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The Impact of Trade Liberalization on Health: Evidence from Pakistan

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Abstract

The literature predicts both positive and negative health outcomes in developing economies as a result of increasing trade. Does openness to trade help to improve health indicators in the case of Pakistan? This study attempts to answer this question using data from 1975 to 2016. This study uses life expectancy and infant mortality as health indicators while trade to GDP ratio as trade openness indicator. For robustness analysis, the study uses international trade taxes, exports to GDP ratio and imports to GDP ratio. The empirical results of the study show that 1% increase in trade to GDP ratio significantly decreases life expectancy by 0.05 years and significantly increases infant mortality by 0.47 deaths. Thus, trade causes adverse effects on health indicators in the case of Pakistan.

Keywords: Trade openness, health indicators, life expectancy, infant mortality.
JEL Classification: I1, F4, F6

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1. Introduction

The relationship of health and trade has become an issue of considerable debate in recent years. The studies of Owen and Wu (2007) and Bergh and Nilsson (2010) suggest that trade decreases international health disparities as it creates gains for the poor countries. Smith and Blouin (2015) argue that trade liberalization improves health both directly and indirectly. Where direct impact of trade on health mediates through the provision of health related goods and services from international markets. While the indirect impact of trade on health mediates as a consequence of competitive prices. For example, the pressure on public funds is alleviated through the purchasing of less expensive foreign goods and service which in turn can facilitate the availability of public funds for health related services.

Conversely when illegal trade such as the trade of drugs increase, health indicators are adversely influenced (Huynen, Martens, & Hilderlink, 2005). Labonte, Mohindra, and Schrecker (2011) states that increasing trade exerts adverse effects on health in country as a result of increasing trade of health damaging products such as tobacco, alcohol and other unhealthy foods. Trade in food categories like edible oils, calorie-rich and nutrient poor food, fatty meats and ultra-processed snack foods increases the concerns of obesity and non-communicable diseases (Blouin, Chopra, & Hoeven, 2009; Friel, Harrersley, Snowdon, Thow, Lobstein, Sanders, & Kumanyika, 2013). The direct channel indicated by Popkin (2006) is that increased trade causes availability of highly processed foods due to which there is harm to health of people in the form of obesity. In an indirect channel, trade has significant positive impact on water pollution which in turn affects infant mortality rate, so health is affected negatively (Jorgenson & Burns, 2004). Cornia, Rosignoli, and Tiberti (2007) suggest that trade openness increases income inequality and economic security which in turn negatively affect the health status in the underdeveloped countries.

The better health indicators indicate high quality labor which is essential to increase economic growth (Bloom, Canning,

& Sevilla, 2004; Strauss & Thomas, 1998). Following Amartya Sen "Capability Approach", the better health in country increases the consumption level as healthy people are capable of consuming goods. The availability of goods can be made by liberalizing trade. The commodities are available at cheaper rates as a result of trade liberalization (Majeed, 2011).

Pakistan being an underdeveloped country, is facing many problems in health sector since its independence. The life expectancy rate of Pakistan is ranked 139th in the world and according to UNICEF report 2014; Pakistan has highest infant mortality rate that is 8.6%[3]. In such situation policies are needed to control deterioration of health situation in Pakistan. Trade liberalization policy is important in this regard. Pakistan is one of the countries which has used trade liberalization regime since 1980's to achieve better macroeconomic goals.

As literature indicates both positive and negative effects of trade liberalization on health, it is important to test this relationship empirically for Pakistan due to its narrow literature. To the best of knowledge there are two studies which investigated the impact of trade on health in Pakistan. One is Alam, Raza, Shahbaz, and Abbas (2015), which shows positive effect of trade on life expectancy, and the other is Ali and Audi (2016) which also reports positive impact of globalization on life expectancy.

The research studies available on analysis for Pakistan suggest that there is positive impact of trade openness on health. However it is observed that the available research do not focus on the exclusive contribution of trade to health as the focus is also on impact of FDI, environmental degradation, and income inequality on health. Moreover the use of one indicator of health that is life expectancy can give less diverse results. The fewer number of indicators use may bias the result towards one side. For this reason, by investigating separately the effect of trade

[3] See UNICEF. (2014). *Pakistan Annual Report 2013*. Islamabad, Pakistan: UNICEF Pakistan.

liberalization on health and by using more than one indicator of health, this study would serve as a baseline for further research on this topic. Thus this study contributes in the empirical literature on trade and health by using diverse indicators of health and focusing on the exclusive impact of trade on health.

Remaining study is structured as follows: Section 2 provides brief explanation of Pakistan's health and trade conditions. Section 3 provides literature review. The methodology is discussed in Section 4. The data is discussed in Section 5. The empirical results are discussed in Section 6. Finally, Section 7 concludes the paper.

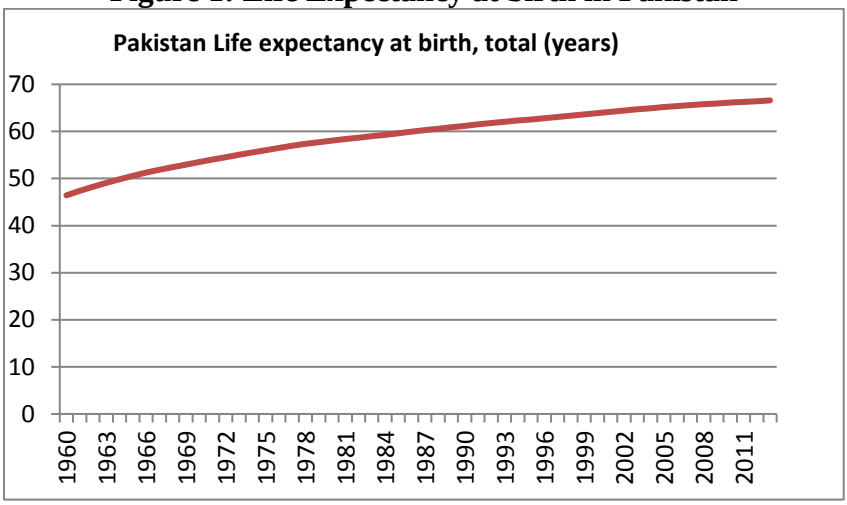
2. An Overview of Health and Trade Liberalization in Pakistan

Official name of Pakistan is "Islamic Republic of Pakistan" and it is located in South Asian region on the main location connecting Central Asia, China and Middle East. Annual growth rate of GDP is 5.28%[4] but it is not enough to keep up with fast population growth of 2.07%[5] annually. Pakistan has not shown any satisfactory improvement in health indicators with respect to time. The trends of life expectancy, infant mortality, health expenditures, and number of physicians are graphed as below:

[4] Pakistan Economic Survey (2016-17)

