

Third Assignment

15 November 2014

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1 Research question and Methodology

As stated in previous assignment, our research project aims to look at the impact of decentralization on health provision in Benin. Access to basic health-related services has been one of the core Millenium Development Goals. It is also regarded as basic human rights and promoted by international organizations. For the past decade, governments and policy makers in developing countries, including Benin, have invested in improving basic sanitation and health-related facilities. Decentralization and devolution of public administration have been two important channels.

In Benin, the legal provision on decentralization has transfered health-related competencies to sub-national entities. Since the year 2002, municipal governments are increasingly responsible for providing basic infrastructures such as water access etc. In that regards, and to offset the vertical imbalance of subnational governments, the central government with the financial support of development agencies have used fiscal decentralization policies (e.g. tax power, intergovernmental transfers) and thereby allowing local governments to meet their expenditures requirements. Proponents of decentralization share the view that public services delivery is more efficient at the local level. Yet, as stated from previous paper, there are many controversies with regards to the efficiency of decentralization mechanisms on public goods delivery. Given the importance of health provision in the overall development of a country, we will draw from theories on public finances and development, using Benin as a case study to investigate the following question : **What impact does decentralization have on the provision of health-related services and infrastructures in Benin?**.

Studying the relationship between decentralization and health provision is a very challenging exercise as it requires consistent and reliable microeconomic data which are, very often, not openly available or not consistent. Therefore, in order to enhance the reliability of our findings, we have decided to broaden our approaches by including a macroeconomic perspective on health provision in Benin. In addition to the micro analysis, we will also look at the health-related expenditures in recent years. This paper is divided into two sections. The first one bring a general overview on health provision in Benin over the years 2005 to 2010. For this, we use data from the World Bank (WB) and the World Health Organization (WHO). We look at overall trends in health-related expenditures over the years 2005 to 2011. The second part looks at health provision on a micro level. We use households surveys and local finances data to analyze the impact of decentralization on four health-related indicators. We also present our basic econometric model.

2 Overview: Data collection and cleaning

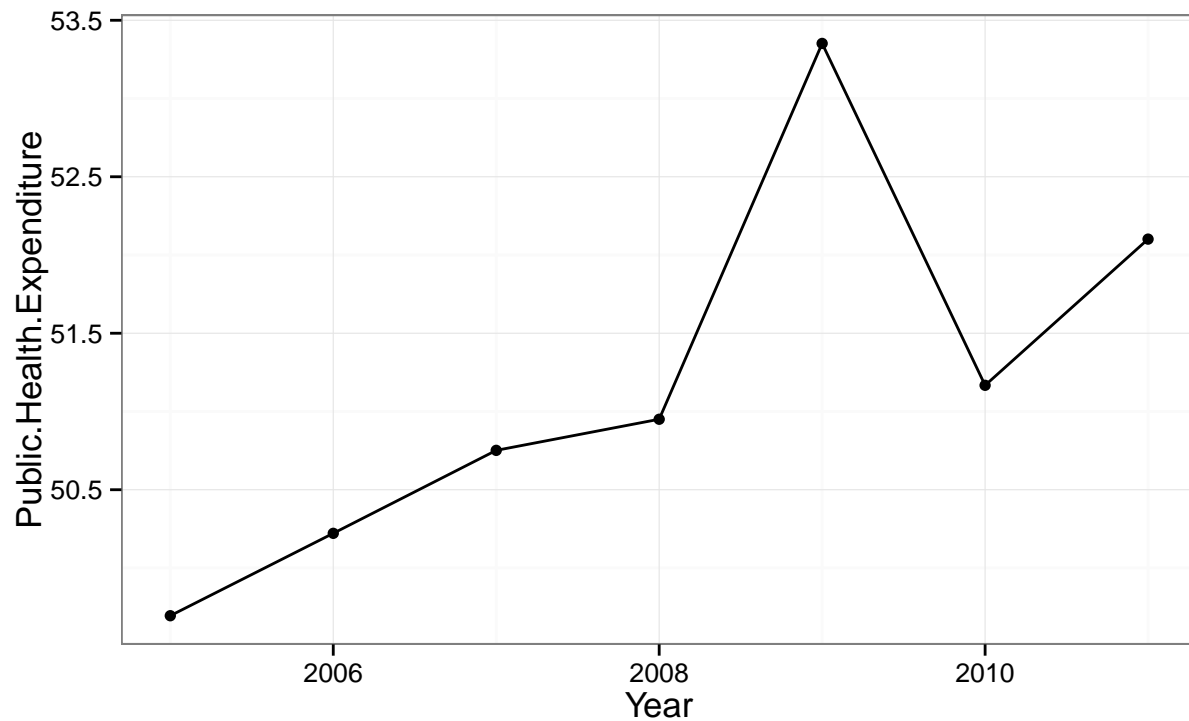
In this section, we use data analytics tools to scrape openly available datasets on Benin's health-related expenditures and services. We first extracted a dataset from the World Bank (WB) which include indicators on Public Health Expenditure, Health Expenditure Per Capita and Improved Sanitation facilities over a seven year timespan (2005:2011). The extracted variables are defined as follow:

