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. Even the United States, which has been a rare exception, is moving towards near-universal coverage through health care reform.[1] Despite the prevalence of universal health care, most studies on the impact of the health insurance coverage on utilization and health have been limited to specific subpopulations, such as infants and children, the elderly or the poor.[2] Estimates from a policy focusing on the elderly (e.g., Medicare in the US) may be different from the average impact of health insurance for the entire population if the price elasticity of the elderly differs from the younger population.[3]

This paper studies the impact of a large expansion in health insurance coverage on utilization and health by examining the case of Japan, which achieved universal coverage for its entire population in 1961. We identify the effect of health insurance by exploiting regional variation in health insurance coverage prior to the full enforcement of universal coverage. 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. Our empirical strategy identifies changes in outcome variables in a prefecture in which the enforcement of universal coverage had a larger impact relative to a prefecture in which the impact was smaller.

This paper also has several other advantages to the past literature. Since the universal health insurance was achieved as early as 1961 in Japan, we can examine impacts of the health insurance expansion in the long run. 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. Also, 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

[1] The Patient Protection and Affordable Care Act passed in March 2010 imposes a mandate for individuals to obtain coverage or pay the penalty.

[2] The examples of studies that examined specific populations are; Currie and Gruber (1996a,b), Hanratty (1996), Chou et al. (2011) on infants and children, Finkelstein (2007), Card et al. (2008, 2009), Chay et al. (2010) on the elderly or Finkelstein et al. (2011) on the poor.

[3] 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.

the previous studies, such as the number of physicians.[4]

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 7.3 percent and outpatient visits by 12.6 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 11.6 percent and 25.1 percent, respectively. Our estimate of the effect on outpatient visits is roughly four times as large as the estimate from the RAND Health Insurance Experiment (hereafter RAND HIE), 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 immediately 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.

Third, despite the massive increases in utilization, we find little evidence on health measured by the age-specific mortality. In addition to the analysis that relies on the prefecture-level variation, we conduct an event study using the municipality level variation in Ibaraki prefecture and confirm that there was no effect on short-term mortality. This lack of short-term effects may be because individuals with acute, life-threatening and treatable health conditions had already sought care at hospitals despite the lack of health insurance. As suggestive evidence, we find no change in the

[4] For example, Finkelstein (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.

number of deaths by treatable diseases at that time such as pneumonia, which should have fallen if universal health insurance coverage enabled some formerly untreated patients to have an access to hospitals or clinics.

Taken together, our empirical results show that a large expansion in health insurance coverage increases health care utilization without any observable short-run improvement in health, and the magnitude of the effect on utilization is much larger than the prediction from individual-level changes in insurance status. Another implication is that a slow supply-side response can constrain attempts to meet the demand increases induced by large policy changes.

This paper is related to several strands of literature. The first relevant literature is the studies of the effect of health insurance on utilization and expenditure. The pioneering works of the RAND HIE (Manning et al. 1987; Newhouse 1992) typically find 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 such as RAND HIE would have predicted. Finkelstein (2007) attributes this larger effect to shift in supply induced by market-wide changes in demand. While we find mixed evidence on such increases in market entries of hospitals and clinics, the magnitude of our estimates on utilization are closer to that of Finkelstein (2007) than estimates from RAND HIE.

The second related literature is the studies that examine whether health insurance improves health. 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 et al. 2010; Card et al. 2009).[5] Our results show that at least in the case of Japan in 1960s, the expansion of health insurance seems to have no short-run health effects.[6]

[5] Chang (2011) find that introduction of Taiwan's National Health Insurance led to the reduction in mortality among the elderly in Taiwan, while Chen et al. (2007) did not find such evidence.

[6] Although Finkelstein and McKnight (2008) find no discernible impact of Medicare expansion on the mortality of the elderly, this is probably because the effect of Medicare on mortality is not large enough to be identified with the region-level aggregate data but detectable with the regression discontinuity design with the individual-level data employed by Chay et al. (2010) and Card et al. (2009). While the same issue may apply to our case, we supplement

Finally, there is growing literature that examines the effect of the large health insurance coverage expansion on various outcomes in less developed countries such as Mexico, Colombia, and Taiwan.[7] Under significant credit constraints in less developed countries, health care utilization without insurance can be inefficiently low (Miller et al. 2009). Japan's per capita gross domestic product in 1956 was about one-quarter of that of the United States at that time.[8] Thus, our estimates may be more relevant to developing countries that are currently considering massive expansion in health insurance coverage, than those of existing studies on developed countries such as the United States.[9] Our results show that countries planning to drastically expand health insurance coverage need to prepare enough financial resources for the anticipated surge in health care expenditures that would be much larger than predicted from individual-level changes in insurance status.

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. Section 8 concludes the paper.

2 Background

This section briefly reviews the history of Japan's universal health insurance system up to the 1960s.[10] Japan's public health insurance system consists of two parallel subsystems: employment-

our prefecture level analysis by event-study analysis at the municipality level to support our results.

[7]For example, see King et al. (2009) for Mexico; Miller et al. (2009) for Colombia; Cataife and Courtemanche (2011) for Brazil; Dow and Schmeer (2003) for Costa Rica; Hughes and Leethongdee (2007), Damrongplasi and Melnick (2009) for Thailand; and Chen and Jin (2010) for China. There are quite a number of studies for Taiwan. See for example, Cheng et al (2007), Chang (2011), and Chou et al. (2011). The studies in Taiwan also look at the effect of the introduction of universal health insurance. However the empirical strategy of these papers mostly relies on the difference-in-difference approaches by comparing those previously covered to those newly covered. Such strategy may not able to capture the effects through market entry argued in Finkelstein (2007) unlike our case that relies on prefecture-level hospital data.

[8]Countries whose per capita GDP is about one-quarter of the United States today include, for example, Chile and Turkey. Also Japan's average life expectancy at that time was 66, whereas that of the United States was 70.

[9]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 in less developed countries now (e.g., pneumonia, bronchitis, gastritis, and duodenitis).

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

based health insurance and the National Health Insurance (hereafter 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 size is about three times as large as Medicare in the United States, which covers 43 million people (The Centers for Medicare and Medicaid Services, 2010).

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 of the employees. 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 by employment-based health insurance.

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.

Both health insurance programs offer similar benefits, covering outpatient visits, admissions, diagnostic tests, and prescription drugs. However, different coinsurance rates were applied depending on the type of insurance and the rates were changed for several times. When universal health insurance was achieved in 1961, the coinsurance rate of the NHI was 50 percent for both household heads and other family members, and that of employment-based health insurance was nearly zero for employees and 50 percent for family members. The coinsurance rate of the NHI for household heads 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 health insurance for family members was also reduced to 30 percent.[11]

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. Then, to address the lack of health insurance among people who were left out from employment-based health 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 seemingly achieved. However, in reality, coverage was far from universal because the medical system was not functioning due to the budgetary constraints incurred from the 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. Those without any health insurance had to bear the full cost of health care utilization. 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.[12] By April 1961, all municipalities had joined the NHI, and universal health insurance was achieved.

Figure 1 shows the time series of health insurance coverage by the NHI, employment-based health insurance, and all types of insurance combined. The figure also includes a linear trend extrapolated from data prior to 1956. Two vertical lines indicate 1956, which is the reference year

[11] The cap on maximum limit on out-of-pocket expenditure had not been introduced until 1973.

[12] In 1959, an amendment to the National Health Insurance Act legally prescribed the mandatory participation to the NHI by April 1961 by all municipalities.

before the start of Four-year Plan, and 1961, which is the year when universal health insurance was achieved. The number of individuals covered by both employment-based health 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 1961, around 30 percent of the total population became newly covered by health insurance.

Crowding-out from employment-based health insurance by the introduction of NHI seems to have been negligible. The insured are likely to have preferred employment-based health insurance because of lower coinsurance rates and the employer's contribution to the premium. In theory, the expansion of the NHI could increase self-employed workers by enabling those to be still insured without employment-based health insurance.[13] Another possibility of crowding out is that the introduction of the NHI could induce firms to reduce its size to less than five employees in order to get exempt from the contribution to employment-based health insurance. Appendix Section A1 assesses both possibilities. We did not find strong evidence for either type of crowding-out.[14]

There are a few important institutional feature of Japan's health insurance system from the supply-side perspective. First is that detailed fee schedules are set by centralized administration, and the reimbursement from the health insurance system to medical providers strictly follows these schedules.[15]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 (Cutler, 1998). Furthermore, from 1963, fee schedules are integrated into a unified schedule that is applied nationwide.[16] Second, there was no effective legal obligation for physicians

[13]See, for example, Madrian (1994) on the job-lock effects of employment-based health insurance.

[14]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 as those prefectures that experienced a small expansion. 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. See Appendix Section A1 for details.

[15]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 through negotiation with the Central Social Insurance Medical Council, which includes representatives of the public, payers, and providers.

[16]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). 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.

or hospitals to provide cares to uninsured patients.[17] Public aid 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 unrestricted until the upper limit of the number of beds in each region was introduced in 1985. In the 1950s and 60s, the government attempted 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.[18] 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, a coordinated system to allocate physicians or nurses across prefectures did not seem to exist.

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 outcomes and explanatory variables. Thus, our unit of observation is the prefecture-year,

[17] Article 19 of the Medical Practitioners Act stipulates that a physician cannot refuse to diagnose and treat without legitimate reason. However it was not very effective because the lack of ability to pay the fee was included in the legitimate reason. 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 stabilizing care and examination to people who arrive in the emergency room for a life-threatening condition without considering whether a person is insured or a person has the ability to pay.

[18] 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.

except for a supplemental event-study using municipality level data from Ibaraki Prefecture.[19] We explain the data from Ibarkai in Section 7.2 in detail. 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.[20] 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 at year 1956, a year before the implementation of Four-year plan as follows. First, the population covered by the NHI in prefecture p in 1956 (NHI_p) is obtained from the Social Security Year Book. Second, the population covered by employment-based health insurance is imputed from nationwide, industry-level coverage rates and the industry composition of each prefecture's workforce.[21] Note that, owing to data limitations, we have to assume that the coverage rate within each industry does not vary across prefectures (i.e., the variation of employment-based health insurance across prefectures is solely attributable to the variation in industry compositions).[22] 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.[23]

Specifically, let E_CovR_j denote the ratio of households covered by employment-based health

[19] It is important to note that our analyses at the prefecture-level can capture the effects thorough hospital entry and exit, unlike studies that rely on hospital-level data. There are 46 prefectures excluding Okinawa, which returned to Japan in 1973.

[20] 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 the health care for the elderly in Japan. Also, attenuation bias caused by migration across prefecture would become severer as the sample period gets longer.

