Tohoku University Research Center for Policy Design Discussion Paper

TUPD-2024-013

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December 2024

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Beyond the public universal health insurance system: The effect of population aging on insurer's responses[†]

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ABSTRACT

The establishment of a universal health insurance system has contributed significantly to improving national health standards and increasing life expectancy. In Japan, where a public system was introduced in 1961, many health indicators have improved substantially; however, population aging threatens the financial sustainability of the current system. This study aims to examine how the fiscal burden of population aging affects health insurance finances established by individual companies or corporate groups and induces changes in the insurer's responses. Using a panel data set of insurers operated by large companies from 2003 to 2018, we find that contributions to healthcare systems for the elderly have a significant negative impact on insurance finances that is almost as large as rising healthcare costs for young members. In addition, the insurers facing financial distress tend to use their own reserve fund without compromising benefits to enrollees. However, they are more likely to dissolve their own health insurance and switch to the other public health insurance plan for small and medium-sized firms when their sustainability deteriorates further. We also find that a large economic shock that severely affects corporate profits has a negative effect on insurance finances. These findings suggest that the design of health insurance policies needs to consider long-term demographic changes after the introduction of universal coverage.

JEL Classifications: I13 · I18

Keywords: Public universal health insurance · Population aging · Budget transfer · Public finance · Fixed effects model · Japan

[†] We appreciate Rinya Suzuki for his excellent research assistant. This study is supported by the research grants from the Japan Society for Promotion of Science (No. 22K01532 and No. 24K04868). The authors assume responsibility for any errors.

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1. Introduction

The development of a health insurance system has contributed greatly to improving national health standards and increasing life expectancy. In 1961, the Japanese government launched a universal public health insurance system, which has provided the Japanese people with better access to high-quality medical care at a low financial cost. As a result, although Japan's health spending as a percentage of the gross domestic product (GDP) is low among Organisation for Economic Co-operation and Development (OECD) countries, the mortality rate and life expectancy in Japan are among the highest in the world (Ikeda et al., 2011). However, the sustainability of the Japanese universal health insurance system is currently threatened by the world's most rapid aging population rate, fiscal rigidity caused by the worst fiscal situation among developed countries, and a declining labor force caused by a falling birth rate (Shibuya et al., 2011). For example, the national medical expenditure for 2022 was 46.7 trillion JPY, about 60 percent of which is used by the elderly aged 65 years and over, who account for 29 percent of the population (Ministry of Health, Labour and Welfare [MHLW], 2024). Patients' charge accounts for only about 12 percent of the total, and the remainder is covered by social insurance premiums (50 percent) and public funds (38 percent), which are mainly paid by the younger population. Although this ratio has not changed much since the 1970s, the total amount of medical expenses has increased 1.6 times since 2000, when the public long-term care insurance system launched, and the burden borne by the younger generation has been growing.

The present study aims to examine how expenditure pressures on the health insurance system affect health insurance financing and insurer behavior in the universal health insurance system. As detailed in the next section, Japan's universal health insurance system consists of several insurance groups that differ in terms of age and occupation. Here, we focus on the Health Insurance Societies (HIS), which are health insurance plans operated by large companies, either individually or in groups. HIS are established under the Health Insurance Law with the approval of the MHLW, but do not receive financial support from the government and are therefore able to conduct flexible and efficient insurance operations. While the main reason for firms to have health insurance is to hedge the risk of paying medical expenses for their employees (Froot et al., 1993; Dalton & Holland, 2017), economic studies have also argued that it provides an opportunity for tax avoidance for employees. That is, health insurance benefits are recognized as tax-exempt wages or fringe benefits for employees, which employees prefer to receive (Feldstein and Friedman, 1977) and which have been shown to reduce turnover (Dale-Olsen, 2006). HIS is differentiated from other public health insurance plans in Japan as part of its employee benefits by setting a lower premium rate than other public health insurance plans and implementing its own fringe benefits.

In recent years, the increase in healthcare costs associated with population aging has forced HIS

insurers to rethink their insurance operations. As the income of retired elderly is generally low, their insurance premium revenue alone cannot cover their substantial medical expenses. Therefore, in Japan's universal health insurance system, health insurance for the elderly receives a huge amount of financial contributions from the younger generation (see Section 2.1). This can be interpreted as a social risk diversification mechanism, but Tordrup et al. (2013) finds that it is difficult to coordinate different opinions among stakeholders. For example, because health insurance for young people is mainly financed by their salary income, HIS does not receive government subsidies, unlike other health insurance groups. Therefore, HIS insurers manage to raise the funds for their contributions by reducing fringe benefits for their members and increasing insurance premium rates. When further financial deterioration or increases in insurance premium rates make it difficult for insurers to maintain their own insurance, some insurers decide to dissolve their own insurance and switch to the Japan Health Insurance Association (JHIA), which covers employees of small and medium-sized companies and their dependents. These responses suggest that even in a mature society, a universal health insurance system is fragile to changes in the social environment. Therefore, understanding the responses of insurers facing changes in the social environment causing financial deterioration and potential impacts on the public is important for designing a sustainable universal health insurance system over the long run. Examining Japan's current difficulties may also have useful policy implications for developing countries, including many Asian countries, which are expected to face population aging in the near future under similar health insurance systems.

Using panel data for HIS insurers from 2003 to 2018, we examine how financial factors, such as financial transfers to elderly healthcare systems (EHS) and health insurance benefits for current enrollees, affect insurers' current accounts and changes in their responses. The results of a fixed effects model show that the impact of increased contributions to EHS on the finances and responses of insurers is similar to the impact of increased medical insurance benefits for enrollees. In addition, we find that insurers facing financial difficulties draw down their reserve funds without reducing benefits to enrollees, and that insurers tend to dissolve their own HIS and transfer to the JHIA when their sustainability declines. We also find that a nationwide economic shock, which has a major impact on corporate profits, has a significantly negative impact on insurance finances.

This article makes several important contributions to the existing literature on public health insurance finances. First, it is related to the literature on the effect of contributions to medical expenses for the elderly by the younger generations on the health insurance finances for the young. Although this is an important analysis in discussing the sustainability of the public health insurance system in an aging society, there are few related studies because sufficient data do not exist for the United States, where most young people have private health insurance (Clark et al., 2011; Larrimore

and Splinter, 2019). In addition, because data from countries with an exclusive health insurance system are only available with yearly variations, it is difficult to identify the true effect of fiscal transfers on insurance finances. The advantage of using Japanese data is the ability to estimate relatively easily the causal effect on outcomes because there are more than 3000 insurers in the universal health insurance system whose insurer-level panel data enable us to use both cross-sectional and time-series variation across insurers. For example, Abe (2007) uses insurer-level data from the HIS, Government-Managed Health Insurance (GMHI), and National Health Insurance (NHI)[1] and finds that the degree of the financial incentive of the insurers to control the healthcare expenditures of the elderly varied significantly among almost 5300 insurers in 1999, and that financial incentives did not appear to restrain expenditures significantly. Yoshida and Tsuruta (2013) uses HIS insurers panel data from 1998 to 2006 to examine how they finance or distribute the costs of the contribution to the EHS. Their results indicate that more than six-sevenths of the changes in the premium adjustment of the employee or employer are associated with changes in the reserve fund, followed by premiums, and finally fringe benefits. Yuda (2016a) uses NHI insurers panel data for 2005 and 2010 to estimate cost and production inefficiencies using stochastic frontier analysis. The results indicate that adverse effects on cost efficiency are associated with aging of the insured population, soft budget constraints due to government subsidies, insurer contributions to the EHS, and an increase in care provider densities. Yuda (2016b) finds that the two major policy reforms for healthcare systems for the elderly in 2008 contribute strongly to the improvement of NHI insurers' finances by using the same data as Yuda (2016a). In addition, a notable exception other than Japan is Lutz and Sheiner (2014), who discusses retiree health insurance in the United States. Lutz and Sheiner (2014) uses the 2011 fiscal year actuarial report and finds that states put their retiree health obligations into long-run fiscal balance by contributing an additional 0.75 percent of total revenue toward the benefit each year. However, to our knowledge, few studies have directly analyzed the effect of fiscal transfer to the EHS on the fiscal balance of health insurances for the young. Although this analysis is similar in motivation to that of Yoshida and Tsuruta (2013), no previous study has focused on the dissolution of HIS insurers.

Our article also contributes to the literature on the effect of changes in the socioeconomic environment on insurance financing in some developed countries. Grigorakis et al. (2017) studies the effect of the 2008 global financial crisis on the Greek healthcare system and finds that changes in patient copayments to the combination of social and private health insurance caused by a deterioration of public health finances due to the 2008 financial crisis had a strong negative

[1] The GMHI and the NHI are the insurers of the Japanese universal health insurance system. Section 2.1 provides the overview of these insurers.

influence on insured copayments for inpatient health care in private hospitals. On the other hand, the Oregon health insurance experiment, in a sense, revealed that the expansion of health insurance due to good financial conditions improved access to health care and reduced both financial risks and the risk of depression among low-income people (Finkelstein et al., 2012). Relatedly, the implementation of the Affordable Care Act basically did not lead to an additional public burden, but did increase prevention and outpatient care (Danagoulian, 2018) and reduce diagnoses of diabetes (Danagoulian, 2018) the mortality rate (Borgschulte and Vogler, 2020). In addition, Duggan et al. (2016) finds that some additional reimbursements in the Medicare Advantage program increased the public burden, but leads to private insurers accruing higher profits and increased advertising expenditures. However, these studies are evidence from societies with a relatively high share of private health insurance. To our knowledge, no studies have examined the impact of major economic shocks and institutional changes on health insurance financing and insurer responses in societies with a large share of public financing, such as Japan. Sharing Japan's experience may have useful policy implications for many developing countries for which universal health insurance systems are managed and financed by the government.

