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TRADE LIBERALIZATION'S INFLUENCE ON HEALTH STATUS IN DEVELOPING ECONOMIES: THEORETICAL INSIGHTS AND REAL-WORLD IMPLICATIONS

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This paper examines the health status of developing nations in the context of liberalization. In the existing literature, trade openness and foreign direct investment (FDI) are often considered substitutes, with one being prioritized over the other to address health issues in developing countries (Chatterjee et al., 2022). Our study presents new evidence by viewing trade openness and FDI as complementary. Theoretically, we use a general equilibrium trade model based on the Heckscher-Ohlin-Samuelson-Venak framework, while static and dynamic panel data approaches are applied empirically. Our sample includes 51 developing countries across Asia, Africa, and Latin America from 1980 to 2019. The findings provide policy recommendations that emphasize trade liberalization to improve health outcomes, particularly life expectancy and infant mortality. Additionally, health-specific trade liberalization is suggested for African and Latin American nations, as economic growth through liberalization can strengthen domestic health infrastructure.

Keywords: Health Status, Foreign Direct Investment, Openness, International Trade, Panel Data
JEL Classification: I11, I15, F11, F13, C23, D58

1. INTRODUCTION

Health of a particular nation is categorically defined in terms of three different forms, namely, quality of life, health care and health status. Among these quality of life and

health care system are the twin force of engine for overall health of a nation, whereas, health status is the outcome of the said forces (Mudu, 2004; Turner, 2007). Therefore, like economic status which illustrates economic conditions of an economy, health status also depicts health conditions of general population of the representative economy. Now such health conditions or scenarios mostly depend upon the ongoing economic activities surrounding the health periphery of a representative economy. It is historically evidenced that health augmented economic policies are efficiently implemented in developed countries and as a result of which the world observes heightened health status for the said group of economies (Bussmann, 2009; Bergh and Nilsson, 2010). However, the other part of the world economy represented by so-called less developed or developing countries are usually characterized by poor health status (Deaton, 2003; Herzer and Nunnenkamp, 2015). In view of developing nation's position as one of the main caterer of overall population of the world and its status as a fast growing economy with high degree of trade liberalization (Bhagwati, 1984), it is a fact that proper economic policy engagement on health has not been observed. As a reason of such poor health status, economists often blame on biased non-health growth activities along with poor health infrastructure of developing economies (Jorgenson, 2009; Mirza, 2004). Therefore, it is vital, to conduct a study to identify the relationship between trade and population health status for developing economies.

Higher population health status via better health infrastructure can be achieved only by investing efficiently in health sector of developing economy (Mushkin, 1962; Grossman, 1972). Investment in health is possible only through capital formation in the domestic health sector. Now as developing economies are often described in terms of lack of capital endowment, hence foreign direct investment in domestic health becomes almost mandatory in order to revamp health infrastructure in developing economies (Sampson and Snape, 1985). Domestic health of developing nations can attract foreign investors if host economy can portray its image as a real open economy to the rest of the world. Increased trade openness may improve export and import of health services owing to different supply channels in the representative developing economy (Chanda, 2001), however, domestic health infrastructure may remain deficient even after adaptation of open image. Moreover, open economy with good governance and transparent health policy may help health sector to cope up with higher health status via domestic capital accumulation in health of developing nations (Bergh and Nilsson, 2010; Jacob and Boateng, 2016). Now such increase in health status depends solely upon the availability of capital. Developing countries are historically suffering from lack of capital. Therefore, offering of increased openness without foreign investment may not provide enough scope for the health sector to enhance population health status (Levine and Rothman, 2006). Again, open economy image may encourage foreign investment in health sector of a developing economy and as a consequence better health status can be achieved via improved health infrastructure (Alsan et al., 2006). However, poor health status can be an unfortunate outcome if such inflow of foreign investment is directed to non-health sector (Rafat et al., 2013).