[21] Specifically, population was divided into the following 13 categories: agriculture, forestry and hunting, fishing, mining, construction, manufacturing, whole sale and retail trades, finance and real estate, transportation and other utility, service, government sector, unknown (employed), and non-employed.

[22] 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.

[23] 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 case without Tokyo and Osaka from the sample.

insurance, among those with a household head working in industry j, in 1956. Let denote W_{pj} the population living in prefecture p with a household head working in industry j in 1956. Then, the imputed population covered by employment-based health insurance in 1956 in prefecture p can be written as $\sum_j W_{pj} * E\_CovR_j$ where E_CovR_j is available from the Comprehensive Survey of the People on Health and Welfare.[24] W_{pj} is calculated as linear interpolations from Census 1955 and 1960.

Lastly, the total population of each prefecture, pop_p, is taken from the Statistical Bureau's website.[25] Then $CovR_p$, the ratio of prefecture p's population who were covered by any kind of health insurance in 1956, is estimated as follows:

$$CovR_p = [NHI_p + \sum_j W_{pj} * E\_CovR_j]/pop_p \tag{1}$$

We define the impact of the health insurance expansion, $impact_p$, as the proportion of the population *without* health insurance in prefecture p in 1956:

$$impact_p = 1 - CovR_p \tag{2}$$

Figure 2 shows the regional pattern of $impact_p$, 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 health insurance tends 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 health insurance and the NHI.[26]

[24] 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 because most agricultural workers were self-employed in Japan at that time. The result did not change much.

[25] These data seem to be interpolated from the Population Census by the Statistics Bureau, and the value is as of October 1st. Thus we take the average of 1955 and 1956 so that we have the population as of April 1 in 1956.

[26] $Var(CovR_p)$ can be decomposed into the variances of the coverage rates by the NHI, that by employment-based

The proportion of the population without health insurance coverage ranged from almost zero in several prefectures including Yamagata and Niigata 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 employment-based health 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. Figure 3 shows the correlation between the *changes* in per capita GNP and $impact_p$. The figure clearly shows that larger increases in the health insurance coverage rate is not driven by the growth of income. Rather, the increases in the coverage rate may be slightly *negatively* correlated with the growth rate of per capita GNP in the long-run. Section 4 discusses how we address the fact that the distribution of the initial health insurance coverage rate may not be completely random.

3.2 Outcome and Explanatory Variables

Our main outcome variables are divided into three categories: 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 in hospital among all inpatients. Outpatient visits are visits to hospitals for non-hospitalization reasons. Note that these variables are limited to utilization of hospitals (defined as medical institutions with 20 or more beds in Japan), because clinics (institutions with no more than 19 beds) are excluded from

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insurance, and the covariance between them. The variance of NHI coverage rates was 0.037, which is larger than $Var(CovR_p) = 0.031$. The variance of employment-based insurance is as small as 0.004, and the covariance between coverage rates of two types is -0.005.

the survey.[27]

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 per 1000 population) for age groups 0–4, 5–9, 50–54, 55–59, and 60–64 years old.[28] We do not report the results on the age group of 10-49 years old because the mortality rate is too low for this group. We also exclude the elderly over 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.[29]

Figures 4–6 present the time-series patterns for each outcome variable used in this study, and compare prefectures whose ratio of uninsured population was greater than the median (27.5%) in 1956 (high impact prefectures) and the others (low impact prefectures). Figure 4 describes the utilization measures (admission, inpatients, and outpatients) per capita. Health care utilization in high impact prefectures seems to have started rising faster than low impact prefectures after the introduction of universal health insurance, but the pattern is not very clear. Figure 5 shows the supply-side variables (hospitals, clinics, beds, bed occupancy rates, physicians, and nurses). Like Figure 4, all variables except for the bed occupancy ratio (BOR) are increasing during our sample period. 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 clinics and physicians before 1956. These two figures invoke the importance of controlling for pre-existing differences across prefectures. Figure 6 plots age-specific mortality rates. All age groups experienced a substantial decline in mortality rate over the study period. Also, low impact prefectures on average had higher mortality rates.

[27] Unlike in the U.S., direct outpatient visits to hospitals are common practice in Japan since there are no restrictions on the patients' choice of medical providers. Therefore the increase in the number of the outpatient visits may reflect that people switch from clinics to hospitals for the outpatient visits. However, almost all of the admissions occur at hospitals, and thus our data captures the universe of the admissions, and inpatient days in Japan.

[28] We also tried gender-specific mortality rates, and the results were the same for both men and women.

[29] 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.

Table 1 reports the summary statistics of all outcome variables. The mean represents the weighted average of outcomes where populations are used as weights, as in the regression analysis. We also show the mean for 1956, the reference year, and that of low impact prefectures and high impact prefectures. Importantly, prefectures whose initial coverage rates are lower (i.e. high impact prefectures) tend to be richer, had more medical resources and lower mortality rates before the implementation of the universal coverage. Thus any bias on the estimated positive effects of health insurance expansion is likely to be *downward* because convergence of economic growth goes against finding the positive effects.

4 Identification Strategy

Our identification strategy is akin 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 to prefectures where it had a smaller effect.

Health insurance coverage before universal health insurance may not be random. For example, income levels in 1956 tend to be higher in prefectures with more uninsured people. Therefore, it is essential to control for unobserved components that are potentially correlated with both initial coverage rate of health insurance and health care utilization as well as health outcomes. In fact, Japan was experiencing a rapid economic growth during the period we study. The speed and timing of such economic growth may have been different across prefectures.[30] 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, and also control for convergence of the growth rates by including interaction terms of the initial value of the outcome variable and year dummies.[31]

[30] 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.

[31] We divide 46 prefectures into the following 10 regions defined by the Statistics Bureau: Hokkaido, Tohoku, Kitakanto-Koshin, Minamikanto, Hokuriku, Tokai, Kinki, Chugoku, Shikoku, Kyushu.

The basic estimation equation is as follows:

$$Y_{pt} = \alpha_p * 1(pref_p) + \delta_{rt} * 1(year_t) * 1(pref_p \in region_r) + \kappa_t * Y_{p1956} * 1(year_t) + \sum_{t \neq 1956} \lambda_t(impact_p) * 1(year_t) + X_{pt}\beta + \varepsilon_{pt} \quad (3)$$

Subscript p indicates prefecture and t indicates year. α_p represents a prefecture fixed effect; δ_{rt} represents region-specific year effects; κ_t is meant to capture the differences in the growth of Y due to the differences in the initial value; and $impact_p$ is the percentage of the population in prefecture p without health insurance in 1956, as defined in (2).

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 equation (3) does not make any *ex-ante* restrictions on the timing of the structural trend break, so we allow the data to show when changes in the time pattern actually occur.

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.

As another robustness check, we include prefecture-specific linear trends in (3) for outcome variables whose data are available at least back to 1952. However, note that we have only four to six observations before the base year, and the change in the insurance coverage was gradual and took four years. Thus, 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. Given this possibility of overfitting, we do not include prefecture-specific linear trends in our main specification.

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; 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 $(\lambda_{66} - \lambda_{61}) - (\lambda_{56} - \lambda_{51})$, i.e. we repeat the same exercise for the period of 1961-66, the second 5 years after the expansion to examine the long-run effects. 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 the following deviation-from-trend model:

$$\begin{aligned} Y_{pt} &= \alpha_p * 1(pref_p) + \delta_{rt} * 1(year_t) * 1(pref_p \in region_r) + \kappa_t * Y_{p1956} * 1(year_t) \\ &+ \gamma_{pre} * year_t * impact_p + \gamma_{mid} * 1(year_t \geq 1956) * (year_t - 1956) * impact_p \\ &+ \gamma_{after} * 1(year_t \geq 1961) * (year_t - 1961) * impact_p + X_{pt}\beta + \varepsilon_{pt} \quad (4) \end{aligned}$$

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. That is, we allow the slope to differ during the expansion period (1956-1961) and the lagged period (1961-1970). A disadvantage of this approach is that we have to impose *ex-ante* restrictions 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 are less likely to use health care services, the bias caused by inter-prefecture migration would be, if any, drives estimates 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 affect the results. Second, it is possible that sicker people migrate from a municipality without NHI to one with NHI within the same prefecture. If so, the actual changes in health insurance status might have been larger among healthier people, and thus the impact on health care utilization and health outcomes might be smaller than the case without such migration.

5 Results on Utilization

5.1 Basic Results

Figure 7 plots the estimated λ_t'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, λ_{56} 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 7 shows the results for hospital admissions. There is no pre-existing trend in the λ_t'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_{61} and λ_{66} are 0.290 and 0.548, respectively.[32] 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 8.5 percent ($= exp[0.290 * 0.28] - 1$) in 5 years and 16.6 percent in 10 years due to the enforcement of universal health insurance. Inpatient days and outpatient visits show very similar trends to admissions: both graphs increase sharply in the late 1950s and stay high until the late 1960s. The magnitudes are larger for outpatient visits than admissions and inpatient days. The estimated λ_{61} and λ_{66} imply that 7.3 and 11.6 percent increases for inpatients days and 12.6 and 25.1 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.[33] 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).[34] Therefore, the RAND HIE suggests that the effect of moving 28 percent of the population from no insurance to having 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 12.6 percent in the 5 years since 1956. Thus, our estimates are about four times larger than what individual-level changes in health insurance would have predicted.

[32] Hereafter, we mainly focus on λ_{61}, i.e. the change up to the full achievement of universal health insurance, and λ_{66}, 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.

[33] An important difference is that the RAND experiment set limits on the maximum out-of-pocket expenditures (MDE) 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.

[34] 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).

5.2 Robustness Checks

Table 2 presents robustness checks of our utilization results. To save space, we only report estimates for the interaction terms of 1961 and 1966. To make the results comparable with our basic results, rows 1 and 5 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 6 indicate that our results are not driven by these prefectures. 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, and 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. Because most of our additional control variables are available only after 1956, we limit the sample to 1956-1970 in this specification.[35] As seen in rows 3 and 7, adding these controls does not significantly change the estimated coefficients. Lastly, rows 4 and 8 show results with prefecture specific linear trends. Although some of the point estimates change, all λ_t's remain statistically significant.

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. We do not perform this test for admissions because data for 1951 are not available. In the first row of Table 3, we take a five year difference in change in the outcome. Both inpatient days and outpatient visits statistically significantly increased after 1956. 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 they are all positive. These results indicate that the effect of the expansion of health insurance on utilization is concentrated to the period when the health insurance coverage was expanding.

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

The rows 3 to 5 in Table 3 show the estimated coefficients of the two slopes in the deviation-from-trend model as equation (4). The slope prior to 1956 is not statistically significant and close to zero for all three outcomes. The coefficients for difference in the slopes before and after 1956 (row 4) are positive for all three utilization measures and indicated changes are in the same order of the estimates from other specifications. For example, the coefficient on the first slope for the admissions is interpreted as an increase of 14.7 percent ($= exp[0.098 * 5 * 0.28] - 1$) by 1961.[36] In contrast, the estimated coefficients for the second slopes (row 4) 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 7.

