Macroeconomic Impacts of Universal Health Coverage: Synthetic Control Evidence from Thailand

[Preliminary – Please do not cite without permission – Comments welcome]

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First Draft, 28 April 2015

Abstract: We study the impact of Universal Health Coverage (UHC) on the macroeconomic performance of Thailand using synthetic control methods. Thailand is compared to a weighted average of control countries in terms of aggregate health and economic performance over the period 1995 to 2012. Our results suggest that financial protection in Thailand has improved relative to its synthetic counterfactual. While out-of-pocket payments as a percentage of overall health expenditures have decreased by 16.9 percentage points, annual government per capita health spending has increased by $78. Conversely, we detect no significant impacts on total health spending per capita nor the share of the government budget allocated to health, since the pool of control countries without UHC have followed similar trends. We can report some positive health impacts as captured by reductions in infant and child mortality. The introduction of UHC had no discernable impacts on GDP per capita. Our results complement micro evidence based on within country variation. The counterfactual design can inform other countries in the region on the causal, short-run percussions and benefits of UHC at the macroeconomic level.

Keywords: Universal Health Coverage, Macroeconomic Impacts, Synthetic Control Approach, Thailand
1. Introduction
This paper examines the impact of universal health coverage\(^1\) (UHC) in Thailand on aggregate health care spending, macroeconomic performance, child and infant mortality rates. Thailand is one of the few developing countries with full-blown UHC. While there are many micro studies on UHC in developing countries (Limwattananon et al., 2015; Gruber et al., 2014; Miller et al., 2013; Wagstaff and Manachotphong, 2012; Barofsky, 2011), there is currently little causal evidence at the aggregate level.

For policymakers it is important to know what will happen to an *entire* economy after the introduction of UHC. Capturing aggregate effects is not straightforward. Evaluating the impact of UHC on just one case, here Thailand, does not lend itself to traditional models of impact evaluation and inference. Establishing credible counterfactuals is no easy task. In this paper we use synthetic control methods (Abadie et al., 2010) to compare Thailand to a plausible group of control countries without UHC. This approach offers a fully data-driven way of finding an optimal weighted average of these control countries so that they closely track Thailand in terms of outcomes of interest prior to UHC. The resulting “synthetic” Thailand is then used to simulate the country’s trajectory in the absence of UHC. Many other countries in the region have also shown improvements in health care. Our goal is to assess whether some of the observed changes in aggregate variables in Thailand can be attributed to the implementation of UHC, net of general trends for Thailand and its regional neighbors. In traditional impact evaluations using micro data, there is uncertainty about the true aggregate values in the population. At the aggregate, we carefully need to check “the ability of the control group to reproduce the counterfactual outcome trajectory that the affected units would have experienced in the absence of the intervention or event of interest.” (Abadie et al., 2010).

In line with existing micro evidence, we can document decreases in out-of-pocket payments and improved financial protection. Based on household data, Limwattananon et al. (2015) show that the Thai UHC reform reduced out-of-pocket expenditures by 28 percent. Similar evidence is reported for Mexico (Barofsky, 2011). Experiences from Taiwan and Mexico underline that UHC facilitates access to health care and financial risk protection for the poor (Lu and Hsiao, 2003; King et al., 2009). By looking at the macro-economic side, we show that government spending swiftly replaced out-of-pocket payments. This is reflected in a 16.9 percentage point increase in government health spending as percentage of total health expenditures. This increase in government health spending is, of course, the exact mirror image of the decrease in out-of-pocket spending. Government per capita health spending has increased by $78. At the same time, there is hardly any effect on *total* per capita health spending and no effect on the government budget share allocated to health. Thus government health spending does not crowd out investments in other public services such as education. Overall, the introduction of UHC has neither harmed nor improved the economic performance of Thailand vis-à-vis the other countries in the region. There are no significant impacts on GDP per capita.

