linear trends

	λ in 1961				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(1) λ shown in Figure 8	-0.410	0.003	0.271	0.298	0.136
	[1.363]	[0.190]	[0.491]	[0.962]	[1.243]
(2) (1) + excluding Tokyo and Osaka	-1.076	0.048	0.623	0.641	0.89
	[1.200]	[0.203]	[0.524]	[1.081]	[1.310]
(3) (1) + more controls	0.88	0.165	0.25	0.55	-0.178
(sample period: 1956-1970)	[1.661]	[0.185]	[0.504]	[1.019]	[1.262]
	λ in 1966				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(4) λ shown in Figure 8	0.701	-0.106	-0.858	0.650	2.297*
	[2.354]	[0.247]	[0.650]	[1.323]	[1.276]
(5) (4) + excluding Tokyo and Osaka	-0.808	-0.185	-0.684	0.530	3.254**
	[2.347]	[0.253]	[0.706]	[1.241]	[1.522]
(6) (4) + more controls	0.657	-0.162	-1.021	0.821	2.002
(sample period: 1956-1970)	[2.201]	[0.206]	[0.694]	[1.267]	[1.289]

d. Female, with prefecture-specific linear trends

	λ in 1961				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(7) λ shown in Figure 8	-1.039	-0.048	0.242	-0.009	-1.19
	[0.706]	[0.194]	[0.550]	[1.053]	[1.243]
(8) (7) + excluding Tokyo and Osaka	-1.928***	-0.103	0.326	0.17	-0.706
	[0.671]	[0.238]	[0.601]	[1.191]	[1.352]
	λ in 1966				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(9) λ shown in Figure 8	-1.526*	-0.348**	-0.964	-0.026	0.043
	[0.758]	[0.172]	[0.606]	[1.296]	[1.127]
(10) (9) + excluding Tokyo and Osaka	-2.689***	-0.504***	-1.250*	-0.378	0.135
	[0.684]	[0.184]	[0.735]	[1.288]	[1.400]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 7: Controlling for pre-existing trend: age specific mortality

Male

Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	2.600	0.854	-0.717	-2.287	-2.234
	[1.508]	[0.258]	[1.177]	[1.727]	[4.218]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	2.442	-0.313	-1.604	-0.904	-6.716
	[1.603]	[0.329]	[1.473]	[1.291]	[3.571]
(Slope prior to 1956) - (Slope in 1956-1961)	-0.150	0.043	0.036	-0.360	-0.999
	[0.251]	[0.042]	[0.188]	[0.383]	[0.652]
(Slope prior to 1961) - (Slope in 1961-1970)	0.270	-0.008	-0.319**	0.032	0.071
	[0.282]	[0.054]	[0.156]	[0.223]	[0.317]

Female

Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	1.288	0.149	0.162	-0.504	-1.890
	[1.410]	[0.331]	[0.878]	[2.383]	[2.313]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	2.808	0.037	-1.239	-0.451	0.134
	[1.249]	[0.258]	[0.883]	[2.279]	[1.675]
(Slope prior to 1956) - (Slope in 1956-1961)	-0.067	0.026	-0.075	-0.209	0.021
	[0.237]	[0.063]	[0.203]	[0.318]	[0.330]
(Slope prior to 1961) - (Slope in 1961-1970)	0.336	-0.005	0.018	0.113	-0.155
	[0.240]	[0.054]	[0.170]	[0.185]	[0.228]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 8: Effect of health insurance coverage on cause-specific deaths and robustness checks

a. Without prefecture-specific linear trends

	λ in 1961		
Dependent variable:	Log (deaths by pneumonia)	Log (deaths by bronchitis)	Log (deaths by gastritis and duodenitis)
(1) λ shown in Figure 6	0.048	0.133	0.329**
	[0.089]	[0.234]	[0.147]
(2) (1) + excluding Tokyo and Osaka	0.113	0.18	0.224**
	[0.101]	[0.249]	[0.104]
(3) (1) + more controls	0.057	0.212	0.360**
(sample period: 1956-1970)	[0.087]	[0.243]	[0.159]