The above-stated arguments have a clear narrative, that is, health status of any developing economies is subjected to the availability of resources to health and adaptability of trade liberalization policies to health. Furthermore, in economic terms these arguments implicitly consider liberalization policies, such as trade openness and

foreign direct investment as substitute with each other, at least in the context of health status of developing countries. In fact, to meet the capital shortage via inflow of foreign direct investment (FDI hereafter) in health, or changes in the direction of inflow of foreign direct investment from non-health to health or domestic capital accumulation in health sector following increased openness, may affect health status positively in developing countries. However, arguments in favour of such trade policies (Martens, Akin, Huynen and Raza, 2010; Dithmer and Abdulai, 2020; Chatterjee and Dinda, 2022) and against of the same (Mirza, 2004; Herzer and Nunnenkamp, 2012) can create confusions among the policymakers before adaptation of trade liberalization to improve health status in developing nations. To eliminate such ambiguity, policymakers of developing regions can consider both trade liberalization responses as complement with each other rather than substitute in nature to enhance health status. Therefore, to get better health status either, increased trade openness may bring technological progress in domestic health via technology transfer from North to South, which in turn may attract foreign investors to invest in health of developing nations, or, profit earned from non-health sector following foreign direct investment may insist policymakers to open health sector to rest of the world in order to attract supply of both medical resources and capital.

Under such backdrop, we first wish to create a theoretical background in order to find economic arguments or channels through which international trade and health status are associated in the context of developing economies. To perform this we consider General Equilibrium (GE hereafter) trade framework in order to establish the above mentioned hypothesis with economic intuitions. Our theoretical model reveals that the presence of complementarities between FDI and Openness is crucial in order to detect health of a developing nation rather by enforcing too much importance on isolated roles of FDI inflow and openness. Next, we conduct a quantitative assessment of the just-mentioned hypothesis based on standard econometric tools. In this regard, we have used the interaction between FDI inflow and openness as an additional measure of trade and by doing so, we have treated them as complement with each other. Specifically, we estimate the combined effects of inflow of FDI and openness on health status in the 51 selected developing countries for the period of 1980–2019 and additionally, the separate effects of trade on health in different geographical regions, namely, Asia, Africa and Latin America.

We believe that our paper contributes to the literature in following ways. First, this study tests the hitherto commonly untested trade variables such as interaction between FDI inflow and openness of countries in understanding the effects of trade on health status. In fact, such relationship has been established theoretically, however, its empirical validation has not been tested yet. The issue of such relationship between trade openness coupled with FDI flow has not been seriously researched in the context of the developing countries, that is, openness and FDI inflow are made complement to each other in order to establish the robust association between trade and population health. Second, on the backdrop of the said complementarity, the present paper uses the battery of GE technique to critically evaluate its presence at the wide bed of theory and prescribe different policy prescriptions for developing nations in the continents of Asia, Africa and Latin America. Third, this research is the first of its kind in studying the association between trade and population health status in developing nations in the

southern hemisphere of the global map using large panel data sources. Aforementioned set up gives us the opportunity to throw some lights in the way of policymaking by challenging the argument that uniform trade policy measure can't optimize the health status of all developing countries, rather, policy measures should be continent-specific or region specific.

The paper is organized as follows. Section 2 considers the review of related literature. Section 3 provides the theoretical model and its analysis. Sections 4 and 5 describe our econometric model, data and the econometric methodology. In Section 6, the main results and various robustness tests are also discussed and Section 7 concludes.

2. LITERATURE REVIEW

By virtue of our paper, here we wish to focus solely to the literature on health and trade liberalization [1]. There is extensive literature on the association of trade liberalization in terms of either foreign direct investment or trade openness and health status for both developed and developing economies. In this section we want to concentrate on both empirical and theoretical existing studies on the said association. Generally, the empirical studies on the relationship between FDI inflows (or trade openness) and health status can be divided into two major groups. The first group focuses on the country-specific studies, while the other group focuses on multi-country studies, and finally, literature with theory are also endorsed.

2.1. Program Country-Specific Studies

We begin our review with the outcomes of country-specific studies in the literature about the association between trade liberalization (either in terms of FDI inflow or increased trade openness) and health status. For instance, Gupta and Goldar (2004), Lautier (2008), Khatun and Ahamad (2012), Ali and Audi (2016), Alam, Islam, Sahazad and Bilal (2020) have revealed positive impact of trade liberalization on health status for India, Tunisia, Bangladesh, Pakistan and Bangladesh respectively, while, Mirza (2004) has found adverse effect of liberalization on health status in case of Pakistan. Gupta and Goldar (2004) have shown that foreign investment in Indian hospital sector improves the health status following health sector goals of India, whereas, Mirza (2004) has found the presence of inequality in services augmenting with fragmented public health system in Pakistan and following this poor health status owing to FDI inflow. Again, Lautier (2008) has claimed regional dimension of external demand for domestic health sector

[1] For detail review on health and FDI one can go through Smith (2004) and Burns, Jones and Merck (2016).

via increased trade openness as the responsible factor for health status enhancement in Tunisia, while, improvement of integrated health service mechanism via increased openness is claimed as the responsible factor for better health status in Bangladesh (Khatun and Ahamad, 2012). In a similar study, Ali and Audi (2016) have proposed a similar positive effect of international trade in terms of trade openness on life expectancy rate at birth in Pakistan. Contemporary studies like, Alam, Islam, Sahazad and Bilal (2020) have found that increased trade openness affects life expectancy positively in Bangladesh in long-run. It is to be noted that for a given cross-section, health quality standard and inflow of foreign direct investment are associated with each other and not only that, quality augmented health status is positively affected by the inflow of FDI (Blonigen and O'Fallon, 2011).

