A Tale of Two Social Insurance Systems in South Korea and Taiwan: A Financial Risk Protection Perspective

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**ABSTRACT**

Universal Health Coverage (UHC) is a widespread policy goal in the 21st century. The aim is to protect people from financial risk while promoting their access to good-quality care. This study examined the social insurance systems of South Korea and Taiwan to explore the critical challenges of achieving effective UHC. By assessing the impact of UHC on financial risk protection (measured by out-of-pocket payment share and catastrophic payment headcount), we found that when South Korea inaugurated its National Health Insurance (NHI) program with a limited benefits package and high cost sharing, it did not reduce the financial burden. Meanwhile, we observed a drop of 5 to 6 percentage points in the catastrophic payment headcount in Taiwan, which offered a universal and rather comprehensive benefits package with a modest cost-sharing design under its single-payer NHI system. The political-economic context of the UHC policy evolution was further explored through an in-depth discussion. We conclude that to provide sufficient financial risk protection against unexpected medical expenses, the design of the insurance scheme, in particular the risk-sharing mechanism, not only matters but is also the key to success.

**Introduction**

Universal health coverage (UHC) is a well-promoted societal goal and political aspiration around the globe\textsuperscript{1} and has been adopted by the United Nations (UN) as one of the 17 Sustainable Development Goals (SDGs) in 2015 to be achieved by 2030. Though its implementation has proceeded at different paces, given national variations in socioeconomic resources and political systems, many countries have aimed to achieve UHC over the past decade, of which the world’s two leading economies—the United States and China—are illustrative examples.\textsuperscript{2,3} Additionally, many low- and middle-income countries in Asia, Africa, and Latin America have achieved or are making efforts to achieve UHC.\textsuperscript{4,5}

There are three main dimensions of UHC, that is, population, services, and direct costs. UHC involves a move away from out-of-pocket (OOP) payment toward some form of prepayment and is expected to improve access to health services and reduce poverty resulting from catastrophic payments.\textsuperscript{6,7} Despite the extension of population coverage to all, a high incidence of catastrophic payments and the resultant impoverishment are probable if patients still have high OOP payments at the point of service. Such payments are incurred when the services covered by insurance are limited and/or the proportion of the costs covered is low. To move toward UHC, therefore, countries need to not only extend insurance coverage to more people but also offer more services and pay a greater part of the cost.\textsuperscript{8}

There is much evidence that moving away from OOP payments to prepayment reduced catastrophic payments\textsuperscript{9–11} while services are not adequately covered and a limited depth of coverage were still major causes of high OOP payments and catastrophic expenditures.\textsuperscript{12} This implies that instituting prepayment or expanding population coverage by itself is not sufficient to completely remove catastrophic health expenditures. What matters is to increase the share of prepayment among total health expenditure, which is in turn determined by the depth of the service coverage and the proportion of costs covered.

South Korea achieved universal population coverage in 1989. However, its service coverage was modest; there was a low contribution rate, and the direct payment share of total health expenditures was as high as 60.37% in 1989.\textsuperscript{13} Taiwan achieved universal population coverage in 1995, with a relatively comprehensive...
service coverage, and the direct payment share was 30.55% of total health expenditures in 1995. This difference in the direct payment share of the two social insurance systems might have implications for the reduction of financial risk in the form of catastrophic payments even after universal population coverage was achieved.

**South Korea**

South Korea adopted an incremental approach to achieving universal population coverage. Insurance coverage was first provided to workers in the formal sector, namely employees in large companies with more than 500 workers in 1977 and was gradually extended to companies with a smaller workforce. In addition, a new insurance scheme was created for government employees and teachers in 1979. These insurance schemes for formal-sector workers covered about 44% of the population by 1985. South Korea finally achieved universal population coverage by creating social insurance schemes for the rural and urban self-employed in 1988 and 1989, respectively. These social health insurance schemes, regardless of their specific population coverage, provided coverage for all immediate family members.

These individual social insurance schemes were merged into the single-payer National Health Insurance (NHI) program in 2000. The program offers coverage of benefits that include inpatient services, ambulatory visits to doctors, licensed traditional medicine practitioners, and dentists, home care, and hospice care. Nonetheless, the proportion of OOP health expenditures still amounted to 30.25% of the total health expenditures in 2019. All providers are paid mainly on a fee-for-service basis, and fee levels are decided by an annual contract between provider groups and the insurer. Some inpatient services are paid based on the diagnosis-related group. As of 2019, NHI revenues relied on contributions assessed at 6.46% of the payroll, with government subsidies comprising 11.63% of the NHI revenues. In the same year, South Korea devoted 8% of its GDP to health, and NHI accounted for 50.73% of national health expenditures.