The remainder of this paper is organized as follows. The next section provides an overview of the Japanese public health insurance system with an explanation of the recent environmental changes in the HIS. Section 3 describes our data and sample and explains our identification strategy. Section 4 reports our empirical results, and Section 5 discusses the robustness of our results through additional analyses. Section 6 concludes.

2. Institutional background

2.1. The Japanese public universal health insurance system and its fiscal sustainability

The Japanese public universal health insurance system, established nationwide in 1961, has increased health equity and achieved good national health standards at a low cost (Ikeda et al., 2011). This historical root is the Health Insurance Act of 1922, which followed the example of the world's first health insurance system in Germany in 1888. The law required companies with 10 or more employees to provide health insurance (HIS) to their employees in order for workers to cope with the risk of illness within the organization[2]. The 1922 Health Insurance Act enacted in 1927 covered only blue-collar workers, which was only three percent of the total population of Japan at the time (Ikegami et al., 2011), but revisions expanded eligibility. In 1938, farmers and self-employed

[2] Because small and medium-sized firms had their own difficulties in operating health insurance for their employees, their health risks were covered under the government-managed health insurance (GMHI) system. The operation of the GMHI was transferred from the Social Insurance Agency by the JHIA in 2008.

persons could voluntarily join NHI, and the revised law in 1958 required all municipalities to implement NHI, which marks the establishment of the current universal health insurance system in Japan. Subsequently, spurred by rapid economic growth in the 1960s and public expectations for the enhancement of social security, the Japanese government established a separate healthcare system for the elderly. Specifically, in 1973, copayment of healthcare services for those aged 70 years and over was free, resulting in a sharp increase in healthcare utilization and expenses. In 1983, the Elderly Health Care system (EHCS) imposed copayments on the elderly to control for the sharp increase in healthcare expenditure; however, most of the expenditures of the elderly was still supported by public funds (50 percent) and financial contributions from other public insurance groups, such as HIS, GMHI, and NHI (50 percent), due to population aging. Other public insurance groups have suffered from increased contributions to the EHCS because of further rising healthcare expenditures due to population aging. In 2008, the EHCS introduced new health insurance plans for those aged 65–74 years (medical insurance system for the early elderly [MIEE]) and for those aged 75 years and over (long-life medical care system [LMCS]). In the MIEE, as the healthcare expenditures of the elderly are financially shared among HIS, GMHI, and NHI insurers, mainly based on the age composition of the insured, this financial transfer is actually from HIS and JNHI insurers to NHI insurers. In the LMCS, those aged 75 years and over pay a 10 percent copayment, but the remaining expenses are covered by the insurance premium (10 percent), public fund (50 percent), and contributions from HIS, JNHI, and NHI insurers (40 percent). The LMCS finances the health costs imposed by the elderly, but the financial burdens on younger generations have also gradually increased in recent years because they are the primary taxpayers, and the gradual increase in healthcare expenditures caused by population aging increases the contributions of taxpayers.

Table 1 summarizes the attributes and financial conditions of the public health insurance programs in 2021. In all insurance programs, the insurance medical benefits account for the largest share of current expenditures. However, regarding the breakdown of the current revenues of the LMCS for those aged 75 years and over, insurance premiums paid by the insured account for only 8.7 percent, with the rest financed by public contributions (50.5 percent) and transfers from other insurance groups (40.6 percent). The amount of the transfer to the LMCS accounts for 23.8 percent (43.1 percent if adding the contributions for the MIEE) of the current expenditures in HIS and 19.9 percent (34.3 percent) in the JHIA, respectively. On the other hand, that of NHI, which includes retirees and low-income households, accounts for only 6.7 percent. In addition, the current revenues of the HIS are almost entirely financed by insurance premiums, whereas public contributions support the finances of the other public health insurance groups because they have a structurally weak financial base: 11.2 percent for the JHIA, 20.0 percent for NHI, and 50.5 percent for LMCS, respectively. These respective current accounts (CA) are slightly in surplus as a result of these public

supports, whereas HIS has a structural problem in that increased contributions to LMCS have a direct impact on the deterioration of HIS finances because they have no public subsidies. Indeed, 52.6 percent of HIS insurers had a CA deficit, with a total deficit of 136.7 billion JPY (Federation of Health Insurance Associations, 2024).

[Table 1. Attributes and account of the Japanese public health insurance program in 2021.]

2.2. Recent responses of the HIS insurer against fiscal deterioration

HIS insurers can manage their operations flexibly and efficiently according to the actual conditions of the insurers while voluntarily assuming financial responsibility. HIS in Japan differentiates itself from other public health insurance plans as part of its employee benefits by setting a lower premium rate than other public health insurance plans and implementing its own fringe benefits, which reduces the burden of healthcare costs on enrollees, such as a reduction in patient copayments and the addition of a maternity allowance[3]. In recent years, however, in response to the increasing burden of contributions to the EHS, HIS insurers have taken several measures to maintain financial sustainability. The first is the drawing down of a reserve fund to finance the financial burden internally. The reserve fund in health insurance finances is generally intended for contingencies such as an unexpected increase in insurance healthcare benefits or a sudden decrease in current revenues, and is set aside on its own initiative with no restrictions on its use.[4] In addition, some HIS insurers review the fringe benefits that have been implemented as part of employee benefits and the ratio of labor and management contributions to insurance premiums. The insurance premiums are basically equally charged by labor and management groups, but in recent years, some HIS insurers have lowered the employer's share to improve corporate profits.[5]

Although each HIS insurer can set its own insurance premium rate[6] according to financial conditions and corporate performance, the premium rate has been increasing in response to the

[3] These stipulated benefits are provided in conjunction with healthcare benefits in accordance with the characteristics of the business category and its financial condition.

[4] The Health Insurance Law stipulates that insurers must set aside three months' worth of each as a legal reserve in case of shortfalls in insurance benefits or payments.

[5] This point is related to the literature on tax incidence: the effect of increases in social insurance premiums on wages and employment (e.g., Hamermesh, 1979; Summers, 1989; Melguizo and González-Páramo, 2013). In Japan, Komamura and Yamada (2004), Tachibanaki and Yokoyama (2008), Hamaaki and Iwamoto (2010), and Kodama and Yokoyama (2018) suggest that a portion of the corporate burden of social insurance premiums is passed on to the insured employees. This increase in employees' burdens may be suppressing the growth of their disposable income during these three decades.

[6] For example, Douven et al. (2020) finds that government subsidies and premium level setting can affect insurer choice.

recent increase in current expenditures[7]. For example, in FY2023, 176 HIS insurers, or 12.8 percent of the total, set premium rates that exceeded those of the JHIA (around 10 percent). When further deterioration of health insurance finances or increases in premium rates make it difficult to maintain a HIS insurer, HIS sometimes chooses to dissolve and transition to the JHIA. Figure 1 summarizes the trends in the number of HIS insurers and JHIA enrollees from 2003 to 2019. During this period, the number of HIS insurers decreased by 12.5 percent, whereas the number of JHIA enrollees increased by 13.9 percent.[8] Although there are some disadvantages to the transition to the JHIA, such as the loss of HIS's unique health benefits, such as fringe benefits and financial support for health check-up costs, and lower insurance premium rates compared with the JHIA, there is also the advantage of suppressing the rise in insurance premium rates. In addition, because the JHIA is financially subsidized by the national treasury, an influx to the JHIA would be a potential fiscal problem by leading to an increase in the national treasury's contribution.

[Fig. 1. Trends in the number of HIS insurers and JHIA enrollees.]

3. Model and data

3.1. Data and sample descriptions

The data used in this study are from the *Summary Tables of Revenue and Expenditure Accounts* compiled by the MHLW. These data include each HIS insurer's information on the attributes, insurance accounts, details of insurance healthcare benefits, property, and claims and debts. Together with the *Health Insurance and Seamen's Insurance Business Status Report*, which comprehensively summarizes the status of other health insurance programs for employees, these statistics contain basic information for the sound management of the public health insurance system, as well as the *Annual Report on the Health Insurance and Mariners Ansurance Activities* that comprehensively summarize their insurance operations.

Our sample is insurer-level (unbalanced) panel data consisting of all 1705 HIS insurers from fiscal year (FY) 2003 to FY2018. The Japanese fiscal year runs from April to March of the following year. The beginning year of this study is FY2003 because of an important policy revision regarding

[7] In addition to the insurance premium rate, there are two other indicators, called required and actual insurance premium rates, to evaluate the financial conditions from various perspectives. The required premium rate covers all the costs of healthcare benefits, and the actual premium rate balances current revenues and expenditures. See Appendix A for more details.

