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# THE EFFECT OF PATIENT COST SHARING ON HEALTH CARE UTILIZATION AMONG LOW-INCOME CHILDREN*

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## *Abstract*

This paper examines how health care utilization among low-income children is affected by a reduction of the coinsurance rate, exploiting an institutional change in the Medical Subsidy for Children and Infants (MSCI) system, as a natural experiment. In 2004, the maximum age for MSCI recipients in Hokkaido Prefecture was raised from 3 years to include all children of preschool age. The implied arc price elasticity of outpatient care utilization is −0.23, which is congruent with the commonly cited value (−0.2) presented in the RAND health insurance experiment.

*Keywords*: price elasticity, cost sharing, difference in differences
*JEL Classification Codes*: I10, H75

## I. *Introduction*

The causal effect of insurance cost sharing on health care utilization and finance is not a new issue in health economics. Almost 30 years ago, authoritative evidence from a randomized controlled trial (RAND Health Insurance Experiment, or RAND HIE) was presented (Manning et al, 1987). Since then, numerous studies have examined how people respond to cost sharing, with some replicating and confirming the results of the RAND HIE. Despite the existence of "gold standard" results from the RAND HIE, there is a risk that these results may have little relevance in light of current socioeconomic environments and insurance systems; this indicates a need to produce additional estimates to better reflect current situations. In addition, it would be beneficial for researchers and policymakers to understand the heterogeneity of the real-

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world impact of cost sharing across individual characteristics (e.g., age, sex, income, and education) and a variety of health care services (e.g., outpatient care, drug prescription, and dental care) in order to design effective and appropriate cost sharing systems. In particular, there has been a lot of speculation that the poor have more elastic demand than the rich and the reduction of cost sharing for the poor may lead to large health benefit (Baicker and Goldman, 2011). Therefore, further studies on the health care demand among low-income population are of particular importance. In addition, to the best of my knowledge, there have been no experimental studies which focus on the children from low-income household since the RAND HIE (Valdez et al, 1985).

With the fulfillment of these needs as motivation, this paper shows how health care utilization in children from low-income households (hereafter referred to as low-income children) responds to changes in cost sharing by exploiting the exogenous reduction of coinsurance rates in Japan in 2004 as a natural experiment. Eighty percent of health care costs for preschool children in Japan is financed through public health insurance plans, while the remaining 20% is paid by patients as an out-of-pocket expenditure. However, localgovernments may subsidize this co-payment on a discretionary basis in order to reduce the financial burden on their constituencies. This subsidy program, designated the Medical Subsidy for Children and Infants (MSCI), has been dramatically expanded in the last decade.

To estimate arc elasticities, I exploit an institutional change in MSCI coinsurance rates in Hokkaido Prefecture as a natural experiment. In October 2004, the prefectural governor Harumi Takahashi expanded MSCI eligibility from children under the age of 3 years to include all preschool- age children. Under this revision, the coinsurance rate for children in this age group was reduced from 30% to 0% for low-income children, whereas it was reduced from 30% to 10% in children from higher-income families. As a result, the reduction in co-payment differed by 10 percentage points between low-income children and middle- or higher-income children. As a baseline specification, a standard difference-in-differences (DD) framework is applied with low-income children as a treat- ment group and higher-income children as a control group. Since this paper utilizes the data of a public health insurance plan in a city which covers mainly vulnerable populations such as part-time workers and self-employed in a homogeneous environment, the treatment and control group would be sufficiently comparable in their health care demand.

The remainder of this paper is structured as follows: Section II presents an overview of the existing literature. Section III summarizes the health care reform implemented in October 2004 in Hokkaido Prefecture and explains the research design employed in this study. Section IV describes the data and summary statistics. Section V reports the results. Lastly, Section VI offers a brief discussion and conclusion.

## II. *Prior Literature*

Before introducing the study strategy and results, I present a brief literature review of the impact of cost sharing on health care utilization. Since there is already a substantial volume of studies that address the impact of out-of-pocket cost on utilization, I focus on studies that have analyzed the impact of cost sharing on outpatient care utilization[1] and studies that rely on experimental identification strategy. The first important contribution on this issue is from the

RAND HIE (Newhouse, 1993), which has provided three main findings that are highly relevant to this study: (1) the centralestimate of arc price elasticity of outpatient healthcare demand is −0.2, (2) children are as responsive as adults in outpatient care utilization, and (3) cost sharing has no significant impact on children's health and the physiologic measure of health (Valdez et al, 1985). Regarding the second issue, the similarities in sensitivity between adults and children appear logically sound, as parents—and not children—decide whether or not to visit a doctor. For this reason, as a first approximation, I compare the health care demand of children with that of adults in previous studies without assumptions of any substantial differences between the two.[2]

Although these three findings have generally been considered a gold standard for health eco-nomic studies over the last three decades, several studies that exploit policy changes in a real-world setting have demonstrated price elasticity in various institutional settings and countries such as France (Chiappori et al, 1998), Belgium (Van De Voorde et al, 2001; Cockx and Brasseur, 2003), and Germany(Winkelmann, 2004). Among these studies, Chiappori et al (1998) present results that are markedly different from the results of the RAND HIE. They show that GP office visits are not elastic to small changes in cost sharing in France, and emphasize the importance of non- monetary cost, rather than out-of-pocket expenditures, on health care utilization. Other studies, however, report significant and moderate responses to cost sharing congruent with the results from the RAND HIE. Recently, two important studies from the United States also present results similar to those of the RAND HIE. Chandra et al (2010) report the price elasticity of GP office visits to be −0.1 for public employees in the state of California. Chandra et al (2014) study the impact of greater cost sharing for the low-income enrollees in Massachusetts' Commonwealth Care program. Given that Baicker and Goldman (2011) point out that "the evidence to support the contention that low-income groups are more price sensitive· · · seems less than fully reliable", it is of particular importance that the elasticity (−0.16) of low-income individuals reported in Chandra et al (2014) is very close to the estimates of the RAND HIE and studies that include populations from various income groups; this implies that the elasticity of low-income groups may not be different from that of more affluentgroups.