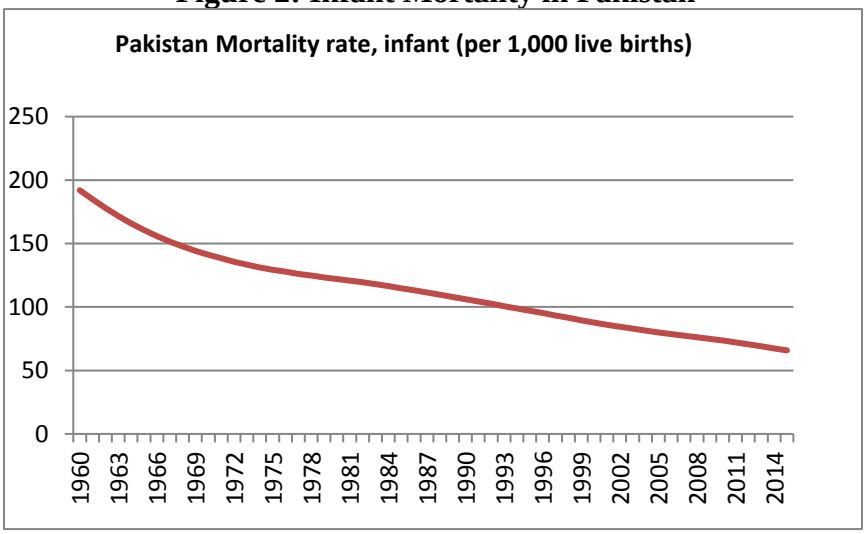
[5] World Development Indicators (2017)

Figure 1: Life Expectancy at birth in Pakistan



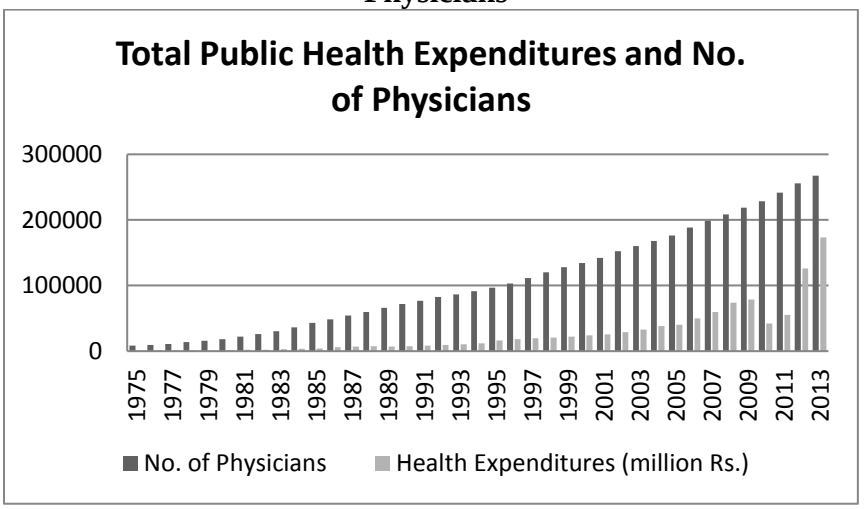
Source: Authors' Transformation on Data from World Bank (2015)

Figure 2: Infant Mortality in Pakistan



Source: Authors' Transformation on Data from World Bank (2015)

Figure 3: Total Public Health expenditures and Number of Physicians



Source: Authors' Transformation on Data from Pakistan Economic Survey (Various Issues)

In Figure 1, it is observed that life expectancy has increased from 46.43 years in 1960 to 66.4 years in 2015. It gives Pakistan a ranking of 127th in world life expectancy. Despite of increase in life expectancy rate, still low life expectancy rate prevails in Pakistan that is 66.4 years as compared to 89.52 years, 84.74 years, 84.68 years, and 84.51 years in Monaco, Japan, Singapore, and Macau respectively. In Figure 2, it is seen that the infant mortality rate has decreased from 192/1000 live births in 1960 to 66/1000 live births in 2015. Like life expectancy, it is observed that infant mortality rate has decreased but it is still very high with 66/1000 live births as compared to a very close neighbour country that is China with 2/1000 live births. The UNICEF report of 2014 states that with 8.6% infant mortality rate Pakistan is among countries with highest infant mortality in world.

In Figure 3, overtime health expenditures and total number of registered physicians are shown. The total public health expenditure has increased. The government has kept share of health expenditures very low thus it has not met the current

requirements. The total public health expenditures have increased from Rs.24.28 billion in 2001 to Rs.173.42 billion in 2013. The massive floods of 2010 in Pakistan caused the decrease in total health expenditures because of the funds which were spent on relief and rehabilitation effort. The total public health expenditures declined from Rs.79 billion in 2009-10 to Rs.42 billion in 2010-11. The health expenditures of Pakistan remained between 0.5-0.8 percent of GDP during 1970-2007. The number of physicians has increased due to the educational awareness but this increase is not satisfactory for population requirements. As of FY2016, there are 184,711 doctors and 16,652 dentists. If the ratio of doctor and dentist to population is observed; it is one doctor per 1,038 individuals and there is one dentist for 11,513 individuals showing a clear inadequacy.

On the other hand the trade policy and trade situation have shown many changes with respect to time. The trade situation in Pakistan could be analyzed through exports and imports trends overtime, observe these graphs:

Figure 4: Trend of Exports of Pakistan

Source: Authors' Transformation on Data from World Bank (2015)

Figure 5: Trend of Imports of Pakistan

Source: Authors' Transformation on Data from World Bank (2015)

In Figure 4, it is seen that exports have rose from $20,143 million to $20,997 million in 2013 to 2014. Not only there is moderate growth in exports, but also ups and downs are observed overtime. The reason could be that in early years, Pakistan was exporting agricultural and primary products while now its exports have been changed to manufactured and semi- manufactured products. Pakistan's exports base and markets are extremely narrow. Cotton group alone contributes 55% of share in it. Before separation Pakistan was exporter of many agricultural and edible products like jute, cotton, fish and rice as East Pakistan was based on agriculture but after separation major exports also got separated.

If Figure 5 is compared with Figure 4, it is observed that Pakistan on every point imports are more as compared to exports. In 2014, the imports were of $37,104.50 million which is very high than the exports. Imports of Pakistan depend upon different situations in the country. The flood and drought situation causes more imports of agricultural and edible commodities while crisis in energy sector, industrial sector etc. cause higher imports of machineries.