- (i) *health expenditure per capita* (*SH.XPD.PCAP*), meaning the sum of public and private health expenditures as a ratio of total population. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation. Data are in current U.S. dollars.
- (ii) *public health expenditure* (*SH.XPD.PUBL*), which consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds.
- (iii) *improved sanitation facilities* (*SH.STA.ACSN*), which actually refers to the access to improved sanitation facilities as the percentage of the population using improved sanitation facilities. The indicator includes flush/pour flush (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet.

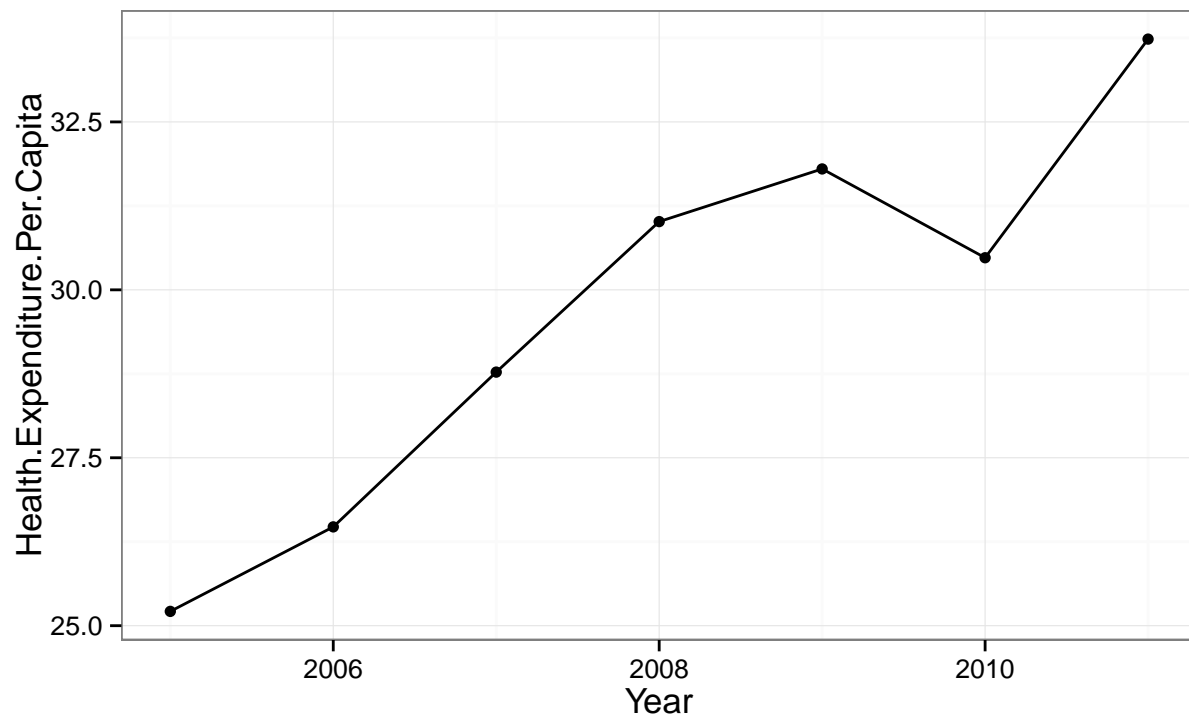
Loading required package: RJSONIO

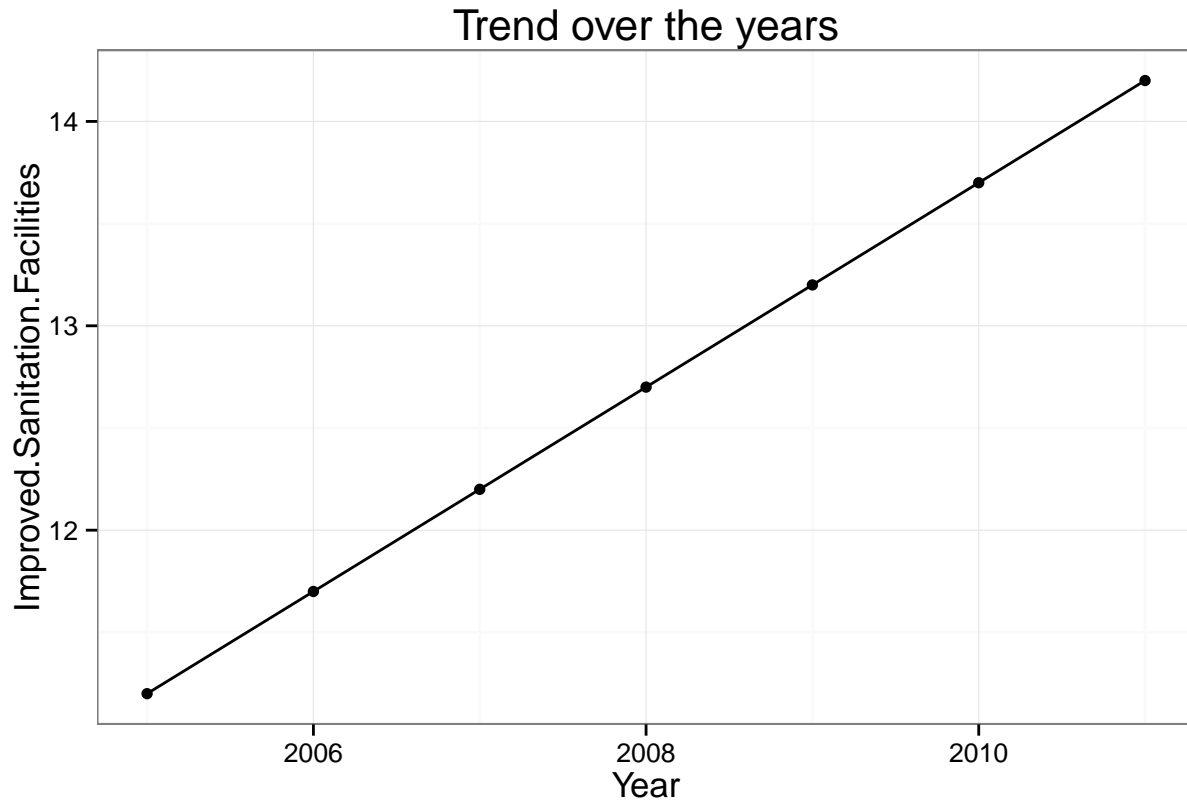
As mentionned from our research proposal decentralization in Benin only begun in the 2000s. As the following graphs (using ggplot in R) demonstrate, there has been a considerable increase in health expenditure in the past few years. Since health expenditures is a decentralized process, we could potentially argue that there is a correlation between health provision and the process of decentralization. Analyzing the micro data shall allow for a confirmation or rejection of this assumption.

