BRIDGING THE UNIVERSAL CARE INEQUALITY GAP IN SOUTH AMERICA WITH A UNIFIED HEALTH SYSTEM: A COMPARISON OF BRAZIL WITH ARGENTINA

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ABSTRACT

This research paper answers to the question of whether a unified health system could achieve better advances in terms of access and quality of care, comparing the health care systems of Brazil and Argentina. Brazil is the only country in South America in having implemented a unified health system, the *Sistema Unico de Saúde*, with the aim of improving access and quality of care. Regardless of the scope of health care policies, a unified system seeks to encourage the participation of all health care sectors and all levels of government, unifying efforts to improve access and quality.

Trends in health care quality indicators showed a significant improvement in indicators of access (study I), and quality of care (study II) in Brazil in comparison with Argentina. The implementation of a unified health care system by the reform of 1989 of Brazil's Constitution acted as a catalyst for the design and implementation of policies, expanding access to health services, as well as improving the quality of care. The positive changes observed in Brazil compared to Argentina could be attributed to the impact of the policies that consolidated Brazil's Unified Health System in 2001, which would not have been possible without the universal care scope and the unified structure of its health care system initiated by the constitution reform. Results of trend analyses, and multivariate and difference-in-difference regressions on quality indicators suggest that the consolidation of a unified health system had positive impacts on improving and maintaining the quality of care in Brazil, namely in matters of out-of-pocket expenditure, and the mortality from of communicable and noncommunicable diseases. Throughout this study, I extend prior research to provide South American countries with information and insights for policy reform following the example of Brazil's unified health care system.

BIOGRAPHICAL SKETCH

Angel Eugenio Benitez Collante was raised in Corrientes, Argentina, where he obtained his Medical Doctor diploma from the *Universidad Nacional del Nordeste*. He pursued medical residency programs at *Hospital Escuela General José Francisco de San Martin*, Corrientes, and at the *Hospital Pediatrico Pedro Garrahan,* Buenos Aires. He participated of health care missions in underserved areas of Argentine by volunteering in the government program *Cirugía Patria Solidaria*. He pursued the Master of Public Health in Biomedical Informatics at *Université Paris Descartes*, France from 2014 to 2015, and he pursued the Master of Public Administration at Cornell University from 2019 to 2021.

To my loving parents, Carmen and Edmundo.

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LIST OF ABBREVIATIONS

NCDs	Non-communicable diseases
CDs	Communicable diseases
OECD	Organization for Economic Cooperation and Development
WB	World Bank
IADB	Inter-American Development Bank
PAHO	Pan American Health Organization
WHO	World Health Organization
UN	United Nations
IARC	International Agency for Research on Cancer of Brazil
HCQI	Health Care Quality Indicators
DEIS	*Dirección de Estadísticas e Información de la Salud* – Health Statistics and Information Directorate of the Ministry of Health of Argentina
DataSUS	*Departamento de informática do Sistema Único de Saúde* – IT department of Unified Health System, Ministry of Health of Brazil
SUS	*Sistema Unico de Saúde* – Unified Health System of the Ministry of Health of Brazil
OOP	Out-of-pocket expenditure
UN-WPP	United Nations-World Population Prospects
UN	United Nations

CHAPTER I

STRUCTURE OF UNIVERSAL HEALTH CARE MODELS

This chapter provides a justification for the analysis of the performance of Brazil and Argentina health care systems. The first section explores the legal and intergovernmental management aspects, providing a frame for comparative analysis. The second section compares the structures of the health care systems of Brazil and Argentina, with special interest on the resources and the infrastructure involved in the delivery of care.

Health Care Systems Characteristics

Achieving universality and equity are objectives of health care systems. However, the way in which countries face challenges in achieving universality and equity in health care vary across the world, influenced by traditions and legal frameworks. Within the last thirty years, the discussion around how to improve the quality and coverage of health care has been in place in South American. Only five countries in the region have universal health coverage, but only Brazil has moved towards a unified system (Jurberg & Humphreys, 2010). In the aftermath of the financial crisis of 2007, public and private international health initiatives focused their attention on how health systems are structured (Nishtar, 2009). Due to the impossibility to achieve the health care targets of the Millennium Development Goals (MDG), the World Health Organization (WHO) has shown increasing interest in health care systems (Evans et al., 2008). Regardless of the varied political and socio-economic realities among countries, the way in which health systems are organized could be a determinant of the health of the population. The WHO considers the Acheson definition, which defines public health as the "art and science of preventing disease, prolonging life and promoting health through the organized efforts of society" (Acheson, 1988). Departing from this definition, the field of public health actions is not limited to the treatment of illness and promotion of health, but it also includes the mastery of health risk. The field of public health is multidimensional and requires coordination across different sectors involving political and collective actions. Through different actions, governmental agencies take care of public health by dealing with the protection and improvement of citizen health and hygiene (Smith & Greenblatt, 2019). The concept of health system refers to the way the institutions and individuals that ensure the delivery of care are organized with the primary intent to promote,

restore or maintain health (WHO, 2007). This includes the inter-sectoral coordination of resources, insurers, providers, payment methods and other actors, as well as the relationships that affect the delivery and quality of care. Even if reductionist, this framing is useful to understand why some countries, following their traditions and a strong path dependence in policymaking around public services, may choose one system over another, in order to meet the needs of the population.

At a first level of dichotomy, a health care system can be classified as universal if its goal is to provide coverage the whole population or, it can be considered non-universal in other cases. In a universal care system, the population has access to health services without experiencing financial hardship (WHO, 2021b). Regarding financing aspects, universal health care models can have a single-payer system, in which a single agency centralizes the financing of health costs, or it can have a multi-payer system in which more than one actor finances the costs of care. For instance, Canada has a single payer system, as well as the United Kingdom, in which the National Health Service provides medical care directly. A universal care model with a multi-payer system is the Bismarck Model in Germany. A particular infrequent case is the Beveridge model, a single-payer and single-provider model of care. Non-universal health care systems include the private health insurance system and out-of-pocket (OOP) payments, which are borne by individuals as they are not covered by the health insurance.

Depending on how health care actors are organized in the marketplace, health care systems can also be classified in two models, the unified model and the mixed model. In a mixed model the privately-financed marketplace health care system coexists with the publicly-financed government health care system (Nishtar, 2007). Conversely, in a unified system, a central level of government coordinates all actors in a country, namely public and private sector, in order to deliver and finance health care. A unified model brings together the advantages of a multi-sectoral collaboration in the delivery of care, the operation of the public sector as well as private for profit and non-for-profit actors, albeit there may be many degrees of unification. However, a health model can present aspects of the other models; for instance, the out-of-pocket payments, which accounts for 20% of the average health care expenditure in rich countries, are also present in universal models (OECD, 2019). Out-of-pocket payments and marketplace provision of services are part of mixed

models (Nishtar, 2007), but they are also present in unified models. Contrary to mixed models, unified care models provide central coordination of health care provision. Brazil's unified model brings together insurers and providers from both private and government sectors (Jurberg & Humphreys, 2010). However, decentralization in policymaking and policy implementation are characteristics of Brazil's federal system of government; since 1996, laws transferred a great part of the responsibility for financing and managing health care, to the 26 states and 5570 municipalities of Brazil (Jurberg & Humphreys, 2010).

Assessment of Health Care Systems' Performance

A simple framework used for assessing the performance of a health system consists of an analysis organized in three steps, as follows: 1) the building blocks, which includes structure and processes, 2) the intermediate outcomes, consisting of efficiency, coverage and quality aspects, and 3) the final outcomes, which include indicators of clinical outcomes and satisfaction (Hurst & Jee-Hughes, 2001).

Both Argentina and Brazil share many cultural, political, and organizational characteristics in the delivery of public services to the population. Additionally, both Argentina and Brazil have a federal system of government and a universal model of health care. However, after its Constitutional reform in 1988, Brazil opted for a unified system of health care which facilitated the expansion of health policy at federal, state and municipal level (Constitution of Brazil, 1988). The recognition of a constitutional right to health care in the *carta magna* did not immediately produce a policy shock, but it initiated a 30-year path that improved access and quality of care (Castro et al., 2019). On the other hand, Argentina kept a fragmented system of a universal health insurance and delivery of care, never having adopted a unified system. The comparative analysis of this research follows the key assumption that factors linked to the implementation of a unified system led to different health care outcomes in both countries, namely indicators of access and quality. However, other socio-economic differences may influence some of the different outcomes and are considered as covariates in this analysis. The hypothesis was that the implementation of a unified health care system is associated with an increase in access and quality of care. This increase could be due to the unification of resources and efforts of all health care actors, or due to other factors to be determined in further research. The objective of this thesis was to provide a comparative analysis to highlight the impact

of the implementation of a unified health system, by assessing selected performance indicators of coverage and quality of care. Argentina had never enacted a unified health care system, and for this reason, it was used as a good counterfactual for Brazil in the comparative analysis of this research.

Characteristics of Health Systems

The Unified Health System of Brazil

Brazil has organized its health care in a unified system, permanently expanding the participation of public and private actors in the *Sistema Unico de Saúde* (SUS), or Unified Health System, created by the Constitution reform of year 1988. The amendment in title VIII, chapter II, article 196 consides health as "a right of all and the duty of the state, guaranteed through social and economic policies aimed at reducing the risk of disease and providing universal and equal access to health promotion, protection and recovery". Article 198 established that public health services are part of a regional and hierarchical network in a unified system (Constitution of Brazil, 1988). The policy changes that followed the Constitution reform led to substantive changes consistent with the language in the constitution. The SUS provides access to health care to virtually all the population (Castro et al., 2019). The private insurance market is regulated by the *Agência Nacional de Saúde Suplementar (ANS)*, the National Agency of Supplemental Health, created by executive law 9656 of June 3, 1998 (Brazil Presidency, 1998). This law entered into force in 2001 after reform 2177-44 of August 24, 2001, which provided a framework for implementation and regulation of basic health services granted to citizens (Brazil Presidency, 2001). This regulation of the health private insurance sector starting in 2021 sets the beginning of the consolidation period of the Brazil unified health system. About 25% of the population supplement the health coverage provided by the SUS purchasing private insurance plans (ANS, 2021). While health care provision is mainly provided by the public sector, the private sector, which has experienced a big increase in investments, utilization, and prices, concentrating more specialist practitioners (Massuda, 2018).

The Mixed Health System of Argentina

In 1943, Argentina made the first step towards the recognition of public health as a problem of public interest, by creating of the National Directorate of Public Health and Social Assistance. In 1949, the

Directorate became the Ministry of Health, the dependent federal agency in charge of public health and responsible for regulating health care. (Belló & Becerril-Montekio, 2011). In Argentina, health care is organized in a mixed model for the delivery and financing of care, with the participation of three main sectors, the public health system, the social insurance system, and the private health system.

The public health sector, is accessible to 100% of the population with no need of enrollment, is the only resource for about 37.6% of the population that cannot afford other coverage. The public sector delivers care through a network of publicly funded health centers organized in three levels of care, primary, secondary, and tertiary, as well as through different primary health national programs, such prenatal and child care, and emergency care in poor neighborhoods. The second sector comprises the *obras sociales*, which is a particular type of social health insurance that has expanded since its creation, in 1970 by executive law 18610, modified by congress in 1989 (Congr. Law, 1989). The *obras sociales* cover about 60% of the population through three main actors, the worker unions' insurance, the public employee insurance, and the *Programa de Atención Médica Integral* (PAMI) which is the federal insurance for the elderly and disabled. Lastly, only 5% of the population seeks coverage through the third sector, provided by for-profit marketplace insurers, the *prepagas de salud* or health prepaid insurers (Rubinstein et al., 2018).

The government seeks to implement universality and equality in care services through regulations that mandate the delivery of comprehensive care. The *Programa Médico Obligatorio* (PMO) or Compulsory Medical Program, wrote by Dr Luis Castiglioni, and implemented by the executive law 504 of May 12, 1998, determines the basic health services that public and private actors must provide, some of them free from copayment (Ex. Law, 1998). The PMO mandates a comprehensive vaccination schedule, birth control, assisted fertilization, and HIV treatments, free for the population. However, the increasingly high costs of medical care and the requirements of delivering the permanently expanding list of services mandated by the PMO led to two situations: several *obras sociales* were integrated to large entities in order to pool risks, while others receive permanent subsidies from the federal government (La Nacion, 2000). The implementation of the PMO aimed to ensure equality of access to health services in a mixed model. However, the PMO also allowed the administration of *obras sociales* to create insurance plans offering

smaller financial coverage to beneficiaries who opted to enroll while moving away from their original *obra social* coverage (Cetrángolo & Devoto, 2002). The aforementioned situations have imposed challenges to Argentina in the sustainability of its mixed model of health care, as well as challenges on equity in health care service delivery to the population. In mixed models, when the actions of different sectors become unbalanced, the increased cost of medical care as a share of the gross national income can compromise quality and equity, which is known as the mixed health systems syndrome (Nishtar, 2009).

