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Health Insurance and Financial Protection:

Evidence from Egypt

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Health Insurance and Financial Protection: Evidence from Egypt *

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Abstract

The paper exploits the phased roll-out of Egypt's Universal Health Insurance System to examine the reform's impact on household financial protection. Using the staggered introduction of the new system as a quasi-experiment, the paper estimates causal effects on out-of-pocket health spending, catastrophic health expenditure, and health insurance coverage. Applying synthetic control methodology, results suggest that the reform reduced out-of-pocket spending by 46.8 percent and catastrophic health expenditure by 33.4 percent. Results are robust across a range of checks, and the findings support nationwide scale-up of the system.

Keywords: universal health coverage, out-of-pocket health expenditure, catastrophic health expenditure, synthetic control methodology, Egypt

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1 Introduction

Over one billion individuals incurred catastrophic out-of-pocket health spending in 2019 (World Health Organization and World Bank, 2023). This means that globally, more than one in ten of the world's population spends more than 10 percent of their income on healthcare. Such payments can push millions of households into poverty, as they reduce households' ability to pay for other necessities, such as food and clothing (World Health Organization and World Bank, 2017; World Health Organization et al., 2010). Reducing this burden has therefore become a central concern for global health policy. Achieving universal health coverage has been a key target of the Sustainable Development Goals (SDGs) since 2015. Health insurance coverage in low- and middle-income countries has been increasing in recent years, with close to half of the total population reporting being covered by health insurance (Das and Do, 2023). Yet, despite the increase in coverage, low- and middle-income countries (LMICs) have experienced the largest increase in the proportion of the population incurring impoverishing out-of-pocket health spending (World Health Organization and World Bank, 2023).

Though expected, having health insurance does not automatically lead to the hoped-for decline in out-of-pocket (OOP) health expenditure or the incidence of extremely high out-of-pocket spending, often called catastrophic health expenditure (CHE). There are several reasons why health insurance systems might not provide the intended financial protection to households. First, cost-sharing can continue to impose a financial burden, particularly on low-income households, especially in situations where the health insurance system relies on cost-sharing or co-payments (Kolasa and Kowalczyk, 2016; World Health Organization and World Bank, 2023). Second, the slow uptake of health insurance may limit its protective effects (Castano et al., 2002; Hooley et al., 2022). Third, many insurance systems do not cover the full range of health services, which means that households must continue to pay for uncovered services (Kolasa and Kowalczyk, 2016; Flourence et al., 2025). Finally, services under the health insurance system might not be perceived of adequate quality, forcing households to seek care from private providers not covered by the health insurance (Adebayo et al., 2015). Other supply-side issues such as long waiting times, geographic proximity, shortages in medicines or poor communication of the services can also limit the benefits of health insurance systems (Adebayo et al., 2015; Flourence et al., 2025). Taken together, these factors indicate that the establishment of a health insurance system does not guarantee a reduction in household healthcare spending.

This paper examines these dynamics in the context of Egypt, a country where out-of-pocket spending remains high. In 2019, Egypt's out-of-pocket spending accounted for about 63 percent of total health care expenditure, compared to 18 percent globally and 29 percent for the Middle East and North Africa (MENA) region (Oxford Business Group, 2022). The Egyptian government sought to address this issue through major structural reforms and a renewed commitment to universal health coverage (UHC). In 2018, a new

Universal Health Insurance Law was enacted, with the aim of reaching universal health coverage across the country. The universal health insurance system is designed to be rolled out in phases, over ten to fifteen years. Implementation began in Port-Said in November 2019, as the pilot governorate.[1] Two years later, it was rolled out to more governorates.

This study exploits the gradual roll-out of the health insurance system, to assess the impact of introducing universal health insurance in the first pilot governorate on household out-of-pocket spending and the incidence of catastrophic health spending, as well as on insurance coverage.[2] The contribution of this paper is twofold. First, the paper contributes to the literature on the causal link between health insurance and household health spending in low- and middle-income countries. Studies evaluating the impact of health insurance on household financial protection demonstrate significant variability in their impacts, with evidence ranging from substantial reductions in financial burden to negligible or even adverse effects (Eze et al., 2023; Erlangga et al., 2019; Rahman et al., 2022). Second and more importantly, this is the first study providing causal evidence on Egypt's universal health insurance system. The paper extends the literature on the financial protection effects of health insurance to West Asia and North Africa, a region for which causal evidence remains largely absent. To the best of my knowledge, this is the first study to employ causal inference methods to evaluate the financial protection effects of universal health insurance in this region. Egypt represents a particularly pertinent case given the fragmented nature of its healthcare system, the scale of its reform agenda, and its distinct institutional and socio-demographic characteristics. All of these factors may shape the effects of health insurance expansion in ways that differ from other studied settings.

This paper employs a quasi-experimental design to examine the causal effects of Egypt's Universal Health Insurance System (UHIS) on household health expenditure. The study utilizes Egypt's Household Income, Expenditure and Consumption Surveys (HIECS) for 2021/22 and earlier years, to evaluate the impact of the health insurance reform on out-of-pocket and catastrophic health spending. At the time of data collection of the latest HIECS, Port-Said was the only governorate where health insurance was launched. A synthetic control methodology is employed to estimate the causal impact of the UHIS in Port-Said. Results indicate that the system led to a 46.8 percent reduction in out-of-pocket health expenditure and a 33.4 percent decline in the probability of incurring catastrophic health expenditure, relative to the synthetic control. The results are robust to a range of robustness and placebo checks. The main channel for the decline in health spending is posited to be an increase in insurance coverage. Difference-in-differences estimates indicate that the reform raised the probability of all household members being covered by health insurance by 74.9 percentage points.

[1]Governorates define the geographic administrative divisions in Egypt, such as states in the United States of America, or provinces in European countries.

[2]Out-of-pocket health spending refers to payments made by households directly at the point of receiving care (Eurostat, 2026; Xu, 2005). Catastrophic health spending arises when such payments exceed a threshold share of household income or consumption, commonly 10 or 25 percent (World Health Organization and The World Bank, 2021).

The increase in insurance coverage suggests that insurance take-up is a key mechanism for the observed effect in household healthcare spending. These findings have significant policy implications, since they imply that the reform is providing meaningful financial protection. The results also offer support for scaling up the new health insurance system nationally, while providing policymakers with empirical evidence that justifies sustained public investment in its financing and implementation.

Egypt's reductions are broadly consistent with effects documented across comparable programmes, with the notable distinction that the reduction in average out-of-pocket spending exceeds that in catastrophic spending, reversing the pattern most commonly observed in the literature. A growing body of experimental and quasi-experimental evidence examines the relationship between health insurance and household health expenditure in low- and middle-income countries (LMICs). The evidence suggests that insurance coverage more reliably reduces catastrophic spending than average out-of-pocket spending, although estimated effects vary across settings, system design, and household characteristics. Experimental estimates for Mexico's *Seguro Popular* find a 23 percent decline in catastrophic expenditure, but no detectable reduction in mean out-of-pocket spending, except for poor households (King et al., 2009). Meanwhile, instrumental variable estimates for the same programme suggest a 54 percent reduction in catastrophic spending alongside lower outpatient costs and lower medicine expenditures, while propensity score matching highlights substantial heterogeneity among insurance beneficiaries (Galárraga et al., 2010; García-Díaz et al., 2018). In Thailand, the Universal Coverage Scheme reduces average medical spending by roughly one-third alongside a significant fall in catastrophic exposure (Limwattananon et al., 2020).

In other contexts, no significant effects on average out-of-pocket spending were detected. In Burkina Faso, community-based insurance produces no significant effect on mean out-of-pocket spending but results in a 30 percent reduction in catastrophic expenditure (Fink et al., 2013). Ghana's National Health Insurance Scheme (NHIS) shows only marginal differences in out-of-pocket spending between insured and uninsured households, despite near-universal eligibility (Younger and Raju, 2022). The evaluation of India's *Rashtriya Swasthya Bima Yojana (RSBY)* finds no significant impact on inpatient out-of-pocket or catastrophic spending (Karan et al., 2017), while India's *Aarogyasri* scheme reduces only inpatient out-of-pocket expenditure (Fan et al., 2012). Some studies attribute the lack of impact to the presence of persistent care-seeking barriers, a narrow benefit package, or low insurance coverage. Meanwhile, other studies attribute the absence of true effects to estimation challenges. For instance, in rural China, a statistically insignificant out-of-pocket estimate is attributed to imprecision from short recall windows and few recent spenders (Gruber et al., 2023). This is a limitation that this paper addresses by drawing on Egypt's HIECS, which employs a recall period of one month, three months and one year for the different health products and services depending upon the consumption frequency and reports the total annual spending, thereby offering a more reliable basis for estimating healthcare expenditure.

Egypt's Household Income, Expenditure and Consumption Surveys (HIECS) also offer a range of demographic variables that serve as key determinants of health spending outcomes. At the household level, it has been identified in the literature that residing in rural areas, belonging to lower income quintiles, having large families, and including elderly members, young children, or individuals with chronic illness or disability are all associated with a higher risk of catastrophic spending (Azzani et al., 2019; Bolongaita et al., 2023). Household head characteristics further compound this vulnerability, with female, older, less educated, and unemployed heads facing greater exposure (Azzani et al., 2019). Evidence from Egypt specifically indicates that higher shares of insured, educated, and wage-earning household members are protective against catastrophic spending (Abdel-Rahman et al., 2021). Meanwhile, at the macro level, lower GDP per capita, reduced public health spending, and limited external health financing are associated with higher out-of-pocket payments (Opoku Frimpong et al., 2022). Including these variables as predictors in the synthetic control model may help improve the estimation of the financial protection effects of the health insurance reform. The model therefore incorporates a selection of these variables, subject to data availability within the household survey and from other data sources.

The remainder of the paper is structured as follows. Section 2 provides background information on Egypt's health insurance system, covering both the pre-reform system and the newly introduced UHIS. Section 3 presents the datasets used in the analysis and section 4 presents the empirical framework adopted. Finally, Section 5 presents and interprets the results, and the last section concludes with a discussion of policy implications.