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 is the shortage of human capital such as physicians and nurses.[37]

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 if the expansion of health insurance coverage sufficiently increases the aggregate demand so that it may induce medical providers to incur the fixed costs to build new institutions.

Thus we begin by testing this hypothesis by estimating the effects of health insurance expansion on the number of medical institutions. The upper-left graph of Figure 8 plots estimated λ_t's in equation (3) with the log of the number of hospitals as the dependent variable. The estimates for 1961 and 1966 are 0.229 and 0.578, respectively, and both are statistically significant at the

[36] 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.

[37] For example, one of the major concerns for the Patient Protection and Affordable Care Act in the U.S., is the shortage of physicians (Association of American Medical College 2010).

conventional level. Therefore, this graph may read as if the hospitals have increased in the areas where utilization indeed increased.

However, the graph also shows a strong pre-existing trend before 1956. Indeed, as shown in rows (4) and (8) in Table 4, once prefecture-specific linear trends are included, the estimated coefficients are no longer significantly positive. Table 5 also reports that the any 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 may not be a causal link.

We repeat the same analysis for clinics; the results are shown in the upper-right graph in Figure 8, and the second column in Table 4. As shown in the graphs, λ_t's are not estimated very precisely. Moreover, none of the estimates presented in Table 4 are statistically significant. We cannot control for pre-existing trend because data of clinics are available only from 1954, thus rows (4) and (8) in Table 4 are blank and Table 5 does not have a column for clinics. 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 8 shows the estimated λ_t'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.[38]

The graphs in the middle row of Figure 8 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 3.4 percent by 1961 and 10.9 percent by 1966.[39] 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 during the late 1950s. Unlike the case of the number of hospitals, we do not observe discernible pre-existing trend

[38] 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.

[39] 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.

for the number of beds. The third column in Table 4 and the second column in Table 5 confirm that the results are not sensitive to the inclusion of prefecture-specific linear trends or controls for pre-existing trends.

The bottom two graphs in Figure 8 show the estimated λ_t's for the number of physicians and nurses. The graph of the number of physicians in Figure 8 shows an increase at a slightly slower pace than that of beds, although the estimated λ_t's are not always statistically significant. Pre-1956 data for the number of physicians are available only from 1953. Thus we do not control for prefecture specific linear trends or pre-existing trend, and rows (4) and (8) in Table 4 are blank and Table 5 does not have a column for physicians. 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 seems to be positive but noisier than that on beds, and the effect 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. Also, it is not surprising 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.[40]

7 Results on Mortality Rates

7.1 Basic Results

To complete the picture of the impact of expansion in health insurance coverage, this section explores whether health insurance benefit health of insured. On the one hand, cheaper access to health care services may improve health outcomes.[41] On the other hand, if the marginal people

[40] 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.

[41] Another potential benefit to patients is the lower risk of unexpected, high out-of-pocket medical spending. However, we cannot explore this benefit because the variance in individual household health care expenditure is not available. Appendix Section A2 shows that at least on average, the introduction of universal health insurance did not affect the out-of-pocket medical expenditures.

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 effects on health outcomes. Therefore the impact of health insurance on health outcomes is *a priori* ambiguous. As the measure of health outcomes, we use age-specific mortality rates.

Figure 9 presents the estimated λ_t's in equation (3) with the mortality rates of five age-groups as the dependent variables. The expansion of health insurance coverage does not reduce the mortality rate for any of the age groups we study. As shown in Table 6, the results do not change after excluding Tokyo and Osaka and adding more controls.

However, row (8) in Table 6 shows that, when prefecture-specific linear trends are controlled, statistically significant negative effects emerges in the late 1960s except for the age group 5-9. At the same time, Table 7 shows that controlling for the pre-existing trends does not yield any statistically significantly negative effects. Thus, we cannot conclude from our analysis whether the expansion of health insurance coverage has long-term negative effects on mortality, but at least in the short-run, there does not seem to be any effects.

7.2 An Event Study in Ibaraki Prefecture

Unlike the other outcome variables, some prefectures publish mortality rates at the municipality level. Since the NHI was introduced at the municipality level, we exploit the municipality level data from Ibaraki prefecture to conduct an event-study analysis. We choose Ibaraki because it had a relatively low coverage rate as of 1956 (59%) among the prefectures whose municipality-level mortality data are available. A low initial coverage rate means that many municipalities introduced the NHI along the implementation of the universal coverage. Ibaraki locates northeast to Tokyo in Kanto area, and it had relatively low per-capita GNP (37th among 46 prefectures) and high mortality rates (about 5-15th, depending on age group) in 1956.

The data are taken from Ibaraki-prefecture Statistical Book (Ibaraki-ken Tokeisho), which provides the number of NHI enrollees, population, and the number of deaths in each municipality. We exclude municipalities that merged during the period of 1956-1961, because these mergers make it difficult to identify the year when the NHI was introduced or fully implemented. Such excluded municipalities include Mito-city, the capital city of the prefecture. Then, for the remaining 73 municipalities, we determine the year of the full implementation of the NHI as the year when the number of NHI enrollees exceeded 90% of the number of enrollees as of 1961. 41 municipalities implemented the NHI fully during the period of 1956-1961.

We define the mortality rate as the number of deaths per 1000 people. Although the data on the NHI participation are available from 1955, the number of deaths and population of each municipality are available only from 1957. Thus we limit our analysis to the period of 1957–1965.[42] Then we estimate the following equation:

$$Y_{mt} = \alpha_m + \sum_{T=-4}^{8} \pi_T(\tau_{mt} = T) + \gamma_m t + \varepsilon_{mt} \tag{5}$$

Y_{mt} is the mortality rate of municipality m in year t. τ_{mt} is time to the year when municipality m fully implemented the NHI measured by years, and π_T is the changes in the mortality rate relative to the year when the municipality fully implemented the NHI.[43] α_m represents municipality fixed effects and γ_m represents municipality-specific linear trends.[44] Standard errors are estimated with clustering by municipality so that ε_{mt} could be correlated within municipality across time.

Figure 10 plots the estimated π_T's. It shows that there was no change in mortality caused by the full implementation of the NHI. Therefore, we conclude that, although there might be some modest effects emerging with lag of 10 years or so, the expansion in health insurance coverage does not affect the mortality rate at least within several years after its implementation.

7.3 Cause-specific Mortality

Both the basic specification using prefecture-level data and the event study using municipality-level data show no short-run decline in the mortality rates. This lack of decline in mortality in

[42] Although data after 1965 are available, we did not to extend our data because across-municipality mobility would attenuate the estimates more severely as we move further from the base year.

[43] Using the year when the NHI introduced (not necessarily fully implemented) yields almost the same results except that 5 municipalities are excluded because they partially introduced NHI before 1956.

[44] We have also tried prefecture-wide year dummies instead of municipality-specific linear trends. Results are qualitatively the same.

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 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.[45] 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 Figure 11 we do not find any statistically significant reduction in the number of deaths by these treatable diseases.[46]

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 micro-level estimates such as RAND HIE. Then we investigate why we find such larger effects, and we find differential supply-side responses argued in Finkelstein (2007). While we do not find that the expansion of health insurance induced the market entries of hospitals and clinics that incur large fixed costs, we find increases in the number of beds, which may be less costly than market entries.

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 of non-fatal diseases. Nonetheless, universal health insurance is unlikely to be the

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

[46] 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 and nurses did not fully catch up, the expansion of health insurance might have reduced the number of physicians and nurses per patient. Although we cannot directly measure the quality of medical treatment, this overcrowding may have lowered the quality of health care services.

main factor explaining Japan's drastic improvement in life expectancy in the 1960s at least in the short-run.

Another limitation of our study is 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 medical 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. Also our results may indicate that slow supply-side response may constrain the ability of the health care system to meet increased demand resulting from expansions in coverage.

A Appendix

A.1 Evidence against Crowding Out of Employment-based Health 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 health insurance. First, the NHI could increase self-employed workers by reducing the penalty of being ineligible for employment-based health 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 health 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 years old or over (14 for 1950). We exclude the owners with paid employees because they might be eligible for employment-based health insurance. Then, we regressed the changes of this ratio from 1955 to 1960 on $impact_p$, the ratio of uninsured in 1956. 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 λ=0) is 1957. The estimated λ is shown in Table A3.

If the expansion of NHI induced some firms to reduce the size and get exempt from employment-based health 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. Furthermore, these two estimates, λ_{63} and λ_{66}, seem to be driven solely by Tokyo and Osaka. As shown in Table A3b, when we exclude Tokyo and Osaka, no λ 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 a lagged response to the NHI expansion.

A.2 The Impact on Household Out-of-Pocket Health Care 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 long-term effects. Specifically, we estimate the following first-difference regression:

$$dY = \beta_0 + \beta_1 impact_p + \beta_2' dX + \varepsilon_p \tag{6}$$

where X includes the same set of control variables added in rows (3) and (7) 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 A4 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 due to 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 health care costs, whereas the introduction of Medicare reduced consumer costs to almost zero, except for a small deductible.