Despite a single-payer approach to health financing, a market-oriented healthcare delivery system is predominant in South Korea: 95% of total health facilities and 91% of all hospital beds were privately owned in 2019. The use of hospital outpatient services is covered, though with higher coinsurance, and hospitals compete with private clinics for patients. Heavy dependence on hospitals for outpatient services is one of the cost drivers in the healthcare sector in South Korea.

**Taiwan**

Taiwan’s path to UHC took 45 years (1950–1995) to traverse. A single-payer NHI program was introduced in 1995 by integrating the four existing social insurance schemes: Labor Insurance (LI, in 1950), Government Employee Insurance (GEI, in 1958, for government employees and their immediate family members), Farmer Insurance (FI, in 1989), and Low-Income Household Health Insurance (LIHHI, in 1990). There were two components in both the GEI and LI, namely pensions (cash benefits) and health benefits (in-kind benefits), and the latter suffered substantial financial insolvency before being merged into the single-payer NHI program. The introduction of the NHI in 1995 only carved out the health insurance component from the original schemes. At that time, coverage was expanded to the remaining uninsured 43% of the population. The NHI program provides the insured with coverage of comprehensive benefits including inpatient services, ambulatory visits to doctors, licensed traditional medicine practitioners, and dentists, home care, and hospice care for a modest copayment/coinsurance. All NHI-contracted providers are subject to a uniform fee schedule (mainly on a fee-for-service basis) under an annually pre-set global budget.

When the NHI was inaugurated, revenue collected through premiums was assessed at 4.25% of the payroll, with government subsidies targeting the vulnerable and employees of specific occupation categories. To resolve a financial deficit and enhance equity in financing, the NHI Administration (NHIA) adopted a dual-track premium collection system in 2013, which included a 4.91% (now 5.17%) premium tax assessed on payroll and an additional 2% (now 2.11%) tax levy on nonpayroll income. As of 2019, current health expenditures used 6.11% of the GDP, and the NHI accounted for 57.23% of national health expenditures.

Taiwan has a market-oriented health-care delivery system, reflecting its free enterprise economy. In 2019, privately owned hospitals account for 68% of all beds and 83% of total hospitals. Nearly 64% of allopathic physicians work in the hospital sector and the rest in private local clinics. Over the years, driven by the payment incentive, hospitals have developed large outpatient departments to maximize patient flows and compete with neighborhood private clinics for patients.

South Korea and Taiwan have taken a similar approach to achieve UHC, mainly by modeling after the German/Japanese system in the mid-1900s by providing coverage first to the working population and then gradually expanding it to the unemployed.
This study first assesses the impact of the NHI policy on financial risk protection (measured by OOP payment share and catastrophic payment headcount). Then, in an in-depth discussion, we examine the historical evolution of these two systems to disentangle the root causes of the divergence, and the different outcomes between the two systems in terms of financial risk protection. Our comparative study of South Korea’s and Taiwan’s experiences in guaranteeing UHC for their populations might help other countries design their UHC system effectively.

**Materials and Methods**

**Data Sources**

To examine the change in the incidence and distribution of catastrophic health expenditure before and after the introduction of NHI, that is, 1988–1995 for South Korea and 1994–2001 for Taiwan. The analytical sample for descriptive/DID analyses consisted of 448,537/106,126 households for South Korea and 113,777/22,191 households for Taiwan.

**Methods**

Catastrophic payment is defined as the OOP payment share that exceeds 10% of a household’s ability to pay, estimated based on household consumption expenditure for this study. OOP payments are incurred at the point of service for health care that includes visits to doctors practicing Western medicine or traditional medicine, dental services, inpatient services, care at nursing homes, home care, prescribed medicines, over-the-counter drugs, and medical equipment and appliances. OOP payments are mainly composed of copayments/coinsurance at the point of service and payments for services not covered by the NHI scheme. The catastrophic payment headcount refers to the proportion of households incurring catastrophic payments (adopted as Indicator 3.8.2 to assess Target 3.8 of UN SDG 3) and was used to detect the extent of financial risk protection under the two NHI schemes.

We first examined the OOP payment share by household expenditure quintile (Figure 1) and the catastrophic payment headcount for the whole survey sample

![Figure 1. Mean out-of-pocket payment share, by total household expenditure quintile. Source: Authors’ analysis of data from the HIES in South Korea and SFIE in Taiwan.](image-url)
The distribution of catastrophic payments was estimated using the concentration index (CI), which indicates whether catastrophic payments occur more frequently among poor households or rich ones. With the CI ranging between −1 and +1, a negative CI implies that poor households are more likely to incur catastrophic payments, while a positive CI implies the opposite.