In comparison with this abundance of studies in various countries, there are, unfortunately, few studies based on quasi-experiments in Japan. Notable exceptions are Kan and Suzuki (2010), who exploit a policy change in the coinsurance rate in 1997 as a natural experiment; and Shigeoka (2014), who employs regression discontinuity design to focus on the discontinuous change in coinsurance rate for patients aged 70 years and above.[3] Among these studies, the results from Kan and Suzuki (2010) are directly comparable with those in this paper because both adopt a similar identification strategy. However, the elasticity (−0.05) reported by Kan and Suzuki (2010) is somewhat small, given that Shigeoka (2014) reports

[1] Many papers that address the impact of cost sharing focus on the impact on prescription drugs rather than on outpatient care. On the former issue, Goldman et al (2007) provides a comprehensive review.

[2] In addition to the RAND HIE, the Oregon Health Insurance Experiments (Finkelstein et al, 2012) also provides evidence in a more recent setting and deals with low-income population as in my study. However, the Oregon HIE generally measures the impact of Medicaid eligibility but not cost sharing.

[3] In Japan, the coinsurance rate in outpatient health care services is 30% for the population under 70 years of age. This is reduced to 10% after the 70th birthday, except for the elderly in high-income households. These institutional settings generate discontinuous changes in health care utilization shortly before and after the 70th birthday.

−0.17 for the price elasticity of outpatient care among an elderly population. With the similar research design with Shigeoka (2014), Fukushima et al (2016) show the price elasticity of around −0.2 among middle-or high-income population.[4]

Among the previous studies that address the impact of MSCI on children's health care utiliza- tion, Bessho (2012) suggests that MSCI does not have any impact on health care utilization in preschool children, basing this conclusion on a cross-sectional framework with nationally represen- tative data from 2008. In addition Takaku (2016) evaluates the impacts of the MSCI expansion from 1995 to 2010 on children's health status but finds no strong improvements. Takaku (2016) also examines the effects on utilization among children with symptoms and reveals that the MSCI increases doctor visits among preschool children whose major symptom is "cough" and "skin prob- lem".

## III. *Research Design*

### 1. Health Care Reform in Hokkaido Prefecture in October 2004

In Japan, the total fertility rate has been in decline over the last three decades, and child poverty has increased since the mid-1990s (OECD, 2012). In 2010, Japan's poverty rate of children under 18 years was similar with those of Canada and Italy but almost double the rates of Germany and Sweden. As the importance to solve these structural problems is widely acknowledged, it has been argued that the cost of child care, especially for low-income households, should be reduced. Follow- ing this argument, many local governments have expanded the policy which reduces out-of-pocket expenditure of child's health care utilization. Although medical costs for preschool children require a 20% co-payment throughout Japan[5], almost all municipalities provide an additional medical sub- sidy through appropriations of local tax revenue under the MSCI program (in Japanese: *Nyu¯yo¯ji iryo¯hi josei*). The maximum age of co this subsidy has dramatically raised in the last decade. The share of municipalities that expanded the age criterion beyond preschool age was only 9.9% in 2000, but this increased to 98% by 2011.[6] In Hokkaido prefecture, as in the other prefectures in Japan, MSCI eligibility has been also expanded during the last decade. In particular, the reform in October 2004 was one of the largest reforms which reduced out-of-pocket expenditure for preschool child'shealth care utilization.

From the viewpoint of an *experimental ideal*, we should exploit pre-post changes in the MSCI in multiple municipalities to explore the impact of MSCI because of the wide range of inter-municipal variations.[7] However, it is difficult to conduct such an analysis due to the low

[4] Since Fukushima et al (2016) use insurance claims from large corporate companies, their study does not include low-income population.

[5] The coinsurance rate for preschool children was reduced from 30% to 20% in 2008 throughout Japan by an initiative of the national government.

[6] Nishikawa (2010) and Nishikawa (2011) provide useful surveys on the expansion of the MSCI.

[7] In general, the system of MSCI differs across municipalities in four aspects. First, municipalities can freely set the eligible age for the MSCI within their jurisdiction. For children older than the upper-limit age, the municipalities offer no benefits. Second, municipalities can restrict eligibility for children from high-income households. In 2012, 25.6% of all municipalities adopted a form of restriction based on household income ceilings (Ministry of Health, Labour and

availability of health insurance claims data in Japan. Instead, I focus on data from a municipality in Hokkaido Prefecture (designated Y City) and exploit an institutional change in Hokkaido Prefecture's MSCI as a natural experiment.[8] In this prefecture, eligibility for the MSCI was expanded from children aged under 3 years to include preschool-age children.[9] For low-income children, the coinsurance rate was reduced from 30% to 0%. For the other children, however, the rate was reduced from 30% to 10%. By exploiting this institutional change, I can estimate the impact of an additional 10 percentage points reduction in the coinsurance rate, as was done in previous studies such as Chiappori et al (1998), Cockx and Brasseur (2003) and Kan and Suzuki (2010).

On the definition of "low-income", Hokkaido prefecture defines low-income households as those in which all household members are exempt from residence-based taxes, and the city implements various support programs for these households based on this definition. The lowest annual taxable income threshold for residence-based tax is 1.29 million JPY for a household comprising a married couple with two children. If the taxable income exceeds this threshold, the parents of the household are required to pay residence-based taxes and theirchildren would then be categorized in the middle- or higher income group. The criteria for defining " low-income " are revised every July.

Table 1 summarizes the changes in coinsurance rates in Y city. The coinsurance rate for children of married couples was 30% before the reform, but it was reduced to 0% for low-income children whose household members were exempt from residence-based taxes. On the other hand, coinsurance rates for middle- and higher-income households decreased to 10%. As for children with lone parents, their coinsurance rate remained unchanged they are already recipients of a more generous welfare program.[10] Also, there is no deductible for the first visit to a doctor in Y city due to the provision of an additional subsidy, which was suitable for my empirical analysis. In other municipalities in Hokkaido prefecture, patients must pay a 580 JPY deductible for their first visit. In addition, MSCI in Y city does not restrict eligibility based on household income. With regard to the administrative system for the subsidy, Y city adopts in-kind transfer for MSCI.

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Welfare, 2013). Third, municipalities can also choose in-kind transfers or repayment for the subsidization. The majority of municipalities adopt in-kind transfers in which the out-of-pocket payment in clinics and hospitals is reduced directly, whereas some municipalities adopt repayment for their MSCI. Under the repayment system, patients (or specifically, their parents) have to pay the co-payment when they obtain health care from pediatricians, but the co-payment is eventually reimbursed in full or in part. Finally, the amount of subsidy varies across municipalities. Some municipalities charge very small out-of-pocket costs for health care utilization to promote the "appropriate" use of pediatric services, whereas the co-payment is rendered completely free in 54% of all municipalities.