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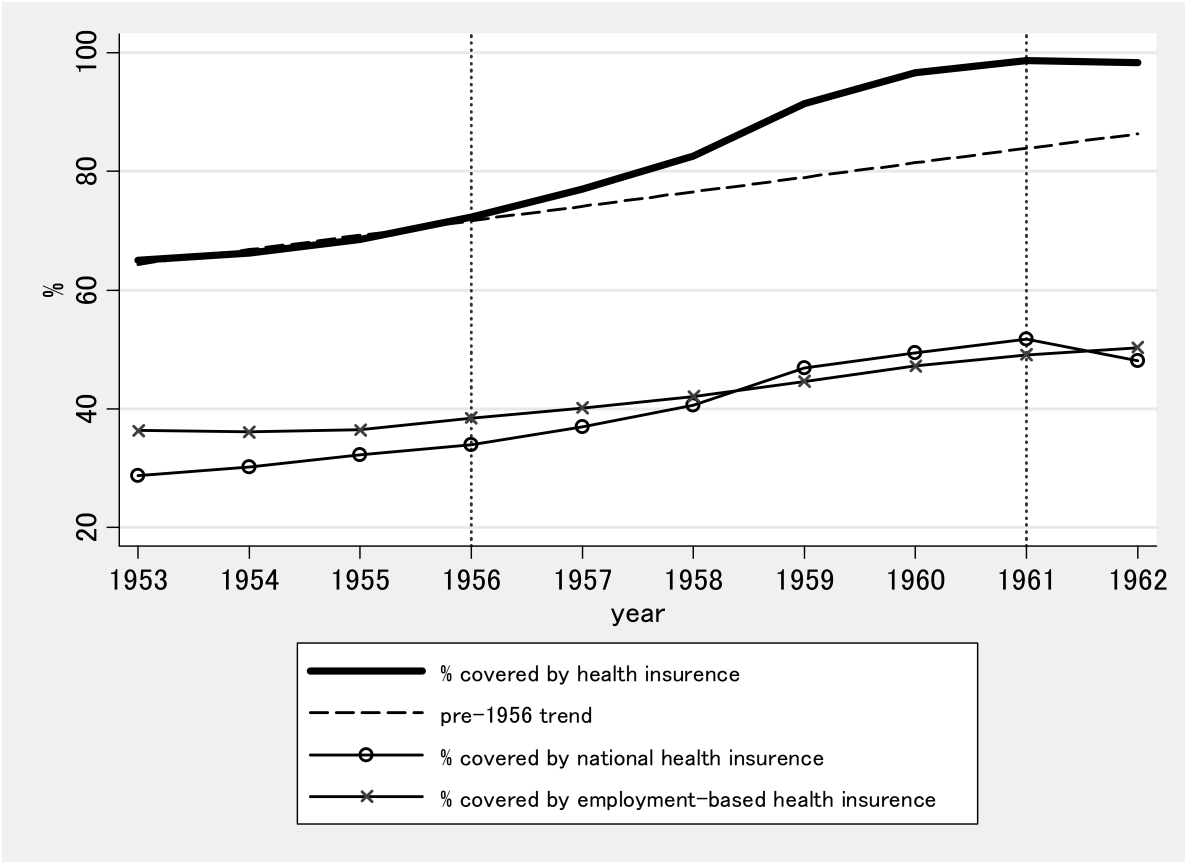

Figure 1: National Time Series of Health Insurance Coverage Rates

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).

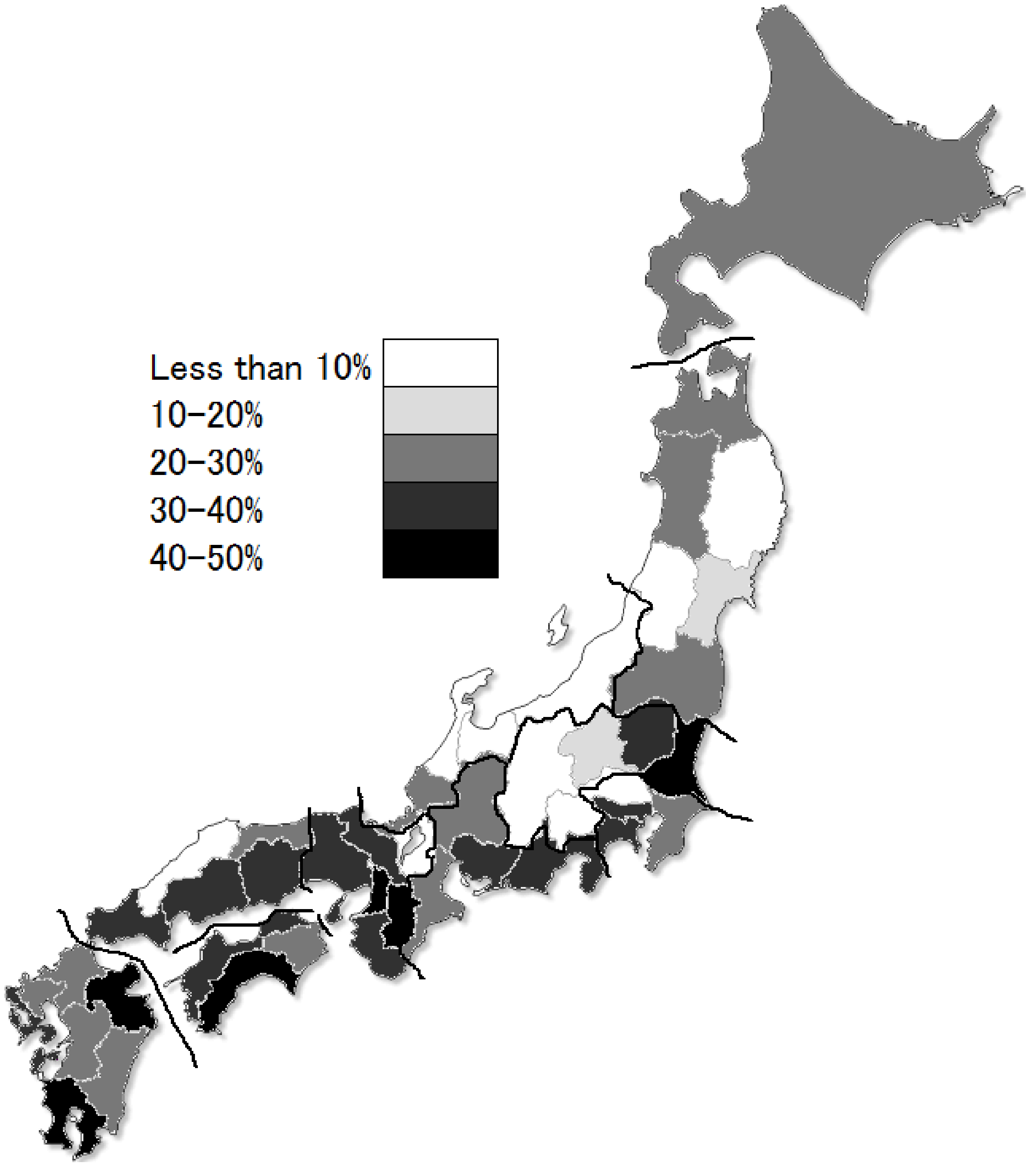

Figure 2: % of Population without Any Health Insurance as of April 1956

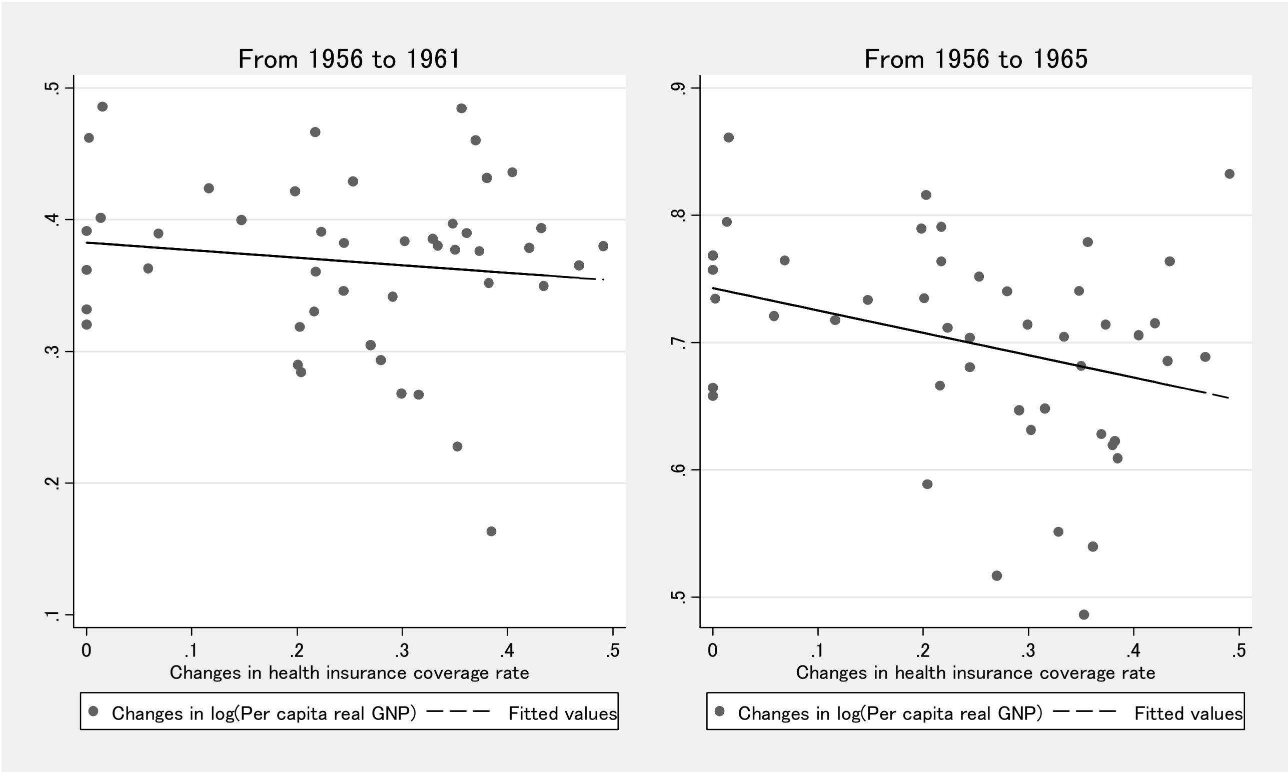

Figure 3: Scatter plots of changes in per capita GNP and health insurance coverage rate