Furthermore, we exploited a descriptive Difference-in-Differences (DID) analysis to assess the impact of UHC on catastrophic payment headcount (a more sophisticated DID estimation setup is presented in the Appendix). In this simple DID comparison, we chose households without any form of insurance in the pre-NHI period (1988 for South Korea and 1994 for Taiwan) as the treatment group because they would have remained uninsured had the NHI not been introduced. As for the comparison group, households least impacted by the introduction of the NHI were ideal candidates, such as households already covered by the Health Insurance for Government Employees and Teachers (HIGET) scheme in South Korea and the GEI scheme in Taiwan. Specifically, households with any member insured by HIGET and GEI in both the pre- and post-NHI periods (1990–1995 for South Korea and 1996–2001 for Taiwan) were chosen as the comparison group because they could still have obtained health insurance coverage even if the NHI had not been introduced.

**Results**

At the initial launch of the NHI program, the private sector in South Korea had a much more significant role in financing health care than in Taiwan. Social insurance in South Korea accounted for only 30.89% (versus 53.92% in Taiwan) of total health expenditures, and a significant financial burden was still imposed upon households in the form of OOP payments (55.74% in South Korea versus 23.97% in Taiwan). Overall, a more pronounced drop of 13.9 percentage points in the OOP payment share was observed for Taiwan, compared to roughly 5 percentage points for South Korea (Table 1).

When examining the mean OOP share by total household expenditure quintile, a distinct difference was observed between South Korea and Taiwan. The households in the higher expenditure quintile incurred a higher OOP payment share relative to their poor counterparts in South Korea, while Taiwan demonstrated an opposite trend, though to a much smaller extent, that is, the average OOP share of health expenditure was smaller than that of South Korea (Figure 1). Additionally, the gap across quintiles seemed to narrow over the years for both countries. A pre-post NHI comparison showed a pronounced drop in the catastrophic payment headcount for Taiwan after the NHI scheme was introduced; however, such an effect was not observed in South Korea (Figure 2). Moreover, in South Korea, a higher proportion of households consistently incurred catastrophic payments over the years than in Taiwan. Nonetheless, more rich households incurred catastrophic payments in South Korea (evidenced by the positive concentration indices), in contrast to the concentrated-on-the-poor distribution observed in Taiwan (Figure 2).
Table 1. Summary of health system characteristics for South Korea and Taiwan in pre- and post-NHI years.

| System characteristics | South Korea | Taiwan |
|------------------------|-------------|--------|
| **Periods**            |             |        |
| pre-NHI                | 1988        | 1994   |
| post-NHI               | 1990        | 1996   |
| **Population size (million)** | 42.03      | 42.87  |
| Economic indicators    |             |        |
| GDP per capita in USD  | 4,692       | 6,514  |
| Current health expenditures as % of GDP | 3.20 | 3.70 |
| National Health Expenditure per capita in USD | 221 | 310 |
| **Health indicators**  |             |        |
| Infant mortality rate  | 12.0        | 10.0   |
| Life expectancy        | Total: 70.30| Total: 71.28 |
|                        | M: 66.31    | M: 67.29 |
|                        | F: 74.57    | F: 75.51 |
| Financing mix           |             |        |
| Public (%)             | 33.49       | 39.51  |
| General government (%) | 9.24        | 8.61   |
| Social security (%)    | 24.25       | 30.89  |
| Private (%)            | 66.51       | 60.49  |
| Out-of-pocket (%)      | 60.70       | 55.74  |
| Private insurance (%)  | 1.04        | 1.20   |
| Other private funds (%)| 4.77        | 3.55   |
| **Health insurance system** |         |        |
| Year of universal coverage | 1989 | 1995 |
| Scheme                 | A compulsory multiple-payer system (1989–2000), which was transformed into a compulsory single-payer scheme (2000–now) | A compulsory single-payer social insurance scheme |
| Social insurance premium contribution rate | 3.19% for employees of private companies, 4.60% for government officials and private school teachers | 4.25% |

Source: Data for Taiwan: MOHW, 2019; Taiwan National Development Council, 2019; Ministry of the Interior, 2019; financing mix is estimated by Lu based on National Health Accounts; Data for South Korea: OECD, 2020; Bank of Korea, 2020; MOHW, 2020; NIH, 2020.

As the descriptive DID results show in Table 2, we observed a non-trivial NHI policy effect (a drop of 5 to 6 percentage points in catastrophic payment headcount) in Taiwan. However, the expected NHI policy effect (reduction in catastrophic payment headcount) was not observed in South Korea. When the NHI scheme was first implemented (the first three post-policy years), a modest NHI policy effect (a drop of 0.44 to 1.04 percentage points) was noted, then followed by an opposite trend (an increase of 0.43 to 1.82 percentage points). Furthermore, the NHI policy effect derived from a linear probability DID model (Appendix) indicates a significantly negative effect in Taiwan (5.02 percentage point drop) and no significant effect in South Korea. Both the DID results (Table 2 and Appendix) confirm our findings that the implementation of the NHI policy results in a lower probability of incurring a catastrophic payment.