[8] Since this study uses data from a city, migration from other municipalities would be a potential threat. How-ever, this is not likely because MSCI eligibility was concurrently expanded in almost all municipalities in Hokkaido prefecture, and the reform that raised the eligibility age of MSCI in Y city was also implemented in its neighboring municipalities.

[9] In Japan, children admit to elementary school on April at the age of 6.

[10] The Medical Subsidy for Children with Single Mothers (MSCSM) provided free health care services for children of single mothers only. Single fathers were not eligible for the MSCSM before October 2004 in Hokkaido. After the reform, however, the MSCSM was renamed "Medical Subsidy for Children with Single Parents" and children with single fathers also became eligible for the public medical subsidy.

TABLE 1. CHANGES IN COINSURANCE RATES IN THE OCTOBER 2004 REFORM

| | Low-Income | | Other | |
|---|---|---|---|---|
| | Before | After | Before | After |
| Outpatient Care | 30% | 0% | 30% | 10% |
| Hospital Care | 0% | 0% | 10% | 10% |

*Note:* Low-income children are defined as those whose parents are exempt from paying residence-based taxes; the remaining children are classified as middle- or higher-income children. The first visit to the doctor is free in Y city, although an initial deductible of 580 JPY is required in almost all other municipalities in Hokkaido Prefecture.

## 2. Difference-in-Differences

The identification strategy used in this study is fairly straightforward. A standard DD technique is exploited to estimate the impact of a quasi-experimental change in cost sharing. The treatment group comprises low-income children whose coinsurance rate was reduced to 0%, while the control group comprises higher-income children whose coinsurance rate was reduced to 10%. My sample consists of monthly data before and after October 2004. In addition, children aged 36 months to 72 monthswhen the reformstarted are includedin the analysis.

I begin by estimating DD models of the form,

$$M_{it}=\alpha_0+\alpha_1 Low_{it}+\alpha_2 Post_{it}+\delta(Low_{it}\times Post_{it})+X_{it}\gamma+Ind_i+Time_t+\epsilon_{it}, \qquad (1)$$

where $M_{it}$ is the medical utilization of individual $i$ in a month $t$. $Low_{it}$ is a dummy variable that is equal to 1 if a child $i$ belongs to a low-income household in a month $t$. $Post_{it}$ takes the value of 1 for the period after October 2004.[11] $\alpha_0$ is a constant term. $\alpha_1$ and $\alpha_2$ are the coefficients for $Low_{it}$ and $Post_{it}$, respectively. $Ind_i$ is an individual fixed effect, and $Time_t$ is a monthly dummy variable. The term $X_{it}$ is a vector of time-varying observables that affect health care utilization in children. Finally, $\epsilon_{it}$ is an error term. Although $\epsilon_{it}$ is serially correlated since medical spending is highly persistent, I address this problem by collapsing monthly data into pre-post periods,as recommended by Bertrand et al (2004).

In this equation, $\delta$ is an adjusted DD estimator of policy change and tracks the behavioral response to a 10% change in cost sharing. In addition, this $\delta$ can be interpreted as sensitivity to cost sharing in low-income children, rather than middle- or higher-income children. Given that child poverty has gathered increasing public attention, the sensitivity of health care demand for underprivileged children may be of importance from a policy perspective.

Following Finkelstein et al (2012), I report the results on the decision to have a positive visit (extensive margin) and the total number of visits. This separation is based on a two-part demand model, which was first incorporated in Duan et al (1983). Since the standard principal-agent theory in health care utilization predicts that a patient determines whether to visit a physician and that the physician determines the entire treatment schedule after the first contact, conventional wisdom leads us to estimate the extensive margin and the total effect separately. If we find no significant effect on the former, it means that the overall effect of co-payment reduction is due to behavioral changes in physicians. In contrast, if the extensive margin is

[11] In the empirical analysis, this variable is absorbed in monthly dummies.

highly responsive to co-payment reduction compared to the changes in the total number of visits, we can conclude that behavioral changes in patients, not physicians, account for the overall effect of the reform. In addition to the analysis on the number of visits, the results on spending per visit are presented, which is observed only for children who visit pediatricians more than once in each unit of time. This variable appears to represent the intensity of care. As in Kan and Suzuki (2010), the natural log of spending per visit is calculated to address the skewed distribution. Finally, the overall effect of the October 2004 reform is considered as the sum of the effect on the total number of visits and spending per visit.

Equation (1) is estimated using a fixed effects model to eliminate time-invariant unobservables that affect children's health care utilization. In particular, it can be reasonably assumed that the characteristics and preferences of parents and children did not undergo any substantial changes during the short periods before and after the reform. Then, the results without $X_{it}$ are presented as my central estimates because there are no plausible variables for $X_{it}$ in my data after controlling for individual fixed effects and time effects. Instead, the whole sample is divided into several subgroups based on the characteristics of children and estimate the heterogeneous impact of coinsurance rate reduction across subgroups.

Nevertheless, there are potentially serious threats to the accuracy of my identification strategy; First, the underlying trend between the treatment and control groups might not be parallel in the absence of the October 2004 reform. If this is the case, the naïve DD estimator necessarily fail to capture the true impact of the reform. With regard to this point, it should be noted that income is a potentially strong predictor of health care demand. Since the seminal work of Case et al (2002), who investigated whether the association between socioeconomic status (SES) and health could be found among children, numerous papers have confirmed that household income plays a crucial role in children's health and health care demand. Therefore, it is questionable that the parallel trend assumption holds true. Second threat is that the sensitivity for the price changes may differ across income status. Since the treatment and control groups were both affected by the reform, differential responses to the coinsurance rate reduction would potentially result in the biased estimate to the price elasticity. On these two threats, however, it should be noted that this study uses the data of enrollees from CHI which generally covers vulnerable populations such as self-employed and part-time employees. Hence, even if the definition of the treatment (low-incomes) and control (middle- and higher- incomes) are based on the household income, we can assure these groups would be sufficiently comparable with each other because they share many socio-economic backgrounds. In addition, I can also exclude high-income children from my control group. This subsample analysis provides plausible robustness checks for my main analysis.