Structure and Infrastructure in Health Care Systems

This section provides an analysis of the structure of the health systems of Argentina and Brazil that help achieve the mission of their universal care model, focusing on similarities and differences regarding the structure of health services. The implementation of universal care in South American countries followed the Alma Declaration of year 1978, which focused on primary health. In the 1990s, the principal scope of primary health in Latin-America was focused on family care, namely maternal and child, and preventative care (WHO, 2008). Big efforts to induce savings while delivering care to all the population in countries with a universal model of care, are focused on the dimensions of primary care, namely preventative care (WHO, 1978). Promoting healthy habits and increasing health controls can be achieved by strengthening the primary care system to reduce the number of preventable surgeries and other costly treatments in the population. For, instance, one strategy to reduce the health expenditure is reducing the number of hospitalizations by improvements in preventative care (IADB, 2018). Developing and maintaining the health system represents one the most important expenditure of a country, representing the second expenditure for Latin-American governments (IADB, 2018).

Brazil has built its health system by progressively enacting and implementing legal mechanisms during the past three decades (Castro et al., 2019). During the years that followed the Alma-Ata Declaration and the reform of the Constitution, policies aiming to increase access have had a scope in primary care, which is the basis of the Unified Health System (SUS) of Brazil, with emphasis on the local level of management (Massuda et al., 2018). Brazil spends 9.2% of its GDP on health, which is just above the average health spending of the group of 37 OECD member countries (OECD, 2019). However, public health expenditure

represents only 4% of GDP, while the rest of health expenditure is complemented by private payments, namely supplementary health insurance and out-of-pocket payments (UN Data, 2021). The *Previne Brasil*, a program of the Ministry of Health, recently implemented by the ordinance 2979, of November 12, 2019, seeks to balance financial values per capita referring to the population effectively registered in the Family Health Strategy (eSF) and Basic Care Units' coverage, transforming the payment scheme in primary care (Ministerio de Saúde, 2019b). After the opening of the Amazon frontier in the 1980s, the migration from rural to urban areas led to non-organized growth of municipalities, who are in charge of delivering the unified care program in Brazil, the SUS. On the other hand, challenges in the logistics to deliver care in rural areas remain, namely in remote areas surrounded by the jungle. Currently, the program *Unidade Fluvial Movil* or Fluvial Mobile Unit, a network of hospital boats covers these areas, funded by federal grants requested and implemented by municipalities (*Ministério Da Saúde*, 2020).

A better understanding of the health care system of Brazil requires an analysis through the lenses of the concept of overlapping intergovernmental relationships in federal systems, described by Deil Wright (Agranoff & Radin, 2015). Brazil's federal government design programs, remove legal obstacles and ensure the administrative framework for the delivery of universal care to the population, such as the permanently updated *Carteira De Serviços Da Atenção Primária À Saúde (CASAPS)* or Portfolio of Primary Health Care Services (Ministerio de Saúde, 2019a). State governments regulate medical education, namely the training of medical professionals by universities and training the community health workers. The local level government manage and maintain the infrastructure of health centers. Primary health units provide basic care and implement national vertical health programs for specific groups. These programs cover child and maternal care, prevalent infectious and noncommunicable and chronic diseases programs, covering maily hypertension, diabetes, women's cancer screening, and mental health (Massuda, 2014). Municipalities implement SUS's actions connected through the *Conselho Nacional de Secretarias municipais de Saúde* (CONASEMS) or National Council of Municipal Health Secretariats. The municipality administration provides the infrastructure of basic care and contracts with private actors for the rest of the services (Ireland et al., 2016). The funding for keeping the SUS model requires a high-level of intergovernmental and public-

private cooperation. Despite the federal system of Brazil, the management of the SUS program ensures direct relationships between the 5570 municipalities with the federal government for categorical grants. The SUS was initially supported by Federal funds collected through the CPMF (Temporary Contribution on Financial Transactions), which was a tax on financial transactions implemented until 2007 (Decree 6306/2007). During the first period before 2007, the federal government provided funding to municipalities, but this participation share has declined over time. For instance, in 2017, when the federal financial participation was reduced from near 100% to 43%, municipalities contributed with 31% of the funding for the program, while the 26% gap was covered by state governments (Piola, 2018). This financial adaptation brings evidence to believe that the constitutional and legal framework, as well as the federal government initial participation acted as a bedrock, that fostered the construction of a sustainable health system with increasing local government participation. The expansion of staffing and infrastructure during the past 30 years has expanded the access to services in the vicinity of beneficiary households (Lindelow et al., 2013). Ratios of health care personnel per 1,000 people in Brazil are of 2.2 for physicians and 10.1 for nurses and midwives (WB data, 2021). The basic functional units of the SUS primary care are the family health teams (eSF), which consist of a family medicine practitioner, a nurse and auxiliary nurse, and 4 to 6 community workers operating in health centers. In 2020, 6886 family health teams integrated the primary care network of Brazil, serving 60% of the population (Ministério Da Saúde, 2020).

Regarding social infrastructure, cities in Brazil have delivered hospitals using a public private partnership model. In the state of Sao Paulo, the use of Public Private Partnerships was a response to the need for efficiency in building hospitals in underserved neighborhoods in the late 1990s (La Forgia & Harding, 2009). The implementation of public private partnerships in San Paulo brought performance-oriented incentives and accountability to the system (La Forgia & Harding, 2009).

In Argentina, the primary health scope of health services was the result of the Alma-Ata Declaration recommendations regarding the need to provide alternatives to big hospitals, for the poor population. The local governments of big metropolitan areas, like Buenos Aires and Cordoba, have built care health centers to serve populations in the place they live, namely in emergency slums. Most of slums were populated by

impoverished citizens, who migrated from rural areas to big cities in the search for job opportunities. The Ministry of Health, a federal dependent agency, is in charge of some national hospitals and some organizations, such as the National Cancer Institute and the National Institute of Tropical Medicine (Ministerio de Salud, 2021). In each province, the provincial ministry of health receives funding for the implementation of programs with certain autonomy. Regarding health care human resources, Argentina presents a ratio of 4 physicians, 2.6 nurses and midwives, per 1000 people (WB data, 2021). The federal government manages higher education, which include national universities that teach the generations of medical professionals. Provincial governments train nurses, nurse assistants, and community health workers. Practical training takes place mainly in hospitals, which are managed by provincial governments, and, in some rare cases, by the federal government. In 2020, the hospital infrastructure in Argentina consisted of 2394 hospitals, which contained nearly 2885 operating rooms, and a rate of 4.99 beds per 1000 population (Statista, 2020) (WB data, 2021). The health care provider network consists of three sectors, the private, the *obras sociales'* hospitals, and the public sector. The private sector accounts for more than 50% of hospital beds and ambulatory facilities in the country, and it has been in permanent expansion. The *obras sociales'* hospitals provide services to their affiliates. The public sector consists of publicly funded hospitals, called "decentralized management, public hospitals", because they are provided with a system of self-management and decision-making regarding the generation of resources through the sale of services to health insurers and citizens. However, they still provide free medical attention to the lowest income citizens (Belló & Becerril-Montekio, 2011). The public sector is accessible to 100% of the population, being the only resource for those who do not have a private or social insurance (*obra social*) plan, which represents about 15.7 million people (Rubinstein et al., 2018). Only a handful of tertiary care public hospitals are managed by the federal government, while the rest of public centers belong to provinces or municipalities (Rubinstein et al., 2018). There are 6433 public health centers specialized in primary care in Argentina, called *Centro de Atención Primaria de Salud* (CAPS). About 54% of CAPS are managed by provincial governments, while the rest of them are managed by municipalities (Stolkiner et al., 2011). In 2016, the Argentine congress enacted the Law 27328, which regulates the contracting of infrastructure projects using

the public private partnership model (Congr. Law, 2016). Since then, several projects were presented, but no project with a public private partnership modality was delivered in the health care infrastructure field.

Discussion

This chapter draws a baseline for understanding the results of the comparative analysis the dimensions of access and quality of care of Argentina and Brazil in chapter II and III. Despite the hospital-centric culture of medical training in big universities and central hospitals, the building blocks of health care in South America requires the development of community health centers, and the staff to operate them (Stolkiner et al., 2011). During the last decades, both countries focused efforts on strengthening of the primary level of care, namely family, maternal, and child care. However, the focus on noncommunicable diseases has become increasingly important, due to the aging of the population. In modern times, an accurate approach includes the comprehensive care of chronic diseases, which focus on early detection, screening, and patient follow-up. In the last decades, both countries ventured in signing public private partnership contracts for the delivery of hospitals, albeit only Brazil completed projects using this modality. The public private partnership approach could help publicly owned hospitals to face the high costs of unfractured projects, the challenges of dealing with aging infrastructures, preventive maintenance, and facility safety (Grainger 2019). However, in order to face these infrastructure challenges, a starting point is to identify the needs of urban growing and rural shrinking areas, and the shared responsibilities of all levels of government in the primary care field. This chapter completed the first level of the conceptual framework for health care systems' assessment in three steps, the building blocks, the intermediate results, and final outcomes of the system (Hurst & Jee-Hughes, 2001). However, all levels are interconnected and leapfrog each other, and their relevance steps may vary depending on the context or the level of quality of care in which a country starts the policy path for improvement. In a first level of analysis, this systematic review describes the main characteristics of health systems of Argentina and Brazil, as well as a description of the elements that supports their structure. The legal framework, the intergovernmental management, and the temporal circumstances in which changes occurred in both countries, allowed comparisons in access and quality between the health system, between the periods before 2001 and after 2001.

CHAPTER II

HEALTH COVERAGE IN UNIVERSAL HEALTH CARE MODELS

This chapter analyzes the dimensions of health care coverage, with emphasis on access to health services. A comparative study of the outcomes of Brazil and Argentina, using regressions and difference-in-difference methods, was conducted to observe trends of selected health coverage indicators. This analysis relates to the second level of analysis of health systems' performance, the intermediate results of processes (Hurst & Jee-Hughes, 2001).

The Dimensions of Universal Health Coverage

In general terms, the concept of health coverage relates to the number of inhabitants who have access to health services in a population. This concept includes not only access to services, but also the quality of financial coverage, namely citizens' entitlement to a total or partial reimbursement for certain health care payments. The concept of universal by the World Health Organization care includes health financial protection and access to quality health care services without financial hardship (WHO, 2021b). Similarly, the intent of the United Nations agenda of Sustainable Development Goal 3, target 8, is "to achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all" (UN SDGs, 2015). In 2017, a report by the World Bank and the WHO revealed that, each year, 800 million people spend more than 10% of their household budget on health care, and at least 100 million people fall into extreme poverty due to health expenses (WHO, 2017). Both countries, Argentina and Brazil, have a universal model of health care, which make comparisons between them possible.

Indicators of health coverage

The 2010 World Health Report proposed a three-dimensional approach to study universal health care coverage as a bottom line to understand its complexity. Regardless of the mechanism that countries put in place to achieve universal coverage, the three dimensions of coverage to consider are: service coverage, financial coverage, and population coverage (The World Health Report, 2010). These three dimensions'

analysis sets a point of departure for selecting indicators relevant to health coverage assessment. Even if the population coverage rate, provides a direct static observation of the rate of insured versus uninsured people, it does not inform about the outcomes of the system. Additionally, recent research showed that the rate of insured population is dissociated with the quality of coverage, namely in maternal and newborn mortality which is still high in countries with universal care (Kruk et al., 2018).

In this chapter, a study focusing on the first two dimensions, service coverage and financial coverage, was performed to assess the actual outcomes of coverage expansion policies. The study assessed indicators of primary care reflecting the quality of health coverage, such as vaccination rates and antenatal care by skilled professionals, as well as indicators of financial risk protection, such as rates of Out-of-Pocket Expenditure (OOP) expenditure.

Study I

Objectives. The objective of Study I was to compare trends of selected health coverage indicators in Argentina and Brazil. The hypothesis was that the implementation of a unified health system leads to an improvement in the selected health coverage indicators of service and health financial risk. In the dimension of service coverage, the focus was placed on access to medical care as well as on preventative care and reproductive, maternal, newborn, children, and adolescent care. In the dimension of financial risk, this study focuses on out-of-pocket expenditure, which is a common measure of effectiveness in coverage in any country, particularly the rate of OOP on health as a percentage of current health expenditure and the rate of OOP on health as a percentage of total health expenditure. In 2001, Brazil consolidated its current unified health system by enacting and implementing laws that regulate the complementary private insurance plans by the ANS agency. The period observed was limited to the availability of data for these indicators, starting from year 2000, which allowed a comparison before and after the year 2001.

Study design. A case-control longitudinal comparative study was conducted using econometric models, consisting of regressions and a difference-in-difference analysis, to test the hypothesis of the study. The countries compared, Argentina and Brazil were selected after an analysis of the characteristics of their health systems, which similarities allowed point of comparisons. Argentina, which does not have a unified

health system, was used as a control for comparison with Brazil, which has implemented a unified health system. The treatment was the implementation of a unified system in 2001, which is the case of Brazil when the law for supplementary health plans was enacted. The identifying assumption was that, if a consolidated unified health system wasn't in place in Brazil since 2001, there would be no difference between the outcome indicators of Brazil and Argentina since that year.

