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Public Spending on Health: Effects on Child Mortality. A Study of the Population without Social Security in Mexico.

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Abstract

The relationship between public spending on health and child mortality has been inconclusive in literature. Discussions about significant associations have largely depended on specific periods and countries studied. This essay focus on the effects of public spending on health on child mortality in the Mexican poorest states. Public spending on health for the population without social security was the specific variable examined considering the implementation of a public health insurance aiming to provide universal health coverage. A more even health system across the country implied a redistribution of public health expenditure between states with relatively high and low income. Based on the models presented, child mortality was a dependent variable expecting to have a significant effect from changes in public health expenditure for population without social security. The public health insurance *Seguro Popular*, is referred as main driver for increasing public health expenditure in poor states. This essay examines the relationship between public health expenditure and child mortality rates.

Key-words: child mortality, public health expenditure, health insurance.

Contents

1. Introduction

Child mortality is largely determined by investments at the early age of individuals. The relationship between health public expenditure and child mortality has varied across studies considering several factors. Maternal education, income, and public spending, among other variables, have shown correlations with childhood mortality (Wang, 2003; Andriando & Monden, 2019). Household income has been presented as one of the most quoted economic variables with a positive relationship to child survival (O´Hare et al., 2014). Public spending on health holds arguable positions about the effects on child fatalities. Health policy through health public spending impacts positively on child survival rate, which means that mortality rate at an early age decreases (Clements et al., 2005). However, Filmer & Pritchett (1997) state that effects may be inconsequent, public health expenditure *per se* does not decline child mortality. Explanations presented by these authors are the public sector efficiency to translate public health expenditure (PHE)[1] into a larger supply of health services, and consumption of health services or goods with a different impact on child mortality. Quality of governance as a link to PHE efficiency was proposed as an additional explanatory variable to understand why PHE had significant effects only in some countries (Rajkumar & Swaroop, 2002).

The rationale of governments' health public policy to reduce child mortality is related to health as a general concept. Health is a crucial determinant of human capital, holding a positive and significant effect on economic growth. An underlying fact, is that unhealthy workers will be less productive. Productivity contraction considers several factors, such as being absent for illness or lower performance because of diseases (Bloom, et al., 2001). At an aggregate level, mortality reduces the labor supply, and morbidity has negative consequences in the economy. As a result, poor health may contribute to poverty and underdevelopment under certain diseases (Cole & Neumayer, 2006).

People with low incomes are frequently in worse health, have higher exposure to risk factors and face higher entry barriers to the health system than the better-off educated (OECD, 2019). One reason that justify governments interferes in health markets is the healthcare finance with public resources for people who cannot afford private insurance or costly health

[1] Public health expenditure refers the same as public spending on health, which is frequently used thought the essay.

interventions (Musgrove, 1996). Individuals with low income, are likely to encounter financial barriers to healthcare even with private or public insurances (Weinick, 2005). The risk of cycles where poverty leads to ill health and ill health maintains poverty presents an issue in health public insurances, placing the role of government to efficiently subsidize healthcare services (Peters et al., 2008).

Universal Health Coverage (UHC) has been the aim of most developing countries through their health public policy. Equal access to healthcare services for the entire population has proposed several health systems to efficiently provide health coverage. The implementation of an effective health insurance to reach UHC has derived in particular health systems integrating public and private providers (Zaman, 2017). Instrumenting access to health services for all individuals has been particularly complex in developing economies. Population-based studies suggested that poor healthcare coverage may be a key determinant of child mortality (Frankenberg, 1995). Also, Ranabhat (2018) stated that UHC has significant results in life expectancy and child mortality, suggesting overall health indicators gains under an efficient health coverage scheme.

Mexico is a Latin-American country that improved life expectancy and child mortality indicators since the second half of the 20th century. Between 1960 and 2000, life expectancy in Mexico rose from 57 to 75 years old, and child mortality declined from 150 to 13.4 (deaths per 1,000 live births). Since the beginning of the 21st century the health system in Mexico gradually advanced to universal health coverage. In 2013, a decade after the first health insurance for individuals without social security, named *Seguro Popular (SP)*, close to 50 million people were affiliated, roughly half of the population. Also, out of pocket expenditure as a share of total healthcare expenditure, passed from 55% in 2003 to 39.9% in 2012. Reducing almost 15% [2] out of pocket expenditure as a share of total healthcare spending. Besides, between 2003-2012, private spending relative to total healthcare spending was reduced by approximately 12%.

This essay examines the public spending on health effects on child mortality in Mexico between 2012 and 2017. The public health expenditure (PHE) focused on resources allocated

[2] Information presented by the Health Ministry Database*: Indicadores Gasto en Salud 2003-2017*. Extracted from: www.dgis.salud.gob.mx

to the population without social security. PHE for the population without social security is the closest proxy to SP, the health public insurance implemented as an instrument for universal health coverage. This study is conducted to measure the impact of PHE on the population without social security on child mortality between 2012 and 2017. This period was barely studied in the literature, where regional differences in terms of health public spending were usually omitted.

The empirical evidence of this study is divided into two parts. In the first part, public spending on health is presented at a regional level, examining changes of PHE among states with comparatively high and low GDP per capita. Shifts in public spending on health are mainly observed for the 9 poorest states in Mexico, where the population was predominantly covered by the public insurance SP. In the second part, I examine if an increase in PHE for population without social security affects child mortality rates. By presenting two models, I study possible links between PHE for population without social security and child mortality. Control variables in the first model and fixed effects in the second model are specified. The study concludes with the models' results derived from the initial hypothesis, and a discussion associated with the findings.

2. Institutional background

Governments can alter their health systems through reforms and public spending on health (Cevik & Taşar, 2013). Several types of health systems' models have been proposed, such as the tax-based financing system and the social insurance system (Zaman, 2017). Differences among health systems have expanded, becoming increasingly complex to cluster health systems in simplified models (Reibling et al., 2019). The performance of health systems to decrease child mortality have suggested comparative variations based on their type of public-private health coverage (Ahmad et al.,2000)

The case of the Mexican health system called the attention because of its expected reverse of health access inequality across regions through the public health insurance SP, this public insurance was an instrument to reach UHC (Knox, 2016; Gakidou et al., 2007). Before 2003, the Mexican healthcare system did not provide an explicit health services package for