**Discussion**

One common feature shared by South Korea and Taiwan on their paths to UHC is the persistent economic growth in the 1980s, which provided the economic resources necessary for the expansion of health insurance coverage. Indeed, both South Korea and Taiwan moved toward UHC during periods of booming economic growth. The South Korean economy showed a high average growth rate of 8.8% in GDP (in real terms) in the decade prior to the introduction of the NHI. Also, Taiwan’s economy took off to reach a historical new height from 1985 to 1995, with an average growth rate of 8% in GDP (in real terms). The economic growth in the 1980s in South Korea and Taiwan thus made achieving UHC feasible.

Given that South Korea and Taiwan both have achieved universal population coverage via the introduction of NHI in 1989 and 1995, respectively, the level of financial risk which the insured were shielded from varied to a great extent. The impact of the NHI on reducing the catastrophic payment headcount was observed in Taiwan, but not in South Korea, which implies that population coverage does not necessarily warrant effective financial protection. What caused these two social health insurance schemes, which shared the common objective of UHC, to diverge in the level of financial risk protection? We first describe the differences in the design of the insurance schemes between South Korea and Taiwan and then attempt to disentangle the root causes of the divergence of these two systems, from the perspectives of historical evolution and political context.

**Design of the Insurance Schemes**

In addition to limited benefits coverage, the South Korean government also imposed substantially high coinsurance at the point of service: 50% for a physician visit at a medical center (roughly $30 USD)—compared to 30% at clinics (roughly $5 USD) and 20% for inpatient services to avert the effect of moral hazard and lessen the financial burden on the government. Additionally, patients had to pay OOP
Table 2. The descriptive results of difference-in-differences between treatment and control group (OOP 10% of total expenditure—Headcount).  

|            | Pre-1 yr | Post-1 yr | Post-2 yrs | Post-3 yrs | Post-4 yrs | Post-5 yrs | Post-6 yrs |
|------------|----------|-----------|------------|------------|------------|------------|------------|
| South Korea |          |           |            |            |            |            |            |
| Treatment group | 15.06%   | 13.75%    | 14.28%     | 14.19%     | 14.56%     | 13.48%     | 13.31%     |
| Comparison group | 14.13%   | 13.86%    | 13.78%     | 14.19%     | 13.19%     | 11.44%     | 10.55%     |
| Taiwan |          |           |            |            |            |            |            |
| Treatment group | 17.41%   | 11.39%    | 11.92%     | 10.60%     | 11.22%     | 11.49%     | 12.30%     |
| Comparison group | 4.20%    | 4.11%     | 3.76%      | 2.75%      | 3.64%      | 3.44%      | 5.25%      |

| South Korea |          |           |            |            |            |            |            |
| Treatment group | −1.31%   | −0.78%    | −0.88%     | −0.50%     | −1.58%     | −1.76%     |            |
| Comparison group | −0.27%   | −0.34%    | 0.07%      | −0.93%     | −2.68%     | −3.58%     |            |
| DID (SK) |          |           |            |            |            |            |            |
| Treatment group | −1.04%   | −0.44%    | −0.95%     | 0.43%      | 1.10%      | 1.82%      |            |
| Comparison group | −6.02%   | −5.49%    | −6.81%     | −6.19%     | −5.92%     | −5.11%     |            |
| DID (TW) |          |           |            |            |            |            |            |
| Treatment group | −0.09%   | −0.44%    | −1.45%     | −0.56%     | −0.76%     | 1.05%      |            |
| Comparison group | −5.93%   | −5.05%    | −5.36%     | −5.63%     | −5.16%     | −6.16%     |            |

for services not covered by the NHI. As a result, the OOP payment share of health expenditures remained exceedingly high (55.74% in 1990), and consequently, hardly any policy effect in reducing households’ catastrophic payments could be observed right after the introduction of the NHI in 1989. Benefit coverage expansion was not an important policy priority before 2000 when insurance plans were consolidated, and the separation of prescribing and dispensing medicines was introduced. The South Korean government made efforts to respond to the public demand for better and more service coverage after the NHI’s financial status improved in 2004.

In contrast, Taiwan’s NHI was inaugurated by merging four social insurance programs and expanding coverage to the uninsured population. It would have been infeasible (if not impossible) to offer anything less than the scope of coverage already provided by the then-existing social insurance schemes. Citing evidence from the RAND Health Insurance Experiment and various studies in the 1990 Technical Report for the NHI Planning, Taiwan’s NHI scheme also launched, for the first time, a cost-sharing requirement at the point of service, to minimize the potential moral hazard. Because the Taiwanese government was also aware of the potential impact of this requirement on socially disadvantaged households’ access to health services—and probable public resistance—it decided to set a rather modest cost-sharing level. Unlike South Korea’s scheme, the insured in Taiwan needed to pay only a copayment of $1.70 USD for a physician visit at a clinic and $7 USD at a medical center, and 10% coinsurance for inpatient services. Moreover, Taiwan’s NHI capped the amount of total coinsurance that a patient has to pay for hospitalization services each year at 10% of the average national income per person.

