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DEMAND AND REIMBURSEMENT EFFECTS OF HEALTHCARE REFORM: HEALTH CARE UTILIZATION AND INFANT MORTALITY IN THAILAND

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ABSTRACT

The Thai 30 Baht program was one of the largest health system reforms ever undertaken by a low-middle income country. In addition to lowering the cost of care for the previously uninsured in public facilities, it also entailed a fourfold increase in funding provided to hospitals to care for the poorest 30% of the population (who were already publicly insured). For the previously uninsured, we find that the 30 Baht program led to increased health care utilization, as well as a shift from private to public sources of care. But, we find a larger increase for the poor who were previously publicly insured, especially amongst infants and women of childbearing age. Using vital statistics records, we find that the increased access to healthcare by the publicly insured poor led to a reduction in their infant mortality of at least 6.5 per 1,000 births. This suggests significant improvements in infant mortality rates can be achieved through increased access to healthcare services for the poor and marginalized groups.

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1 Introduction

Over the last several decades, many developing countries have either considered or implemented health reform which provides universal healthcare access for their citizens.[1] Often, reform focuses on the extension of insurance to the uninsured. However, this ignores a second dimension of health reform: the reimbursement to hospitals for existing public programs. This is especially important in developing countries, which often have public programs for their poorest citizens that are strained for funding. Since the poorest citizens are often also the sickest citizens, the structure and reimbursement of their programs can be just as, if not more, important than the extention of insurance to the previously uninsured.

One of the countries which illustrates these complex issues associated with health reform is Thailand. In 2001, Thailand implemented the 30 Baht program, one of the largest, most ambitious reforms ever undertaken by a developing country. Prior to 30 Baht, roughly 30% of Thailand was not insured through any existing program and was required to pay out-of-pocket for healthcare utilization. But like many developing countries, Thailand had a pre-existing program which provided free care to the poor.[2] The Medical Welfare Scheme (MWS) covered another 30% of the population and was arguably underfunded with re-imbursements to public hospitals of roughly 250 Baht (~$6) per enrollee per year (Damrongplasit and Melnick [2009]; Donaldson et al. [1999]).

The 30 Baht reform, which began in 2001, had two important features. First, it allowed otherwise uninsured individuals to obtain healthcare in public facilities for only 30 Baht (~$0.75) per disease. Second, it financed the care by providing a 1,200 Baht (~$30) payment to public hospitals per non-privately insured patient, regardless of the actual utilization of those patients. This represented a dramatic fourfold increase in funding for those previously enrolled in the MWS program. Thus, not only did the program lower the cost of care for

[1] A non-exhaustive list of low and middle-income countries implementing large-scale health reforms which seek universal coverage include Brazil in 1988, Israel 1995, Taiwan 1995, Thailand in 2001, and most recently Peru in 2010.

[2] Although the poor was the primary focus of the program the young (1-15), old (>60), students (13-15), along with local village heads were also eligible to enroll.

the previously uninsured; it also dramatically increased the reimbursement to hospitals for treating low income patients.

In this paper, we investigate the impacts of both extending insurance coverage to the previously uninsured and increasing the reimbursement for the publicly insured poor in Thailand. We begin by investigating the impact of the 30 Baht reform on medical utilization. Using data on inpatient utilization, we find that the program led to a moderate increase in healthcare utilization for the previously uninsured. However, we find a larger impact for those who were previously insured by the low income MWS program, for whom there was rising hospital reimbursement. The impacts for both groups are concentrated in public hospitals, which is consistent with the targeting of the funds. Moreover, for the previously uninsured we find evidence of a switch in utilization from private to public facilities, consistent with a response to the decrease in relative price of care in public versus private facilities induced by the 30 Baht program. Finally, we show that the increase in utilization for the MWS enrollees is especially large amongst infants and women of childbearing age (20-30).

We then turn our focus to infant mortality. Across countries, there is a broad negative relationship between income and infant mortality.[3] While some have argued this link to be causal (Pritchett and Summers [1996]), the channel by which an increase in income yields lower infant mortality is less well-known (e.g. increased healthcare expenditure versus improved nutrition). Previous studies have established a cross-sectional correlation between the provision of health services and infant mortality, conditional on country-level income (Anand and Barnighausen [2004]). But, to our knowledge there are no studies examining the causal impact of a large scale increase in access to medical care on infant mortality in a low-middle income country.

We use the 30 Baht program to estimate a lower bound on the causal impact of the increased access to care for the MWS enrollees on their infant mortality by focusing on the relationship between the fraction of a province enrolled in the MWS program and the

[3] Pritchett and Summers [1996] estimate a long-run elasticity of income on infant mortality ranging from -0.2 to -0.4.

trends in their infant mortality rates. Our results suggest the increased access to medical services for the poor led to a significant reduction in their infant mortality. Using vital statistics records from the Thailand Ministry of Public Health, we first document a robust positive correlation between the fraction of a province enrolled in the MWS program and the provincial infant mortality rate in each of the 4 years prior to 2001 for which we were able to obtain data. In other words, prior to 30 Baht the negative relationship between income and infant mortality holds across provinces within Thailand. However, after the 30 Baht program, this correlation evaporates and is statistically indistinguishable from zero in years 2002-2008 (both in each year and jointly). We estimate that the 30 Baht program, which provided a funding increase of less than $25 per capita, led to a reduction in infant mortality amongst the poor in Thailand of at least 6.5 per 1,000 births. Since the MWS group is roughly 30% of the population, this implies an aggregate reduction in Thailand's infant mortality rate of at least 2 per 1,000 births.

Our paper proceeds as follows. In Section 2 we present background on the 30 Baht program. Section 3 presents a theoretical model of the impacts of the demand and reimbursement changes put in place by this program. In Section 4 we present results of the estimates of the impact of the program on inpatient healthcare utilization. Section 5 examines the impact of the program on infant mortality. Section 6 concludes.

2 The Thai 30 Baht Program

2.1 Background

In 2001, Thailand became one of the first low-middle income countries to implement a universal health coverage scheme. Long a goal of liberal reformers, universal coverage was a key element of the political platform of Thaksin Shinawatra, a populist leader who came to power in February 2001. Making quick work of this promise, the 30 Baht program ensured every Thai citizen access to low cost health services in public facilities by the fall of 2001.[4]

As discussed in the introduction, the 30 Baht program had two key features. It not only allowed nearly everyone access to care in public facilities for a cost of 30 Baht (~$0.75) per disease, but it also sought to remove a historical inequity in the provision of healthcare in Thailand by equalizing the per-person resources available for healthcare in public hospitals. The Thai government computed the number of individuals in the province who were either uninsured or publicly insured through the MWS program. It then transferred to provincial hospitals in each year $1,200 Baht (~30) per person in these categories, regardless of actual utilization by that population.[5] So hospitals moved from a system of collecting reimbursement from the uninsured, and receiving a small government reimbursement for the publicly insured, to a system where both groups were reimbursed at 1,200 Baht.