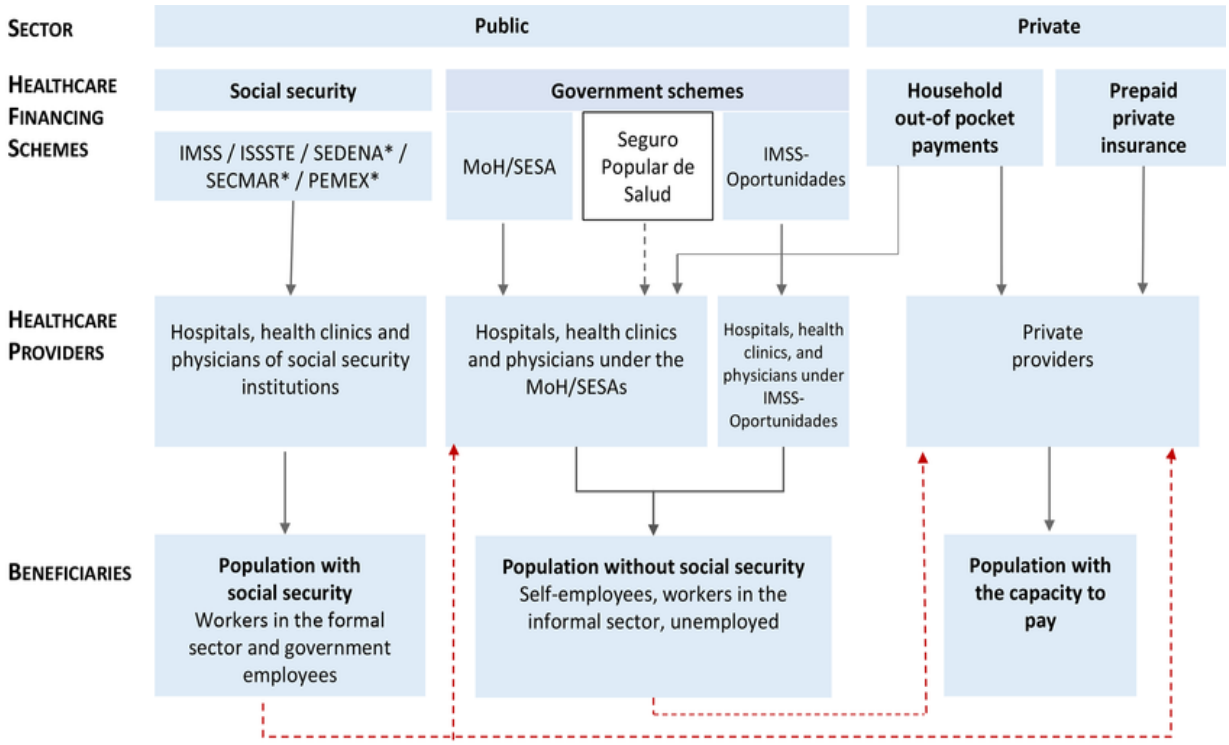
population without a formal job. Uninsured workers and their families depended on states' underfunded health services (Bonilla & Aguilera, 2013). Health services and interventions specified in SP and states' implementation expected improvements on health outcomes, such as child mortality (Urquieta & Villareal, 2015).

2. 1 The Mexican health system

The Mexican health system is integrated into a top-down scheme. Public and private sectors are the main division, with a more complex organization in the public sector. Resources in the public sector display a first segmentation of the population based on their occupation. Funding schemes characterize a difference in health coverage as introduced in Figure 1. Aside from the funding scheme, beneficiaries are classified on their legal labor condition. Public health insurance based on formal or informal occupation determines their access to mixed or public insurance (Gómez-Dantes et.al., 2010). Private coverage offers health insurance according to market demand, where the disposable income of individuals determines access to private insurance. The assumption behind private insurance is the condition of individuals with the capacity to pay (Ávila, et.al, 2016). In 2019, approximately 8% of Mexicans had private insurance, recognizing the predominance of public insurances.

The population without social security has another type of health public insurance that differs from the population with social security. Federal and local governments are the financing axis for the population without social security. Individuals in this group are self-employees, workers in the informal sector and unemployed, with respective families. Ministry of Health and State Health Services, are the providers of *Seguro Popular*. IMSS *Oportunidades* is another healthcare public insurance derived from the mentioned IMSS. Healthcare insurances for the population without social security are oriented for citizens with lower incomes. *Seguro Popular*, is the largest public health insurance in the country, which depends on federal/state contributions, and an individual fraction. SP had a share of almost half of the population in 2012 (52.7 million people affiliated).

Figure 1. The Mexican health system



Source: Figure presented and modified by (Ávila, et. al., 2016), based on the original (Frank J., Gómez Dantes, et.al., 2015).

2.2 Reform of 2003: Seguro Popular (SP)

In 2000, about 3 to 4 million Mexican families incurred impoverishing health expenditures, showing an ineffective national health system able to provide universal coverage for the population (Frenk et al., 2009). Disconnections within the public healthcare programs affected in a higher proportion those individuals and families without social protection. The most relevant reform in the Mexican health system was in 2003, implementing the national health insurance named *Seguro Popular (SP)*[3]. SP was more than an insurance, it was the

[3] The creation of *Seguro Popular*, formally known as the system of social health protection, System of Social Health Protection, was part of the General Health Law (*Ley General de Salud)*. By modifying the constitutional article number 4, regarding the universal right to health protection, and their level of responsibilities to instrument the coverage from a federal to a provincial distribution of responsibilities. (Flamand and Moreno, 2014)

public policy instrument in the Mexican healthcare system, which aimed to provide insurance for more than 50 million citizens previously excluded from the social security system (Gutierrez, et al., 2014).

Before 2003, the federal government allocated resources by state capacity to offer medical services, mainly calculated by the number of people affiliated to IMSS, ISSSTE, and states' health services budget[4]. After the reform, each state received federal resources according to the number of people affiliated to *Seguro Popular*. The aim was a public budget allocation based on the number of affiliations by state, instead of the public budget determined by states' public healthcare supply (Nigenda et al., 2015). The new model of public budget allocation by states' governments was driven by SP demand. Registrations determined the health public spending for population without social security.

Since the implementation of SP, the fiscal mechanisms promoted a public budget redistribution among states to reach UHC. This economic shift allocated health federal resources based on the number of people affiliated to the public health insurance *Seguro Popular*. Registrations of families to SP accounted for the number of people affiliated by state, which determined the federal subsidies by state. Consequently, poor states expected to increase their health public spending through federal subsidies. Three economic aspects supposed a higher public spending on health for the population without social security in states with lower income: high-income inequality between regions[5], highest rates of job informality, and higher poverty rates[6]. Therefore, states with lower income were expected to be more benefited in their health public spending through SP implementation.