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\(^1\) We apply the WHO’s definition of UHC. The goal of the scheme is “to ensure that all people obtain the health services they need – prevention, promotion, treatment, rehabilitation and palliation – without risk of financial ruin or impoverishment” (WHO, 2013). We use the terms universal health coverage and universal health care interchangeably. The former is often used in the context of developing countries to stress the idea of full population coverage. The latter pertains to the quality of care in developed countries (Stuckler et al., 2010).
Previous micro evidence has further reported positive impacts of UHC on health outcomes and behaviors. UHC positively affected working age people (Wagstaff and Manachotphong, 2012), demand for outpatient services (Panpiemras et al., 2011), or preventive check-ups. There is no evidence that ex ante moral hazard increased (Ghislandi et al., 2013). Gruber et al. (2014) also show that infant mortality rates decreased due to better access to health services among the poor. While we do not have time series data on health seeking behavior, we do have comprehensive mortality data at the national level. Aggregate infant and child mortality decreased by 20 percent relative to counterfactual countries in the region.

In the most closely related study, Moreno-Serra and Smith (2015) assess the impact of universal health coverage at the global level measuring coverage with pre-paid public and private health expenditure and immunization rates. The study estimates the effects of health coverage for a large panel of 153 countries over the period 1995 to 2008 by means of an instrumental variables approach to account for reverse causality. Expanding health care coverage improves population health as captured by reductions in child and adult mortality. Higher government health spending drives the reductions in mortality rates. We complement this macro-economic evidence by zooming in on just one case, namely Thailand.

The WHO keenly advocates UHC as demonstrated by the 2013 World Health Report on universal health coverage. Only few developing countries have fully implemented such schemes. In 2009, only 58 countries worldwide were classified as having attained full UHC with Thailand being one of them (Stuckler et al., 2010). The country has introduced the UHC policy, originally known as the 30 baht project, in 2001. Three different schemes are in place: Two employment-based schemes and the newly introduced, tax-financed Universal Coverage Scheme. The nationwide roll-out of the Universal Coverage Scheme was completed within a year, reaching a coverage of 71 percent. Coverage further increased to 95 percent in 2003, and 98 percent by 2011 (International Health Policy Program, 2011). Health care coverage was extended to 18.5 million uninsured people out of a population of 62 million (Towse et al., 2004). The benefit package for the insurees includes inpatient and outpatient care by accredited facilities as well as access to prescribed medication. The Thai experience in UHC implementation can inform health policies in other lower-middle income countries.

The remainder of the paper is structured as follows. Section 2 presents the data sources, indicator definitions and the synthetic control approach. Section 3 discusses the results and related robustness tests. Section 4 concludes.

2. Methods

Data sources and definition of indicators

In our analysis, we used data from the World Health Organization’s Global Health Observatory. In order to assess the impact of Thailand’s policy on universal health coverage we singled out five health-spending indicators. First, we assess the impact of the policy on financial protection as measured by out-of-pocket expenditures. We use the indicator out-of-

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2 The instruments CO2 emissions and conflict deaths are used to generate exogenous variation in population health. The relationship between the instrumented mortality rates and the health coverage indicators is taken as yielding causal results.
3 The employment based schemes are the following: the Civil Servants Medical Benefits Scheme covering current and retired civil servants and their dependents and the Social Security Scheme providing benefits to employees of establishments with more than 10 workers.
pocket expenditure as a percentage of total health expenditure. This indicator measures the relative importance of direct payments by households keeping total spending fixed. The variable does not include regular insurance payments. Existing evidence indicates that high out-of-pocket payments are strongly related with catastrophic health spending and impoverishment (Chuma and Maina, 2012; Ghosh, 2011; Yardim et al., 2010; Xu et al., 2007). Second, the complementing expenditure category is government expenditure on health as a percentage of total expenditure on health. If financial protection against catastrophic health spending is achieved, government spending needs to increase correspondingly. This is almost a mechanic relationship in many developing countries, since out-of-pocket payments and government health expenditures constitute the two major components of total expenditure on health. The residual category is constituted by private insurance programs and contributions to health care financing from charities. Third, we study total health expenditures per capita. Fourth, we use government expenditure on health per capita. Fifth, we consider another core indicator of health financing systems in the form of government expenditure on health as a percentage of total budget. The indicator proxies the relative importance of public health spending keeping total budget fixed.

