Effects of Universal Health Insurance on Health Care Utilization and Health Outcomes: 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 outcomes 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 medical institutions is unchanged, there is suggestive evidence of increases in the numbers of beds and physicians. This slow supply-side response may constrain the ability of the health care system to meet increased demand resulting from expansions in coverage. Third, we do not find strong evidence of reduced mortality rates for any age categories, but we do find some reduction in tooth cavities among elementary and junior high school children.

Keywords: universal health insurance, utilization, health outcomes, supply-side response, tooth cavities, 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. However, despite the prevalence of universal health care, most studies on the impact of the expansion in 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) or the elderly (Finkelstein 2007; Card, Dobkin, and Maestas 2008; Chay, Kim, and Swaminathan 2010).[2] Therefore, we still have much to learn about the impacts of universal health insurance on the medical utilization and health outcomes of the general population

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 in 1961. 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 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 in the late 1950s had a larger impact relative to a prefecture in which the impact was smaller. Our findings

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

[2] One exception is Kolstad and Kowalski (2010). They examine the impact of Massachusetts reforms expanding health insurance coverage for the entire state population to near-universal levels. However, their work is limited to one state, and the estimated effects may be smaller than in the case of nation-wide expansion if there is substantial general equilibrium effect as argued by Finkelstein (2007). Furthermore, their analysis is limited to utilization.

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 percent and outpatient visits by 7.9 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 percent and 11.3 percent, respectively. Our estimate of the effect on outpatient visits is roughly three 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. On the one hand, the expansion of health insurance coverage did not increase the number of hospitals and clinics. On the other hand, we find suggestive evidence that number of beds and physicians increased in response to the expansion of the health insurance coverage. However, even these responses occurred at a slower rate than the increases in the health care utilization. These results may imply that a slow supply-side response can constrain attempts to meet the demand increases induced by large policy changes (e.g., the Patient Protection and Affordable Care Act in the United States). This may be especially true for the supply of physicians and nurses because of training times.

Third, despite the massive increases in utilization, we do not find strong evidence that the implementation of universal coverage affected health outcomes. Although we find reductions in tooth cavities among elementary and junior high school children, we do not have clear evidence for reduced mortality rates of children or the elderly. The most convincing explanation for this finding is that individuals with life-threatening, treatable health conditions may have 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 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. Our results also suggest the existence of some sort of general equilibrium effects. The second relevant research thread consists of studies that examine whether health insurance indeed improves health outcomes. Except for positive effects for infants (Currie and Gruber 1996b; Hanratty 1996), there is little consensus on the health benefits of health insurance (see Levy and Meltzer, 2008, for a recent review of the literature).[3]

This paper makes four contributions to the literature. First, our data cover the entire population and are not limited to elderly or infants. Therefore, we can assess more general impacts from the expansion of health insurance coverage. For example, if the health care utilization of the elderly is more sensitive to price changes because older people are more likely to be credit-constrained, estimates that focus on the elderly may overstate the average impact of health insurance for the entire population. 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.[4] Third, we explore morbidity of less severe diseases, unlike most previous studies that only examine mortality as a health outcome. Fourth, we offer evidence in the developing country setting. Japan's per capita gross domestic product in

[3]The only two exceptions that find positive effects of health insurance coverage on health outcomes for people other than infants are Chay, Kim, and Swaminathan (2010) and Card, Dobkin, and Maestas (2009). Chay, Kim, and Swaminathan (2010) examine the same event as Finkelstein (2007) and Finkelstein and McKnight (2008) using a regression discontinuity design with individual-level data and find that Medicare eligibility at age 65 results in a decline in mortality at the threshold age. Card, Dobkin, and Maestas (2009) use a similar identification strategy, relying more on recent data, and shows that Medicare eligibility results in a 1-percentage-point decline in the probability of death among patients with non-deferrable admissions into a hospital.

[4]Finkelstein (2005, 2007) finds a large increase in employment in hospital sectors *excluding* physicians in response to the introduction of Medicare in the United States.

1956 was about one-quarter of that of the United States at that time.[5] Thus, our estimates are more relevant to developing countries currently thinking of introducing universal health insurance, such as Mexico, than those of existing studies on developed countries such as the United States.[6]

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.[7] Japan's public health insurance system consists of two parallel subsystems: the employment-based health insurance and the NHI.[8] 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).

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

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

[6] 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 so different from the causes of death of individuals in developing countries (e.g., pneumonia, bronchitis, gastritis, and duodenitis).

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

[8] 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. If the household head enrolls to an employment-based health insurance, his dependent spouse and children are also covered with higher coinsurance rates. In NHI, each household member is counted as an insured enrollee, although different coinsurance rates were applied to household heads and other family members in some periods such as 1963-68. Coinsurance rates of employment-based insurance also changed for several times. For example, when universal health insurance was achieved in 1961, coinsurance for the employee was nearly zero but it was 50 percent for family members but the coinsurance 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.

is also encouraged. Then, to redress the lack of health insurance among people who were left out from the employment-based insurance system, the NHI was introduced in 1938.

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 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 the municipality, not individuals, and there is no option for individuals living in the covered municipality to opt out. Also, in Japan at that time, purchase of private health insurance was not a realistic alternative to publicly offered health insurance.

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, and the unemployed—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. This amendment also mandated compulsory NHI participation by individuals not covered by any other form of health insurance (i.e., employer-based health insurance). Note that the enrolment to universal health insurance cannot be replaced with purchases of private insurance.

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.

An important institutional feature of Japan's health insurance system is the stringent price control by the government. A detailed national fee schedule is set by centralized administration, and this schedule is applied to all medical providers. Since the reimbursement from the health insurance system to medical providers strictly follows this schedule, there is little room for each hospitals or physicians to charge differential fee for specific type of patients like the case of the United States.[9] 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).[10]

In contrast, 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.[11] Regarding the private institutions, Medical Care Facilities Financing Corporation was founded in 1960 to

[9] Ikegami (1991, 1992) and Ikegami and Campbell (1995) describe the medical system in Japan in detail. 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.

[10] 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.

[11] 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%.

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.

3 Data

Our data come from various sources with hard-copy documentation. Our unit of observation is the prefecture-year.[12] 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. 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,

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

[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 the 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

[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.

NHI.[17]

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).

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 perform robustness checks allowing prefecture-specific trends. Note also that people who are to be covered by the NHI in large cities tend to be younger and thus potentially healthier than those in rural areas. Thus, people who were left without coverage until the implementation of the universal coverage were not likely to be the poorest and sickest people.

3.2 Outcome Variables

Our main outcome variables are health care utilization and health outcomes. There are three measures for utilization: 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 are excluded from the survey. From a different source, we also obtain the numbers of hospitals and clinics. We also examine medical inputs (beds, physicians, and nurses) to explore the supply-side responses to the expansion of health insurance coverage.

As health outcomes, we examine mortality and morbidity. We use the mortality rate because

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

it is one of the few objective, well-measured health outcomes and is often easily available and comparable across different countries. We compute the age-group-specific mortality rate (number of deaths per 1000 population) for age groups 0–4, 5–9, 50–54, and 55–59 years old. Children and the elderly are of particular interest because of high rates of mortality; however, we exclude elderly individuals more than 60 years old, to prevent our results from being confounded by the expansion of the pension system, which occurred around the same time as the achievement of universal health insurance.[18]

However, health insurance may improve morbidity or functional limitations without any detectable impact on mortality. Thus, as the measure of morbidity, we use the proportion of primary and secondary school children with tooth cavities.[19] Although tooth cavity is only one of many types of mild disease, this variable should shed some light on the impact of such diseases on child morbidity; because the enrollment for primary and secondary schools was nearly 100 percent at that time, it represents the entire population of children aged 6–14 years old.[20] The health insurance coverage of dental treatment in Japan is interesting because private health insurance in the United States does not always cover dental treatments.

Figures 3–5 present the national time-series patterns for each outcome variables used in this study. Figure 3 describes the utilization measures (admission, inpatients, and outpatients). Figure 4 shows the supply-side variables (hospitals, clinics, beds, bed occupation rates, physicians, and nurses). Figure 5 plots age-specific mortality rates and the ratio of school children with tooth cavities.