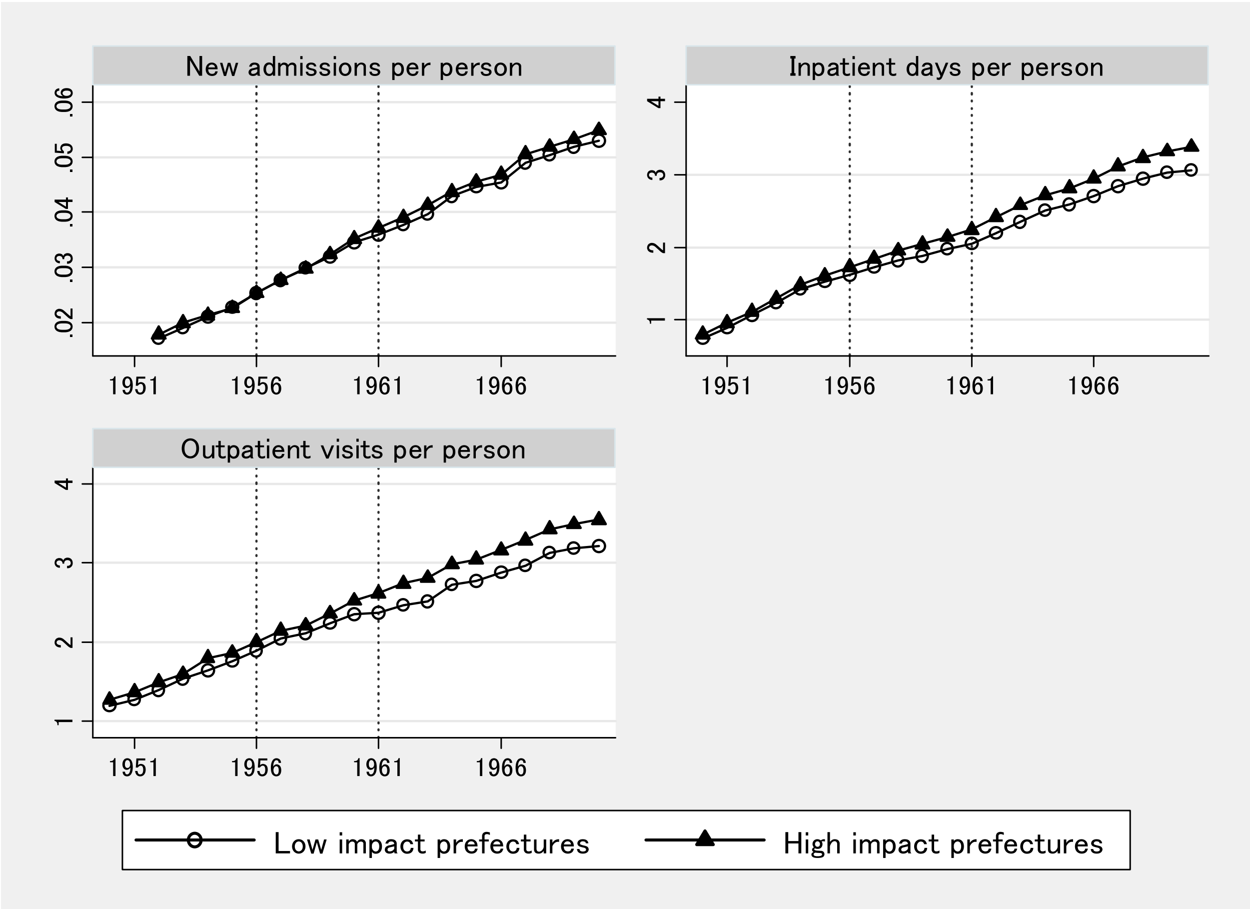

Figure 4: Time Series of Health Care Utilization (Average Weighted by Population)

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 27.5% in 1956, i.e. lower than the median.

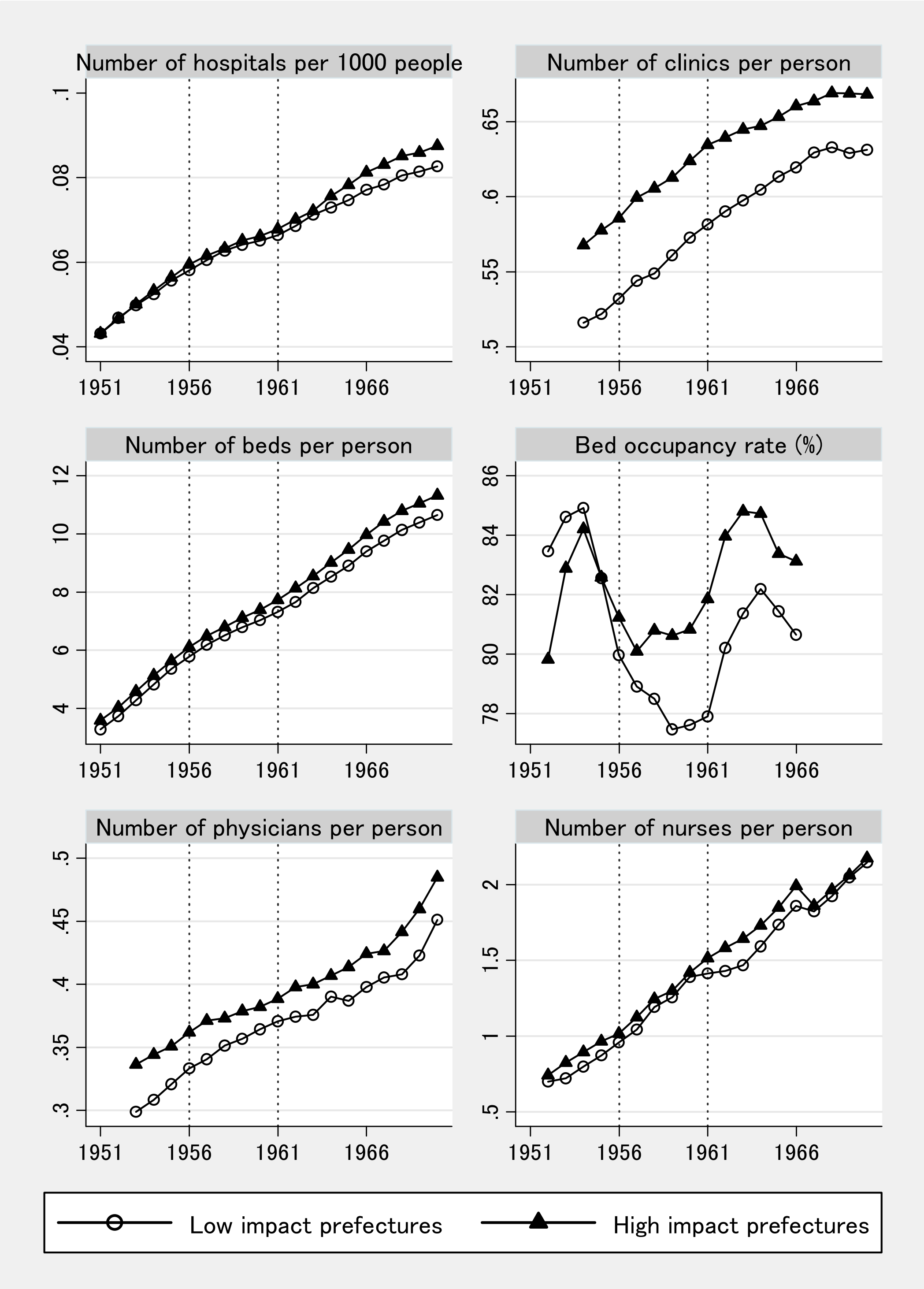

Figure 5: Time Series of Per Capita Supply of Health Care (Average Weighted by Population)

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 27.5% in 1956, i.e. lower than the median.

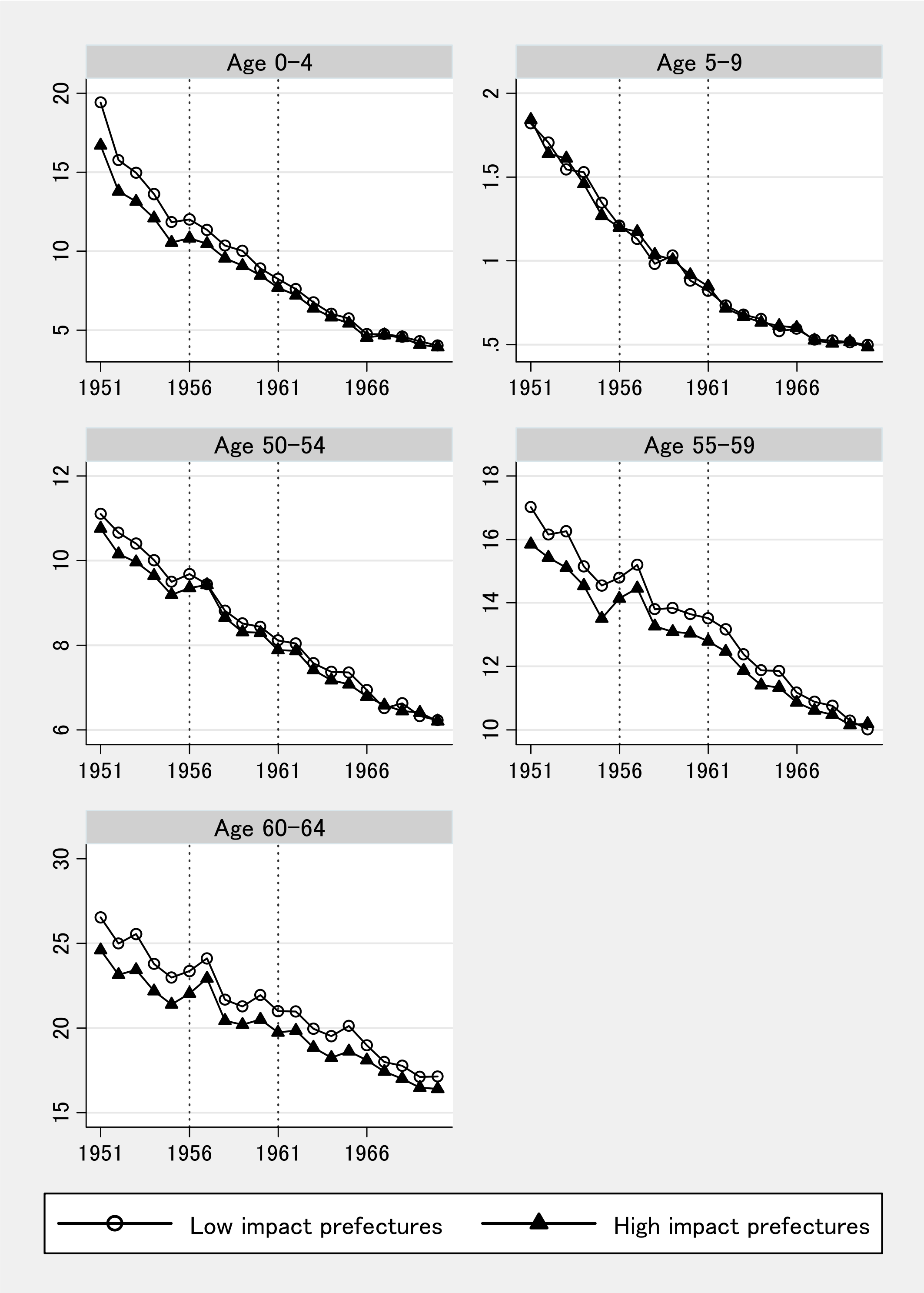

Figure 6: Time Series of Age Specific Mortality Rates (Average Weighted by Population)

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 27.5% in 1956, i.e. lower than the median.