2 Background

2.1 Egypt's Original Health Insurance System

Public health insurance in Egypt was developed in the mid-1960s, as part of the country's socialist movement. In 1964, the Health Insurance Law Number 62 was passed, along with a Presidential decree establishing the Health Insurance Organisation (HIO) (Hetta, 2024). The law covered public sector employees with a pilot in Alexandria, but was then rolled out to the whole country, adding more categories of beneficiaries (Hetta, 2024). The HIO used to cover about 60 percent of the population, offering basic healthcare to formal workers, students and pensioners. Funding within the HIO consisted of separate funding pools for the different population groups, with restricted cross-subsidies across the separate pools (Khalifa et al., 2022). Meanwhile, other health coverage systems were developed. A system called the "Programme for the Treatment at the Expense of the State" was established, to cover poor households that are not covered by the

HIO. Additionally, labour unions were encouraged to start health insurance schemes in the 1980s, and develop their own insurance systems. Finally, private health insurance was introduced in the 1990s, being targeted to large state-owned or private employers and wealthy individuals (Elsheemy and Gomaa, 2024). Together, the fragmentation of insurance providers, growing population pressure, and fiscal constraints contributed to shortfalls in health service provision and broader strains on the healthcare system (Elsayed, 2023; Rashad and Sharaf, 2015b; Hetta, 2024).

System failures kept out-of-pocket health payments persistently high in Egypt. According to Egypt's national health accounts for 2019/20, out-of-pocket payments accounted for around 60 percent of current health expenditures, and remained around this level for the past 20 years (World Health Organization Regional Office for the Eastern Mediterranean, 2023). Between 2018/19 and 2019/20, the share declined slightly from 62.7 percent to 59.3 percent, coinciding with higher government spending in the health sector following the introduction of the universal health insurance (World Health Organization Regional Office for the Eastern Mediterranean, 2023). Egypt also fares poorly compared to other countries when it comes to catastrophic health spending. According to the World Bank (2024), 31 percent of the population spent more than 10 percent of household consumption or income on out-of-pocket health care expenditure in 2017, compared to 14 percent for Lower Middle Income countries, almost 16 percent for the Middle East and North Africa (MENA) region and 13 percent globally (World Bank, 2024). These pressures have been pushing households into financial hardship. In 2011, one fifth of the population were pushed into financial catastrophe due to out-of-pocket health payments, and 3 percent were pushed into extreme poverty (Rashad and Sharaf, 2015a). Such findings stress the importance of improving health insurance coverage as part of the social protection umbrella in Egypt.

2.2 New Universal Health Insurance System

In order to improve social protection and healthcare, Egypt decided to revamp its healthcare system. On 11 January 2018, the Egyptian Parliament passed a bill to ratify Egypt's new Universal Health Insurance Law, Law No. 2 of the year 2018 (Al Tamimi and Company, 2018; Sharkawy & Sarhan Law Firm, 2018; State Information Service (SIS), 2018). The main objectives of Egypt's universal health insurance reform are twofold. First, to ensure equitable access for all members of society to high-quality medical services, including comprehensive preventive care and early diagnostic interventions. Second, to provide financial protection against high out-of-pocket health expenditures, by covering the insurance costs for individuals and families who are unable to afford healthcare. In sum, the reform aims to reduce poverty and improve public health outcomes by restructuring the management of health insurance, and establishing a set of new organisations and mechanisms responsible for managing healthcare funding and service provision (Presidency of the Arab Republic of Egypt, 2025; Mathauer et al., 2018).

The Ministry of Health and Population (MOHP) is the body responsible for overseeing the administration of the universal health insurance, with the support of the World Health Organization (WHO), through a loan of USD400 million (World Health Organization, 2020). The new law establishes three organizations, namely 1) “The Universal Health Insurance Authority” (UHIA) to act as the purchaser of health services, 2) “The Egypt Healthcare Authority” (EHA) to act as the provider, and 3) “The General Authority for Healthcare Accreditation and Regulation” (GAHAR) for setting quality standards for health facilities. UHIA is the main body responsible for contracting healthcare services from both public and private providers, which are then delivered to individuals through EHA hospitals and health units, and overseen by GAHAR.

According to UHIA, registration for the health insurance system takes place at the primary health care units, whereby individuals need to bring their national identity documents (IDs), and their children’s birth certificates, to set up a “Family Health Card.” This means that only households with a registered address in a governorate where the system has been launched can register, while the system is being rolled out. To receive medical services, household members need to register with the primary health care unit covering their catchment area, and to pay the insurance contributions if they are not exempt. The primary health care unit then allocates a family doctor to the household, who can refer patients to specialist doctors or provide care directly. The specialist doctor can also refer patients to hospitals. The health insurance system covers initial medical examinations, x-rays and medical analyses, as well as surgical interventions including dental care. However, it does not cover public health, mental health or preventive services. In addition, the insurance does not cover family planning or vaccination services, nor disasters, epidemics, or ambulance services (Presidency of the Arab Republic of Egypt, 2025; Universal Health Insurance Authority, 2024).[3] For covered services, citizens have the right to claim a refund for medical costs incurred outside of the system, in cases of emergencies (Universal Health Insurance Authority, 2024).

There are five main health insurance enrolment categories which define how the system is financed. These categories are formal sector employees, pensioners, beneficiaries of unemployment benefits, self-employed and informal workers, and unprivileged individuals. The National Organization for Social Insurance (NOSI) transfers the insurance contribution of the first three categories, namely formal workers, pensioners and unemployed with benefits to UHIA. Formal employees are required to pay their own contribution as well as that of their dependents. Workers pay 1 percent payroll tax to enrol, in addition to 3 percent for non-working spouses and 1 percent for each other dependent (World Bank, 2025a). Employers also have to pay 3 percent of employees’ taxable wage per month to the health authority (Presidency of the Arab Republic of Egypt, 2025). For pensioners, the health insurance contribution is deducted from the pension before

[3]UHIA website states that the government is committed to providing these uncovered services for free (Universal Health Insurance Authority, 2024).

disbursement. Similarly, NOSI transfers the contributions of those eligible for unemployment benefits to UHIA. Self-employed and informal workers are required to pay 5 percent of their wage as declared in their tax returns to UHIA. Meanwhile, the state treasury covers the contribution of those who cannot afford to pay. This contribution is equivalent to 5 percent of the monthly national minimum wage, and is transferred from the Ministry of Finance to UHIA.

The government uses the database of Egypt's largest cash transfer programme, "Takaful and Karama" (TKP), to identify the most vulnerable households, whose contributions are covered by the state. Beneficiaries of TKP are automatically exempt from co-payments for health services under the new law. The same applies to individuals covered by other social protection programmes such as social security and children's pensions. The government also covers contributions for additional underprivileged groups, including 1) unemployed individuals ineligible for unemployment benefits; 2) individuals without family support such as those living in social care facilities, homeless individuals, and adopted children; 3) persons with disabilities; 4) people living in areas exposed to natural or man-made disasters; and 5) people whose average income is insufficient to cover basic needs (World Bank, 2025a). Finally, patients with chronic diseases or cancer are exempt from paying their contributions, or co-paying medical costs (Universal Health Insurance Authority, 2024).

The UHIS is designed to be rolled out over ten to fifteen years, in six phases. Table A1 in the Appendix presents the distribution of the governorates across each phase of implementation. Phase 1 includes Port-Said, Ismailia, Suez, South Sinai, Luxor and Aswan. The selection of Phase 1 governorates was based on their health system readiness and capacity, while also accounting for social protection considerations by including high poverty governorates such as Luxor and Aswan (Center for Strategic and International Studies (CSIS), 2018; Egypt Healthcare Authority, 2024). Official roll-out dates for the governorates of the first phase are presented in Table A2. The system was launched in July 2019 in Port-Said, and officially started in November 2019. Port-Said has long served as Egypt's pilot governorate for government initiatives. It was selected by the government for being demographically representative, relatively small and technologically advanced, making it more manageable than larger governorates (Egypt Healthcare Authority, 2024).[4]

Over the period covered by the data used in this study, the system was launched in Port-Said and Luxor. In February 2021, the universal health insurance system was officially rolled out to Luxor, but operations commenced in July 2021 (Center for Strategic and International Studies (CSIS), 2018; Egypt Healthcare Authority, 2024). The latest HIECS was collected between 2021 and 2022. However, only Port-Said serves as the treated governorate in the analysis. Luxor is excluded because implementation there was incomplete by the time of data collection, and it was still too early for the reform to have plausibly affected household

[4]Port-Said was also used as the pilot for the food subsidy reforms in 2013, before their national roll-out (Center for Strategic and International Studies (CSIS), 2018).

spending. In any governorate, the health insurance system takes at least six to nine months to become fully operational. Further time is then needed before households can benefit and spending patterns begin to change.

Emerging evidence is already documenting positive experiences among users of the universal health insurance system. A growing number of descriptive and analytical studies examined Egypt's health system since the reform (Hammad et al., 2025; Sadoun et al., 2025; ElBeheiry, 2025; Ahmed et al., 2025). In a descriptive study assessing patient satisfaction in Port-Said, 48 percent of service users reported being highly satisfied with the medical services provided, and 73 percent rated the overall health system responsiveness as "good" (Ismail et al., 2023). Another study compared perceptions in Port-Said with an urban district in Gharbia governorate, and found that the UHIS beneficiaries reported significantly higher perceived overall satisfaction and accessibility, though no significant difference in perceived service quality was found between UHIS and non-UHIS users (Hammad et al., 2025). Neither study establishes causality, but both suggest that the universal health insurance reform may be improving users' experiences and access to health services.

3 Data

3.1 Expenditure Surveys

Egypt's Household Income, Expenditure and Consumption Surveys (HIECS) are repeated cross-sectional datasets that have been collected regularly from 1958/1959 to 2021/2022. The surveys are nationally representative and collected by Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS). The Economic Research Forum (ERF) provides cleaned and harmonized datasets for HIECS from 1999/2000 to 2021/22. The following rounds have been retrieved from the ERF data portal: 1999/2000, 2004/2005, 2008/2009, 2010/2011, 2012/2013, 2015, 2017/2018, 2019/2020 and 2021/2022 (OAMDI, 2025). The 2019/2020 survey was not used in the analysis because the governorates are not identified in the data (i.e. the data are missing the governorates variable, and only regions are recorded). Only 50 percent of all survey samples are provided, with no personally identifiable information (PII). All household surveys cover both rural and urban areas. The surveys contain information on income sources, expenditure items and household consumption patterns. In addition, the surveys collect socio-economic and demographic information. HIECS have informed the design of several national and local development projects, including the targeting of "Takaful and Karama."

