The Effect of Public Health Expenditure on Infant Mortality: Evidence from the SAARC Countries

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CERTIFICATE

This is to certify that this thesis entitled: "**The Effect of Public Health Expenditure on Infant Mortality: Evidence from the SAARC countries**" submitted by Syed Zain Ul Abideen is accepted in its present form by the Department of Health Economics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree of M. Phil in Health Economics.

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The following areas have been critically monitored.

1. Conformance to APA format.
2. Precision & Correctness of the language.
3. Literature Review is relevant and comprehensive.
4. Relevance of references with the text.
5. Methodology and Estimation techniques are appropriate.

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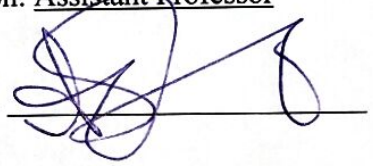
Signature: 

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Candidate of M. Phil Health Economics at the Pakistan Institute of Development Economics do hereby declare that the thesis: **"The Effect of Public Health Expenditure on Infant Mortality: Evidence from the SAARC countries"** Submitted by me in partial fulfillment of M. Phil Degree, is my original work, and has not been submitted or published earlier. I also solemnly declare that it shall not, in future, be submitted by me for obtaining any other degree from this or any other university or institution.

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Syed Zain Ulabideen

Abstract

The challenges faced by policy makers are to allocate limited resources across the range of preferences that contribute to poverty reduction and human development; including capital expenditures on health, education, infrastructure and recurrent expenditures. With the scarce resources, it is very important to allocate the resources in more efficient way. However, there are doubts about efficiency of public health expenditures in several countries. To clarify such doubts, this study is based on the investigation of the relationship between public healthcare expenditure with infant mortality rate of SAARC countries. Panel data of SAARC countries is used in this research study from the year 2002 to 2014 with focus on Pakistan. Existing literature reveals the significant relation between public health expenditure with infant mortality, but there is a debate on the impact of public health expenditure on infant mortality, some countries have more public health expenditure but the health outcomes are low as compared to those countries where the public health expenditure are low but having improved health outcomes. The difference of opinion in literature about public health expenditure impact on infant mortality rate could be because of poor methodology, in panel data, there are more chances of aggregation bias and OLS type regression cannot remove the aggregation bias. Empirical Bayesian methodology is used in this study to overcome aggregation bias. In Empirical Bayesian the estimates of the model parameter are calculated by taking an average of individual country which helps in capturing the country heterogeneities and the prior which highlights the commonalities of the specific geographical region. The results of study reveal a negative impact of health expenditure on infant mortality in SAARC countries. Increase in 1 unit of public health expenditure is associated with the reduction of 0.08 unit infant mortality rate in SAARC countries.

Contents

Chapter 1

Introduction

Public health expenditures refer to the government expenditures on health inspections, health promotion, public health nursing, vaccination, occupational health, food, drug safety initiatives and on programs preventing the spread of communicable diseases and non-communicable diseases. It aims to improve health indicators like life expectancy, child mortality and infant mortality etc. There are number of studies which show that public health expenditure actually improves health outcomes like Gupta, *et al*. (1999), and Homaie, *et al*. (2013). However, many other studies are skeptical about efficiency of public health expenditure in term of improving health outcomes. For example United States spends 13.8% on health making it top spender on health, but it has 37th place in the health outcomes. On contrary France spends 9.8% on health but has the highest rank in health outcomes among 191 countries (WHO, 2001). Therefore not only the government spending matters but its execution and monitoring also has a role, it is essential for the government to use the resources effectively and efficiently to achieve desired targets.

SAARC countries including Pakistan are among the Middle income countries with lower ranks in many indicators. Therefore, it is more important for these countries to use the public money more efficiently. Therefore this study tries to analyze the efficiency of public health expenditure on infant mortality in the SAARC countries with focus on Pakistan. Infant mortality is chosen to represent the health outcomes.

Infant mortality is the term used to describe any deaths arising in children who are born alive but who die before their first birthday. Infant mortality is a sensitive

measure of the overall health of a population. It reflects the apparent association between the causes of infant mortality and other factors that are likely to influence the health status of whole populations, such as their economic development, general living conditions, social well-being, rates of illness and the quality of the environment.

As it is stated earlier, there is difference in opinion about effect of public health expenditure on health outcomes some studies show effective impact of public health expenditure on health outcomes like Gani, (2009) Farag, (2010) and Paxson and Scady, (2005) etc. while some studies argues that health expenditure may be ineffective in improving health outcomes due to poor government policies (Berger and Messer, 2002, Mckec, 2004, Bokahri *et al*, 2007, Filmer and Pritchett, 1997) etc. The difference of opinion in literature about public health expenditure impact on infant mortality might be because of the poor methodology, because in panel data there are more chances of aggregation bias, and OLS type of regression is not appropriate for removing aggregation bias. To overcome aggregation bias the Empirical Bayesian methodology is well suited for estimation, because in Empirical Bayesian the estimates of the model parameter are calculated by taking an average of individual country which helps in capturing the country heterogeneities and the prior which highlight the commonalities of the specific geographical region.

This research will investigate the impact of public health expenditure on the infant mortality in SAARC countries using panel data; the result of each SAARC country will be compared with Pakistan for observing affectivity and efficiency of health system policies in Pakistan. The public health expenditure is relatively low in Pakistan so it is necessary that the money must be spent effectively and efficiently to

achieve better health outcomes thus this research seek to measure the impact of infant mortality.

1.1 Problem Statement

The efficient provision of health care services is responsibility of modern welfare state. Beside the production of these services covering the growing needs of the modern society – mainly in a comprehensive and free, without exceptions for the whole population, manner – can be driven publicly or privately, usually parallel or in various forms of complementarity. Increasing public health expenditure is one of the option pursuing better health outcomes. But consequently, resources allocated to the health sector are partly wasted, leading to low quality health service delivery and poor health outcomes. So far no study exist on impact of health expenditure of SAARC countries, but looking at the debate that exist in different studies related to the impact of public health expenditure on health outcomes, it is very important to expose what happens in our environment. Further in existing studies the used methodology is poor, the OLS type regressions and related methodology for panel data resulted more chances of aggregation bias.

1.2 Research Questions

To what extent can the improvement in infant mortality in SAARC countries from 2002 to 2014 be attributed with change in public health expenditures?

Is Pakistan using public health expenditure effectively compared rest of the SAARC countries?

1.3 Objectives

The main objective of the thesis is to analyze efficiency of public health expenditures in achieving the health outcomes. This can be split down into following sub-objectives

- To analyze the impact of public health expenditure on infant mortality in SAARC countries.
- To compare efficiency of public health expenditure of Pakistan with SAARC countries.

1.4 Significance of the Study

All countries around the globe have agreed to work for achievement of Sustainable Development Goals (SDGS) by 2030. The goal 3 of SDGs refers to "ensure healthy lives and promote wellbeing for all at all ages". Being signatory to SDGs, Pakistan also have to improve the given health indicators specially to reduce infant mortality rate. As public health expenditure is one of the key elements for achieving those goals. This study will help in finding that either public health expenditure in Pakistan is used efficiently or not, the advantage of the study is that Pakistan health expenditure impact on infant mortality rate will be compared with the rest of SAARC countries which will helping in understanding the effectiveness of health policies in Pakistan, which may be useful for policy makers to develops effective policies with in limited budget.

Outline of Thesis

This thesis is arranged as followed. Chapter 1 present introduction, problem statement, research questions, research objective, significance of research Chapter 2 represent background of SAARC countries in which the situation of infant mortality and Health expenditures are discussed. Chapter 3 reviews the literature of previous research work including data and methodologies which are previously used. Chapter 4 discussed the variables and the technique that how the data is used for the estimations and will discuss the model which is used in the estimation. Chapter 5 will present the estimation results, interpretation of tables, comparison of the SAARC nations that how public health expenditure effect infant mortality rate. Chapter 6 which is the final chapter is Conclusion, after viewing the results which is discussed in chapter 6 some suggestion will be added which might be helpful for policy makers for future policies.

Chapter 2

Background

The population of the SAARC countries is 1891 million, which is roughly 25% of the world population (Worldometers, 2018). SAARC annual population growth rate was (1.20%) in 2018, higher than average population growth rate of East Asian countries (0.35%) and Europe (0.08%) and lesser then sub-Saharan Africa (2.69%) and Africa (2.52%) (Worldometer, 2018). About 34.7% populations living in urban areas while 65.3 population of South Asia lives in rural areas in 2018 (Worldometers, 2018). India is most populous country having 1.352 billion population followed by Pakistan with 200.8 million and Bangladesh with 166.3 million population as in 2018 (Worldometers, 2018). South Asia is considered as the under- developed region by several aspects. For instance, Human Development Index (HDI) average for SAARC countries was recorded to be 0.638 in 2018 where the world average is 0.728 (HDI, 2018). Per capita GNI of SAARC countries is $5,605 (constant 2011 PPP $ in 2014) which was far below than the average of the world average $14,301. Similarly the rate of adult literacy in South Asia was 71.3% in 2016 as compared with 80% world-wide average (UNESCO, 2017).