On the trade policy side, the sequence of trade regimes has changed many times; if tariffs and management of exchange rate are observed. Zaidi (2005) stated that initially Pakistan managed exchange to a fixed level, after Korean War started Pakistan's trade policy liberalized to 85%. The liberal trade regime of Pakistan formally began in 1977-88, the free list was increased by adding 91 more items in it. The tariffs were reduced from 77% to 66%. Under Structural Adjustment Programme 1988, trade liberalization was done extensively; maximum tariff was reduced from 225% to 90% in 1988. The formation of WTO[6] had not significantly affected trade in Pakistan, as most trade reforms were made before it. The trade policy announced in 1996-1997 was encouraging exports and further liberalizing imports to improve trade balance situation in Pakistan; the Rupee was twice devalued under managed floating system, textile exports promoted through textile quota system introduction, tariff rates reduced from 65% to 45%.

Pakistan external trade had a strong growth recovery through fiscal year 1999-2000. The trade policy adopted in 2007-09 was also continuation of export led growth strategy in which emphasize was on; improved market access, trade promotion infrastructure strengthening, improving skill development and provision of state in art physical structure. After the approval of the Cabinet on January 30, 2013, the Ministry of Commerce of Pakistan launched STPF[7] 2012-2015. This trade policy framework was formed on the main targets of reducing unemployment and poverty in Pakistan by producing and exporting more diversified products to international market. The main feature to be noticed is that the trade policy of Pakistan has been kept on changing in short term thus showing no persistent long term effects. The trade policy of Pakistan has liberalized sharply, which caused loss to domestic producers as they faced higher competition.

[6] World Trade Organization
[7] Strategic Trade Policy Framework

3. Literature Review

There is available literature which investigated the effect of trade openness on health indicators for developed as well as underdeveloped countries. Sapkota (2011) studied the effect of globalization on quality of life. The impact was analyzed particularly on human development, gender development and poverty in developing countries. Applying Fixed Effect Model on the panel of 124 countries for nine years from 1997; the results suggested that globalization has significant impact on human poverty and it positively affects human and gender development. Stevens, Urbach, and Wills (2013) investigated the effect of trade openness on health using fixed effect model on panel data. The empirical results revealed that free trade appear to be associated with better health outcome particularly for lower income countries. Further this study theoretically suggested two mechanisms which might lead to this relationship. One mechanism is that trade promotes economic growth, which then provides greater opportunity to public authorities to spend on health sector of the economy. Second mechanism is that knowledge spill over effects will occur, which means increased knowledge and product diffusion is increased that is from basic germ theory to the modern pharmaceutical medicines and medical treatments.

Globalization can be further divided into dimensions like economic, social, and political dimension. Tsai (2007) used dialectical model and empirically tested the direct and indirect impact of global flows on human welfare. Using wide globalization measure and Random Effect Modeling on three wave panel data for time period 1980-2000 the results were drawn. The results showed significant positive impact of political globalization, while economic and social globalization have no clear effect when developmental level and regional differences are operated as controls. Globalization has significant impact on HDI. Limitations of study are that QOL[8] is not measured in

[8] Quality of Life

subjective well-being due to data scarcity and empirical assessment for full understanding of globalization human consequences is not done.

Bergh and Nilsson (2010) investigated the association between the dimensions of globalization (economic, social and political) and life expectancy. Study used panel of 92 countries for time period of 1970-2005. Using index of globalization, KOF index[9]; the results state that globalization has positive strong impact on life expectancy. There are some more findings drawn by using a procedure that removing high income countries from sample then re-estimating and gradually approaching to poor. These results say that when high income countries are there, then there is positive association; approaching to medium then insignificant relationship; and in poorest countries it is again significant and positive. The effect of social globalization is insignificant and political globalization impact is negative when it is significant.

The studies which used trade side of global integration are very significant for our analysis. Owen and Wu (2007) analyzed the relationship between a country's trade openness and several health outcomes. Using panel of 139 countries the Fixed Effect Approach was applied. The findings are that increased trade openness causes lower rates of infant mortality and higher average life expectancies. In rich countries this association is blurred but in developing countries results holds very much true. Trade may actually decrease international health disparities as gains are enjoyed primarily by poorest countries. Novignon and Atakorah (2016) studied the linkages of increased trade integration on health sector of the economies of forty two Sub-Saharan African countries. The study used three indicators of health that are life expectancy rate, infant mortality rate, and under five mortality rate. The results found that all health indicators improve with increased trade integration.

[9] See Dreher (2006)

Jurgenson and Burns (2004) studied structural factors impact of trade openness on water pollution and infant mortality. Both OECD and non-OECD countries are included. The study results suggested export commodity concentration has no direct effect on infant mortality but through water pollution, as it has significant positive impact on water pollution which in turn affect infant mortality rate. Moreover some studies suggest that trade can further be divided in types that is legal and illegal trade. Like Huynen et al. (2005) made conceptual analysis for the health effects of globalization. The resulting model explicitly visualized that globalization effects the institutional, economic and socio cultural, and ecological determinants of health. This study indicated that trade is of two kinds; legal and illegal trade. The legal trade benefits in terms of health but illegal like drug trade has negative impact on health.

There is a deficiency of literature for Pakistan in analysing the impact of trade on health as there are only a couple of studies which investigated impact of trade on health in Pakistan. Alam et al. (2015) examined the impact of trade openness and foreign direct investment on life expectancy by using time series data for Pakistan over the time period of 1972-2013. The results suggested that there is increase in life expectancy with increase in trade openness and FDI. Ali and Audi (2016) studied the effect of income inequality, environmental degradation, and globalization on life expectancy in Pakistan. By using ARDL approach, the results indicate that with increase in income inequality and environmental degradation there is decrease in life expectancy while with increase in globalization there is increase in life expectancy.

The narrow literature for Pakistan suggests that there is positive impact of trade openness on health but it is observed that they have not studied the impact of trade openness on health separately as there is also focus on impact of FDI, environmental degradation, and income inequality on health in Pakistan. Moreover the use of one indicator of health that is life expectancy can give less diverse results. The selective use of indicators use may bias the result towards one side. For this reason, by

investigating separately the effect of trade liberalization on health and by using more than one indicator of health, this study would serve as a baseline for further research in this topic.

4. Methodology and Estimation Technique

For the exploration of empirical results, first there is a need to specify methodology and estimation technique, which will be used in this study. The health indicators are affected by open trade regimes as suggested in literature (Bergh & Nilsson, 2010; Novignon & Atakorah, 2016; Owen & Wu, 2007). On one hand; literature shows that trade openness effects life expectancy positively, and infant mortality negatively, according to Owen and Wu (2007). While on the other hand, literature also supports that open trade impact is negative on life expectancy and positive on infant mortality according to Popkin (2006). The channel made by following literature is shown in Figure 6.