The null hypothesis used for statistical tests of indicators selected for this study was that there was no difference between Brazil and Argentina after the consolidation of a unified health system in Brazil. In the case there were a significant difference, this null hypothesis would be rejected.

H_0: $\mu_1=\mu_2$ or $\mu_1-\mu_2=0$; H_1: $\mu_1\neq\mu_2$

Methods. The aggregated data for this study were available the websites of the UN-WPP, WHO, PAHO-PLISA, UN data, and the statistics department of each country's national health agency, the DEIS of the Ministry of Health of Argentina and the DataSUS of the Ministry of Health of Brazil. The variables of study were the indicators consisting of rates of events per individual (cases/individual), in order to depart from a regularized format and, avoid confusion by using other formats such as percentages or per thousand. The indicators consisted of rates adjusted by age (PAHO, 2021). In cases in which an age-adjusted rate was not available, the age-adjusted rate was computed using the available raw data. The variables were incorporated manually into comprehensive data frame using Excel®, verifying the congruence on values among the different sources. The software STATA® was used to perform multivariate linear regression, multivariate log-regressions, and difference-in-difference regressions.

The dependent variables comprised indicators of two selected dimensions of health coverage, as follows:

1) a composite indicator, the immunization rate, consisting of the average of vaccination for BCG, Polio, DPT3c and MMR1 rates in children of 1-year old, used as an indicator of coverage (USAID, 2012); 2) three indicators of reproductive health and maternal care, used as indicators of coverage: a) unmet need for family planning, b) modern contraceptive prevalence use, and c) births delivered by skilled attendants; 3) Two indicators of hospital activity, used as indicators of access: a) medical visits rate, and b) admissions' rate. In the case of visit rate, a difference-in-difference study was not possible due to the unavailability of

data before the year 2003 for Argentina. For assessing health financial risk coverage, indicators selected were the out-of-pocket expenditure as a percentage of the current health expenditure (OECD, 2019), and the out-of-pocket expenditure as a percentage of the private health expenditure.

The three macro-economic indicators of health financing were included as covariates, as follows: 1) current health expenditure as a percentage of gross domestic product (CHE-GDP), 2) domestic general government health expenditure as a percentage of gross domestic product (GGHE-D-GDP), 3) domestic general government health expenditure as a percentage of current health expenditure (GGHE-D-CHE).

In all regressions, a logarithmic transformation of the response variable and the continuous non-binary variables independent allowed to analyze outcomes, by reducing heteroscedasticity based on the examination of the linear model residuals, helping to meet the assumptions of inferential statistics.

For the difference-in-difference study, the dummy variable for the year post-treatment called *year2016* was built, considering 2000 as the baseline and 2016 as the end state; *year2016* had a value of 0 in 2000, and *year2016* had the value of 1 in 2016. The treatment binary variable was *unified*, which relates to the condition of having a unified health system, which is the case of Brazil. The interaction term *unified2016 was* the product of the dummy variable for year of treatment, the condition of having a unified system. The econometric model, included the β_3 difference-in-difference estimate, as follows:

$$y = \beta_0 + \beta_1\, unified + \beta_2\, year2016 + \beta_3\, unified2016 + \varepsilon$$

The interpretation of the difference-in-difference estimator, β_3, served to predict the impact of the unified health system on the indicators of health coverage.

Results.

Observation of trends. A first graphical observation of the indicator distribution trends allowed comparisons between countries. During the period of analysis 2000-2016, both Argentina and Brazil seem to follow a similar trend in increasing rates of immunization (Figure 1). Regarding maternal and reproductive health indicators, there was an increase in the prevalence of the use of modern contraceptives, albeit Brazil presented higher rates of contraception than Argentina across the period of study (Figure 2).

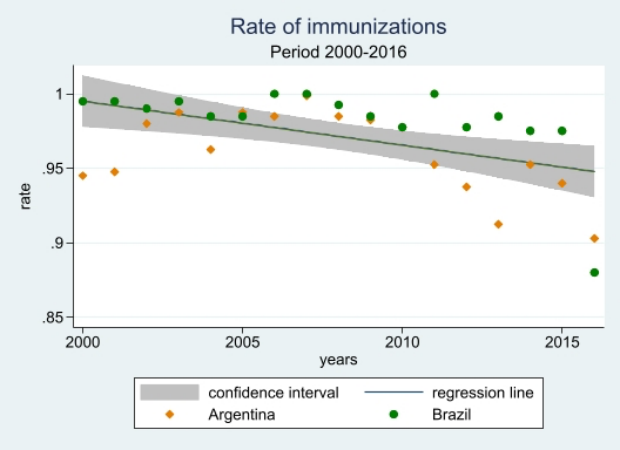

Figure 1: Immunization with BCG, Polio, DPT3cv and MMR1, 2000-2016 (PAHO, 2021).

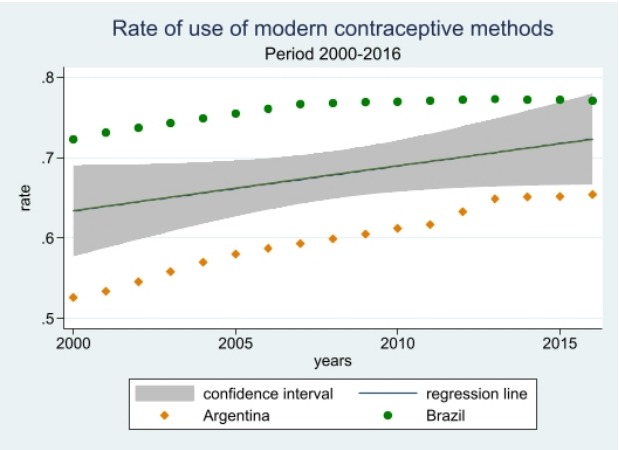

Figure 2: Use of modern contraceptive methods, 2000-2016 (PAHO, 2021).

During the period of analysis, both, Argentina and Brazil, showed similar decreasing trends in their rates of unmet need for family planning, albeit Brazil presented lower rates (Figure 3). The rate of deliveries attended by skilled birth attendants followed similar trends in both countries (Figure 4).

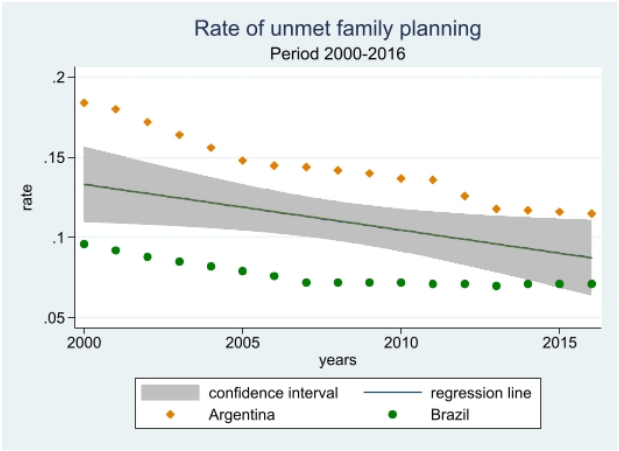

Figure 3: Unmet need for family planning, 2000-2016 (PAHO, 2021).

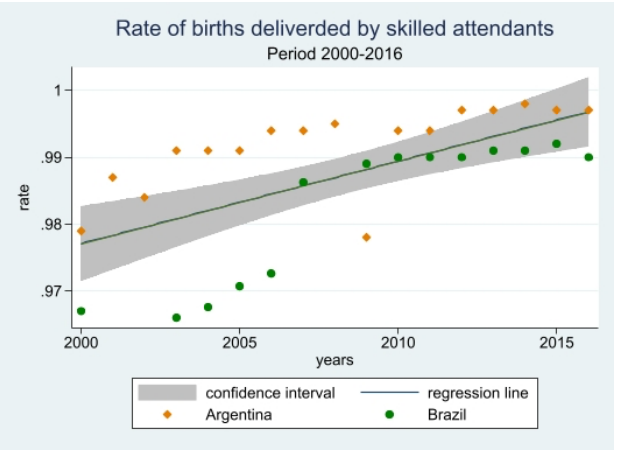

Figure 4: Deliveries attended by skilled birth attendants, 2000-2016 (PAHO, 2021).

During the period of analysis, medical visit rates increased in Brazil, while in Argentina these rates remained relatively stable (Figure 5). Both countries, Argentina and Brazil presented a descending trend in rates of hospitalization (Figure 6).

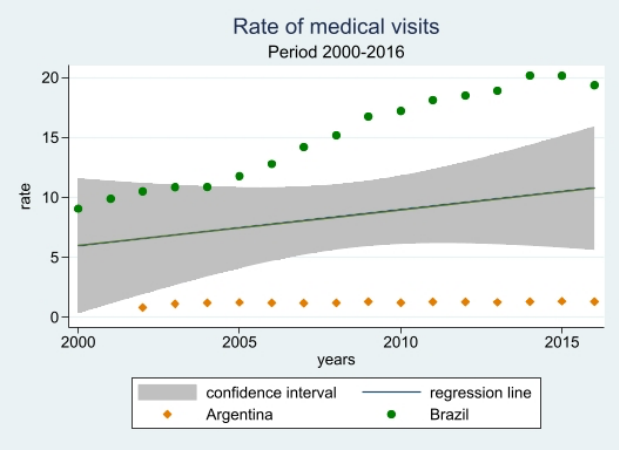

Figure 5: Medical visits per population, 2000-2016. Sources: DataSUS and DEIS

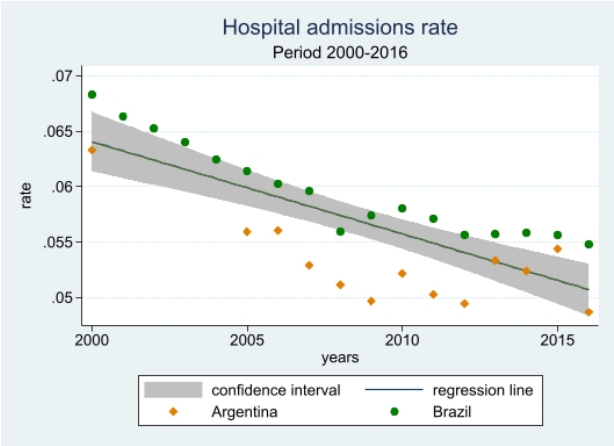

Figure 6: Hospital admissions per population, 2000-2016. Sources: DataSUS and DEIS

The health financial risk coverage, expressed as the rate of out-of-pocket expenditure as a percentage of GDP, decreased in both countries, albeit this decrease was bigger in Brazil, (Figure 7). During the first half of the period of analysis, rates of out-of-pocket expenditure as a percentage of private expenditure on health presented a descending trend in both countries. However, in 2010, these rates exponentially increased in Argentina (Figure 8).

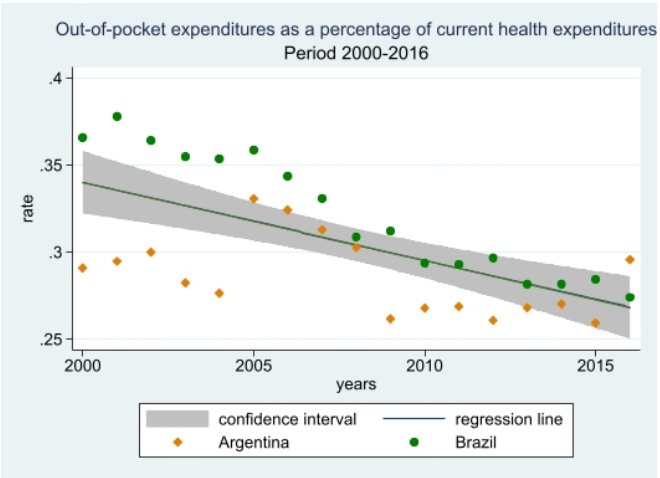

Figure 7: Out-of-pocket expenditure as a percentage of current health expenditure, 2000-2016, Global Health Expenditure Database (WHO, 2021a)

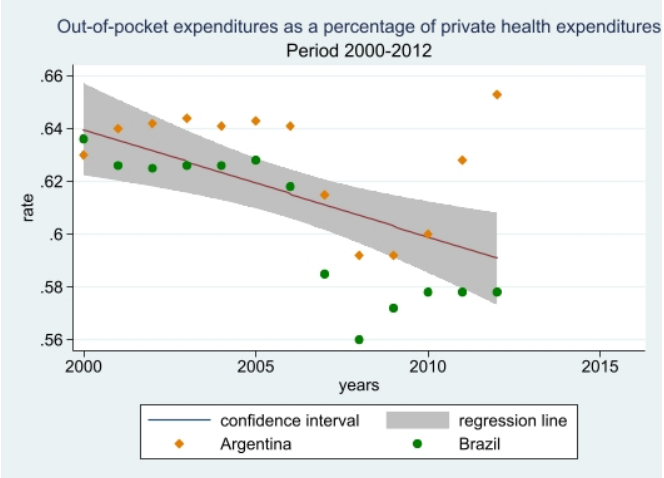

Figure 8: Out-of-pocket expenditure as a percentage of private health expenditure, 2000-2012 (UN Data, 2021)

Multivariate regressions. The multivariate regressions showed significant association for variations in all the response variables, which were access and coverage indicators, across the period of analysis

(Appendix). In Brazil, the population was $2.6x10^{-3}$ percentage points more likely to be vaccinated than in Argentina, albeit this was not statistically significant. Similarly, in Brazil's unified health system, the population was 0.068 percentage points less likely to be in a situation of unmet need for family planning ($p<0.001$). Conversely, in Brazil it was a 0.18 percentage points more likely to find a higher rate of use of modern contraceptive methods than in Argentina ($p<0.001$). However, rates of deliveries attended by skilled birth attendants were likely to be significantly lower than in Argentina by $1.5x10^{-2}$ percentage points ($\beta= -0.015$, $p<0.05$). In all three reproductive and maternal care indicators these results were statistically significant at the 95% level. The rate of visits per population in Brazil was 11.36 percentage points higher than in Argentina ($p<0.001$). The admission rate was also likely to be higher in Brazil than in Argentina by $5.4x10^{-3}$ percentage points, albeit this was not statistically significant (Appendix).