Expenditure outcomes in the data are deflated using annual inflation estimates. Where a survey round spans two calendar years, a weighted inflation rate is applied based on the share of data collection occurring in each year. For instance, if one quarter of data collection took place in 2021 and three quarters in

2022, expenditures are deflated using 25 percent of the 2021 inflation rate and 75 percent of the 2022 rate. This approach is adopted because the exact timing of data collection is not reported at the household or governorate level.[5]

The outcome variables used in the analysis are household out-of-pocket health spending, and catastrophic health spending. Out-of-pocket payments are payments made by individuals at the point of receiving healthcare, including consultation fees, purchases of medication and hospital bills (Xu, 2005). In this study, health spending is measured as the total household expenditure on healthcare. The analysis is conducted on per capita out-of-pocket spending.[6] Catastrophic health spending is defined differently across studies, with thresholds set at 10 percent, 25 percent, or 40 percent of varying denominators such as total income, total consumption, non-food consumption, or capacity to pay (World Health Organization, 2024a).[7] In this paper, catastrophic health spending is defined as exceeding 10 percent of total household expenditure, consistent with the SDGs indicators (World Health Organization, 2024b). The outcome variable is a dummy equal to one if the household spends more than 10 percent of its total expenditure on healthcare.

3.2 Governorate-level Data

Governorate-level variables are merged with the household data to enrich the set of predictors available for the synthetic control model. These data are drawn from reports and statistics published by Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS) and the Ministry of Planning, Economic Development and International Cooperation. Drawing on the literature reviewed above and subject to data availability, the governorate-level predictors included are real health gross domestic product (GDP) per capita, real GDP per capita, urbanisation rate, elderly dependency ratio, and population at the governorate level. Additional predictors are derived from the household survey itself, comprising the share of male-headed households and the share of literate-headed households, aggregated at the governorate level.

4 Empirical Framework

4.1 Identification Strategy

Quasi-experimental research designs are situations where treatment has not been randomized, often when a true experiment is not feasible or ethical (Capili and Anastasi, 2024). The absence of random assignment

[5] Table A3 in the appendix reports the data collection periods, total sample size per survey round, and the inflation rate applied, calculated using annual inflation estimates from the World Bank (2025b).

[6] Per capita spending is used rather than per adult equivalent unit (AEU) because the ages of household members are not identified in the data. Only the number of household members is provided.

[7] Capacity to pay is usually defined as total household consumption minus the average amount spent on food, housing (rent) and utilities (water, electricity and fuel used for cooking and heating) by households between the 25th and 35th percentiles of the household consumption distribution (World Health Organization, 2024a).

makes it essential that treatment and control groups are comparable. The roll-out of Egypt's universal health insurance represents a quasi-experiment, since the system was not implemented throughout the country at the same time. The UHIS implementation was designed to be introduced in phases, making it an ideal setting to explore the impacts of the reform. With data available before and after the introduction of the system, it is possible to assess whether the health insurance reform produced a measurable change in Port-Said relative to governorates where it had not yet been introduced.

The synthetic control method (SCM) is applied to estimate the causal impact of the UHIS on household financial protection. SCM is used given the large pool of control units and the availability of pre-treatment data for the outcome variables and predictors. At the time of data collection, Port-Said was the only fully treated governorate. Although the reform was also rolled out in Luxor, implementation was incomplete and it is unlikely that household spending was affected given the early stage of roll-out. Hence, Port-Said constitutes the treatment group. Luxor is excluded from the analysis because its partial exposure to the reform during the study period could contaminate the control group and bias the estimates.[8] Since only Port-Said has been treated, there are several potential control governorates. The synthetic control method is therefore ideal for constructing a control group that closely matches Port-Said from the pool of untreated governorates.

4.2 Synthetic Control Methodology

Synthetic control methods have been described as "the most important innovation in the policy evaluation literature in the last 15 years" (Athey and Imbens, 2017). Originally introduced by Abadie and Gardeazabal (2003), the methods have since been extended and refined (Abadie et al., 2010, 2015; Abadie, 2021; Abadie and L'Hour, 2021). SCM is particularly well-suited for settings where a small number of units are exposed to an intervention and the outcome of interest is measured at the aggregate level (Abadie and L'Hour, 2021). The method allows the estimation of causal effects through producing an "optimal" counterfactual to the "treated" units from the pool of "donor" control units, by using pre-intervention data. By comparing post-treatment outcomes between the treated unit and its synthetic control, the causal impact of the intervention can be estimated.

Synthetic control methodology has several advantages relative to alternative quasi-experimental methods. First, it removes subjective researcher bias in selecting the control group, and creates a control group that is comparable to the treated group (Abadie et al., 2010; Abadie, 2021; Abadie and L'Hour, 2021). Explicit weights are assigned to donor units based on the resemblance of pre-treatment characteristics between the controls and the treated unit(s), rather than arbitrarily (Cunningham, 2021). This makes the synthetic

[8] Removing Luxor or retaining it within the analysis does not change the results, as it was not selected for Port-Said's synthetic control group.

counterfactual transparent, since the weight assigned to each donor unit is known (Abadie, 2021). Second, by design, the methodology prevents extrapolation, since the synthetic control weights are non-negative and sum to one, which also allows for straightforward interpretation (Abadie and Gardeazabal, 2003; Abadie, 2021). Third, unlike difference-in-differences, the synthetic control method relaxes the parallel trends assumption, allowing a valid counterfactual to be constructed even when pre-treatment trends differ between the treated and control units. It also permits unobserved confounding characteristics to vary over time. Additionally, the method provides clear information about how well the donor pool and the synthetic control can approximate the treated units. This is captured by the root mean squared prediction error (RMSPE), which measures the average deviation between the treated unit and its synthetic counterpart in the pre-treatment period, whereby a lower RMSPE indicates that the synthetic control more closely tracks the treated unit prior to the intervention (Abadie et al., 2010; Abadie, 2021). Finally, since inference is based on permutation, the results can be validated through a range of robustness checks and placebo tests, strengthening confidence in the estimated impacts.

The description of the synthetic control methodology follows Abadie (2021). Suppose that we observe an outcome of interest Y_{jt}, for each unit j and time t. The data span units $j = 1, 2, 3, ..., J + 1$ and T periods, with the first T_0 periods preceding the intervention, such that $1 < T_0 < T$. For each unit j, we also observe a set of k predictors of the outcome, $X_{1j}, X_{2j}, ..., X_{kj}$, which can include pre-intervention values of Y_{jt} or pre-intervention covariates. Both can help predict the synthetic control, but are also assumed to be unaffected by the intervention.

Unit $j = 1$ is assumed to be the treated unit. The "donor pool" is the set of units from which a comparison group can be created, comprising units $j = 2, 3, ..., J + 1$. The potential outcome for the treated unit under the intervention is denoted Y^I_{1t}, for post-intervention period $t > T_0$. Meanwhile, Y^N_{1t} denotes the potential outcome in the absence of the intervention. The treatment effect for unit 1 in period t (where $t > T_0$) is therefore:

$$\tau_{1t} = Y^I_{1t} - Y^N_{1t} \tag{1}$$

Synthetic control methods postulate that a weighted combination of donor pool units may approximate the treated unit more closely than any single untreated unit alone. The weights are chosen so that the resulting synthetic control best resembles the treated unit in terms of pre-intervention values of the outcome predictors (Abadie, 2021). Given a set of non-negative weights that sum to one W, where $W = (w_2, ..., w_{J+1})$, the synthetic control estimate of Y^N_{1t} and the corresponding treatment effect τ_{1t} are, respectively:

$$\hat{Y}_{1t}^{N} = \sum_{j=2}^{J+1} w_j Y_{jt} \tag{2}$$

and

$$\tau_{1t} = Y_{1t} - \hat{Y}_{1t}^{N} \tag{3}$$

Hence, the estimated treatment effect for the treated unit at $t = T_0 + 1, ..., T$ is:

$$\hat{\tau}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \tag{4}$$

where W^* is the set of weights $W^* = (w_2^*, ..., w_{J+1}^*)$ that minimizes $||X_1 - X_0 W||$, whereby the $k \times 1$ vector X_1 contains the values of the predictors for the treated unit. Meanwhile, the $k \times J$ matrix $X_0 = [X_2 ... X_{J+1}]$ contains the values of the predictors for the untreated units.

This paper estimates a synthetic control model for Port-Said, using pre-treatment governorate-level variables as predictors. Following the literature reviewed above, a series of predictors have been used, based on data availability. Predictors are drawn from the household survey and external data sources, as described in section 3. Predictors derived from the household survey are the share of male-headed households and the share of literate household heads. Those drawn from external sources are GDP per capita, health GDP per capita, urbanisation rate, elderly dependency ratio, government hospital beds per capita, the share of private health units, and population size. The analysis is conducted using *Stata 17*.

4.3 Difference-in-Differences Methodology

A key mechanism through which the health insurance system reduces out-of-pocket spending is expanding health insurance coverage. Health insurance coverage lowers the share of medical expenses borne by individuals at the point of care, since insured households can utilise healthcare services without drawing on their income or savings. To assess the impact of the reform on health insurance coverage in Port-Said, difference-in-differences (DiD) is used rather than synthetic control. Although the HIECS individual-level files record health insurance status for all household members, the insurance variable is not available in HIECS rounds prior to 2015, leaving only two pre-treatment observation points (2015 and 2017). This precludes the use of synthetic control for the coverage analysis, as the method requires a sufficient number of pre-treatment periods to construct a credible counterfactual. Difference-in-differences (DiD) is therefore the appropriate estimator for this outcome.

Difference-in-differences has been a widely used quasi-experimental method for causal inference and has seen considerable methodological development in recent years. The key identifying assumption for DiD is the parallel trends assumption, which establishes that in the absence of treatment, the treated and control groups would have followed the same average trajectory over time (de Chaisemartin and D'Haultfoeuille, 2023). This can be tested using pre-treatment placebo tests that compare treatment and control groups, to establish that treatment is not endogenous and that the control group can be used as a valid counterfactual to the treatment group (Cunningham, 2021).

In addition to parallel trends, the DiD estimator requires the Stable Unit Treatment Value Assumption (SUTVA), no spillovers, and no anticipation. SUTVA states that the potential outcomes for each unit are unrelated to the treatment status of other units (Cunningham, 2021). No spillovers requires that untreated households are not affected by the reform, and no anticipation requires that future treatment does not affect current outcomes (de Chaisemartin and D'Haultfoeuille, 2023). All three assumptions are satisfied in this setting. Spillovers outside Port-Said are unlikely, since the system is only operational there. Additionally, residents of other governorates cannot enrol before the reform reaches their governorate. Selective migration to Port-Said in anticipation of the reform is also implausible, given that the enrolment system requires official residency in Port-Said. SUTVA therefore holds. On anticipation, while households could in principle delay non-urgent care to avoid costs prior to enrolment, this is not feasible for urgent medical needs. Moreover, repeated delays in implementation due to COVID-19 make it unlikely that households would postpone treatment in anticipation of a reform whose timeline remains uncertain.