In Figure 6, channel indicates that health outcomes are both negatively and positively affected by trade liberalization. This study taking life expectancy rate and infant mortality rate as indicators of health. Our main focus in study is health relationship with trade liberalization, so the study takes model of Bergh and Nilsson (2010) and add lagged value of trade liberalization measure. Bergh and Nilsson (2010) stated that health indicators are affected after a lag as this specification reduces the bias from reverse causality. It is:

$$Health_t = f(TradeOpenness_{t-1}, Othercontrols_t)$$

Lynch et al. (1998) found strong effects of income on health indicators. Pamuk, Fuchs, and Lutz (2011) found strong effects of per capita gross national income on health indicators such as higher income leads lower infant mortality. Following this the per capita GDP is used as control variable in our study models. Grossman (1972) indicated that the medical health facilities are strong predictors of health status so this study includes total government expenditures (excluding health

expenditures), health expenditures, and number of physicians as controls in the models.

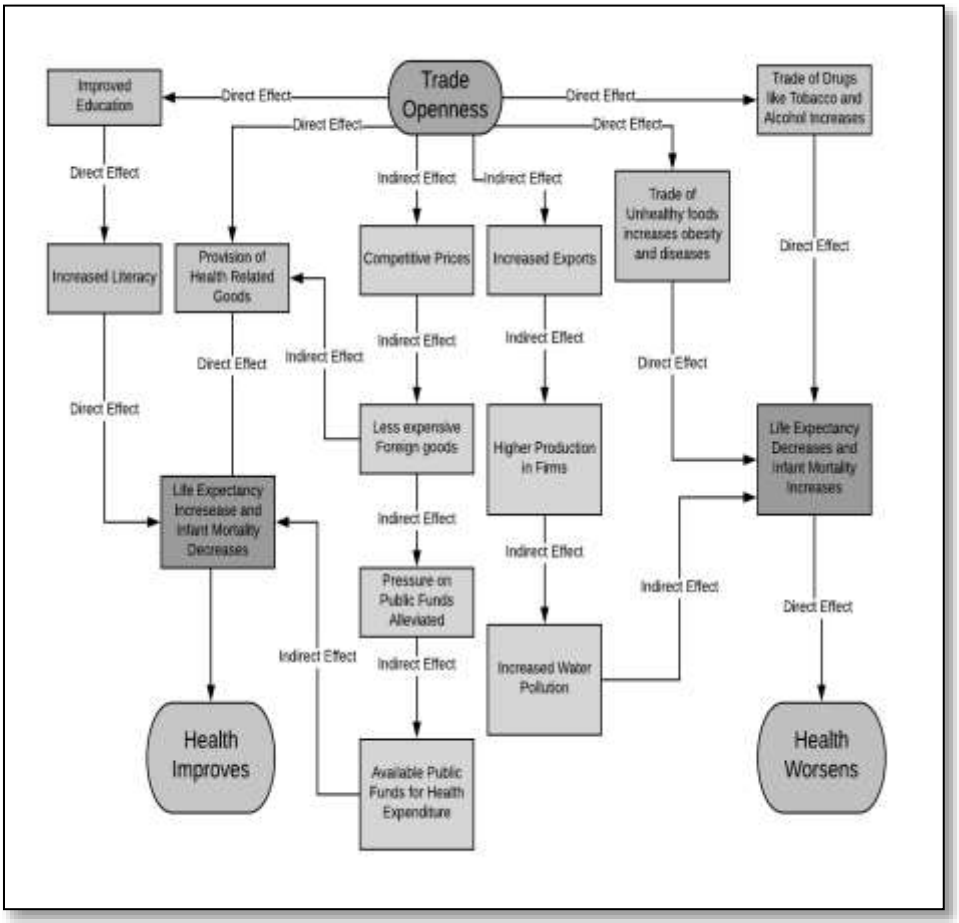
Further there is use natural log form of some variables as Benoit (2011) states that "*Logarithmic transformations are also a convenient means of transforming a highly skewed variable into one that is more approximately normal*". Thus the final modification of model is done by adding log of per capita GDP, total government expenditures (excluding health expenditures), log of health expenditures, and number of physicians and nurses in each equation:

$$LE_t = \gamma_0 + \gamma_1 lnPGDP_t + \gamma_2 T_{t-1} + \gamma_3 lnGE_t + \gamma_4 lnHE_t + \gamma_5 NP_t + \varepsilon_t \quad \textbf{(1)}$$

$$IM_t = \theta_0 + \theta_1 lnPGDP_t + \theta_2 T_{t-1} + \theta_3 lnGE_t + \theta_4 lnHE_t + \theta_5 lnNNU_t + \varepsilon_t \quad \textbf{(2)}$$

Where $lnPGDP_t$ = log of Per capita GDP, T_{t-1} = lag of Trade openness measured by trade to GDP ratio, LE_t = Life expectancy rate, IM_t = Infant mortality rate, $lnGE_t$ = log of Government expenditures (excluding health expenditures), $lnHE_t$ = log of Health expenditures, NP_t = Number of Physicians, and NNU_t = Number of Nurses.

Figure 6: Theoretical Linkage between Trade Openness and Health Indicators



Note: This is authors' analysis from available research (Huynen et al., 2005; Labonte et al., 2011; Owen & Wu, 2007; Popkin, 2006; Smith & Blouin, 2015) .

The specified models will be estimated with Ordinary Least Squares analysis. Error Correction Mechanism (ECM) is used to confirm the long run relationship of health and trade openness by observing sign and significance of lag error term. Further to confirm the cointegration among variables, Johansen Co-integration test approach is used. Stationarity of data is checked by Augmented Dickey Fuller (ADF) unit root test (which do not allow structural break) and Clemente, Montañés, and

Reyes (CMR) unit root test (which allows structural break). The Granger causality test is used to study the causal relationship between variables. Further for investigating the stability of models CUSUM test is applied. The Breusch Godfrey LM test is applied to test serial correlation. White's Heteroskedasticity test is done to test heteroskedasticity of the models.

5. Data

This study is using time series data of Pakistan over the time period of 1975-2016. The data for different variables is taken from Pakistan Economic Survey (various issues) and World development indicators (2017). As the study is studying the impact of trade liberalization on health outcomes; this needs variables for both exogenous and endogenous side. For trade liberalization measure, the study is using trade to GDP ratio in main models, while for robustness analysis this study has taken trade liberalization measures that are international trade tax revenue, exports to GDP ratio, and imports to GDP ratio. Life expectancy rate and infant mortality rate are used as health indicators.