[8] Given that more than half of HIS insurers are in deficit, this reduction may be small. Yoshida and Tsuruta (2013) speculates that this may be because the dissolution of HIS requires the approval of at least three-fourths of the members of the association, which consists of equal numbers of representatives of carriers and insured persons.

the calculation of insurance premium for HIS and JHIA insurers. Before FY2003, the insured insurance premium was based on monthly salary, but after the revision, it was based on annual income including bonuses. Yoshida and Tsuruta (2013) confirms that this revision discontinuously reduced the insurance premium rates of HIS insurers, but it is difficult to distinguish this impact from the year effect because this revision was uniformly changed and implemented at the same time. In addition, our end of year is FY2018 because the data in FY2019 include the first wave of the COVID-19 pandemic period: from February to May in 2020, when healthcare utilization decreased substantially (Suzuki and Yuda, 2022).

3.2. Empirical model

We estimate the following two-way fixed effects model to evaluate the effect of changes in the social environment and institutional reforms mentioned above on the finances and responses of HIS insurers:

$$Y_{it} = \beta_0 + \mathbf{x_{it}}\boldsymbol{\beta_x} + \mathbf{z_{it}}\boldsymbol{\beta_z} + \alpha_i + \tau_t + u_{it} \quad (1),$$

where the dependent variable Y_{it} is the CA and the behavioral responses of the HIS insurer *i* in year *t*. There are two variables related to the CA: one is *CA deficit*, which takes the value of one if the CA balance is in deficit, and the other is the *CA balance ratio*, which is defined as current expenditure divided by current revenue. Because larger values for these variables indicate a worse financial condition, the coefficient of the factor adversely affecting insurance finances is estimated to be positive. The variables related to insurer response that are determined independently by each insurer to improve one's own financial condition are the variables on the *insurance premium rate*, the amount of the *reserve fund*, the *fringe medical benefit ratio*, the *employer's share of insurance premiums*, and *dissolution*. The *insurance premium rate* is the level of HIS insurer *i* in year *t* itself, and a binary variable that takes the value of one when the HIS *i*'s insurer premium rate exceeds the average premium rate of the JHIA in year *t*. As mentioned above, the *reserve fund* is a voluntary and independent reserve set aside by each insurer to ensure smooth operation. The *fringe medical benefit ratio* is the ratio of the cost of fringe benefits to the cost of insurance healthcare benefits. The social insurance premium is paid in equal shares by employer and employee, and the *employer's share of insurance premiums* is its share of a company. *Dissolution* is a dummy variable that takes the value of one if insurer *i* is dissolved in year *t*.

$\mathbf{x_{it}}$ is a vector of dependent variables consisting of fiscal factors that have a significant impact on outcome variable *Y* and includes *insurance healthcare benefits*, *high-cost medical expenses*, and *contributions to the EHS*. *Insurance healthcare benefits* are stationary insurance benefits that accrue

when the enrollees use the insured medical services specified in the Health Insurance Law. The high value of healthcare benefits has a negative impact on the finances of HIS insurers. The high-cost medical expenses system covers a substantial portion of a patient's copayment when the monthly amount exceeds a certain level determined by age and income[9]. The insurer's finances would deteriorate if healthcare utilization occurred with high costs. *Contributions to the EHS* are the annual sum amounts of contributions to the EHS, specifically including the EHCS (to 2007), the Retiree Health Care System for retirees (to 2014), the MIEE (from 2008), and the LMCS (from 2008). The increased burden associated with the growing number of the elderly would have a negative impact on health insurance finances. The monetary variables rather than the total amount of standard remuneration and bonus are per enrollee amounts to adjust for the insurer size.

$\mathbf{z_{it}}$ is a vector of independent variables consisting of insured attributes, such as the *number of insured persons* and *share of female insured persons*, the *average age of insured persons*, and the *number of dependents*, *total remuneration*, and business category dummy variables[10]. In general, the larger the number of insured, the more stable the premium revenue; the younger the average age also contributes to stable insurance finances because younger populations have a lower risk of illness. In addition, Karaca-Mandic et al. (2011) finds a negative correlation between insured size and reserve fund, and Dranove et al. (2000) finds that workplaces with a higher proportion of women have a lower share of insurance premiums paid by the employer. The total remuneration is the sum of the average monthly remuneration multiplied by 12 (months) plus the total bonus for all employees. The increase in labor costs could be a burden on HIS finances. α_i is insurer fixed effects, τ_t is year fixed effects, and u_{it} is an error term. Note that the year fixed effects τ_t controls for the effects of both the macroeconomic conditions and the policy changes uniformly implemented in a year, such as the introduction of the new EHS of the LMCS and MIEE after FY2008 and the revision of the insurance premium calculation after FY2017. We also estimate robust standard errors clustered by insurer to account for serial correlation in the error term within the insurer.

Table 2 summarizes the summary statistics of the main variables. Of the dependent variables, 51.9 percent of HIS insurers have a CA deficit, and CA expenditures are higher than CA revenues by 2.8 percentage points on average. The mean insurance premium rate is 8.092 percent, which is about two percentage points lower than that of the JHIA (around 10 percent). However, 16.5 percent

[9] The usual copayment rate for enrollees under age 70 years is 30 percent, but its monthly upper limit is 80,100 JPY + (total medical expenses – 267,000 JPY) × 1%. The remaining is covered by health insurance.

[10] Appendix B provides summary statistics and empirical results for the business category fixed effects. Note that there are some insurers that have different business categories because of company reorganization and mergers during the study period.

of HIS insurers have higher insurance premium rates than the average of the JHIA. As for financial factors, the mean amount of reserve fund per enrollee is 135 million JPY, indicating that the insurer has a sufficient amount of the reserve, as well as a low share of the fringe medical benefits of all insurance healthcare benefits, which is consistent with Table 1. The mean employer's share of the insurance premiums is 55.1 percent, indicating that employers pay slightly higher social insurance premiums than employees on average. The mean of the dissolved HIS insurer in 16 years is 1.4 percent.

[Table 2. Summary statistics.]

Regarding the independent variables, high-cost medical expenses account for only 3.8 percent of the insurance healthcare benefits, but the contributions of the EHS correspond to 86.7 percent of the insurance benefits. In addition, the standard deviation of the number of insured persons and dependents is more than twice the mean, indicating a large difference among insurers. The mean of women insured is 26.5 percent, and the mean age of the insured is 41.6 years. The standard deviation of total remuneration is also larger than its mean, suggesting that our study period includes the global financial crisis of 2008 to 2009, the Great East Japan Earthquake in 2011, and the period of economic recovery due to "Abenomics" after 2013.

The right-hand side of Table 2 shows summary statistics only for the dissolved HIS insurers. They have a worse CA balance, 33.4 percent have a higher insurance premium rate than that of the JHIA, and a smaller reserve fund and fringe medical benefit ratio. In addition, because their insurance healthcare benefits, number of enrollees, and total amount of standard remuneration and bonuses are also smaller, the scale of the dissolved insurers is relatively small. In an empirical analysis, we use the logs of all continuous variables, but add one (JPY) for monetary values and 0.001 for ratios for variables with a minimum value of zero.

4. Main results

Table 3 summarizes the estimation results of the fixed effects model on the effect of insurers' fiscal factors and attributes on CA balance and insurers' responses.

[Table 3. Effects on HIS insurers' current accounts and responses.]

Columns 1 and 2 summarize the estimated effects on the CA balance. For the fiscal factors, the coefficients on insurance healthcare benefits provided to enrollees and on the contribution to the EHS are significantly positive, and their elasticities are close. More specifically, a 10 percent

increase in insurance healthcare benefits significantly increases the probability of a CA deficit by 6.63 percentage points and the CA ratio by 2.93 percent, while a 10 percent increase in the contributions to the EHS increases the probability of a CA deficit by 6.21 percentage points and the CA ratio by 2.46 percent, respectively. These results suggest that the burden of contributions to the EHS on the financial condition of HIS has a similar magnitude of impact as the burden of covering the medical expenses of their own enrollees.

Columns 3 and 4 summarize the estimated effects on insurance premium rates. Only the coefficient on the contribution to the EHS is significantly positive, indicating that a one percent increase in the contribution significantly increases the insurance premium rate for HIS by 3.4 percent and the probability of exceeding the average insurance premium of the JHIA by 5.7 percentage points. Because the coefficient of insurance healthcare benefits is not significant, it is inferred that the HIS increases its own insurance premium rate to cover the contribution to the EHS.

Columns 5–8 summarize the estimated effects on responses of the HIS insurers. Regarding the effect of fiscal factors on the disposable income and healthcare utilization of insured persons, the coefficients on the fringe medical benefit ratio (column 6) and the employer's share of premiums (column 7) are both close to zero. On the other hand, the contribution to the EHS has a negative effect on the level of reserve fund (column 5), suggesting that a 10 percent increase in the contribution reduces the reserve fund by 10.8 percent. In addition, an increase in the contribution significantly increases the probability of HIS dissolution, implying that a 10 percent increase in the contribution raises the probability of HIS dissolution by 17.0 percentage points. By contrast, an increase in insurance healthcare benefits for enrollees has a significant negative effect on the probability of HIS dissolution. In addition, the increase in high-cost medical expenses has limited effects on all outcome variables.

These results have two important implications. One is that the contribution to the EHS has a significant burden on most of the fiscal indicators of HIS financing, which is consistent with the results of Yuda (2016a) for the NHI. The other implication is that it can be inferred that HIS insurers facing financial deterioration have avoided reducing the treatment and benefits to the insured by drawing down their reserve fund. This result is consistent with that of Yoshida and Tsututa (2013), who uses data from a period prior to our analysis. Finally, we find that a further increase in the EHS burden significantly increases the probability that an HIS insurer decides to dissolve.