A two-way fixed effects (TWFE) model is appropriate here given the structure of the data. Given the non-random selection of the choice of Port-Said as the pilot governorate, the model includes time and governorate fixed effects. Including governorate fixed effects minimizes estimation biases that result from unobserved factors at the governorate level. Meanwhile, time fixed effects account for time-varying factors that may be affecting the results. The TWFE estimating equation takes the following form:

$$Y_{igt} = \alpha_0 + \alpha_1.Treat_{ig} + \alpha_2.Post_t + \delta(Treat_{ig}.Post_t) + \varepsilon_{igt} \quad (5)$$

whereby $Treat_{ig}$ is a dummy equal to one if the observation is from Port-Said, and $Post_t$ is a dummy equal to one if the observation is from the post-treatment survey round.

$$\hat{\delta} = \left(\overline{Y}_{\text{treat, post}} - \overline{Y}_{\text{treat, pre}}\right) - \left(\overline{Y}_{\text{control, post}} - \overline{Y}_{\text{control, pre}}\right) \quad (6)$$

The coefficient of interest is $\hat{\delta}$, capturing the average change in insurance coverage in Port-Said relative to the control governorates, following the introduction of the universal health insurance reform.

5 Results

5.1 Descriptive Statistics

Port-Said is distinct from most governorates in Egypt along several key dimensions. Table 1 presents summary statistics, comparing Port-Said to its synthetic control and the average of all non-treated governorates. The synthetic control is implemented separately for deflated per capita household out-of-pocket health spending and the share of households who incurred catastrophic health spending at the governorate level, in other words, the incidence of spending more than 10 percent of household spending on healthcare. Since both variables are analysed separately, each outcome has its own synthetic control.

Table 1 reveals that the synthetic control closely replicates Port-Said's pre-treatment outcome trajectory for both out-of-pocket and catastrophic health spending, yet the unweighted average of all governorates does not. Comparing Port-Said to the unweighted average of all governorates yields large discrepancies across both pre-treatment outcomes and covariates. Differences are particularly pronounced for household head literacy, real GDP per capita, and urban share. The large discrepancy in both pre-treatment outcomes and the remaining predictors confirms that using all governorates would be an inappropriate counterfactual. Turning to the synthetic control, household head-level characteristics are comparable, as the gender composition and literacy rate of the household head are broadly similar across Port-Said and both synthetic controls. However, differences emerge for governorate-level predictors. The synthetic control group has larger population size and higher real health GDP per capita than Port-Said. Conversely, Port-Said has a notably higher real GDP per capita, urban share, and share of residents aged 65 and older, relative to both the synthetic controls and the all-governorates average.

The imbalance in the pre-treatment covariates does not, however, undermine the internal validity of the synthetic control design. This imbalance is a direct consequence of the optimisation process underlying the synthetic control method, whereby greater weight is placed on achieving pre-treatment balance on the outcome path than on the remaining predictors. Abadie et al. (2015), Abadie et al. (2010), and Abadie (2021) establish that causal inference under the synthetic control approach does not require that individual predictors be matched precisely. Rather, it requires that the pre-treatment outcome path is closely reproduced. A synthetic control that closely reproduces the pre-treatment outcome trajectory implicitly accounts for both observed and unobserved determinants of that outcome (Abadie, 2021). Hence, the covariates imbalance does not invalidate the causal interpretation.

The main analysis uses data from 2008 onwards, for two reasons. First, the pre-2008 period may be subject to comparability concerns across governorates, rendering earlier observations unreliable as a basis for constructing the counterfactual. Second, restricting the sample to 2008 onwards yields a closer pre-treatment fit between Port-Said and its synthetic control, as reflected by a lower Root Mean Squared Prediction Error (RMSPE), relative to using the full sample from 1999. A close pre-treatment match implies that the synthetic control more accurately replicates the pre-treatment trajectory of the treated unit, strengthening the internal validity of the design.[9]

Table 1: Summary statistics: predictor means

Variable	Out-of-pocket health expenditure			Catastrophic health expenditure		
	Port Said	Synthetic control	All	Port Said	Synthetic control	All
Pre-treatment outcome						
2008	5.261	5.260	4.887	0.182	0.170	0.149
2010	5.609	5.612	5.295	0.269	0.256	0.236
2012	5.662	5.668	5.502	0.242	0.258	0.277
2015	5.944	5.925	5.565	0.251	0.262	0.306
2017	5.751	5.749	5.557	0.288	0.282	0.321
Covariates (2017)						
Male-headed share	0.826	0.840	0.830	0.826	0.846	0.830
Literate head share	0.815	0.734	0.665	0.815	0.704	0.665
Real health GDP per capita	263.9	631.6	374.5	263.9	602.0	374.5
Real GDP per capita	98,777	22,766	15,863	98,777	22,381	15,863
Urban share	100.0	50.0	39.9	100.0	51.7	39.9
Share aged 65+	6.012	3.734	3.831	6.012	3.605	3.831
Population (000s)	749.4	5,085.2	4,561.0	749.4	5,322.8	4,561.0

Note: The table compares Port Said to the synthetic control and the unweighted average of all other governorates. Out-of-pocket health expenditure is measured as the log of per capita household out-of-pocket health spending at the governorate level. Catastrophic health expenditure refers to the share of households within the governorate spending more than 10 percent of total household expenditure on healthcare.

5.2 Main Results

The synthetic control estimates indicate that the introduction of the universal health insurance reform reduced both out-of-pocket health spending and the incidence of catastrophic health expenditure in Port-Said relative to the counterfactual. Figure 1 graphically illustrates the effect of the introduction of the universal health insurance system on out-of-pocket health spending. The left-hand panel (Panel 1a) plots out-of-pocket spending for Port-Said and its synthetic control. The vertical intervention line is placed at 2017, the last survey year prior to the reform.[10] Prior to this date, the two series track each other closely, lending credibility to the synthetic control as a valid counterfactual. After 2017, the trajectories diverge, reflecting the estimated impact of the health insurance system on out-of-pocket spending. As Panel 1a shows, out-of-pocket health spending rises between 2017 and 2021 for the synthetic control group, while

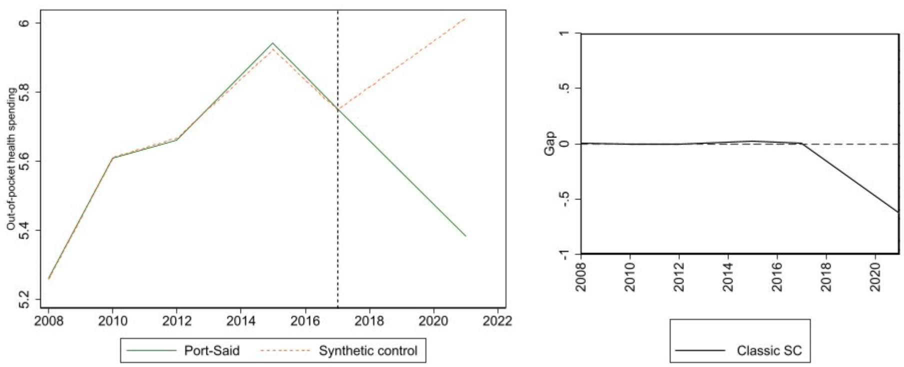
[9]The RMSPE for the out-of-pocket spending synthetic control is 0.009 using data from 2008 onwards, compared to 0.230 when the full sample from 1999 is used. For catastrophic health spending, the corresponding figures are 0.012 and 0.055, respectively. Estimates based on the full 1999 sample are reported in the Appendix in Figure A1 and Tables A4 and A5 as a robustness check.

[10]This is done to visually display the impact, since the 2017 survey round is the last dataset used pre-treatment. As mentioned earlier, the 2019 datasets does not include the governorates, which makes it unsuitable for the analysis.

it declines for Port-Said, suggesting that the reform led to a meaningful reduction in out-of-pocket health spending in Port-Said. The right-hand panel (Panel 1b) plots the gap between Port-Said and its synthetic control over time. In the pre-intervention period, the gap is close to zero, confirming the pre-treatment fit of the synthetic control. Following the introduction of the UHIS, a negative gap emerges, indicating that out-of-pocket spending in Port-Said is substantially lower than its synthetic control.

Figure 1: Synthetic control estimation for out-of-pocket health spending

(a) (b)

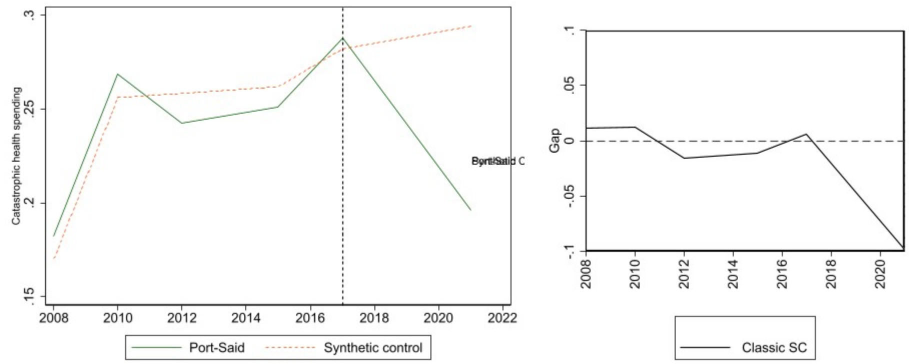


Note: The graph shows the gap between Port-Said and its synthetic control. The latest data point prior to the intervention is 2017. Hence, the change in the outcome variable between 2017 and 2021 presents the impact of the universal health insurance on out-of-pocket spending.

Figure 2 presents the equivalent analysis for catastrophic health spending. The pre-intervention fit is somewhat weaker than in the out-of-pocket spending case, as shown in Panel 2a, where Port-Said and its synthetic control do not follow each other closely. This is also reflected in the gap line in Panel 2b, which fluctuates above and below the zero line throughout the pre-intervention period. Nonetheless, both panels in Figure 2 indicate that the incidence of catastrophic health spending falls for Port-Said post the introduction of the universal health insurance, while rising for the synthetic control. Collectively, the results suggest that the reform is associated with a decline in out-of-pocket health spending and catastrophic health spending in Port-Said.