	λ in 1966		
Dependent variable:	Log (deaths by pneumonia)	Log (deaths by bronchitis)	Log (deaths by gastritis and duodenitis)
(4) λ shown in Figure 6	0.084	0.156	0.127
	[0.099]	[0.333]	[0.207]
(5) (4) + excluding Tokyo and Osaka	0.071	0.246	-0.008
	[0.127]	[0.410]	[0.183]
(6) (4) + more controls	0.046	0.115	0.106
(sample period: 1956-1970)	[0.114]	[0.325]	[0.189]

b. With prefecture-specific linear trends

	λ in 1961		
Dependent variable:	Log (deaths by pneumonia)	Log (deaths by bronchitis)	Log (deaths by gastritis and duodenitis)
(7) λ shown in Figure 6	0.015	0.182	0.231*
	[0.077]	[0.196]	[0.128]
(8) (7) + excluding Tokyo and Osaka			

	λ in 1966		
Dependent variable:	Log (deaths by pneumonia)	Log (deaths by bronchitis)	Log (deaths by gastritis and duodenitis)
(9) λ shown in Figure 6	-0.033	0.122	-0.115
	[0.094]	[0.240]	[0.115]
(10) (9) + excluding Tokyo and Osaka			

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table9: Effect of health insurance coverage on cause-specific deaths, with controls for time trends

Dependent variable:	Log (deaths by pneumonia)	Log (deaths by bronchitis)	Log (deaths by gastritis and duodenitis)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	-0.040	0.194	0.379
	[0.148]	[0.373]	[0.207]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	-0.051	0.083	-0.152
	[0.143]	[0.359]	[0.190]
(Slope prior to 1956) - (Slope in 1956-1961)	0.002	0.033	0.054
	[0.031]	[0.072]	[0.053]
(Slope prior to 1961) - (Slope in 1961-1970)	0.000	0.033	-0.081*
	[0.024]	[0.052]	[0.041]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Appendix Table A1: Variable definitions and data sources

Variable name	Definition	Source
Admissions	Total number of new admissions in the calendar year. All hospitals, not including clinics.	(B)
Inpatient days	Total inpatient days (sum of days in the hospital of all patients) in the calendar year. All hospitals, not including clinics.	1950-51:(A) 1952-70:(B)
Outpatient visits	Total number of outpatient visits in the calendar year. All hospitals, not including clinics.	1950-51:(A) 1952-70:(B)
Expenditures by the NHI	Total healthcare expenditures paid through the NHI (i.e. total healthcare expenditures excluding out-of-pocket spending).	(I)
Number of medical claims	Number of claims made to the NHI by medical institutions.	(I)
Hospitals	Number of hospitals, all kinds, as of December 31	(D)
Clinics	Number of all clinics as of December 31.	(D)
Age specific mortality rates	Total number of deaths of people in the age group divided by population of the same age group interpolated from Census. Per thousand population.	(E) and (F)
Tooth cavities	Ratio of students who have tooth cavities. Based on mandatory medical examination of all students in elementary and junior high school students.	(J)
Physicians	Number of doctors who were working in hospitals as of December 31.	(D)
Nurses	Number of nurses (incl. practical nurses) who were working in hospitals as of December 31.	(D)
Beds	Total number of beds in hospitals and clinics, as of December 31.	(D)
Bed occ. rate	Bed occupancy rate, inpatient/365/number of beds as of July 1	(B)
Total population	Population as of October 1. For years 1950, 55, 60, 65 and 70, taken from Census. Data of inter Census years are interpolated by the Statistics Bureau.	(E) with interpolation
GDP deflator	Prefecture level GDP deflator in the 68SNA system with 1980 as the base year.	(G)
Real GNP per capita	Prefecture level GNP, deflated by prefecture GDP deflator.	(G)
Fiscal rev-exp ratio	Local government's revenue to expenditure ratio. Sum of prefecture and municipal governments. Revenue includes transfers from the national government but excludes transfers between prefecture and	(H)

	municipal governments.	
Fiscal exp on health and sanitation	Local government's expenditure on health and sanitation. Sum of prefecture and municipal governments.	
Population by age group	Population by age group as of October 1. Interpolated from Census.	(E) with interpolation

Data sources:

(A) Japan Statistical Year Book, Bureau of Statistics

(B) Hospital Report, Ministry of Health and Welfare

(C) Annual Statistical Report of National Health Conditions, Health and Welfare Statistics Association

(D) Survey of Medical Institutions, Ministry of Health and Welfare

(E) Population Census, Bureau of Statistics

(F) Vital Statistics, Ministry of Health and Welfare

(G) Prefecture SNA in 68SNA format, available at http://www.esri.cao.go.jp/jp/sna/kenmin/68sna_s30/main.html