4 Each state had local infrastructure and personal to attend population without a health insurance. Annual budgets approved from the central government created disparity between states healthcare services. Financing of healthcare federal subsidies depended on the evaluations previous approved budgets and political agreements.

5 For the year 2012, GDP per capita was 5 times higher between the capital (2nd richest) and the poorest state.

6 Calculations from GDP per capita by state (constant prices 2008), database provided by: SEMARNAT. And National Poverty Report (2012), CONEVAL: www.coneval.org.mx/Informes

Table 1. Seguro Popular. Public insurance as an instrument for UHC.

Definition	Voluntary[7] public health insurance for the population economically excluded from any health coverage. The aim was to provide health services through an individual* and public financed insurance for families without social security: informal workers and unemployed.
Coverage	A set of health interventions and pharmaceuticals covering 249 conditions and 307 drugs[8]. Among benefits are vaccines to prevent pneumococcus (an infection related to children pneumonia) and rotavirus (a common cause of childhood diarrhea), pregnancy services, childbirth, and child cancer interventions (e.g. leukemia and tumors).
Supply Structure	Based on hospitals' networks in each country state, managed by each state local government. The hospitals, clinics, and medical employees were part of each state health service. Investments in new infrastructure also derived from insurance financing by state.
Financing*	Subsidies from federal public health resources, and states at a lower proportion. Individual contributions by the family were contemplated as part of the insurance with an annual fee, excluding this annual fee the poorest families[9].

Source: Own elaboration from *Seguro Popular- Salud Presentation 2006*: www.salud.gob.mx. And *Comisión Nacional de Protección Social en Salud. Seguro Popular. 2014*: www.gob.mx/cms

[7] Officially defined as a voluntary insurance. Families have to register in their local Health Departments and pay the affiliation quotas. Or register without any fee if their income is in the lowest percentiles.

[8] Conditions and drugs covered are defined in the Universal Catalogue of Health Services for the year of 2006. There is a variance of conditions covered in selected years. High cost and complex interventions belong to another fund named "catastrophic events".

[9] The annual fee by family was calculated according to the income of the person affiliated. The two lowest deciles were exempt from any contribution. And from the third to the tenth decile a table of proportional contributions was designed at affordable fees.

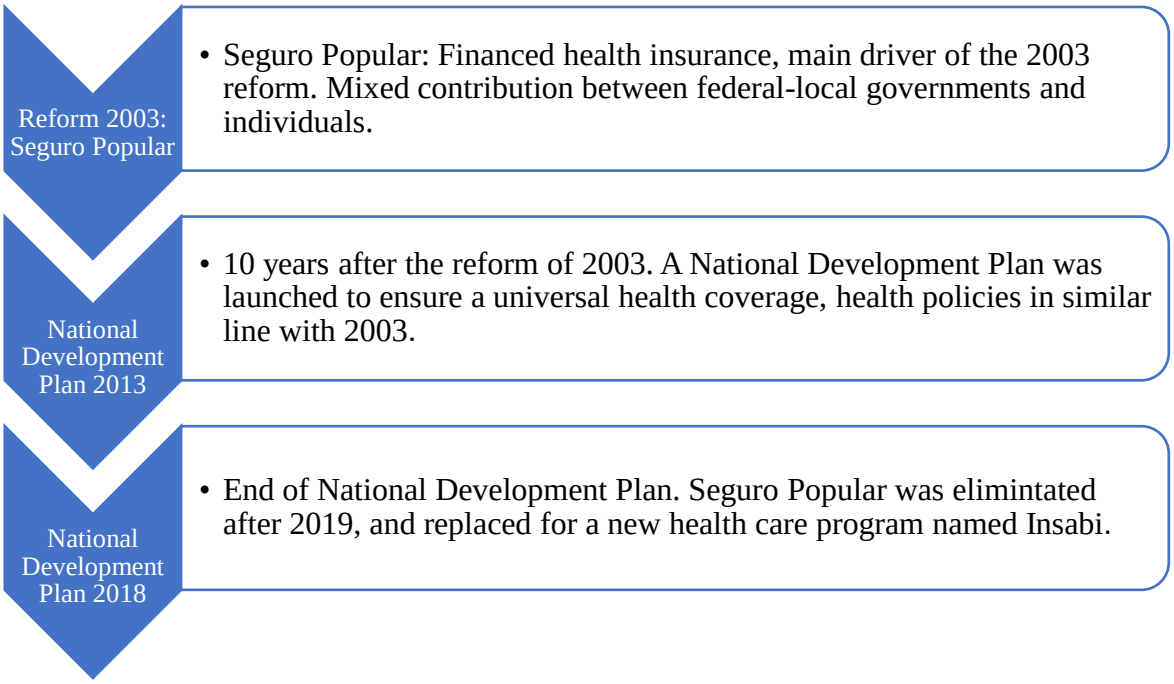
The public financing for most of the poorest states emphasized SP insurance. Redistribution of the federal health public budget across the states was expected to reduce inequalities for the states with lower health coverage. The integration of SP was possible through states' participation in the federal budget according to the number of individuals affiliated. Previous to the reform, the central government allocated health public resources to the states through a system based on institutions that provided health services for the population with social security, approximately 50% of the population in 2003.

The public budget system since 2003 allocated resources by each state based on the number of people affiliated to a public insurance, presenting a path-breaking incentives' scheme from the central government to the states (Flamand & Moreno, 2014). This fiscal system set the guideline to reverse the uneven fiscal distribution. The impact in health services can be still observed by the difference in children's mortality under the age of 5, though. In 2015, the state of Oaxaca had 18 cases per 1,000 live births, while Nuevo Leon, 11.1.[11] , showing the contrasting states' health outcomes in different regions. States with better health infrastructure and more formal employees received a higher proportion of the health public budget.

After implementing *Seguro Popular*, the fiscal redistribution generated expectations in poor regions, where an increase in the number of people affiliated to SP was a turning point for better public healthcare (Frenk, et. al, 2006). The identified issue on the federal health budget allocation was that every fiscal year the public health budget had to be negotiated per state considering the available annual resources. Political bias and historical inertia from previous public health budgets generated inefficiencies on health public spending and a problem of transparency (Chemor et al., 2018; Frenk & Knaul, 2005). In other words, the reform expected a more efficient health public spending that did not depend on the annual budgets presented and approved by the federal government under a series of unclear criteria for the states.

[11] CONEVAL (2018). Diagnostic study about the right to health. National Commission for Evaluation of the Social Development Policies.