We complement the health spending data with GDP per capita (PPP, constant $2005) from the World Bank’s World Development Indicators, as well as infant and child mortality from the UN Inter-Agency Group for Child Mortality Estimation. The mortality data is in part based on simulations and have to be interpreted with this caveat on mind. Infant mortality represents the number of infants dying before reaching one year of age, per 1,000 live births in a given year. Child mortality is also known as under-five mortality and refers to the death of infants and children before reaching the age of five expressed per 1,000 live births.

Statistical analysis and composition of control group
Our empirical model analyzed the evolution of annual health spending, the overall performance of the economy and child mortality rates. We compare Thailand’s performance with those of a synthetic control group, which is composed of a weighted average of other countries in the Asia and Pacific region without a system of universal health care coverage.

The synthetic control method is a fully data-driven way of determining a counterfactual for Thailand and allows for causal estimates in contexts with only one treated unit and a few control units. The pool of donor countries consists of 17 countries4, for which health and macroeconomic data are available for a period of six years before and 12 years after the UHC reform in Thailand.

The method searches for an optimal combination of weights for the set of control countries to minimize the pre-treatment difference between the outcome of interest, say health spending in Thailand. The applied weights result from a recursive algorithm (quasi Newton method), sum up to one, are non-negative and range from zero to one. The computed sample weights are then applied to the post-treatment outcomes to simulate Thailand’s path in the absence of UHC. If a good pre-treatment fit between Thailand and the synthetic control group is achieved, all differences in post-treatment health spending can be plausibly attributed to the universal health care policy of the country.5 Other than matching Thailand and the countries

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4 The countries included in the analysis are Bangladesh, Cambodia, Fiji, Indonesia, Kiribati, Lao People's Democratic Republic, Marshall Islands, Micronesia, Nepal, Pakistan, Papua New Guinea, the Philippines, Samoa, Solomon Islands, Tuvalu, Vanuatu, and Vietnam.

5 For further information about this technique, we suggest consulting the following studies: Abadie and
in the synthetic control group in terms of the pre-treatment outcome variable, we also include two additional control variables among the predictors that describe the economic potential and the size of the country (GDP per capita (in log) and the total size of the population).

We carefully constructed the pool of control countries in the region and excluded outlier controls as advised by Abadie et al. (2010). We excluded developed countries (Japan and Australia). Two countries leave the sample due to missing data (Myanmar and Timor-Leste). We also dropped countries with health financing systems that are (nearly) universal or are moving towards universal health coverage based on health care acts and literature (Minh et al., 2014; Asian Development Bank, 2011; Somanathan and Hafez, 2010; Rannan-Eliya and Sikurajapathy, 2009). Finally, we exclude the special cases of India and China from the analysis, as they are considerably bigger in geographical size, feature populations 18 times bigger than Thailand, and generate a volume of GDP (in 2005 PPP) that is at least 7.5 times bigger. Especially the considerable differences in these economies lead us to exclude the two countries from the study: The total volume of GDP is crucial for tax revenues and thus the financing of government interventions such as universal health coverage.

Summary statistics with pre- and post-treatment averages are presented in Table 1. Comparing the pre- and post-treatment average of Thailand, we get a first impression of the achieved financial protection and the government health financing. However, one needs to assess the findings from comparisons of time means with a lot of caution because we might be picking up mere time trends.