Figure 3 indicates that all of the utilization measures were increasing over the entire sample period. Figure 4 shows that both capital inputs (beds) and labor inputs (physicians and nurses) were also increasing over the entire sample period. The bed occupancy rate declined in the late 1950s and increased in the 1960s after the achievement of universal health insurance, probably

[18] In fact, we examined the mortality of individuals older than 60 years old, but did not find any change.

[19] In 1958, School Health and Safety Act was enacted and annual dental checkup was mandated to all elementary and junior high school. Our data of tooth cavities are based on the record of these school-based checkups. Note that this policy was implemented to all prefectures equally, and thus it cannot bias our estimates as long as we control for nation-wide year effects.

[20] Therefore, our findings are not caused by the selection of children into schools. Japanese law requires the completion of 9 years of education (6 years in primary school and 3 years in secondary school).

due to the increase in inpatients. Figure 5 indicates that all of the age groups in our sample experienced a substantial decline in mortality rate over the study period. However, the proportion of children with tooth cavities was increasing for students of both genders in both primary and secondary schools. This increase may reflect changes in children's diet associated with a rise in family income, but may reflect other reasons.

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. 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 effect of health insurance expansion on health care utilization 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.[21] Therefore, it is essential to control for unobserved components that

[21] It is difficult to know *a priori* whether the average income is positively or negatively correlated with the initial

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. The identifying assumption is that trends in the outcome variables would have been the same across prefectures in the absence of the enforcement of universal coverage, although we relax this assumption later.

The basic estimation equation is as follows:

$$Y_{pt} = \alpha_p * 1(pref_p) + \delta_t * 1(year_t) + \sum_{t \neq 1956} \lambda_t (impact_{p,1956}) * 1(year_t) + X_{pt}\beta + \varepsilon_{pt} \qquad (3)$$

Subscript p indicates prefecture and t indicates year. α_p represents a prefecture fixed effect; δ_t represents nationwide year effects; and $impact_{p,1956}$ is the percentage of the population in prefecture p without health insurance in 1956, as defined in (2).[22]

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 chagne in trend is likely to be attributable to the expansion of health insurance. It is important to note that the equation (3) 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.

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health coverage rate. If the rich prefecture has large firms, and thus attains a high rate of employer-based insurance coverage, it can be positively correlated. However, if the poor prefectures implement the national health insurance earlier to insure the poor, the relation can be negative. Indeed, the average income is negatively correlated with the initial health insurance coverage rate.

[22] 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.

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.

So far, we have assumed that trends in the outcome variables are the same across prefectures in the absence of the enforcement of universal coverage. However, since the distribution of health insurane coverage prior to 1956 may not be completely random, trends in the outcome variables may vary across prefectures even without changes in health insurance coverage. Given this concern, we include prefecture-specific linear time trend in (3) as a robustness check.

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 destinct from zero. We also estimate and $(\lambda_{66} - \lambda_{61}) - (\lambda_{56} - \lambda_{51})$, i.e. we repeat the same excercise for the period of 1961-66, the second 5 years after the expanson.

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

$$
\begin{aligned}
Y_{pt} &= \alpha_p * 1(pref_p) + \delta_t * 1(year_t) + \gamma_{pre} * year_t * impact_{p,1956} \\
&+ \gamma_{mid} * 1(year_t \geq 1956) * (year_t - 1956) * impact_{p,1956} \\
&+ \gamma_{after} * 1(year_t \geq 1961) * (year_t - 1961) * impact_{p,1956} + X_{pt}\beta + \varepsilon_{pt}
\end{aligned}
\tag{4}
$$

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.

5 Results on Utilization

5.1 Basic Results

Figure 6 plots the estimated λ's from equation (3) 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 0.199 and 0.304, respectively.[23] 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 5.7 percent ($= exp[0.199 * 0.28] - 1$) in 5 years and 8.9 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 the late 1950s and stay high until the late 1960s. The magnitudes are larger for inpatient days and

[23] 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.

outpatient visits than admissions. The estimated λ_{1961} and λ_{1966} imply that 9.4 and 12.3 percent increases for inpatients days and 7.9 and 11.3 percent increases for outpatient visits by 1961 and by 1966, respectively, due to the enforcement of universal health insurance.

5.2 Robustness Checks

Table 2 presents robustness checks of our utilization results. To save space, we only report coefficients calculated for the interaction terms in 1961 and 1966. To make the results comparable with our basic results, rows 1 and 5 repeat the results from the basic specification. This basic specification assumes that, without the expansion of health insurance, each prefecture would have exhibited similar changes in the outcome variables or such prefecture-specific trends are not correlated with the health insurance coverage rates in 1956. Although Figure 6 shows no apparent pre-existing trend before 1956, to check the robustness of our identification strategy, we allow each prefecture to have its own linear time trend. Rows 2 and 6 show that, except for outpatient visits losing the statistical significance, our estimated coefficients are robust to the inclusion of prefecture-specific linear trend.

Second, 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 3 and 7 indicate that our results are not driven by these prefectures. Third, 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.[24] As seen in rows 4 and 8, adding these controls does not significantly change the estimated coefficients.

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

Another way to deal with pre-existing trends other than the inclusion of prefecture-specific linear trend is to 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, although all of the coefficients are positive. 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 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 (4). 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 and statistically significant for all three utilization measure, and indicated changes are in the same order of the estimates from other specifications. For example, the coefficient for the outpatient visits in the first row is interpreted as an increase of 10.1 percent($= exp[0.069 * 5 * 0.28] - 1$) by 1961.[25] In contrast, the estimated coefficients for the second slopes are all negative but 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.

[25] 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.

5.3 Comparison to the RAND HIE

It is informative to compare our estimates with those from the RAND HIE, although we should use considerable caution in making this comparison because of differences in the coinsurance systems. In particular, 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.[26] However, because this limit on maximum payment should cause medical utilization to be higher than would be the case otherwise, the estimates from RAND HIE may rather overestimate the size of the medical expenditures compared to our case, so it goes against finding our disproportionately larger estimates than the RAND HIE.

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.[27] 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).[28]

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 11.3 percent in the 10 years since 1956. Thus, our estimates are more than three times larger than what individual-level changes in health insurance would have predicted.

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

[26] Manning et al. (1987) ignored MDE in their analysis because differences among plans with 5, 10, and 15 percent upper limits are too small to detect at the level of annual expenditures. Thus, they pooled across these different expenditure ceilings. Keeler et al. (1988) isolated the cost-sharing effects in the absence of such limits for spending estimates. However, this estimate is not available for utilization.

[27] Note that we slightly understate the effect from the RAND experiment because we use a 95-percent coinsurance instead of a 100-percent coinsurance rate (i.e., no insurance).

[28] 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).

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 will not, and thus generate additional general-equilibrium effects through the increased supply capacity.[29] 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 or add beds.[30]

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 equation (3) with the log of the number of hospitals as the dependent variable. The estimated coefficients for 1961 and 1966 are 0.13 and 0.34, respectively, and both are statistically significant. Therefore, this graph may read as if the hospitals have increased in the areas where the utilization indeed increased.

However, the graph also shows a strong pre-existing trend before 1956. As shown in Table 4, once prefecture-specific linear trends are controlled, the positive effects on the number of hospitals disappear. Except that adding more controls makes λ_{1966} positively significant, the coefficients

[29] 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.

[30] 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 A1 presents suggestive evidence that is consistent with this spillover hypothesis, although we need to view these results with caution because of limitations in the data.

are insignificant in all specifications. Table 5 reports the results from two other approaches to account for pre-existent trends, and it confirms the same result as Table 4. 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 Figure 7 and the second column in Tables 4 and 5. In the basic specification shown in Figure 7, λ's are not estimated very precisely. Furthermore, the results are not robust to controlling for pre-existing trends. On the one hand, Table 4 show that inclusion of prefecture-specific linear trends makes the estimates positively significant, probably because of a strong upward trend prior to 1956. On the other hand, either of the two methods presented in Table 5 does not produce the same results. Overall, the response of the number of clinics is not very clear.