Trend over the years



Trend over the years





The second dataset is taken from the WHO indicators, in particular, from the Global Health Observatory Data Repository. What we want is the dataset that refers to the density of health infrastructures per 100000 population, including:

- (i) Health posts, that are either community centres or health environments with a very limited number of beds with limited curative and preventive care resources normally assisted by health workers or nurses,
- (ii) Health centers, which includes the number of health centres from the public and private sectors, per 100,000 population
- (iii) Number of district/rural hospitals from the public and private sectors, per 100,000 population,
- (iv) Number of provincial hospitals from the public and private sectors, per 100,000 population,
- (v) Number of specialized hospitals delivering mainly tertiary care from the public and private sectors, per 100,000 population. These specialized hospitals could be regional, specialized, research hospitals or Federal/National Institutes.
- (vi) Number of specialized hospitals delivering mainly tertiary care from the public and private sectors, per 100,000 population. These specialized hospitals could be: regional, specialized, research hospitals or Federal/National Institutes.

However, these variables are only known for the years 2010 and 2013. We import this Dataset with an URL from the WHO website, that we call infrastructures. From this dataset we definitely have to extract only the country we are interested in (BEN). From this point, the dataset has to be cleaned of all those columns that we really don't need, since the original one shows also elements such as if it was published, comments, NA elements etc. . .

2.1 Merging datasets

Once we have our datasets, it is useful to merge them together so as to work easily and quickly with one dataset that would include all the needed variables.

3 Micro perspective

In this section, we explore decentralization and health provision at the 77 municipalities in Benin. The datasets on local finances are obtained from the National Commission on Local Finances of Benin. Health-related expenditures and provision are from Benin's Integrated Modular Surveys on Household Living Conditions (EMICoV) and the Demographic and Health Survey.

3.1 Description of Variables

3.1.1 Independent variable: Decentralization

Loading Data and cleaning

```
## Loading required package: bitops
```

Checking

```
##   Cities ID Year decentralization population Density pubexp.c
## 1 Abomey 69 2005           0.614      86181      607      1234
## 2 Abomey 69 2006           0.486      89100      627      2109
## 3 Abomey 69 2007           0.376      92099      649      3346
## 4 Abomey 69 2008           0.447      95175      670      2749
## 5 Abomey 69 2009           0.292      98336      693      3717
## 6 Abomey 69 2010           0.327     101586      715      3365
```

```
## [1] "Cities"          "ID"              "Year"
## [4] "decentralization" "population"      "Density"
## [7] "pubexp.c"
```

```
##           Cities ID Year decentralization population Density pubexp.c
## 459 Zogbodomey 77 2007           0.369      85041      103      2177
## 460 Zogbodomey 77 2008           0.459      87882      107      2166
## 461 Zogbodomey 77 2009           0.183      90801      110      2483
## 462 Zogbodomey 77 2010           0.240      93801      114      1716
## 463           NA   NA              NA          NA        NA        NA
## 464           NA   NA              NA          NA        NA        NA
```

```
## [1] 19
```