5. Robustness checks

In this section, we first discuss the robustness of our estimation results in the previous section. We compare the results on the outcome variables by the three business categories of the firm. Then, we estimate the results by specifically considering the effects of the large economic shocks that

occurred during our study period.

5.1. Results using the subsamples of the business category

There are 29 business categories of the large firms operating a HIS insurer in the sample, and there may be heterogeneity in the behavioral responses of HIS insurers because market structures and business strategies can differ by business category. If clear heterogeneity exists, the results can provide useful implications for understanding how future population aging can affect health insurance financing in countries and regions where the industrial structure is skewed toward certain business types. In this subsection, we use the same framework by creating three subsamples, such as manufacturing and wholesale and retail, and service businesses.

Table 4 summarizes only the results of the financial factors on the outcome variables, and shows that in all subsamples, the results basically show the same trends as those shown in Table 2. However, the actual impacts of insurance healthcare benefits and contributions to the EHS on the CA balance, insurance premiums, and the probability of dissolution, differ by business category. First, regarding the effect on the CA balance, the elasticities of insurance healthcare benefits and contributions to the EHS for manufacturing businesses are about 1.4 and 1.25 times larger than the averages shown in Table 2, respectively. In wholesale and retail businesses, the elasticity of insurance healthcare benefits is slightly larger than the average, but that of the contributions to the EHS is only about 60–70 percent. As a result, the estimated elasticity of insurance healthcare benefits is about three times larger than that of contributions to the EHS for wholesale and retail businesses. Regarding service businesses, the elasticity of the contribution to the EHS is about the same as the average, but that of insurance healthcare benefits is only about half. In other words, the contribution to the EHS imposes about twice the burden on the HIS financial condition in service businesses than the insurance benefits to their own members.

[Table 4. Effects on HIS insurers' current accounts and responses by business category.]

The effect of the contribution to the EHS on insurance premium rates is larger than average for service businesses, about the same as the average for manufacturing businesses, and smaller for wholesale and retail businesses. The probability of exceeding the average insurance premium rate of the JHIA is large for manufacturing business, about the same as the average for service businesses, and insignificant for wholesale and retail businesses. As in the results in Table 2, the coefficients on the fringe medical benefit ratio and employer's share of the premium are close to zero, but the negative elasticity of the reserve fund is larger than average for manufacturing and service businesses, but not significant, and the coefficient is estimated to be negative for wholesale and

retail businesses. Finally, the contribution to the probability of dissolution of HIS is large for manufacturing businesses and about average for service businesses, but insignificant for wholesale and retail businesses.

5.2. Effects of the economic shocks

As shown in Table 1, the current revenue of HIS is almost entirely financed by insurance premium revenue from the insured, which is collected as a fixed percentage of the employee's salary and bonus. Therefore, when the income of the insured decreases because of the deterioration of the economic environment, the financial condition worsens because the insurance premium revenue also decreases. In this subsection, we further control for the impact of two major economic shocks that occurred during our study period: the global financial crisis in 2007 and the Great East Japan Earthquake in 2011. Specifically, we estimate equation (2) below, which includes interaction terms between the fiscal variables and a dummy variable of the economic shocks.

$$Y_{it} = \beta_0 + \mathbf{x_{it}}\boldsymbol{\beta_x} + (\mathbf{x_{it}} \times \mathbf{1}(S_t = 1))\boldsymbol{\beta_{sx}} + \mathbf{z_{it}}\boldsymbol{\beta_z} + \alpha_i + \tau_t + u_{it} \quad (2)$$

where $\mathbf{1}(S_t = 1)$ is a dummy variable that takes the value of one in the year when the growth rate of the real GDP is negative due to economic shock. The global financial crisis caused a sharp decline in demand in Europe and the United States. In Japan, which has an export-dependent economic structure, the manufacturing and export industries in particular suffered a financial blow, and Japan's growth rates were –1.0 percent in 2008 and –5.5 percent in 2009. On the other hand, the Great East Japan Earthquake of 2011, although a localized natural disaster, had a significant negative impact on the economic performance of the affected areas, and the further disrupted supply chains reduced Japan's real GDP growth rate by 0.47 percentage points in the following year (Carvalho et al., 2021). Although the Japanese government attempted to stabilize temporarily the finances of public health insurance groups such as the JHIA and NHI by reducing premiums, no such measures were taken for HIS insurers. On the other hand, the Great East Japan Earthquake also worsened the health of residents in the affected areas (Yamamura, 2016; Sannabe et al., 2020; Yuda and Lee, 2022; Yuda, 2024), and medical costs increased (Matsuyama et al., 2018).

Table 5 reports the estimated effects of the fiscal variables and their intersection terms of the economic shocks. The effects of fiscal variables on the outcome variables are almost the same as in Table 2, regardless of considering the two large economic shocks of the financial crisis and Great East Japan Earthquake. However, some new insights are observed in the coefficients of the intersection terms. Specifically, for the intersection term with the global financial crisis, a 10 percent increase in contributions to the EHS additionally worsened the probability of a CA deficit by 1.8

percent, worsened the CA ratio by 0.9 percentage points, increased the insurance premium rate by 2.6 percent, increased the probability of exceeding the average insurance premium of the JHIA by 8.3 percent, and increased the probability of dissolving the HIS by 4.5 percent. We also confirmed larger additional effects of an increase in insurance healthcare benefits on the insurance premium rate and the probability of dissolution compared with those of the contribution to the EHS.

[Table 5. Effects of large economic shocks on HIS insurers' current accounts and responses.]

Regarding the intersection with the Great East Japan Earthquake, although the additional adverse effects are not as extensive as those of the global financial crisis, we found that the increase in contributions to the EHS further deteriorated the CA to the same extent as that during the financial crisis, and that the increase in high-medical expenses additionally raised the probability of dissolution by 0.6 percentage points.

6. Concluding remarks

In this paper, we use insurer-level panel data, including the detailed attributes and financial status of HIS, to examine the effects of financial factors on the CA and responses of HIS insurers. The results using a fixed effects model show that the effect of increased contributions to the EHS on insurer finances and responses is similar in magnitude to that of increased healthcare costs for current enrollees. In addition, we find that insurers facing financial difficulties draw down their reserve fund without reducing treatment and benefits to the insured, but that finance deterioration from HIS insurers tends to dissolve their own HIS and moves to the JHIA. Furthermore, we find that the nationwide large economic shock on corporate earnings have a significant negative impact on HIS finances.

One important point suggested by our results is the responses of HIS insurers in the face of financial difficulties. HIS insurers tend to draw down their reserve fund without reducing treatment and benefits provided to their enrollees. The changes in responses by insurers suggests that the design of the system should consider the incentive structure of insurers (companies) to design a sustainable universal health insurance system that can be sustained over the long term. For example, the significant effect of the contribution to the elderly, who are not enrollees of the HIS, may reduce incentives and voluntary efforts to reduce health risks and control medical expenses. Our results may provide a new interpretation of the role of reserve funds in insurance finance. The source of reserve funds in HIS is the cumulative surplus from past health insurance operations paid by the previously insured. In Japan, where the problems of a low birthrate and a rapidly aging population are the most serious in the world, there is large intergenerational disparity on social security benefits

(Morinobu and Nakamoto, 2012), but reserve funds have helped alleviate this disparity, even if it may not be large. In addition, the existence of heterogeneity in HIS responses across business categories suggests that the long-run transition of industrial structures accompanying economic development may make it difficult to predict future sustainability, particularly for - countries.

This study focuses on the effect of increased contributions to the EHS on insurance finances and responses, but further research is needed to interpret the mechanism for sustainability of the universal health insurance system. For example, Japan introduced a public long-term care (LTC) insurance system in 2000, which covers LTC services not covered by public health insurance. Because Japan's LTC insurance system imposes a greater insurance premium burden on mainly those aged 65 years and over, our results and implications may not be useful for societies where health insurance covers both healthcare and LTC services. In addition, focusing on individual behaviors after the transition from HIS to the JHIA is also important when discussing the sustainability of universal health insurance, but the changes that have occurred in individual health investment behaviors, healthcare utilization, and health because of the loss of various HIS-specific welfare benefits remain unclear. In addition, although we have analyzed the effects of two large economic shocks, there are differences in both regional and temporal aspects between the global financial crisis and the Great East Japan Earthquake. This implies that it is not yet possible to identify which of these heterogeneities has had the greater influence. Therefore, more evidence using natural experimental environments is needed to gain a better understanding of comprehensive mechanisms.

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Online Appendices on "Beyond the public universal health insurance system: The effect of population aging on insurer's responses"

Appendix A. Empirical analysis using required and actual insurance premium rates

As mentioned in footnote 7, the National Federation of Health Insurance Societies (2024) uses required and actual insurance premium rates to evaluate the financial condition of HIS insurers from multiple perspectives. The required insurance premium rate is defined as the premium rate to cover the entire cost of healthcare benefits:

$$required\ premium\ rate = \frac{\text{Insurance healthcare benefits+Contributions for the EHS+Other contributions}}{\text{Total amount of standard remuneration and bonus}} \quad \text{(A1)}.$$

The real insurance premium rate is defined as the premium rate to balance between current revenues and expenditures:

$$actual\ premium\ rate = \frac{\text{Current expenditures}-(\text{Current revenues}-Insurance\ premium\ revenue)}{\text{Total amount of standard remuneration and bonus}} \quad \text{(A2)}.$$

Table A1 summarizes the results of estimating equations (1) (columns 1–4) and (2) (columns 5–8) by the fixed effects model by replacing the insurance premium rates with these premium rates, respectively. The estimation results show that there are no significant differences from the results shown in Tables 3 and 5.