3. Results
The impact of universal health coverage using the synthetic control method

In short, UHC has led to significant shifts in Thailand’s health spending relative to its synthetic control. Further, we detect no impacts (neither beneficial nor harmful) on GDP per capita. Conversely, the synthetic control methods pick up some reduction in infant and child mortality in line with existing micro evidence (Gruber et al., 2014).

Figure 1 presents trends before and after the policy of Thailand and its synthetic control, i.e. the weighted average of control countries. In the same Figure, we also plot a simple average of control countries. Across Panels the synthetic control group provides a much tighter pre-policy fit than a simple average, corroborating the choice of synthetic control methods. Table 1 also presents the statistics for the pre-treatment balancing between Thailand and the synthetic control countries, as well as the corresponding average values after the introduction of UHC. The closeness of the pre-treatment Thai averages with the pretreatment synthetic control averages shows that across variables a good control group was created that closely mimics the Thai situation before the introduction of UHC.

How swiftly and strongly have expenditure patterns at the aggregate reacted relative to the synthetic control unit. Put differently, what would have happened in the absence of UHC? Out of-pocket-spending has decreased following the introduction of UHC (Figure 1, Panel A). The mean reduction in out-of-pocket-spending between Thailand and the synthetic control countries, i.e. difference in means post-policy, was 16.9 percentage points (Table 1).


6 These countries are Malaysia, Palau, Sri Lanka, and Tonga.

7 India is six times bigger than Thailand and China is more than 19 times bigger in geographical size.
Government health spending as percentage of total health expenditures perfectly offset this fall (Figure 1, Panel B). This perfect substitution arises almost mechanically due to the small residual categories (expenses for private insurance programs and contribution to health care financing from charities). The Thai government thus managed to protect its people against the economic hardships associated with (catastrophic) health care expenses. Note that near coverage was only obtained in 2003 (International Health Policy Program, 2011), which may explain some of the sluggish, or lagged effects.

Concerning per capita government health spending (in logs), we see a steady upward trend following UHC although the difference between Thailand and its synthetic control seems less pronounced as compared to the difference in out-of-pocket spending (Figure 1, Panel C). Yet, the mean difference in log between amounts to 39 percent indicating that the Thai government considerably augmented its health financing and supporting the results found for the government contribution to the overall health costs. The question is now whether the considerable increases in government financing affect the per capita total health expenditures. We present the results in Figure 1, Panel D. While there is an upward trend in per capita total health costs experienced in Thailand and across the region, we do not find that the total health costs in Thailand increase more due to UHC. If there is an increase at all it occurs after 2007 pointing at the possibility that in the medium to long run inflationary dynamics might further increase total health costs rendering UHC unaffordable. However, we do not observe a similar steady increase in the share of the government budget that is allocated to health care financing (Figure1, Panel E). In fact, while Thailand seems to allocate a higher share of the government budget to health care, we cannot establish a good pre-treatment trend for this variable. Further, we observe that after the year 2008, the share of the Thai government budget used for health declines again. Thus, the government spending’s profile does not point to inflationary dynamics in the health sector.

Next consider the impacts on GDP per capita (Figure1, Panel F). A priori and at least in the short-run, UHC could either benefit or hurt the macro economy. Therefore, we want to verify if UHC coincided with major macroeconomic changes relative to the control countries. Panel F in Figure 1 suggests that Thailand has closely tracked its synthetic counterfactual before the introduction of UHC. Thereafter, we see a small positive impact on GDP, yet this effect is not “statistically significant” as we discuss later. Clearly, UHC has not harmed the productivity of the country.