The 30 Baht program was introduced in the context of a disparate system of health care access. About 20% of the Thai population was enrolled in two employer-based insurance programs that were left largely untouched by the 30 Baht program. The Civil Servant Medical Beneficiary Scheme (CSMBS) provided free care to civil servants and their families in public facilities. The Social Security Scheme (SSS) provided free care to other formal sector workers (program was mandatory for formal sector employers). Because these programs were left unchanged around the introduction of 30 Baht, the combination of these two groups will provide a natural control group for portions of our analysis.[6]

Another 30% of the population were enrolled in the Medical Welfare Scheme (MWS), a government program for the poor, young (ages 1-15) and elderly (ages 60+).[7] Prior to 30 Baht, this program was arguably underfunded, with a global budget of only 250 Baht (~$6)

[4] The program began with several pilot provinces in early 2001, expanding to more pilots throughout the summer and covering all provinces by November 2001.

[5] Public hospitals in Thailand are managed primarily at the provincial level. Each province has one major hospital, along with numerous smaller hospitals (usually 1 per Amphoe/County) and clinics.

[6] A very small fraction (~1%) of the population, primarily upper class workers in Bangkok, has private insurance coverage. We exclude this group in our inpatient utilization analysis.

[7] The program also covered the handicapped (all ages) and religious and community leaders. The definition for eligibility based on income (the relevant eligibility criteria for most members) was an income threshold of 2,000 Baht per person or 2,800 Baht per household (~$2.25/day)

per enrollee per year (Donaldson et al. [1999]). When the 30 Baht program began in 2001, MWS enrollees were automatically enrolled in the 30 Baht program, but waived of its 30 Baht copay. As a result of absorbing this program into the 30 Baht program, funding to public hospitals to care for the poor increased from a global budget of 250 Baht per enrollee to the 1,200 Baht per enrollee, a four-fold increase (~$25).

The remaining 50% of the population was not covered under any of the above programs. However, they did have access to a previously existing government program, the 500 Baht program, which allowed households to obtain free care in public facilities for a cost of 500 Baht per household per year with no underwriting restrictions.[8] About two-fifths of the uninsured (or 20% of the total population) took up this option.

Thus, for the previously uninsured, the 30 Baht program lowered the cost of public healthcare from a maximum of 500 Baht per household per year to 30 Baht per disease (a cost reduction in the vast majority of cases). From the public hospital's perspective the 30 Baht program replaced these out-of-pocket payments and 500 Baht payments (which were matched with an additional 500 Baht from the central govt) with the 1,200 Baht per person capitation.

Figure 1 summarizes the three groups in the population and the way in which each was affected by the 30 Baht program. The UNINS faced a price reduction for care but also provided less revenue to hospitals. The MWS faced no change in the price of obtaining care, but the funding to hospitals significantly increased. The Control group (CSMBS and SSS) had no formal change to their programs around the introduction of 30 Baht.

3 Theoretical Impacts of the 30 Baht Program

We provide a stylized model to clarify the varying forces at play and highlight the potential impacts of the 30 Baht program on utilization and health. We suppose each group (e.g.

[8] Not every service was free under the 500 Baht program or the 30 Baht program (e.g. dialysis was not covered in 2001). The set of covered procedures for 30 Baht was essentially the same set of procedures covered under the 500 Baht and MWS programs.

MWS, UNINS) has a representative agent with an additively separable utility function, $U(h,c) = u(c) + v(h)$, where u is the utility from consumption, c, and v is the agent's health which is produced through the utilization of health services, h.[9] We assume u and v are twice differentiable, increasing, and strictly concave. Health services are provided by two sources: public health services, h_{pub}, and private health services, h_{priv}, so that $h = h_{priv} + h_{pub}$. We normalize units of health services, h_{priv}, and consumption, c, so that prices are equal to 1. We assume h_{priv}, h_{pub}, $c \geq 0$.

We assume public hospitals produce public care, h_{pub}, at a cost of 1. But, government programs affect the supply of public care. Specifically, we assume care at public hospitals is offered at price p but is subject to a budget constraint,

$$h_{pub} \leq p h_{pub} + b$$

where b captures funds provided from the government for the care of a given group. Note that if $p \geq 1$, the budget constraint does not limit care. But if $p < 1$, so that care is provided below cost, then the amount of public care provided by the hospitals is limited by the size of the government subsidy,

$$h_{pub} \leq \frac{b}{1-p} \tag{1}$$

Given this environment, the representative agent for a given group chooses h_{pub}, h_{priv}, and c, to maximize $u(h_{pub} + h_{priv}, c)$ subject to two constraints: the supply constraint (1) and the budget constraint

$$p h_{pub} + h_{priv} + c \leq W$$

where W is agent's wealth. By varying the parameters (p, b, W), the model provides predictions for the impacts of the 30 Baht program on the two groups (MWS and UNINS).[10]

[9] Additive separability is only a stylistic assumption which renders more straightforward predictions about the program on health.

[10] By modeling each group as having separate parameters, (p, b, W), we rule out the potential that hospitals cross-subsidize groups. One could allow the hospital to spend an increase in the provincial budget for the MWS on non-MWS patients in the province. But, we have tested for and found no evidence of such

UNINS We assume the UNINS have wealth W^U which does not vary over time. Prior to 30 Baht, the uninsured paid out-of-pocket for care and had the option of purchasing a 500 Baht card. For simplicity, we abstract from the nonlinear pricing and assume stylistically that $p^{U,Pre} = 1$.[11] In reality, our interviews with households and doctors suggest public and private care have relative advantages; public hospitals are generally better suited for complicated cases, whereas private facilities tend to be faster and more convenient. Assuming a price of one captures their substitutability and is also broadly consistent with our interviews with hospital administrators and existing literature which suggests the UNINS tended to cover their hospital expenses at public facilities (Donaldson et al. [1999]).