[Table A1. Empirical results using other premium rates.]

Appendix B. Business category

The summary statistics of the main variables by the three business categories for firms operating HIS are summarized in Table B1. The table also includes the specific businesses of each category used in Section 5.1. Table B2 shows the estimation results on outcome variables for each business category omitted in Table 2. In the regression analysis, there are two baseline categories, "Agriculture, forestry and fisheries" and "Mining and quarrying of stone and gravel", because there is only one firm in the latter category.

[Table B1. Summary statistics by business category.]

[Table B2. Summary statistics and estimation results for business category fixed effects.]

Table 1. Attributes and account of the Japanese public health insurance program in 2021.

Health insurance group	HIS		JHIA		NHI		LMCS	
Enrollees	Employees of a large company and their dependents		Employees of a small and medium company and their dependents		Farmers, self-employed, retired, unemployed, etc.		Those who aged 75 and older	
Number of insurers	1,388		1		1,716		47	
Number enrolled (1,000 people)	28,382		40,265		25,369		18,434	
Percentage of total population (%)	22.7		32.2		20.3		14.7	
Average age of the insured	35.7		38.7		54.4		82.9	
Annual income per the insured household (1,000 JPY)	5,651		3,951		1,404		885	
Per capita medical expenses (JPY)	171,432		194,413		395,118		939,766	
Current revenues	Amount	%	Amount	%	Amount	%	Amount	%
Insurance premium	8,265	98.6	9,855	88.6	2,299	9.9	1,389	8.7
Contribution by the national treasury	3	0.0	1,246	11.2	3,052	13.1	5,116	32.1
Contribution by the prefectural government					1,030	4.4	1,570	9.9
Contribution by the municipal government					576	2.5	1,353	8.5
Transfer to the LMCS							6,477	40.6
Transfer to the MIEE					3,792	16.3		
Others	115	1.4	23	0.2	12,533	53.8	29	0.2
Total amount	8,383	100.0	11,125	100.0	23,281	100.0	15,934	100.0
Current expenditures	Amount	%	Amount	%	Amount	%	Amount	%
Insurance medical benefits	4,247	50.2	6,702	61.9	8,758	37.8	15,808	99.4
Contribution to the LMCS	2,013	23.8	2,160	19.9	1,553	6.7		
Contribution to the MIEE	1,638	19.3	1,554	14.4	3	0.0		
Payment to the RHS	0	0.0	0	0.0				
Others	569	6.7	413	3.8	12,852	55.5	94	0.6
Total amount	8,467	100.0	10,829	100.0	23,167	100.0	15,902	100.0
Current account balance	−85		296		115		33	
Current revenue and expenditure ratio	1.010		0.973		0.995		0.998	

Notes: This table summarizes the attributes and account of representative insurers in the Japanese public health insurance system from the MHLW (2023). The unit of "Amount" in the current revenues, current expenditures, and current account balance is billion JPY. The average (highest and lowest) exchange rate in 2021 was 109.83 (102.68, 115.33) JPY/USD.

Table 2. Summary statistics.

Sample	All insurers		Dissolved insurers	
	Mean	Std.dvi	Mean	Std.dvi
Dependent variables				
CA deficit [=1]	0.519	0.500	0.630	0.483
CA balance ratio	1.028	0.265	1.119	0.570
Insurance premium rate	8.092	1.309	8.005	1.336
1[HIS premium > JHIA premium]	0.165	0.372	0.334	0.472
Reserve fund [million JPY]*	135.100	334.174	124.560	465.457
Fringe medical benefit ratio	0.021	0.018	0.018	0.018
Employer's share of insurance premiums	0.551	0.051	0.551	0.047
Dissolution [=1]	0.014	0.117	0.151	0.358
Independent variables				
Insurance healthcare benefits [millions of JPY]*	108.947	18.801	102.891	17.605
High-cost medical expenses [millions of JPY]*	4.307	2.988	4.553	2.882
Contributions for the EHS [millions of JPY]*	94.375	27.760	82.953	28.133
Number of insured persons [1,000 people]	10.659	25.177	6.941	32.115
Share of female insured persons	0.265	0.166	0.258	0.174
Average age of insured persons [years]	41.595	3.099	42.253	3.521
Number of dependents [1,000 people]	9.440	20.373	4.754	9.757
Total remuneration [billions of JPY]	11.379	26.099	4.715	10.233
Number of observations	23,545		2,158	
Number of insurers	1,705		325	

Notes: This table summarizes the means and standard deviations of the main variables for all insurers and for dissolved insurers. * denotes the amount per enrollee. The average (highest and lowest) exchange rate over the period analyzed (FY2003 to FY2018) is 104.10 (76.30, 124.22) JPY/USD.

Table 3. Effects on HIS insurers' current accounts and responses.

Dependent variable	[1] CA deficit	[2] ln [CA balance ratio]	[3] ln [Insurance premium ratio]	[4] 1[HIS premium > JHIA premium]	[5] ln [Reserve fund]	[6] Fringe medical benefit ratio	[7] ln [Employer's share of premium]	[8] Dissolution
ln [Insurance healthcare benefits]	0.663**	0.293**	0.005	0.023	0.310	0.006**	0.004	−0.073**
	(0.079)	(0.029)	(0.014)	(0.037)	(0.625)	(0.001)	(0.004)	(0.014)
ln [High-cost medical expenses]	0.011	0.006*	0.001	0.005	0.049	0.000*	−0.001*	0.000
	(0.006)	(0.002)	(0.002)	(0.005)	(0.057)	(0.000)	(0.000)	(0.001)
ln [Contributions for the EHS]	0.621**	0.246**	0.034**	0.057**	−1.078**	0.001*	−0.001	0.017**
	(0.064)	(0.023)	(0.005)	(0.014)	(0.178)	(0.000)	(0.001)	(0.004)
ln [Number of insured]	−0.279**	−0.102**	0.001	0.069	−0.221	0.000	0.003	0.031*
	(0.070)	(0.033)	(0.017)	(0.055)	(0.620)	(0.002)	(0.006)	(0.015)
ln [Share of female insured]	0.094	0.055	0.016	0.083*	−0.489	−0.002	−0.013*	−0.026**
	(0.054)	(0.029)	(0.014)	(0.040)	(0.563)	(0.001)	(0.005)	(0.010)
ln [Average age of insured]	−0.619**	−0.217**	0.492**	1.056**	−8.239**	−0.028**	0.025	0.110**
	(0.230)	(0.084)	(0.058)	(0.169)	(2.094)	(0.007)	(0.020)	(0.039)
ln [Number of dependents]	0.270**	0.069*	0.065**	0.051	−0.446	−0.001	−0.004	−0.069**
	(0.073)	(0.030)	(0.017)	(0.050)	(0.608)	(0.002)	(0.005)	(0.015)
ln [Total remuneration]	−0.143**	−0.059**	−0.018**	−0.033**	0.514**	0.001	0.004	0.003
	(0.020)	(0.009)	(0.005)	(0.012)	(0.124)	(0.000)	(0.002)	(0.002)
Constant	−3.055**	−1.528**	0.156	−2.917**	33.788**	0.092**	−0.755**	−0.126
	(0.775)	(0.254)	(0.217)	(0.623)	7.860)	(0.024)	(0.071)	(0.142)
H_0: Business category fixed effects = 0	65.542**	61.207**	97.239**	932.371**	14.559***	9.341**	19.993**	3.630***.
H_0: Year fixed effects = 0	99.058**	94.285**	171.998**	40.744**	23.958***	27.033**	9.241**	8.893**
Observations	23,545	23,545	23,545	23,545	23,545	23,545	23,545	23,545
Insurers	1,705	1,705	1,705	1,705	1,705	1,705	1,705	1,705
Adjusted R-squares	0.270	0.446	0.613	0.096	0.073	0.141	0.084	0.022

Notes: This table reports the estimation results of equation (1) for the effects of the insurers' financial and attribute variables on their current accounts and responses. The upper values are the coefficients estimated by the fixed effects model, and the lower values in parentheses are the clustered robust standard errors at the insurer level. All regressions include the business category (see Appendix B) and year fixed effects. ** and * denote significance at the 1 and 5 percent levels, respectively.

Table 4. Effects on HIS insurers' current accounts and responses by business category.