A study on equity in healthcare use reveals that South Korea demonstrates a strong pro-rich tendency at medical centers and a pro-poor tendency at lower-level provider institutions. That is, the rich who can afford high cost sharing are more likely to seek care at the high-end, sophisticated tertiary-care institutions, while the less well-off are more likely to seek services at public-funded health centers or clinics. Although a similar pattern is observed in Taiwan, the magnitude and discrepancy among the different provider levels are not as pronounced as in South Korea (Figure 3).

The differential access to providers reflects discrepancies in the extent of financial risk protection across the socio-economic strata, and it also explains the pro-rich distribution of the catastrophic payment headcount observed in South Korea.

### Historical Evolution

In its early stage, social health insurance in South Korea and Taiwan was introduced by authoritarian governments, which gave priority to economic growth over social welfare. Policymakers in lower-income societies under an authoritarian government believed that aggregate economic growth would trickle down. However, welfare was sacrificed for rapid economic growth to a significant extent. In terms of insurance membership, social health insurance in the two economies was selective rather than universal. The programs benefited mainly government officials and employees of large companies, while leaving a significant proportion of the population, most of whom needed social protection, uninsured.

Meanwhile, the then-existing social health insurance schemes in South Korea and Taiwan exhibited some distinct differences in organizational structure, financing mechanism, and cost-sharing requirement. The South Korean health insurance system adopted a multiple
insurance funds model, whereby insurance funds were not pooled, and each insurance fund set its own premium dependent on enrollees’ utilization rates. Given the inherent differences in financial solvency among insurance funds, it was challenging, if not impossible, to provide comprehensive benefit packages and maintain low cost sharing as the government subsidy was negligible. In contrast, the Taiwanese health insurance system was composed of only four social insurance schemes, namely, LI, GEI, FI, and LIHHL. Though premium contribution rates were set independently, the scope of benefit coverages was comparable as the insurance schemes were partially or fully subsidized (only low-income households) by the government. Essentially, there was no coinsurance requirement for insured services, except for 10% on drug costs prescribed in ambulatory visits for some GEI insured. These distinct features of the South Korean and Taiwanese health insurance systems manifested the differences in the magnitude of financial risk protection provided even before achieving universal population coverage.

**Political Context**

In the 1980s, both South Korea and Taiwan experienced a transition to democracy, which motivated the then-authoritarian ruling parties to strategically focus on improving social welfare to win votes in the forthcoming presidential elections in a new environment of political competition. Achieving UHC proved to be an effective item on the political agenda.29

In the mid-1980s, the then-authoritarian South Korean government proposed to expand health insurance coverage to the self-employed and unemployed. It has been suggested that the president and the presidential candidate of the ruling party—both former military generals—wanted to obtain political support and legitimacy by proposing UHC as a major priority before the 1987 presidential election.15 By that time, South Korea had run social health insurance schemes for the employed with a “low contribution–low benefit coverage” design, which seemed to work without any apparent controversy for the first decade of implementation. In addition to being part of the UHC proposal, the self-employed lobbied for the government to subsidize 50% of their premium contribution, just as the employees whose employers paid half of their premium. The request, by the self-employed, for a premium subsidy implied a sizable financial burden on the government budget. Despite the country’s strong economic growth, the South Korean government was daunted by the potential financial challenges arising from expanding both the population coverage and the scope of benefits. However, the then-ruling party soon recognized that expanding the population coverage would rally support and win votes. Meanwhile, little attention was given to benefits coverage.

Taiwan’s NHI program was implemented in 1995 after nearly a decade of planning. The planning task force, led by international and domestic experts, recommended a social insurance model that closely followed the legacy of the existing social insurance schemes, which were suffering from significant financial insolvency. The mounting
financial deficit was due to the comprehensive benefits coverage being priced at a low-cost premium and ineffective management of the insurance schemes. With a fast-growing economy as its backbone, the ruling party seized the NHIF as a golden opportunity to overhaul the social health insurance system and was determined to exploit political will to move forward with UHC. In addition, the timing of the implementation was carefully calculated to maximize the potential gain in the upcoming legislative and presidential election campaigns in 1995 and 1996, respectively. Despite the fact that the then-ruling party had overwhelming political dominance for decades, the 1996 presidential election was the first in which the president was directly elected through popular votes. Hence, there was much uncertainty about then President Lee’s reelection prospects. The introduction of the NHIF scheme was perceived as one of the key policies to win votes and undercut the then-opposition party, Democratic Progressive Party’s popular appeal. It would have been politically infeasible to cut back on the scope of benefits under the single-payer umbrella with a uniform benefits coverage design.