For sensitivity analysis two variables will be included i.e. improved water facility and improved sanitation facility taken from UNICEF[10] data (2016). The data of these variables is available from 1990-2016. For convenience the listing of all variables used in the study with their form and sources is as:

[10] United Nations International Children's Emergency Fund

Table 1: Data Units and Sources

Variable	Form	Sources
GDP Per Capita (lnPGDP)	Constant 2010 U.S. dollars.	World development indicators (2017)
Life Expectancy at Birth (LE)	Years	World development indicators (2017)
Infant Mortality Rate (IM)	Death per 1000 births	World development indicators (2017)
Trade to GDP ratio (T)	Ratio	World development indicators (2017)
International trade tax revenue (TTR)	Million Rupees	Pakistan Economic Survey (various issues)
Exports to GDP ratio (EXP)	Ratio	World development indicators (2017)
Imports to GDP ratio (IMP)	Ratio	World development indicators (2017)
Health expenditures (lnHE)	Million Rupees	Pakistan Economic Survey (various issues)
Total Government Expenditures (Excluded Health Expenditure) (lnGE)	Million Rupees	Pakistan Economic Survey (various issues)
No. of Physicians registered (NP)	Number of people	Pakistan Economic Survey (various issues)
No. of nurses registered (NNU)	Number of people	Pakistan Economic Survey (various issues)
Total Population with Improved Water Facility (IWF)	Number of people	UNICEF Data (2016)
Total Population with Improved Sanitation Facility (ISF)	Number of people	UNICEF Data (2016)

6. Empirical Results

6.1. Unit Root Test

Before doing estimations this study checks the stationarity of the time series data as this study is using. The order of integration is checked for all variables individually. This study did Augmented Dickey Fuller unit root test (which do not allow structural break) and Clemente, Montañés, and Reyes unit root test (which allows structural break). The null hypothesis for both tests is that there is unit root against the alternative hypothesis that there is no unit root. The probability value of t-statistic will be observed. Both of the tests suggest that all variables are integrated at first order, as they fail to reject the null hypothesis at level and reject the null hypothesis at first difference form. This means that all variables has unit root at level while no unit root at first difference. The results are summarized in Table 2 and 3 for Augmented Dickey Fuller unit root test (which do not allow structural break) and Clemente, Montañés, and Reyes unit root test (which allows structural break) respectively:

Table 2*:* ADF Test Results

	Variable	ADF at Level	ADF at First Difference	Conclusion
1.	lnPGDP	0.19(0.96)	-3.46(0.01)	I(1)
2.	LE	0.46(0.99)	-2.57(0.10)	I(1)
3.	IM	-0.95(0.75)	-3.00(0.15)	I(1)
4.	T	-2.17(0.49)	-7.26(0.00)	I(1)
5.	TTR	2.61(1.00)	-1.85(0.06)	I(1)
6.	lnHE	3.92(0.99)	-5.96(0.00)	I(1)
7.	lnGE	-0.58(0.86)	-3.72(0.01)	I(1)
8.	NP	-1.57(0.48)	-3.33 (0.07)	I(1)
9.	NNU	-2.45(0.34)	-5.24(0.00)	I(1)

Variable	ADF at Level	ADF at First Difference	Conclusion
10. Exp	-0.67(0.96)	-5.89(0.00)	I(1)
11. Imp	-3.06(0.12)	-7.69(0.00)	I(1)
12. IWF	0.21(0.73)	-2.82(0.00)	I(1)
13. ISF	-0.94(0.93)	-3.80(0.03)	I(1)

Note: p-values are in Parentheses

6.2. Error Correction Model (ECM)

The variables are not stationary at level so there is need of a justification that there exists a long run relationship then this study can apply OLS on models. In ECM, the coefficient of lag of error is the feedback effect which shows the extent to which any disequilibrium in the previous period effects any adjustment in dependent variable. It has negative and significant sign in both main models as results show that there exists a long run association, thus this study applies OLS technique of estimation. The ECM estimated results for main models are in appendix (See Table A1).

Table 3: Clemente, Montañés, & Reyes Unit Root Test

Variable	CMR Test at Level	CMR Test at First Difference	Conclusion
1. lnPGDP	-3.13(0.60)	-4.35 (0.06)	I(1)
2. LE	-4.00(0.36)	-4.91(0.01)	I(1)
3. IM	-1.05(0.99)	-4.43(0.05)	I(1)
4. T	-2.99(0.69)	-7.55(0.01)	I(1)
5. TTR	-3.17(0.58)	-6.70(0.01)	I(1)
6. LnHE	-2.41(0.92)	-8.39(0.01)	I(1)
7. LnGE	-2.81(0.78)	-4.83(0.02)	I(1)
8. NP	2.84(0.99)	-5.62(0.01)	I(1)

Variable	CMR Test at Level	CMR Test at First Difference	Conclusion
9. NNU	2.21(0.99)	-5.09(0.01)	I(1)
10. Exp	-1.83(0.99)	-6.14(0.01)	I(1)
11. Imp	-3.56(0.34)	-7.94(0.01)	I(1)
12. IWF	-3.47(0.39)	-4.48(0.04)	I(1)
13. ISF	-2.45(0.91)	-4.35(0.06)	I(1)

Note: p-values are in Parentheses.

6.3. Johansen Cointegration Test

For confirmation of log run relationship further the study applies Johansen Cointegration test. It is to check whether there is cointegration relationship among variables or not. In Johansen Cointegration test purpose is to determine whether a group of non-stationary series is cointegrated or not. All variables are integrated of first order so the pre requisite of the test is fulfilled. The results of our models for Johansen Cointegration test are:

Table 4: Johansen Cointegration Test on Main Models

Models	Hypothesized No. of CE(s)	Eigen value	Trace Statistic	5% Critical Value	Prob.
1.	None	0.76	161.93	95.75	0.000
2.	None	0.69	146.08	97.75	0.000

The results for cointegration test show that all both models fail to reject the null hypothesis at 5% significance level. The conclusion is that variables have cointegration relationship. Now the study move towards the OLS results which similar to the normalized coefficients may represent the long run estimates as their residuals are stationary at level allowing for weak exogeneity.

6.4. OLS Results

The OLS estimation results are summarized in Table 5 for the models previously explained in methodology of this study. The first column is for equation one with dependent variable life expectancy rate; and second column is for equation two with dependent variable infant mortality rate. The value of R^2 is 0.99 for both equation one and two respectively. This study has taken trade to GDP ratio as an indicator of trade liberalization. Further it has taken three more proxies i.e. exports, imports and international trade taxes for robustness analysis.