In Brazil, the rate of OOP expenditure as a percentage of current health expenditure was $2.15x10^{-3}$ percentage points likely to be higher than in Argentina, albeit this was not statistically significant ($\beta= 0.0021$, $p=0.968$). However, the rate of OOP expenditure as a percentage of private expenditure on health was 0.045 percentage points ($\beta= 0.045$, $p=0.16$) likely to be smaller than in Argentina.

Log-log multivariate regressions. The log-log regressions showed that in the unified health system of Brazil, the population was 5.4 % ($\beta= 0.054$) more likely to be vaccinated, albeit this was not statistically significant. In Brazil's unified health system, the population was 80% ($\beta= -0.804$) less likely to be in a situation of unmet need for family planning, which was statistically significant ($p<0.001$). Conversely, in Brazil, it was significantly 33 % ($\beta= 0.336$) more likely to find a higher rate of modern contraceptive use methods than in Argentina ($p<0.001$). In Brazil, the rate of deliveries attended by skilled birth attendants was 15.21 % ($\beta= -0.0152$) percent likely to be significantly lower than in Argentina ($p<0.05$). These results on maternal and reproductive health were all statistically significant at the 95% level. The rate of visits per population was 230 % percent more likely to be significantly higher in Brazil ($\beta= 2.305$) than in Argentina ($p<0.001$). The admission rate was also likely to be significantly higher in Brazil than in Argentina by 12.99 % ($\beta= 0.1299$) ($p<0.05$). In the case of these two access indicators, the results were statistically significant at the 95% level. In Brazil, the rate of out-of-pocket expenditure as a percentage of current health

expenditure was 0.28 % (β= 0.028) percent more likely to be higher than in Argentina. Conversely, the rate of out-of-pocket expenditure as a percentage of private expenditure on health was 5.5 % (β= –0.055) likely to be lower in Brazil than in Argentina. However, these results of log-log multivariate regression on these two health financing indicators were not statistically significant.

Difference-in-difference log-level regressions. In Brazil, the unified system was associated with a reduction in the immunization rate in 1-year-old children of 7.7% (β_3= –0.077). The consolidation of Brazil's unified health system decreased the rate on unmet need for family planning by 16.83 % (β_3= 0.168). In Brazil, the rate of modern contraceptive use in the population decreased by 15.35% (β_3= –0.153). However, the unified system increased the rate of deliveries attended by skilled birth attendants in Brazil by 0.5 % (β_3= 0.005). Brazil's unified system increased the rate of admissions by 4.2 % (β_3= 4.2). A difference-in-difference regression for medical visits was not possible due to the unavailability of visits in Argentina for the year 2000. The unified system reduced the rate of out-of-pocket expenditure as a percentage of current health expenditure by 30.48 % ($\beta_{3=}$ –0.304) through the period 2000-2016. It also reduced the rate of out-of-pocket expenditure as a percentage of private expenditure on health by 13.14 % ($\beta_{3=}$ –0.1314) during the period 2000-2012. In this last case, the difference-in-difference regression was performed for the period 2000-2012 due to the unavailability of data for 2016 (Appendix).

Discussion

This chapter compared indicators of health coverage of a unified and a mixed model of health, by using common indicators of access, preventative care, and health financing. The results of the study I show that the implementation of the SUS in Brazil was associated with a statically significant improvement in reproductive health indicators. The vaccination rate in children of 1-year old may not be an accurate indicator to compare health coverage between both countries; especially in a time in which massive vaccination campaigns led by international organizations has been successful in giving access to the basic immunization schedule, which includes BCG, Polio, MMR1 and DPT3 (DHS WHO Global Health Observatory database, UNICEF). The expansion on medical visits rate and the smaller increase in admissions' rate was statistically significant, which suggests a big expansion in health care access. The log-

log multivariate regression determined that the increase in out-of-pocket expenditure as a percentage of current health expenditure by 2.8% and, the decrease of out-of-pocket expenditure as a percentage as a percentage of private health expenditure by 5.5%, were not statistically significant. The reason can be that, in developing countries, health insurance plans provided by public or private actors may not cover all health expenditure. Morover, the decrease in these two health financing indicators was faster in Brazil than in Argentina in the log-level difference-in-difference regression could be due to the consolidation of the unified health system and to the increase in the share of government participation. However, this could be clearly due to the high increase of this kind of expenditure in Argentina during the last years of the period of analysis (Figures 7 and 8).

However, the limitations of the study I comprised the availability of data and the limited number of selected measures, consisting of four service coverage measures, two access measures, and two health-financing measures.

The selection of relevant indicators may vary among countries as well as the availability of data for the assessment of coverage. The implementation of universal coverage does not necessarily ensure that the morbidity and mortality will be reduced in the population (Kruk et al., 2018). In order to assess the performance of a system, the next step was to conduct an assessment of health care quality indicators, which are the final outcomes. Chapter III explores the quality of care by conducting a comparative study of the outcomes of the health systems of Argentina and Brazil, namely communicable and noncommunicable diseases.

CHAPTER III

THE QUALITY OF CARE IN UNIVERSAL CARE MODELS

This chapter analyses to which degree the model of a health system is a determinant in the improvement of the quality of care, by conducting a comparative study between Argentina and Brazil. The study in this chapter assesses the third level of the traditional three-step framework for health systems analysis, the clinical outcomes at the population level (Hurst & Jee-Hughes, 2001).

The Dimensions of Health Care Quality

The indicators that are used to assess the quality of care are classified in three dimensions, process, structure and outcomes (Donabedian, 1966). Each indicator can also belong to one or more of the six domains of health care quality defined by the Institute of Medicine, namely safety, effectiveness, patient-centeredness, timeliness, efficiency and equity (IOM, 2001). The permanent assessment of the quality of care is important for providing overarching principles for specific direction in policy-making (IOM, 2001). The quality of care can be assessed at many levels of a health system. This chapter compares the outcomes of Brazil with Argentina in matters of the actual outcomes of the system, which are clinical outcome indicators of population health.

Indicators of Health Care Quality

The most pragmatic measures for assessing health care quality are the indicators of clinical outcome in the domain of safety, which includes different conditions of morbidity and mortality by using clinical diagnoses as medico-economic data. The analysis of health care quality can be reduced to two big groups of indicators of morbidity and mortality: communicable and noncommunicable diseases. The communicable diseases (CDs) belong to a large list of illnesses caused by infectious agents and that can be transmitted from person to person, requiring the communication of the event for public health reasons (CDC, 2021). In contrast, the noncommunicable diseases (NCDs), also known as chronic diseases because they are of long duration, do not pass from person to person (CDC, 2021). NCDs have a slow progression and recognize risk factors such as overweight and high blood pressure, as well as toxic habits such as tobacco and alcohol. The main

four NCDs that are responsible for the most of NDCs mortality are cancer, diabetes, cardiovascular diseases, and the chronic obstructive pulmonary disease (COPD) (CDC, 2021). Noncommunicable diseases (NCDs) are the leading causes of death in the Region of the Americas (PAHO, 2019). Thus, the key for prevention of NCDs is reducing their main risk factors, as well as promoting the practice of physical inactivity. The early detection can prevent premature deaths from complications of the NCDs. In general, the public sector focus on NCDs as a crossroad for diverse kinds of policy, covering from accident prevention to tax policy; for instance, taxes on the consumption of alcohol and tobacco. Aggregated rates were used to build composite indicators, which summarize information about the clinical dimensions of analysis, albeit conceptual and statistical flaws could limit their usefulness (Barclay et al., 2019). However, flaws can be addressed and some indicators proved to be useful, such as the rate of mortality from maternal, perinatal and nutritional conditions and communicable diseases, which is used for benchmarking in international comparisons (PAHO, 2021). The agenda of the Pan American Health Organization (PAHO) includes ways to address both communicable and non-communicable diseases and supports the use and diffusion of data on NCDs mortality and health risks prevalence (PAHO, 2021)

Study II

Objectives. The goal of Study II is to compare trends of selected health quality indicators by using econometric methods. The hypothesis of this study was that the implementation of a unified health system is associated with an improvement in selected quality indicators of mortality, namely communicable and noncommunicable diseases. The reform in the constitution needs laws to be enacted and implemented, which in the case of Brazil occurred in 2001 when the law that regulates the complementary private insurance plans by the ANS agency entered in force. The use of data of Argentina and Brazil available from year 2000 is justified for the reason that, a policy, in order to effect change, should be evaluated before and after its implementation. Additionally, changes in the clinical outcomes will take more time to manifest in the reported statistics of the population.

Study design. A case-control comparative study, was conducted using econometric models, consisting of regressions and a difference-in-difference analysis. The treatment group was Brazil, and the control group

was Argentina, which had never implemented a unified health system.

The null hypothesis of statistical tests for indicators in this study was that there is no difference between Brazil and Argentina after the consolidation of a unified health system in Brazil; in the case there is a significant difference, the null hypothesis was rejected.

H_0: $\mu_1=\mu_2$ or $\mu_1-\mu_2=0$; H_1: $\mu_1\neq\mu_2$

Methods. Data for this study was available per country population in PAHO-PLISA website (PAHO, 2021). The variables of analysis were presented as indicators consisting of age-adjusted rates of their prevalence in the population as follows: maternal and childcare indicators, three main risk factors of non-communicable diseases, diabetes, hypertension and overweight, and four indicators of composite mortality from communicable and noncommunicable diseases (NCDs). First, an exploratory trend analysis was conducted by observing graphs of variable distribution across years of the period. Then, regression analyses were performed by considering mortality indicators to be response variables, as follows: 1) Communicable, maternal, perinatal and nutritional conditions, which virtually includes all the measures that are not considered as NCDs (WHO-TGHO, 2021). 2) mortality from communicable diseases 3) mortality from noncommunicable diseases 4) mortality from cancer. Two control variables were selected for their capacity to impact on the health of populations, as follows: 1) rate of improved sanitation facilities 2) rate of improved water supplies.

All variables were incorporated manually into a comprehensive data frame in an Excel® sheet, verifying congruence among different sources of data. Statistical software STATA® was used to perform multivariate regression, multivariate log-regressions, and difference-in-difference regressions. The logarithmic transformation of response variables and continuous non-binary variables allowed to normalize their distribution and reduce heteroscedasticity in the models based on examination of the linear model residuals. Like study I, the difference-in-difference treatment binary variable *unified* relates to the condition of having a unified health system, which is the case of Brazil. The interaction term *unified2016 was* the product of the dummy variable for the year of treatment, the condition of having a unified system in 2016. The econometric model, included the β_3 difference-in-difference estimate, as follows:

$$y = \beta_0 + \beta_1\, unified + \beta_2\, year2016 + \beta_3\, unified2016 + \varepsilon$$

Results

Observation of trends. A first graphical observation of the distribution trends of life expectancy, risk preconditions for NCDs, and rates of mortality from communicable and noncommunicable diseases allowed to identify similarities and differences between countries. During the period 1990-2018, both Argentina and Brazil increased their life expectancy at birth measured in years, through the past thirty years (Figure 9). During the period 1980-2017, health risk conditions for noncommunicable diseases have increased, namely prevalence rates of obesity in children and adolescents, and diabetes. Conversely, raised blood pressure rates decreased in both countries, possibly due to the expansion of preventative primary care visits (Figure 5,10-12). Through 2000-2016 period, neonatal and post-neonatal mortality rates decreased in both countries, following similar parallel trends (Figures 13 and 14).