Optimization between consumption and healthcare utilization yields the first order condition,

$$u'\left(c^{U,Pre}\right) = v'\left(h_{pub}^{U,Pre} + h_{priv}^{U,Pre}\right)$$

which, combined with the budget constraint $h_{pub}^{U,Pre} + h_{priv}^{U,Pre} + c^{U,Pre} \leq W^U$, determines consumption, $c^{U,Pre}$, and overall health utilziation $h_{pub}^{U,Pre} + h_{priv}^{U,Pre}$. Because public and private healthcare utilization have the same price, the uninsured are indifferent between public and private utilization.

After 30 Baht, the price of public healthcare is reduced to 30 Baht (~\$0.75), which in the model we consider to be effectively zero: $p^{30B} \approx 0$. To fund care, the government provides a payment to hospitals $b^{30B} > 0$, so that the government budget constraint is given by $h_{pub}^{U,Post} \leq b^{30B}$. Thus, as long as the marginal utility of public healthcare utilization is positive, the agent will consume the maximum amount of public care, $h_{pub}^{U,Post} = b^{30B}$. Private utilization, $h_{priv}^{U,Post}$, optimizes the tradeoff between an additional unit of consumption and an

spillovers; for example, the increase in utilization we will find for the MWS patients appears to be uniform across provinces and does not vary systematically with the fraction of the province enrolled in the MWS program. Moreover, we will show all of our results are robust to the inclusion of provincial-by-year fixed effects, which would control for any provincial-level budgetary impacts.

[11] We use superscripts to denote reference to the group (MWS vs UNINS) and time period (pre 30 Baht and post 30 Baht).

additional unit of health services,

$$u'\left(W^U - h_{priv}^{U,Post}\right) = v'\left(\frac{b^{30B}}{1-p} + h_{priv}^{U,Post}\right)$$

and consumption is then given by $c^{U,Post} = W^U - h_{priv}^{U,Post}$. Overall health utilization is given by $h^{U,Post} = h_{priv}^{U,Post} + h_{pub}^{U,Post}$.

The model makes two predictions about the impact of the 30 Baht program on healthcare utilization of the UNINS. First, because the price of public utilization has gone down and private utilization is still an option at the same price, total utilization must be higher than before 30 Baht:

$$h^{U,Post} \geq h^{U,Pre}$$

Second, depending on the size of the 30 Baht subsidy, b^{30B}, the program can lead to an increase or a decrease in private utilization. If the 30 Baht payment b^{30B} were sufficiently small, then agents will compensate by seeking additional care in private facilities. But, if b^{30B} is sufficiently large, then the 30 Baht program will crowd out private care.

MWS For the MWS, $p^{MWS} = 0$ both before and after 30 Baht. Prior to 30 Baht, the government provides a small but positive amount of funds $b^{MWS} > 0$, roughly 250 Baht ($6), for their (Donaldson et al. [1999]). Because care is free, the MWS recieve $h_{pub}^{MWS,Pre} = b^{MWS}$. Since the MWS enrollees are quite poor, we stylistically assume that $w_{MWS} \approx 0$. This implies that the MWS do not utilize any care in the private market because the marginal utility of consumption is higher than that of healthcare:

$$v'\left(b^{MWS}\right) < u'\left(w^{MWS}\right)$$

Thus, $h_{priv}^{MWS,Pre} = 0$ so that overall utilization is given by $h^{MWS,Pre} = h_{pub}^{MWS,Pre}$.

The 30 Baht program increases the funding provided to hospitals to provide care: $b^{30B} > b^{MWS}$. MWS agents will now choose $h_{pub}^{MWS,Post} = b^{30B}$, an increase in care, and they continue to consume no care in the private market: $h_{priv}^{MWS,Post} = h_{priv}^{MWS,Pre} = 0$. Thus, the MWS have no change in private utilization and overall utilization is given by $h^{MWS,Post} = b^{30B}$.[12]

Cross-group Health Comparisons Prior to 30 Baht, the small funding of the MWS program implies that utilization for the MWS group is lower than for the UNINS. Thus, the marginal value of healthcare utilization is larger for the MWS than the UNINS, $v'\left(b^{MWS,Pre}\right) > v'\left(h^{U,Pre}\right)$. Provided that the 30 Baht program is sufficiently funded (i.e. b^{30B} is sufficiently large) so that $h_{priv}^{U,Post} = 0$, both groups will choose total healthcare utilization of b^{30B} so that the 30 Baht program will lead to an equalization of the marginal value of healthcare services across the UNINS and MWS:

$$v'\left(h^{MWS,Post}\right) = v'\left(h^{U,Post}\right) = v'\left(b^{30B}\right)$$

Summary of Model Predictions For the uninsured, the reduction in the price of care should lead to an increase in their healthcare utilization. The increase in public utilization is bounded by the public hospitals' resources under 30 Baht. If the provision of public care under 30 Baht is large enough, then it may lead to a crowd-out of private care. For the MWS, the increase in the supply of healthcare translates to an increase in utilization, despite no change in the price of care in public facilities. Finally, the model suggests that 30 Baht can lead to an equalization in of health outcomes (and the marginal value of healthcare) between the UNINS and MWS.

With this framework in mind, the remainder of this paper discusses the impact of the 30 Baht program on healthcare utilization and infant mortality.

[12]The prediction of zero private care usage for the MWS is a simplifiation. A richer model which allows for imperfect substitutability between private and public care would generate our testable predictions and still deliver some positive private utilization for the MWS. But, the result of zero private care for the MWS is the result is qualitatively consistent with the data, which shows MWS use significantly less (about half) public care than the UNINS (both before and after 30 Baht).

4 Healthcare Utilization

4.1 Data and Sample

We begin our analysis of the 30 Baht program with its effects on inpatient utilization. We use data from the Health and Welfare Survey (HWS) from years 2001 and 2003-2005.[13] This survey is a national cross section of all 76 Thai provinces[14], with roughly equal sized samples from each province. The survey provides a wide range of health utilization and insurance coverage information. In particular, respondents are asked whether or not they have been admitted as an inpatient in the last 12 months, which will be our measure of utilization.[15] The survey also provides information on insurance status, including whether an individual was part of the MWS, SSS/CSMBS, or UNINS in 2001, and whether an individual was part of SSS/CSMBS or 30 Baht in 2003-2005. Although the survey is not a panel, it distinguishes between individuals enrolled in the free care (no copay) version of the 30 Baht program (i.e. the "roll-over" portion of the MWS) from those who must pay the 30 Baht copay (i.e. those who were previously enrolled in the MWS program). This allows us to classify individuals into the three groups (UNINS, MWS, CONTROL) in each year of the survey.