The MDGs reported some improvement in health indicators of SAARC countries, such as rates of malnutrition, life expectancy, infant mortality rate and incidence of some infectious diseases like tuberculosis, and human immunodeficiency virus (HIV) (UNDP, 2015), but yet the SAARC region is struggling with a series of issues related to population health, inadequate access to healthcare services, poor sanitation, high prevalence of malaria, mental health issues and also a series of chronic diseases (e.g. diabetes, cardiovascular disease etc. (MDGs, 2015). There are differences in SAARC

nations regarding characteristic like population structure, population density, fertility rates and mortality rate, stage of demographic transition, urbanization and literacy levels.

2.1. Health Expenditure

There is a steady increase in rate of total health expenditure in SAARC countries over past 20 years. Table 1 highlights the trend of health care expenditures (as a % of GDP?) for SAARC countries against OECD group and World total health expenditure for the period 1995 - 2014. One can see there is a continuously increasing trend in total health expenditure of SAARC countries over the years for the SAARC as well as for OECD and the global average, yet total health expenditure of SAARC region are far below from OECD group and world. The share of total health expenditure of SAARC countries was 4.37 of GDP in 2014 while the share of OECD countries was 12.36% of GDP in 2014 (WDI, 2017). The world share of total health expenditure was 9.97% of GDP. Between 2005 and 2014, the growth rate of total health expenditure in OECD countries was 12.5%, but this growth rate is only 7% in South Asia.

Table 1**:** Trend of Health Expenditure in SAARC Countries as % of GDP?

Region	Total health expenditure as % of GDP			Public health expenditure % of THE		
	1995	2005	2014	1995	2005	2014
South	3.76	4.07	4.37	4.43	4.80	5.25
OECD	9.23	10.99	12.36	13.41	16.23	17.76
World	8.52	9.80	9.97	15.11	15.39	15.61

Source: World Development Indicators, World Bank, (2016). THE refers to total health expenditure

SAARC countries condition of public health expenditure (% of total health expenditure) is also very poor. Growth in public health expenditure of SAARC countries is not convincing, as it is observed in Table 1, that SAARC countries public health expenditures are far below from OECD group and world average public health expenditure. Table 1 highlights the trend of increase in public health expenditure of SAARC countries from 4.43% in 1995 to 5.25% in 2014. In contrast share of public health expenditure of OECD group was 17.76% of total health expenditure while the share of world public health expenditure was 15.61% of total health expenditure.

The World Bank, (2015) report explains the public health expenditure as a share of GDP and per capita expenditure in South Asian countries for the year 2013. Table 2 shows that Maldives have highest public health expenditure in SAARC countries. For Maldives, the public health expenditure as % of the GDP was recorded to be 6.22% in 2013 and higher per capita expenditure is $720.46. Bhutan has the second highest share of public health expenditure which records as 3.59% public health expenditure of total GDP in 2013 and 89.75$ per person on health care. The share of public health expenditure of Nepal and Pakistan records as 2.58% and 2.60% of total GDP, while the share of per person health expenditure in was 39.03$ while Pakistan per person health expenditure was 39.01$ in 2013. The share of public health expenditure in Afghanistan record as 1.72% of total GDP and per person health spending was 54.96$. Sri Lanka share of public health expenditure was 1.43% and had second highest per person health expenditure 102.50$. Bangladesh share of public health expenditure was 1.31% of the total GDP, while share the lowest per person spending in SAARC countries which was 31.63$ per person spending. India share the lowest present of public health expenditure 1.28% of total GDP and per person health spending was 61.47$.

Table 2: Trend of Health Expenditure and Per Person Health Expenditure in SAARC countries for the year of 2013

Countries	Public health expenditure % of GDP	Per person health expenditure ($)
Afghanistan	1.72	54.96
Bangladesh	1.31	31.63
Bhutan	3.59	89.75
India	1.28	61.47
Maldives	6.22	720.46
Nepal	2.58	39.03
Pakistan	2.60	39.01
Sri Lanka	1.43	102.50

Source: World Development Indicators, World Bank, (2016).

On the other hand the correlation between GDP per capita and government health expenditure (percentage of total health expenditure) is low, which ranges from 21.2 percent in Afghanistan to 57.6 percent in Bhutan. Bhutan has high level of government health expenditure as a percentage of total health expenditure, in Pakistan the share of government health expenditure in total expenditure records as 24% (NHA, 2014).

2.2. Infant Mortality

All South Asian countries are signatory to the Sustainable Development goals (SDGs), the SDGs goal 3 refers to health and well-being. SAARC countries have to reduce infant mortality rate to 12 deaths per 1000 per live birth. But some South Asian countries are currently off-track to achieve SDGs. If the current rate of reduction in infant mortality continues South Asia will be able to reduce newborn deaths to 20 per 1000 live births by 2030 (Debapriya Bhattacharya, 2015).

There are some improvements recorded in infant mortality rate in SAARC region. The infant mortality rate decreased from 80.10 to 43.30 infant deaths per 1000 live births from the year 1995 to 2014. While form the period of 1960 to 2014 the infant mortality death rate decreased by approximately 74% which is just under just under three-quarters (WDI, 2016). The successful programs for immunization, control of diarrheal diseases and vitamin A supplementation are considered to be the most significant contributors to the decline in child and infant deaths (UNICEF, 2015).But still it is a long way to achieve the target specified in SDGs.

Table 3 shows that over the period of 1946-2000, Sri Lanka has been one of the most successful developing countries in SAARC in terms of infant & child mortality reduction. At its current level of 8.3 infant deaths per 1,000 live births Maldives reduced infant mortality from 68 in 1990 to 8 in 2015. Afghanistan, with highest IMR in 1990 has made faster reductions in IMR from 118.8 per 1,000 live births in 2003 to 56.7 per 1,000 live births in 2014. All other countries have registered a significant progress over the years except Pakistan and India which are off track on this indicator- reducing infant mortality from 106.4 in 1990 to 66.4 per 1,000 live births in 2014 in Pakistan, and India was able to reduce infant mortality from 88.5 in 1990 to 37.2 in 2014 (WDI, 2017).

Table 3: Infant Mortality Rate, Per 1,000 Live Births

	1990	**2000**	**2005**	**2010**	**2014**	**2015(Target)**
Afghanistan	118.8	90.2	78.4	65.6	56.7	46 (2020)
Bangladesh	99.7	64	50.4	38.9	31.5	31
Bhutan	89.6	57.8	44.9	34.2	28.6	30
India	88.5	66.7	55.7	45.3	37.2	26.6
Maldives	68	35.1	22.3	11.2	8	11
Nepal	97.5	60.2	47.3	37.5	31.2	36
Pakistan	106.4	87.9	79.8	72.8	66.4	40
Sri Lanka	18.1	14.2	12.3	10	8.5	6.0

Source: (WDI, 2017)

World total 34% of the infant deaths occur in SAARC countries (Black, RE. . 2003). The statistic shows that every year 130 million babies are born of which every 4 million babies dies in their first four weeks. 0ne-third of neonatal deaths occurs in India, Bangladesh and Pakistan. . The period during first four week is called neonatal period, and the death is called neonatal death which is the subgroup of infant mortality. The top 10 countries which shares 67% of total neonatal death are India (27%), China (10%), Pakistan (7%), Nigeria (6%), Bangladesh (4%), Ethiopia (4%), Democratic Republic of the Congo (3%), Indonesia (2%), Afghanistan (2%) and United Republic of Tanzania (2%). In those top 10 countries Pakistan, Bangladesh, India and Afghanistan are SAARC countries. The causes of the neonatal deaths are: (28%), severe infections (26%), asphyxia (23%) and neonatal tetanus (7%) (Lawn, . 2005, UNICEF, 2004).

About 11million of children in South Asian countries are born underweighted each year which shares the 50% of the world low birth weight total which is consider as the main reason of high infant mortality rate is SAARC countries of (Paul and Beorari, 2002). The UNICEF, (2004) report discussed that the infant who are weighted

between 2000-2499 grams at birth is 4 times more possible to die during first 28 days of life as compare to those infants whose weight lie between 3000-34999 grams.

There are inequalities in health care services in urban and rural areas like rural areas newborn death ranged 48 in 1000 live births while the newborn death rate in urban areas is 34 per 1000 live birth. Also the newborn mortality rate is high among those women who do not have any education as compare to those women who have some level of education, 53 out of 1000 children dies in those families where women have do not had any education, and 30 newborn die out of 1000 where women have some secondary or higher level of education. In Sri Lanka almost all the deliveries are attended by health staff while only 42% of deliveries in Bangladesh are attended by health staff.

2.3. Skill Birth Attendant (SBA) Coverage

Skill birth attendant is the birth or delivery which is assisted by health care professional like midwife, physician, obstetrician, nurse or other health care professionals who provide emergency health care services to women during pregnancy and delivery and after postpartum period. Globally 80% of the birth occurred with the assistance of skilled health professionals in the period of 2012-2017 (WHO, 2017). The study of Anne, *et al*. (2011) reported that 25 percent of neonatal death can be reduced due to skill birth attendants. South Asia countries have the low average of skill birth attendant, although skilled birth attendant percentage is increase from 36.2 percent in 2000 to 49.8 percent in 2010 but this increase only takes SAARC countries leverage on Sub-Saharan Africa. Sri Lanka have the highest skill birth attendant percentage which is 98.6.The skill birth attendant in Afghanistan is increased from 14.3 in 2003 to 38.6 in 2011; one of the main reasons in increasing

SBA usage is due to the Community Midwife Education (CME) program. The SBA contributed an 80% of the maternal death reduction use of SBAs (Rasooly, 2014). In Bangladesh the skill birth attendant is increase from 5% in 1996 to 29% in 2011, Bangladesh has the lowest skill birth attendant rate in SAARC countries. In Nepal the skill birth attendant record 55.6 in 2014. The skill birth in India record 52.3 in 2008 while in Pakistan the skill birth attendant percentage is recorded as 52.1 in 2013. In Bhutan the skill birth is recorded as 74.6 in 2012. In Maldives 98.8% of birth are attended by skill health care professional in 2011(WDI, 2017).