While it is reassuring that UHC has reduced out-of-pocket spending and did not hurt the macroeconomic performance, an important question is whether it had an impact on health outcomes. Annual data on health outcomes that are responsive in the short term are limited. Here we use infant and child mortality from the UN Inter-Agency Group for Child Mortality Estimation. Results have to be interpreted cautiously in a panel setting. Infant and child mortality rates are at least in part based on simulations and estimates. However these mortality estimates are widely used and have already been analyzed in panel settings (Moreno-Serra and Smith, 2015), as well as with the synthetic control method (Pieters et al., 2014). Panel G in Figure 1 illustrates a decline in infant mortality due to UHC, averaging a reduction of more than three children per 1,000 after the introduction of the policy. For child mortality a reduction of four children per 1,000 can be observed (Figure 1, Panel H). Again, there is some indication of a lagged effect.
Falsification tests and pseudo p-values

While we have presented evidence that the impacts of UHC are “economically” important, i.e. sizeable, it is also important to judge the statistical significance of the observed impacts. In other words, does the case of Thailand stand out from the data? Of course, the synthetic control method cannot supply the classical tests of statistical significance due to the small sample.

However we can gauge significance using pseudo p-values based on exact inference or permutation (Fremeth et al, 2013; Rosenbaum 2002a, 2002b). In Figure 2, we falsely assign the policy one-by-one to all the other countries in the pool of control countries resulting in 17 pseudo-treatments. The pseudo-treatments are presented in gray, the Thai impact is taken from Figure 1 and presented in black. The lines represent the difference between the falsely attributed country and the synthetic control. Thus, for a good fit prior to the treatment in 2001, we expect the lines to be tightly aligned around zero. For an economically important difference after 2001, we expect the line to deviate considerably from zero.

Five indicators in Figure 1 exhibited visible changes in trends following the introduction of UHC. Are these in anyway special? Figure 2 illustrates that prior to the policy all eight Thai indicators closely track their synthetic counterpart. After the policy, a number of variables clearly stand out relative to the placebos: out-of-pocket payments and government health expenditures as percentage of total health expenditures, per capita government health expenditures and the mortality indicators. We do not find similar changes for the falsely assigned control countries; they do not exhibit a similarly tight pre-treatment trend. The parallel trend of the control countries is best for government health expenditures as percentage of total health expenditures (Figure 2, Panel B). But for all the other indicators that changed in response to the UHC policy we cannot establish similarly good pre-treatment trends of the falsely assigned control countries prior to 2001.

Figure 2, Panel A shows that the impact on out-of-pocket expenditures is most pronounced for Thailand. No other country has managed a similar decrease. In fact some countries even experienced an increase. Similarly, no country has augmented its government contribution to total health costs by as much as Thailand (Figure 2, Panel B). When turning to per capita government expenditures on health we observe that Thailand ranks among the two countries with highest expenditures (Figure 2, Panel C) whereas for total health expenditures Thailand ranks somewhere in the middle (Figure 2, Panel D). The picture looks similar for government health expenditures as percentage of total government spending (Figure 2, Panel E). Thailand does not seem to disproportionately favor the health sector. In fact, a couple of other countries in the region equally allocate higher budget shares to the health sector. Similarly, we do not find that the overall macro-economic conditions of Thailand are very different from those of other countries in the region (Figure 2, Panel F). In terms of its achievements in reducing infant and child mortality Thailand outperforms the other countries as shown in the bottom two panels of Figure 2. Note that the mortality indicators for many of the falsely attributed countries do not have a good fit prior to the policy. Furthermore, many of the placebo models feature increases in mortality.