Next, we also 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.[31]

The graphs in the middle row of Figure 7 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 4.6 percent by 1961 and 10.0 percent by 1966.[32] 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. The third column in Tables 4 and 5 confirms this observation. Although $(\lambda_{61} - \lambda_{56}) - (\lambda_{56} - \lambda_{51})$ is not statistically significant at the conventional

[31] 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.

[32] 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 schools and nursing colleges.

levels, they are very similar to those from our basic specification.[33]

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 shows an increase at a slightly slower pace than that of beds, although the estimated λ's are not always statistically significant. The fourth column of Table 4 also shows that the point estimates becomes smaller with controls for prefecture-specific linear trends. The response of the number of nurses is noisier and apparently weaker.

To recapitulate our results, we do not find evidence for increases in the number of the hospitals and clinics in response to the expansion of health insurance, while we find suggestive evidence for increases in the number of beds and physicians. Nevertheless, the estimated increases in the number of beds and physicians are not always statistically significant and the rate of increase is likely to be slower than the increase in the demand for the health care services.

7 Results on Health Outcomes

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.[34] 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.

[33] The estimated coefficients from the $(\lambda_{61} - \lambda_{56}) - (\lambda_{56} - \lambda_{51})$ and the basic specification (row (1) of Table 4) are 0.154 and 0.159, respectively.

[34] 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 the appendix A2, the introduction of universal health insurance did not affect the average out-of-pocket expenditures.

7.1 Mortality

Figure 8 presents the estimated λ's in equation (3) with the mortality rates of four age-groups as the dependent variables. Apparently, the expansion of health insurance coverage did not reduce the mortality rate for any of the age groups we study. Indeed, the estimated effect for children aged 0-4 years is positive and increasing over the sample period.[35] However, the graphs also show upward trends in the mortality rate in the prefectures with lower health insurance coverage rates in 1956. Thus, the positive λ's are likely to be merely reflecting the pre-existing trends and do not necessarily imply the causal effect of health insurance expansion. If so, it does not make much sense to perform the same kind of robustness checks we have done for utilization in Table 2 and for supply-side response in Table 4. Therefore, we skip such a table, and present only the two robustness checks dealing with the pre-existing trends.

In fact, as shown in Table 6, once the pre-existing trends are controlled, the spurious positive effects disappear. However, the estimated coefficients are mostly statistically insignificant, and the few significant ones are in unstable signs. Although the strong pre-existing trends makes it hard to obtain robust estimates of the effect of health insurance coverage on mortality rate, there does not seems to be any strong evidence for substantial decreases in the mortality rates.

7.2 Morbidity

In contrast, Figure 9 shows modest declines in tooth cavities although the estimated coefficients are not always statistically significant. The decline is more apparent among primary school students. The implied magnitudes of the coefficients from the basic specification in Table 7 are 2.1 and 2.3 percent declines for male primary students, and 2.7 and 2.5 percent for female primary students, 5 and 10 years since 1956, respectively. Furthermore, we conduct robustness checks in the same

[35] A large portion of these increases comes from infant mortality. However, this result should be interpreted with considerable caution, because it may just reflect improved compliance in death reports; around this time, more births start taking place in hospitals/clinics. In fact, we find that the expansion of health insurance coverage is positively correlated with the number of deliveries at hospitals/clinics. However, this result may be real. As Currie and Moretti (2008) suggest, a program that aims to improve birth outcomes can result in poorer average measured infant health. For example, if more unhealthy fetuses survive, or if fertility increases among those women who are most likely to have poor birth outcomes, the average measured infant health could potentially decline. In fact, we find that there is a positive association between health insurance coverage and fertility (results not shown). Because health insurance in Japan provides pregnant women with lump-sum payments, it is possible that health insurance spurred higher fertility rates because of this income effect.

manner as for health care utilization outcomes. Table 7 shows that the results are robust to various specification changes.[36]

This decline in tooth cavities could have substantial positive externalities. For example, Blumenshire (2008) shows that children who have both poor oral health and general health are more likely to have poor school performance. Although data on morbidity rates of other diseases are not available, if there were similar declines in other relatively minor illness, it would imply substantial improvement of peoples' welfare by the expansion of health insurance, which is not captured by the change in mortality rate.

7.3 Possible Explanations

The primary explanation for the lack of decline in mortality is that individuals with 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.

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.[37] 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 Table 8, we do not find any statistically significant changes in the number of deaths by these treatable diseases.[38] 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.

[36] Unfortunately, the data on tooth cavities among children for earlier years are not available for further investigation of the pre-existing trend.

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

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

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.

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 modest increases in the number of beds and physicians in response to the expansion of health insurance coverage. However, even physicians and beds increase at a slower rate than the increase in the 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. We do not find a significant reduction in the mortality rate, although we find marginally significant reduction in the morbidity of tooth cavities among elementary and junior high school children. Admittedly, our results on health outcomes are limited to mortality and tooth cavities, 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 than tooth cavities do. Nonetheless, universal health insurance is unlikely to be the main factor explaining Japan's drastic improvement in life expectancy in the 1960s.

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 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.2 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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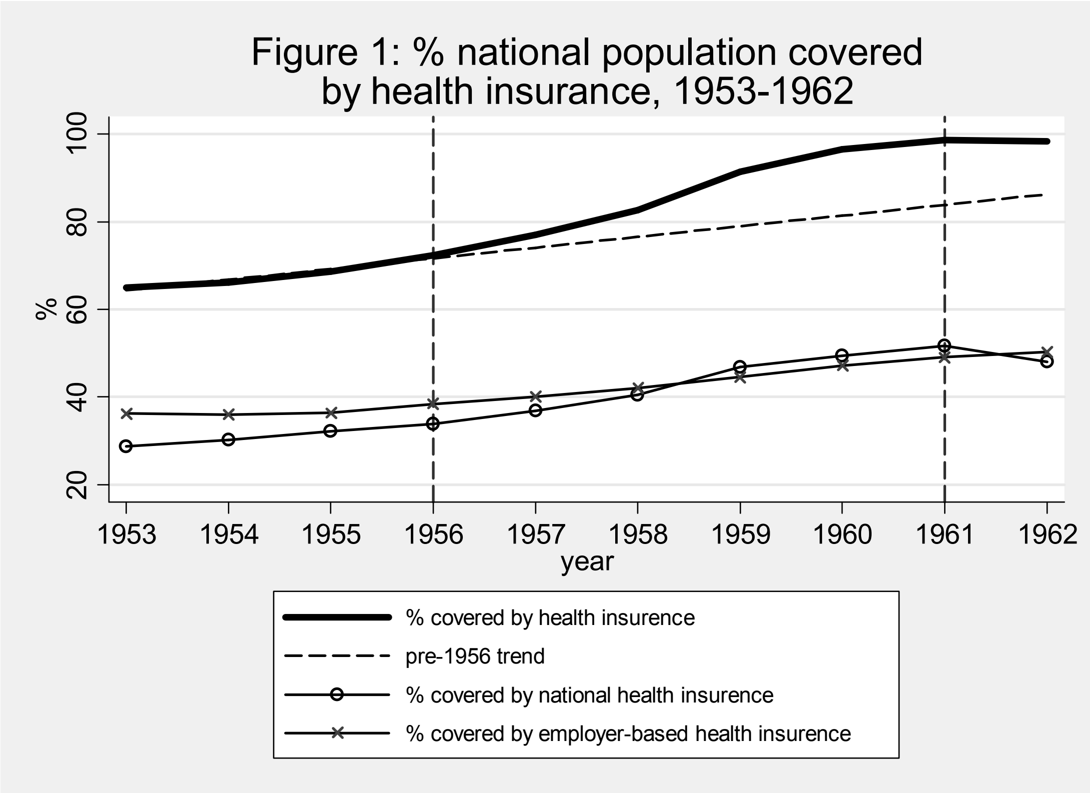


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved.