Table 5: Parameters Estimates of OLS model

Variables	Life Expectancy EQ1:LE	Infant Mortality EQ2:IM
Intercept	20.19 (3.83) ***	326.99 (4.91) ***
LnPGDP	2.66 (2.06) **	-14.01 (-0.88)
T_{-1}	-0.057 (-2.42) **	0.47 (2.66) **
NP	-0.0001(-2.3) **	-
NNU	-	0.001 (1.31)
lnHE	0.26 (1.67) *	-1.52 (-1.16)
lnGE	1.84 (5.81) ***	-10.89 (-3.20) ***
R Squared	0.996	0.993
Observations	42	42
F-Statistic	2017.36	1041.21
Prob (F-Statistic)	0.000	0.000

Note: The *, **, and *** shows significance at 10%, 5%, and 1% respectively and t-statistics for coefficients are in parentheses

The trade to GDP ratio shows significant coefficient of negative sign with life expectancy. The 1% increase in trade to GDP ratio decreases life expectancy by 0.057 years. The impact of trade to GDP ratio on infant mortality is positive and significant at 10 percent significance level; there is 0.47 units increase in infant mortality rate due to 1% increase of trade to GDP ratio. The results are consistent with Cornia et al. (2007) and Jorgenson and Burns (2004) while inconsistent with studies that are: Owen and Wu (2007), Tsai (2007), Bergh and Nilsson (2010), Alam et al. (2015) and Ali and Audi (2016). Our result

contradicts the conclusion of a part of previous research, which predicted positive impact of trade openness. Our focus is especially on the result of Alam et al. (2015) and Ali and Audi (2016), which are specifically for Pakistan. These studies claimed the positive impact of trade openness on health status in Pakistan which is opposite to our results.

The negative impact of trade openness on health measures might be due the illegal or demerit goods trade problem indicated in Huynen et al. (2005). Labonte et al. (2011) states that increased trade causes adverse effects on health, due to increased trade of health damaging products for example tobacco, alcohol and unhealthy foods occurs. This negative impact of trade openness on health indicators can also be due to increased artificial and inorganic methods of cultivation adopted from increased trade as there is increase in imports of insecticide, pesticides and artificially growing methodologies and instruments. Rafique, Iqbal, Faiz, and Hashmi (2009) by using imported canned food items sample suggested that that there is high concentration of harmful metal elements in canned food. Thus it could be the reason that preservatives used in canned and processed food imported are harmful for health; they contain chemicals which cause many dangerous diseases. Furthermore trade in goods particularly in food categories like edible oils, calorie-rich and nutrient poor food, fatty meats, and ultra-processed snack foods will increase the concerns of obesity and non-communicable diseases (Blouin et al., 2009; Friel et al., 2013). Increased trade cause availability of highly processed foods due to which there is harm to health of people in the form of obesity (Popkin, 2006).

Infant mortality increases due to an increase in trade is a serious matter of concern. In Pakistan there is high production of fake medicine and powdered milk which is sold in the name of imported medicines. The illegal fake drugs market is highly established in Pakistan which is causing high risk to the new born children. The reports of medicine manufacturers of the EU and US Trade Office have indicated that nearly 50% of the drugs sold in Pakistan are counterfeit (Nishtar, 2006). The control variables are showing correct signs, the effect of government expenditures,

health expenditures and number of physicians in country is positive on life expectancy and negative on infant mortality.

6.5. Sensitivity Analysis

The study will do sensitivity analysis by adding the two main indicators of health status. Esrey, Potash, Roberts, and Shiff (1991) indicated that there is strong literature evidence which investigated the effect of water supplies and excreta disposal facilities on health. It further suggested that research have reported positive impacts of improved water supplies and sanitation facility of health status. Due to the data availability of water and sanitation facility this study will do analysis from 1990 to 2016 with two variables i.e. total population with improved water facility and total population with improved sanitation facility. The Error correction model and Johansen cointegration test for the sensitivity analysis have been reported in appendix (See Table A2 and A3). The lag of error is significant and negative in both models suggesting that there error correction mechanism. While Johansen cointegration test also suggests that there exists long run relationship among variables. Thus the study reports sensitivity analysis in Table 6.

In Table 6, it has given our main model's sensitivity analysis. One model is with dependent variable life expectancy and other is with dependent variable infant mortality. It is observed that the sign and significance of our focused relationship of study is still similar after including more control variables and changing data time period. The effect of trade openness is negative and significant on life expectancy while positive and significant on infant mortality. One unit increase in trade to GDP ratio decreases life expectancy by 0.01 years with 10% significance level. There is 0.08 units increase in infant mortality with one unit increase in trade to GDP ratio and it is significant on 5% significance level. The coefficients have decreased intensity but the sign and significance are same, thus showing the robustness of our results.

Table 6: Sensitivity Analysis Parameters Estimates of OLS model

Variables	Life Expectancy	Infant Mortality
	EQ1:LE	EQ2:IM
Intercept	51.22 (26.13) ***	185.80 (10.16) ***
lnPGDP	-0.06 (-0.22)	-7.05 (-2.49) **
T_{-1}	-0.014 (-1.97) *	0.081 (2.11) **
NP	0.001 (4.8) ***	-
NNU	-	-0.001 (-0.85)
lnHE	-0.087 (-2.28) **	0.03 (0.10)
lnGE	0.16 (1.972) *	2.28 (2.88) ***
IWF	0.001 (20.8) ***	-0.001 (-18.10) ***
ISF	-2.52 (-5.7) ***	0.001 (2.8) **
R Squared	0.999	0.999
F-Statistic	10924.25	2065.27
Prob (F-Statistic)	0.000	0.000

Note: The *, **, and *** shows significance at 10%, 5%, and 1% respectively and t-statistics for coefficients are in parentheses.

6.6. Robustness Analysis

This study has done OLS estimation with one proxy of trade i.e. Trade to GDP ratio but there is a need to check that how are these health indicators are affected by other trade measures. The proxies which the study will compare are trade to GDP ratio, exports to GDP ratio, imports to GDP ratio, and international trade tax revenue. This study will compare effect of different proxies on both models one by one. The Error Correction Models are reported in appendix (see Table A4 and A5). The robustness analysis for life expectancy model is in Table 7:

Table 7: Robustness Analysis for Life Expectancy Model

Variables	**LE**	**LE**	**LE**	**LE**
Intercept	20.19***	18.35***	29.93***	24.42***
	(3.837)	(3.26)	(5.43)	(6.76)
lnPGDP	2.66**	2.92**	1.37	2.37***
	(2.06)	(2.31)	(1.106)	(2.76)
lnGE	1.84***	2.12***	1.457***	1.62***
	(5.81)	(6.33)	(4.64)	(7.69)
lnHE	0.26*	0.33*	0.24	0.21*
	(1.67)	(1.93)	(1.38)	(1.78)
NP	-0.000**	-0.00**	0.00	-0.00**
	(-2.33)	(-2.60)	(0.67)	(-2.00)
T_{-1}	-0.057**	-	-	-
	(-2.42)			
TTR_{-1}	-	-0.576***	-	-
		(-2.77)		
EXP_{-1}	-	-	0.06**	-
			(2.52)	
IMP_{-1}	-	-	-	-0.075***
				(-7.02)
R-Squared	0.996	0.995	0.995	0.997
F-Statistic	2017.365	1706.50	1647.66	3373.79
Prob (F-Statistic)	0.000	0.000	0.000	0.000

Note: The *, **, and *** shows significance at 10%, 5%, and 1% respectively and t-statistics for coefficients are in parentheses

In Table 7, it is observed that the negative and significant effect of trade to GDP ratio and trade taxes on life expectancy. These two proxies are opposite to each other while they have similar results so it can be said that trade liberalization and trade restriction are showing conflicting results. Exports to GDP ratio show significant positive impact while import to GDP ratio show significant negative impact on life expectancy. The increased imports will cause more harm to life expectancy than its benefits. These results are not robust to the measures used thus this study

concludes that trade measure is critical in this analysis. For infant mortality model the results are shown in Table 8.