Figure 2: Synthetic control estimation for catastrophic health spending

(a) (b)



Note: The graph shows the gap between Port-Said and its synthetic control. The latest data point prior to the intervention is 2017. Hence, the change in slope between 2017 and 2021 presents the impact of the universal health insurance on catastrophic spending incidence.

The governorate weights underlying the synthetic control estimates and the estimation results are reported in Table 2. The weights for out-of-pocket and catastrophic health spending are drawn from different governorates, with some overlap. The weights differ across both outcomes because the synthetic control minimises the pre-treatment discrepancy separately for each outcome, selecting the combination of donor governorates that most closely approximates Port-Said's pre-treatment trajectory in each case. For out-of-pocket spending, the governorates with the largest weights are Qualioubia, Damietta, and Cairo. For catastrophic health spending, the largest weights are assigned to Ismailia, Giza, and Cairo. Several of these governorates share common features with Port-Said, which lends further plausibility to their selection as donors. For instance, Damietta is a Lower-Egypt governorate characterised by a low poverty rate, a port city economy and a significant manufacturing base, all features shared with Port-Said. Ismailya similarly lies on the Suez Canal Corridor, as does Port-Said. Furthermore, Cairo and Port-Said are two of the four urban-only governorates in Egypt.

Table 2: Synthetic control donor weights

Governorate	Out-of-pocket health expenditure	Catastrophic health expenditure
Cairo	0.173	0.147
Alexandria	0	0
Suez	0	0
Damietta	0.312	0.073
Dakahlia	0.063	0
Sharkia	0	0
Qalyubia	0.424	0
Kafr el-Sheikh	0	0
Gharbia	0	0
Monofia	0	0
Beheira	0.028	0
Ismailia	0	0.317
Giza	0	0.272
Bani Sweif	0	0
Fayoum	0	0
Menia	0	0.191
Assiut	0	0
Sohag	0	0
Qena	0	0
Aswan	0	0
ATT	−0.631	−0.098
RMSPE	0.009	0.012
Percentage change	−46.78%	−33.43%

Note: The table presents the donor weights assigned to each governorate in constructing the synthetic control for out-of-pocket health spending and catastrophic health spending, respectively, alongside the root mean squared prediction error (RMSPE), the average treatment effect on the treated (ATT), and the implied percentage change. For out-of-pocket expenditure, the percentage change is computed via exponential transformation as $[e^{\text{ATT}} - 1] \times 100$. For catastrophic expenditure, the percentage change is calculated as the ATT divided by the synthetic control's predicted value in 2021.

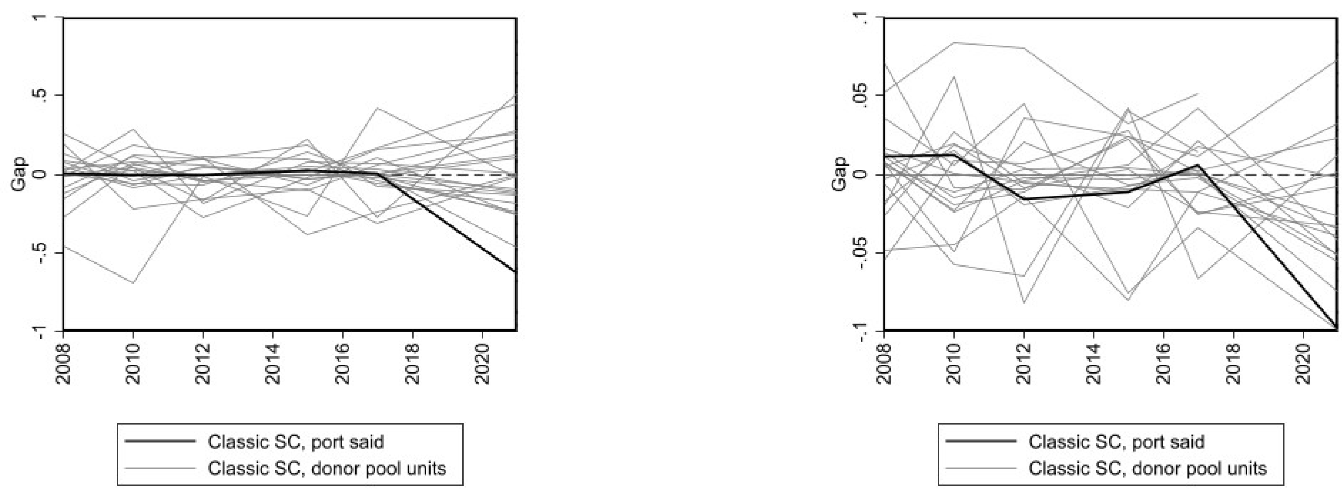
The results indicate that the universal health insurance reform reduced per capita out-of-pocket health expenditure by an estimated 46.8 percent and the incidence of catastrophic health expenditure by approximately 33.4 percent in Port-Said. (Table 2).[11] The credibility of these estimates and the causal interpretation rests on two pillars. First, the close pre-treatment fit between Port-Said and its synthetic control provides evidence that the synthetic control serves as a credible counterfactual. The RMSPE for out-of-pocket spending is 0.009, and for catastrophic health spending is 0.012, both reflecting that the synthetic control closely tracks Port-Said's pre-treatment trajectory. Second, permutation-based placebo tests confirm that the results are unlikely to have occurred by chance. Permutation methods consist of iteratively reassigning treatment to each unit in the donor pool, and estimating "placebo effects" for each unit (Abadie, 2021; Abadie et al., 2015). The resulting gaps between the placebo-treated units and their respective synthetic controls are pre-

[11] The estimated impact is computed as the average treatment effect on the treated (ATT) relative to the synthetic control's predicted value in 2021.

sented in Figure 3, for both out-of-pocket health spending and catastrophic health spending. As shown in both panels, the gap for Port-Said consistently exceeds that of the donor placebo governorates, confirming that the estimated reductions in both out-of-pocket and catastrophic health spending are not haphazard.[12]

Figure 3: Placebo gaps for control governorates

(a) Out-of-pocket health expenditure (b) Catastrophic health expenditure



Note: The figure presents the gap between Port-Said and its synthetic control alongside the placebo gaps for all donor governorates, using HIECS data from 2008 onwards. The latest pre-intervention data point is 2017. The divergence observed between 2017 and 2021 reflects the estimated impact of the universal health insurance reform on out-of-pocket health expenditure and catastrophic health expenditure, respectively.

The estimated reduction in per capita out-of-pocket spending (46.8 percent) exceeds the estimated reduction in the incidence of catastrophic health spending (33.4 percent). These two outcomes measure different dimensions of financial protection, whereby out-of-pocket spending captures the level of health expenditures, while catastrophic health spending captures the share of households exceeding a defined threshold relative to household expenditure. Hence, direct comparison should be interpreted with caution. Nevertheless, the pattern observed here differs from that found in the broader literature, where insurance interventions tend to produce larger proportional reductions in catastrophic health spending than in out-of-pocket spending. Several studies have examined the impact of health insurance on both out-of-pocket expenditure and catastrophic health expenditure. A recent meta-analysis of community-based health insurance in low- and middle-income countries reported a 6 percent reduction in out-of-pocket expenditure alongside a 31 percent reduction in catastrophic health expenditure (Eze et al., 2023). Mexico's *Seguro Popular* programme reduced

[12]As a robustness check, the effect of the reform is also estimated using difference-in-differences (DiD). The DiD results yield a statistically significant negative coefficient, similar to the synthetic control. However, pre-treatment trend tests indicate that the parallel trends assumption is violated, rendering the DiD unreliable and the estimate potentially biased. The violation of parallel trends assumption further justifies the use of the synthetic control methodology, which constructs a counterfactual that accounts for pre-treatment trajectories without requiring parallel trends.

the incidence of catastrophic health expenditure by 23 percent among insured households, with no detectable effect on aggregate out-of-pocket spending except among low-asset households (King et al., 2009). In Burkina Faso, a cluster-randomised evaluation of community-based health insurance similarly found no significant effect on out-of-pocket spending but a 30 percent reduction in the likelihood of catastrophic expenditure (Fink et al., 2013).

Several potential explanations may account for the pattern observed in Egypt. First, health insurance reform in Port-Said may have broadly reduced out-of-pocket payments across the distribution, including among households that did not cross the catastrophic threshold. In this case, the reform would compress per capita out-of-pocket spending levels substantially while generating a more modest reduction in the share of households incurring catastrophic spending. Households that incurred catastrophic health expenditure prior to the reform may have continued to exceed the 10 percent threshold even after a reduction in out-of-pocket payments. Second, insurance coverage may have been incomplete, with the most vulnerable households remaining disproportionately uncovered at the early stages of the roll-out. Enrolment at the initial stages of the reform was likely impeded by logistical barriers, particularly for informally employed workers and households eligible for government-subsidised coverage, who may have been less likely to register. As a result, the reform may have had a more limited impact on the households with the highest incidence of catastrophic expenditure. Third, insurance coverage may have induced households to utilise healthcare services that they would otherwise have foregone. Since not all services and products are fully covered by the scheme, and given that the scheme imposes cost-sharing requirements per individual, insured households may have increased their healthcare utilisation sufficiently offsetting part of the reduction in out-of-pocket payments, leaving some households above the catastrophic threshold.[13] Distinguishing between these mechanisms would require individual-level data to conduct heterogeneity analysis, which is not feasible with the available dataset. Meanwhile, the role of health insurance coverage as a potential mechanism underlying these results is discussed further in Section 5.4.