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

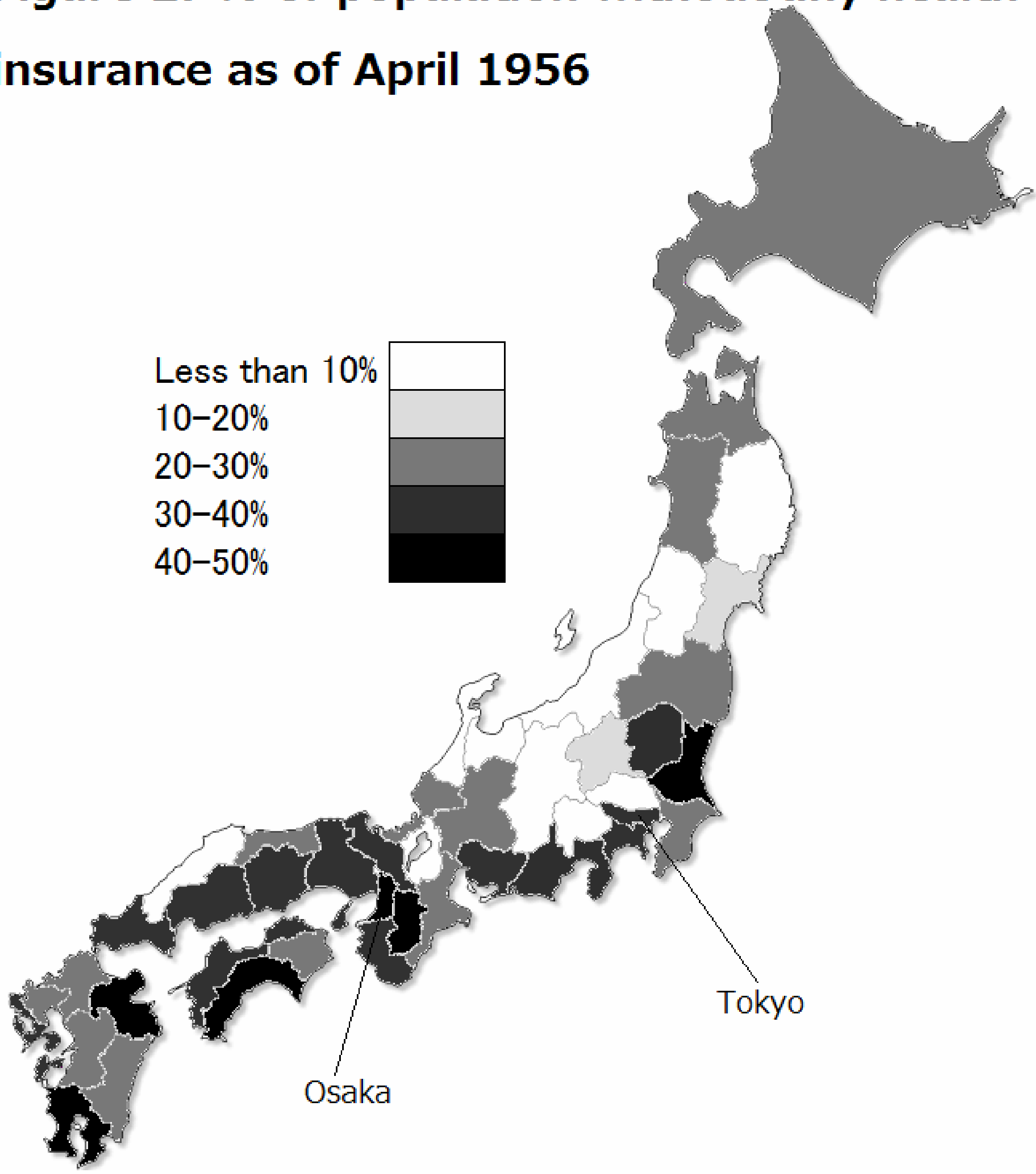


Figure 3: National time series of utilization

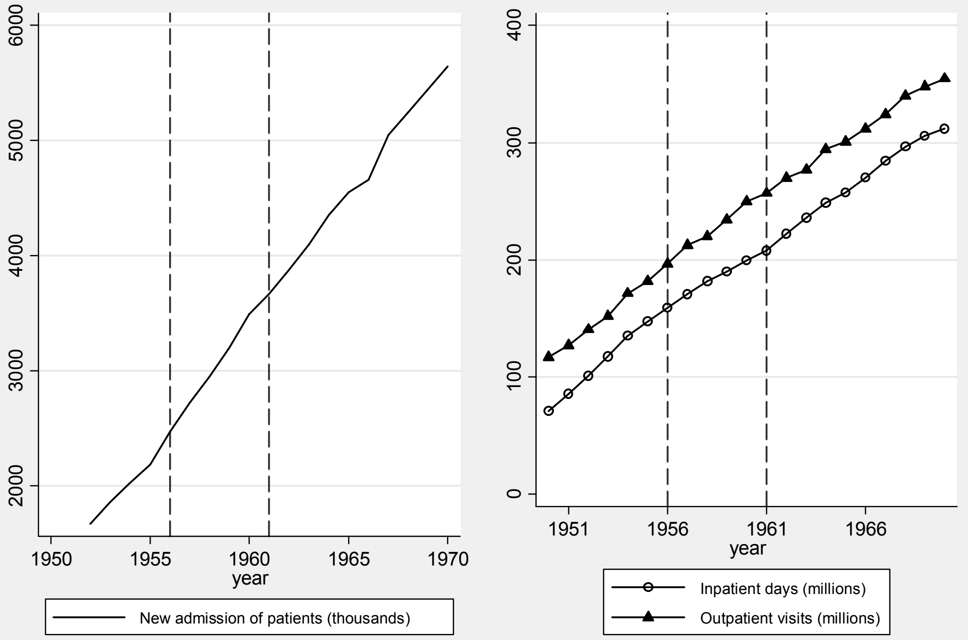
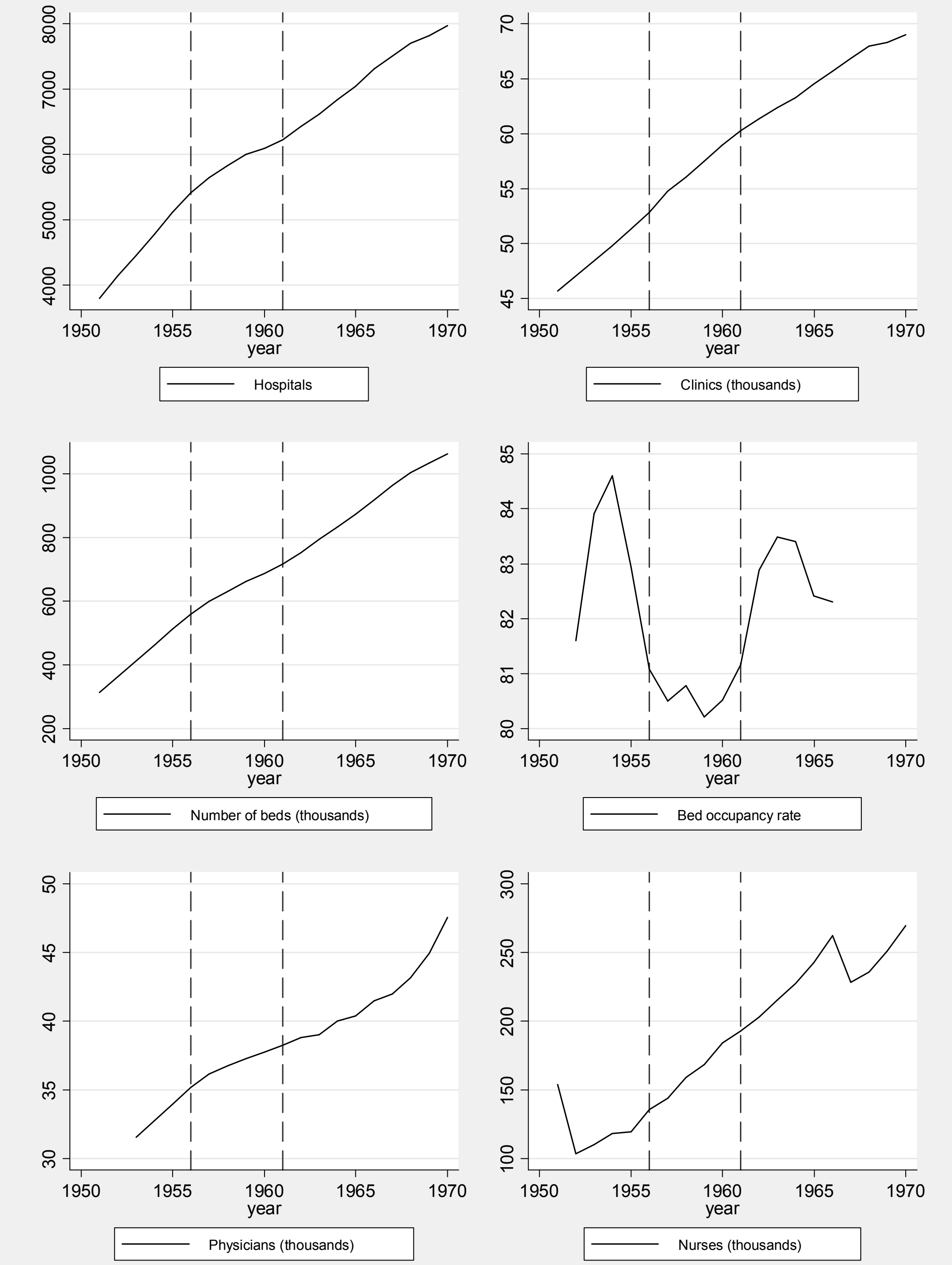