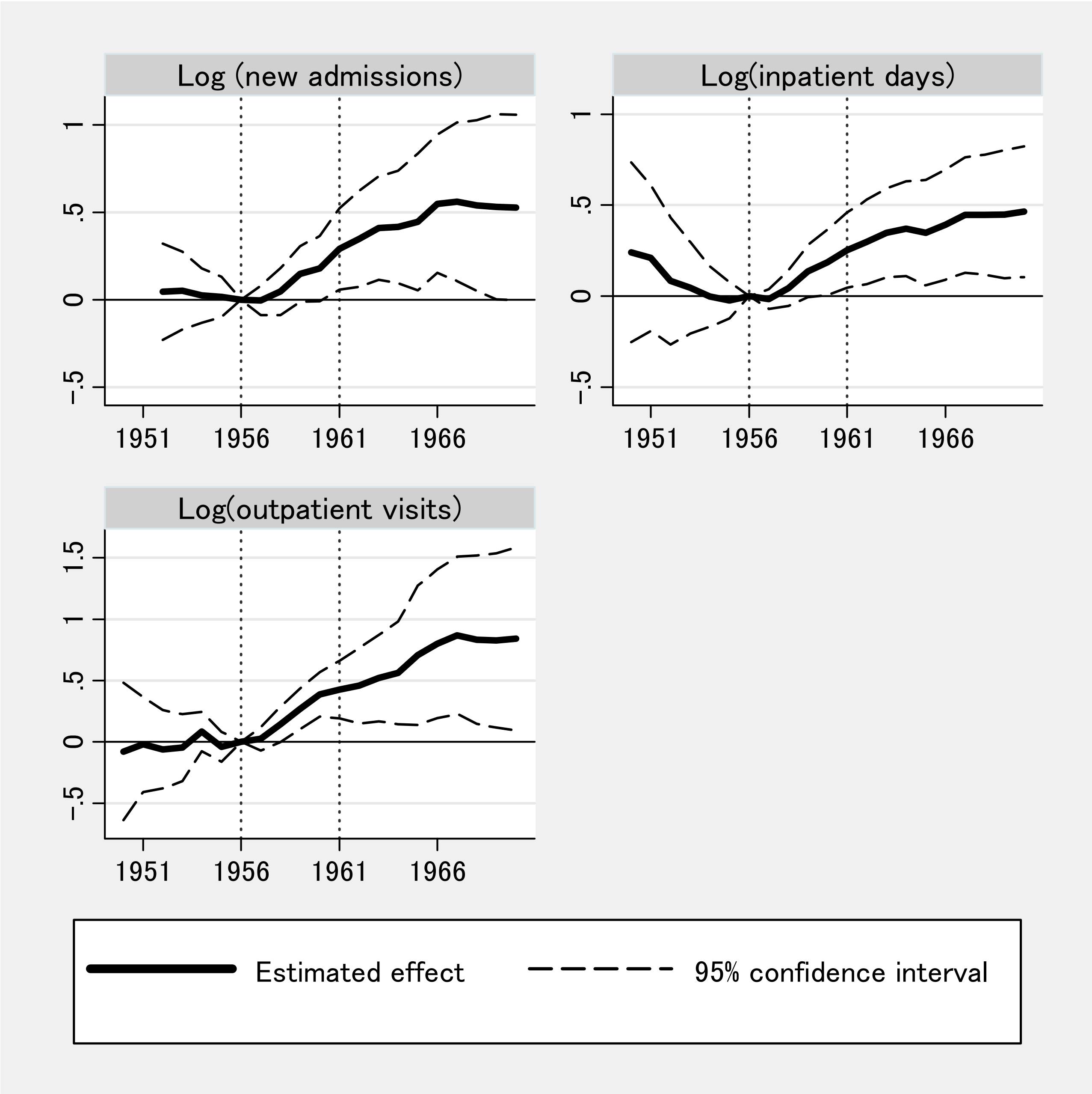

Figure 7: Effect of Health Insurance Coverage on Healthcare Utilization

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, interactions between year dummies and the value of the dependent variable as of 1956, log population and the ratio of over 65 in population. Standard errors are clustered by prefecture.

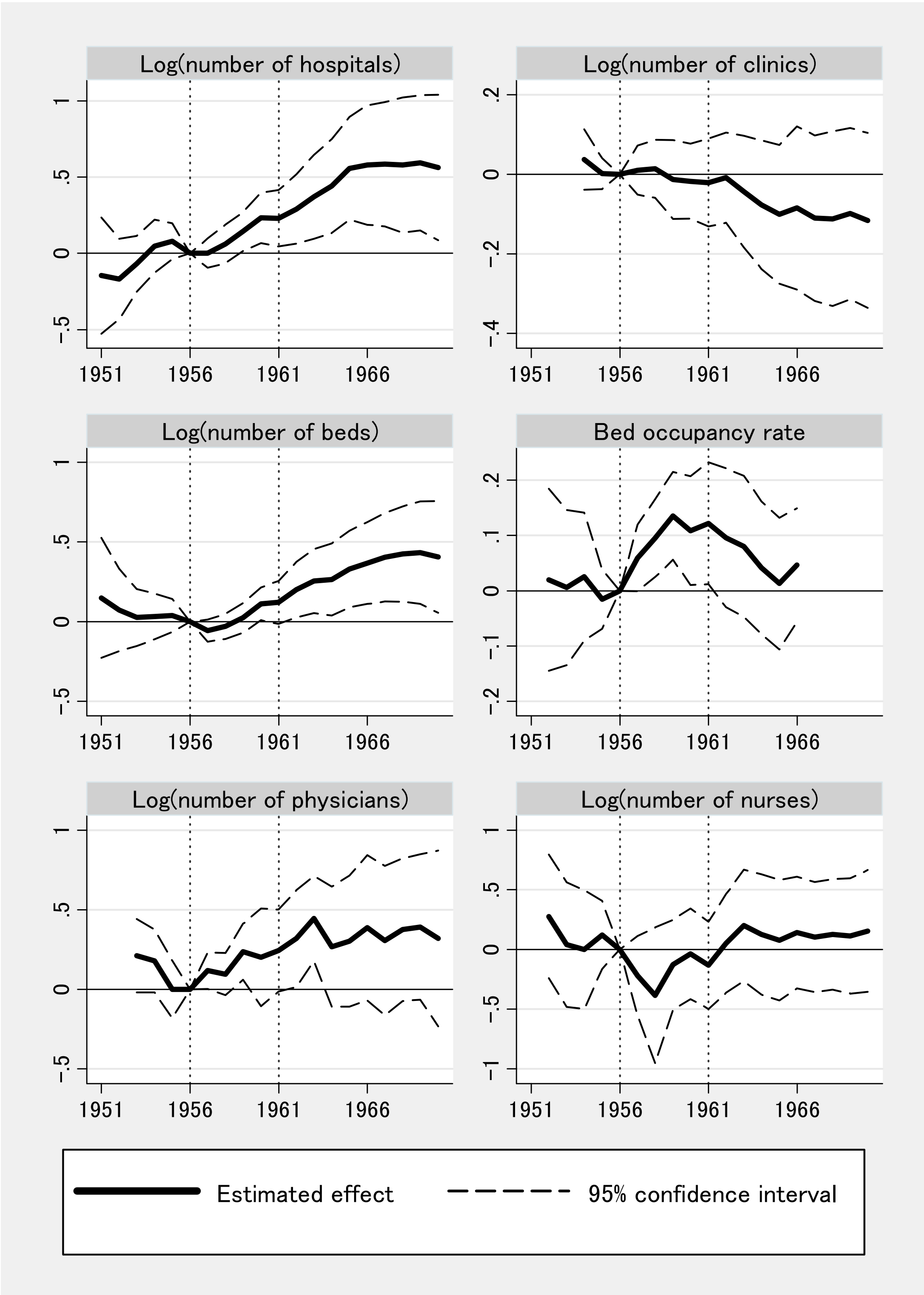

Figure 8: Effect of Health Insurance Coverage on Supply of Health Care

Note: Two vertical lines indicate 1956, the reference year, and 1961, the year in which universal health insurance was achieved. Regressions on which these graphs are based include prefecture-fixed effects, region-specific year effects, interactions between year dummies and the value of the dependent variable as of 1956, log population and the ratio of over 65 in population. Standard errors are clustered by prefecture.

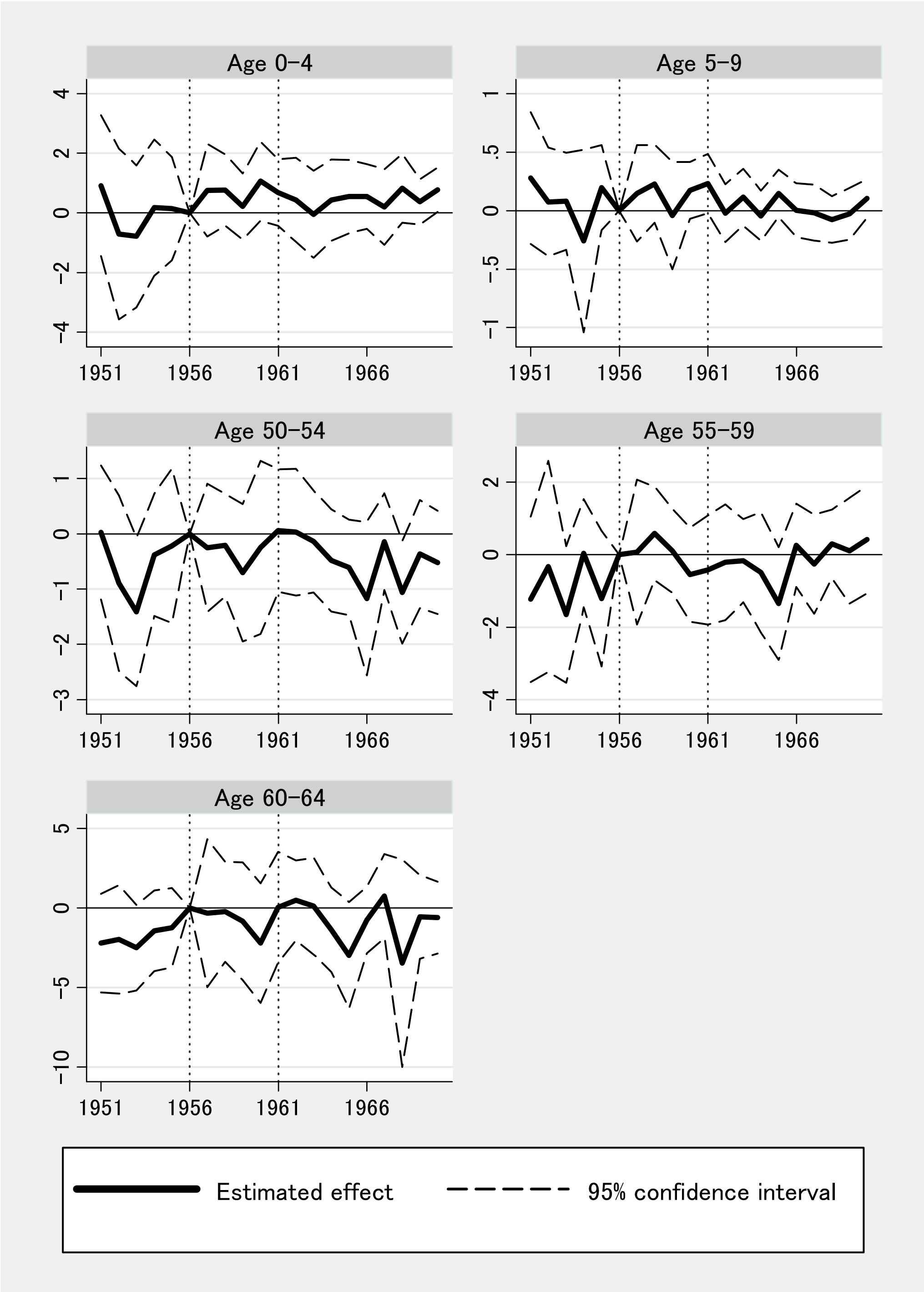

Figure 9: Effect of Health Insurance Coverage on Age-Specific Mortality Rates

Note: Mortality rate is number of deaths per 1000 population. 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, interactions between year dummies and the value of the dependent variable as of 1956, log population and the ratio of over 65 in population. Standard errors are clustered by prefecture.