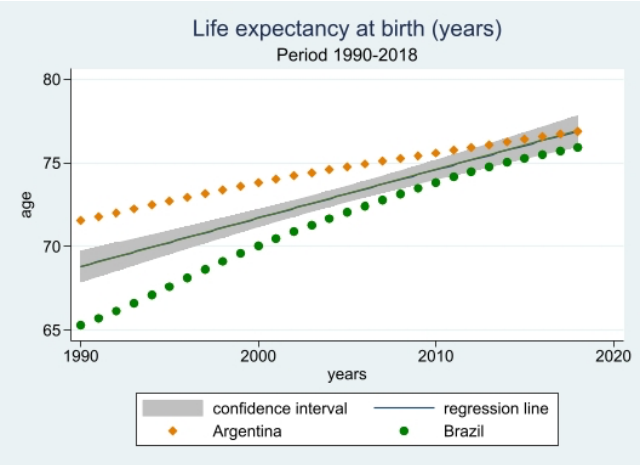

Figure 9: Life expectancy at birth, in years, 1990-2018 (PAHO, 2021)

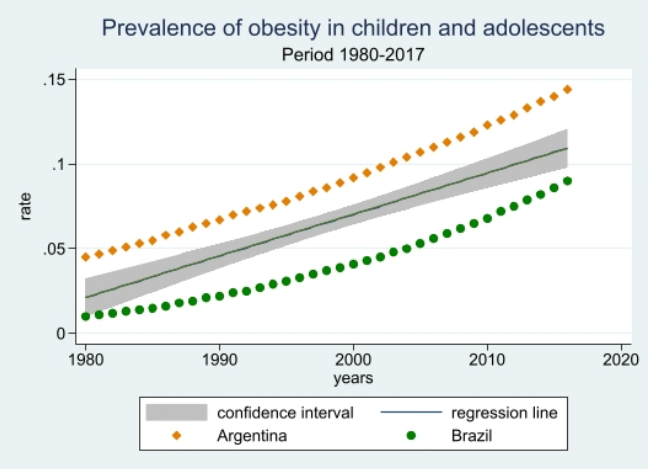

Figure 10: Prevalence of obesity in children and adolescents, 1980-2015 (PAHO, 2021)

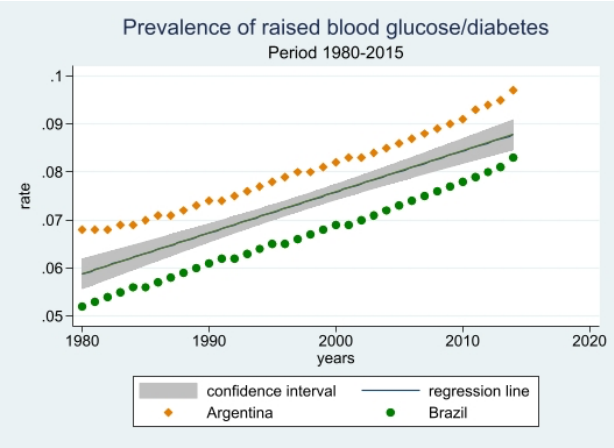

Figure 11: Prevalence of raised blood glucose and diabetes (PAHO, 2021).

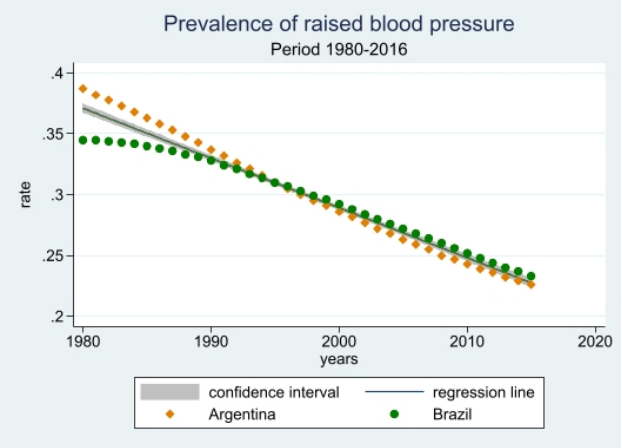

Figure 12: Prevalence of raised blood pressure (PAHO, 2021).

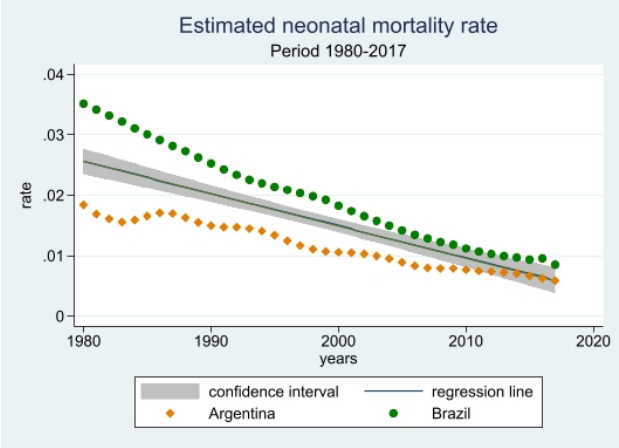

Figure 13: Neonatal mortality rate (PAHO, 2021)

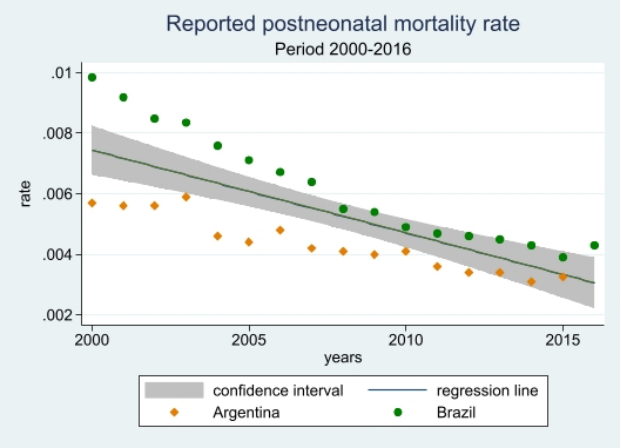

Figure 14: Post-neonatal mortality (PAHO, 2021)

Regarding children aged 1 to 4 years old and under 5 years old, the rates of mortality have decreased in both countries, showing Brazil a steeper slope (figures 15 and 16).

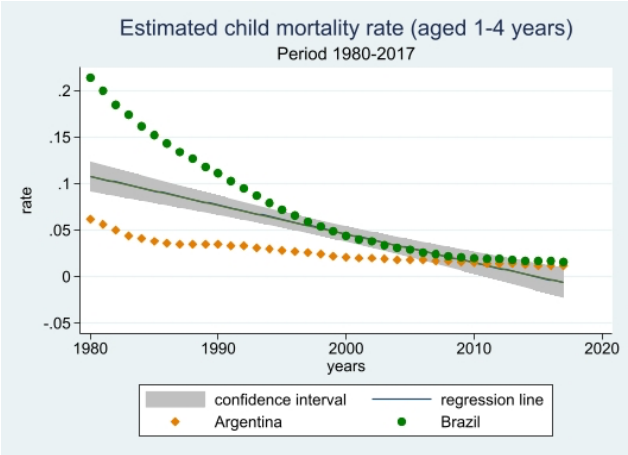

Figure 15: Estimated mortality rate of children aged 1-4 years, period 2000-2012 (PAHO, 2021)

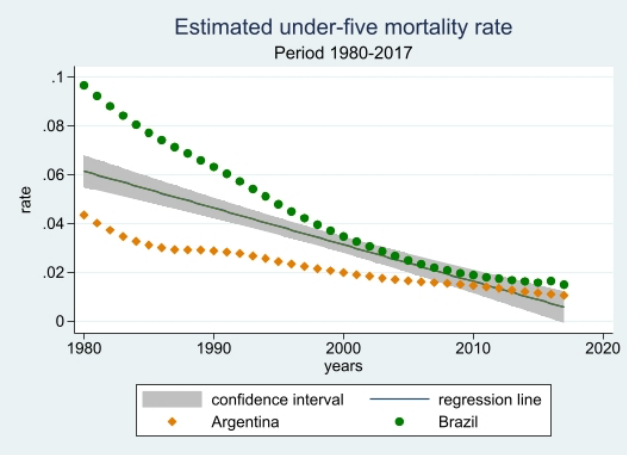

Figure 16: Estimated mortality rate of children under five years old, 2000-2016 (PAHO, 2021)

Through the period of analysis, rates of mortality from communicable diseases experienced a constant decrease in Brazil and were overall lower than in Argentina, in the last year of this period. However, this was partly due to an increase in the rate of mortality from NCDs in Argentina during the last year of the period (Figure 17). Mortality rates from communicable, maternal, perinatal, and nutritional conditions showed a descending trend in Brazil, while Argentina remained stable over time, albeit showing with yearly oscillations (Figure 18). There was tendency to a decrease in rates of mortality from noncommunicable diseases in both countries, Argentina and Brazil; even if the rate in Brazil was higher than in Argentina in great part of the period, it was lower than Argentina in the last year of available data (Figure 19). The mortality from cancer, a noncommunicable disease, follows a downturn pattern in both countries, albeit Brazil showed a lower rate across the period (Figure 20).

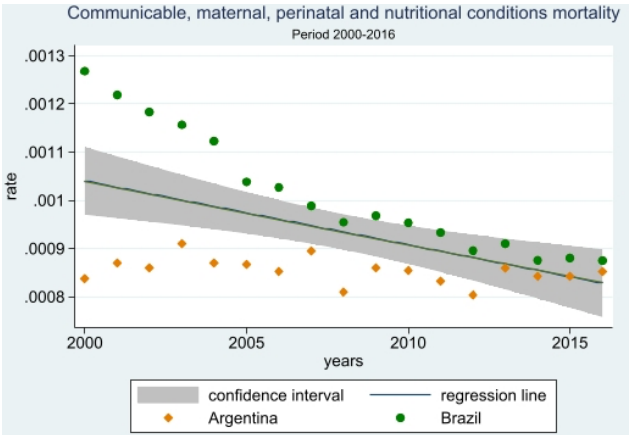

Figure 17: Communicable disease mortality, 2000-2016 (PAHO, 2021).

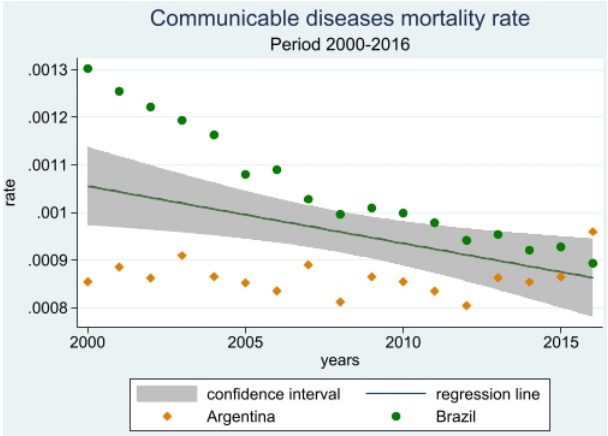

Figure 18: Communicable, maternal, perinatal and nutritional condition mortality, (PAHO, 2021).

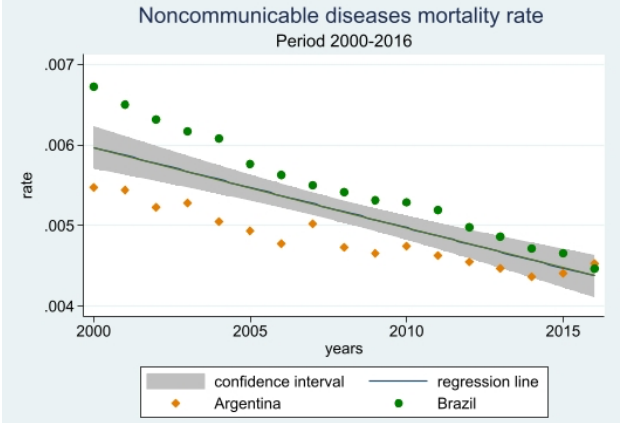

Figure 19: Noncommunicable disease mortality, 2000-2016 (PAHO, 2021)

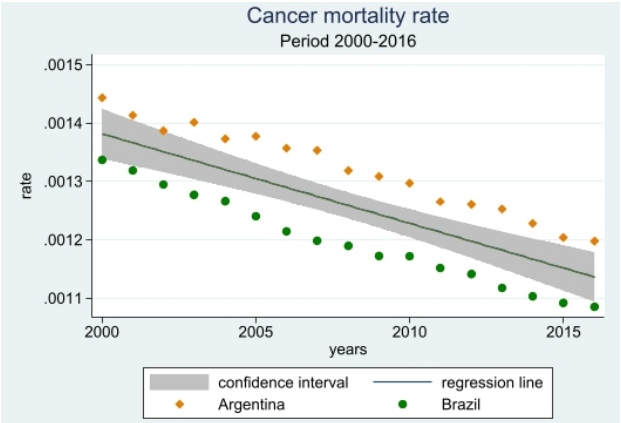

Figure 20: Cancer mortality, 2000-2016 (PAHO, 2021).