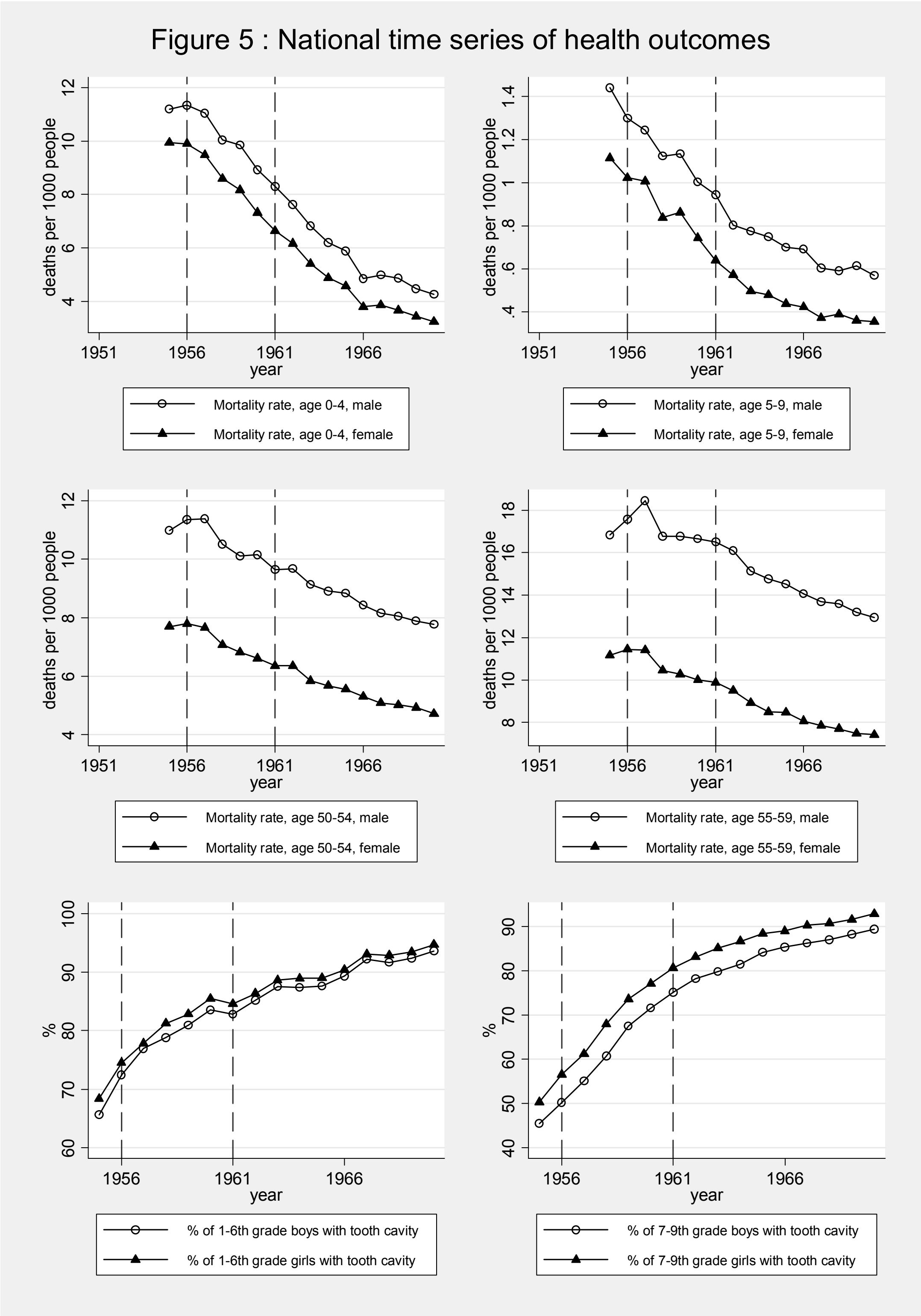


Figure 4: National time series of capital and labor inputs

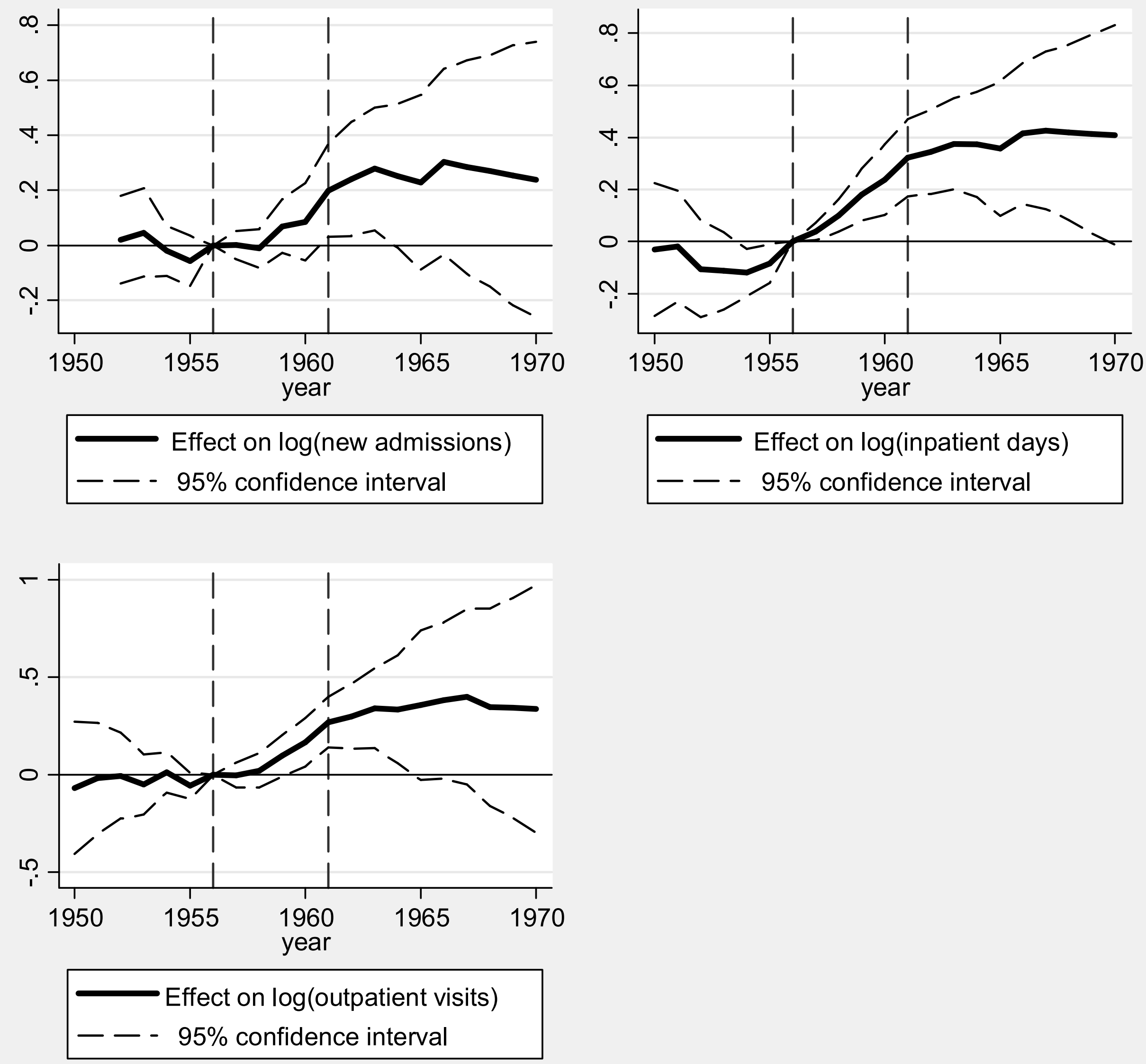


Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved.