Table 1 presents the summary statistics of our sample, broken out by group. We provide the mean age, fraction female, and fraction employed (in any paying work, formal or informal) before and after the 30 Baht program began (i.e. 2001 versus 2003-2005 in our sample). In general, the means are similar, although not identical. The control group experiences a significant increase in age (~2 years) which is larger than the other groups (~1 year for MWS and UNINS). The fraction employed increases for the CONTROL and UNINS groups

[13] We thank our partners at the University Thai Chamber of Commerce for compiling and translating this survey into English.

[14] In 2001, the survey is conducted in April/May, roughly 5 months before the beginning of the 30 Baht program in 70 of the 76 provinces. Six provinces took part in a pilot study which was underway in April/May of 2001; we exclude these provinces in our analysis. An additional 15 provinces began a pilot study in June of 2001, after the HWS was complete.

[15] The surveys also provide information for outpatient utilization and the presence of sickness, however the recall window changes from 2 weeks in 2001 to 1 month in years 2003-2005. Since this recall window changes over the same time period as the start of the 30 Baht program, we focus most of our results on inpatient utilization.

by about 2.5-3pp but less for the MWS (0.7pp). Gender shares remain virtually unchanged in each group over time. We will be able to control for these demographic variables in our regressions and assess the robustness of our results to their inclusion or exclusion.

4.2 Specification and Results

Table 2 presents the means of 12 month inpatient utilization rate for the CONTROL, UNINS, and MWS groups, broken out separately before and after the beginning of the 30 Baht program in 2001. The top row shows that overall inpatient utilization increased by 0.36pp, or roughly 5.4% over the pre-30 baht utilization rate of 6.65pp. Thus, the simple time series estimate suggests the 30 Baht program led to an increase in overall inpatient utilization.

Breaking out the results by our three groups, we find that the increase in overall utilization is primarily driven by an increase in utilization by the MWS group. The utilization rate for the MWS group increases from 0.0711 to 0.0792, a difference of 0.0081 ($p<0.01$). For the previously uninsured, we find a modest, yet statistically insignificant increase of 0.0021 (~3% of baseline utilization of 0.0585). Finally, we find no significant change for the control group (-0.0004). This is reassuring since these programs were technically unaffected by the introduction of the 30 Baht program.

The bottom two rows show the estimated difference in utilization between the treatment groups and the CONTROL group. The results show that the UNINS have lower utilization than the CONTROL group both before (-0.0207) and after (-0.0182) the introduction of 30 Baht. This implies a difference-in-difference estimate of 0.0025 ($p>0.10$), which suggests the 30 Baht program had a modest but statistically insignificant impact on inpatient utilization. For the MWS group, prior to 30 Baht this group had significantly lower utilization rates than the CONTROL group (-0.0085); after 30 Baht, the difference is positive and statistically insignificant (0.0003; $p>0.10$). This implies a difference-in-difference estimate of 0.0088 ($p<0.01$), which implies that the 30 Baht program led to a 12% increase in utilization for the MWS group.

The analysis heretofore has not included any controls for demographics, which are potentially important given the nonzero changes in sample composition outlined in Table 1. We estimate regressions of the form

$$inpat_{igt} = \beta^{UNINS} * UNINS_g * Post30_t + \beta^{MWS} MWS_g * Post30_t + + \alpha_t + \kappa_g + X_{igt}\Gamma + \epsilon_{igt} \quad (2)$$

where subscripts i index individuals, g indexes insurance groups (e.g. UNINS, MWS, CONTROL), and t indexes year (2001, 2003, 2004, 2005). The variable $inpat_{igt}$ is an indicator for inpatient utilization in the past 12 months, α_t is a year fixed effect, κ_g is a group fixed effect (MWS, UNINS, CONTROL), and X_{igt} is a set of demographic control variables including age deciles interacted with gender and 15 household income bins[16]. The variables $UNINS_g$ and MWS_g are indicators for the previously uninsured and MWS group, and $Post30_t$ is an indicator for years 2003-2005[17]. The coefficient β^{UNINS} and β^{MWS} capture the difference-in-difference estimate of the impact of the program on the previously uninsured and the MWS group.

The results in Table 3 largely support the findings of the difference-in-difference specification of a large increase in utilization for the MWS and a more modest effect on the previously uninsured. Our estimate of 0.0086 ($p<0.01$), an increase of 12%, for the MWS group in column I remains very similar to the results in Table 2. For the UNINS, we now estimate a slightly larger (and now statistically significant) increase in inpatient utilization of 0.0048 ($p<0.05$), an increase of 8% over the baseline utilization rate of 0.0585 in 2001.

Column II adds province-by-year fixed effects which capture potential provincial-level supply or demand shocks, such as the opening of a new private clinic or an outbreak of sickness. Since these fixed effects may be soaking up causal impacts of the program (e.g.

[16]One concern with including household income is that it may be a causal outcome of an increase in healthcare utilization. Our results do not change significantly with or without income controls.

[17]We aggregate these post 30 Baht years for statistical power. Separate estimates by year are very similar but have wider standard errors.

a private clinic may be less likely to open because of the 30 Baht program), we do not include these controls in our primary specification. But it is re-assuring that including these additional controls does not significantly affect our results. We estimate an increase of 0.0076 ($p<0.05$) for the MWS and 0.0044 ($p<0.05$) for the previously uninsured, statistically indistinguishable from our results without province-by-year fixed effects.

Private vs. Public Utilization The 30 Baht program provided free care only in public, not private hospitals. Columns III and IV present separate estimates for inpatient utilization in public and private hospitals. Re-assuringly, we find the increase in utilization for the MWS group is entirely concentrated in public utilization (0.0081, $p<0.01$) as opposed to private utilization (0.0009, $p>0.10$).

Moreover, this breakout reveals that the program led to a substitution of public for private utilization amongst the previously uninsured: we find an increase of 0.0068 ($p<0.01$) in public utilization and a decrease of -0.0017 ($p<0.10$) in private utilization. This is consistent with public options becoming relatively less expensive as a result of the 30 Baht program.

Women and Children In addition to analyzing the impact on each group as a whole, we can also analyze the impact for subgroups. Setting the stage for our subsequent focus on infant mortality, we focus on women aged 20-30 and infants aged 0-1. Columns V present results of the difference-in-difference specification restricted to a sample of only women aged 20-30 and infants; Column VI presents the results from the complementary sample of those who are neither women aged 20-30 or infants.