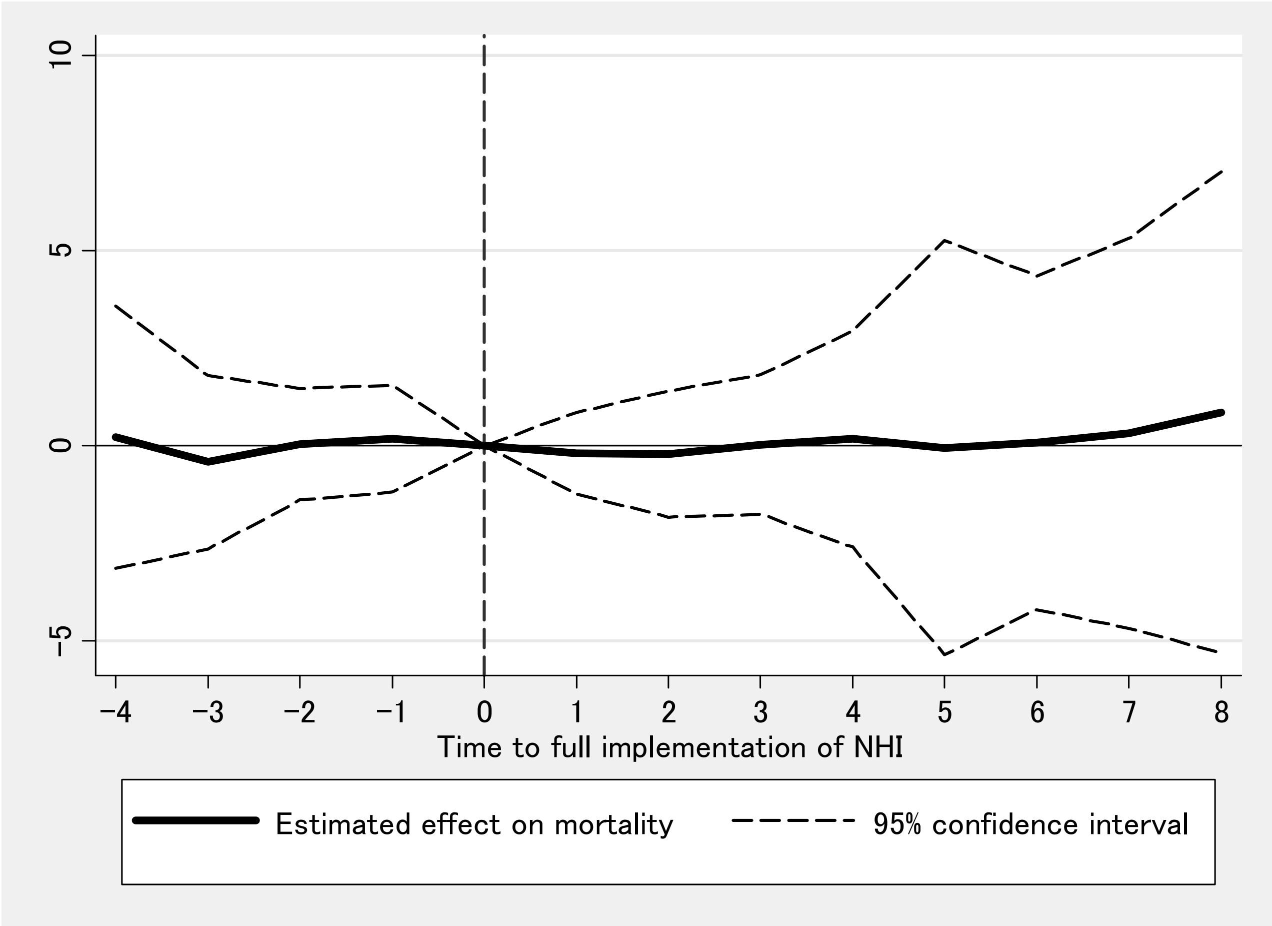

Figure 10: Mortality Rates by Time to Full Implementation of the NHI

Note: The sample includes 41 municipalities in Ibaraki prefecture that fully implemented NHI during the period of 1957-1961. Regressions on which these graphs are based include municipality fixed effects and municipality-specific linear trends. Standard errors are clustered by municipalities.

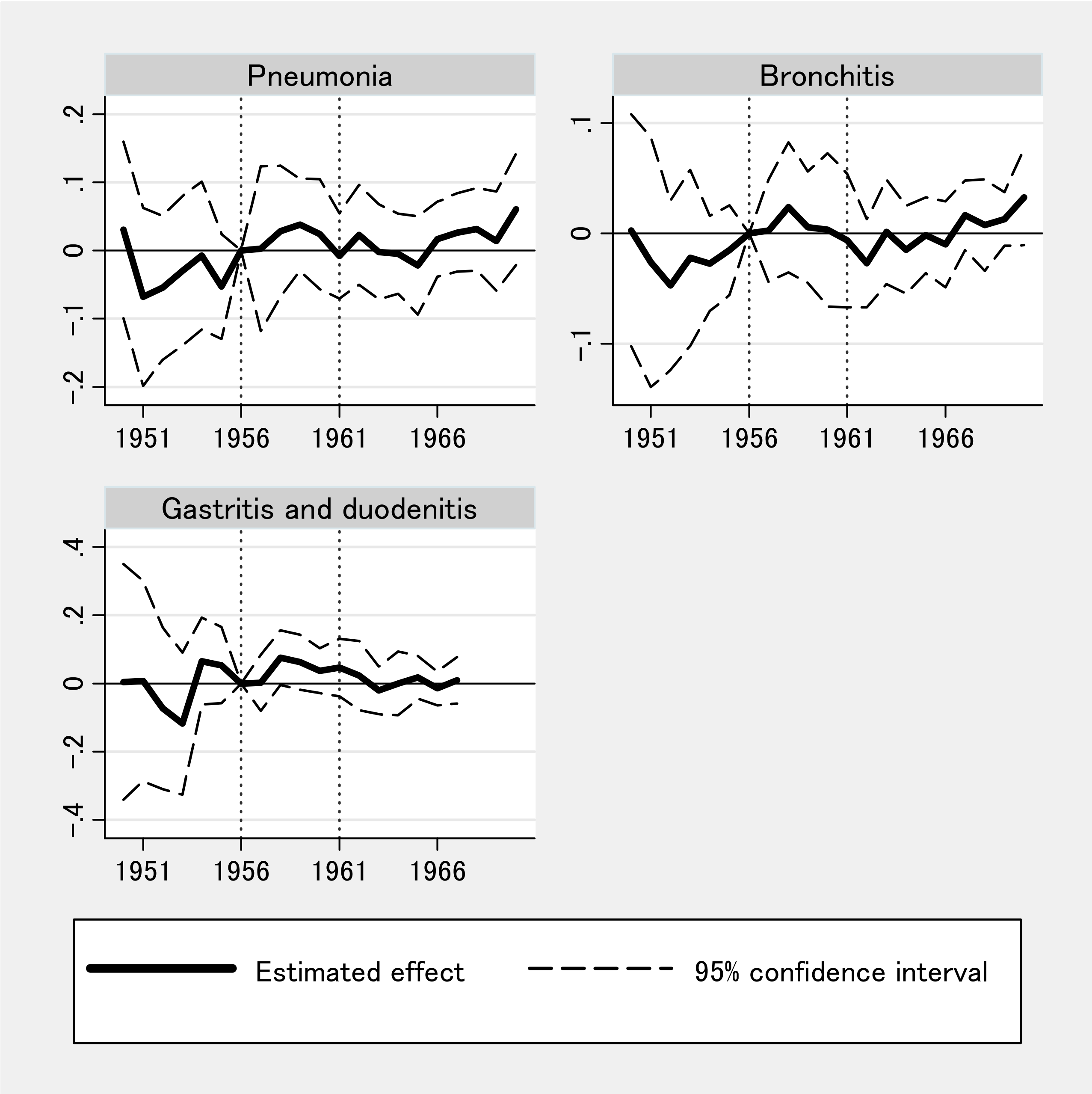

Figure 11: Effect of Health Insurance Coverage on Mortality Rates by Treatable Diseases

Note: Mortality rate is number of deaths per 1000 population. The data for gastritis and duodenitis are not available after 1968 because of the changes in classification. 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, interactions between year dummies and the value of the dependent variable as of 1956, log population and the ratio of over 65 in population.

Table 1: Mean of Dependent and Control Variables

Variable	Obs	Available period	Whole period	All prefectures in 1956	High impact prefectures in 1956	Low impact prefectures in 1956
Admission (thousands)	874	1952-70	148.5	91.5	118.4	48.0
Inpatient days (thousands)	966	1950-70	7517.1	5610.1	7087.2	3224.9
Outpatient visits (thousands)	966	1950-70	9744.5	7322.9	9388.6	3987.3
Hospitals	920	1951-70	215.4	180.9	223.3	112.5
Clinics	782	1954-70	2455.6	1911.7	2494.0	971.4
Number of beds in hospitals	828	1951-70	27619.7	19439.1	24420.5	11395.3
Bed occupancy rate (%)	690	1952-66	82.1	81.1	81.6	80.2
Number of physicians in hospitals	828	1953-70	1516	1349.7	1739.1	720.9
Number of nurses in hospitals	874	1952-70	5884.6	3649.9	4774.8	1833.4
Mortality rate: age 0-4	920	1951-70	8.1	10.6	9.9	11.8
Mortality rate: age 5-9	920	1951-70	0.9	1.2	1.1	1.2
Mortality rate: age 50-54	920	1951-70	8.2	9.6	9.4	9.8
Mortality rate: age 55-59	920	1951-70	12.9	14.5	14.2	15.0
Mortality rate: age 60-64	920	1951-70	20.5	22.8	22.3	23.7
Population (thousands)	966	1950-70	3325.8	2939.6	3607.4	1861.2
Population over 65 (%)	966	1950-70	4.9	3.9	3.8	4.2
Real GNP per capita (1980 thousand yen)	736	1955-70	700.7	378.9	415.0	320.5
Real local gov. expenditure on health and sanitation (1980 thousand yen)	690	1956-70	5.6	1.8	1.9	1.5
Local gov. expenditure to revenue ratios	690	1956-70	1.03	1.02	1.03	1.01
Real medical expenditures per person by NHI (1000 yen in 1980 price)	644	1957-70	20.1	6.7 (in 1957)	6.8 (in 1957)	6.6 (in 1957)

Note: Mortality rate is the number of deaths per 1000 population. High impact prefectures are prefectures whose uninsured rate was 27.5% or higher in 1956. Low impact prefectures are prefectures whose uninsured rate was lower than 27.5% in 1956. 27.5% is the median uninsured rate in 1956.