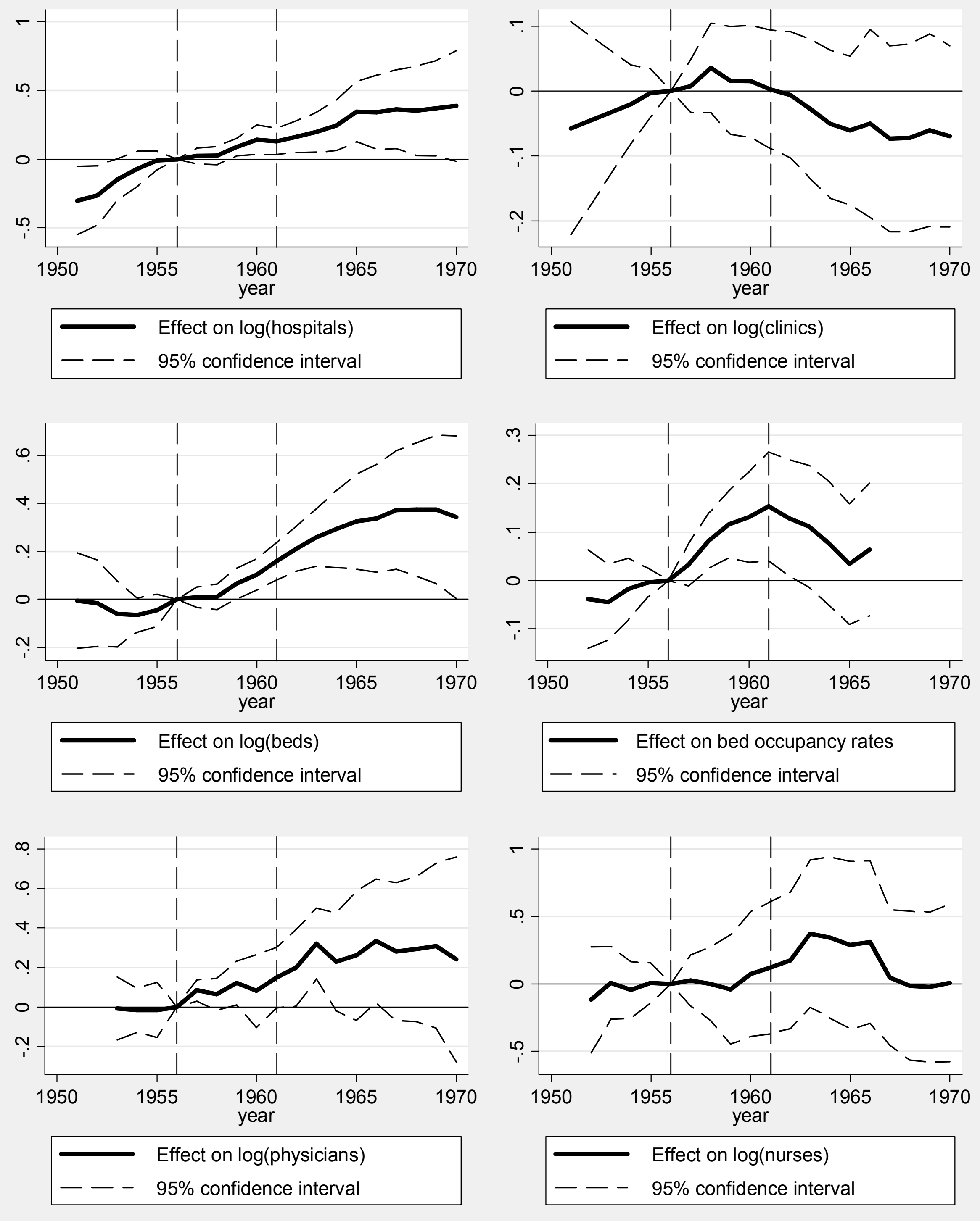
Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved

Figure 6: Effect of health insurance coverage on health care utilization



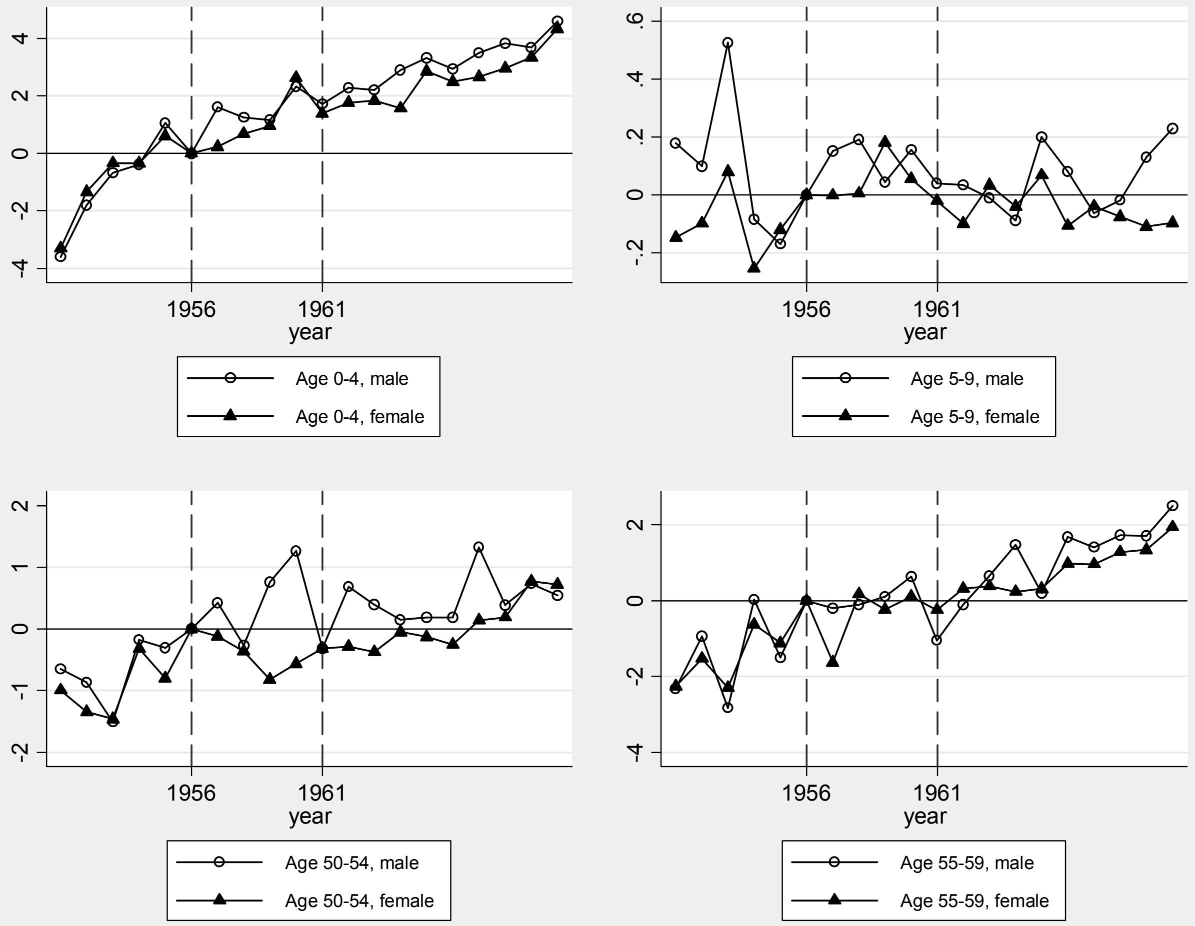
Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved.