## IV. *Data and Descriptive Statistics*

### 1. Data

This paper uses insurance claims data of CHI enrollees in Y city, located in Hokkaido Prefecture. In general, characteristics of CHI enrollees is those of low-incomes since CHI covers several vulnerable population. In Japan, children are covered under the same health insurance plan as their designated household head. Broadly, there are three types of health insurance plans for working-age adults in Japan: society-managed insurance; a health insurance plan managed by the Japan Health Insur- ance Association (JHIA); and Citizens' Health Insurance (CHI), which is a residence-based health insurance plan. These three plans account for almost 90%[12] of health insurance for those under 75 years of age. Adults who work for large firms participate in society-managed insurance, whereas those who work for small and medium enterprises are included in health insurance programs man- aged by the JHIA. Other adults must obtain coverage through the CHI in their residential area.[13] Hence, children covered under CHI are the children of employees of small firms (with fewer than five employees), self-employed workers in the agricultural and retail/service sectors, or the unemployed. In general, children covered under CHI are from families with lower household incomes than those of children whoseparents are coveredunder the other types of insurance. In addition, CHI enrolls those who are unemployed and are therefore no longer covered under employment-based plans. Ac- cordingly, their children may also be shifted from employment-based plans to CHI coverage due to loss of employment of the household head. Although we do not know the exact volume of changes in health insurance plans due to employment transitions, this may be a reason why the financial situation of persons covered under CHI plans can be considered more fragile than those covered under employment-based plans. In addition, income status of CHI enrollees in Y city is generally lower than the Japanese average of CHI enrollee since the characteristics of this city are consistent with those of a small city. Although I am unable to disclose the geographic location of Y city, The population is approximately 40, 000and the major industries are fishing and tourism.

For the construction of the data set, insurance claims data from Y city from April 2000 to March 2011 are utilized. These claims are monthly bills, which include health care costs, number of visits, clinical departments of the clinic or hospital where care was provided, a code denoting an impatient or outpatient episode, and age and sex of the patient. In addition to these bills, I use a list of CHI enrollees in Y city that includes the years and months when a person was enrolled in and withdrawn from the CHI. This CHI enrollment list is matched to the insurance claims data set by using the household ID, patient age and sex.

Among the complete data set, I focus on the period from April 2003 to March 2006, spanning the 18-month duration before and after October 2004.[14] Subsequently, preschool children with married couple aged 36 months and over when the reform started are included in the analysis.[15] When a child was over preschool age or below 36 months, the observations are excluded. Next, two children whose outpatient health care costs were extremely high are also

[12] The remaining 10% is included in Mutual Aid Associations that cover those employed in the public sector.

[13] A comprehensive and historical review of the Japanese health care system is provided in Ikegami et al (2011) and other articles published in *The Lancet*, August 30, 2011.

[14] In this paper, a low-income child is defined as one whose household members are exempt from residence-based tax. Hence, any tax reform may change the definition of low-income households. With regard to this point, it is impossible to use data from before April 2002 due to a raise in the lower threshold of taxable income for residence-based tax. In addition, residence-based tax was drastically reformed in 2006 through comprehensive revisions of local taxes and intergovernmental transfers implemented by then-Prime Minister Junichiro Koizumi. In order to avoid the influence of these institutional changes, my analysis focuses on the period from April 2003 to March 2006.

[15] This eliminates potential bias which accrues from the immigration of household with children (e.g. some low-income household with sick children may move to Y city after the reform.).

excluded since their out-of-pocket expenditures reaches stop-loss amounts.[16] Finally, I create longitudinal data of 193 children with married couples during 18 months before and after the October 2004 reform.

The details of the variables are summarized as follows:

**Health Care Utilization**

On the health care utilization, a dummy variable is created that takes the value of 1 if a child utilizes outpatient care more than once in a month and a value of 0 otherwise. If a child is enrolled in CHI in a given month but their bill is not found in insurance claims, I can reasonably confirm that they did not use health care services in that month. To calculate spending per visit, total health care costs are divided by the number of visits. This variable is not observed if a child did not utilize any health care services in that month.

**Income Status**

To identify the household income level, I use a code in the insurance claims that categorize house- holds into 3 groups according to income. In this code, a child is categorized as being from a low-income household if none of his/her family members pay residential tax (in Japanese: *Jyu- minzei Hikazei Setai*).According to the estimates by Tanaka (2013), the share of these non-taxable households is only less than 10 percent in the households with working-age heads. In addition, a child is categorized as being from a high-income household if the amount of taxable income of his/her household exceeds 6 million JPY (in Japanese: *Jyoui Syotoku Sya*). Other children are cat- egorized as being from a middle-income household. Since this code is included in insurance claims, and not the enrollee list, it is not possible to confirm the household income level of all children at a given month. Therefore, I identify low income children if they are categorized as being from a low-income household during last 12 months before October 2004.[17] In the same manner, children from high-income household are identified. Finally, number of low-income children is 39 and that of middle- or higher-income children is 151. Among the latter, I additionally identify 60 children[18] from high-income household.

Finally, two limitations related to using the insurance claims data of Y city should be noted. First, the sample does not represent the entire Japanese population. As mentioned previously, Y city is small and it is plausible that children and their parents who live in urban areas have differ- ent preferences regarding health care services. Second, the insurance claims data do not contain information on important personal characteristics such as educational attainment and employment status, although the longitudinal nature of the data may alleviate some of these problems, as men- tioned in Kan and Suzuki (2010). Despite of these limitations, the data of Y city and October 2004 reform provide a good opportunity to investigate the effect of cost sharing among low-income children, who have been a main target of recent family policies.

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[16] In Y city, out-of-pocket expenditure for outpatient care never exceeded 12,000 JPY due to stop-loss.

[17] Although it is possible that the income status changes over time, this may not be severe threat for my analysis. For example, I find only 3 low-income children who moved to middle-income class in the next year of the October 2004 reform.

[18] Since households that do not report their income are also categorized as being a "high-income household", my estimate here is probably higher than the actual number of household with taxable income of 6 million JPY and over.