There are some disparities in the access of skill birth attendant in SAARC countries, Table 4, show inequitable distribution of skill birth attendants in richer and poor quintiles; Afghanistan poorest quintile is having only 11.7% access to skill birth attendant as compare to riches quintiles which are having 80% access to skill birth attendant. In Bangladesh only 11.5 percent of the poorest quintile has the access skill birth attendant as compare to richest quintile which had 63.7% access to skill birth attendant. Bhutan poorest quintile access to skill birth records as 34.3% in 2011 while the richest quintile had 95.1% access to skill birth attendant. India richest quintile has 88.8% access to skill attendant as compare to the poorest quintile which had only 19.4% access to skill birth attendant. Maldives and Sri Lanka has somehow equitable distribution of skill birth attendant as Maldives lowest quintile access to skill birth attendant was 88.6 and the richest access to skill birth attendant records 99.3, while Sri Lanka has the best equitable access to skill birth attendant the poorest quintile have 97.4% of access to skill birth attendant while the richest quintile skill health attendant was 99.4. In Pakistan the poorest skill birth attendant quintile access records as 29.8 while the richest quintile access to skill birth attendant was 85.2. Nepal also has inequitable access to skill birth attendant, in Nepal the poorest quintiles access

record 10.7 as compare the richest quintile which was recorded 81.5% access to skill birth attendant.

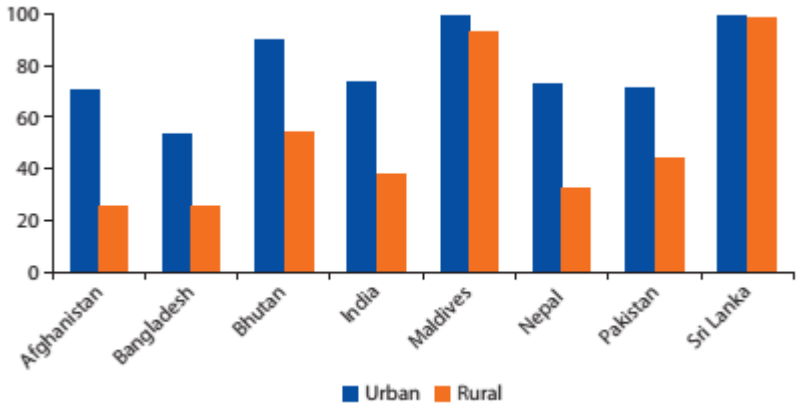
Table 4: Skill birth attendance across wealth quintiles in SAARC countries

	Poorest	second	Middle	Fourth	Richest
Afghanistan	11.7	21.2	32.7	40.7	80
Bangladesh	11.5	18.6	28.2	43.2	63.7
Bhutan	34.3	43.3	67.3	80.9	95.1
India	19.4	31.8	49	67.2	88.8
Maldives	88.6	92.6	95.4	98.4	99.3
Nepal	10.7	23.7	35.9	53	81.5
Pakistan	29.8	38.1	51.2	68.9	85.2
Sri-Lanka	97.4	98.4	98.9	99.2	99.4

Source: (WDI, Report 2017)

There are also disparities in access to skilled birth attendance exist by residence. This means the people who are living in rural area in SAARC countries having lesser access as compare to those residents who are living in urban areas. Nepal and Afghanistan have the largest gap between urban and rural access, in Nepal and Afghanistan urban peoples are more likely to have access to skill birth attendant as compare to rural residents. In Sri Lanka the access to skill birth attendant is most equitable in SAARC countries, the gap between urban access and rural access to skill birth attendant is very narrow.

Skill birth attendance by residence in SAARC countries



Source: (WDI, Report 2017)

2.4. Reproductive Health

The SAARC countries have achieved a tremendous decline in fertility rate from 4.2 in 1990 to 2.6 in 2012. The level of fertility in Nepal record 2.3 births per women, Bangladesh (2.2), Bhutan (2.3), Maldives (2.3), Sri Lanka (2.3) and India (2.6), but the pace of reducing total fertility remains low in Pakistan and Afghanistan. In Pakistan the total fertility record as 3.802 birth per women in 2011 while Afghanistan has still high fertility rate which records 5.5 birth per women in 2011 (WDI, 2017).The early age marriage pregnancy is risky for mother and child both. Their children have higher risk of illness and death. Bangladesh has the lowest average age for early marriage which records as (15.5 years) and at first birth (18.1 years).

2.5. Inputs to the Health System

The number of hospital beds in Pakistan and Bangladesh is the lowest in SAARC countries which are 0.6 per 1000 population (WDI, 2015). Maldives has the highest number of hospital beds 4.3 per 1000 population in SAARC countries followed by Sri

Lanka which had 3 beds per 1000 peoples and Bhutan which has 1.5 beds per 1000 peoples, Afghanistan, Pakistan, Bangladesh had lesser then 1 hospital bed.

Maldives has the highest number of physician per 1000 population in SAARC countries which was 1.4 in 2015 followed by Pakistan which was 1.2 physicians per 1000 population. The rest of the SAARC countries had lesser than 1 physician per 1000 population. Bhutan had the lowest physician per 1000 population which was 0.023 in 2015 (WDI, 2015). The nurses and midwives numbers is also higher in Maldives, which was 5 per 1000 population and Bhutan has the lowest numbers of mid wives and nurses which was 0.1 per 1000 population, Sri Lanka has 1.7 nurses and midwives per 1000 population and the rest of SARC countries which includes Pakistan, Bangladesh, India, Nepal has lesser then 1 number midwives and nurse per 1000 population. In Afghanistan the number of nurses increases from 566 in 2002 to 3,651 in 2011. In Afghanistan total 77% of health facilities have one female health provider. As there are some areas where women face religious and cultural constraints, so female health providers are essential for the provision of health services in such areas (Rasooly, . 2014).

As the percentage of public health care in South Asian countries is below then the global public health spending and the out of pocket health expenditure is high. Some countries like Sri-Lanka remove the user fee on reproductive, maternal, newborn, and child health services to reduce the financial barrier (Witter, *et al*. 2000). The free available services in Sri Lanka are considered as the major factor of reducing the infant and maternal mortality rate (Pathmanathan, *et al*. 2003). Most of health services are provided free since the 1930 in Sri Lanka, which is why Sri Lanka has the most equitable distribution of services almost 70% of poor population used the public hospitals (Pathmanathan, *et al*. 2003). In Bhutan the first tier health services (basic

primary health care) is provided free of cost but yet the out-of-pocket expenditures are high especially on referrals. The public health services are weak in Afghanistan, but there is some improvement recorded in reduction of infant mortality rate after the regime of Taliban end in 2002. The Afghan government contracted the NGOs to provide the health services basic health facilities in specific geographical regions. 42 separate contracts were given to NGOs for the delivery of health services which are mostly keen to rural areas, which is nearly 90% percent of rural population (Benderly, 2010). Further those contracts are changed in to performance-based partnership with the support of World Bank for ensuring better provision of health services. That performance-based partnership for basic health facilities was implemented in 11 provinces (Benderly, 2010). In Bhutan 28 hospitals, 156 BHUs, and 654 outreach clinics, provide free of charge health services under the Bhutan's universal health coverage policy (Torgay, *et al*. 2011).

Different strategies are used in south Asian countries for controlling the children mortality like in Bangladesh and India neonatal care has been included as an integral component of essential service delivery or primary health care. The Nepal governments undertake the decision of Safe Motherhood Program (SMP) in ten districts Safe Motherhood Program (SMP) included the newborn care, which was very help full in the reduction of neonatal death rate. During 1990 a number of programs were started in south Asian countries like Child Survival Program, Baby Friendly Hospital initiatives, Extended Program of immunization (EPI), Control of diarrheal diseases, training of traditional birth attendants (TBA), acute respiratory infection (ARI) control program and the National Program for family planning and Primary care. The study of India reveals that India has high infant mortality rate because of high fertility rate

2.6. Leadership and Governance

Leadership and governance is one of the essential building blog out of six building blogs which was provided by WHO for health system strengthening. The Leadership and governance provide appropriate policies, strategies and guidelines for national health system. The SAARC countries did not achieved the targets of MDGs but they have taken steps for ensuring good health for infant. These steps includes Nepal's 1998 Reproductive Health Strategy which was beneficial for both mother and children safety. India's 2000 National Population Policy. Afghanistan also adopted different strategies like National Reproductive Health Policy (2012–2016) and it's National Strategic Health Plan 2011–2015 which improved the access to health facilities like emergency, Maternal, Neonatal, and Child health (Government of the Islamic Republic of Afghanistan 2011). Pakistan also started relevant policies for mother and new born which are the 1994 National Program for Family Planning and Primary Health Care, Lady Health Workers, the 2003 MNCH Program, and the 2005 MNCH Strategic Framework (Bhutta, *et al*. 2013).