5.3 Decomposing Health Spending

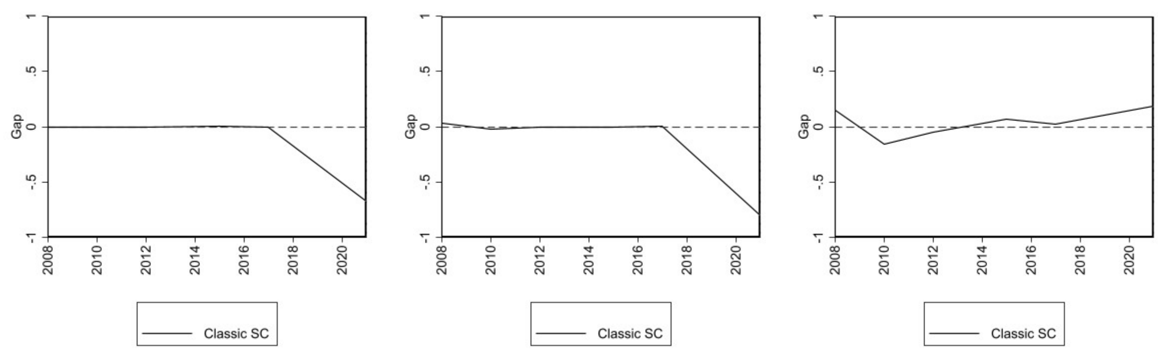
Out-of-pocket health spending comprises household expenditure on pharmaceutical and medical products, outpatient and hospital services, and therapeutic appliances and equipment. Figure 4 presents the synthetic control results for the decomposition of out-of-pocket health spending, into the three components. As shown in the figure, the health insurance reform led to a reduction in expenditure on pharmaceutical and medical products and outpatient and hospital services, but an increase in spending on therapeutic appliances and equipment. The permutation-based placebo gaps for the three components of out-of-pocket spending are

[13] The system exempts poor and vulnerable households and those with chronic conditions from cost-sharing (Khalifa et al., 2022).

presented in Appendix Figure A2. For pharmaceutical and medical products, and outpatient and hospital services, the post-treatment gap for Port-Said substantially exceeds those of all placebo governorates, providing evidence that the observed reductions are unlikely due to chance. Meanwhile, for therapeutic appliances and equipment, Port-Said's gap is not clearly distinguishable from the placebo distribution, suggesting that the estimated increase is not robust, based on permutation-based inference.

Figure 4: Synthetic control estimation: Out-of-pocket health spending decomposition

(a) Pharmaceuticals and medical products (b) Outpatient and hospital services (c) Therapeutic appliances and equipment



Note: The graphs show the gap between Port-Said and its synthetic control. The latest data point prior to the intervention is 2017. Hence, the gap between 2017 and 2021 presents the impact of the universal health insurance on the spending outcomes.

5.4 Health Insurance Coverage

This section examines health insurance coverage as the primary mechanism through which the reform operates. The impact of rolling out the UHIS on health insurance coverage is estimated using difference-in-differences. Three definitions of insurance coverage are considered: whether the household head is insured, whether all household members are insured, and whether any household member is insured. The key identifying assumption underlying the difference-in-differences estimator is the parallel trends assumption, which requires that, in the absence of treatment, the treated and control groups would have followed the same trajectory over time. The parallel trends assumption is tested both graphically and empirically.

Table 3 presents the results for all three measures. The estimated effects are 5.1 percentage points for any member insurance, 39.7 percentage points for household head insurance, and 74.9 percentage points for all members insurance Since the UHIS is a family-based insurance scheme, under which all household members are enrolled together through the household head, the estimates for all-members insurance coverage are more reflective of the impact of the reform. The share of households where all members are insured increased by about 75 percentage points, relative to a pre-treatment mean of just 10.5 percent, reflecting the near-universal uptake of the family enrolment model introduced by the UHIS.

The validity of these estimates rests on the parallel trends assumption. The assumption is satisfied for the any-member measure ($F(1, 21) = 1.35$, $p = 0.258$), marginally violated for the all-members measure ($F(1, 21) = 3.25$, $p = 0.086$), and rejected for the household head measure ($F(1, 21) = 5.15$, $p = 0.034$). Strictly speaking, the estimates for the household head and all-members measures should be interpreted with caution. Nonetheless, the large magnitude of the estimated effects, particularly the 75 percentage point increase in all-members coverage relative to a pre-treatment mean of just 10.5 percent, is difficult to attribute to factors other than the UHIS reform. No comparable policy intervention was introduced in Port-Said during this period, and the scale of the increase far exceeds what would be expected from underlying trends in insurance coverage alone. The estimates are therefore interpreted as strongly suggestive of a substantial expansion in household insurance coverage driven by the introduction of the UHIS.

Table 3: Difference-in-differences results: Insurance coverage

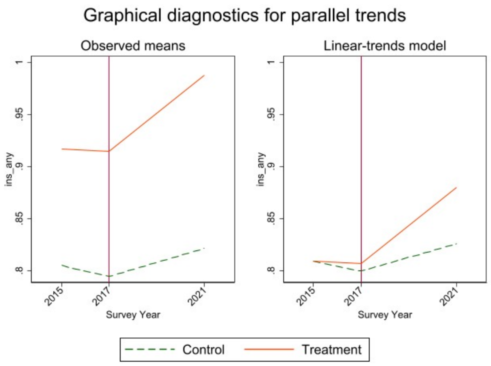
	(1) Any HH member has insurance	(2) HH head has insurance	(3) All HH members have insurance
ATET	0.051***	0.397***	0.749***
	(0.004)	(0.012)	(0.011)
Observations	35450	35450	35450
Mean dep. var.	0.812	0.389	0.105

Note: Treated = Port-Said. Control = all other governorates except Luxor. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

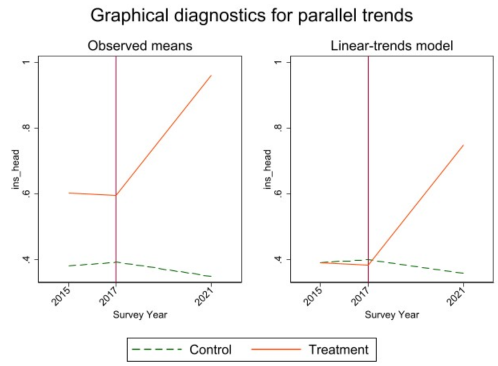
Figure 5 presents the pre-treatment trends and the gap between the treatment and control groups after the introduction of universal health insurance reform in Port-Said, using all three definitions. As shown in the figure, there is a clear a divergence in coverage rates post-treatment, with a higher average rate of insurance coverage in Port-Said following the introduction of the UHIS. This substantial increase in insurance coverage is further reflected in higher household spending on insurance and other health financial services, as shown by the synthetic control estimates presented in Figure 6.

Figure 5: Difference-in-differences: Insurance coverage

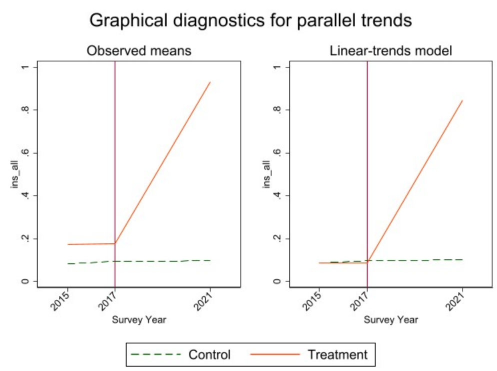
(a) Any HH member has insurance



(b) HH head has insurance

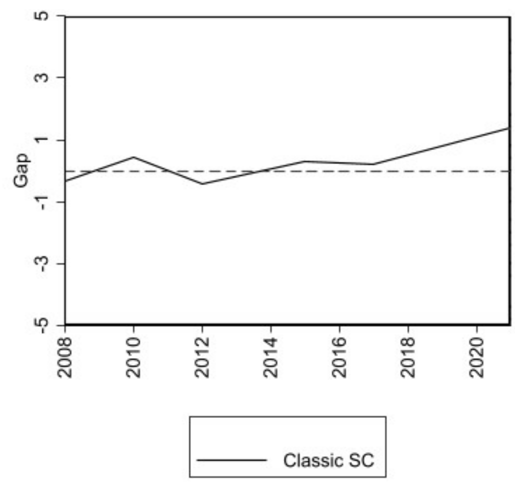


(c) All HH members have insurance



Note: Treatment took place in 2019. Yet, the vertical line is set at 2017 for better visualization, since 2017 is the latest data round prior to the introduction of the universal health insurance system in Port-Said. Hence, the line showing the impact runs from 2017 to 2021.

Figure 6: Synthetic control estimation: Insurance and financial services



Note: The graph shows the gap between Port-Said and its synthetic control. The latest data point prior to the intervention is 2017. Hence, the change in slope between 2017 and 2021 presents the impact of the universal health insurance on insurance and financial services spending.

5.5 Falsification and Robustness

This section presents a series of falsification and robustness checks to assess the credibility of the synthetic control estimates. Several checks are conducted for the synthetic control estimator, as suggested by Abadie (2021) and Abadie et al. (2015). The results of each check are discussed below, and the corresponding figures are presented in the Appendix. Taken together, the conducted tests confirm that the estimated reduction in out-of-pocket health spending and catastrophic health spending in Port-Said are attributable to the universal health insurance reform, rather than arising by chance.

To assess the sensitivity of the results to the pre-intervention sample, the synthetic control is re-estimated using all data from 1999. By using earlier pre-treatment survey rounds (adding the data from 1999 and 2004), the results continue to indicate a decline of 37.8 percent in out-of-pocket health spending and 35.1 percent in catastrophic health spending, as presented in Appendix Tables A4 and A5, and Figure A1. A second robustness check examines whether the results are sensitive to the composition of the donor pool. In this check, each of the donors receiving a positive weight is removed one at a time, and the synthetic control is re-estimated and presented in Appendix Figure A3. As shown in the figure, the estimated gap between Port-Said and its synthetic control using all donors falls within the distribution of the estimated gaps with excluded donors. This indicates that the estimates are robust to the composition of the donor pool, and that the results are not driven by any individual donor governorate, lending further confidence to the estimates. Finally, the synthetic control is estimated for different categories of household spending, such as education, housing, and transportation. Appendix Figure A4 shows that the estimated decline in out-of-pocket health spending is not observed for these other types of expenditures, which strengthens the causal interpretation of the main results.

A further falsification check involves artificially backdating the intervention, by assigning a placebo treatment date earlier than the real intervention date. The reform is assumed to have been introduced in 2015. As Figure A5 shows, even when the intervention is artificially backdated to 2015, the decline in out-of-pocket and catastrophic health spending for Port-Said is observed at the time of the true intervention, rather than at the placebo year. This test confirms again that the results are attributable to the reform itself.[14] Additionally, I estimate the model using pre-treatment outcome values as the only predictors, which yields results consistent with the main model. Finally, I estimate the results on health spending using difference-in-differences. Results are presented in Table A6 in the appendix. Results show a statistically significant decline in both out-of-pocket spending and catastrophic health spending. However, parallel trends are not satisfied, which undermine the interpretation of the results.

For catastrophic health spending, I estimate the model using the 25 percent threshold for catastrophic health expenditure, which similarly shows a decline. However, this decline does not satisfy the permutation inference test (Appendix Figure A6). This is expected, since the 25 percent threshold captures only households with the most severe spending burden. These households are likely to remain above the threshold even after a reduction in out-of-pocket payments, as a larger absolute reduction in spending is required to move them below it. Hence, the ability of the reform to produce a statistically detectable reduction at the 25 percent threshold is inherently more limited than at the 10 percent threshold.