Multivariate Regressions. In Brazil, rates of mortality from communicable maternal, perinatal, and nutritional conditions were likely to be $1.58x10^{-6}$ percentage points smaller than in Argentina, albeit this was not statistically significant (Appendix). The mortality rate from communicable diseases was $5.2x10^{-5}$ percentage points bigger in Brazil than Argentina ($p<0.05$). The mortality rate from noncommunicable diseases was likely to be $4.7x10^{-4}$ percentage points bigger in Brazil, statistically significant at the 95% level of confidence ($p<0.05$). Brazil was likely to present a rate of mortality from cancer that was $1.6x10^{-4}$ percentage points smaller than Argentina ($p<0.01$).

Log-log multivariate Regressions. Under Brazil's unified system, the mortality rate from communicable, maternal, perinatal, and nutritional conditions was likely to be 7.8% ($\beta_3 = 0.078$) bigger than in Argentina, albeit this was not statistically significant. The mortality from communicable diseases was likely to be 13 % ($\beta_3 = 0.13$) bigger in Brazil, statistically significant at the 95% level of confidence ($p= 0.005$). The mortality from noncommunicable diseases was likely to be 15.7 % ($\beta_3 = 0.157$) bigger in Brazil, statistically significant at the 99% level of confidence ($p= 0.001$). However, Brazil was likely to have a smaller rate of mortality from cancer, than Argentina by 10.9 % ($\beta_3 = -0.109$), which was statistically significant at the 99% level of confidence ($p<0.01$), (Appendix).

Difference-in-difference log-level regressions. The effect of a unified system in Brazil at the end of the period was a decrease by 38.7 % ($\beta_3 = -0.387$) in the mortality rate of the composite indicator communicable, maternal, perinatal, and nutritional conditions. The effect of a unified system was a decrease in the rate of mortality from communicable diseases by 49.33 % in Brazil. ($\beta_3 = – 0.493$). The impact of the unified system was a decrease in the rate of the mortality from noncommunicable by 22 % ($\beta_3 = 0.22$). The unified system of Brazil affected a decrease in the rate of mortality from cancer by 2.2 % ($\beta_3 = 0.022$). In the case of these four selected mortality indicators, the difference between 2000 and 2016 outweighed the difference between Argentina and Brazil in case the unified system was not implemented (Appendix).

Discussion

The study II provided a frame for interpretation of the impact that the unified system had in decreasing the mortality of four mortality indicators, cancer, noncommunicable, communicable, and, maternal, perinatal, nutritional and noncommunicable conditions, along the period 200-2016.

Since the consolidation of a unified health system in Brazil, Brazil showed to reduce the rates of mortality from communicable and noncommunicable diseases at a faster pace than Argentina during all the period of analysis. The decrease in the mortality rate from communicable and noncommunicable diseases could be one of the achievements of the unified health system, because it developed preventative programs in family care and, comprehensive screening programs for early detection of chronic diseases, such as the program of the cancer institute (INCA, 2018).

However, the increase in children and adolescent overweight, and raised blood glucose in blood will require more control and detection programs in the next decades because they are risk factors for noncommunicable diseases. The increase in these risk factors in both countries, Argentina and Brazil may predict an increase in this composite indicator, mortality from noncommunicable diseases. This scenario will bring new challenges in escalating the coverage to more patients suffering from chronic diseases in the future.

DISCUSSION

The purpose of this work was to provide a strategic analysis of selected indicators to assess the improvements in health care performance associated with the implementation of a unified health system in Brazil, by comparing Brazil with Argentina which has never implemented a unified health system. Even if every health system has advantages and disadvantages this research aimed to answer the question whether the implementation of a unified system is a good option for Latin-American countries in matters of access and quality of care improvement. The comparative analysis of the two health systems was conducted following the three steps of the framework for health care performance assessment, building blocks of the system, intermediate outcomes and final outcomes (Hurst & Jee-Hughes, 2001).

Chapter I analyzed how Brazil's constitutional reform of 1988 fixed a vision for the nation's public health. This vision has been gradually achieved thanks to legal instruments that were enacted in the years that followed the constitutional reform; universality and equality in health services became constitutional rights in Brazil. The unified health system started to fully operate in 2001 with the creation of the regulatory agency for private insurance as a supplement of the SUS. This regulation of the coexistence of the private insurance sector, as supplement for the payments for services, consolidated the operation of Brazil's unified health care system. The enactment of the law that mandated the federal regulation of private insurance plans by the ANS marked a point in the timeline that allowed a comparative before-after study. In the first analysis, the building blocks of the system, the main challenge would be to update the structures to include a wider focus on chronic care. The migration from a hospital-centric vision of health care to a community health center-centric vision requires an adaptation to the change in epidemiologic profile due to the aging of the population. Well-organized networks of small community centers have proven to be effective in delivering preventative and maternal and childcare. Investments in systems including infrastructure and human resources were traditionally planned to deliver family care. However, the focus on preventative care is expanding to cover early detection and follow-up of chronic diseases. This transformation could be strategic in South American countries in which the fiscal situation is tighter than in developed countries. In

Argentina and Brazil, the pressure to lower the health care costs is high, especially because the cost of care has a tendency to increase in the long run due to the increase in costs of new treatments for people that live longer. However, the focus is not only on medical care but also on management of services, diagnosis, digital health, and digitalization of medical records. In both countries, Argentina and Brazil, overlapping intergovernmental relationships are involved in the policies that determines the level of health of populations. However, in Brazil, the declaration of the constitutional right to universal and equal care and, the creation of a unified health system, created a bedrock for health policies, acting as a catalytic for expansion and sustainability of policy across time. This catalytic effect of policies is similar to the catalytic effect of the Medicaid program implementation in the United States, described by Thompson (Thompson, 2012). The increasingly important participation of private actors in the publicly funded sector and, the completion of projects using a public-private partnership approach could achieve more efficiency and quality of care by optimizing available resources.

Chapter II assessed, at a second level of analysis, the intermediate outcomes of the health care systems of Argentina and Brazil, including a comparative study, which had a case-control design. Achieving universal health care is one of the targets of the SDGs adopted in 2015, which propose a comprehensive definition of universal care, including health financial protection (UN SDGs, 2015). However, it should be paired of quality standards that can only be maintained and improved with permanent evaluation of quality indicators. The consolidation of Brazil's unified health system was associated with an important expansion in the access to medical visits and a reduction in the out-of-pocket expenditure rate as a percentage current health expenditure by 30.4%.

Chapter III provided with arguments for the third level of this strategic comparative analysis of Brazil and Argentina health systems, by conducting a comparative assessment of quality indicators. The decreasing trends in aggregated mortality rates provide consistent evidence for the association of the unified health system and an improvement in quality indicators.

Even if both countries, Argentina and Brazil, have made progress in terms of coverage and quality over the past decades, the unified model of delivery of care has obtained greater improvements in clinical outcome

indicators in the population. However, an opposite-direction reasoning is also possible, allowing an open question to whether Argentina is living a stagnant period in its economy and population health indicators, while Brazil is expanding its industry and quality of live, albeit high levels of inequalities persist in both countries.

More research must be done to highlight the deficiencies of Argentina's mixed health care model as well as challenges encountered. Argentina's situation relates to the vicious cycle in which mixed health systems may get captured, called the mixed health systems syndrome by Nisthar in 2009, in which the system losses its balance and fails to effect the quality because of financing deficits (Nishtar, 2009). The permanent increase in out-of-pocket expenditure as a percentage of private expenditure on health care in Argentina is a clear sign of this syndrome (Figure 8).

PERSPECTIVES

This seminal research work provides some evidence to justify further research on the impact of health care models. The question about how to achieve better access and quality of care, by opting for a better model of health care is in the interest of several Latin American countries. The nonlinear path that Brazil has transited can bring insights to Latin America settings, in which the national health spending, the sum of public and private spending could significantly decrease only by centralizing administrative procedures under a unified health system.

Starting in the 1990, the strategy for delivering universal care to populations has been family-centered in Latin America at large. This affected the planning of the structure of the services as well as the social infrastructure (health centers). In Brazil, these actions were possible thanks to the unified system. However, new challenges arise with the aging of the population and the increase in the rates of noncommunicable disease risk factors.

The limitations of this study include the characteristics of the available macro-economic aggregated data. This study did not used cross-sectional data for sex, due to missing values in collected data frames, but adjusted by age. The logarithmic transformation of the response variable and non-binary variable, reducing heteroscedasticity based on examination of the linear model residuals, allowing accurate comparison using log-log multivariate regressions and log-level difference-in-difference regressions. Additionally, the type of available data collected by international organizations on the basis of traditional health economics, presented limitations to this work. Novel behavioral economics or value-based approaches to the delivery of care would be gradually incorporated by organizations, making it available for further research.

This research used a traditional econometric benchmarking approach, in which a non-exhaustive list of internal and external factors influenced the outcomes of a health care system. Moreover, the inclusion of covariates helped to see the whole picture. Even if the study of coverage, included macro-economic measures of health-financing, and the study of the quality included socio-economic indicators, this work could not include the myriad of factors that affect the health of populations.

Furthermore, a more in-depth discussion on the main leading noncommunicable diseases should focus on behavioral and lifestyle aspects of risk factors, namely healthy habits, which are the factors that strengthen a health system from bottom-up by making the health of their population more resilient.

Because health care is a multidimensional field, which involves every aspect of life, in order to achieve a more comprehensive performance evaluation, a good recommendation could be to conduct research beyond medical assistance indicators, by adding new dimensions to the classic list of indicators used in research in this field. For instance, in addition to patient satisfaction, some indicators of patient education would be useful to measure healthy habits that make the whole system more resilient. Moreover, in order to adapt to the changing epidemiological profile in populations, health systems are increasingly investing in education and wellbeing activities to balance physical and mental health, as well as curative and palliative care for chronic conditions.

This work presented an overview analysis of trends of coverage and quality indicators of Brazil and Argentina and did not cover recent digital innovations. Moreover, performing hospital digitalization projects, social media, or telemedicine services, which has become increasingly important, especially during COVID-19 pandemic, the first pandemic that took place in the social media era. Additionally, the cost of projects that countries' health systems faced in bringing about patient education and combating misinformation could be included in further analysis.

CONCLUSION

The results of this research suggest that underfunded Brazil's unified health system can perform as well as Argentina's mixed model, or even better in the case of some key performance indicators. The three levels of analysis provide evidence to argue in favor of the implementation of a unified model in South American countries to achieve quality in universal care. Brazil's unified system seems to perform well in times in which efforts in the public health field are transitioning from a mainly family care scope to a more comprehensive scope that includes early detection and follow-up of noncommunicable diseases.

Observations in the first level of analysis, the building blocks of a health system, suggest that a unified system could have a catalytic effect on the expansion of policy and health care services, while maintaining stable or reducing the level of health expenditure as a percentage of the GDP.

The second level of analysis, focused on the immediate results of the process, suggests that the consolidation of a unified system can bring improvements in the two main dimensions of universal coverage. Improvements in access to care were associated with the expansion of medical services for the population. Improvements in health financial risk protection were associated with a reduction of out-of-pocket expenditure as a percentage of the current health expenditure, and a reduction of the out-of-pocket expenditure as a percentage of private health expenditure.

At a third level of analysis, the results provide evidence for estimating the positive effects of the consolidation of a unified health system, by revealing an improvement in the clinical outcomes of the population, namely by a significant decrease in the rates of mortality from cancer, noncommunicable diseases, communicable diseases, and from communicable, maternal, perinatal, nutritional conditions.

This research suggest that the consolidation of Brazil's unified health system is associated with improvements in coverage and quality of care, at a faster and more consistent pace than Argentina's mixed model of health care. Thus, the implementation of a unified health system could be the strategy to consider in search for the improvement of access and quality of care in South American countries.