The accountability is very low in SAARC countries although for health professional e.g. doctors, nurses, physician etc. SAARC countries have initiated innovative downstream social accountability mechanisms. But there is a strong influence of political parties on health professional like in Punjab Pakistan the high rate of health professionals absenteeism was attributed to political connections (Callen, *et al*. 2013). Further in Bangladesh the rate of absenteeism records 35% of health professionals and in India the rate of absenteeism recorded as 40% of health professionals but the influence of political parties are protecting them from being fired for absenteeism (Deussom, *et al*. 2012).

The study of Taylor, (2012) indicated that there is lack of political will for nutrition interventions in Bangladesh that is why the policies and strategies are not effective, the study further discuss that Bangladesh is also lacking in evidence-based decision making which is also a main cause of high infant mortality rate in Bangladesh. In Sri Lanka the health strategies like national health and nutrition programs are highly favored by political will, they have a proper feedback system from stakeholders which become main input in making future planning and policies, also the policies are made by technical and research experts and on evidence base. The best things about Sri Lanka policies are that their policies are faxable and can be easily modified with the change in behavior and life style (de Silva, *et al*, 2009).

2.7. Community-Based Interventions

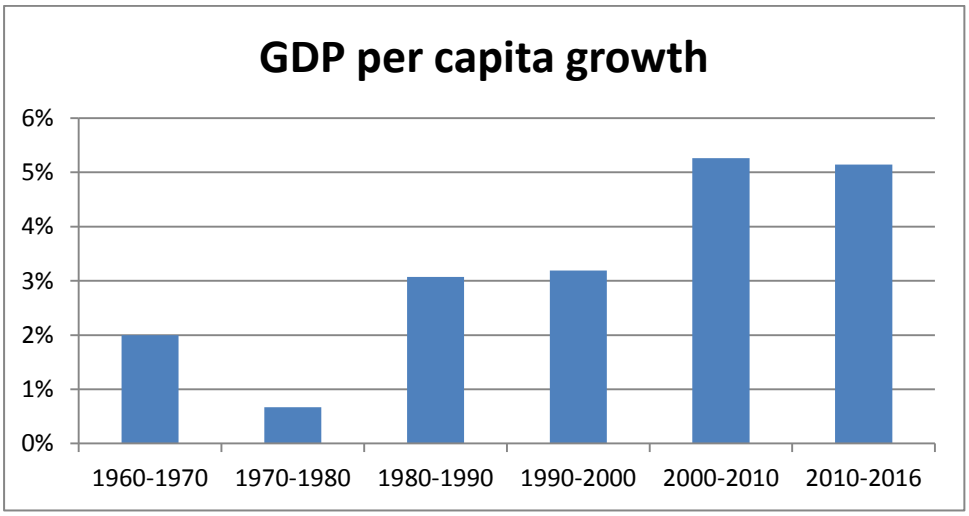
Several studies focused on community-based intervention, these studies discuss that the community-based intervention has the potential to improve the health seeking behavior and health care of the community (Bhutta, 2015; Piane, 2009; Piane and Clinton, 2014). Different intervention are implemented in SAARC countries like mobilizing and empowering communities through different health campaigns, seminars and health education and tips by community lady workers etc. led to the reduction in neonatal mortality rate. In Pakistan community based intervention is implemented for the sake of good health of mother and children through community lady health workers, which are involved in community health education sessions, tips and training hot to take care of newborn babies etc. This program was implemented in Hala and Matiari sub-districts. After implementation of the program a reduction in neonatal mortality occurs in specific areas (Bhutta, *et al*. 2008). In Nepal an intervention is implemented for awareness of the child and mother safety like pre-

natal and post-natal care. The intervention was based on participatory learning which was held through native community women (Condo, *et al*. 2014). In Bangladesh the intervention was implemented in 3 districts for improving the health of mother and newborn child through women's group participatory action for community women (Azad, *et al*. 2010), very similar intervention also implemented in Jharkhand and Orissa districts of India for the betterment of mother and newborn child health by providing health education and tips for pre-natal and post-natal care. The intervention in India and Bangladesh cause a reduction in neo-natal mortality rate (Tripathy, *et al*. 2010, Azad, *et al*. 2010).

2.8. Economic Growth

According to WDI, report (2017) the population living below then $1.90 a day in South Asian countries records 18.8% in 2012. However this figure indicates significant improvement because back in 1990 it was approximately 50.6% population who were living on less than $1.90 per day. The number of peoples living on less than $1.25 per day is accounting 77.8% of the extremely poor world-wide which is a very high figure. The economic growth records as 6.5% over the 20 year period South Asian countries. The GDP growth rate was 4.3% in the beginning of 1960 than it decreased to 3.1% growth rate of GDP in 1970. Then in next decade 1980 the GDP growth increase to 5.5% and in 1990 the there was a slight decrease in GDP growth rate fell to 5.3%. While 2000 decade is considered as a golden era for economic growth in South Asian countries the GDP growth rate raised to 7%. Moreover it is expected in future that the growth of GDP will accelerate positively because of India by expansion in the Indian economy and favorable oil prices. The GDP per capita of South Asian countries varies over the time like in 1960 to 1970 the

GDP per capita records as 2.02% then the growth rate of GDP per capita fall to 0.69% from 1970 to 1980. Then an increasing trend is recorded in the South Asian countries in 1980 to 1990 in the GDP per capita growth rate which was 3.09% and from 1990 to 2000 the GDP per capita growth rate was 3.21%. While from 2000 to 2010 the growth rate of GDP per capita was further increase to 5.29%.



Source: (WDI, 2017)

The growth rate of GDP per capita of Sri-Lanka is consistently increasing after the "South Asian dip" in 1970. The Sri-Lanka rebound from the downturn and since that time has usually performed better than the other nations in the region. The Growth rate of GDP per capita of Sri-Lanka records 6.00% in 2009. While Pakistan GDP per capita grown sluggishly from 1980 averaging 2.00% since 2000. The economic data of for Afghanistan, Bhutan, and Maldives is incomplete but a positive trend is recorded in the growth rate of economies of for Afghanistan, Bhutan, and Maldives. But a decrease in growth rate is recorded in Afghan economy after 2013 (WDI, 2013).

SAARC countries

As mention earlier SAARC is the most populated region in the world with diversified population structure, fertility rate, mortality rate, demographic transition, urbanization and literacy levels etc. SAARC countries average public health expenditure is recorded as 2.59% in 2013 of total GDP. While WHO recommendation that countries should spend 5% of GDP (or GNP) on health (WHO, 2003). Some of SAARC countries were unable to achieve MDGs target of reducing infant mortality while the study of Debarpriya Bhattacharya, (2015) suggested that with the current rate of reduction the SAARC countries will be able to reduce infant mortality to 20 per 1000 live birth to year 2030 while the target which is stetted for the reduction of infant mortality in SDGs for SAARC countries is 12 deaths per 1000 live birth to year 2030. There are disparities in access to health care facilities in SAARC countries, rural infant are more likely to die than the urban infant in SAARC countries. The inequitable distribution of wealth, leadership weaknesses etc. are also affecting the infant mortality in SAARC countries.

Chapter 3

Literature Review

This chapter provides an overview of earlier studies which examined the relationship between public health expenditure and infant mortality rate. This chapter is divided in to two sections; section 1 provide the studies which revealed the positive impact of health expenditure with infant mortality, while the section 2 provide the studies which revealed the negative impact of public health expenditure

3.1 Studies finding significant relationship between public health expenditure and health outcomes

A study of Anyanwu and Erhijakpor, (2007) in which they use 47 African countries data from 1999-2004 reveals a positive relationship between health expenditure and the health outcomes, their study predicted that increase of total health care expenditure per capita reduces that infant mortality by 2.2%. Another study of Gupta, *et al* (1999) in which they use 50 developing countries reveals the relationship between health expenditure and mortality rate that increase in the health expenditure reduces the child mortality rates. Issa and Ouattara, (2005) also find a similar relation as the Gupta, *et al* (1999) found in there study that the increase in health expenditure reduces the child mortality, they use both public and private health expenditure in their study and used the data of 160 countries. The variables which were used in their study were infant mortality rate, public and private health expenditure, female enrolment rate and CO2 emission which captured the cleanliness of the environment. They categorized the low income 106 countries in one group and the 54 high income countries in other group. The data used in that paper covered the period 1980-2000. The ordinary least squares OLS estimation is used for the estimations then they applied fixed effects (FE) and random effects (RE) estimations techniques

respectively. The result reveals that the public health expenditure is more effective than the private health expenditure in decreasing the infant death rate in low income groups. While in high income countries the private expenditure on health has more impact on infant mortality rate than the public expenditure on health. One more study which is conducted in developing country Uganda by Sewanayana and Younger, (2004) reveals positive impact of public health spending on infant mortality rate.