Universal population coverage was achieved in both South Korea and Taiwan amid strong political forces exerted by the then-dominant ruling parties, who perceived UHC as an effective vote-winning strategy and, even more interestingly, followed a path-dependent approach. While maintaining a “low contribution—low benefits” design, South Korea expanded population coverage by increasing the number of insurance funds, which were almost financially independent. This “additive” approach to achieving UHC had implications in terms of introducing limited risk pooling and redistributive effect, and also imposing a limitation on raising the level of financial protection through large-scale benefits coverage expansion, due to diverse financial situation across the insurance funds. In contrast, the Taiwanese government decided that its comprehensive benefits coverage should remain intact to optimize the program’s political feasibility while integrating four existing social insurance schemes into a single-payer system to achieve UHC. Essentially, the government’s policy focus determined the landscape of the UHC as reflected by its coverage effectiveness in the initial phase.

Universal health coverage will continue to be an important policy goal that most nations aspire to achieve, but it is not a cure-all panacea for strengthening financial risk protection in terms of minimizing catastrophic payments and potential medical impoverishment. To provide sufficient financial protection against unexpected medical expenses, the design of the insurance scheme—in particular, the risk-sharing mechanism—not only matters but is the key to success in shielding people from financial risks. Recognizing that every health system has its own uniqueness and taking account of its historical evolution and cultural context, we still hope that this tale of two prominent social health insurance systems in Asia, South Korea and Taiwan, will shed some light on the road to UHC for countries sharing common economic and political development traits.

Note

[a]. To mitigate potential moral hazard induced by insurance coverage, insurance schemes often impose cost-sharing mechanisms in the form of coinsurance and copayment at the point of service. Coinsurance (rate) is a proportion of a medical bill that the patient has to pay, and copayment means a fixed/lump sum monetary amount paid by the patient. However, a higher level of cost-sharing is more likely to expose the insured to a higher level of financial risk. The cost-sharing mechanisms in South Korea and Taiwan are detailed in the “Design of the insurance schemes” in the paper’s Discussion section.

Acknowledgments

The authors appreciate the editorial assistance provided by Asia Health Policy Program (Shorenstein Asia-Pacific Research Center, Stanford University) led by Karen Eggleston, and valuable comments by Adam Wagstaff and Kharris Templeman, however, the authors are solely responsible for the views presented in this paper.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Funding

JR Lu and JT Sheu are grateful for the grant support of the Ministry of Science and Technology [NSC 99-2410-H-182-003-MY3, MOST107-2410-H-182-014-MY3, MOST 109-2410-H-182-006, and MOST 110-2410-H-182-011] in Taiwan, from which this paper is derived. TJ Lee is also grateful for the support of the National Research Foundation of Korea Grant, funded by the Korean Government (NRF-2013S1A2A1A01066691).
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Appendix: Estimation Model—Difference-in-Differences set-up

1. Estimation Models

We exploited a DID estimation strategy to assess the impact of UHC on catastrophic health payment headcount. The DID estimation is often adopted to evaluate the policy impact. Various studies have investigated the NHI impact on household saving and consumption pattern through the application of the DID analysis and SFIE data. Since we aimed to estimate the policy effect on the average, instead of applying a nonlinear probability estimation model, such as logit or probit model, we adopted a linear probability model as follows:

\[ y_i = \beta_0 + \beta_1 \times \text{Post}_i + \beta_2 \times \text{Tx}_i + \beta_3 \times \text{Post}_i \times \text{Tx}_i + x_i \gamma + \epsilon_i \]  

(1)

where \( y_i \) equals to one if a household’s OOP payment share exceeds 10% of total household expenditure, and zero otherwise. The model includes a variable indicating the post-NHI years (Post); a dummy variable for treatment group (Tx) and an interaction term of Post \( \times \) Tx; and a vector of household characteristics \( (x_i) \). Household characteristics are represented by age, gender, and educational attainment level of household head; household income; presence of children under five or any elderly persons in the household; and the urbanization level of a household’s residence. The household characteristics of the analytical sample, treatment versus comparison group, are listed in Table A1. Results of equation (1) are shown in Table A2. From Table A1, the NHI policy effect derived from DID estimated coefficients of interaction (Treatment X Post-NHI) indicates a significantly negative effect in Taiwan (5.02 percentage point drop) and no significant effect in South Korea. This confirms our findings that the implementation of the NHI policy results in a lower probability of incurring catastrophic payment.