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APPENDIX

STATA® Output sheet

```
___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   16.1   Copyright 1985-2019 StataCorp LLC
  Statistics/Data analysis            StataCorp
                                      4905 Lakeway Drive
     MP - Parallel Edition            College Station, Texas 77845 USA
                                      800-STATA-PC        https://www.stata.com
                                      979-696-4600        stata@stata.com
                                      979-696-4601 (fax)
Stata license: 75-user 8-core network, expiring  1 Sep 2021
Serial number: 501609205717
  Licensed to: CISER
               Cornell University
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***STUDY I**

```
. *Multivariate Regression
. * Preventative care:
. regress Immunization unified exppercentofgdp govexppercenthealthexp govexppercentgdp
year, robust

Linear regression                               Number of obs     =         34
                                                F(5, 28)          =       6.51
                                                Prob > F          =     0.0004
                                                R-squared         =     0.5301
                                                Root MSE          =      .0218
------------------------------------------------------------------------------
             |               Robust
Immunization |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .0026889   .0365783     0.07   0.942    -.0722383    .0776161
exppercentofgdp |  -11.54809   7.272155    -1.59   0.124    -26.44443    3.348238
govexppercenthealt~p |  -1.715403    1.19995    -1.43   0.164     -4.17339    .7425835
govexppercentgdp |   18.75199   12.91737     1.45   0.158    -7.708053    45.21203
        year |  -.0019975   .0013036    -1.53   0.137    -.0046678    .0006728
       _cons |   6.016837   2.887288     2.08   0.046     .1024961    11.93118
------------------------------------------------------------------------------

. * Reproductive-maternal-newborn-child-adolescent care
. regress unmetfamilyplanning unified exppercentofgdp govexppercenthealthexp
govexpperc
> entgdp year, robust

Linear regression                               Number of obs     =         34
                                                F(5, 28)          =     163.55
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9697
                                                Root MSE          =     .00708
------------------------------------------------------------------------------
             |               Robust
unmetfamilyplanning |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |  -.0682972   .0123315    -5.54   0.000    -.0935571   -.0430372
exppercentofgdp |   5.219837   2.129081     2.45   0.021     .8586113    9.581062
govexppercenthealt~p |   .8414396    .426618     1.97   0.059    -.0324478    1.715327
govexppercentgdp |  -9.816165   4.084493    -2.40   0.023    -18.18287   -1.449461
        year |  -.0024242   .0004146    -5.85   0.000    -.0032734    -.001575
       _cons |   4.568472   .7479323     6.11   0.000     3.036402    6.100541
------------------------------------------------------------------------------
```

```
. regress contraceptivemodernmethods unified exppercentofgdp govexppercenthealthexp
govexppercentgdp year, robust

Linear regression                               Number of obs     =         34
                                                F(5, 28)          =     381.31
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9850
                                                Root MSE          =     .01165
------------------------------------------------------------------------------
                    |               Robust
contraceptivemoder~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------
            unified |    .181229   .0193698     9.36   0.000     .1415517    .2209063
     exppercentofgdp |  -8.065649   3.583551    -2.25   0.032    -15.40622   -.7250785
govexppercenthealt~p |   -1.18674   .7140792    -1.66   0.108    -2.649465     .275985
    govexppercentgdp |   15.20352   6.929453     2.19   0.037     1.009177    29.39786
                year |   .0043143   .0006558     6.58   0.000     .0029709    .0056576
               _cons |  -7.448227   1.218929    -6.11   0.000     -9.94509   -4.951363
------------------------------------------------------------------------------

.
. regress deliverybyskilledattendants unified exppercentofgdp govexppercenthealthexp
govexppercentgdp year, robust

Linear regression                               Number of obs     =         31
                                                F(5, 25)          =      20.57
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8066
                                                Root MSE          =     .00462
------------------------------------------------------------------------------
                    |               Robust
deliverybyskilleda~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------
            unified |  -.0159407   .0073956    -2.16   0.041    -.0311724   -.0007091
     exppercentofgdp |   -.525572   1.096755    -0.48   0.636    -2.784382    1.733238
govexppercenthealt~p |  -.0361679   .2378185    -0.15   0.880    -.5259642    .4536285
    govexppercentgdp |   .1677983   2.186683     0.08   0.939    -4.335761    4.671357
                year |   .0018671   .0002054     9.09   0.000     .0014441    .0022902
               _cons |  -2.699604   .4094602    -6.59   0.000    -3.542903   -1.856305
------------------------------------------------------------------------------



. Access:
. regress visitsrate unified exppercentofgdp govexppercenthealthexp govexppercentgdp
year, robust

Linear regression                               Number of obs     =         32
                                                F(5, 26)          =     474.33
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9794
                                                Root MSE          =     1.1788
------------------------------------------------------------------------------
                    |               Robust
          visitsrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------
            unified |   11.36861   2.931871     3.88   0.001      5.34206    17.39516
     exppercentofgdp |   108.8664   458.5404     0.24   0.814    -833.6769     1051.41
govexppercenthealt~p |   26.36369    105.184     0.25   0.804    -189.8452    242.5726
    govexppercentgdp |  -488.5347   953.9327    -0.51   0.613    -2449.371    1472.302
                year |   .7007496   .0515482    13.59   0.000     .5947909    .8067083
               _cons |  -1406.473   113.3156   -12.41   0.000    -1639.396   -1173.549
------------------------------------------------------------------------------
```

```
. regress admissionsrate unified exppercentofgdp govexppercenthealthexp
govexppercentgdp year, robust

Linear regression                               Number of obs     =         30
                                                F(5, 24)          =      61.56
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8763
                                                Root MSE          =     .00202
------------------------------------------------------------------------------
             |               Robust
admissionsrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
      unified |   .0054567   .0038372     1.42   0.168    -.0024629    .0133762
 exppercentofgdp |  -.3295623    .682156    -0.48   0.633    -1.737463    1.078338
govexppercenthealt~p |  -.0814368   .1450417    -0.56   0.580    -.3807882    .2179146
govexppercentgdp |   .8776504   1.392868     0.63   0.535    -1.997088    3.752389
        year |  -.0008189   .0001086    -7.54   0.000    -.0010431   -.0005948
       _cons |   1.729677   .1825972     9.47   0.000     1.352815    2.106539
------------------------------------------------------------------------------

. * Financial risk coverage:
. regress ooppercentofche unified exppercentofgdp govexppercenthealthexp
govexppercentgdp year, robust

Linear regression                               Number of obs     =         34
                                                F(5, 28)          =      17.86
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7064
                                                Root MSE          =     .02029
------------------------------------------------------------------------------
             |               Robust
ooppercentofche |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
      unified |   .0021562   .0540588     0.04   0.968    -.1085781    .1128906
 exppercentofgdp |  -4.163734   7.393706    -0.56   0.578    -19.30905    10.98159
govexppercenthealt~p |  -1.039271   1.658329    -0.63   0.536    -4.436205    2.357663
govexppercentgdp |   9.119152   14.88404     0.61   0.545    -21.36941    39.60772
        year |   -.004189   .0009961    -4.21   0.000    -.0062293   -.0021486
       _cons |   9.198878   1.901013     4.84   0.000     5.304828    13.09293
------------------------------------------------------------------------------

. regress ooppercentofprivexp unified exppercentofgdp govexppercenthealthexp
govexppercentgdp year, robust

Linear regression                               Number of obs     =         26
                                                F(5, 20)          =      11.61
                                                Prob > F          =     0.0000
                                                R-squared         =     0.6696
                                                Root MSE          =     .01744
------------------------------------------------------------------------------
             |               Robust
 ooppercentofprivexp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+--------------------------------------------------------------
      unified |  -.0454066   .0311097    -1.46   0.160    -.1103002    .0194871
 exppercentofgdp |  -23.46737    8.41957    -2.79   0.011    -41.03029   -5.904453
govexppercenthealt~p |  -3.876606   1.302368    -2.98   0.007    -6.593298   -1.159913
govexppercentgdp |   44.07039   15.50708     2.84   0.010      11.7232    76.41759
        year |  -.0063661    .001328    -4.79   0.000    -.0091363   -.0035958
       _cons |   15.45553   3.010562     5.13   0.000     9.175604    21.73545
------------------------------------------------------------------------------
```

```
. *Log-log Multivariate regression
. * Preventative care:
. regress Immunization unified logexppercentofgdp loggovexppercenthealthexp
loggovexppercentgdp year, robust
note: logexppercentofgdp omitted because of collinearity

Linear regression                               Number of obs     =         34
                                                F(4, 29)          =       7.47
                                                Prob > F          =     0.0003
                                                R-squared         =     0.4920
                                                Root MSE          =     .02227
------------------------------------------------------------------------------
                   |               Robust
        Immunization |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   .0543561   .0508053     1.07   0.293    -.0495523    .1582646
  logexppercentofgdp |          0  (omitted)
loggovexppercenthe~p |   .3019646   .2824207     1.07   0.294    -.2756506    .8795798
 loggovexppercentgdp |  -.1651758   .0936538    -1.76   0.088    -.3567193    .0263676
                year |  -.0026298   .0017338    -1.52   0.140    -.0061758    .0009163
               _cons |   5.911604   3.419505     1.73   0.094    -1.082069    12.90528
------------------------------------------------------------------------------

. * Reproductive-maternal-newborn-child-adolescent care
. regress logunmetfamilyplanning unified logexppercentofgdp loggovexppercenthealthexp
loggovexppercentgdp year, robust
note: logexppercentofgdp omitted because of collinearity

Linear regression                               Number of obs     =         34
                                                F(4, 29)          =     440.12
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9851
                                                Root MSE          =     .04401
------------------------------------------------------------------------------
                   |               Robust
logunmetfamilyplan~g |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |  -.8049544   .0720468   -11.17   0.000    -.9523065   -.6576022
  logexppercentofgdp |          0  (omitted)
loggovexppercenthe~p |   -.942312   .3729337    -2.53   0.017    -1.705047   -.1795769
 loggovexppercentgdp |     .25757   .1356042     1.90   0.067    -.0197717    .5349116
                year |  -.0203113   .0024274    -8.37   0.000    -.0252759   -.0153467
               _cons |   39.08798   4.873264     8.02   0.000     29.12103    49.05492
------------------------------------------------------------------------------

. regress logcontraceptivemodernmethods unified logexppercentofgdp
loggovexppercenthealthexp loggovexppercentgdp year, robust
note: logexppercentofgdp omitted because of collinearity

Linear regression                               Number of obs     =         34
                                                F(4, 29)          =     257.75
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9709
                                                Root MSE          =     .02414
------------------------------------------------------------------------------
                   |               Robust
logcontraceptivemo~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   .3367234   .0373634     9.01   0.000     .2603066    .4131401
  logexppercentofgdp |          0  (omitted)
loggovexppercenthe~p |    .328502   .1963487     1.67   0.105    -.0730763    .7300803
 loggovexppercentgdp |   .0014222   .0745371     0.02   0.985    -.1510232    .1538676
                year |   .0059701   .0015124     3.95   0.000     .0028768    .0090634
               _cons |  -12.31929   3.076259    -4.00   0.000    -18.61095   -6.027636
------------------------------------------------------------------------------
```

```
. regress logdeliverybyskilledattendants unified logexppercentofgdp
loggovexppercenthealthexp loggovexppercentgdp year, robust
note: logexppercentofgdp omitted because of collinearity

Linear regression                               Number of obs     =         31
                                                F(4, 26)          =      22.25
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8053
                                                Root MSE          =     .00463
------------------------------------------------------------------------------
                    |               Robust
logdeliverybyskill~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------
            unified |  -.0152137   .0046309    -3.29   0.003    -.0247326   -.0056948
  logexppercentofgdp |          0  (omitted)
loggovexppercenthe~p |   .0313899   .0243915     1.29   0.209    -.0187476    .0815274
 loggovexppercentgdp |  -.0395548   .0124521    -3.18   0.004    -.0651504   -.0139592
                year |   .0018771   .0002172     8.64   0.000     .0014307    .0023235
               _cons |  -3.879138   .4540761    -8.54   0.000    -4.812504   -2.945771
------------------------------------------------------------------------------


. *Access:
. regress logvisitsrate unified logexppercentofgdp loggovexppercenthealthexp
loggovexppercentgdp year, robust

note: loggovexppercenthealthexp omitted because of collinearity

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =    2093.30
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9966
                                                Root MSE          =      .0792
------------------------------------------------------------------------------
                    |               Robust
       logvisitsrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------
            unified |   2.305225    .087896    26.23   0.000     2.124877    2.485572
  logexppercentofgdp |  -.0820279   .5070959    -0.16   0.873    -1.122503     .958447
loggovexppercenthe~p |          0  (omitted)
 loggovexppercentgdp |  -.6703836   .3185744    -2.10   0.045    -1.324044   -.0167229
                year |   .0533594     .00385    13.86   0.000     .0454598     .061259
               _cons |  -109.2207   7.824408   -13.96   0.000    -125.2751   -93.16634
------------------------------------------------------------------------------

. regress logadmissionsrate unified logexppercentofgdp loggovexppercenthealthexp
loggovexppercentgdp year, robust
note: loggovexppercenthealthexp omitted because of collinearity

Linear regression                               Number of obs     =         30
                                                F(4, 25)          =      79.14
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8641
                                                Root MSE          =     .03609
------------------------------------------------------------------------------
                    |               Robust
   logadmissionsrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------
            unified |   .1299738   .0494818     2.63   0.015     .0280641    .2318836
  logexppercentofgdp |   .0590819   .2144428     0.28   0.785    -.3825713    .5007351
loggovexppercenthe~p |          0  (omitted)
 loggovexppercentgdp |   .0837531   .1703991     0.49   0.627    -.2671903    .4346966
                year |  -.0141222   .0014678    -9.62   0.000    -.0171452   -.0110991
               _cons |   25.83183   3.017484     8.56   0.000      19.6172    32.04645
------------------------------------------------------------------------------
```