Dependent variable	[1] CA deficit	[2] ln [CA balance ratio]	[3] ln [Insurance premium ratio]	[4] 1[HIS premium > JHIA premium]	[5] ln [Reserve fund]	[6] Fringe medical benefit ratio	[7] ln [Employer's share of premium]	[8] Dissolution
Panel A: Manufacturing business								
ln [Insurance healthcare benefits]	0.948**	0.398**	−0.021	−0.005	−0.544	0.006**	0.006	−0.095**
	(0.133)	(0.048)	(0.019)	(0.054)	(0.936)	(0.001)	(0.004)	(0.021)
ln [High-cost medical expenses]	0.007	0.003	0.001	0.003	0.035	0.000	−0.002*	−0.001
	(0.010)	(0.004)	(0.002)	(0.008)	(0.078)	(0.000)	(0.001)	(0.003)
ln [Contributions for the EHS]	0.784**	0.308**	0.036**	0.077**	−1.313**	0.000	0.000	0.021**
	(0.040)	(0.012)	(0.004)	(0.016)	(0.199)	(0.000)	(0.001)	(0.006)
Observations	11,761	11,761	11,761	11,761	11,761	11,761	11,761	11,761
Insurers	852	852	852	852	852	852	852	852
Adjusted R-squares	0.321	0.543	0.591	0.101	0.064	0.132	0.072	0.023
Panel B: Wholesale and retail business								
ln [Insurance healthcare benefits]	0.823**	0.330**	0.067*	0.129	−0.689	0.006*	0.009	−0.052
	(0.178)	(0.078)	(0.034)	(0.147)	(2.278)	(0.003)	(0.008)	(0.046)
ln [High-cost medical expenses]	−0.006	0.009*	0.002	0.010	0.151	0.000	0.001	0.002
	(0.014)	(0.005)	(0.003)	(0.015)	(0.186)	(0.000)	(0.001)	(0.003)
ln [Contributions for the EHS]	0.359**	0.166**	0.019*	0.038	−0.616	0.001	−0.003	0.012
	(0.126)	(0.042)	(0.009)	(0.027)	(0.347)	(0.000)	(0.002)	(0.011)
Observations	3,258	3,258	3,258	3,258	3,258	3,258	3,258	3,258
Insurers	254	254	254	254	254	254	254	254
Adjusted R-squares	0.260	0.426	0.697	0.111	0.131	0.172	0.157	0.030
Panel C: Service business								
ln [Insurance healthcare benefits]	0.274**	0.164**	0.003	0.024	1.855*	0.005*	−0.002	−0.057**
	(0.107)	(0.046)	(0.022)	(0.043)	(0.779)	(0.002)	(0.006)	(0.019)
ln [High-cost medical expenses]	0.022*	0.009*	−0.002	0.007	0.003	0.001**	−0.001	0.000
	(0.010)	(0.004)	(0.003)	(0.007)	(0.089)	(0.000)	(0.001)	(0.001)
ln [Contributions for the EHS]	0.631**	0.230**	0.045**	0.060**	−1.369**	0.001	0.000	0.017**
	(0.108)	(0.043)	(0.010)	(0.021)	(0.256)	(0.001)	(0.002)	(0.006)
Observations	8,526	8,526	8,526	8,526	8,526	8,526	8,526	8,526
Insurers	646	646	646	646	646	646	646	646
Adjusted R-squares	0.231	0.359	0.613	0.089	0.080	0.152	0.106	0.022

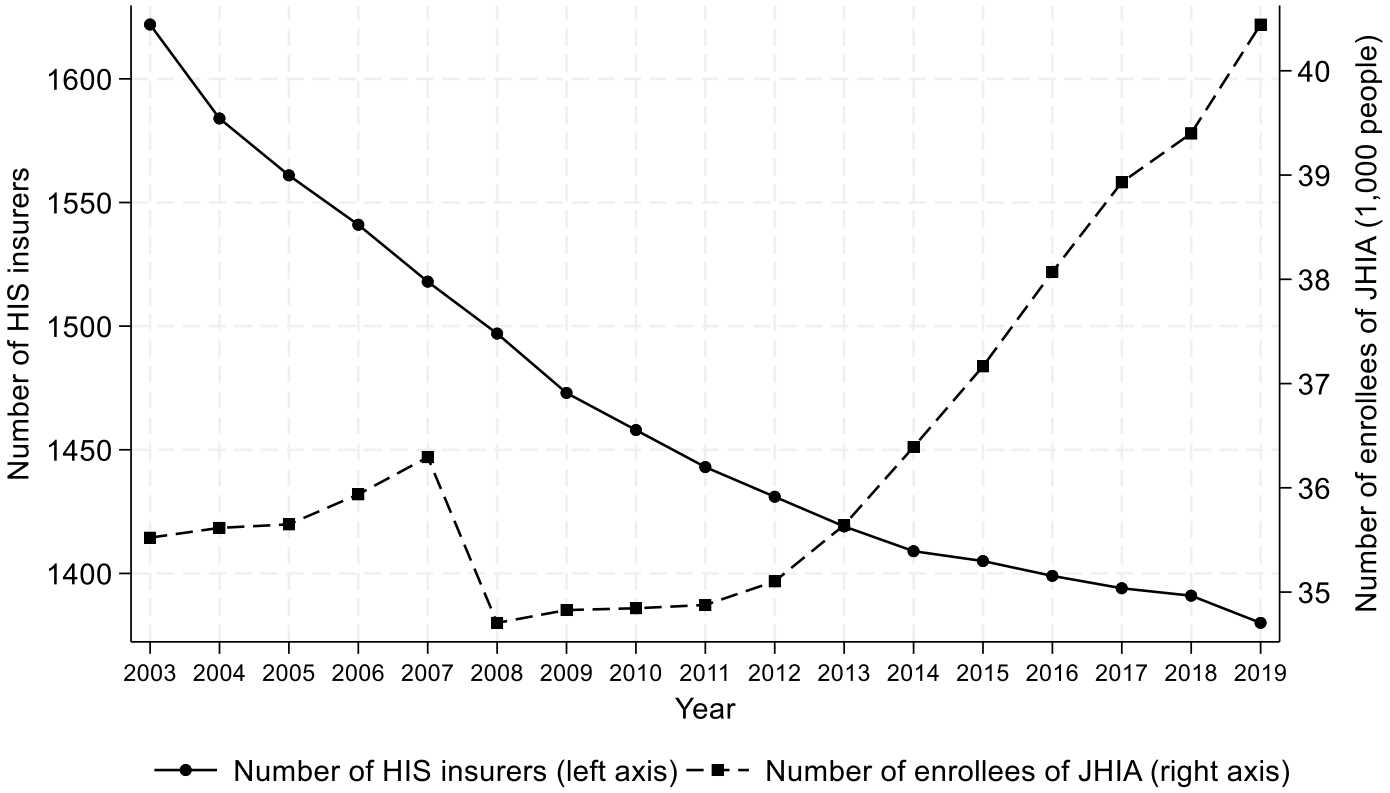
Notes: This table reports the estimation results of estimating equation (1) for the effects of the insurers' financial variables on insurers' current accounts and responses by using subsamples. The upper values are the coefficients estimated by the fixed effects model, and the lower values in parentheses are the clustered robust standard errors at the insurer level. All regressions include the insurer's attributes, business category (see Appendix B), year fixed effects, and a constant term. ** and * denote significance at the 1 and 5 percent levels, respectively.

Table 5. Effects of large economic shocks on HIS insurers' current accounts and responses.

Dependent variable	[1] CA deficit	[2] ln [CA balance ratio]	[3] ln [Insurance premium ratio]	[4] 1[HIS premium > JHIA premium]	[5] ln [Reserve fund]	[6] Fringe medical benefit ratio	[7] ln [Employer's share of premium]	[8] Dissolution
Panel A: Global financial crisis (2008-2009)								
ln [Insurance healthcare benefits]	0.682**	0.302**	0.007	0.001	0.054	0.006**	0.005	−0.086**
	(0.082)	(0.029)	(0.014)	(0.039)	(0.640)	(0.001)	(0.004)	(0.014)
ln [Insurance healthcare benefits]	−0.232*	−0.107**	−0.017	0.113*	1.822*	0.002	−0.003	0.064*
× Global financial crisis	(0.097)	(0.037)	(0.016)	(0.053)	(0.762)	(0.002)	(0.005)	(0.025)
ln [High-cost medical expenses]	0.010	0.005*	0.001	0.006	0.048	0.000*	−0.001*	0.000
	(0.007)	(0.002)	(0.002)	(0.005)	(0.061)	(0.000)	(0.001)	(0.001)
ln [High-cost medical expenses]	0.013	0.007	−0.003	−0.007	−0.036	0.000	0.001	−0.005
× Global financial crisis	(0.010)	(0.004)	(0.002)	(0.007)	(0.071)	(0.000)	(0.001)	(0.004)
ln [Contributions for the EHS]	0.612**	0.242**	0.033**	0.054**	−1.060**	0.001*	−0.001	0.015**
	(0.066)	(0.023)	(0.005)	(0.014)	(0.181)	(0.000)	(0.001)	(0.004)
ln [Contributions for the EHS]	0.182*	0.074*	0.026*	0.083*	−0.327	−0.001	−0.004	0.045*
× Global financial crisis	(0.077)	(0.030)	(0.012)	(0.035)	(0.453)	(0.001)	(0.003)	(0.018)
Observations	23,545	23,545	23,545	23,545	23,545	23,545	23,545	23,545
Insurers	1,705	1,705	1,705	1,705	1,705	1,705	1,705	1,705
Adjusted R-squares	0.271	0.448	0.614	0.097	0.073	0.141	0.084	0.023
Panel B: Great East Japan Earthquake (2011)								
ln [Insurance healthcare benefits]	0.668**	0.290**	0.008	0.033	0.296	0.006**	0.004	−0.071**
	(0.080)	(0.029)	(0.014)	(0.037)	(0.632)	(0.001)	(0.004)	(0.014)
ln [Insurance healthcare benefits]	−0.100	0.037	−0.044*	−0.175**	0.317	−0.002	0.001	−0.043
× Great East Japan Earthquake	(0.147)	(0.029)	(0.020)	(0.066)	(0.869)	(0.002)	(0.004)	(0.029)
ln [High-cost medical expenses]	0.011	0.006*	0.001	0.005	0.050	0.000*	−0.001*	0.000
	(0.006)	(0.002)	(0.002)	(0.005)	(0.057)	(0.000)	(0.000)	(0.002)
ln [High-cost medical expenses]	0.006	−0.001	0.000	0.004	−0.007	0.000	0.000	0.006*
× Great East Japan Earthquake	(0.011)	(0.003)	(0.003)	(0.007)	(0.077)	(0.000)	(0.000)	(0.002)
ln [Contributions for the EHS]	0.612**	0.242**	0.033**	0.055**	−1.031**	0.001*	−0.001	0.018**
	(0.066)	(0.023)	(0.005)	(0.014)	(0.180)	(0.000)	(0.001)	(0.004)
ln [Contributions for the EHS]	0.188*	0.079**	0.012	0.055	−1.060**	0.001	−0.002	−0.010
× Great East Japan Earthquake	(0.077)	(0.022)	(0.011)	(0.035)	(0.410)	(0.001)	(0.003)	(0.016)
Observations	23,545	23,545	23,545	23,545	23,545	23,545	23,545	23,545
Insurers	1,705	1,705	1,705	1,705	1,705	1,705	1,705	1,705