Figure 2. Seguro Popular timeline (2003-2018)



In 2013, the National Development Plan (2013-2018) was carried out by the federal government. The national plan defined strategies to improve health policies in the country. Health public resources allocation in 2013 remained the same as in 2003, each state received a budget corresponding to the number of affiliations to SP. A public healthcare system with private collaborations in SP for some diseases theoretically proposed more active participation of the private sector (León, et al., 2019). Nonetheless, private participation was inconclusive, the insurance did not provide sufficient information to prove public-private collaborations.

The more even distribution implied additional resources to the poorest states, closing the health public spending gap with the richest states. A state with a high proportion of the population without social security was expected to be benefited since 2003 because of the number of people registered to SP insurance. Particularly the states with families classified in the lowest income percentiles, which were exempted from any SP annual fee. SP insurance expected to increase the amount of health public spending in poor states as part of the federal re-distribution strategy.

Health policies in 2012, were oriented to the consolidation of improvements in health outcomes and indicators stated since 2003. By explicitly quoting the National Development Plan, two main points are suggested. First, the plan expected child mortality rate to decline as a key health outcome, but no specific rate was defined as a goal at the national or regional level. Second, the institutional framework is the same as in 2003, SP public insurance did not change its incentives scheme. In summary, the NDP is relevant for the study because of the years studied, from 2012 until 2017. Nonetheless, it follows the health public policy direction of the 2003 reform to reduce child mortality.

3. Related literature

Since 2000, authors in academia and world organizations have discussed the performance of Mexican health policies. The aim of the country has been a constant progress to provide health coverage for its population (OECD,2012). Perspectives of health policy literature in Mexico emphasize legal shifts in the healthcare system since 2003. The 2003 reform represented a driver to provide healthcare to the population without social security, which adds up to more than half of the population[16].

Potential outcomes about SP registration rates since the reform have been measured by authors such as Gutierrez, et al. (2014), and (León, et al., 2019). These authors mentioned that approximately 45% of the total population registered in the new healthcare insurance SP (more than 50 million registrations), reducing to a low record level the population without health insurance. Infant mortality as a health outcome of SP implementation was studied by Pfutze (2014), presenting the negative association between infant mortality and SP coverage in the first 5 years of the reform. No studies were found regarding child mortality relationship with public health expenditure for population without social security as a proxy to SP.

The model of public budget allocation for health services provided a more transparent legal framework. Chemor et al (2018) proposed that risk of public resources inefficient spending by states was reduced, enhancing better healthcare performance at a regional level. However, comparative studies based on public health expenditure and effects on child mortality at a

[16] Mexican Health Secretary Data Indicators (2017).

regional level are scarce. Most of the studies have specialized in health status indicators and legal shifts within the Mexican healthcare system.

Authors, such as, Frenk et al (2009) and Gutierrez et al (2014) defined the health's policy economic motivations since 2003. Among their conclusions were that shifts in the public budget allocation were important to solve labor segmentation in public healthcare, and states efficiency to provide healthcare would determine the health outcomes. Studies published by Flamand & Moreno (2014) explained the bureaucracy differences from the health system in Mexico before 2003, and problems experienced by implementing *Seguro Popular* in different states, pointing out the necessary states' closer regulation for SP healthcare quality.

Since 2013, the academic literature about the evolution of SP reduced. One reason is that the National Development Plan (2013-2018) was a national plan and not a reform as in 2003. The objectives specified in the mentioned plan had fewer elements to prove than the reform. As there were no additional financial resources for SP, the NDP focused on a more effective SP regulation and constant monitoring of public health expenditure (Aguilera et. al, 2015). Regulations from the central government to improve the quality of health services were discussed by (Doubova, 2018). Authors concluded that since 2012 health public spending was stagnated, therefore SP improvements had to focus on subsidies' monitoring through federal-local coordination.

4. Data

The regional data was extracted from selected Mexican institutions with open databases or census reports, the following federal institutions were consulted to cluster information: National Institute for Statistics and Geography (INEGI), Ministry of Health (Secretaría de Salud in Spanish), National Population Commission (CONAPO by its initials in Spanish), and Ministry of Environment and Natural Resources (SEMARNAT). These Mexican institutions were the source of information to compile the data at a regional level through queries in available government census or databases.

Model data was specifically collected from government institutions' depending on each variable. Information regarding public spending on health and public spending on health per

capita for population without social security was consulted from the Health Ministry open database, *Expenditure in Health Database, 1993-2017 (constant prices 2017*). This database contains public health expenditure for all the Mexican states, including detailed information about the public health expenditure for population without social security. The health outcome of child mortality by state in 2012 and 2017 was collected in a database captured manually from the information available at the National Population Commission (CONAPO by its initials in Spanish). The advantage of collecting manually the data of child mortality from the National Population Commission, instead of the statistics available at the National Institute for Statistics and Geography (INEGI) was that child mortality by state was presented in terms of rate by state.

GDP per capita by state was consulted from the Ministry of Environment and Natural Resources, *Database GDP per capita 2003-2017 (constant prices of 2008)*, which was used to capture GDP per capita by state. Data about female education by state was consulted from the household and population census between 2000-2018 provided by the National Institute for Statistics and Geography (INEGI). Regarding female education, the data query from INEGI was filtered for population by level of education, specifying for the female gender and high school education finished as a proportion of the total female population by state.

5. Methods

A comparison between the 32 Mexican federal entities was done to classify states into 3 groups based on their GDP per capita[17] in 2012. From average GDP per capita in 2012, 9 federal entities were above the mean, and 23 below the average. As a result, the 9 federal entities with a higher GDP per capita formed the first group of High-Income Federal Entities, 12 entities were considered Average Income states, and the least 9 observations formed the last group of Low-Income states. The classification introduced the relative GDP per capita position of each state by listing them in ascending order. The point of this simple classification is to provide the GDP per capita of the states where a higher or lower impact

[17] GDP per capita by state for the year 2012, the first year considered for the calculation extracted from the database provided by www.semarnat.gob.mx, constant prices of 2008. Available data at INEGI.

of SP would be expected. Also, by classifying states based on their GDP per capita is possible to introduce states' comparisons of public spending on health per capita for population without social security in 2012 and 2017.