The results suggest that the 30 Baht program had a disproportionate impact on the utilization of women of childbearing age and infants, especially amongst the MWS group. In particular, among the MWS we find an increase of 0.0217 ($p<0.05$) for women aged 20-30 and infants, compared to an increase of 0.0085 ($p<0.05$) for the rest of the MWS group. We also find a larger increase amongst women aged 20-30 and infants for the UNINS (0.0065 versus 0.0052), although the increase for women and children is not statistically significant (arguably due to the smaller sample size).

In short, our results suggest significant increases in utilization for the UNINS, but generally larger increases for the MWS, and among the MWS an especially large increase in utilization for women aged 20-30 and infants.

5 Infant Mortality Specification and Results

Our results heretofore suggest that the 30 Baht program led to an increased access to care for those previously enrolled in the MWS. What effect did this have on outcomes? In this section, we provide a lower bound estimate of the impact of the 30 Baht program on infant mortality for the MWS group and for the aggregate impact on mortality.

5.1 Data

We obtained 1-year infant mortality rates at the province level from 1997-2008 complied from death certificate registries made available by the Thailand Ministry of Public Health[18]. In many developing countries, vital statistics registries are extremely incomplete. However, Thailand has been recognized as a leader in vital statistics registries among low and middle-income countries (Setel et al. [2007]), making it uniquely well-suited for assessing the impact of the expansion of medical access to the poor on infant mortality.

However, as is even a problem in richer countries, under-reporting of deaths remains a significant concern, especially among infants.Table 4 reports two average mortality rates that illustrate this potential concern. The first column reports the average mortality rate based on death registry records kept by the Ministry of Public Health (MoPH), which are the rates that we use in our analysis. The second column reports the estimated country-level infant mortality rate from the World Bank Development Indicator database. The latter is generally thought to not suffer under-reporting issues, as it combines information from

[18] We merge with provincial GDP data ("Gross Provincial Product" data) from the National Statistics Office which province provincial level GDP data for use as controls in our regressions.

household surveys (conducted infrequently - about every 5-10 years), the vital statistics registry, and modeling assumptions to attempt to remove the impact of under-reporting.

The significant under-reporting in the vital statistics database is driven by the fact that many infant deaths, especially those occuring outside of a hospital, often go un-recorded (Tangcharoensathien et al. [2006]). For deaths occuring at the hospital, medical death certificates are issued on the spot and automatically recorded in the death registry. But if a death occurs outside the hospital, the head of household and head of the village must file a death notification report to the local government registrar, an action that is not always taken.

As we will discuss further below, because the 30 Baht program led to an increase in hospital utilization in areas with more MWS people, infant mortality under-reporting likely imposes a bias against finding that the 30 Baht program reduced infant mortality, since the program could have increased reported infant mortality indirectly by increasing healthcare utilization by the MWS. So although we would ideally have no such measurement error, it is reassuring that it likely renders our results to be a lower bound on the impact of the 30 Baht program on infant mortality.

5.2 Provincial-level Specification

Ideally, we would obtain individual-level infant mortality data which could be matched to health scheme (i.e. MWS, UNINS, CONTROL). We would then run a regression of the death of an infant conditional on birth in the past year, d_{igt}, on our difference-in-difference specification,

$$d_{igt} = \beta^{UNINS} * 10 * UNINS_g * Post30_t + \beta^{MWS} * 10 * MWS_g * Post30_t + +\alpha_t + \kappa_g + \eta_{igt} \quad (3)$$

where we multiply the terms UNINS and MWS by 10 for comparability to the 1/1000 infant mortality rate which we use below.

Unfortunately, our infant mortality data is only available at the provincial level. We therefore rely on a provincial-level identification strategy. Averaging equation (3) across individuals in each province yields

$$\begin{aligned} infantmort_{pt} &= \beta^{UNINS} * \mu_p^{UNINS} * Post30_t + \beta^{MWS}\mu_p^{MWS} * Post30_t + \\ &\quad +\alpha_t + \gamma^{MWS}\mu_p^{MWS} + \gamma^{UNINS}\mu_p^{UNINS} + \bar{\eta}_{pt} \end{aligned} \tag{4}$$

where $infantmort_{pt}$ is the 1/1000 infant mortality rate in province p in year t, μ_p^{UNINS} is the fraction of the province which is previously uninsured, and μ_p^{MWS} is the fraction of the province previously enrolled in the MWS program. In principle, with data on the provincial shares, μ_p^{UNINS} and μ_p^{MWS}, one could estimate the impact for both the MWS and previously uninsured. However, in practice, μ_p^{UNINS} and μ_p^{MWS} are highly negatively correlated (-0.85), a mechanical result of the fact that the sum of the fractions enrolled in MWS, UNINS, and CONTROL must equal 1. Therefore, with our data from just 76 provinces, we cannot separately identify the impact on both the MWS and UNINS.

Instead, we devise an empirical strategy to identify a *lower bound* for the impact of the 30 Baht program on the infant mortality on the MWS group. Our primary specification is given by

$$infantmort_{pt} = \beta^{FracMWS}\mu_p^{MWS} * Post30_t + \gamma_p + \alpha_t + \epsilon_{pt} \tag{5}$$

where we include provincial fixed effects, γ_p, and year fixed effects, α_t. Figure 2 plots the distribution of μ_p^{MWS}, showing substantial variation with a standard deviation of 0.11 (largely reflecting the unequal distribution of income across provinces). In some specifications we will also include time-varying provincial characteristics, which will consist of provincial-level GDP and 1-year lagged GDP.

From equations (4) and (5), it is clear that

$$\beta^{FracMWS} = \beta^{MWS} + cov\left(\mu_p^{MWS}, \mu_p^{UNINS}\right)\beta^{UNINS} \tag{6}$$

Provided that the 30 Baht program did not lead to an increase in infant mortality, we will have $\beta^{UNINS} \leq 0$. Since $cov\left(\mu_p^{MWS}, \mu_p^{UNINS}\right) < 0$ (recall the correlation was -0.85), it is clear that $\beta^{FracMWS} \geq \beta^{MWS}$, so that $\beta^{FracMWS}$ understates the true impact of the 30 Baht program on the infant mortality of the MWS group.