The studies of Gani, (2009), Farag, (2010) and Paxson and Scady, (2005) also revealed that increase in health expenditure cause a decrease in children mortality rate. The Hitiris and Posnett, (1992) examined the relationship in between infant mortality and different determents like health expenditure, age and GDP per-capita income. They used 20 OECD countries over the period from 1960-87. Their study reveals the strong relationship between infant mortality and the determents like the increase in expenditure or GDP per capita income cause a decrease in the infant mortality rate. In the study of Santerre and Grubaugh, (1994) they used 12 European countries as a comparison with United States. They analyzed overall health system performance of those selected 12 European countries and then they compared the results with the United States for observing the impact of health system on infant mortality rate. The determents which are used in their study was number of physicians per capita, income per capita, per capita education spending, female labor force participation rate, , population density, alcohol spending per capita, tobacco spending per capita, a technology variable, and country fixed effects, the date of those 12 OECD countries was taken of the period from 1960-87. They converted all variables in to log, the findings of their study reveals that the increases in alcohol and tobacco spending also increase the infant mortality rate. While the increase in GDP per capita income and per capita physicians, decrease the infant mortality rate. They found high

R-square of 0.86 from this regression and the coefficients which were used were mostly found consistent with prior findings. Their study found that the USA infant mortality exceeded from the actual infant mortality rate for every year over the period from 1973-87 as compared to 12 observed countries. Their study conclusion was that the USA health care system is perhaps better than the OECD countries. Nonetheless, when looking at the raw data, the fact that the U.S infant mortality rate tends to exceed that of other OECD countries.

In the study of Crémieux, Ouellette, & Pilon, (1999) they estimated health production function for which they used health care spending effect on health outcomes in 10 Canadian states in which they used data of over 15 years from 1978-1992 . They used two models in their study, double-log specifications and liner model. The double-log specifications (GLS) model was specifically use for the correction of heteroskedasticity and autocorrelation. Their study reveals the health spending effect on infant mortality like the increase in health spending decrease the infant mortality rate, also they observe that the increasing number of physician decrease the infant mortality rate. They specify that 10% increase in the health spending cause .50 percent decrease in male infant mortality and (0.40)% decrease in female mortality. Those figures differs because female are biologically strong and there mortality rate is lesser than the male infant mortality rate.

One more study which was conducted by Homaie, *et al* (2013) they used panel date from 1995 to 2010 of 20 EMR countries to investigate the public and private health expenditure effect on infant mortality. The study reveals a negative relationship between public health expenditures and GDP with infant mortality rate. Meaning the increase in public health expenditures and GDP reduce the infant mortality rate. The study of Ahmed and Ali, (1992) reveals that the incidence of child mortality is higher

in working women as compare to the non –working women. The study also reveals that the child mortality rate is higher in working women of rural areas as compare to working women of the urban areas. They discussed that working women devote less time to the taking care of their children and thus expose them to a greater risk of ill-health. There will be addition in my study that it will include public health spending per-capita income and there effect on infant mortality also the study will add an updated figure of child mortality in working women. The Kuen Kim, and Shannon, R. Lane (2013) conducted the study of 17 OECD countries in which they used the data from 1973 and 2000. There results reveal the significant relationship between public health expenditure and infant mortality rate, they concluded that 1% increase in public health expenditure decreases infant mortality rate by .077. The data was analyzed through LINEAR MIXED MODEL in SPSS the p value of public health expenditure recorded less than .001, which reveals the high significance. They discuss that increasing the public health expenditure is an efficient strategy to improve overall health condition among citizens.

The public health expenditure is an important tool for government to influence on health outcomes not only infant mortality rate but with other health outcomes as well like life expectancy, under-5 mortality rate and maternal mortality rate. Studies reveal a significant relation between public health expenditure and life expectancy like the study of Jaba, *et al* (2014) examined the relationship between healthcare expenditures (dependent variable) impact with life expectancy and under-5 mortality, the result of the study reveals a strong association between public heath expenditure with life expectancy and under-5 child mortality. Another study by Akinci, *et al* (2014) also reveals significant associations between health public health expenditure (input) with infant, under-5 child and maternal mortality rate; their study concluded that increase

in the public health expenditure cause a reduction in infant, under-5 child and maternal mortality rate. The study was conducted in Middle Eastern and Northern African countries using yearly data from 1990 to 2010.

Mays and Smith, (2011) conducted a study to analyze the relationship between increase in public health expenditure and prevented deaths specifically related to infant mortality, cancer, diabetes and cardiovascular disease. The result of the study reveals that an increase in public health expenditure by 10% causes a decline in infant mortality by 1.1 to 6.9 percent. Study also reveals the significant impact of increase in public health expenditure with cancer, diabetes and cardiovascular disease. Maruthappu, *et al*. (2015) examined the relationship between public health expenditure, unemployment and HIV mortality in there study. They conducted a study by using 74 countries data from 1981 to 2009. The result of the study reveals a negative effect of public health expenditure with HIV mortality mean the increase in public health expenditure led to decrease in HIV mortality rate. Another related study to Maruthappu, *et al*. (2015) is conducted by Vavken, *et al*. (2002) in Austria in which the estimated the relationship between an increase in public healthcare expenditures with cardiovascular disease, injury, poisoning, and malignant disease. They used ordinary least squares; two stage least squares, and Prais-Winsten method for estimations. Their results reveals that increase of public health expenditure led t decrease in overall mortality, cardiovascular disease, injury, poisoning, and malignant disease.

In study of Bokahri, *et al* (2007) suggested that the public health expenditure is not significantly improve the health outcomes, furthermore they discussed that increase in national income can improve the health outcomes. Farahani, *et al* (2009) conducted a study to estimate the effect of number of physician per 1000 population impact on

short and long run determinants of infant mortality. The study result reveals the short run impact that an increase in one number of physicians per 1000 population decrease 15% within 5 years while in long run the infant mortality reduces 45% in 15 years. Zafar, (2013) conducted a study in SAARC countries to estimate the relation of health expenditure with economics growth and life expectancy. He used panel data of SAARC countries from the year 1986 to 2010. The model used in study is Panel EGLS methodology. The variables used in the study are Health, GDP, fertility rate, life expectancy. The result reveals that when health expenditure increase that led an increase in life expectancy which means less mortality rate which means that the human capital is increase which cause an increase in economic growth.

Khan, *et al*. (2016) conducted a study in SAARC countries for examining the health care expenditure impact on the economic growth. The independent variables used in the study were labor force, literacy rate, elderly population of age 65 and above and per capita income, while health care expenditure use as dependent variable. They used SAARC countries data from 1995-2012. They investigate both short and run impact of health expenditure with economic growth by using Dynamic Ordinary Least Square (DOLS) and Seemingly Unrelated Regression (SUR) techniques. Their study reveals the short run bi-directional causality exists between the variables and also reveals the long run relationship. Besley and Masayuki, (2006) study reveals that the better health outcomes depends on the higher spending level and more superior policies for health care. Shi, *et al* (2004) conducted the study in US states reveals that the improving the basic health units will cause a decline in infant mortality rate. They concluded that increase one doctor in primary care per 10000 population is associated with reduction of infant mortality and less low birth weights. The study conducted by Craigwell, *et al*. (2012) estimated the efficacy of public spending on health care and

education using 19 Caribbean countries; there study reveals that health expenditure has a significant positive effect on health status. In the study of Rajkumar and Swaroop, (2008) examined the links between public spending, governance, and outcomes using 91 developed and developing countries. Their study result reveals that public spending on health care is not only the sole factor to improve the social outcomes; but the quality tools such as well-functioning budget formulation, execution and monitoring are essential in producing a better health position

3.2 Studies finding insignificant /negative relationship between public health expenditure and health outcomes

There are some studies which show no significant effect of public health expenditure on infant mortality rate like the study of Filmer and Pritchett, (1997) present empirical evidence that suggests that public spending on health is not the dominant driver of child mortality outcomes. There studies discussed that the impact of public spending on health is quite small, with a coefficient that is typically both numerically small and statistically insignificant at conventional levels. The study of Burnside and Dollar, (1998) also found no significant relationship between health expenditure and infant mortality rate in low-income countries. In the study of Santerre, et.al (1991) in which they tried to determine the effect of government on the performance of the health care sector, they used 20 Organization for Economic Cooperation and Development (OECD) countries panel data from 1960 to 1985. There results reveal that government involvement has no impact on infant mortality since the estimated coefficient on the government variable is not statistically different from zero at conventional levels of significance. Even though there study reveals a significant effect of real GDP on infant mortality they discussed that 10 percent increase in real GDP per capita causes a 6.5 to 8.9 percent decrease in infant mortality. Their study also reveals that greater quantity of medical services leads to a decrease in infant mortality.

The Berger and Messer, (2002) study in which they used 20 OECD countries from year 1960 to 1992 reveals that public health expenditure causes more mortality. They concluded that some time government are not well qualified to effectively use the health expenditure in the country which cause a disaster in health system of the country, they also discussed that corruption also can damage the health delivery system. Another study by Bokahri, *et al* (2007) discussed that government health expenditure did not significantly improve health outcomes such as child mortality. They concluded that increase in national income improve the health outcomes. Another study by Mckec, (2004), also discussed that there is no consistent and significant relation exist between public health spending and health outcomes, One more study which is conducted by WHO, (2011) in Indian states reveals that there is no impact of public health spending on infant mortality, that was a panel study in which the data was used from the year 1980 to 1999.

3.3 Literature Gap

I am trying to explore the relationship between public health expenditure and infant mortality rate with in SAARC countries by using panel data, latter the results will be compared with country Pakistan because the focus country of this study is Pakistan. There are some existing studies on the public health expenditure impact on infant mortality rate like (Issa and Ouattara, 2015) but there is aggregation bias in their study the OLS type regression cause 'informationally' inefficient estimates of the parameters of the model. The Empirical Bayesian model will be used to avoid that aggregation bias. In Empirical Bayesian the estimates of the model parameter are calculated by taking an average of individual country which helps in capturing the country heterogeneities and the prior which highlight the commonalities of the

specific geographical region. The problem of not having enough information can be avoided by estimating single country regression methodology, thus the Empirical Bayesian become more ‘informationally’ efficient.