### Table A1. Household characteristics of the analytical sample—treatment vs. comparison group.

|                      | South Korea |           | Taiwan |           |
|----------------------|-------------|-----------|---------|-----------|
|                      | Comparison  | Treatment  |         | Comparison| Treatment  |
| Sample size          |             |           |         |           |           |
| Age (Household head) |             |           |         |           |           |
| < 20 (%)             | 27,110      | 79,016    |         | 8,973     | 13,218    |
| 20–34 (%)            | 0.15        | 0.00      | ***     | 0.00      | 0.36      | ***       |
| 35–44 (%)            | 30.51       | 24.22     |         | 18.13     | 10.21     |           |
| 45–64 (%)            | 35.27       | 42.65     |         | 36.83     | 15.87     |           |
| ≥ 65 (%)             | 33.95       | 31.94     |         | 43.73     | 22.74     |           |
| Gender (Household head) |            |           |         |           |           |
| Male (%)             | 93.53       | 91.46     | ***     | 84.93     | 72.82     | ***       |
| Female (%)           | 6.47        | 8.54      |         | 15.07     | 27.18     |           |
| Education (Household head) |           |           |         |           |           |
| Graduate school (%)  | 9.06        | 0.74      | ***     | 11.71     | 0.61      | ***       |
| College (%)          | 54.97       | 16.70     |         | 63.27     | 15.45     |           |
| Senior high school (%)| 34.67       | 51.97     |         | 20.37     | 21.11     |           |
| Junior high school (%)| 1.20        | 19.93     |         | 2.14      | 16.76     |           |
| Elementary school (%)| 0.10        | 10.65     |         | 2.51      | 46.07     |           |
| Household with kids under 5 |       |           |         |           |           |
| Yes (%)              | 33.60       | 30.93     | ***     | 25.28     | 8.84      | ***       |
| Household with elderly |            |           |         |           |           |
| Yes (%)              | 15.38       | 16.29     | ***     | 24.30     | 67.16     | ***       |
| Region               |             |           |         |           |           |
| Taipei region (%)    | -           | -         |         | 43.64     | 31.68     | ***       |
| Northern region (%)  | -           | -         |         | 10.41     | 11.36     |           |
| Central region (%)   | -           | -         |         | 13.87     | 17.08     |           |
| Southern region (%)  | -           | -         |         | 11.85     | 14.27     |           |
| Eastern region (%)   | -           | -         |         | 4.00      | 5.45      |           |
| Kao-ping region (%)  | -           | -         |         | 16.23     | 20.15     |           |
| Region               |             |           |         |           |           |
| Seoul (%)            | 21.21       | 29.18     | ***     | -         | -         |           |
| Other cities (%)     | 78.79       | 70.82     | -       | -         | -         |           |
| Urbanization         |             |           |         |           |           |
| City (%)             | N/A         | N/A       | 82.43   | 74.20     | ***       |
| Town (%)             | N/A         | N/A       | 14.34   | 18.97     |           |
| Rural area (%)       | N/A         | N/A       | 3.23    | 6.83      |           |
| Annual household income (USD) | 22,756      | 17,625    | ***     | 65,256    | 21,756    | ***       |
| Annual household disposable income, per equivalent adult (USD)| 8,172       | 7,002     | ***     | 23,846    | 11,848    | ***       |

1 USD = 731.47 KRW (as of 1988); 1 USD = 26.24 NTD (as of 1994); *** p < 0.001, ** p < 0.01, * p < 0.05; For Taiwan, regions are grouped by NHIA branch office. For South Korea, regions are categorized as Seoul and other cities since Household Income and Expenditure Survey data was collected from urban households. Comparison group: household members with HIGET/GEI benefits. Treatment group: household members without any social insurance.
Table A2. NHI policy effect on household catastrophic payment headcount, results from DID linear probability models.