Figure 7: Effect of health insurance coverage on supply of health care



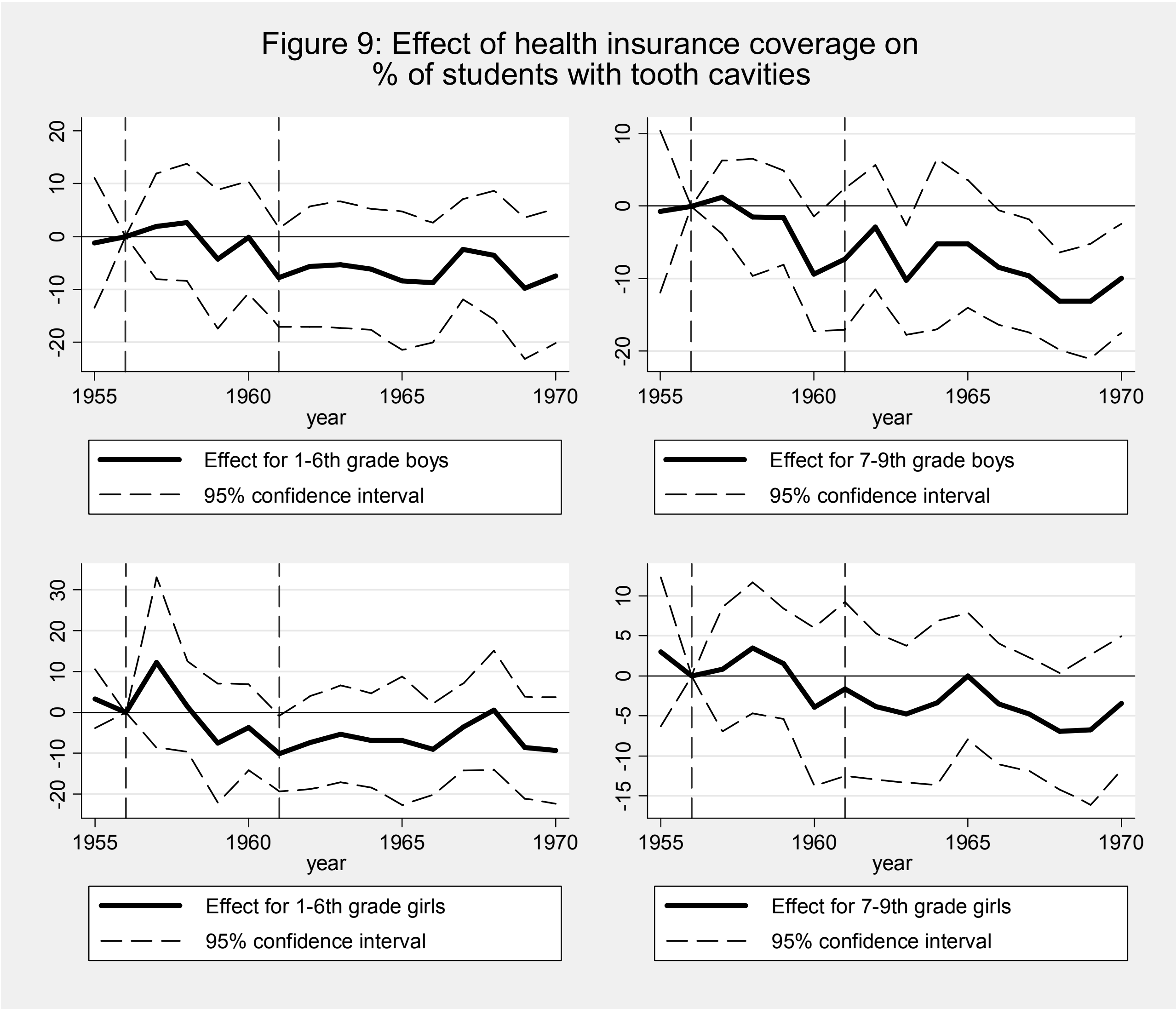
Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved.

Figure 8: Effect of health insurance coverage on age-specific mortality rates



Note: None of the coeficients is statistically significantly negative.

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



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

Figure A1: Effect of health insurance coverage on
NHI copayment and claims per person

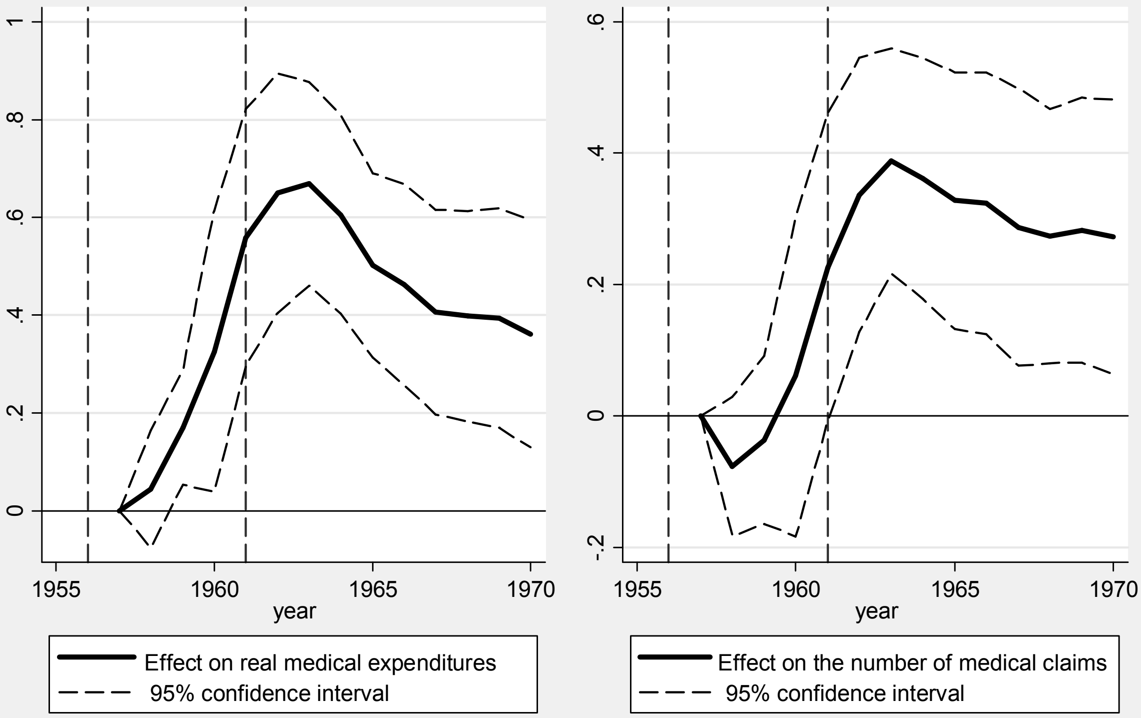


Table 1: Mean of dependent and control variables

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
% with tooth cavities: 1-6th grade boys	736	1955-70	84.6	72.5	68.1	69.6
% with tooth cavities: 7-9th grade boys	736	1955-70	74.7	50.2	43.6	51.3
% with tooth cavities: 1-6th grade girls	736	1955-70	86.1	74.5	70.3	72.5
% with tooth cavities: 7-9th grade girls	736	1955-70	79.6	56.6	52	56.6
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

	λ in 1961		
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(1) λ shown in Figure 6	0.199**	0.322***	0.270***
	[0.084]	[0.073]	[0.064]
(2) adding prefecture-specific linear trends	0.167***	0.346***	0.092
	[0.059]	[0.049]	[0.057]
(3) (2) + excluding Tokyo and Osaka	0.148**	0.310***	0.120*
	[0.058]	[0.051]	[0.066]
(4) (2) + more controls (sample period: 1956-1970)	0.271***	0.385***	0.158
	[0.073]	[0.064]	[0.102]
	λ in 1966		
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(5) λ shown in Figure 6	0.304*	0.415***	0.381*
	[0.167]	[0.134]	[0.199]
(6) adding prefecture-specific linear trends	0.291***	0.514***	0.069
	[0.080]	[0.066]	[0.089]
(7) (6) + excluding Tokyo and Osaka	0.321***	0.508***	0.145
	[0.102]	[0.081]	[0.111]
(8) (6) + more controls (sample period: 1956-1970)	0.601***	0.711***	0.301***
	[0.102]	[0.087]	[0.098]