Chapter 4

Materials and Methods

The study is a panel data descriptive study. The specification of the data is discussed as the Infant mortality rate per 1000 live births, total fertility rate per women, GDP per capita (current $), public health expenditure as % of total health expenditure total health expenditure and female labor force participation rate (% of female population ages 15 and above) WDI 2017, the SAARC countries require data is extracted from WDI 2017 of the year from2002 to 2014. The time frame is determined by data availability of selected variables.

Variables Identification

The variables public health expenditure, infant mortality rate, female fertility rate and GDP per capita are retrieved from the study of (Micheal Ko Boachie, and K. Ramu, 2015). While female labor force participation rate is retrieved from the study of (Satar Rezaei, et.al 2015). The variable total health expenditure is retrieved from the study of (Novignon, *et al* 2012).

Methodology

The literature reveals the impact of several variables that are partially correlated with the infant mortality rate. The empirical Bayes framework developed and named by Robins (1956). Briggs (1999) used the empirical Bayesian method to estimate cost effective analysis of drugs, also Ikuho *et al*. (2006) used Empirical Bayesian approach for comparing estimates of value of statistical live for environmental policy analysis.

The basic methodology consists of running panel date regressions of the form is

$$y_{it} = \alpha_i + \beta_i PHE_{it} + \beta_{2i} FFR_{it} + \beta_{3i} FER_{it} + \beta_{4i} PCI_{it} + \beta_{5i} the_{it} + \varepsilon_{it} \quad (1)$$

In equation 1 the dependent variable y on the left side represent the infant mortality rate and on the right side of the equation represent independent variables in which (PHE) represent public health expenditure, (FFR) represent female fertility rate, (FER) represent female employment rate and (PCI) represent the GDP per capita income and (THE) represents total health expenditure. The subscripts i represent country and t represent time. But the equation (1) cannot guarantee that the error term will be white noise, so the lagged output levels are added to take into account the serially correlated error terms.

$$y_{it} = \alpha_i + \beta_i PHE_{it} + \beta_{2i} FFR_{it} + \beta_{3i} FER_{it} + \beta_{4i} PCI_{it} + \beta_{5i} the_{it} + \gamma_i y_{it-1} + \varepsilon_{it} \quad (2)$$

As the infant mortality rate is the prior variable Equation 2 expressed the first difference form. In the first equation the lagged output is excluded due to reason that the infant mortality rate is expected to be serially uncorrelated. Thus the model takes the (d) which represent the first difference.

$$dy_{it} = \alpha_i + \beta_i PHE_{it} + \beta_{2i} FFR_{it} + \beta_{3i} FER_{it} + \beta_{4i} PCI_{it} + \beta_{5i} the_{it} + \varepsilon_{it} \quad (3)$$

The literature shows the strong negative impact of public health expenditure on infant mortality meaning that increase in the public health expenditure cause a decrease in the infant mortality rate. The Empirical Bayesian test will be running on equation (2) and (3) for the results.

3.1 Empirical Bayesian Methodology

The Empirical Bayesian methodology is consisting of three-step procedure. In first step the individual country regressions will be estimated which are equivalent to data

information of the classical Bayesian methodology. In second step the commonalities between all the countries will be estimated as a weighted average of the individual country parameter estimates which serve as common prior information this will capture the country heterogeneities and the priors which reflect the commonalities of that specific geographical region. In third step it will be updating the individual country estimates by combining the individual tendency and the common tendency (prior).

The details of the EB estimation procedure are as follows:

Let $Y_i = X_i\beta_i + \varepsilon_i$ represent the regression model for single country where $X_i = (x_{i1}, x_{i2} \ldots x_{iT})$. Is the T*(k + 1) matrix of regressors, and each row of matrix could be written as $x_{it} = (1, x_{it}^1, x_{it}^2 \ldots . x_{it}^k)$. where I represent the N individual countres and the k represent the number of regression. Similarly assume $Y_i = y_{i1}, y_{i2} \ldots y_{iT})$" is a T*1 matrix of the dependent variable.

For each cross we can get OLS estimates of the parameters which are as follow.

$$\hat{\beta} = (\dot{X}_i X_i)^{-1} \dot{X}_i Y_i \qquad (4)$$

The variance-covariance matrix for the estimated matrix of coefficient is

$$\text{cov}(\hat{\beta}) = \widehat{\sum_i} = \widehat{\sigma^2} (\dot{X}_i X_i)^{-1} \qquad (5)$$

Where $\widehat{\sum_i}$ is the variance of a random variable. The bigger value of $\widehat{\sum_i}$ will indicate the smaller precision of the estimate. Therefore the $\hat{\sum}_1^{-1}$can be used as a precision of the estimated random variable $\widehat{\beta_\iota}$. Individual countries N can be extracted from $\widehat{\beta_i}$ and $\widehat{\sum_i}$ by using OLS. But those estimates can suffer from inefficient parameters, hence an individual country average attribute and the entire group of countries which will be

used in the study are expected to be captured the true nature of underlying relationship between variables.

Different level of reflection arises from each country parameters, so it will be unfitting to take the simple average of various heterogeneous estimates. So the weighted average is suggested by Empirical Bayesian framework for common structure among countries.

Let μ represent the common attributes of SAARC countries.

$$\mu = (\hat{\sum}_1^{-1} + \hat{\sum}_2^{-1} + \ldots \hat{\sum}_N^{-1})^{-1} \quad \{\hat{\sum}_1^{-1}\widehat{\beta_1}\, \hat{\sum}_1^{-1}\widehat{\beta_2} \ldots\ldots \hat{\sum}_N^{-1}\widehat{\beta_N}\} \qquad (6)$$

The weighted average of $\widehat{\beta_1} \ldots \widehat{\beta_N}$ is used to calculateμ. The weights are assigned to $\widehat{\beta_1} \ldots \widehat{\beta_N}$ according to its precision. The study of Zaman (1996) reveals that the according to Bmpirical Bayesian terminology μ represent the sum of the precision of all countries.

The inverse equation of Ω^{-1} is follow:

$$\Omega^{-1} = = \hat{\sum}_1^{-1} + \hat{\sum}_2^{-1} + \ldots \hat{\sum}_N^{-1} \qquad \textbf{(7)}$$

The variance of μ will be

$$\Omega = (\hat{\sum}_1^{-1} + \hat{\sum}_2^{-1} + \ldots \hat{\sum}_N^{-1})^{-1} \qquad \textbf{(8)}$$

The Empirical Bayesian is more accurate than the OLS parameters for individual country. The precision depend on the inclusion of the data, meaning that if someone wants to increase the precision simply increase the data inclusion in Empirical Bayesian estimate.

The $\widehat{\beta_i}$ will be calculated separately through OLS estimate to estimate the weighted sum. Through this process the Empirical Bayesian parameters will be retrieved from the weighted average of OLS estimate of $\widehat{\beta_i}$ and the prior.

Let $\widehat{\beta_\iota}^{EB}$ represent the estimate of $\widehat{\beta_i}$

$$\widehat{\beta_\iota}^{EB} = (\hat{\sum}_1^{-1} + \Omega^{-1})^{-1} \{\hat{\sum}_1^{-1}\widehat{\beta_\iota} + \Omega^{-1}\mu\} \quad (9)$$

Finally the covariance of the Empirical Bayesian estimate is:

$$cov\widehat{\beta_\iota}^{EB} = (\hat{\sum}_1^{-1} + \Omega^{-1})^{-1} \quad (10)$$

$\hat{\sum}_1^{-1} + \Omega^{-1}$ show the Empirical Bayesian estimates which reveals the sum of the precision of individual country and prior information. The quality of Empirical Bayesian is reveal from the fact that Empirical Bayesian methodology takes it prior information from the average tendency of all individual countries.

Description of Variables used in the estimation

GDP Per Capita Growth

GDP per capita is the total GDP divided by total population, GDP per capita is an independent variable in this study. It is expected that countries with a higher GDP would have lesser infant mortality rate. Because countries with higher per capita income will be able to spend more on health, they might have better living conditions which will affect the infant mortality rate negatively.

Infant Mortality Rate

Infant mortality rate is defined as the death of children with in their first year of life. It is calculated as the number of death of children divided by 1000 live born. In this

study infant mortality is the dependent variable. Infant mortality is one of the core indicators of country health outcomes.

Health Expenditure

Health expenditure is defined as the total health spending by government, which includes recurrent and capital investments by government on health care. Which cover all health provision activities like preventive or curative health services, nutrition activities and family planning. This study aims to investigate that either public health spending correlates with infant mortality? If an increase in public health spending cause a reduction in infant mortality the scale of the reduction will provide the efficiency of public health expenditure but if the correlation is negative, it may indicate that it is better to put individuals in charge of their own health spending.

Total Fertility Rate

Fertility rate is defined as the number of child births to a woman during her child bearing year (15-49). It is measured as the total births of children annually divide by number of child bearing age women. Countries with high HDI (human development index) are usually lower rate of fertility. While the trend in fertility rate in SAARC countries is also decreasing. In this study the fertility rate is an independent variable. This study will help in finding the impact of fertility rate with infant mortality.