6 Conclusion

Realizing financial risk protection is one of the key goals of achieving universal health coverage (UHC). Without health insurance, individuals are forced to pay out-of-pocket, creating both a barrier to accessing healthcare and a source of financial risk for households. Achieving universal health coverage is not only a national goal for many countries, but also a global objective outlined through the third Sustainable Development Goal (SDG 3). SDG 3 includes realizing "financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all" (World Health Organization Regional Office for the Western Pacific, 2016). Egypt has reaffirmed its commitment to improving healthcare by enacting a new Universal Health Insurance Law. This paper examines whether the introduction of universal health insurance in Egypt's pilot governorate, Port-Said, has succeeded in reducing household healthcare spending.

[14] Data from 1999 onwards is used for this check, to allow for sufficient pre-treatment rounds.

The objective of the paper is to assess the impact of introducing the Universal Health Insurance System (UHIS) in the first pilot governorate in Egypt on household out-of-pocket health spending and the incidence of catastrophic health spending. Using synthetic control methodology, the findings indicate that the introduction of the UHIS in Port-Said led to a decline of 46.8 percent in per-capita household out-of-pocket health spending, and a decline of 33.4 percent in the incidence of catastrophic health spending. These findings are broadly consistent with evidence from other health insurance systems in low- and middle-income countries, with the notable exception that reductions in catastrophic spending are typically larger than reductions in average out-of-pocket spending in the existing literature.

The more modest reduction in catastrophic health spending relative to out-of-pocket health spending may be attributed to several potential factors. First, the reform's benefits may have been distributed broadly across the household income distribution, including households whose spending did not reach the catastrophic threshold. In this case, the reform would compress average out-of-pocket spending levels while generating a more modest reduction in the share of households incurring catastrophic expenditure. Second, coverage may have been incomplete at the early stages of the roll-out, with the most vulnerable households remaining disproportionately uninsured. Third, insurance coverage may have induced households to utilise healthcare services that they would otherwise have foregone. Since not all services and products are fully covered by the scheme, insured households may be spending less on average, but some households may nonetheless exceed the 10 percent catastrophic threshold as a result of increased healthcare utilisation.

The results have several policy implications. First, the findings support the continued scale-up of the system, suggesting that sustaining and expanding the system is justified on the basis of providing financial protection. Second, the results indicate that the UHIS has succeeded in substantially expanding health insurance coverage in Port-Said, suggesting that the programme is operationally effective and reaching households as intended. Finally, ensuring that coverage reaches the most vulnerable households, including those in the informal sector and those eligible for government-subsidised enrolment, remains a priority for maximising the financial protection effects of the reform.

These findings suggest several directions for future research. First, longitudinal data spanning extended periods are necessary to estimate the long-term effects of the UHIS. To build on the results of this paper, rigorous evidence on coverage, targeting, access, and utilisation is needed. Further research should also evaluate the impact on citizens' health. Larger and richer data are also needed to allow for heterogeneity analysis, examining whether the effects of the UHIS differ across population subgroups. Additionally, it is important to assess whether the system is financially sustainable and equitable. Finally, future research shall examine how household spending patterns might have shifted in response to the UHIS, and whether the introduction of health insurance plays a significant role in reducing poverty and improving inequality.

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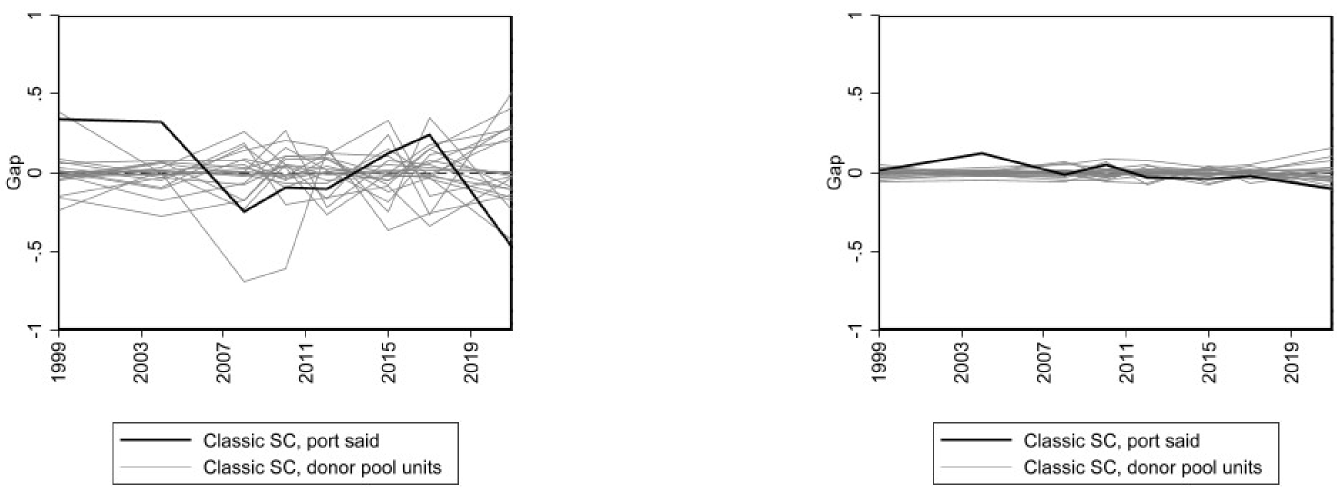
A Appendix

A.0.1 Figures

Figure A1: Varying pre-intervention duration

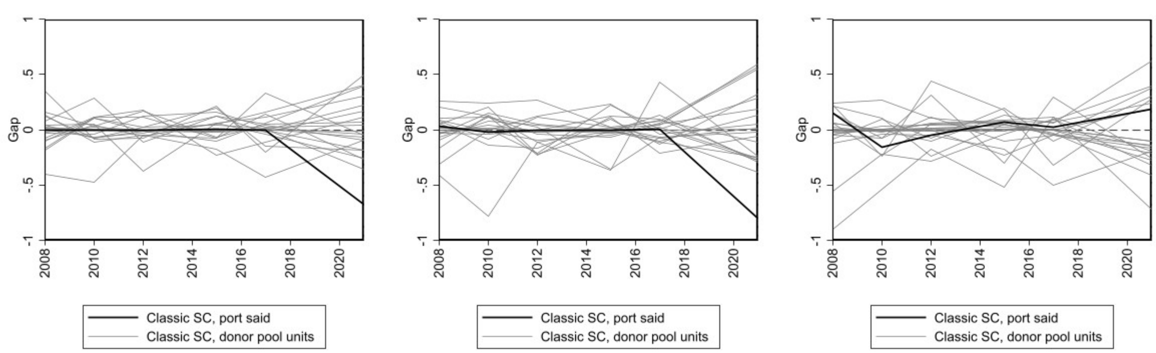
(a) Out-of-pocket health spending (b) Catastrophic health spending



Note: The graphs show the gap between Port-Said and its synthetic control along with placebo gaps for all other governorates, using all HIECS rounds from 1999 onwards. The latest data point prior to the intervention is 2017. Hence, the divergence between 2017 and 2021 presents the impact of the universal health insurance on the spending outcomes.

Figure A2: Permutation-based placebo gaps for health spending decomposition

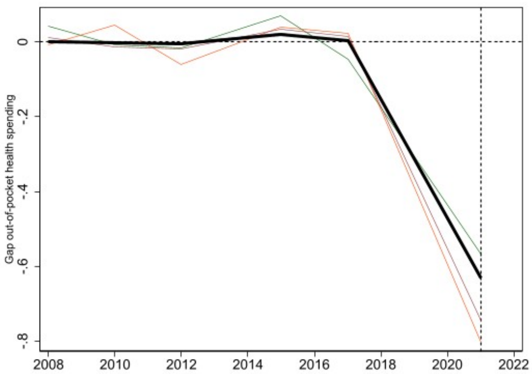
(a) Pharmaceuticals and medical products (b) Outpatient and hospital services (c) Therapeutic appliances and equipment



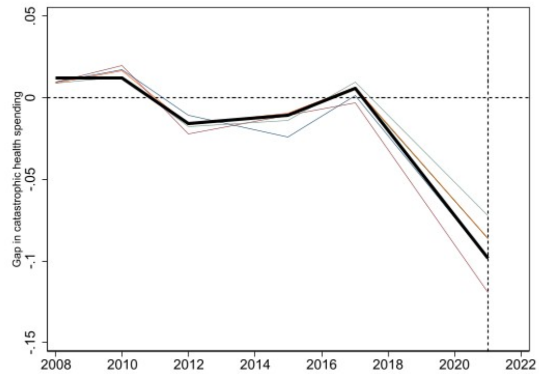
Note: The graphs show the gap between Port-Said and its synthetic control, along with placebo gaps for all other governorates. The latest data point prior to the intervention is 2017. Hence, the divergence between 2017 and 2021 presents the impact of the universal health insurance on the spending outcomes.

Figure A3: Changing the donor pool

(a) Out-of-pocket health spending



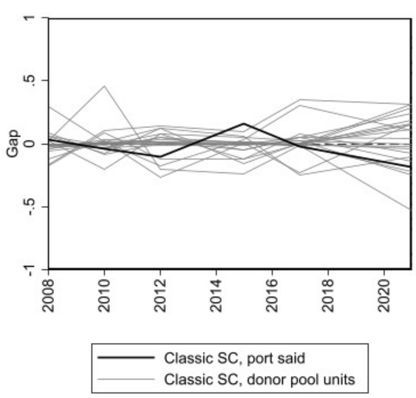
(b) Catastrophic health spending



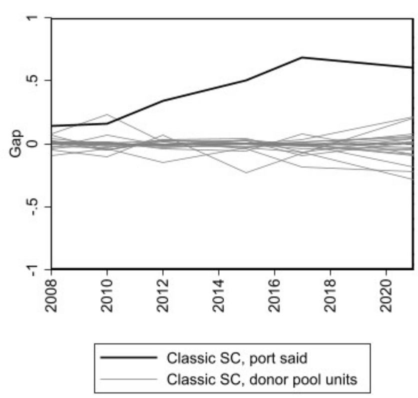
Note: The synthetic control is estimated, by removing each of the donors that received a weight for the synthetic control, to ensure that the results are not driven by a single donor. As the figure shows, Port-Said synthetic control placebos are all located around the original Port-Said synthetic control which uses the entire donor pool. The figures for out-of-pocket and catastrophic health spending indicate that results are robust and the estimate is not driven by a single donor.