Table 8: Robustness Analysis for Infant Mortality Model

Variables	IM	IM	IM	IM
Intercept	326.99***	358.51***	264.68***	311.89***
	(4.91)	(8.26)	(5.54)	(9.41)
lnPGDP	-14.01	-17.96*	-5.81	-15.82**
	(-0.88)	(-1.83)	(0.59)	(-2.02)
lnGE	-10.89***	-15.66***	-7.66***	-8.46***
	(-3.20)	(-6.28)	(-2.86)	(-4.74)
lnHE	-1.52	-2.31*	-1.74	-1.29
	(-1.16)	(-1.77)	(-1.16)	(-1.21)
NNU	0.00	0.00***	-0.00*	-0.00
	(1.31)	(2.86)	(-1.78)	(-0.44)
TTR_{-1}	-	7.20***	-	-
		(4.44)		
EXP_{-1}	-	-	-0.64**	-
			(-2.63)	
IMP_{-1}	-	-	-	0.655***
				(6.95)
R-Squared	0.993	0.993	0.992	0.996
F-Statistic	1041.21	1148.796	878.38	1751.94
Prob (F-Statistic)	0.000	0.000	0.000	0.000

Note: The *, **, and *** shows significance at 10%, 5%, and 1% respectively and t-statistics for coefficients are in parentheses

Trade to GDP ratio increase causes increase in infant mortality while trade restriction increase through trade taxes also increases infant mortality rate in country. The increased exports show significant negative effect on infant mortality while increased imports show significant positive impact on infant mortality. Thus in the infant mortality model again results are conflicting.

The study concludes from the above results that relationship of trade openness and health is highly sensitive to the use of trade measures. Our robustness analysis is showing consistency with earlier findings of Harrison (1996) and Greenway, Morgan, and Wright (2002), which stated that choice of time period and trade measures are important for study findings.

6.7. Tests and Diagnostics

To check autocorrelation, heteroskedasticity, and stability tests were applied. This study have also applied Granger causality test to confirm the causality among variables. The time series data has expected autocorrelation, so this study did the serial correlation LM test as shown in Table 9a:

Table 9a: Serial Correlation LM Test

Model No.	F statistic	Prob. (F stat)	Conclusion	Solution
1.	9.97	0.000	Auto correlation	Newey-West HAC
2.	19.18	0.000	Auto correlation	Newey-West HAC

Models reject null hypothesis of no autocorrelation with significance level of 5%, thus the study applied Newey-West HAC, so results do not get spurious due to this problem. This study did test to check heteroskedasticity that is White's heteroskedasticity test as shown in Table 9b:

Table 9b: White's Heteroskedasticity Test

Model No.	F statistic	Prob. (F stat)	Conclusion
1.	2.01	0.10	No Heteroskedasticity
2.	2.17	0.07	No Heteroskedasticity

It is found that both main models fail to reject the hypothesis at 5% significance level. There is no heteroskedasticity while the estimations are done under Newey-West HAC, so standard errors and t- stats are not affected by heteroskedasticity if it exists in any case. CUSUM stability test plots the recursive residuals cumulative sum of model together with the 5% critical lines.

The test indicates parameter instability if the cumulative sum goes outside the area of two critical lines. In this study first model have shown stability as their cumulative sum of recursive estimates lies between the 5% critical lines while second model is sensitive to regime change, the graphs are shown in Figure 7 and 8.

In addition, the causality is tested between health indicators and trade measures by Granger causality test. The lag order is 2 lags, selected by Likelihood ratio, Final prediction error, Schwartz Information, and Hannan-Quinn information criteria. There is no causality between trade and life expectancy while there is unidirectional causality is from trade to GDP ratio to infant mortality rate. Table 10 shows the results as:

Figure 7: Model 1 CUSUM Test

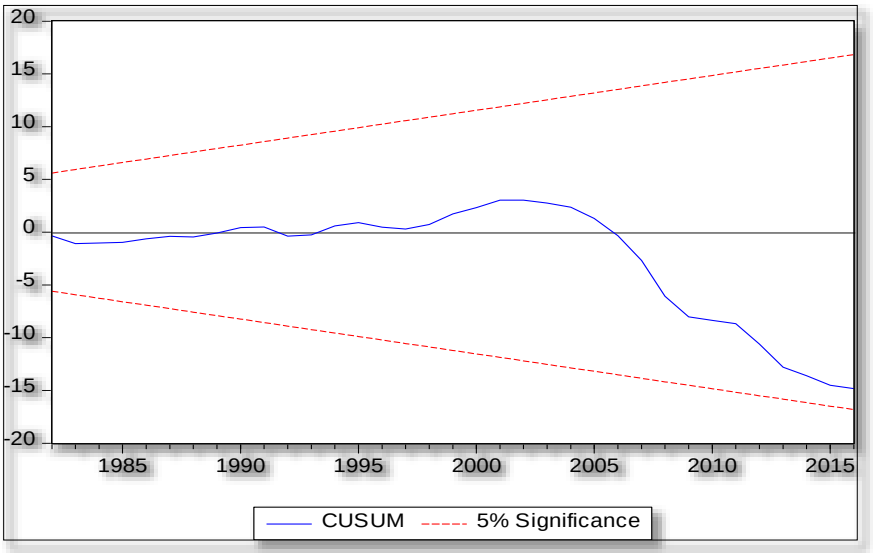


Figure 8: Model 2 CUSUM Test

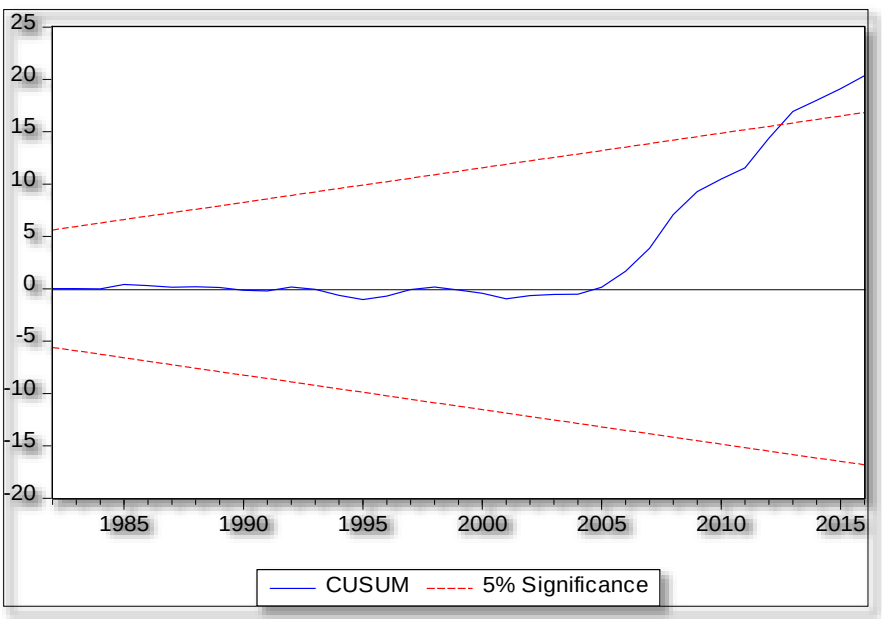


Table 10: Granger Causality Test

Null Hypothesis	Obs.	F-Statistic	Probability
T does not Granger Cause LE	40	0.22	0.80
LE does not Granger Cause T	40	1.19	0.31
T does not Granger Cause IM	40	4.07	0.02
IM does not Granger Cause T	40	2.70	0.10

7. Conclusion

By using more indicators of health that is life expectancy and infant mortality rate, the study found that there is negative effect of trade liberalization on health in Pakistan. The results suggest that trade to GDP ratio increases infant mortality and decreases life expectancy. This might be due to the artificial methods of production and increased trend of canned food, which are dangerous for health in country. Rafique et al. (2009) indicated that there is high concentration of harmful metal elements in canned food.

The other reason of this negative effect of trade on health can be that increased trade may give rise "Fake Medicine Crisis". Increase in trade can cause more production and sale of fake medicines in the country, as the imported medicines are imitated. So counterfeit medicines are produced and sold in name of being imported one. As also indicated earlier that reports have shown that nearly 50% of the drugs sold in Pakistan are counterfeit (Nishtar, 2006).

In robustness analysis of these models using four different trade measures (trade to GDP ratio, exports to GDP ratio, imports to GDP ratio, and international trade taxes); all of them are showing different results. The effect of both trade to GDP ratio, and trade taxes on life expectancy is negative and significant while on infant mortality both have positive and significant impact. Thus it is concluded that trade liberalization and trade restriction are showing conflicting results. Exports to GDP ratio show significant positive impact while import to GDP ratio show

significant negative impact on life expectancy. The increased exports show significant negative effect on infant mortality while increased imports show significant positive impact on infant mortality. So it is observed that results are highly sensitive to trade measures in the model.

This study concludes that trade liberalization affects health outcomes negatively in the case of Pakistan. The health situation of country should be taken seriously as it is very important in determination of human capital of the country. There is a need of restriction on that type of commodities which affects health negatively. Furthermore trade and health relationship is not automatic rather it depends on careful arrangement of policies of governments to ensure the development in country. The complementary policies are needed to translate the true effects of trade.

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Annexure A

Table A1: Estimated Error Correction Mechanism of Main Model

Dep. Variable	Life Expectancy	Infant Mortality
Variables	Coefficient	Coefficient
Intercept	0.311***	-1.877***
LnPGDP	0.268	0.625
T_{-1}	-0.004*	0.016
LnGE	0.111	0.722*
LnHE	0.006	-0.104
NP	-0.0001***	-
NNU	-	0.001***
Lag of Error	-0.101***	-0.044***
R-squared	0.657	0.50
F-Statistic	10.57	5.353
Prob(F-Statistic)	0.000	0.001

Note: *, **, & *** shows significance at 10%, 5%, & 1% respectively.

Table A2: Estimated Error Correction Mechanism of Sensitivity Analysis Models

Dep. Variable	**Life Expectancy**	**Infant Mortality**
Variables	Coefficient	Coefficient
Intercept	0.26***	-1.42***
lnPGDP	-0.74**	-0.325
T_{-1}	-0.001	0.016
LnGE	0.128*	1.42**
LnHE	-0.010	0.09
NP	-0.001	-
NNU	-	0.001
IWF	0.001	-0.001*
ISF	-0.001*	0.008**
Lag of Error	-0.193*	-0.117*
R-squared	0.64	0.51
F-Statistic	3.80	2.20
Prob (F-Statistic)	0.01	0.08

Note: *, **, & *** shows significance at 10%, 5%, & 1% respectively.

Table A3: Johansen Cointegration Test on Models of Sensitivity Analysis (1990-2016)

Models	Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.
1.	None	0.999	574.78	159.52	0.000
2.	None	0.999	498.46	159.52	0.000

Table A4: Estimated Error Correction Mechanism of Robustness Analysis Models (Life Expectancy)

Dep. Variable	Life Expectancy	Life Expectancy	Life Expectancy	Life Expectancy
Variables	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	0.311***	0.318***	0.313***	0.307***
lnPGDP	0.268	0.165	0.060	0.128
LnGE	0.111	0.083	0.122	0.144*
LnHE	0.006	-0.0033	-0.01	0.001
NP	-0.0001***	-0.001***	-0.001***	-0.001***
T_{-1}	-0.004*	-	-	-
TTR_{-1}	-	-0.002	-	-
EXP_{-1}	-	-	0.002	-
IMP_{-1}	-	-	-	-0.004
Lag of Error	-0.101***	-0.08***	-0.06**	-0.09**
R-squared	0.657	0.636	0.584	0.563
F-Statistic	10.57	9.62	7.72	7.09
Prob (F-Statistic)	0.000	0.000	0.000	0.000

Note: *, **, & *** shows significance at 10%, 5%, & 1% respectively

Table A5: Estimated Error Correction Mechanism of Robustness Analysis Model Life Expectancy

Dep. Variable	**Infant Mortality**	**Infant Mortality**	**Infant Mortality**	**Infant Mortality**
Variables	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	-1.877***	-1.92***	-1.89***	-1.85***
lnPGDP	0.625	1.036	1.186	0.793
lnGE	0.722*	0.68	0.73*	0.58
lnHE	-0.104	-0.06	-0.05	-0.10
NNU	0.001***	0.001***	0.001**	0.001**
T_{-1}	0.016	-	-	-
TTR_{-1}	-	0.19	-	-
EXP_{-1}	-	-	-0.01	-
IMP_{-1}	-	-	-	0.029**
Lag of Error	-0.044***	-0.02**	-0.03**	-0.06***
R-squared	0.50	0.40	0.47	0.51
F-Statistic	5.353	3.545	4.866	5.738
Prob(F-Statistic)	0.001	0.01	0.001	0.001

Note: *, **, & *** shows significance at 10%, 5%, & 1% respectively.