Female Labor Force

FE represent female labor force participation rate of the total labor force. This study investigates that either the female employment rate has any impact on infant mortality rate or not? Generally with female employment the contribution of income to the household increase, so there are more chances that the female employment will negatively affect the infant mortality, because the more will be the income of household the higher will be the probability to spend on health care.

Total Health Expenditure

Total health expenditure is the amount of all healthcare expenses during one year. Those expenses include public, private, insurance payments etc. this study will investigate that is there is any relation between total health expenditure and infant mortality? Total health expenditure is an independent variable in this study.

The data was available from the year of 2002 to 2014 of SAARC countries. SAARC countries are consisting of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri-Lanka.

Variables	**Source**
Infant mortality rate	WDI 2017
Public health expenditure	WDI 2017
Female fertility rate	WDI 2017
Female employment rate	WDI 2017
GDP per capita	WDI 2017
Total health expenditure	WDI 2017

Chapter 5

Results and Discussion

In first step the EB results for the regional panels with common attributes of South Asia countries are discussed then the individual countries of SAARC region results are compared. In both cases the public health expenditure, total health expenditure, fertility rate, female employment rate and per capita expenditure impact on infant mortality is examined. Table 5, and Table 6, represents the common attributes of South Asian countries.

Table 5 presents the results of estimation when lag form of variables are used. The table reveals that there is a strong statistical significant effect of all chosen independent variables such as public health expenditure, female fertility rate, GDP per capita, total health expenditure and female employment rate on infant mortality.

Equation 2 is estimated for SAARC via the methodology is mentioned in Chapter 4

Table 5: EB Priors: Infant mortality: SAARC panel results

Variables	Countries Results
Public health expenditure (phe)	-0.088 (-16.4)
Female fertility rate (ffe)	1.416 (8.35)
Female employment rate (fe)	0.128 (18.1)
GDP per capita (GDPpc)	-0.0001 (-26.5)
Total health expenditure (the)	0.763 (1.1)
Infant mortality (imr)	1.039 (96.2)

T-statistics are in parentheses

In Table 5 the coefficient of public health expenditure is -0.88 which carries negative sign. This implies that increase in public health expenditure decreases the infant mortality rate. The t-statistic indicates that the relationship is highly significant. Therefore, this outcome matches with the studies finding significant impact of public health expenditure on infant mortality rate mentioned in Section 3.1. Row 2 of Table 5 indicates that 1 unit increase in female fertility rate increases infant mortality rate by 1.4 units. The study of study of Zakir, *et al*. (1999) supports positive impact of female fertility rate. In their study they found that increase in 10% of female fertility rate lead to increase in infant mortality by 8.2%. 1 unit change in female employment rate cause a positive change in infant mortality rate by 0.12 times. The positive rate of change is proven in study of Rezaei, *et al*. (2015) they discussed that employed women might not have time to breast feed their children or to take good care of their children. Unit change in GDP per capita is having minor impact on infant mortality which is .001. Jiménez Rubio, (2009) used panel data of 20 Organization for Economic Co-operation and Development(OECD) countries from 1970 to 2001 which reveals the significant negative association between GDP per capita and infant mortality rate, there study results showed that 10% increase in GDP per capita causes a 1% decrease in infant mortality rate.

Table 6 presents the results of estimation when difference form of variable are used. The table reveals that public health expenditure, GDP per capita, total health expenditure and female employment rate have the strong statistical significant effect on infant mortality while there is no significant evidence found between female fertility rate relations on infant mortality rate.

Equation 3 is estimated for SAARC via the methodology is mentioned in Chapter 4

Table 6: EB Priors: Infant mortality: difference form variables: SAARC panel results

Variables	Countries Results
Public health expenditure (phe)	-0.046 (-11.4)
Female fertility rate (ffr)	0.076 (1.30)
Female employment rate (fe)	0.0770 (4.67)
GDP per capita (GDPpc)	-.0003 (-5.05)
Total health expenditure (the)	-0.167 (-5.43)

T-statistics are in parentheses

Table 6 show the coefficient of public health expenditure is -0.46, the negative sign indicating negative effect of public health expenditure on infant mortality, and the t-statistic is greater than 2 indicating that the relation is strongly significant. There is no statistical significance evidence found regarding female fertility rate. While 1 unit changes in Female employment rate positively affects infant mortality by 0.77 times. While the GDP per capita is having a very minor effect on infant mortality, the coefficient of GDP per capita is -0.0003, negative sign indicates a decrease in infant mortality by increasing GDP per capita. Row 5 in table 6 indicates that one unit changes in total health expenditure causes 0.16 unit reduction in infant mortality.

Country Estimates

Table 7 and Table 8 provide the individual country estimates of South Asian region that how the infant mortality is affected by public health expenditure, female fertility rate, female employment rate, GDP per capita and total health expenditure.

Public Health Expenditure

Table 7, present the results of estimation when lag form of variables are used. The results show significant negative impact of public health expenditure on infant mortality of SAARC countries except Afghanistan, Maldives and Sri-Lanka. The magnitude of the change in infant mortality in India is high as compare to other SAARC countries. In India 1 unit change in public health expenditure reduces infant mortality by 0.44. The second highest magnitude is associated with 0.34 reduction in infant mortality is for Bhutan. In Pakistan 1 unit change in public health expenditure reduces the infant mortality rate by 0.06 units. The impact of public health expenditure on infant mortality is very small in Sri Lanka, which is 0.001 carrying negative sign which means unit change in PHE decrease infant mortality rate by 0.001.This implies that Pakistan is having low efficiency of public health expenditure compare to Bangladesh, Bhutan, India and Nepal

Table 8, present the results of estimation when difference form of variables are used. The result show statistically significant impact of public health expenditure with infant mortality of Pakistan, India and Nepal. In Pakistan coefficient is -0.013with a negative sign and significant t-statistic value, the coefficient of public health expenditure in India is greater in magnitude, which is – 0.037. While 1 unit changes in public health expenditure decrease the infant mortality by 0.006 times in Nepal.

Homaie, *et al* (2013) supports the evidence of negative impact of public health expenditure with infant mortality rate. This implies that efficiency of public health expenditure of Pakistan is low as compare to India but better than Nepal.

Equation 9 is estimated for SAARC via the methodology is mentioned in Chapter 4

Table 7: EB Priors: Infant mortality: Countries results

Variables	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri-Lanka
Public health expenditure	0.512 (1.24)	-0.240 (-16.0)	-0.344 (-57.9)	-0.441 (-5.55)	-0.013 (-0.16)	-0.192 (-30.1)	-0.068 (-3.25)	-0.001 (-0.01)
Female fertility rate	12.44 (23.9)	0.815 (0.46)	4.494 (1.28)	15.45 (2.02)	0.115 (0.01)	-1.613 (-0.64)	6.994 (2.12)	0.280 (0.02)
Female employment rate	-0.269 (-8.18)	-0.513 (-4.44)	-0.141 (7.69)	-0.157 (-0.63)	-0.0001 (-0.01)	0.303 (3.10)	0.120 (1.22)	0.003 (0.03)
GDP per capita	-0.0008 (-3.32)	-0.004 (-6.79)	0.0005 (2.18)	0.003 (4.79)	0.0003 (3.16)	-0.001 (-1.18)	0.003 (4.89)	5.37E-05 (0.13)
Total health expenditure	-0.078 (2.77)	-3.706 (-16.3)	-1.697 (-34.6)	-0.870 (-4.05)	0.092 (0.44)	0.367 (18.8)	-0.244 (-1.06)	0.083 (0.04)
Infant mortality lag	-0.518 (-14.4)	-0.326 (-3.28)	-0.030 (-0.16)	0.843 (1.59)	-0.019 -(0.16)	0.127 (0.79)	-0.979 (-7.70)	-0.010 (-0.01)

T-statistics are in parentheses

Equation 9 is estimated for SAARC via the methodology is mentioned in Chapter 4

Table 8: EB Priors: Infant mortality: Countries results

Variables	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri-Lanka
Public health expenditure	0.002 (0.23)	0.066 (1.72)	0.003 (0.21)	-0.037 (-2.19)	0.002 (0.02)	-0.006 (-3.84)	-0.013 (-2.70)	0.0001 (0.05)
Female fertility rate	6.435 (4.42)	4.025 (2.48)	1.407 (2.78)	4.515 (1.52)	0.142 (0.03)	-2.833 (-1.87)	1.490 (0.63)	0.001 (0.03)
Female employment rate	-0.016 (-0.14)	-0.326 (-1.78)	0.026 (0.52)	-0.380 (-6.30)	-0.005 (-0.01)	-0.011 (-0.06)	-0.097 (-2.72)	4.9E-05 (0.01)
GDP per capita	-0.0001 (-0.18)	0.001 (1.50)	-0.0005 (-1.52)	0.0007 (2.95)	-0.0001 (-1.48)	0.0003 (0.23)	0.0001 (3.17)	-2.6E-06 (-0.01)
Total health expenditure	-0.0298 (-0.45)	-0.392 (-1.59)	0.148 (2.10)	0.161 (0.44)	-0.046 (-0.14)	-0.013 (-0.15)	-0.060 (-0.99)	0.0001 (0.01)

T-statistics are in parentheses

Fertility Rate

Table 7, Pakistan, India and Afghanistan are having statistically significant impact of female fertility with infant mortality rate, while there is no statistically significant evidence found regarding other 5 SAARC countries. The coefficient of female fertility rate in India is higher in the magnitude which is 15.45 with a significant t-statistic value. The coefficient is positive, indicating that increase in fertility rate also increase the infant mortality. In Afghanistan the coefficient of female fertility rate 12.4 which indicates positive impact and in Pakistan the coefficient is 6.99 with a positive sign and significant t-statistic value. This implies that the efficiency of India and Afghanistan is higher in magnitude than Pakistan.