TABLE 2. DESCRIPTIVE STATISTICS

| | Treatment | | Control | |
|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. |
| **Prob. of Visits** | | | | |
| Total Outpatient Care | 0.45 | 0.50 | 0.50 | 0.50 |
| Pediatrics | 0.26 | 0.44 | 0.32 | 0.47 |
| Internal Medicine | 0.14 | 0.35 | 0.10 | 0.30 |
| Dermatology | 0.03 | 0.18 | 0.08 | 0.27 |
| Other | 0.11 | 0.32 | 0.09 | 0.29 |
| Dental Care | 0.09 | 0.29 | 0.15 | 0.35 |
| Drug Prescription | 0.10 | 0.30 | 0.17 | 0.37 |
| **N. of Visits** | | | | |
| Total Outpatient Care | 1.08 | 1.66 | 1.13 | 1.63 |
| Pediatrics | 0.53 | 1.22 | 0.70 | 1.37 |
| Internal Medicine | 0.27 | 0.86 | 0.15 | 0.51 |
| Dermatology | 0.05 | 0.30 | 0.12 | 0.48 |
| Other | 0.23 | 0.76 | 0.16 | 0.62 |
| Dental Care | 0.20 | 0.78 | 0.35 | 1.10 |
| Drug Prescription | 0.21 | 0.76 | 0.36 | 1.06 |
| **Ln (Costs / visits)** | | | | |
| Total Outpatient Care | 6.18 | 0.44 | 6.13 | 0.47 |
| Pediatrics | 6.15 | 0.54 | 6.14 | 0.50 |
| Internal Medicine | 6.23 | 0.29 | 6.22 | 0.35 |
| Dermatology | 5.82 | 0.49 | 5.94 | 0.41 |
| Other | 6.22 | 0.61 | 6.03 | 0.75 |
| Dental Care | 6.00 | 0.62 | 6.14 | 0.65 |
| Drug Prescription | 5.47 | 0.48 | 5.67 | 0.48 |
| N. of Children | 39 | | 154 | |
| Mean Follow-up Months | 22.05 | | 28.18 | |
| Obs. | 860 | | 4,340 | |

*Note:* This table summarizes outpatient medical utilization and the characteristics of the sample. The data cover 36 months from April 2003 to March 2006. Low-income children are defined as those whose parents are exempt from paying residence-based taxes; the remaining children are classified as middle- or higher-income children. "Other" denotes the medical utilization of outpatient care excluding internal medicine, pediatrics, and dermatology.

## 2. Descriptive Statistics

Table 2 presents the summary of my data according to children's household income status. The mean follow-up period is approximately 2 years for both groups. The proportion of children who visit doctors more than once a month is 45% in low-income households (Treatment group), while it is 50% in middle- or higher-income households (Control group). The number of visits per month is 1.08 in low-income households and 1.13 in higher-income households. Subsequently, health care spending per visit is calculated as a proxy for treatment intensity. The natural log of spending per visit is 6.18 for low-income children, which is slightly higher than that of their higher-income counterparts. This suggests that children receive identical treatment once they visit the doctor, regardless of their household income status. However, there are no differences in treatment intensity of pediatric services by income status. Finally, it should be noted that mean follow-up months in the treatment group (22 months) is shorter than in that in control group (28 months). This probably reflects high attrition rate among low-income children because some low-income children move to public welfare system.[19]

## V. *Results*

### 1. Graphical Representation

Turning to the empirical results, I present the unadjusted sample means of the outcome variable by the treatment and control groups to check the key assumptions required for DD equation. Panel A in Figure 1 presents the average number of outpatient visits during April 2004 to March 2006, with the monthly raw data grouped into half-year average values. First, the number of visits among preschool children from low-income households, denoted using diamond-shaped markers with blue solid lines, was almost stable at approximately 1 to 1.25 days per month before the October 2004 reform was implemented; the number among preschool children from higher-income households, denoted using circle markers with red solid lines, decreased slightly during the same period. In the standard DD framework presented in Equation (1), the former is used as the treatment group and the latter as the control. The DD estimation appears to have surface validity as the trends were sufficiently similar during the pre-reform period. However, it is not the case for the outpatient care costs per visit in Panel B. In Panel B in Figure 1, trends during the pre-reform period seems to be different because of the irregular increases of outpatient care cost per visit in the low-incomes during October 2003 to March 2004. Therefore, my DD specification may be inappropriate for this variable.

### 2. Main Results

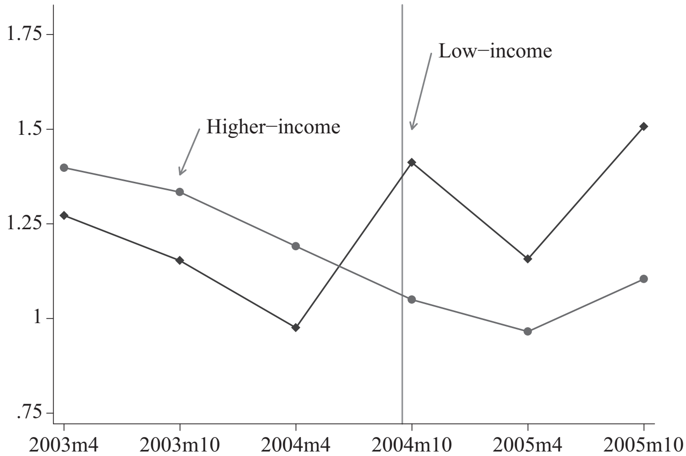
The estimation results based on Equations (1) are reported in Table 3. Columns (1) and (2) both present the DD estimates of the probability of doctor visits. Column (1) uses the raw monthly data in the estimation while Column (2) groups the data into pre-post terms to address the underestima- tion of standard errors in the DD estimator with long time series Bertrand et al (2004). In Column (1), the DD estimate of the probability is 0.1138 and significant, suggesting that the probability to use outpatient health care services more than once a month would increase by approximately 11% after the reform. Although the DD estimate is not significant in Column (2), this is largely due to a differencein the measurement of the "probability"; the dependent variablein Column (2) is a dummy variable that takes the value of 1 if a child saw a physician or pediatrician more than once in the pre-post reform period spanning 18 months. Furthermore, the reform shows a significant impact on the total number of visits in Columns (3) and (4). The DD estimate based on monthly data indicates that a 10 percentage point reduction in cost sharing increases the total number of visits by 0.49 days per month. This result still demonstrates robustness even if the data are collapsed into the pre-postperiod (Column [4]).