Adjusted R-squares	0.270	0.447	0.614	0.097	0.073	0.141	0.084	0.022

Notes: This table reports the estimation results of estimating equation (2) for the effects of the insurers' financial variables and interaction terms with economic shocks on the insurers' current accounts and responses. The upper values are the coefficients estimated by the fixed effects model, and the lower ones in parentheses are the clustered robust standard errors at the insurer level. All regressions include the insurer's attributes, business category (see Appendix B), year fixed effects, and a constant term. ** and * denote significance at the 1 and 5 percent levels, respectively.



Notes: Composed by the authors with reference to the MHLW (2023). The solid line indicates the number of HIS insurers, and the dashed line indicates enrollees of the JHIA.

Fig. 1. Trends in the number of HIS insurers and JHIA enrollees.

Table A1. Empirical results using other premium rates.

Dependent variable	[1] All insurers	[2] Manufacturing business	[3] Wholesale and retail business	[4] Service business	[5] Global financial crisis	[6] (intersection)	[7] Great East Japan Earthquake	[8] (intersection)
Panel A: Required premium rate								
ln [Insurance healthcare benefits]	0.356**	0.396**	0.636**	0.199**	0.372**	−0.124**	0.368**	−0.003
	(0.055)	(0.059)	(0.207)	(0.064)	(0.058)	(0.043)	(0.056)	(0.033)
ln [High-cost medical expenses]	0.011**	0.010**	0.017**	0.008**	0.011**	0.001	0.005*	−0.003
	(0.002)	(0.002)	(0.005)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
ln [Contributions for the EHS]	0.321**	0.384**	0.237**	0.319**	0.318**	0.056*	0.317**	0.087**
	(0.023)	(0.010)	(0.039)	(0.044)	(0.024)	(0.023)	(0.024)	(0.021)
Observations	23,545	11,761	3,258	8,526	23,545		23,545	
Insurers	1,705	852	254	646	1,705		1,705	
Adjusted R-squares	0.844	0.894	0.796	0.863	0.845		0.846	
Panel B: 1[HIS Required premium > JHIA premium]								
ln [Insurance healthcare benefits]	0.351**	0.539**	0.572**	0.105*	0.317**	0.048	0.360***	0.050
	(0.046)	(0.081)	(0.129)	(0.051)	(0.046)	(0.076)	(0.047)	(0.076)
ln [High-cost medical expenses]	0.009**	0.014**	0.007	0.001	0.009**	0.002	0.002	0.007
	(0.003)	(0.004)	(0.009)	(0.004)	(0.003)	(0.007)	(0.003)	(0.006)
ln [Contributions for the EHS]	0.333**	0.428**	0.284**	0.262**	0.318**	0.335**	0.327**	0.129**
	(0.029)	(0.023)	(0.070)	(0.039)	(0.028)	(0.050)	(0.029)	(0.039)
Observations	23,545	11,761	3,258	8,526	23,545		23,545	
Insurers	1,705	852	254	646	1,705		1,705	
Adjusted R-squares	0.202	0.260	0.215	0.139	0.208		0.204	
Panel C: Actual premiums rate								
ln [Insurance healthcare benefits]	0.335**	0.387**	0.613**	0.171**	0.348**	−0.129**	0.350***	−0.018
	(0.050)	(0.050)	(0.201)	(0.048)	(0.052)	(0.045)	(0.050)	(0.030)
ln [High-cost medical expenses]	0.006**	0.005	0.011*	0.008**	0.006**	0.003	0.000	−0.001
	(0.002)	(0.003)	(0.005)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
ln [Contributions for the EHS]	0.286**	0.354**	0.198**	0.280**	0.282**	0.088**	0.282**	0.086**
	(0.027)	(0.014)	(0.045)	(0.050)	(0.028)	(0.031)	(0.027)	(0.022)
Observations	23,544	11,761	3,257	8,526	23,544		23,544	
Insurers	1,705	852	254	646	1,705		1,705	
Adjusted R-squares	0.778	0.851	0.728	0.780	0.780		0.781	
Panel D: 1[HIS actual premium > JHIA premium]								

ln [Insurance healthcare benefits]	0.475**	0.732**	0.573**	0.173*	0.456**	−0.085	0.505**	0.011
	(0.061)	(0.108)	(0.156)	(0.069)	(0.062)	(0.086)	(0.063)	(0.106)
ln [High-cost medical expenses]	0.003	0.000	0.015	0.003	0.002	0.006	−0.005	−0.008
	(0.004)	(0.007)	(0.012)	(0.005)	(0.004)	(0.007)	(0.004)	(0.009)
ln [Contributions for the EHS]	0.474**	0.615**	0.371**	0.393**	0.457**	0.395**	0.466**	0.175**
	(0.047)	(0.032)	(0.104)	(0.074)	(0.047)	(0.059)	(0.048)	(0.055)
Observations	23,545	11,761	3,258	8,526	23,545		23,545	
Insurers	1,705	852	254	646	1,705		1,705	
Adjusted R-squares	0.242	0.311	0.239	0.182	0.247		0.244	

Notes: This table reports the estimation results of estimating equations (1) (columns 1–4) and (2) (columns 5–8) by replacing the original premiums with the required premium rate (*Panels A and B*) and actual premium rate (*Panels C and D*), respectively, for the effects of the insurers' financial variables and the interaction terms with economic shocks on the insurers' current accounts and responses. The upper values are the coefficients estimated by the fixed effects model, and the lower values in parentheses are the clustered robust standard errors at the insurer level. All regressions include the insurer's attributes, business category (see Appendix B), year fixed effects, and a constant term. ** and * denote significance at the 1 and 5 percent levels, respectively.

Table B1. Summary statistics by business category.

Sample	Manufacturing business		Wholesale and retail business		Service business	
	Mean	Std.dvi	Mean	Std.dvi	Mean	Std.dvi
Dependent variables						
Current account deficit [=1]	0.499	0.500	0.556	0.497	0.532	0.499
Current account balance ratio	1.024	0.270	1.038	0.205	1.029	0.278
Insurance premium rate	8.196	1.184	8.323	1.358	7.861	1.417
1[HIS premium > JHIA premium]	0.153	0.360	0.227	0.419	0.158	0.365
Reserve fund [million JPY]*	120.356	140.592	146.119	510.145	151.227	425.570
Fringe medical benefit ratio	0.021	0.017	0.016	0.017	0.024	0.020
Employer's share of insurance premiums	0.553	0.044	0.527	0.045	0.557	0.060
Dissolution [=1]	0.013	0.114	0.016	0.125	0.014	0.116
Independent variables						
Insurance healthcare benefits [millions of JPY]*	108.594	17.047	105.779	19.320	110.645	20.637
High-cost medical expenses [millions of JPY]*	4.494	3.036	3.930	2.848	4.193	2.954
Contributions for the EHS [millions of JPY]*	95.015	27.491	92.056	27.443	94.377	28.202
Number of insured persons [1,000 people]	9.101	19.853	12.192	28.365	12.223	29.881
Share of female insured persons	0.197	0.120	0.324	0.190	0.336	0.172
Average age of insured persons [years]	42.147	2.471	40.590	3.376	41.218	3.576
Number of dependents [1,000 people]	9.297	19.895	9.123	19.924	9.757	21.177
Total remuneration [billions of JPY]	11.652	27.355	9.937	22.870	11.553	25.458
Number of observations/ Number of insurers	11,761/ 852		3,258/ 254		8,526/ 646	

Business categories	Agriculture, forestry and fisheries/ Mining and quarrying of stone and gravel/ Construction/ Manufacture of food and tobacco/ Manufacture of textile mill products/ Manufacture of lumber and wood products and furniture/ Manufacture of paper and paper products/ Printing and allied industries/ Manufacture of chemical and allied products/ Manufacture of fabricated metal products/ Manufacture of machinery/ Miscellaneous manufacturing industries	Wholesale trade/ Retail trade (food and beverage)/ Retail trade except for food and beverage	Finance and insurance/ Real estate and goods rental and leasing/ Transportation / Information and communications/ Electricity, gas, heat supply and water/ Accommodations, eating and drinking services/ Medical, health care and welfare/ Education, learning support/ Compound services/ Living-related and personal services and amusement services/ Worker dispatching services/ Scientific research, professional and technical services/ Miscellaneous services/ Public affairs

Notes: This table summarizes the means and standard deviations of the main variables in the subsamples employed in Table 4, as well as the specific business categories in the subsamples. * denotes the amount per enrollee. The average (highest and lowest) exchange rate over the period analyzed (FY2003–FY2018) is 104.10 (76.30, 124.22) JPY/USD.