(H) Annual Report on Local Public Finance Statistics, Ministry of Home Affairs

(I) Annual Report on Social Security and Statistics, General Administrative Agency of the Cabinet

(J) School Health Survey, Ministry of Education, Science, Sports and Culture

Appendix Table A2: the effect of the NHI expansion on the changes in self-employment ratio 1955-1960

	All prefectures		Excl. Tokyo and Osaka	
	(1)	(2)	(3)	(4)
$Impact_p$ defined by equation (2)	-0.000	0.006	-0.006	0.002
	[0.145]	[0.013]	[0.014]	[0.121]
Changes in Self-emp. ratio 1950-1955		0.389***		0.430***
		[0.107]		[0.101]
Observations	46	46	44	44
R2	0.00	0.19	0.00	0.25

Note: Robust standard errors are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table A3 Effect of the NHI expansion on establishment size

a. All prefectures

	log(number of establishments with 1-4 employees)	log(number of establishments with 5-9 employees)	log（number of all employees）	% establishments with 1-4 employees	% establishments with 5-9 employees
λ_{51}	-0.050	0.014	0.099	-0.079	-0.011
	[0.073]	[0.132]	[0.233]	[0.119]	[0.016]
λ_{54}	0.026	0.036	0.025	0.002	-0.001
	[0.034]	[0.044]	[0.029]	[0.013]	[0.005]
λ_{60}	-0.051	-0.116*	-0.045	0.006	-0.006
	[0.041]	[0.061]	[0.042]	[0.013]	[0.004]
λ_{63}	-0.045	-0.107	-0.09	0.033*	-0.009
	[0.048]	[0.089]	[0.054]	[0.018]	[0.007]
λ_{66}	-0.016	-0.185*	-0.082	0.052**	-0.016*
	[0.052]	[0.105]	[0.056]	[0.023]	[0.009]
Observations	276	276	276	276	276
R-squared	0.999	0.999	0.997	0.911	0.988

b. Excluding Tokyo and Osaka

	log(number of establishments with 1-4 employees)	log(number of establishments with 5-9 employees)	log（number of all employees）	% establishments with 1-4 employees	% establishments with 5-9 employees
λ_{51}	-0.045	0.068	0.149	-0.109	-0.001
	[0.079]	[0.130]	[0.245]	[0.123]	[0.017]
λ_{54}	0.009	0.061	0.023	-0.009	0.004
	[0.036]	[0.047]	[0.031]	[0.011]	[0.005]
λ_{60}	-0.018	-0.045	-0.017	0.002	-0.003
	[0.035]	[0.046]	[0.038]	[0.012]	[0.004]
λ_{63}	-0.056	-0.058	-0.073	0.012	-0.001
	[0.056]	[0.096]	[0.063]	[0.012]	[0.006]
λ_{66}	-0.011	-0.068	-0.031	0.017	-0.006
	[0.062]	[0.095]	[0.065]	[0.017]	[0.007]
Observations	264	264	264	264	264
R-squared	0.997	0.998	0.992	0.825	0.975

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Appendix Table A4: Robustness checks for NHI copayment and claims

	λ in 1961		
Dependent variable:	Log(copayment expenditures)	Log(number of claims)	Log(expenditures per claim)
(1) λ shown in Figure A1	0.529***	0.406***	0.123
	[0.113]	[0.096]	[0.075]
(2) adding prefecture-specific linear	0.438***	0.398***	0.040
trends	[0.083]	[0.082]	[0.061]
(4) (2) + more controls	0.506***	0.393***	0.113
(sample period: 1956-1970)	[0.110]	[0.095]	[0.073]
	λ in 1965		
Dependent variable:	Log(copayment expenditures)	Log(number of claims)	Log(expenditures per claim)
(5) λ shown in Figure A1	0.431***	0.547***	-0.117
	[0.108]	[0.074]	[0.079]
(6) adding prefecture-specific linear	0.409***	0.551***	-0.143
trends	[0.133]	[0.080]	[0.098]
(7) (6) + more controls	0.448***	0.530***	-0.082
(sample period: 1956-1970)	[0.117]	[0.079]	[0.082]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Appendix Table A5 The Effect of universal health insurance on households' out-of-pocket medical expenditure

	Ratio of medical expenditure in household expenditure		Log(medical expenditure)	
	1959-1964	1959-1969	1959-1964	1959-1969
% insured in population as of 1958	0.002	0.002	0.170	-0.003
	[0.004]	[0.010]	[0.209]	[0.436]
Observations	46	46	46	46