Decentralization typically defined in public planning, management and decision making as the transfer of authority and power from higher to lower levels of governing or from national to sub-national levels[@rondinelli1983collins]. It has different characteristics for different writers as describe as delegation,devaluation,de-concentration,and privatization of responsibility and authority of tasks to lower level of administration. Decentralization system involves two different measures: level and degree. Decentralizations may occur at system or organization level[@mintzberg1979].Degree can be defined as

the distribution of power over the decision made inside an organization. This has led to long debate in related literature and few argument on the best measurement. Due to this high degree of complexity, which encompasses a number of political, fiscal and administrative dimension, it is difficult to assess and measure the outcome of decentralization in an empirical study. For the purpose of this exercise, we propose here to use a Revenue autonomy (RA) measure approach used by [akai2002sakata] and [habibi2003etal] to proxy for decentralization. A large part of the debate on decentralization measurement regards the choice between revenue versus expenditure decentralization. Because decentralized health provision implies both decentralized revenues and expenditures, we have chosen this proxy which accounts for both. Its measurement implies taking the ratio of own-source revenues to the total of expenditures for each municipality over the year 2005 to 2011. The data on local finances are obtained from the National Commission on local finances.

3.1.2 Dependent variables

Like decentralization, it is very challenging to find a composite proxy for health provision. Drawing from Benin's Integrated Households Survey (EMICoV) and the Demographic and Health Survey, we have decided to focus on some key variables which include (i) the access to basic sanitation services: *access to water*, *access to toilet facilities*, (ii) access to health-related infrastructure *water provision infrastructure*, *hospital*.

3.1.3 Explanatory variables

As stated from our proposal, we will also take into account heterogeneity between the municipalities. For this reason, as so far, we have decided to include population, population density, per capita consumption, households health consumption, indicators on poverty, literacy rate, as well as the percentage of households which favor decentralization in each municipality. These control variables are drawn from Benin's Integrated Modular Surveys on Households Living Conditions (EMICoV)

4 Basic Regression models

4.0.4 Model estimations

```
##
## Call:
## lm(formula = pop_wateraccess ~ decentralization, data = decenthealth)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -55.56 -11.68   0.32  13.63  32.42
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      66.89       2.86   23.41  <2e-16 ***
## decentralization    5.25       7.29    0.72    0.47
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 18.7 on 150 degrees of freedom
## (389 observations deleted due to missingness)
## Multiple R-squared:  0.00345,    Adjusted R-squared:  -0.0032
## F-statistic: 0.519 on 1 and 150 DF,  p-value: 0.472
##
```

```
## Call:
## lm(formula = pop_wateraccess ~ decentralization + population +
##      Density + Year, data = decenthealth)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -50.20 -13.19   0.39  13.16  38.31
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -5.05e+03  2.07e+03  -2.44   0.016 *
## decentralization  4.85e+00  7.86e+00   0.62   0.538
## population      2.76e-05  3.01e-05   0.92   0.360
## Density         7.49e-04  2.15e-03   0.35   0.728
## Year           2.55e+00  1.03e+00   2.47   0.015 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 18.1 on 147 degrees of freedom
## (389 observations deleted due to missingness)
## Multiple R-squared:  0.0867, Adjusted R-squared:  0.0619
## F-statistic: 3.49 on 4 and 147 DF,  p-value: 0.00936
```

```
##
## Call:
## lm(formula = pop_wateraccess ~ decentralization + population +
##      Density + pubexp.c + consump.c + ind_pauv_mon + Year, data = decenthealth)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -48.55 -13.56  -0.19  12.53  38.20
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -2.83e+03  2.42e+03  -1.17   0.24
## decentralization  5.43e+00  8.31e+00   0.65   0.51
## population      3.10e-05  3.02e-05   1.03   0.31
## Density        -1.10e-03  2.53e-03  -0.44   0.66
## pubexp.c        1.88e-03  1.15e-03   1.63   0.10
## consump.c       5.96e-06  1.28e-05   0.47   0.64
## ind_pauv_mon    2.29e-01  1.70e-01   1.34   0.18
## Year           1.43e+00  1.21e+00   1.19   0.24
##
## Residual standard error: 18 on 144 degrees of freedom
## (389 observations deleted due to missingness)
## Multiple R-squared:  0.113, Adjusted R-squared:  0.0698
## F-statistic: 2.62 on 7 and 144 DF,  p-value: 0.0142
```

```
##
## Please cite as:
##
## Hlavac, Marek (2014). stargazer: LaTeX code and ASCII text for well-formatted regression and summary
## R package version 5.1. http://CRAN.R-project.org/package=stargazer
```