5.3 Results

Historical Relationship Between Income and Infant Mortality Before presenting our primary regression results from the specification given by equation 5, we first use a simple specification to document the historical inequality in infant mortality rates across provinces and its changes around the introduction of the 30 Baht program. We estimate separate regressions for each year $t = 1997, ..., 2008$ of the form

$$infantmort_{pt} = a + \tilde{\beta}_t^{FracMWS} FracMWS_p^{2001} + \epsilon_{pt}$$

where $infantmort_{pt}$ is the 1-year infant mortality rate (per 1000 births) in province p in year t. The coefficient $\tilde{\beta}_t^{FracMWS}$ captures cross-provincial the relationship between the fraction enrolled in the MWS program in 2001 and the infant mortality rate (deaths per 1,000 births) of the province in year t.

Figure 3 plots the coefficients for each year. The cross-provincial relationship within Thailand prior to 30 Baht is broadly consistent with the cross-country negative relationship between income and infant mortality. We find a robust positive relationship between the fraction MWS in a province and infant mortality: poorer provinces had higher infant mortality rates. But after 30 Baht, this relationship evaporates; the coefficients for $\tilde{\beta}_t^{FracMWS}$ are essentially zero for every year after 30 Baht[19]. This suggests the program had a significant impact on infant mortality; it even suggests that the 30 Baht program removed the historical cross-provincial correlation between $FracMWS$ and infant mortality.

Impact of 30 Baht: Primary Empirical Specification Our specification in equation (5) estimates the drop in $\tilde{\beta}_t^{FracMWS}$ around the introduction of 30 Baht in 2001 and also includes current and lagged provincial GDP levels as controls. Our primary specification focuses on a 2 year window around the introduction of 30 Baht and excludes the year 2001 (since 30 Baht began in the middle of this year).

The results for $\beta^{FracMWS}$ are presented in Table 5. We estimate a significant coefficient of -6.4512 ($p<0.01$), indicating the 30 Baht program led to a reduction in infant mortality for the MWS group of at least 6.45 per 1,000 births. The remaining columns assess the robustness of the coefficient to alternative specifications. Column II removes controls for current and lagged provincial GDP, Column III expands the analysis to a 4 year window (1997-2005) and Column IV contracts the analysis to a 1 year window (2000-2002). Column V estimates a median regression, as opposed to the standard mean regression, which is generally more robust to the presence of outliers. We estimate a coefficient of -7.6486 ($p<0.05$) in the median regression specification, statistically indistinguishable from our estimate of -6.4512 in the mean regression.

Finally, as mentioned in the previous subsection, one may be concerned that the 30 Baht program significantly impacted reporting of births and deaths. One may also be concerned that there was some other change in vital statistics recording around the introduction of 30 Baht. To test this, we ask whether the 30 Baht program had any impact on recorded births in the vital statistics registry. Column VI reports results from a regression of recorded births using our primary specification in equation (5). The results show that we cannot reject the null hypothesis of no relationship between the 30 Baht program and recorded births. This is

[19] A joint test for all post 30 Baht coefficients equal to zero cannot be rejected at any standard significance levels.

reassuring and suggests results are not driven by changes in vital statistics recording around the introduction of 30 Baht.

A remaining identification concern is that there was something else implemented in 2001, aside from the increased access to care associated with the 30 Baht program, that led to the relative reduction in infant mortality in high MWS versus low MWS provinces. Most notably, Thaksin came to power in 2001 under a populist, pro-poor platform. The 30 Baht program was the cornerstone of the healthcare policy, but Thaksin also implemented various economic policies to promote economic growth for the poor. In particular, the so-called "Million Baht Fund", analyzed in detail in Kaboski and Townsend [2009, 2011], provided 1 million baht to each village for use in micro-loans. Yet these loan funds were provided uniformly across provinces, in contrast to the 30 Baht program which led to a differential change in funding correlated with the fraction MWS in the province. Other concerns may simply be that Thaksin implemented other policies which led to economic expansion in poorer areas (i.e. with higher MWS). But, as shown in Table 6, our results are quite robust to the inclusion of current and lagged provincial-level GDP variables, suggesting that changing economic conditions does not explain the sharp reduction in infant mortality around the introduction of the 30 Baht program. Thus, our results do not appear to be driven by other contemporaneous factors correlated with the fraction of MWS enrollees in each province.

Measurement Error As shown in Table 4, infant mortality is significantly under-reported in the vital statistics registry. Here, we discuss how such under-reporting affects the interpretation of our results. In particular, we consider three plausible types of under-reporting. All of these forms of measurement error render our estimate a lower bound for the impact of the 30 Baht program on infant mortality for the MWS group.

First, suppose under-reporting is a level effect, so that $infantmort_{pt} = in\hat{fantmort}_{pt} + a_t$ where $in\hat{fantmort}_{pt}$ is the vital statistics report and $a_t > 0$ is the under-reporting level by year. In this case, a_t will be aborbed into the time fixed effect and will not introduce any bias into the estimates of $\beta^{FracMWS}$. Our estimate of 6.5 should be thought of as being relative to the current average mortality rate of 15, and thus we estimate that the 30 Baht program led to a reduction in the infant mortality rate of at least 6.5 relative to a pre-30 Baht baseline of 15+6.5=21.5, which is a 30% reduction in infant mortality. Multiplying the estimate of 6.5 by the fraction of the population in the MWS group (~30%) implies an aggregate reduction in infant mortality of at least 2 per 1,000 births.

Second, suppose under-reporting is proportional, so that $infantmort_{pt} = \gamma * \hat{infantmort}_{pt}$ where $\gamma \approx \frac{15}{6.5}$ is the ratio of the world bank estimates to the vital statistics registry estimates. In this case, each recorded infant death represents γ total infant deaths, so that the lower bound for $\beta^{FracMWS}$ of 6.5 is actually $\gamma\beta^{FracMWS} = 15$. This implies that the 30 Baht program led to a reduction in infant mortality of 15 deaths per 1,000 births among the MWS, a 50% reduction relative to a baseline infant mortality rate of 30 for the MWS group (because the pre-30 Baht relationship was 6.5, which, multipled by γ, yields 15, so that the MWS infant mortality rate was 15 points higher than the mean of 15). This implies the 30 Baht program led to an aggregate reduction in infant mortality in Thailand of at least 4.5 per 1,000 births (15*0.3=4.5).

Third, suppose the 30 Baht program increases the reporting of infant mortality deaths, as my be expected because of the increase in hospital utilization and the higher propensity to report infant deaths if they occur in a hospital (Tangcharoensathien et al, 2006 [Tangcharoensathien et al., 2006]). Since utilization increases were largest amongst the MWS group, this type of measurement error would lead to an increase in reporting of MWS infant deaths under the 30 Baht program. This renders our estimate of 6.5 per 1,000 births a further understatement of the true effect on the MWS group, and 2/1,000 remains a valid lower bound estimate of the impact of the 30 Baht program on the aggregate infant mortality rate in Thailand.