The main hypothesis to be tested in this essay is that public spending on health per capita for population without social security significantly reduces child mortality. This hypothesis was tested with 64 observations, representing the 32 Mexican states in 2012 and 2017. The defined regressions used ordinary least squares (OLS) in two specified models. The first model was tested with control variables and years fixed effects. The second model focused on public spending on health per capita for population without social security as the independent variable, adding states fixed effects. In both models, robust standard errors were applied. The models introduced the following equations denoting (1) for the first model, and (2) for the second model:

$$(1)\ CM_{it} = \beta_0 + \beta_1 * PHE_{it} + \tau * G_{it} + \psi * F_{it} + i.year + \varepsilon_{it}$$

$$(2)\ CM_{it} = \beta_0 + \beta_1 * PHE_{it} + i.states + i.year + \varepsilon_{it}$$

Child mortality[18] depending on public health expenditure for population without social security[19] is presented in equations of model 1 and model 2 because of the hypothesis of this essay. The value of the dependent variable, child mortality, is expected to be negatively impacted by β1 in both models. From public spending on health per capita it was specifically selected the variable related to public spending on health per capita for the population without social security. The underlying reason for this distinction in public health expenditure per capita is that the poorest states depend more on health public spending focalized to population without social security. As a result, public spending on health per capita for the population without social security was the best approximation to the efficiency of *Seguro Popular*, the

[18] Child mortality is measured in the rate of deaths for every 1,000 live births, under the age of five.

[19] *PHE* refers to public health expenditure per capita for population without social security due the hypothesis purposes. Values in thousands of Mexican pesos (constant prices of 2008).

public insurance implemented to reverse restrictions to healthcare services based on labor occupation.

The first model tested the variable of public spending on health per capita for population without social security (*PHEit)* on child mortality (*CMit*) as a health outcome. GDP per capita by state (*Git)* in Mexican pesos, and female rate of high school education by state[20] (*Fit)* were the two control variables included in the regression. The year fixed effects specified as *i.years* was added to control the omitted variables within the states that may influence the outcome variable because of expected variation over time with constant effects across states. In this case, it reduced the risk of omitted variables in states' observations that change over time and may influence child mortality. Idiosyncratic error term was expressed as εit.

The first control variable was GDP per capita by state (G*it)*, which was assumed to affect child mortality. GDP per capita by state was expected to reduce child mortality considering the income effects on life quality over time. More disposable income for health expenses and the effects on individuals' time-life has been accepted in the literature as a positive variable of child survival (O´Hare et al., 2014; Lartey et al., 2016). GDP per capita was related to public health expenditure per capita because of the GDP per capita positive relationship with public spending on health as proposed by (Farag, M. et al., 2009). Also, in the case of Mexico, states with lower income were expected to gradually increase their public health expenditure per capita through SP. Since it was not possible to calculate household income by region, GDP per capita was the closest proxy to income by state.

The second control variable was related to the effects of education on child mortality. The female rate with high school education by state (*Fit)* was a control variable considering the impact of maternal education on child mortality in selected countries (Kiross et. al., 2019). Causalities of child mortality reduction under higher levels of maternal education may be due to knowledge about diseases, and proximity to health facilities (Andriano & Monden, 2019). The female rate with high school education by state was linked to public spending on health per capita considering that higher levels of education may explain access to formal labor

[20] Female rates of high school education is measured as a proportion of the total female population by state.

employment (Riddel & Song, 2011). Available data regarding female education by state in Mexico provided a proxy to maternal education. Female education was expected to be higher in states with relatively better GDP per capita because of the relationship between GDP per capita and years of education.

The second model tested health public spending on health for population without social security (*PHEit)* on child mortality (*CMit*) with a fixed-effects model. This model focused on public spending on health per capita for population without social security as the independent variable of interest, effects of the observations related to states and years were fixed in the regression as introduced by *i.states* and *i.years*. The states fixed effect was included to eliminate the risk of bias due to omitted factors that may vary across states while being constant over time. The states and time fixed effects aimed to provide a better impact assessment of public spending on health per capita for population without social security on child mortality. No additional covariates were included because of the 2 years' time-difference since no further reforms expected to affect child mortality.

In the case of model 1 and model 2, the tests were done with the variables at their original values, and logarithms to prove the consistency of the models. By testing the robustness of the standard errors there was no clear difference between models with logs and without logs. Residuals of models with logs and without logs did not suggest that any one of the two models were clearly superior as shown in graph 1 and graph 2 of the appendix. The two models were tested under variables at original and log values, but residuals' tests did not show the best fit of the observations.

6. Results

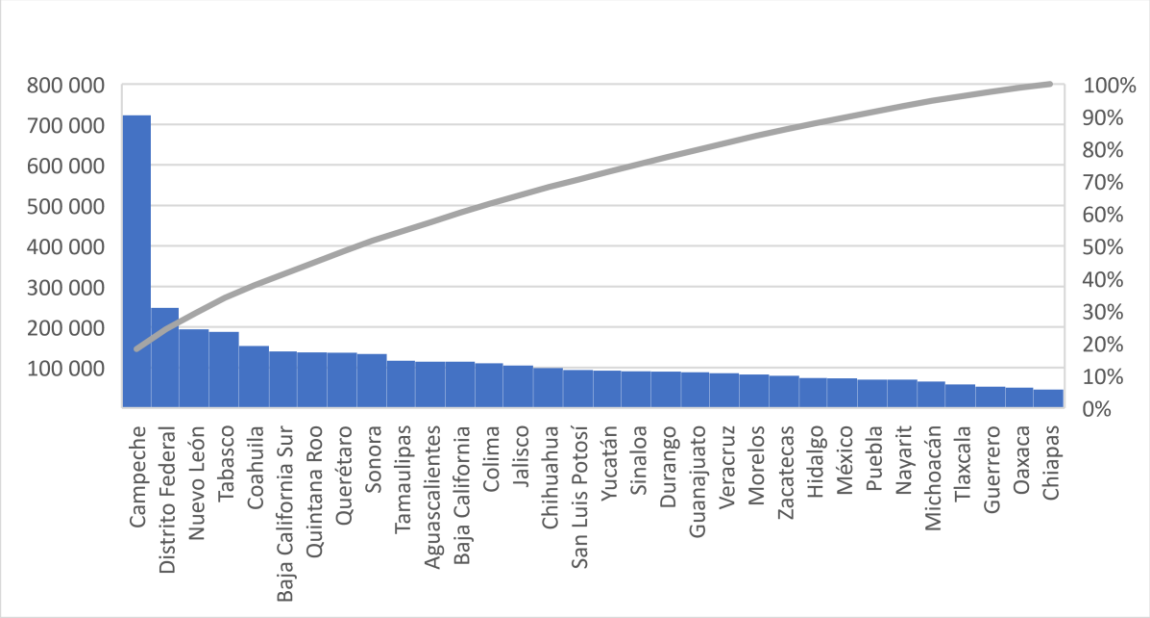
6.1 Descriptive Analysis

A classification[21] of each state by GDP per capita in 2012 introduced the GDP per capita distribution across states. The GDP per capita by state in the first year of the studied period indicated the position of each state from lowest to highest absolute value. Distribution of the

[21] Classification of states by list is shown in Table 1 of the appendix.