```
. * Financial risk coverage:
. regress logooppercentofche unified logexppercentofgdp loggovexppercenthealthexp
loggovexppercentgdp year, robust

note: logexppercentofgdp omitted because of collinearity

Linear regression                               Number of obs     =         34
                                                F(4, 29)          =      15.90
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7065
                                                Root MSE          =     .06381
------------------------------------------------------------------------------
                     |               Robust
  logooppercentofche |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   .0280376   .1016377     0.28   0.785    -.1798348    .2359099
  logexppercentofgdp |          0  (omitted)
loggovexppercenthe~p |  -.4547991   .4903091    -0.93   0.361    -1.457594    .5479956
 loggovexppercentgdp |   .1380422   .1883079     0.73   0.469    -.2470907    .5231751
                year |  -.0128757   .0034313    -3.75   0.001    -.0198935   -.0058578
               _cons |   24.76523   7.010206     3.53   0.001     10.42775    39.10271
------------------------------------------------------------------------------

. regress logooppercentofprivexp unified logexppercentofgdp loggovexppercenthealthexp
loggovexppercentgdp year, robust
note: logexppercentofgdp omitted because of collinearity

Linear regression                               Number of obs     =         26
                                                F(4, 21)          =      10.20
                                                Prob > F          =     0.0001
                                                R-squared         =     0.5598
                                                Root MSE          =     .03236
------------------------------------------------------------------------------
                     |               Robust
logooppercentofpri~p |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   -.055701   .0624766    -0.89   0.383    -.1856282    .0742262
  logexppercentofgdp |          0  (omitted)
loggovexppercenthe~p |   -.131315   .2840405    -0.46   0.649    -.7220095    .4593795
 loggovexppercentgdp |   .0710776   .0843927     0.84   0.409    -.1044267    .2465819
                year |  -.0066491   .0019853    -3.35   0.003    -.0107778   -.0025204
               _cons |   13.01372   3.978745     3.27   0.004     4.739471    21.28798
------------------------------------------------------------------------------


. *Difference-in-difference log-level regressions for 2000-2016 period:
. *Preventative care:
. regress logImmunization unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logImmuniz~n |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .0515578          .        .       .            .           .
    year2016 |  -.0455243          .        .       .            .           .
 unified2016 |  -.0772965          .        .       .            .           .
       _cons |  -.0565704          .        .       .            .           .
------------------------------------------------------------------------------
```

```
. * Reproductive-maternal-newborn-child-adolescent care
. regress logunmetfamilyplanning unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logunmetfa~g |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |  -.6505877          .        .       .            .           .
    year2016 |  -.4700037          .        .       .            .           .
 unified2016 |   .1683356          .        .       .            .           .
       _cons |  -1.692819          .        .       .            .           .
------------------------------------------------------------------------------

. regress logcontraceptivemodernmethods unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logcontrac~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |    .318108          .        .       .            .           .
    year2016 |   .2178062          .        .       .            .           .
 unified2016 |   -.153527          .        .       .            .           .
       _cons |  -.6424541          .        .       .            .           .
------------------------------------------------------------------------------

. regress logdeliverybyskilledattendants unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logdeliver~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |  -.0123332          .        .       .            .           .
    year2016 |   .0182191          .        .       .            .           .
 unified2016 |   .0052874          .        .       .            .           .
       _cons |  -.0212236          .        .       .            .           .
------------------------------------------------------------------------------
```

```
. *Access:
. regress logadmissionsrate unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logadmissi~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .0758374          .        .       .            .           .
    year2016 |  -.2629807          .        .       .            .           .
 unified2016 |   .0427737          .        .       .            .           .
       _cons |  -2.759755          .        .       .            .           .
------------------------------------------------------------------------------

. * Financial risk coverage:
. regress logooppercentofche unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logoopperc~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .2289487          .        .       .            .           .
    year2016 |   .0158265          .        .       .            .           .
 unified2016 |  -.3048666          .        .       .            .           .
       _cons |  -1.234283          .        .       .            .           .
------------------------------------------------------------------------------


***Difference-in-difference 2000-2012 for OOP as exp of private exp:
*note: data not available for 2016

. regress logooppercentofprivexp unified year2012 unified2012, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logoopperc~p |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .0094787          .        .       .            .           .
    year2012 |   .0358573          .        .       .            .           .
 unified2012 |   -.131482          .        .       .            .           .
       _cons |  -.4620354          .        .       .            .           .
------------------------------------------------------------------------------
```

***STUDY II**

```
. * Multivariate Regressions

. regress mortcommmatperinatalrate unified  improvedsanitationurbanrate
improvedwaterurbanrate year, robust

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =     356.98
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9691
                                                Root MSE          =     2.4e-05
------------------------------------------------------------------------------
                     |               Robust
mortcommmatperinat~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------
             unified |  -1.58e-06   .0000593    -0.03   0.979    -.0001232      .00012
improvedsanit~anrate |   -.000172   .0003724    -0.46   0.648     -.000936     .000592
improvedwaterurban~e |  -.0069094   .0010382    -6.66   0.000    -.0090396   -.0047793
                year |  -1.65e-06   1.23e-06    -1.34   0.190    -4.18e-06    8.73e-07
               _cons |   .0110232    .002201     5.01   0.000     .0065072    .0155392
------------------------------------------------------------------------------

. regress commdiseasesmortageadjrate unified  improvedsanitationurbanrate
improvedwate
> rurbanrate year, robust

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =     453.78
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9756
                                                Root MSE          =     2.3e-05
------------------------------------------------------------------------------
                     |               Robust
commdiseasesmortag~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------
             unified |   .0000524   .0000574     0.91   0.370    -.0000654    .0001701
improvedsanit~anrate |  -.0002498   .0003618    -0.69   0.496    -.0009921    .0004926
improvedwaterurban~e |  -.0066349   .0009991    -6.64   0.000    -.0086849    -.004585
                year |  -1.34e-06   1.18e-06    -1.13   0.268    -3.76e-06    1.09e-06
               _cons |   .0101365    .002109     4.81   0.000     .0058093    .0144638
------------------------------------------------------------------------------


. regress noncommdismortageadjrate unified  improvedsanitationurbanrate
improvedwaterurbanrate year, robust

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =     626.57
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9826
                                                Root MSE          =     8.8e-05
------------------------------------------------------------------------------
                     |               Robust
noncommdismortagea~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------
             unified |   .0004777   .0002059     2.32   0.028     .0000553    .0009001
improvedsanit~anrate |  -.0017949   .0012771    -1.41   0.171    -.0044153    .0008254
improvedwaterurban~e |  -.0139936   .0037486    -3.73   0.001    -.0216852   -.0063021
                year |  -.0000726   4.08e-06   -17.80   0.000    -.0000809   -.0000642
               _cons |   .1647806   .0073481    22.43   0.000     .1497036    .1798576
------------------------------------------------------------------------------
```

```
. regress mortcancerrate unified  improvedsanitationurbanrate  improvedwaterurbanrate
year, robust

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =    1356.70
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9918
                                                Root MSE          =     9.3e-06
------------------------------------------------------------------------------
                     |               Robust
      mortcancerrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   -.000166   .0000185    -8.95   0.000     -.000204   -.0001279
improvedsanit~anrate |   .0002218   .0001232     1.80   0.083     -.000031    .0004745
improvedwaterurban~e |  -.0009918   .0003185    -3.11   0.004    -.0016454   -.0003382
                year |  -.0000145   5.84e-07   -24.84   0.000    -.0000157   -.0000133
               _cons |   .0313871   .0010972    28.61   0.000     .0291359    .0336384
------------------------------------------------------------------------------


. *Log-log multivariate regression
. regress logmortcommmatperinatalrate unified  logimprovedsanitationurbanrate
logimprovedwaterurbanrate year, robust

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =     455.15
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9647
                                                Root MSE          =     .02501
------------------------------------------------------------------------------
                     |               Robust
logmortcommmatperi~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   .0782184   .0606741     1.29   0.208    -.0462746    .2027113
logimprovedsanitat~e |  -.1822869   .1257039    -1.45   0.159    -.4402101    .0756362
logimprovedwaterur~e |  -5.181055   .9522643    -5.44   0.000     -7.13494   -3.227171
                year |  -.0026725   .0014018    -1.91   0.067    -.0055487    .0002038
               _cons |  -2.027502   2.824068    -0.72   0.479    -7.822011    3.767007
------------------------------------------------------------------------------

. regress logcommdiseasesmortageadjrate unified  logimprovedsanitationurbanrate
logimprovedwaterurbanrate year, robust

Linear regression                               Number of obs     =         32
                                                F(4, 27)          =     547.56
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9714
                                                Root MSE          =     .02465
------------------------------------------------------------------------------
                     |               Robust
logcommdiseasesmor~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------------
             unified |   .1309781   .0582065     2.25   0.033     .0115482     .250408
logimprovedsanitat~e |  -.1931209     .12188    -1.58   0.125    -.4431979    .0569561
logimprovedwaterur~e |  -4.788943   .9079102    -5.27   0.000    -6.651821   -2.926065
                year |  -.0022623   .0013471    -1.68   0.105    -.0050262    .0005016
               _cons |  -2.856718   2.715025    -1.05   0.302     -8.42749    2.714054
------------------------------------------------------------------------------
```

```
. regress lognoncommdismortageadjrate unified  logimprovedsanitationurbanrate
logimprovedwaterurbanrate year, robust
Linear regression                               Number of obs     =         32
                                                F(4, 27)          =     889.40
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9836
                                                Root MSE          =     .01588
------------------------------------------------------------------------------
                     |               Robust
lognoncommdismorta~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------
             unified |   .1572438   .0368561     4.27   0.000     .0816214    .2328663
logimprovedsanitat~e |  -.2062489   .0749195    -2.75   0.010     -.359971   -.0525269
logimprovedwaterur~e |  -1.042715   .5961976    -1.75   0.092    -2.266012    .1805813
                year |   -.015413   .0007197   -21.42   0.000    -.0168897   -.0139364
               _cons |    25.3182   1.445507    17.52   0.000     22.35227    28.28414
------------------------------------------------------------------------------

. regress logmortcancerrate unified  logimprovedsanitationurbanrate
logimprovedwaterurbanrate year, robust
Linear regression                               Number of obs     =         32
                                                F(4, 27)          =    1426.65
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9916
                                                Root MSE          =     .00746
------------------------------------------------------------------------------
                     |               Robust
   logmortcancerrate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------------+--------------------------------------------------------
             unified |  -.1099369   .0171435    -6.41   0.000    -.1451126   -.0747613
logimprovedsanitat~e |  -.0088017   .0374135    -0.24   0.816    -.0855678    .0679644
logimprovedwaterur~e |  -.5499647   .2639604    -2.08   0.047    -1.091567   -.0083628
                year |  -.0111761   .0004738   -23.59   0.000    -.0121482    -.010204
               _cons |   15.78979   .9660324    16.34   0.000     13.80766    17.77193
------------------------------------------------------------------------------
```

***Dif-in-dif: Quality study 2000-2016**

```
. *Preparation
. keep if year == 2000 | year == 2016
(0 observations deleted)
. * The dummy variable is unified
. * The interaction variable is year2016*unified:
. gen year2016= 0
. replace year2016= 1 if(year== 2016)
(2 real changes made)
. gen unified2016= 0
. replace unified2016= 1 if(year== 2016 & unified== 1)
(1 real change made)

. regress logmortcommmatperinatalrate unified year2016 unified2016, robust
Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logmortcom~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .4140897          .        .       .            .           .
    year2016 |   .0165634          .        .       .            .           .
 unified2016 |  -.3875537          .        .       .            .           .
       _cons |  -7.084243          .        .       .            .           .
------------------------------------------------------------------------------
```

```
. regress logcommdiseasesmortageadjrate unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0

------------------------------------------------------------------------------
             |               Robust
logcommdis~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .4220977          .        .       .            .           .
    year2016 |   .1168265          .        .       .            .           .
 unified2016 |  -.4933801          .        .       .            .           .
       _cons |  -7.065647          .        .       .            .           .
------------------------------------------------------------------------------


. regress lognoncommdismortageadjrate unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
lognoncomm~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |   .2056017          .        .       .            .           .
    year2016 |  -.1892443          .        .       .            .           .
 unified2016 |  -.2208948          .        .       .            .           .
       _cons |  -5.207342          .        .       .            .           .
------------------------------------------------------------------------------


. regress logmortcancerrate unified year2016 unified2016, robust

Linear regression                               Number of obs     =          4
                                                F(0, 0)           =          .
                                                Prob > F          =          .
                                                R-squared         =     1.0000
                                                Root MSE          =          0
------------------------------------------------------------------------------
             |               Robust
logmortcan~e |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     unified |  -.0764503          .        .       .            .           .
    year2016 |  -.1866312          .        .       .            .           .
 unified2016 |  -.0220265          .        .       .            .           .
       _cons |  -6.541072          .        .       .            .           .
------------------------------------------------------------------------------
```