Spillovers Since our empirical approach for the impact of the program on infant mortality is at the provincial level, we cannot immediately rule out the potential that the 30 Baht program lowered infant mortality for non-MWS individuals in areas with lots of MWS enrollees. Thus, our estimates of 6.5 per 1,000 births for the impact on the MWS group could be an overstatement of the impact of the program on the MWS group if some of these reductions accrued to the non-MWS groups in areas with a high fraction of MWS enrollees. However, even if this is the case, our estimates for the aggregate impact on infant mortality of 2 per 1,000 births remain a valid aggregate lower bound. Moreover, to the extent to which the program did improve the infant mortality rate for the non-MWS group overall (not just in high-MWS areas) our results understate the true impact of the program on the infant mortality rate of the MWS group.

6 Conclusion

Our paper has shown the complicated responses that can arise when countries reform their health care systems to increase access for underserved populations. The 30 Baht program in Thailand did increase care for the uninsured, along with shifting that care partially from private to public settings. But there were even stronger effects on the care of those who were previously insured, but for whom the government was under-reimbursing health care providers. Although such utilization results are context specific, Thailand was not unique among developing countries in having an under-funded free care program for the poor. Thus, the re-imbursement impacts are likely to be of quite important for other countries considering healthcare reform.

In addition to showing the utilization increased amongst the poor, this paper also contributes to the literature on the impact of health services on health and the disparities in health across countries. In particular, our results suggest that access to healthcare has the ability to reduce infant mortality amongst the poor. Indeed, the sharp reduction in infant mortality observed between 2000 and 2002 is consistent with the fact that the most common causes of infant mortality in the world are from treatable diseases, such as dehyration (associated with diarrhea), pneumonia, and infection ([Dupas, 2011]). Given the relatively large magnitudes of our estimates (6.5/1000 for the MWS group), our results suggest that improved access to medical services could go a long way to improve the large disparities in infant mortality rates both across and within countries.

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Table 1: Summary Statistics

Group	Pre-30 Baht	Post 30-Baht	p-value (pre-post)	p-value (D-in-D)
Control				
Age	35.8	37.7	0***	
Female	0.530	0.528	0.570	
Employed	0.682	0.711	0***	
UNINS[1]				
Age	32.5	33.4	0***	0***
Female	0.523	0.526	0.120	0.204
Employed	0.631	0.657	0***	0.662
MWS				
Age	29.7	30.5	0.021**	0.002***
Female	0.525	0.523	0.636	0.930
Employed	0.310	0.318	0.390	0.02**
Sample Size	200,926	182,543		

[1]Includes individuals who owned 500 Baht cards in 2001

Table 2: Inpatient Utilization (12mo)

Group	Pre 30 Baht	Post 30 Baht	Difference
All Groups	0.0665	0.0701	0.0036**
	(0.0019)	(0.0023)	(0.0017)
Control	0.0793	0.0789	-0.0004
	(0.0034)	(0.0041)	(0.0027)
UNINS	0.0585	0.0606	0.0021
	(0.0018)	(0.0021)	(0.0017)
MWS	0.0711	0.0792	0.0081***
	(0.0024)	(0.0022)	(0.0027)
Difference			
UNINS - Control	-0.0207***	-0.0182***	0.0025
	(0.0026)	(0.0026)	(0.0023)
MWS - Control	-0.0082**	0.0003	0.0085***
	(0.0035)	(0.0038)	(0.0032)

Standard errors clustered by province (70 provinces)

*** p<.01, ** p<.05, * p<.10

Table 3: Inpatient Utilization (12mo)

Group	I Inpatient Utilization	II Inpatient Utilization	III Inpatient Utilization (Public)	IV Inpatient Utilization (Private)	V Inpatient (Women&Child Sample)	VI Inpatient (non-women&child)
Individual Classification						
UNINS*Post30	0.0048**	0.0044*	0.0068***	-0.0017*	0.0065	0.0052**
	(0.0023)	(0.0023)	(0.0022)	(0.0010)	(0.0064)	(0.0025)
MWS*Post30	0.0086***	0.0076**	0.0081***	0.0009	0.0217**	0.0085**
	(0.0031)	(0.0031)	(0.0031)	(0.0013)	(0.0098)	(0.0033)
Mean Dep Var (03-05)	0.0701	0.0701	0.0604	0.0095	0.1002	0.0667
Controls						
Year FE	X	X	X	X	X	X
Group FE	X	X	X	X	X	X
Age, Gender, Income	X	X	X	X	X	X
Province FE		X				
Province x Year FE		X				
Women&Child*Post30						

Standard errors clustered by province (70 provinces)

*** p<.01, ** p<.05, * p<.10

Table 4: 1yr Infant Mortality Rate (per 1,000 Births)

Year	MoPH[1]	WB Dev Ind[2]
1997	4.6	16
1998	4.7	16
1999	6.7	16
2000	6.2	15
2001	6.2	15
2002	6.3	14
2003	6.9	14
2004	7.2	13
2005	7.3	13
2006	7.1	13
2007	7.0	12
2008	6.8	12

Standard errors clustered by province (76 provinces)

[1]Source: Ministry of Public Health Vital Statistics Registry

[2]Source: World Bank / Thailand Survey of Population Change

*** p<.01, ** p<.05, * p<.10

Table 5: Infant Mortality Rate (Provincial level; per 1000 births)

Dependent Variable	Infant Mort (per 1000) I	Infant Mort (per 1000) II	Infant Mort (per 1000) III	Infant Mort (per 1000) IV	Infant Mort (per 1000) V	Births (1000s) VI
FracMWS*Post30	-6.4512***	-6.7560***	-5.3845***	-5.3678*	-7.6486**	-0.2426
	(2.3145)	(2.1719)	(2.0162)	(2.9651)	(3.0154)	(1.8170)
Specification						
Year FE	X	X	X	X	X	X
Province FE	X	X	X	X		X
Provincial GDP	X		X	X		X
Prov GDP (Lagged)	X		X	X		X
Median Regression					X	
FracMWS					X	
Sample Range	1999-2003 (excl 2001)	1999-2003 (excl 2001)	1997-2005 (excl 2001)	2000-2002 (excl 2001)	1999-2003 (excl 2001)	1999-2003 (excl 2001)

Standard errors clustered by province (76 provinces)