GDP per capita in Figure 3 shows the cumulative distribution by the Pareto line in grey, and the corresponding value for each observation is named by state. Observations by state are ordered from the highest GDP per capita in 2012, which is the state of Campeche, to the least GDP per capita, Chiapas. This GDP per capita distribution by state presents more than double of GDP per capita differences in some states, supporting the idea of high inequality across states in the country.

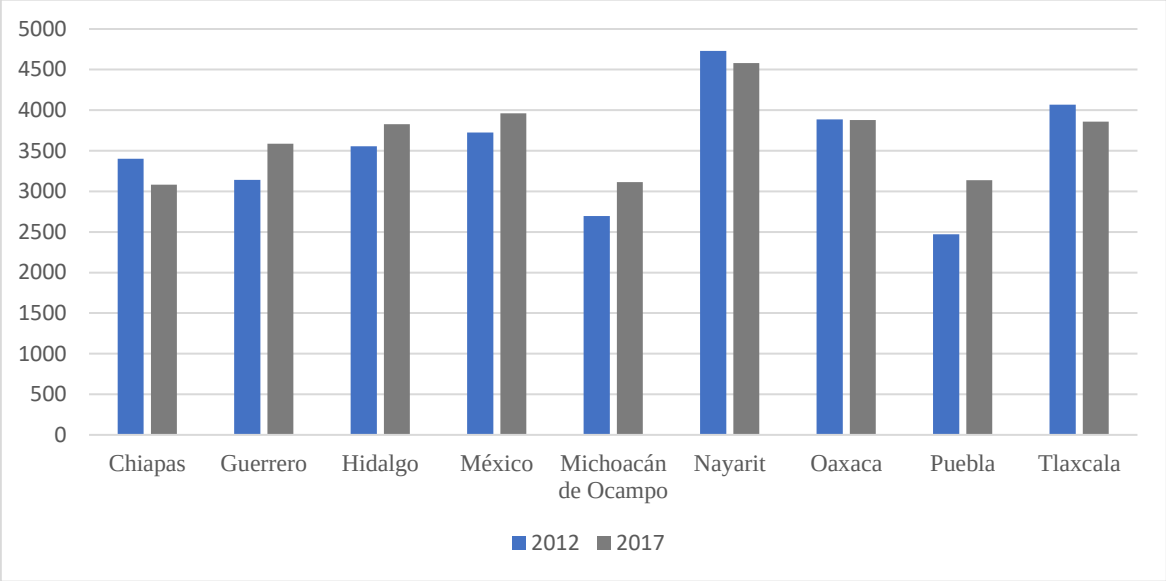
Figure 3. Distribution GDP per capita by state in 2012, MXN pesos (constant prices of 2008)



Source: Own elaboration from database provided by semarnat.gob.mx., based on INEGI. Sistema de Cuentas Nacionales. Population projections in Mexico, estimations between 1990-2019.

Figure 4 shows that public spending on health per capita for population without social security increased in 5 out of the 9 poorest states between 2012-2017. The other 4 states presented a decrease of public spending on health per capita for population without social security. There is no general increase of health public spending per capita for population without social security in 4 selected states with lower GDP per capita. Reductions in public health expenditure for population without social security in some of the poorest states is a different outcome from SP expected effects on health public spending. Possible explanations may be linked with issues in states' SP budgets as discussed in the following section by (Nigenda, 2015).

Figure 4. Public spending on health per capita for population without social security in the 9 poorest states, 2012-2017 (constant prices 2017).

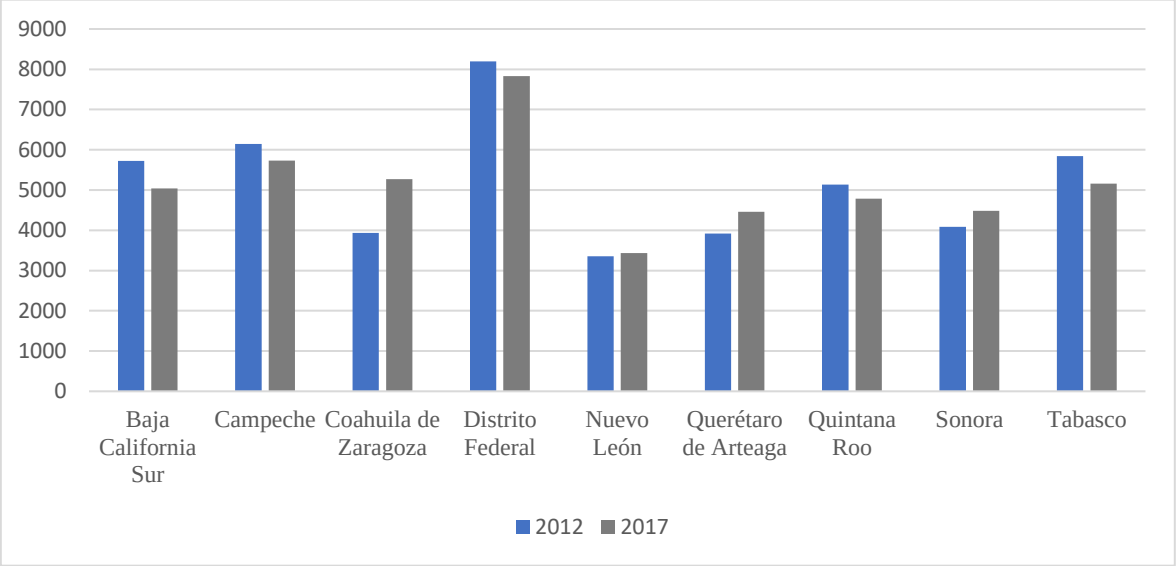


Source: Own elaboration with database published by semarnat.gob.mx. based on INEGI. Sistema de Cuentas Nacionales. www.dgis.salud.gob.mx/contenidos/sinais/gastoensalud

Figure 5 presents that 4 out of 9 states with high GDP per capita decreased their public spending on health per capita for population without social security. The difference in states with lower and higher GDP per capita is that states with lower GDP per capita expected to increase their public spending on health per capita for population without social security, while not necessarily in the richest states according to SP design to redistribute public health expenditure. The increase of public health expenditure for population without social security in the richest states was unexpected as a higher proportion of the population depended on public health expenditure for population with social security. Nonetheless, redistribution of public spending on health through public spending on health for population without social security was reasonable to increase in states with high GDP per capita as each state administrate the number of affiliations[22] to SP.