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 7	0.290**	0.253**	0.426***
	[0.116]	[0.103]	[0.116]
(2) Excluding Tokyo and Osaka	0.267**	0.218**	0.389***
	[0.116]	[0.108]	[0.132]
(3) More controls	0.279**	0.265**	0.412***
(sample period: 1956-1970)	[0.105]	[0.104]	[0.130]
(4) Prefecture specific	0.192**	0.449***	0.409***
linear trends	[0.073]	[0.064]	[0.110]
	λ in 1966		
Dependent variable:	Log(admissions)	Log(inpatient days)	Log(outpatient visits)
(5) λ shown in Figure 7	0.548***	0.392**	0.800**
	[0.196]	[0.150]	[0.301]
(6) Excluding Tokyo and Osaka	0.459**	0.302*	0.637**
	[0.195]	[0.157]	[0.294]
(7) More controls	0.567***	0.412***	0.884***
(sample period: 1956-1970)	[0.188]	[0.149]	[0.272]
(8) Prefecture specific	0.403***	0.786***	0.748***
linear trends	[0.066]	[0.089]	[0.077]

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)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	--	0.462**	0.481**
	--	[0.203]	[0.158]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	--	0.349	0.353
	--	[0.221]	[0.261]
Slope prior to 1956	-0.028	-0.048	0.006
	[0.032]	[0.042]	[0.043]
(Slope in 1956-1961) - (Slope prior to 1956)	0.098**	0.117**	0.085**
	[0.046]	[0.048]	[0.038]
(Slope in 1961-1970) - (Slope prior to 1961)	-0.038*	-0.044*	-0.038
	[0.022]	[0.023]	[0.048]

Note: Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. The first two rows for Log(admissions) are blank because the data for 1951 are not available.

Table 4 Robustness Checks for Supply of Health Care

	λ in 1961					
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	BOR	Log(physicians)	Log(nurses)
(1) λ shown in Figure 8	0.229**	-0.021	0.121*	0.122**	0.243*	-0.132
	[0.092]	[0.055]	[0.067]	[0.055]	[0.128]	[0.181]
(2) Excluding Tokyo and	0.183*	-0.031	0.085	0.115**	0.241*	-0.24
Osaka	[0.092]	[0.053]	[0.070]	[0.057]	[0.130]	[0.261]
(3) More controls	0.205**	-0.013	0.130*	0.128**	0.168	-0.102
(sample period: 1956-1970)	[0.091]	[0.055]	[0.069]	[0.061]	[0.118]	[0.186]
(4) Prefecture specific	-0.017	--	0.075*	0.351***	--	-0.146
linear trends	[0.060]	--	[0.039]	[0.059]	--	[0.218]
	λ in 1966					
Dependent variable:	Log(hospitals)	Log(clinics)	Log(beds)	BOR	Log(physicians)	Log(nurses)
(5) λ shown in Figure 8	0.578***	-0.085	0.368***	0.047	0.387*	0.142
	[0.194]	[0.102]	[0.128]	[0.051]	[0.226]	[0.232]
(6) Excluding Tokyo and	0.509**	-0.096	0.304**	0.022	0.387*	-0.068
Osaka	[0.201]	[0.096]	[0.135]	[0.061]	[0.225]	[0.250]
(7) More controls	0.622***	-0.083	0.384***	0.070	0.372*	0.182
(sample period: 1956-1970)	[0.164]	[0.092]	[0.127]	[0.061]	[0.203]	[0.233]
(8) Prefecture specific	0.145	--	0.299***	0.443***	--	0.157
linear trends	[0.089]	--	[0.065]	[0.083]	--	[0.225]

Note: BOR stands for bed occupancy rate. Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Rows (4) and (8) for log(clinics) and log(physicians) are left blank because available data prior to 1956 are limited to less than 4 years for these two outcomes.

Table 5: Controlling for Pre-existing Trend: Supply of Health Care

Dependent variable:	Log(hospitals)	Log(beds)	BOR	Log(nurses)
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	0.084	0.270	--	--
	[0.195]	[0.199]	--	--
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	0.204	0.397*	--	--
	[0.273]	[0.212]	--	--
Slope prior to 1956	0.030	-0.037	0.003	-0.098*
	[0.031]	[0.035]	[0.022]	[0.058]
(Slope prior to 1956) - (Slope in 1956-1961)	0.023	0.078*	0.019	0.125
	[0.037]	[0.045]	[0.020]	[0.081]
(Slope prior to 1961) - (Slope in 1961-1970)	-0.011	-0.005	-0.046***	-0.003
	[0.037]	[0.021]	[0.016]	[0.059]

Note: BOR stands for bed occupancy rate. Clinics and physicians are excluded from the analyses because of the lack of pre-1956 data. Standard errors, estimated with clustering by prefecture, are presented in the brackets. *, **, *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. The first two rows for BOR and log(nurses) are blank because the data for 1951 are not available.

Table 6: Robustness Checks for Age Specific Mortality

	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 9	0.681	0.231*	0.057	-0.422	0.042
	[0.552]	[0.126]	[0.550]	[0.747]	[1.728]
(2) Excluding Tokyo and Osaka	0.222	0.311**	0.286	0.154	1.505
	[0.563]	[0.150]	[0.558]	[0.740]	[1.504]
(3) More controls	0.614	0.200	0.068	-0.358	-0.253
(sample period: 1956-1970)	[0.548]	[0.132]	[0.580]	[0.860]	[1.790]
(4) Prefecture specific	-0.485	0.213	-0.239	-1.219	-1.119
linear trends	[0.783]	[0.168]	[0.606]	[0.816]	[1.588]
	λ in 1966				
Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
(5) λ shown in Figure 9	0.547	0.003	-1.175*	0.260	-0.758
	[0.538]	[0.114]	[0.689]	[0.572]	[1.037]
(6) Excluding Tokyo and Osaka	0.176	0.075	-0.797	0.724	0.102
	[0.579]	[0.125]	[0.637]	[0.494]	[0.997]
(7) More controls	0.675	-0.048	-1.041	0.487	-0.912
(sample period: 1956-1970)	[0.527]	[0.116]	[0.719]	[0.585]	[1.083]
(8) Prefecture specific	-1.490**	-0.063	-1.832***	-1.279*	-3.028***
linear trends	[0.636]	[0.182]	[0.615]	[0.758]	[0.886]

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

Dependent variable:	Age 0-4	Age 5-9	Age 50-54	Age 55-59	Age 60-64
$(\lambda_{61}-\lambda_{56})-(\lambda_{56}-\lambda_{51})$	1.594	0.510	0.082	-1.655	-2.168
	[1.514]	[0.328]	[0.917]	[1.244]	[2.551]
$(\lambda_{66}-\lambda_{61})-(\lambda_{56}-\lambda_{51})$	0.779	0.051	-1.207	-0.551	-3.010
	[1.054]	[0.309]	[0.830]	[1.449]	[1.829]
Slope prior to 1956	0.067	-0.019	0.071	0.247	0.406
	[0.240]	[0.041]	[0.125]	[0.220]	[0.317]
(Slope prior to 1956) - (Slope in 1956-1961)	0.004	0.037	-0.047	-0.346	-0.444
	[0.310]	[0.055]	[0.159]	[0.283]	[0.426]
(Slope prior to 1961) - (Slope in 1961-1970)	-0.078	-0.035	-0.082	0.168	-0.027
	[0.188]	[0.037]	[0.163]	[0.166]	[0.258]

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)	-0.005	-0.010	0.001	-0.004
	[0.018]	[0.015]	[0.018]	[0.150]
Changes in Self-emp. ratio 1950-1955		0.389***		0.431***
		[0.104]		[0.097]
Observations	46	46	44	44
R2	0.00	0.19	0.00	0.26

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 establishments)	% establishments with 1-4 employees	% establishments with 5-9 employees
λ_{51}	-0.064	0.001	0.069	-0.067	-0.012
	[0.087]	[0.134]	[0.228]	[0.118]	[0.018]
λ_{54}	0.034	0.046	0.029	0.005	-0.001
	[0.043]	[0.046]	[0.036]	[0.015]	[0.006]
λ_{60}	-0.059	-0.135*	-0.051	0.007	-0.006
	[0.047]	[0.069]	[0.046]	[0.015]	[0.005]
λ_{63}	-0.043	-0.115	-0.097*	0.040*	-0.010
	[0.048]	[0.095]	[0.053]	[0.020]	[0.008]
λ_{66}	-0.013	-0.224*	-0.094*	0.064**	-0.020*
	[0.052]	[0.119]	[0.056]	[0.027]	[0.010]
Observations	276	276	276	276	276
R-squared	0.999	0.999	0.997	0.91	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 establishments)	% establishments with 1-4 employees	% establishments with 5-9 employees
λ_{51}	-0.062	0.063	0.129	-0.106	0.000
	[0.094]	[0.135]	[0.247]	[0.124]	[0.018]
λ_{54}	0.011	0.075	0.026	-0.009	0.005
	[0.046]	[0.051]	[0.039]	[0.013]	[0.006]
λ_{60}	-0.017	-0.049	-0.016	0.004	-0.003
	[0.037]	[0.052]	[0.040]	[0.014]	[0.004]
λ_{63}	-0.054	-0.05	-0.074	0.014	-0.001
	[0.058]	[0.101]	[0.063]	[0.013]	[0.007]
λ_{66}	-0.005	-0.081	-0.032	0.022	-0.008
	[0.064]	[0.109]	[0.066]	[0.019]	[0.009]
Observations	264	264	264	264	264
R-squared	0.997	0.998	0.992	0.823	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 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
$Impact_p$ defined by equation (2)	-0.002	-0.003	-0.037	-0.237
	[0.004]	[0.011]	[0.203]	[0.481]
Observations	46	46	46	46