Table 1: Effect of decentralization on water access

	<i>Dependent variable:</i>		
	pop_wateraccess		
	(1)	(2)	(3)
(Intercept)	5.25 (7.29)	4.85 (7.86)	5.43 (8.31)
Decentralization		0.0000 (0.0000)	0.0000 (0.0000)
Population		0.001 (0.002)	−0.001 (0.003)
Population Density			0.002 (0.001)
consump.c			0.0000 (0.0000)
ind_pauv_mon			0.23 (0.17)
Year		2.55** (1.03)	1.43 (1.21)
Constant	66.89*** (2.86)	−5,049.00** (2,073.00)	−2,832.00 (2,419.00)
Observations	152	152	152
R ²	0.003	0.09	0.11
Adjusted R ²	−0.003	0.06	0.07
Residual Std. Error	18.67 (df = 150)	18.05 (df = 147)	17.98 (df = 144)
F Statistic	0.52 (df = 1; 150)	3.49*** (df = 4; 147)	2.62** (df = 7; 144)

Note:

*p<0.1; **p<0.05; ***p<0.01

Call: lm(formula = pop_toiletaaccess ~ decentralization, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -23.77 -18.19 3.31 15.58 50.90

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) 24.04 2.74 8.77 3.6e-15 *** decentralization -3.99 6.99 -0.57 0.57

— Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘.’ 0.1 ‘.’ 1

Residual standard error: 17.9 on 150 degrees of freedom (389 observations deleted due to missingness) Multiple R-squared: 0.00217, Adjusted R-squared: -0.00448 F-statistic: 0.326 on 1 and 150 DF, p-value: 0.569

Call: lm(formula = pop_toiletaaccess ~ decentralization + population + Density + Year, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -29.83 -5.74 -2.63 5.00 29.79

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) -1.95e+04 1.04e+03 -18.75 <2e-16 **decentralization 7.60e+00 3.93e+00 1.93 0.055 .**

population 2.71e-05 1.51e-05 1.80 0.074 .

Density 2.01e-03 1.08e-03 1.87 0.064 .

Year 9.69e+00 5.16e-01 18.77 <2e-16 — Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘.’ 0.1 ‘.’ 1

Residual standard error: 9.04 on 147 degrees of freedom (389 observations deleted due to missingness) Multiple R-squared: 0.751, Adjusted R-squared: 0.744 F-statistic: 111 on 4 and 147 DF, p-value: <2e-16

Call: lm(formula = pop_toiletaaccess ~ decentralization + population + Density + pubexp.c + consump.c + ind_pauv_mon + Year, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -27.19 -5.43 -2.18 3.98 26.47

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) -1.87e+04 1.19e+03 -15.70 <2e-16 **decentralization 4.41e+00 4.09e+00 1.08 0.282**

population 3.19e-05 1.49e-05 2.15 0.034

Density 9.71e-04 1.24e-03 0.78 0.436

pubexp.c 6.98e-04 5.66e-04 1.23 0.220

consump.c 1.46e-05 6.30e-06 2.32 0.022 *

ind_pauv_mon -2.55e-02 8.39e-02 -0.30 0.761

Year 9.32e+00 5.94e-01 15.70 <2e-16 * — Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘.’ 0.1 ‘.’ 1

Residual standard error: 8.85 on 144 degrees of freedom (389 observations deleted due to missingness) Multiple R-squared: 0.766, Adjusted R-squared: 0.755 F-statistic: 67.4 on 7 and 144 DF, p-value: <2e-16

Call: lm(formula = connect_soneb ~ decentralization, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -23.80 -14.95 -8.70 3.46 75.89