[22] The number of affiliations by state by has been independent of any economic condition at regional level, affiliations have been managed by each state based on SP demand.

Figure 5. Public spending on health per capita for population without social security in the 9 richest states, 2012-2017 (constant prices 2017).



Source: Own elaboration with database published by semarnat.gob.mx., based on INEGI. Sistema de Cuentas Nacionales. And Secretaria de Salud: Gasto en Salud 1993-2017. www.dgis.salud.gob.mx/contenidos

6.2 Regression results

In the first model there was a significant and positive relationship between public spending on health per capita for the population without social security and child mortality as presented in Table 2 with the models' specifications (variables with logs and without logs). However, it is unlikely to believe that this positive relationship is caused by public health expenditure per capita for population without social security. Factors that were not accounted by the control variables may be the causal effect of a positive relationship with child mortality. For instance, diseases related to maternal health and poverty ratios in rural areas are believed to bias the positive effects on child mortality.

GDP per capita was not significantly correlated with child mortality in the first model without logs, and negatively correlated with statistical significance in the model with logs. GDP per capita as presented in the first model with logs, was negatively correlated with child mortality, which was an expected result from the model specification according to the negative impact of income on child mortality proposed by (O´Hare et al., 2014). Female

education, presented a significant effect on child mortality in the first model, including variables with and without logs. The negative impact showed marginal effects on child mortality by an increase in the rate of female population with high school finished, coefficients presented in Table 2. The negative relationship between child mortality and female education was a result that supported other empirical studies which suggested the same effects under different circumstances (Kiross et. al., 2019; Andriano & Monden, 2019).

The second model introduced state fixed effects to control omitted variables across states. The model results in the model without logs indicated a negative and significant relationship, in line with the hypothesis. The negative impact of public health expenditure for population without social security on child mortality would be the expected effect of SP. However, the specification with logs indicated a positive and insignificant relationship, deriving in a less reliable result of the model without logs. The sensitivity to the specification leads to inconclusive results.

Table 2. Main Results.

	(1) CM	(2) CM	(3) CMlog	(4) CMlog
PHE per capita	0.000528*	-0.000311*		
	(2.65)	(-2.19)		
GDP per capita	-0.00000298			
	(-1.67)			
Female Education	-0.787***			
	(-8.31)			
PHE per capita log			0.207***	0.00655
			(3.51)	(0.54)
GDP per capita log			-0.0945*	
			(-2.06)	
Female E. log			-0.961***	
			(-8.54)	
_cons	28.12***	13.59***	4.877***	2.423***
	(15.95)	(19.19)	(9.29)	(23.66)
N	64	64	64	64

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

7. Discussion

The results suggested that effects of public spending on health per capita for population without social security on child mortality were positive in the first model. The positive relationship is likely due to omitted variables across states. Sensitivity to specifications in the second model represented a limitation to hold a negative relationship, leading to inconclusive results in this second model. Control variables are strongly suggested to impact child mortality based on our models' tests. The proportion of female education with high school finished by state showed a negative and significant relationship with child mortality as proposed by (Andriando & Monden, 2019). GDP per capita negative correlation with child mortality was sensitive to the models' specifications, presenting a likely negative impact on child mortality, which follows the argument of (Lartey et al., 2016). Influence from several factors is suggested to add relevant explanatory variables to child mortality rate, such as household income, maternal education or health technologies improvements.

Changes in child mortality may not be explained by SP based on our models' tests, which differs from Pfutze (2014) because there is no evidence in this essay to hold that higher public investments in SP improve child survival. Explanations of possible inconsequential effects of public spending on health per capita for population without social security on child mortality are linked to public health expenditure shifts in some states with no substantial variations, or inefficient public spending on health depending on the states' annual reports (Flamand & Moreno, 2015). The inefficiency of public health expenditure has been particularly discussed as the lack of transparency[23] in the states' health public spending annual reports (Nigenda, 2015).

7.1 Limitations

This study has several limitations regarding the data used for the models. Public health expenditure data in 2003-2017 did not provide for all the years detailed regional information

[23] Based on evidence documented by (Nigenda, 2015), the public insurance SP was one of the social programs with more observations from the Federal Audit Authority. Reducing reliability of approved budgets and actual spending. This issue has been pointed out as the cause of a tense relation between states and federal authorities.

related to public health expenditure for population without social security. This constraint related to available years was an initial barrier to examine longer periods as public health expenditure was the independent variable studied- Most of the variables at regional levels were from census or reports available just for specific years, selecting 2012 and 2017 for this essay. Female rate of high school education, and GDP per capita at regional levels were compiled from different sources, which points out a disconnection in government institutions for states' data queries. The disconnection of regional information limited the extension of the models tested.

Effects of SP on child survival at an early age were examined by Pfutze (2014), but scarce literature regarding specific effects of public health expenditure on child mortality in Mexico limited the comparisons with other essays, no similar essays were found about public spending on health for population without social security and child mortality as the central hypothesis. SP effects on child mortality were related to public spending on health for population without social security as the best variable to estimate the performance of this health public insurance. Nonetheless, there was no data that may be directly linked to child mortality, such as expenses on pregnancy treatments and children infections vaccines.

8. Conclusion

The regression models did not give strong support to the hypothesis that higher public spending on health would be associated with lower child mortality. Female education was a control variable that presented a negative relationship with child mortality based on the models' tests. The redistribution of public spending on health showed an increase of public spending on health per capita for population without social in certain states with lower income, which may be caused by affiliations to SP. Since not all states with lower income increased their public health expenditure per capita for population without social security, it is not considered to be a general effect of SP that the poorest states increase public spending on health as mentioned by (Frenk et. al, 2005).

Further research with longer periods including regional observations would generate a more complete study of SP effects on child mortality. Data at regional levels regarding public

spending on health is suggested to hold stronger arguments about the effects of SP on child mortality. An interesting result from the models' tests was the negative impact of female education on child mortality, providing an empirical background about additional variables that may determine child mortality.

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Appendix.

Table 1. PIB per state in Mexico, constant prices, 2012.