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)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	0.224	0.304***	0.251**
	[0.126]	[0.106]	[0.117]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	0.130	0.075	0.093
	[0.151]	[0.113]	[0.177]
(Slope prior to 1956) - (Slope in 1956-1961)	0.080***	0.079**	0.069**
	[0.023]	[0.033]	[0.028]
(Slope prior to 1961) - (Slope in 1961-1970)	-0.069***	-0.045**	-0.053*
	[0.018]	[0.020]	[0.027]

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

	λ in 1961				
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
(1) λ shown in Figure 7	0.130***	0.002	0.159***	0.148*	0.119
	[0.047]	[0.045]	[0.039]	[0.076]	[0.244]
(2) adding prefecture-specific linear	-0.080*	0.225***	0.158***	0.066	0.136
trends	[0.041]	[0.054]	[0.026]	[0.063]	[0.238]
(3) (2) + excluding Tokyo and Osaka	-0.047	0.245***	0.160***	0.025	0.404*
	[0.035]	[0.041]	[0.029]	[0.064]	[0.212]
(4) (2) + more controls	0.015	0.171***	0.201***	0.078	0.425
(sample period: 1956-1970)	[0.057]	[0.039]	[0.046]	[0.088]	[0.283]
	λ in 1966				
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	Log(physicians)	Log(nurses)
(5) λ shown in Figure 7	0.342**	-0.05	0.339***	0.335**	0.309
	[0.133]	[0.072]	[0.112]	[0.156]	[0.299]
(6) adding prefecture-specific linear	-0.039	0.393***	0.389***	0.259**	0.426
trends	[0.099]	[0.092]	[0.048]	[0.103]	[0.256]
(7) (6) + excluding Tokyo and Osaka	0.065	0.491***	0.412***	0.138	0.806***
	[0.074]	[0.058]	[0.051]	[0.090]	[0.201]
(8) (6) + more controls	0.261***	0.328***	0.540***	0.259*	1.113***
(sample period: 1956-1970)	[0.068]	[0.047]	[0.070]	[0.149]	[0.357]

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)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	-0.171	-0.055	0.154	0.138	-0.023
	[0.118]	[0.074]	[0.112]	[0.157]	[0.383]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	-0.089	-0.110	0.174	0.176	0.049
	[0.178]	[0.108]	[0.138]	[0.158]	[0.334]
(Slope prior to 1956) - (Slope in	-0.033	-0.018	0.053**	0.033	0.056
1956-1961)	[0.026]	[0.018]	[0.026]	[0.035]	[0.087]
(Slope prior to 1961) - (Slope in	0.002	-0.006	-0.023	-0.025	-0.077
1961-1970)	[0.024]	[0.010]	[0.020]	[0.032]	[0.091]
	-0.171	-0.055	0.154	0.138	-0.023

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: Controlling for pre-existing trend: age specific mortality

Sample:	Age 0-4, male	Age 0-4, female	Age 5-9, male	Age 5-9 female	Age 50-54, male	Age 50-54, female	Age 55-59, male	Age 55-59 female
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	-1.919	-1.927	0.218	-0.168	-0.967	-1.308	-3.367***	-2.497
	[1.646]	[1.232]	[0.181]	[0.255]	[0.825]	[0.928]	[1.043]	[1.937]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	-2.375	-2.203	0.219	-0.234	-0.142	-0.924	0.421	-1.034
	[1.587]	[1.621]	[0.239]	[0.200]	[1.267]	[0.843]	[1.036]	[1.612]
(Slope prior to 1956) - (Slope in 1956-1961)	-0.613**	-0.389*	0.04	-0.01	-0.154	-0.290*	-0.39	-0.237
	[0.269]	[0.209]	[0.033]	[0.059]	[0.194]	[0.148]	[0.238]	[0.311]
(Slope prior to 1961) - (Slope in 1961-1970)	0.090	0.051	0.002	-0.028	-0.055	0.198**	0.253*	0.099
	[0.154]	[0.151]	[0.036]	[0.040]	[0.099]	[0.090]	[0.132]	[0.172]

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: Robustness checks for morbidity rate of tooth cavities

	λ in 1961			
Sample:	1-6th grade boys	7-9th grade boys	1-6th grade girls	7-9th grade girls
(1) λ shown in Figure 9	-7.447	-7.11	-9.910**	-1.546
	[4.715]	[4.904]	[4.589]	[5.529]
(2) adding prefecture-specific linear	-11.968**	-8.493*	-14.185***	-2.38
trends	[4.528]	[4.380]	[3.874]	[5.071]
(3) (2) + excluding Tokyo and Osaka	-13.159**	-11.427***	-14.766***	-6.827
	[5.234]	[4.147]	[4.347]	[4.514]
(4) (2) + more controls	-17.383***	-12.317***	-18.267***	-5.316
(sample period: 1956-1970)	[5.241]	[4.128]	[4.627]	[4.328]

	λ in 1966			
Sample:	1-6th grade boys	7-9th grade boys	1-6th grade girls	7-9th grade girls
(5) λ shown in Figure 9	-8.267	-8.213*	-8.879	-3.318
	[5.739]	[4.201]	[5.560]	[4.061]
(6) adding prefecture-specific linear	-15.310***	-9.080*	-15.606***	-3.465
trends	[4.800]	[4.543]	[3.944]	[4.538]
(7) (6) + excluding Tokyo and Osaka	-16.628**	-8.458	-17.265***	-7.412*
	[6.175]	[5.356]	[4.575]	[4.102]
(8) (6) + more controls	-31.029***	-17.879***	-29.125***	-9.679*
(sample period: 1956-1970)	[6.416]	[6.047]	[5.789]	[5.073]

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, with controls for time trends

Dependent variable:	Log (deaths by pneumonia)	Log (deaths by bronchitis)	Log (deaths by gastritis and duodenitis)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	-0.087	-0.330	0.226
	[0.150]	[0.279]	[0.193]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	-0.041	-0.021	0.039
	[0.114]	[0.261]	[0.180]
(Slope prior to 1956) - (Slope in 1956-1961)	0.028	0.014	0.046
	[0.031]	[0.040]	[0.040]
(Slope prior to 1961) - (Slope in 1961-1970)	-0.002	-0.004	-0.060**
	[0.029]	[0.036]	[0.027]

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: Robustness checks for NHI copayment and claims

	λ in 1961	
Dependent variable:	Log(copayment expenditures)	Log(number of claims)
(1) λ shown in Figure A1	0.559***	0.227*
	[0.130]	[0.116]
(2) adding prefecture-specific linear trends	0.464***	0.182*
	[0.102]	[0.103]
(3) (2) + excluding Tokyo and Osaka	0.587***	0.324***
	[0.069]	[0.048]
(4) (2) + more controls	0.467***	0.197*
(sample period: 1956-1970)	[0.099]	[0.099]
	λ in 1965	
Dependent variable:	Log(copayment expenditures)	Log(number of claims)
(5) λ shown in Figure A1	0.463***	0.324***
	[0.102]	[0.099]
(6) adding prefecture-specific linear trends	0.346*	0.287*
	[0.205]	[0.156]
(7) (6) + excluding Tokyo and Osaka	0.734***	0.543***
	[0.095]	[0.053]
(7) (6) + more controls	0.531***	0.319***
(sample period: 1956-1970)	[0.135]	[0.112]

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 A3 The Effect of universal health insurance on households' out-of-pocket medical expenditure

	Ratio of medical expenditure in house hold expenditure		Log(medical expenditure)	
	1959-1964	1959-1969	1959-1964	1959-1969
% insured in population as of 1958	0.001	0.000	0.064	-0.107
	[0.003]	[0.007]	[0.127]	[0.232]
Observations	46	46	46	46