Table B2. Summary statistics and estimation results for business category fixed effects.

Dependent variable	[1] Mean/ Std.dvi	[2] CA deficit	[3] ln [CA balance ratio]	[4] ln [Insurance premium ratio]	[5] 1[HIS premium > JHIA premium]	[6] ln [Reserve fund]	[7] Fringe medical benefit ratio	[8] ln [Employer's share of premium]	[9] Dissolution
Agriculture, forestry and fisheries	0.002								
	[0.041]								
Mining and quarrying of stone and gravel	0.000								
	[0.015]								
Construction	0.039	0.548**	0.194**	−0.213**	−1.093**	3.211*	−0.003	0.036*	−0.031
	[0.193]	(0.143)	(0.071)	(0.045)	(0.164)	(1.315)	(0.004)	(0.017)	(0.028)
Manufacture of food and tobacco	0.035	0.306**	0.101**	−0.105**	−0.859**	1.690**	0.000	0.010**	−0.010**
	[0.184]	(0.014)	(0.004)	(0.003)	(0.011)	(0.121)	(0.000)	(0.001)	(0.002)
Manufacture of textile mill products	0.025	0.633**	0.150**	−0.208**	−0.949**	1.238	0.006*	0.041**	−0.066
	[0.156]	(0.195)	(0.058)	(0.049)	(0.148)	(0.847)	(0.003)	(0.015)	(0.045)
Manufacture of lumber and wood products and furniture	0.005	0.588**	0.127*	−0.212**	−1.092**	1.202	0.001	0.031	−0.014
	[0.069]	(0.151)	(0.052)	(0.052)	(0.154)	(0.897)	(0.002)	(0.017)	(0.028)
Manufacture of paper and paper products	0.005	0.091	0.016	−0.128**	−1.373**	0.355	0.006*	0.049**	0.018
	[0.071]	(0.163)	(0.046)	(0.044)	(0.150)	(1.400)	(0.002)	(0.015)	(0.030)
Printing and allied industries	0.007	0.511*	0.204**	−0.230**	−1.149**	3.526*	0.009	0.047*	−0.051
	[0.086]	(0.201)	(0.062)	(0.057)	(0.146)	(1.683)	(0.005)	(0.020)	(0.035)
Manufacture of chemical and allied products	0.112	0.332*	0.072	−0.118**	−0.998**	0.776	0.003	0.038*	−0.001
	[0.315]	(0.162)	(0.045)	(0.044)	(0.151)	(1.393)	(0.002)	(0.015)	(0.030)
Manufacture of fabricated metal products	0.037	0.306*	0.092*	−0.150**	−1.001**	0.605	0.002	0.041**	−0.041
	[0.190]	(0.136)	(0.041)	(0.041)	(0.134)	(0.876)	(0.002)	(0.015)	(0.033)
Manufacture of machinery	0.199	0.356**	0.102*	−0.169**	−0.986**	0.820	0.004	0.038*	−0.037
	[0.399]	(0.132)	(0.040)	(0.040)	(0.124)	(0.913)	(0.002)	(0.015)	(0.033)
Miscellaneous manufacturing industries	0.033	0.262*	0.083*	−0.140**	−0.964**	1.022**	0.002	0.037*	−0.017
	[0.179]	(0.115)	(0.036)	(0.038)	(0.116)	(0.359)	(0.002)	(0.015)	(0.025)
Wholesale trade	0.056	0.419**	0.114*	−0.195**	−1.057**	2.199*	0.003	0.035*	−0.028
	[0.229]	(0.129)	(0.046)	(0.044)	(0.125)	(0.872)	(0.002)	(0.015)	(0.027)
Retail trade (food and beverage)	0.013	0.415**	0.179**	−0.256**	−1.272**	1.550	0.004	0.041**	−0.067*
	[0.115]	(0.138)	(0.055)	(0.048)	(0.164)	(1.015)	(0.003)	(0.015)	(0.031)
Retail trade except for food and beverage	0.070	0.459**	0.097	−0.183**	−1.069**	1.029	0.002	0.034*	−0.035
	[0.254]	(0.149)	(0.051)	(0.048)	(0.135)	(0.911)	(0.003)	(0.017)	(0.028)

Finance and insurance	0.128	0.556**	0.192**	−0.257**	−1.242**	1.674	0.000	0.022	−0.053
	[0.334]	(0.187)	(0.047)	(0.047)	(0.259)	(0.964)	(0.004)	(0.028)	(0.028)
Real estate and goods rental and leasing	0.005	0.539**	0.189**	−0.290**	−1.222**	1.891	−0.005	−0.038	−0.067*
	[0.073]	(0.198)	(0.054)	(0.052)	(0.177)	(0.965)	(0.005)	(0.052)	(0.032)
Transportation	0.063	0.317*	0.152**	−0.203**	−1.033**	0.710	0.005	0.040*	−0.033
	[0.243]	(0.159)	(0.053)	(0.049)	(0.154)	(1.166)	(0.003)	(0.018)	(0.030)
Information and communications	0.040	0.388*	0.148*	−0.198**	−1.068**	2.030*	0.001	0.035	−0.053
	[0.197]	(0.182)	(0.058)	(0.052)	(0.145)	(0.972)	(0.003)	(0.019)	(0.029)
Electricity, gas, heat supply and water	0.015	0.766**	0.280**	−0.229**	−0.800*	3.162*	−0.006	0.003	−0.014
	[0.122]	(0.191)	(0.077)	(0.063)	(0.321)	(1.607)	(0.004)	(0.026)	(0.028)
Accommodations, eating and drinking services	0.008	0.309	0.158**	−0.172**	−1.009**	−0.675	0.001	0.038*	−0.064*
	[0.088]	(0.188)	(0.061)	(0.057)	(0.150)	(1.851)	(0.003)	(0.018)	(0.028)
Medical, health care and welfare	0.015	0.438**	0.237**	−0.220**	−1.182**	−0.179	0.004	0.044*	0.014
	[0.121]	(0.169)	(0.062)	(0.067)	(0.165)	(1.802)	(0.006)	(0.019)	(0.062)
Education, learning support	0.008	0.415	0.166*	−0.194**	−1.159**	1.794	0.001	0.085*	−0.034
	[0.092]	(0.259)	(0.070)	(0.062)	(0.151)	(1.040)	(0.007)	(0.041)	(0.031)
Compound services	0.011	0.207	0.141*	−0.200**	−0.854**	0.951	0.002	0.023	−0.032
	[0.102]	(0.167)	(0.059)	(0.056)	(0.184)	(1.178)	(0.003)	(0.021)	(0.029)
Living-related and personal services and amusement services	0.008	0.407*	0.183**	−0.239**	−1.117**	2.724**	0.000	0.028	−0.046
	[0.091]	(0.203)	(0.066)	(0.063)	(0.148)	(0.968)	(0.005)	(0.021)	(0.029)
Worker dispatching services	0.002	−0.108	−0.004	−0.026	−1.087**	2.929**	−0.045**	0.041*	−0.057*
	[0.048]	(0.213)	(0.058)	(0.058)	(0.146)	(0.946)	(0.015)	(0.018)	(0.029)
Scientific research, professional and technical services	0.006	0.356	0.161**	−0.222**	−1.115**	3.986**	0.002	0.051**	−0.037
	[0.076]	(0.187)	(0.062)	(0.057)	(0.145)	(1.365)	(0.003)	(0.018)	(0.029)
Miscellaneous services	0.046	0.478**	0.191**	−0.235**	−1.099**	1.580	0.003	0.035	−0.039
	[0.209]	(0.165)	(0.056)	(0.049)	(0.144)	(0.923)	(0.003)	(0.018)	(0.028)
Public affairs	0.006	−0.105	0.060	−0.128*	−1.137**	0.661	0.000	0.019	−0.039
	[0.080]	(0.168)	(0.059)	(0.056)	(0.184)	(1.176)	(0.003)	(0.021)	(0.029)

Notes: This table reports the means and standard deviations and estimation results of estimating equation (1) for the effects of business category fixed effects on insurers' current accounts and responses. In column 1, the upper values are the mean and the lower values in brackets are the standard deviation. In columns 2–9, the upper values are the coefficients estimated by the fixed effects model, and the lower values in parentheses are the clustered robust standard errors at the insurer level. All regressions include the main variables presented in Table 3 and year fixed effects. ** and * denote significance at the 1 and 5 percent levels, respectively.