Related, we calculated ratios of post to pre-intervention root mean square errors (RMSE) for all placebos and Thailand. The logic behind the RMSE ratios is simple: A relatively large difference between treatment and control post as compared to prior UHC would indicate
significant and large impacts. We also need to take into account the sign of the impact. To this end we multiply the RMSE by minus 1 if the average impact was negative (Fremeth et al., 2013). We then rank the 18 RMSEs and calculate pseudo $p$-values. For example, say Thailand is ranked first. The chance of this is $1/18$ or $5.5\%$. While the $p$-values can be interpreted in the usual fashion, it is important to note that classical critical values can be misleading. Clearly, the smallest possible $p$-value is $5.5\%$. Moving down just one rank, already yields $2/18$ or $11\%$. Figure 3 presents this more nuanced picture of “statistical significance” by relating pre and post-UHC differences between treatment and control and taking into account the sign of the impacts. The RMSE ratios of out-of-pocket payments, infant and child mortality rank lowest indicating a “statistically significant” reduction due to UHC (Figure 3, Panels A, G, H); the RMSE ratio of per capita government health expenditures ranks highest pointing to a “statistically significant” increase (Figure 3, Panel C). In other words we can assign pseudo $p$-values of $5.5\%$ to all these impacts. The $p$-value for government health expenditures as percentage of total health expenditures is $2/18$ or $11\%$ (Figure 3, Panel B). For the three remaining variables -per capita total health expenditures, government health expenditures as percentage of total government spending and GDP per capita- we observe increases but they are not statistically significant (Figure 3, Panels D, E, F). Overall, we conclude that based on the synthetic control approach we find economically and “statistically significant” effects of UHC on financial protection working through increases in government health care spending and improved health as captured by reduced infant and child mortality.

4. Conclusion
We complemented existing microeconomic evidence on universal health coverage in the case of Thailand. Financial protection against catastrophic health expenditures was attained by means of increased government spending for health. Total per capita spending for health has not responded to UHC. Overall, UHC has been macro-economically neutral in that GDP per capita has been unaffected, at least in the short run.

These patterns can inform lower-middle income countries on possible aggregate consequences of introducing UHC. In countries as diverse as Ghana, South Africa and Tanzania governments are still struggling to establish more inclusive health care systems (Mills et al., 2012). To date, especially the African health systems are still underdeveloped and emergency health expenditures are often financed with asset sales (Leive and Xu, 2008).

One limitation of our study is that we cannot disaggregate impacts by income groups. Do the poor benefit from UHC? At the aggregate there are no reliable data at hand. However the existing micro studies suggest that the poor benefit more in contexts as diverse as Thailand, Mexico and Columbia (Prakongsai et al., 2015; Limwattananon et al., 2012; Miller et al., 2013; Galárraga et al., 2010; Somkotra and Lagrada, 2009; Limwattananon et al., 2007; NaRanong and NaRanong, 2006). Another caveat of macro-level studies is that they cannot address differences in utilization and spending across schemes and regions, which have been identified as major challenges of the prevailing Thai system. Further evidence is needed to improve the UHC scheme and reap its full benefits (Lindelow, 2012). Yet, it is remarkable that Thailand has achieved the implementation of UHC without compromising access for those with prior coverage (Damrongplasit and Melnick, 2009).

While the last decade has seen considerable improvements in health systems and financing thereof across many developing countries, it is still challenging to carry out rigorous macro-
economic assessments due to the lack of detailed nationally representative time series data on health indicators. In particular, aggregate health system indicators (‘number of hospital beds’, ‘number of nurses and midwives’, and ‘number of physicians’) are not available for cross-country comparison over many years. More comparable data across space and time is needed to monitor and evaluate health policies such as UHC.

References
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Tables and Figures

Table 1: Summary Statistics

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<td>Synthetic Control</td>
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## Table 2: Country weights for the construction of the synthetic control group

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<th>Government health expenditures as % of total health expenditures</th>
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Figure 1: The impact of universal health care coverage in Thailand on aggregate variables

Panel A: Out-of-pocket expenditures as % of total health expenditures

Panel B: Government health expenditures as % of total health expenditures

Panel C: Log government health expenditures per capita (PPP $)

Panel D: Log total health expenditures per capita (PPP $)

Panel E: Government health expenditures as % of total government spending

Panel F: Log GDP per capita (constant $)

Panel G: Log infant mortality (per 1,000)

Panel H: Log child mortality (per 1,000)
Figure 2: Placebo tests of falsely attributing the policy to other countries in the pool of control countries (Impact on Thailand in black)

Panel A: Out-of-pocket as % of total health expenditures

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Figure 3: Ratios of pre- and post-intervention root mean square error (RMSE)

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