In addition, there seems to be no significant reduction in treatment intensity as a result of

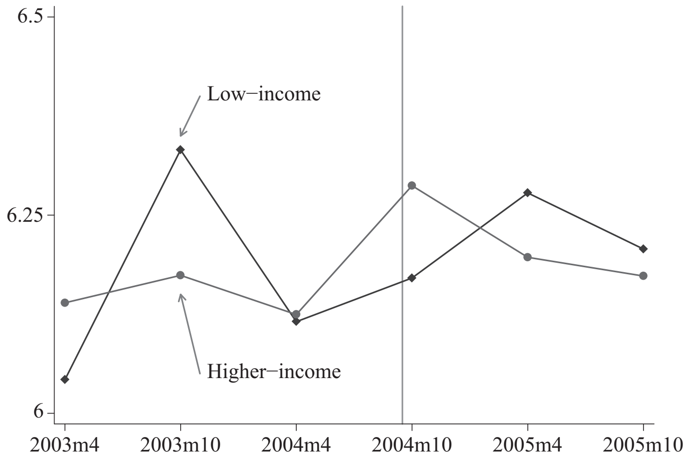
[19] Note that this study does not include children who joined the CHI after the policy change, since my sample consists of children who were enrolled in the CHI in October 2004.

FIGURE 1. DIFFERENCE-IN-DIFFERENCES ANALYSIS

PANEL A. AVERAGE NUMBER OF OUTPATIENT VISITS




PANEL B. LOG OUTPATIENT CARE COSTS PER VISIT




*Note:* These figures plot the 6-month averages of the numbers of outpatient visits (Panel A) and log spendings per visit (Panel B) by subgroups. The values for October 2004 are the mean values from October 2004 until March 2005. Diamond-shaped markers represent the averages of low-income children, while circle-shaped markers represent those of higher-income children. The vertical line denotes October 2004, in which the reform was implemented.

the reform. The coefficient of outpatient care costs per visit in Column (5) is negative and significant, but the DD estimate in Column (6) dose not present a significant result. Significant estimate in Column (5) may be because the underling trends would not be similar on this outcome. For instance, Panel B in Figure 1 shows that spendings per visit among low-incomes irregularly increased during October 2003 to March 2004. This may lead to the severe exaggeration of the negative impact on costs per visit. Without such a irregular increase, there would be no systematic changes in the costs per visit. Consistent with the RAND HIE

Table 3. Main Results on Outpatient Health Care Utilization

| | Prob. of Visits | | N. of Visits | | Ln(Costs/Visits) | |
|---|---|---|---|---|---|---|
| | Monthly (1) | Pre/Post (2) | Monthly (3) | Pre/Post (4) | Monthly (5) | Pre/Post (6) |
| Low* Post | 0.1138** | 0.107 | 0.4959** | 0.4745* | -0.1417** | -0.1386 |
| | [0.049] | [0.077] | [0.193] | [0.248] | [0.062] | [0.117] |
| N. of children | 193 | 193 | 193 | 193 | 191 | 191 |
| Obs. | 5,200 | 371 | 5,200 | 371 | 2,542 | 351 |
| R Squared | 0.037 | 0.786 | 0.034 | 0.802 | 0.044 | 0.746 |

*Note:* This table presents the estimated impact of the expansion of the MSCI according to the characteristics of children by employing DD technique. The sample includes the children of married couples and covers the period spanning 18 months before and after October 2004. Columns (1) and (2) present the results of the probability of visits. Columns (3) and (4), and (5) and (6) present the results of the number of visits and the natural log of health care spending per visit, respectively. Columns (1), (3) and (5) use the monthly raw data; the other columns use the data collapsed into pre- and post-reform periods. All equations are estimated by OLS regression with individual fixed effects. Time effects are controlled by monthly dummies in Columns (1), (3) and (5), and post-reform dummy variables in Columns (2), (4) and (6). Standard errors are clustered by household. ***, $p < 0.01$. **, $p < 0.05$. *, $p < 0.1$.

(Leibowitz et al, 1985), which reveals that the average medical bill per episode did not differ among cost sharing and free plans, this paper may suggest that cost sharing does not affect the amount of services provided once parents take their children to the doctor and medical treatment is initiated, while the more accurate examination would be neededfor this issue.

Using the estimated parameters, I calculate arc elasticity—which uses the midpoint rather than the initial point to measure the magnitude of changes—of outpatient health care demand ($\epsilon$), applying the DD estimate from Table 3 to the following formula and taking into account the fact that the average numberof visits in low-income childrenis 1.08, as shown in Table 2:

$$\epsilon = \frac{\dfrac{q_a - q_b}{(q_a + q_b)/2}}{\dfrac{p_a - p_b}{(p_a + p_b)/2}} = \frac{\dfrac{0.4959}{1.08}}{\dfrac{0 - 10}{(0 + 10)/2}} = -0.229, \tag{2}$$

where $q$ represents the outcomes, $p$ is the coinsurance rate, and $a$ and $b$ indicate the “after” and “before” periods, respectively. Given that the coinsurance rate in my control group decreased from 30% to 10%, I can assume the treatment group was affected by the *additional* reduction in the coinsurance rate from 10% to 0%. This assumption postulates that health care utilization in the treatment group in a counterfactual case (where their coinsurance rate in the post-reform period would decrease from 30% to 10% instead of the actual 0%) can be extrapolated using the actual trend of the control group. This is equivalent to assuming that price elasticity of the treatment group (i.e., low-income children) would be the same as the control group (middle- and high- income children). Given the contention that the former would be more sensitive to changes than the latter, this assumption would seem to be demanding. It is, however, a reasonable assumption since a recent review paper summarizes that there is no reliableevidence to supportthis contention (Baicker and Goldman, 2011). Furthermore, Chandra et al (2014) find price elasticity of low-income patients to be similar to those calculated for higher-income patients. Taken together, I conclude that the arc elasticity of health care demand among low-income children is −0.23, which is essentially the same as the commonly cited value of RAND HIE, i.e., −0.2. Of course, it is possible that the sensitivities to the price changes are not actually the same between the treatment and control groups. But even if that were the case, my results suggest that the low-income patients investigated here are no more responsive than the patients in the RAND HIE because the DD analysis used in this study overestimates price elasticity if patients in the treatment group are more sensitive than those in the control group.

In addition, it is useful to decompose the total elasticity into extensive and intensive margins. Since the effects on the extensive margin is 0.1138 in Table 3 and mean probability of visit among low-income children is 0.45 in Table 2, the elasticity on extensive margin is −0.13 (−(0.1138/0.45)/2). Compared with the total elasticity (−0.23), the extensive margin seems to be important.