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) 15.92 5.09 3.13 0.0025 ** decentralization 24.36 15.44 1.58 0.1189

— Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘.’ 0.1 ‘.’ 1

Residual standard error: 24.1 on 74 degrees of freedom (465 observations deleted due to missingness) Multiple R-squared: 0.0325, Adjusted R-squared: 0.0195 F-statistic: 2.49 on 1 and 74 DF, p-value: 0.119

Call: lm(formula = connect_soneb ~ decentralization + population + Density + Year, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -23.63 -13.50 -5.18 4.34 76.73

Coefficients: (1 not defined because of singularities) Estimate Std. Error t value Pr(>|t|)

(Intercept) 2.10e+01 5.36e+00 3.92 0.00020 **decentralization 1.07e+01 1.46e+01 0.73 0.46531**

population -6.01e-05 4.75e-05 -1.26 0.21015

Density 1.26e-02 3.37e-03 3.73 0.00038 Year NA NA NA NA

— Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘.’ 0.1 ‘.’ 1

Residual standard error: 20.9 on 72 degrees of freedom (465 observations deleted due to missingness) Multiple R-squared: 0.291, Adjusted R-squared: 0.261 F-statistic: 9.84 on 3 and 72 DF, p-value: 1.62e-05

Table 2: Effect of decentralization on toilet access

	<i>Dependent variable:</i>		
	pop_toiletaccess		
	(1)	(2)	(3)
(Intercept)	−3.99 (6.99)	7.60* (3.93)	4.41 (4.09)
Decentralization		0.0000* (0.0000)	0.0000** (0.0000)
Population		0.002* (0.001)	0.001 (0.001)
Population Density			0.001 (0.001)
consump.c			0.0000** (0.0000)
ind_pauv_mon			−0.03 (0.08)
Year		9.69*** (0.52)	9.32*** (0.59)
Constant	24.04*** (2.74)	−19,453.00*** (1,038.00)	−18,705.00*** (1,191.00)
Observations	152	152	152
R ²	0.002	0.75	0.77
Adjusted R ²	−0.004	0.74	0.75
Residual Std. Error	17.91 (df = 150)	9.04 (df = 147)	8.85 (df = 144)
F Statistic	0.33 (df = 1; 150)	110.90*** (df = 4; 147)	67.36*** (df = 7; 144)

Note:

*p<0.1; **p<0.05; ***p<0.01

Call: lm(formula = connect_soneb ~ decentralization + population + Density + pubexp.c + consump.c + ind_pauv_mon + Year, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -32.67 -11.09 -4.85 4.13 75.31

Coefficients: (1 not defined because of singularities) Estimate Std. Error t value Pr(>|t|)

(Intercept) -3.85e+00 1.38e+01 -0.28 0.7810

decentralization 1.12e+01 1.45e+01 0.77 0.4422

population -3.89e-05 4.55e-05 -0.86 0.3954

Density 5.47e-03 3.83e-03 1.43 0.1584

pubexp.c 5.27e-03 1.58e-03 3.33 0.0014 ** consump.c -4.17e-07 1.58e-05 -0.03 0.9790

ind_pauv_mon 1.36e-01 2.35e-01 0.58 0.5657

Year NA NA NA NA

— Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘.’ 0.1 ‘.’ 1

Residual standard error: 19.8 on 69 degrees of freedom (465 observations deleted due to missingness) Multiple R-squared: 0.391, Adjusted R-squared: 0.338 F-statistic: 7.38 on 6 and 69 DF, p-value: 4.03e-06