*** p<.01, ** p<.05, * p<.10

Figure 1: Population Groups Impacted by 30 Baht

Group	Description	30 Baht Program Impact	Pop %
UNINS (+500 Baht)	Either • Paid out-of-pocket or • Enrolled in 500 Baht program	• Individuals face lower price of care • Hospitals receive 1,200 Baht capitation per person, replacing out-of-pocket payments or 1,000 Baht per household payment for 500 Baht program	50%
MWS	Free care program in public facilities for poor, elderly (>60) and children (<15).	• Increased hospital funding from 250 Baht to 1,200 Baht	30%
CONTROL	Social Security Scheme (SSS) • Mandatory free care program for formal sector workers Civil Servants (CSMBS) • Free care program for civil servants and their families	• No formal change	20%

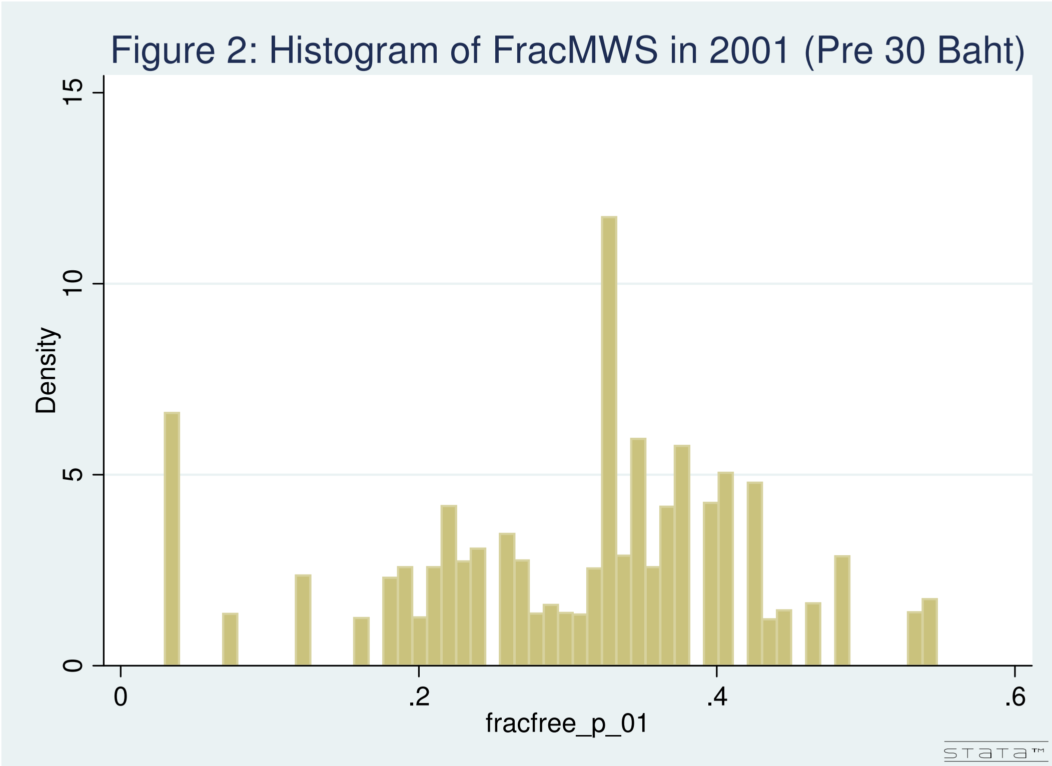
Figure 2: Histogram of FracMWS in 2001 (Pre 30 Baht)
Density
0
5
10
15
0
.2
.4
.6
fracfree_p_01

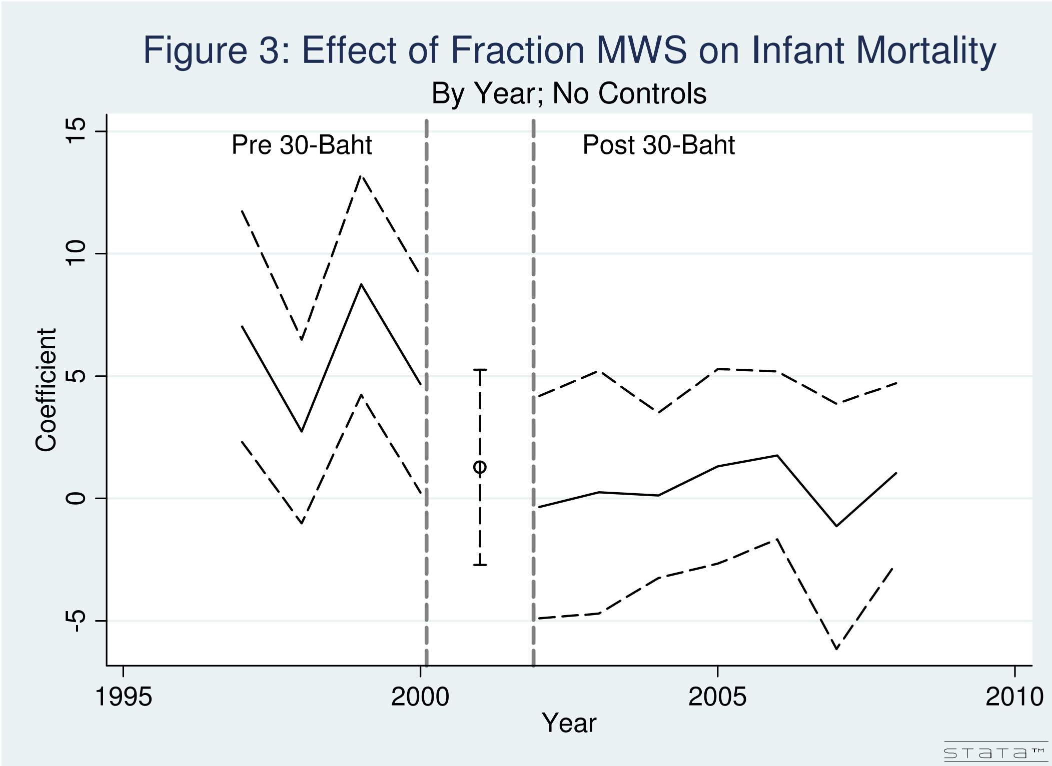

Figure 3: Effect of Fraction MWS on Infant Mortality
By Year; No Controls
Pre 30-Baht
Post 30-Baht
Coefficient
15
10
5
0
-5
1995
2000
2005
2010
Year
stata™