| Probability of households incurring catastrophic payment | South Korea | Taiwan |
|----------------------------------------------------------|-------------|--------|
| | Coef. | S.E. | Coef. | S.E. |
| Intercept | 0.1061 | * | 0.0430 | 0.0484 | *** | 0.0122 |
| Interaction terms | | | | | | |
| Treatment group \( \times \) Post-NHI years | -0.0146 | | 0.0099 | | -0.0502 | *** | 0.0100 |
| Group (ref: control group) | 0.0284 | ** | 0.0092 | | 0.0456 | *** | 0.0103 |
| Post-NHI year (ref: Pre-NHI year) | | | | | | |
| Post-NHI | -0.0189 | ** | 0.0070 | | -0.0034 | | 0.0067 |
| Household head’s age-sex (ref: 35–44 male) | | | | | | |
| <20 male | 0.0000 | - | 0.0000 | | - | - | - |
| 20–34 male | 0.0213 | *** | 0.0046 | | 0.0146 | * | 0.0065 |
| 45–64 male | -0.0030 | | 0.0044 | | 0.0043 | | 0.0053 |
| ≥ 65 male | -0.0778 | | 0.0510 | | 0.0845 | *** | 0.0078 |
| <20 female | 0.0000 | - | 0.0000 | | - | - | - |
| 20–34 female | -0.0217 | | 0.0137 | | 0.0198 | * | 0.0098 |
| 35–44 female | 0.0419 | | 0.0237 | | 0.0168 | | 0.0088 |
| 45–64 female | -0.0140 | | 0.0247 | | 0.0152 | * | 0.0076 |
| ≥ 65 female | 0.0000 | - | 0.1751 | *** | 0.0157 |
| Household head’s education level (ref: Elementary school and below) | | | | | | |
| Graduate school | -0.0641 | | 0.0101 | | -0.0492 | *** | 0.0101 |
| College | -0.0526 | | 0.0067 | | -0.0600 | *** | 0.0067 |
| Senior high school | -0.0220 | | 0.0065 | | -0.0439 | *** | 0.0065 |
| Junior high school | -0.0120 | | 0.0076 | | -0.0305 | *** | 0.0076 |
| Household income level (ref: Lowest 20%) | | | | | | |
| Lower 20% | 0.0098 | | 0.0080 | | -0.0031 | | 0.0080 |
| Middle 20% | 0.0144 | * | 0.0081 | | -0.0012 | | 0.0081 |
| Higher 20% | 0.0356 | *** | 0.0090 | | 0.0091 | | 0.0090 |
| Highest 20% | 0.0529 | *** | 0.0097 | | 0.0127 | | 0.0097 |
| Household with kids under 5 (ref: without) | 0.0182 | *** | 0.0053 | | -0.0077 | | 0.0053 |
| Household with elderly (ref: without) | 0.0307 | *** | 0.0046 | | 0.0633 | *** | 0.0046 |
| Region (ref: Taipei region) | | | | | | |
| Northern region | - | - | 0.0169 | * | 0.0067 |
| Central region | - | - | 0.0183 | *** | 0.0057 |
| Southern region | - | - | 0.0290 | *** | 0.0061 |
| Eastern region | - | - | 0.0559 | *** | 0.0093 |
| Kao-ping region | - | - | 0.0330 | *** | 0.0053 |
| Region (ref: Seoul) | | | | | | |
| Other cities | 0.0048 | | 0.0039 | | - | - | - |
| Levels of urbanization (ref: City) | | | | | | |
| Town | - | - | -0.0042 | | 0.0054 |
| Rural area | - | - | -0.0022 | | 0.0090 |

* Catastrophic payment is defined as out-of-pocket health payment exceeding 10% of total household expenditure.

** p-value<0.001 ** p-value<0.01 * p-value<0.05.

2. Tests of potential selection issue

As to the estimation of equation (1), there are two potential estimation issues. First, a linear probability model was chosen over a non-linear probability model in estimating the NHI policy effect, which may not be considered most appropriate for the binary variable examined here. However, under a non-linear regression model set-up, the policy effect cannot be estimated by reading off the parameter coefficients directly, and the complexity of the approximation techniques may divert the key discussions from the policy effect. Nonetheless, we did follow the approach proposed by Ai and Norton (2003) and Norton et al. (2004) in non-linear regression model and found the results to be insensitive to the use of non-linear models rather than least squares (Table A3). Second, a potential selection issue between treatment and comparison groups might make our estimation of equation (1) inconsistent. In order to resolve the potential econometric issue, we first compared results by using matched samples based on the propensity score matching (PSM) method and unmatched samples while estimating equation (1). Then, we also compared results by including and excluding all exogenous variables (Xs). If selection bias is present, the DID policy effect estimated from the matched sample would be significantly different from that from the unmatched sample. In addition, if there is selection bias, the DID policy effect estimated from models with and without exogenous variables (Xs) would be significantly different from each other as well. However, we found no evidence of significant selection bias (Table A3).
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**Table A3. Robustness check.**

|                  | Unmatched sample |                  | PSM matched sample |                  |
|------------------|-------------------|-------------------|--------------------|-------------------|
|                  | Non-linear logit  | OLS               | OLS (without the Xs)| Non-linear logit  | OLS               | OLS (without the Xs)|
|                  | Coef. (S.E.)      | Coef. (S.E.)      | Coef. (S.E.)       | Coef. (S.E.)      | Coef. (S.E.)      | Coef. (S.E.)       |
| Korea            | 0.0016(0.0070)    | 0.0005(0.0068)    | 0.0018(0.0068)     | −0.0143(0.0105)   | −0.0146(0.0099)   | −0.0146(0.0099)    |
| Taiwan           | −0.0619(0.0134)   | ***               | −0.0688(0.0102)    | ***               | −0.0567(0.0104)   | ***               |

*Catastrophic* health care payment is defined as households incurring more than 10% of total household expenditures on health care.

**p-value<0.001 **p-value<0.01 *p-value<0.05; a—these are mean interaction effect and mean standard error computed based on Ai and Norton (2003) and Norton et al. (2004).