The Table 8, results indicate statistically significant relationship between female fertility and infant mortality in Afghanistan, Bangladesh and Bhutan while there is no statistically significant evidence found of the rest of 5 SAARC countries. In Afghanistan the coefficient of fertility rate is greater in magnitude which is 6.4. In Bangladesh the coefficient is 4.02 an in Bhutan the coefficient is 1.4. All 3 countries coefficient carries positive sign indicating increase in fertility rate also increase infant mortality. This implies that female with more children might not have time to take good care of all their children or maybe they face income constraints for health care, feeding, proper living areas etc.

Female Employment Rate

In Afghanistan, Bangladesh, Bhutan and Nepal the female employment rate have statistically significant effect while in Pakistan, India, Maldives and Sri-Lanka there is no statistically significant evidence found. In Afghanistan the coefficient is -0.26, the negative sign indicates inverse relation between female employment rate and infant mortality. In Bangladesh 1 unit change in female employment rate cause a reduction of 0.51 times in infant mortality. While the coefficient in Bhutan is -0.14 indicating negative relation between female employments rate on infant mortality. In Nepal the coefficient is 0.3 and indicates positive sign, meaning 1unit changes in female employment increase the infant mortality rate by 0.3. The study of Rezaei, *et al* (2015) also shows positive impact of female employment rate with infant mortality; they discussed that due to employment status of mother the infant might not be taken good care, proper breast feeding etc.

These results implies that with high female labor force participation the house hold income increases due to which the household have enough income to spent on health,

this might be the reason of decrease in infant mortality due to increase in female labor force participation rate.

Table 8, reveals the statistically significant impact of female employment rate with infant mortality of Pakistan and India, while there is no statistically significant evidence found regarding the rest of 6 SAARC countries. 1unit change in female employment rate negatively affects the infant mortality rate by -0.09 times in Pakistan. In India coefficient of female employment rate is -0.08, indicating negative relation between female employment rate on infant mortality rate. The results implies that the efficiency of female employment rate on infant mortality of Pakistan is better than India

GDP Per Capita

Table 7, reveals GDP per capita is having a significant impact on infant mortality in 6 out of 8 SAARC countries. In Nepal and Sri-Lanka t-statistic do not indicate any relation between GDP per capita and infant mortality. 1 unit change in GDP per capita negatively affects the infant mortality by 0.0008 times in Afghanistan and 0.004 times in Bangladesh. Hitiris and Posnett, (1992) study supports the negative impact of GDP per capita with infant mortality rate. While in Pakistan, Maldives, Bhutan and India the impact of GDP per Capita is positive. 1 unit changes in GDP per capita increase infant mortality by 0.0003 times in Maldives. In India and Pakistan the coefficient is 0.0005 indicating positive relation between IMR and GDP per capita. The study of (Baum, 2005) discuss that not only wealth but inequalities in wealth also have effect on health outcomes. This is why GDP per capita is not strong predictor of improvement in infant mortality. He also discussed that country with equal

distribution of wealth are having better health outcomes than the countries that had high wealth.

Table 8, shows that GDP per capita in Pakistan and India are having statistically significant affect while there is no statistically significant evidence found regarding the rest of SAARC countries. The coefficient of GDP per capita in India is 0.0007. The coefficient of GDP per capita in Pakistan is 0.0001. Both countries coefficients are positive which indicates that change in GDP per capita positively affect the infant mortality.

The result implies a positive impact of GDP per capita on infant mortality of Pakistan, Bhutan, Maldives and India. But comparatively the increase rate in infant mortality due to increase in GDP per capita is higher in Pakistan as compare to Maldives and Bhutan.

Total Health Expenditure

Table 7 shows that total health expenditure is having a significant impact on infant mortality in 5 out of 8 SAARC countries. The t-statistic does not indicate any relation between total health expenditure and infant mortality in Pakistan, Sri-Lanka and Maldives. In Afghanistan 1 unit change in total health expenditure negatively affects the infant mortality by 0.07 times. In Bangladesh 1 unit change in total health expenditure negatively affects the infant mortality rate by 3.70 times. The coefficient is -1.69 in Bhutan, indicating negative relationship between total health expenditure on infant mortality. While in Nepal the coefficient is 0.36, which indicate positive relation between total health expenditure on infant mortality rate. The study of Novignon, *et al* (2012) also found positive relation between total health expenditure and infant mortality, than they split the total health expenditure in public and private

than they found the negative relation between public and private health expenditure and infant mortality.

Table 8 reveals that only Bhutan has statistically significant impact of total health expenditure with infant mortality rate. While there is no statistically significant impact of total health expenditure with infant mortality is found of the rest of SAARC countries. The coefficient of total health expenditure is 0.14, carries a positive sign which indicate that increase in total health expenditure increase the infant mortality.

Chapter 6

Conclusion and Recommendation

This study explored the impact of public health expenditures, GDP per capita, Female employment rate, Fertility rate, and Total health expenditure on infant mortality of SAARC countries. Panel data of SAARC countries is used in this research study from the year 2002 to 2014. Empirical Bayesian method is used for the estimations. The result reveals a strong negative statistically significant relation of public health expenditure with infant mortality in regional panel of SAARC countries. The result shows that 1 unit change in public health expenditure inversely affects the infant mortality rate by 0.088 times, there are several studies which support the strong negative relation of public health expenditure with infant mortality rate like (Sewanayana and Younger, 2004), Anyanwu and Erhijakpor, 2007), (Gupta, *et al* 1999). Similarly female fertility rate results reveal the positive impact with infant mortality meaning that increase in female fertility rate lead to increase in infant mortality rate, the study of Rezaei, *et al*. (2015) also reveals a positive impact of female fertility rate with infant mortality rate. GDP per capita, female labor force participation rate and total health expenditure reveals a statistically significant negative relation with infant mortality meaning that increase in those variables causes a decline in infant mortality rate by significant ratio. Several studies support the evidence of a negative relation of GDP per capita, female employment rate and total health expenditure with infant mortality rate, (Hitiris and Posnett, 1992), (Gani, 2009), (Farag, 2010) and (Paxson and Scady, 2005).

In Pakistan the public health expenditure is significantly effective, the results shows that change in 1 unit of public health expenditure negatively affect the infant

mortality by 0.06 times. But neighboring SAARC countries decline in infant mortality is higher in Magnitude due to increase in public health expenditure than Pakistan. Female fertility rate is positively associated with infant mortality rate in Pakistan meaning that unit increase in female fertility rate increase the infant mortality rate by 6.9, while the efficiency in India is higher where 1 unit decrease in Female fertility decreases the infant mortality rate by 15.4 units. While there is weak statistical significant evidence found regarding the impact of female employment rate with infant mortality rate in Pakistan, an increase in 1 unit of female employment cause a decline in infant mortality rate by 0.09 units in Pakistan, while in Bangladesh the impact of decline in infant mortality is 0.32 times which is higher than Pakistan. The GDP per capita income is having a positive impact with infant mortality rate in Pakistan, although the impact is too small but it is positive, 1 unit increase in GDP per capita income causes an increase of 0.0001 times in infant mortality rate, while in Afghanistan, Bhutan, India and Sri-Lanka the GDP per capita is negatively associated with infant mortality rate. There is no statistical significant proof found regarding the impact of total health expenditure with infant mortality rate in Pakistan. While in Afghanistan, Bhutan and Bangladesh results revels strong statistical negative impact of total health expenditure with infant mortality rate where 1 unit change in Afghanistan total health expenditure cause a decline of 0.07 times in infant mortality, in Bangladesh the impact is high where 1 unit change in total health expenditure cause a decline of 3.4 times in infant mortality rate.

Limitation of the Study

This study has few limitations; the Data was available only from 2002 to 2014 so the long term effect is not clearly explored of selected variables. Second because of unavailability of data only few variables which is associated with infant mortality rate are used in this study, there are also other variable which is associated with infant mortality rate like female education etc. Third the public health expenditure is inter linked with other variables also like number of physician, number of hospitals, development budget and current budget etc. but because of unavailability of data those variable is not examined in this study.

Recommendations

I. Even though the increase in public health expenditure is strongly negatively associated with infant mortality rate in Pakistan, but yet comparatively the efficiency of health expenditures of India and Bhutan is better than Pakistan. There are some improvements like allocation of funds on health development sector, improving health strategies number of hospital and health professionals is needed.

II. Reduction of female fertility rate in Pakistan will be crucial for reducing the infant death rate. In Pakistan 1 unit decrease in female fertility is associated with a decrease of 6.9 times with infant mortality.

III. GDP per capita in Pakistan is having a positive effect on infant mortality, meaning that there is inequitable distribution of wealth. The provision of social safety net is necessary in Pakistan, like community interventions, exemption of poor quintile from user fee or insurance schemes for poor

quintile, which will improve the utilization of health services of poor quintile and will reduce the inequalities for the access of health care in country.

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