When comparing my results with those of a previous quasi-experimental study of Japanese adults (Kan and Suzuki, 2010), the arc elasticities in this paper are two or three times higher. In addition, I find significant effects on doctor visits in both the extensive margin and total visits, while Kan and Suzuki (2010) do not find any effect on the number of visits. Given that Kan and Suzuki (2010) attribute their low estimates partly to the presence of patients with inelastic demand, such as patients with chronic illnesses, the reason why my estimate among children is higher than that of Kan and Suzuki (2010) may be that chronic illness such as diabetes and hypertension are uncommon among children.

In addition, it is also of particular importance that this paper presents the elasticity among low-income children. Although conventional wisdom suggests that the poor may be more sensitive to cost sharingthan more affluentindividuals, this paperdoes not supportthis conclusion. Instead, the estimated elasticity is very close to those calculated for middle- or higher-income population (Fukushima et al, 2016). Although it is possible that my results overestimate price elasticity, these findings still indicate that low-income patients are no more responsive to price changes than their higher-income counterparts (Fukushima et al, 2016), even when using the conservative criteria for comparison.

Lastly, my results are markedly different from Bessho (2012), who finds no impact of MSCI on health care utilization in preschool children using nationally representative data. It is possible that this difference is due to the differences in research design: a major difference is that Bessho (2012) is based on a cross sectional framework, while this study employs a natural experiment.

## 3. Supplemental Analysis

### 1) Results by Clinical Department

Next, the results on the overall health care utilization are presented, which is the sum of outpatient care, inpatient care, dental care and drug prescriptions. Given that cost sharing for outpatient services could reduce utilization of complementary services such as hospitalization[20]

[20] Chandra et al (2010) and Karaca-Mandic et al (2012) show significant offsets in the elderly population and in children with asthma in the United States. In particular, Karaca-Mandic et al (2012) investigate the relationship between out-of-pocket medication costs and asthma-related hospitalization, using insurance claims for children with asthma who

TABLE 4. RESULTS BY CLINICAL DEPARTMENT

| | | Outpatient Care | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | Pediatrics | Internal Medicine | Dermatology | Other | Dental Care | Drug Prescription |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| **Prob. of Visits** | | | | | | | |
| Low* Post | 0.0923** | 0.0457 | 0.0609 | 0.0485** | 0.0178 | 0.0282 | 0.0859** |
| | [0.046] | [0.058] | [0.052] | [0.022] | [0.041] | [0.031] | [0.040] |
| Obs. | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 |
| **N. of Visits** | | | | | | | |
| Low* Post | 0.7851*** | 0.0326 | 0.1921 | 0.0948** | 0.1763 | 0.0786 | 0.2202*** |
| | [0.297] | [0.209] | [0.134] | [0.038] | [0.131] | [0.079] | [0.081] |
| Obs. | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 |
| **Ln(Costs/Visits)** | | | | | | | |
| Low* Post | -0.0558 | -0.3206*** | -0.102 | 0.396 | 0.2592* | -0.1055 | 0.2085 |
| | [0.061] | [0.094] | [0.120] | [0.385] | [0.137] | [0.183] | [0.228] |
| Obs. | 2,917 | 1,614 | 551 | 385 | 295 | 504 | 711 |

*Note:* This table presents the estimated impact of the expansion of the MSCI according to clinical department by employing DD technique. The sample includes all the children of married couples, and covers the period spanning 18 months before and after October 2004. "Other" denotes the medical utilization of outpatient care excluding internal medicine, pediatrics and dermatology. All equations are estimated by OLS regression with individual fixed effects and monthly dummies. Standard errors are clustered by household. ***, $p < 0.01$. **, $p < 0.05$. *, $p < 0.1$.

and emergency room (ER) visits[21], it is meaningful to examine its impact on overall health care costs.

In this supplemental analysis, I can also determine the types of outpatient clinics that a child visits, as insurance claims data contain information regarding the specialty of clinics such as pedi- atric care and dermatology. Although parents generally take their children to clinics that provide pediatric services, they are free to choose clinics offering specialized care (such as dermatology and orthopedics) when the symptoms of their children appear to require such care.[22] Regardless of whether care is sought at pediatric clinics or clinics for other specialties, out-of-pocket expendi- ture of parents remains the same. In this subsection, outpatient care is divided into four clinical specialties: pediatric care, internal medicine which specializes in primary care mainly for adults, dermatology, and otherservices.

Table 4 summarizes the results from OLS regressions. Column (1) presents the results of total health care services, which consists of hospitalization, outpatient care, dental care and drug prescription.[23] DD estimates suggest that cost sharing in outpatient care increases the total

had commenced asthma control therapy between 1997 and 2007 in the United States.

[21] Miller (2012a) argues that non-urgent ER visits would decrease if patients can afford to receive adequate out-patient treatments before the sudden deterioration of health, as seen in reduced ER usage after the Massachusetts Health Care Reform. Kolstad and Kowalski (2012) also find significant reduction in ER utilization and length of hospital stay in an examination of the same reform as Miller (2012a). In addition, Miller (2012b) obtains similar results using a sample of children under 18 years of age.

[22] In Japanese clinical settings, pediatric clinics provide primary care treatment for a variety of children's conditions such as the common cold, sore throat, diarrhea, asthma, vomiting, dry skin, and influenza. On the otherhand, other clinical departments deal mainly with adults, but also treat children.

[23] Insurance claims data do not contain information on the use or non-use of emergency room services.

number of days that a patient utilizes health care services by 0.78 days per month. This implies that a subsidy for the utilization of outpatient care increases the total health care cost even if it might reduce the hospitalization and other health care services that complement outpatient care; however, I am unable to definitively show the results of hospitalization due to the small sample size.[24]

Column (2) reports the results of pediatric care. All equations produced non-significant esti-mations, indicating that pediatric care for children is not responsive to cost sharing. The results are similar in Column (3). Dermatological care and drug prescription, however, are utilized with relatively high elasticity. DD estimates in Column (4) show that the number of visits increased by 0.09 days per month. Moreover, DD estimates in Columns (6) and (7) show that the number of visits increases by 0.22 days for drug prescription. These results indicate that the utilization of health care services other than pediatrics and dental care services is elastic to cost sharing. Specif- ically, these impacts suggest that price elasticities for dermatological care and drug prescription are 0.95[25] and 0.52[26], respectively. With regard to the result on dermatological care, it is likely that treatments for allergic diseases such as allergic dermatitis are quite elastic to out-of-pocket expenditures. Furthermore, the expansion of the MSCI had a positive impact on drug prescription. Given that the common cold and fever are the major reasons for pediatrician visits, my results can be interpreted to show that children's health care demand is inelastic if they present with clear symptoms of illness. Nevertheless, the clinical symptoms of some chronic diseases such as allergic dermatitis and nasal inflammation are sometimes unclear and the decision on whether to see a doctor tends to rely on the parents' subjective assessment of their child's health conditions. Partly because of this reason, the co-payment policy can be an important factor in influencing health care utilization. In a previous study, Takaku (2016) also shows the MSCI expansion is related to the increasing visits among preschool children with "cough" and "skin problem". Consistent with these results from other data, this paper suggests that health care utilization among preschool children with skin problems, who may visit dermatologist, is quite responsive to cost-sharing.