State	PIB 2012, constant prices million MXN pesos
Ciudad de México	2 633 935
México	1 339 995
Nuevo León	1 113 818
Jalisco	995 286
Veracruz de Ignacio de la Llave	779 730
Campeche	714 787
Guanajuato	570 922
Tabasco	564 004
Coahuila de Zaragoza	549 552
Puebla	524 226
Sonora	495 926
Tamaulipas	466 371
Chihuahua	459 166
Baja California	456 024
Michoacán de Ocampo	352 030
Sinaloa	330 191
Querétaro	318 294
San Luis Potosí	297 294
Chiapas	284 734
Oaxaca	239 680
Hidalgo	222 797
Guerrero	218 118
Quintana Roo	215 710
Yucatán	214 701
Durango	182 943
Morelos	175 718
Aguascalientes	167 706
Zacatecas	148 729
Baja California Sur	117 346
Nayarit	100 800
Colima	90 540
Tlaxcala	89 919

Source: Own elaboration from www.inegi.org.mx/programas/pibent/2013

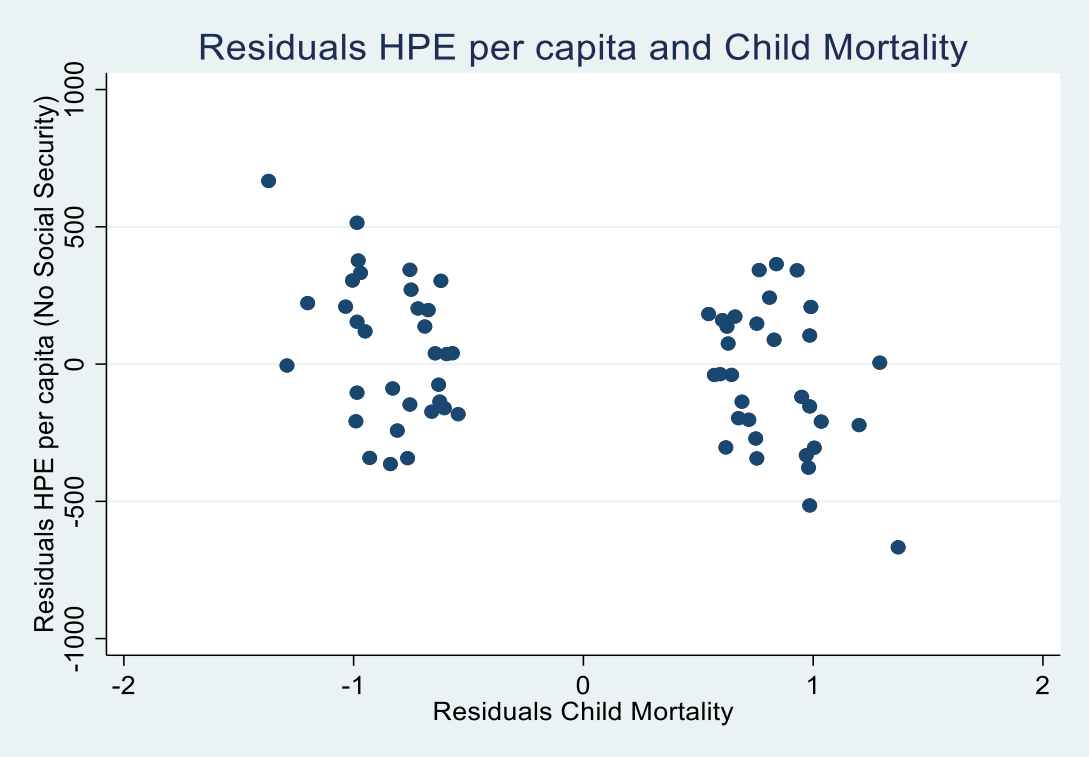
Table 2. Models tests with years and states fixed effects

	(Model 1) CM	(Model 2) CM	(Model 1 logs) CMlog	(Model 2 logs) CMlog
PHE per capita	0.000528*	-0.000311*		
	(2.65)	(-2.19)		
GDP per capita	-0.00000298			
	(-1.67)			
Female Education	-0.787***			
	(-8.31)			
2012	0	0	0	0
	(.)	(.)	(.)	(.)
2017	-0.0529	-1.636***	-0.0198	-0.118***
	(-0.11)	(-23.32)	(-0.62)	(-77.87)
Baja California		-0.928*		-0.0403***
		(-2.61)		(-5.69)
Baja California Sur		0.864***		0.0600***
		(4.82)		(9.82)
Campeche		4.651***		0.323***
		(14.27)		(51.34)
Chiapas		-0.781*		-0.0216**
		(-2.39)		(-2.77)
Chihuahua		0.552**		0.0570***
		(3.37)		(9.84)
Coahuila		10.78***		0.676***
		(27.60)		(120.88)
Colima		4.062***		0.282***
		(16.79)		(39.47)
Distrito Federal		0.0132		-0.0923***
		(0.03)		(-9.51)
Durango		4.724***		0.341***
		(28.28)		(61.51)

Guanajuato	4.282***	0.347***
	(16.68)	(57.54)
Guerrero	7.182***	0.521***
	(17.15)	(67.09)
Hidalgo	0.753*	0.0971***
	(2.60)	(15.88)
Jalisco	-0.333	0.00876
	(-0.86)	(1.30)
México Estado	4.794***	0.396***
	(13.41)	(48.01)
Michoacán	-0.152	0.0277***
	(-0.48)	(4.20)
Morelos	3.641***	0.303***
	(15.43)	(49.91)
Nayarit	-0.0163	0.00518
	(-0.07)	(0.96)
Nuevo León	-1.288**	-0.0737***
	(-3.43)	(-9.92)
Oaxaca	9.053***	0.607***
	(16.99)	(101.64)
Puebla	5.998***	0.468***
	(17.78)	(52.37)
Querétaro	2.009***	0.181***
	(8.30)	(33.79)
Quintana Roo	0.288	0.0231***
	(1.52)	(5.18)
San Luis Potosí	1.523***	0.159***
	(6.33)	(24.10)
Sinaloa	1.761***	0.171***
	(6.88)	(28.85)
Sonora	0.793**	0.0844***

		(2.88)		(14.89)
Tabasco		3.707***		0.271***
		(12.89)		(49.40)
Tamaulipas		2.006***		0.153***
		(8.49)		(26.39)
Tlaxcala		4.083***		0.329***
		(14.11)		(54.25)
Veracruz		1.902***		0.192***
		(6.12)		(29.27)
Yucatán		4.150***		0.308***
		(25.06)		(45.62)
Zacatecas		4.708***		0.361***
		(23.72)		(64.16)
PHE per capita log			0.207***	0.00655
			(3.51)	(0.54)
GDP per capita log			-0.0945*	
			(-2.06)	
Female Education log			-0.961***	
			(-8.54)	
_cons	28.12***	13.59***	4.877***	2.423***
	(15.95)	(19.19)	(9.29)	(23.66)
N	64	64	64	64

Graph 1. Residuals of Model 2, variables without logs



Graph 2. Residuals of Model 2, variables with logs.