Table 3: Effect of decentralization on water delivery infrastructure

	<i>Dependent variable:</i>		
	connect_soneb		
	(1)	(2)	(3)
(Intercept)	24.36 (15.44)	10.69 (14.56)	11.17 (14.45)
Decentralization		-0.0001 (0.0000)	-0.0000 (0.0000)
Population		0.01*** (0.003)	0.01 (0.004)
Population Density			0.01*** (0.002)
consump.c			-0.0000 (0.0000)
ind_pauv_mon			0.14 (0.23)
Year			
Constant	15.92*** (5.09)	21.01*** (5.36)	-3.85 (13.79)
Observations	76	76	76
R ²	0.03	0.29	0.39
Adjusted R ²	0.02	0.26	0.34
Residual Std. Error	24.09 (df = 74)	20.91 (df = 72)	19.79 (df = 69)
F Statistic	2.49 (df = 1; 74)	9.84*** (df = 3; 72)	7.38*** (df = 6; 69)

Note:

*p<0.1; **p<0.05; ***p<0.01

Call: lm(formula = pubhosp ~ decentralization, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -8.71 -6.99 -4.17 2.78 51.99

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) 9.32 1.69 5.50 1.6e-07 ** *decentralization* -8.97 4.32 -2.08 0.04

— Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘:’ 0.1 ‘’ 1

Residual standard error: 11.1 on 150 degrees of freedom (389 observations deleted due to missingness) Multiple

R-squared: 0.0279, Adjusted R-squared: 0.0215 F-statistic: 4.31 on 1 and 150 DF, p-value: 0.0395

Call: lm(formula = pubhosp ~ decentralization + population + Density + Year, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -15.08 -3.04 -0.58 1.33 46.61

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) -7.84e+03 1.04e+03 -7.57 3.9e-12 ***decentralization*** **-4.50e+00 3.93e+00 -1.15 0.2536**

population **4.75e-05 1.50e-05 3.16 0.0019** *Density* -2.70e-03 1.07e-03 -2.51 0.0131

Year 3.90e+00 5.16e-01 7.57 3.8e-12 *** — Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘:’ 0.1 ‘’ 1

Residual standard error: 9.02 on 147 degrees of freedom (389 observations deleted due to missingness) Multiple

R-squared: 0.367, Adjusted R-squared: 0.35 F-statistic: 21.3 on 4 and 147 DF, p-value: 7.23e-14

Call: lm(formula = pubhosp ~ decentralization + population + Density + Year, data = decenthealth)

Residuals: Min 1Q Median 3Q Max -15.08 -3.04 -0.58 1.33 46.61

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) -7.84e+03 1.04e+03 -7.57 3.9e-12 ***decentralization*** **-4.50e+00 3.93e+00 -1.15 0.2536**

population **4.75e-05 1.50e-05 3.16 0.0019** *Density* -2.70e-03 1.07e-03 -2.51 0.0131

Year 3.90e+00 5.16e-01 7.57 3.8e-12 *** — Signif. codes: 0 ‘’ **0.001** ’’ 0.01 ’’ 0.05 ‘:’ 0.1 ‘’ 1

Residual standard error: 9.02 on 147 degrees of freedom (389 observations deleted due to missingness) Multiple

R-squared: 0.367, Adjusted R-squared: 0.35 F-statistic: 21.3 on 4 and 147 DF, p-value: 7.23e-14

Table 4: Effect of decentralization on health services infrastructure

	<i>Dependent variable:</i>		
	pubhosp		
	(1)	(2)	(3)
(Intercept)	−8.97** (4.32)	−4.50 (3.93)	−4.50 (3.93)
Decentralization		0.0000*** (0.0000)	0.0000*** (0.0000)
Population		−0.003** (0.001)	−0.003** (0.001)
Population Density		3.90*** (0.52)	3.90*** (0.52)
Constant	9.32*** (1.69)	−7,836.00*** (1,036.00)	−7,836.00*** (1,036.00)
Observations	152	152	152
R ²	0.03	0.37	0.37
Adjusted R ²	0.02	0.35	0.35
Residual Std. Error	11.06 (df = 150)	9.02 (df = 147)	9.02 (df = 147)
F Statistic	4.31** (df = 1; 150)	21.29*** (df = 4; 147)	21.29*** (df = 4; 147)
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01	