2) Robustness Checks

One of the potential threats for this study is that my DD analysis is based on the comparison between low-income children and middle- or higher-income children. Although I have already confirmed that pre-treatment trends in number of visits are quite similar in both groups, this does not rule out the possibility that responses to co-payment is completely different between the treatment and control groups. In order to address this point, though far from completely plausible, it is useful to exclude high-income children from DD analysis and focus on children of similar income status. Since my data categorize a child as being from a high-income household if the amount of taxable income of his/her household exceeds 6 million JPY, I can exclude them and compare low-income children and middle-income children.[27]

The results from this subsample analysis are summarized in Table 5. In this Table, I find

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[24] The data in this paper include 53 hospital episodes, which is too small a number to examine the determinants of spending per hospitalization. With regard to the probability for hospital admission, my findings do not show any significant impact of the October 2004 reform.

[25] $-(0.0948/0.05)/2=-0.948$

[26] $-(0.2202/0.21)/2=-0.524$

[27] Out of 151 children in a baseline control group, 60 high-income children are excluded.

Table 5. Robustness Checks

| | | Outpatient Care | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Total | Pediatrics | Internal Medicine | Dermatology | Other | Dental Care | Drug Prescription |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Prob. of Visits** | | | | | | | | |
| Low* Post | 0.0608 | 0.0726 | 0.0272 | 0.0547 | 0.0282 | 0.0139 | 0.0307 | 0.0494 |
| | [0.049] | [0.051] | [0.061] | [0.053] | [0.020] | [0.044] | [0.033] | [0.041] |
| Obs. | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 |
| **N. of Visits** | | | | | | | | |
| Low* Post | 0.6300** | 0.3724* | -0.0266 | 0.1758 | 0.0545* | 0.1687 | 0.0861 | 0.1560* |
| | [0.314] | [0.200] | [0.217] | [0.137] | [0.029] | [0.135] | [0.092] | [0.087] |
| Obs. | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 | 3,372 |
| **Ln(Costs/Visits)** | | | | | | | | |
| Low* Post | -0.0214 | -.12845* | -0.3142*** | -0.1339 | 0.3946 | -0.0471 | 0.1209 | 0.2231 |
| | [0.067] | [.0685] | [0.103] | [0.128] | [0.446] | [0.207] | [0.229] | [0.166] |
| Obs. | 1,824 | 1,613 | 1,030 | 355 | 184 | 375 | 399 | 466 |

*Note:* In these DD analysis, children from high income household are excluded. "Other" denotes the med- ical utilization of outpatient care excluding internal medicine, pediatrics and dermatology. All equations are estimated by OLS regression with individual fixed effects and monthly dummies. Standard errors are clustered by household. ***, $p < 0.01$. **, $p < 0.05$. *, $p < 0.1$.

the reduced cost sharing increase number of total visits in Column (1). In addition, I find significant increases in the number of visits in total outpatient care (Column 2), dermatological care (Column 5) and drug prescription (Column 8). Although the precision of the estimates generally becomes lower because of the reduction of sample size than main results, subsample analysis here also suggests that main findings in this paper remain unchanged even if I focus on the children of similar incomestatus.

## VI. *Discussion*

In the face of an increasing child poverty rate and a declining birth rate, Japan has reduced patient cost sharing in the last two decades to support households with children and improve access to public health care services especially for underprivileged children, led by the initiative of local governments. In addition to the standard coinsurance rate set by the national government, many municipalities subsidize the co-payment of children's health care utilization on a discretionary basis. This paper examines the consequences of this subsidy program, named the Medical Subsidy for Children and Infants.

By exploiting a recent institutional change in MSCI in Hokkaido Prefecture, the impact of cost sharing on health care utilization in low-income children is identified by comparing pre-post changes of health care utilization between low-income children (treatment group) and middle- or higher- income children (control group).The implied arc price elasticity of outpatient health care demand is −0.23, which is almost the same as the value presented in the RAND HIE. Furthermore, it is particularly noteworthy that the estimated elasticity of low-income children in this paper (−0.23) is similar to those estimated in higher-income populations in other settings. This finding contradicts the well-known hypothesis that low-income individuals are more affected by changes in co-payment than higher-income individuals. Instead, my paper is consistent with the findings of Chandra et al (2014), in that low-income patients are very similar with their higher-income counterparts with regard to sensitivity to cost sharing.

As a policy implication, we should note that there has been a lot of speculation that the poor have more-elastic demand and their health conditions are more likely to be affected by cost sharing (Baicker and Goldman, 2011). However, the estimated price elasticity observedin this paper is also around −0.2, which is close to the results from middle- or high-income elderly population in Japan presented by Fukushima et al (2016). Given that the share of low-income households defined in this paper (we call them "non-taxable household") is only less than 10 percent in the all household with working-age heads in Japan (Tanaka, 2013), it is quite suggestive that they show fairly similar responses to cost sharing with the enrollee of health insurance plans in large corporations, which is observed in Fukushima et al (2016). In addition, this suggestion appears to remain valid even if my DD analysis had led to the overestimation of price elasticities because of the higher responsiveness of the treatmentgroup patients (i.e. low-income households) to price changes.

Taken together, this paper suggests that the price elasticity of health care demand does not change by income level, at least to a large extent. In addition, since health consequences of reduced cost sharing hinge on how patients seek physician consultations additionally, my study also suggests that the impact of the MSCI expansion on health among low-income children is quite limited, as observed in the general child population (Takaku, 2016). However, it is possible that greater use of dermatological services observed in this paper is associated with the alleviation of the skin diseases among preschool children. Further studies on this issue would provide more fruitful insights on the consequence of the recent MSCI expansion.

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