Figure A4: Other household expenditures

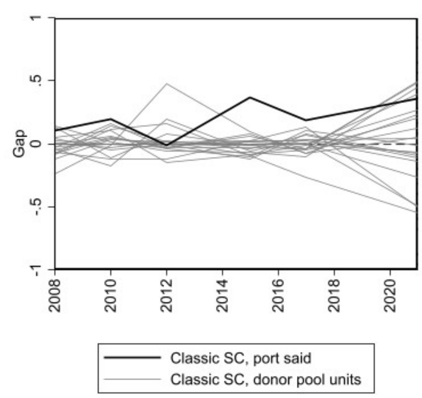
(a) Education spending



(b) Housing spending



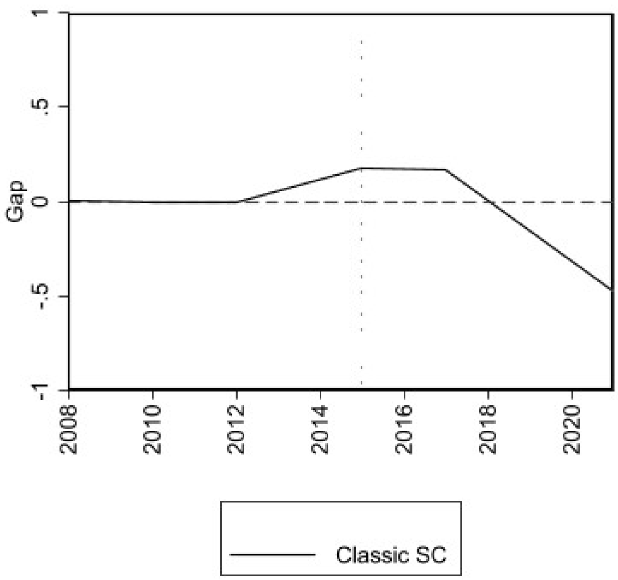
(c) Transport spending



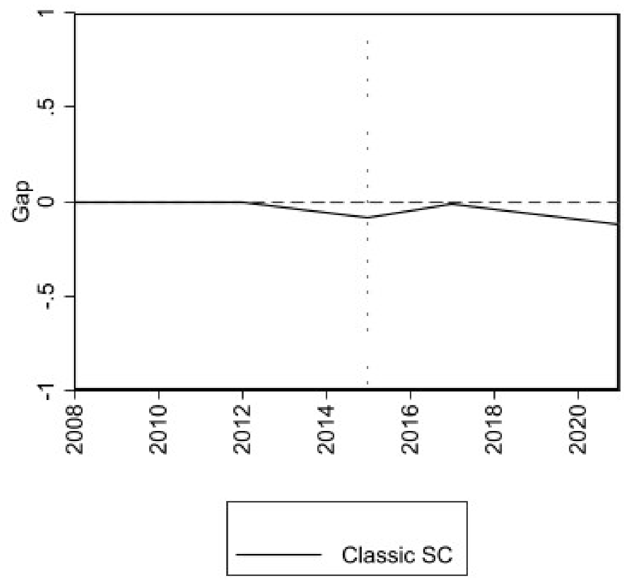
Note: The figure presents the synthetic control results for per capita spending on education, per capita housing spending, and per capita spending on transportation. Spending on education shows a decline for Port-Said from 2015. The decline does not seem to be related to the insurance, since it starts prior to the implementation of the intervention. For spending on housing and transport, the graphs indicate an increase in per-capita household spending in Port-Said, compared to its synthetic control.

Figure A5: Artificially backdating the intervention time

(a) Out-of-pocket health spending

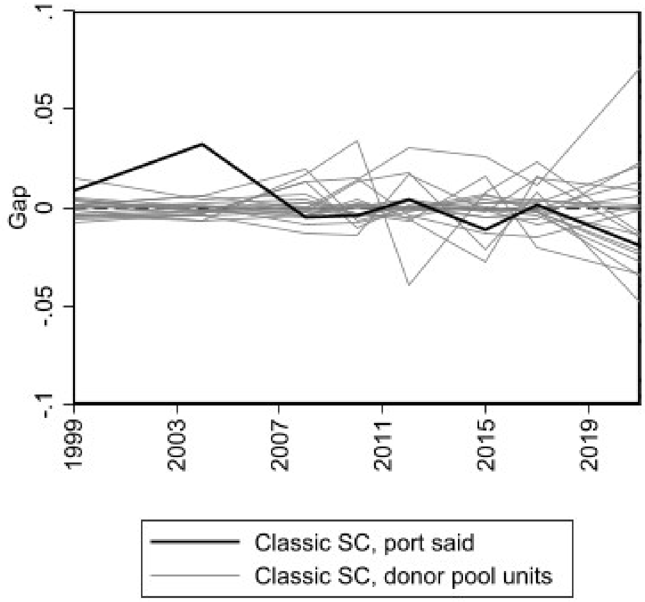


(b) Catastrophic health spending



Note: A decline in out-of-pocket and catastrophic health spending for Port-Said is observed following the time of the real introduction of the health insurance, even though the model artificially backdated the time of the intervention to 2015 (indicated by the vertical dashed line).

Figure A6: Catastrophic health expenditure at the 25 percent threshold



Note: The graphs show the gap between Port-Said and its synthetic control along with placebo gaps for all other governorates, using 25 percent as the threshold for catastrophic health spending. The latest data point prior to the intervention is 2017. Hence, the divergence between 2017 and 2021 presents the impact of the universal health insurance on the spending outcomes.

A.0.2 Tables

Table A1: Phases of UHIS implementation by governorate

Phase	Governorate	Poverty level (%)
Phase 1	Port-Said	7.6
	Ismailia	32.4
	Suez	20.0
	South Sinai	51.5
	Luxor	55.3
	Aswan	46.2
Phase 2	North Sinai	51.5
	Matrouh	51.5
	Qena	41.2
	Red Sea	51.5
Phase 3	Damietta	14.6
	Alexandria	21.8
	Beheira	47.7
	Kafr El Sheikh	17.3
	Sohag	59.6
Phase 4	New Valley	51.5
	Minya	54.7
	Fayoum	26.4
	Beni-Suef	34.4
	Assyut	66.7
Phase 5	Dakahlia	15.2
	Gharbia	9.4
	Menoufia	26.0
	Sharqia	24.3
Phase 6	Cairo	31.1
	Giza	34.0
	Qalioubiya	20.1

Note: Figures based on estimates from Egypt's Household, Income, Expenditure and Consumption Survey (HIECS) for 2018, provided from World Bank (2020).

Table A2: UHIS actual roll-out

Governorate	Start date
Port-Said	July 2019
Luxor	July 2021
Ismailia	July 2022
South Sinai	January 2024
Suez	December 2024

Notes: Effective implementation may vary. For instance, in Port-Said the system was officially launched in July 2019, but implementation took place in November 2019.

Table A3: HIECS rounds

Survey year	Start date	End date	Sample size	Avg. inflation
1999/2000	01/10/1999	30/09/2000	48,000	44.8
2004/2005	01/07/2004	30/06/2005	48,000	56.4
2008/2009	01/04/2008	30/03/2009	48,658	82.8
2010/2011	01/07/2010	30/06/2011	26,500	105.0
2012/2013	01/07/2012	30/06/2013	24,863	123.5
2015	01/01/2015	31/12/2015	25,000	156.8
2017/2018	01/10/2017	30/09/2018	26,000	256.1
2021/2022	01/10/2021	30/09/2022	26,000	352.2

Note: The table summarises the Egyptian Household Income, Expenditure and Consumption Surveys (HIECS) used in the analysis. Average inflation is reported as weighted average between the two years in which the data was collected (except for the 2015 round which was collected within one year).

Table A4: Summary statistics: Predictor means (Using HIECS 1999 onwards)

Variable	Out-of-pocket health spending		Catastrophic health spending	
	Port-Said	Synthetic control	Port-Said	Synthetic control
Pre-treatment outcome				
1999	5.769	5.433	0.129	0.118
2004	5.618	5.297	0.236	0.112
2008	5.261	5.507	0.182	0.192
2010	5.609	5.705	0.269	0.218
2012	5.662	5.768	0.242	0.272
2015	5.944	5.820	0.251	0.293
2017	5.751	5.509	0.288	0.311
Covariates (2017)				
Male-headed share	0.826	0.817	0.826	0.823
Literate head share	0.815	0.787	0.815	0.795
Real health GDP per capita	263.9	1,695.5	263.9	865.3
Real GDP per capita	98,777	39,458	98,777	32,844
Urban share	100.0	99.0	100.0	98.4
Share aged 65+	6.012	4.806	6.012	4.443
Population (000s)	749.4	7,601.6	749.4	3,705.8

Note: The table compares Port-Said to its synthetic control. Out-of-pocket spending is log out-of-pocket household health spending per capita, at the governorate level. Catastrophic health spending refers to the share of households within the governorate who paid more than 10 percent of their household spending to healthcare expenditures.

Table A5: Synthetic control donor weights (Using HIECS 1999 onwards)

Governorate	Out-of-pocket spending	Catastrophic health spending
Cairo	0.563	0.077
Alexandria	0.430	0.472
Suez	0	0.425
Damietta	0	0
Dakahlia	0	0
Sharkia	0	0
Qualioubia	0	0
Kafr el-Sheikh	0	0
Gharbia	0	0
Monofia	0	0
Beheira	0	0
Ismailia	0	0
Giza	0	0.026
Bani Sweif	0	0
Fayoum	0	0
Menia	0	0
Assiut	0	0
Sohag	0	0
Qena	0	0
Aswan	0.007	0
ATT	−0.474	−0.106
RMSPE	0.230	0.055
Percentage Change	−37.75%	−35.14%

Note: Results in the table are based on analysis using all predictors. The table presents the weights for each of the synthetic controls, the root mean squared prediction error (RMSPE), the estimated average treatment effect on the treated (ATT) and estimated percentage change based on the ATT. Percentage change for out-of-pocket spending is calculated by applying exponential transformation (percentage change $= [e^{ATT} - 1] \times 100$). For catastrophic health spending, percentage change between treated and control is calculated by dividing the estimated treatment effect by the synthetic control in 2021.

Table A6: Difference-in-differences results: Health spending

	(1) Health expenditure per capita	(2) Catastrophic health spending
ATET	-0.925***	-0.177***
	(0.059)	(0.015)
Observations	139832	139832
Mean dep. var.	5.077	0.167

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$