2.2. Theoretical Studies

There exits very few theoretical studies in which liberalization and health issues are analysed (Chatterjee and Gupta, 2014; Chaudhuri and Mukhopadhyay , 2014; Chatterjee and Gupta, 2015; Gupta and Chatterjee, 2016). Chatterjee and Gupta (2014) and Chaudhuri and Mukhopadhyay (2014) have used similar type of three-sector general equilibrium models and shown that a movement from a regime of international health capital immobility to a regime of international health capital mobility may lead to an increase in health status in the presence of nutritional efficiency of workers. Apart from that, it has also been shown that social welfare of a small open economy will improve. Moreover, Chatterjee and Gupta (2014) have introduced the concept of international fragmentation in the health sector and shown that the composite volume of trade in health services through international fragmentation and commercial presence increases the health status in developing countries. Again, Chatterjee and Gupta (2015) have mixed both Heckscher-Ohlin-Samuelson and Neo- Heckscher-Ohlin frameworks and have developed a hybrid type of trade theoretic general equilibrium model. In such a set up they have shown that a movement from a regime of capital immobility to a regime of capital mobility may lead to an expansion of the health status quality and at the same time such type of finite change may lead to a contraction of quality of this health care sector. More interestingly, Gupta and Chatterjee (2016) incorporate the idea of asymmetric information in the context of trade in health services between North and South. This study has found that trade in health service not only reduces the cost of health quality signalling but also improves the overall quality of health status in the South due to an increase in its demand. The demand for high-quality health status in the South increases not only for an increase in the number of foreign patients but also because of an increase in the number of domestic patients who want to consume such high-quality health services.

To summarize the literature review, there has been an explosion of research on the relationship between trade liberalization (either in terms of increased trade openness or FDI inflow) and health status; however the existing research efforts failed to provide clear evidence on the relationship between these two variables. More precisely, we trace

two important points. One, the impact of trade openness and FDI on health status is ambiguous. Two, presence and relevance of the interaction or complementarity between FDI and openness on health status are not researched yet empirically. The dearth of literature to cope up with the just-stated points has motivated us to perform a clinical study to get robust yield from trade on health status.

Table 1. Summary of Existing Literature

Article	Countries	Methodology	Outcomes
Multi-Country empirical studies			
Gupta and Goldar (2004)	India	Time series analysis	FDI affects health positively
Mirza (2004)	Pakistan	Time series analysis	FDI affects health negatively
Lautier (2008)	Tunisia	South-South trade & Time series analysis	Openness affects health positively
Khatun and Ahamad (2012)	Bangladesh	Comparative analysis and descriptive statistics	Openness affects health positively
Ali and Audi (2016)	Pakistan	ARDL	Openness affects health positively
Alam, Islam, Sahazad and Bilal (2020)	Bangladesh	ARDL	Openness affects health positively
Multi-Country empirical studies			
Levine and Rothman (2006)	134 countries	Frankel and Romer's Gravity model	openness affects health negatively
Alsan et al. (2006)	74 countries	Panel data analysis	Health affects FDI positively
Outreville (2007)	41 developing countries	Ranking analysis and Spearman rank order correlation	FDI affects health positively
Owen and Wu (2007)	219 countries	Panel data analysis	openness affects health positively
Azémar and Desbordes (2009)	70 developing countries	Panel data analysis	FDI affects health negatively
Bussmann (2009)	134 countries	Panel data analysis	openness affects health positively
Jorgenson (2009)	33 developing countries	Panel data analysis	FDI affects health negatively

Note: ARDL refers to Autoregressive distributed lag, OLS refers to Ordinary least squares.

Table 1. Summary of Existing Literature (cont')

Article	Countries	Methodology	Outcomes
Country-specific empirical studies			
Bergh and Nilsson (2010)	92 countries	Panel Fixed-effect and panel-corrected standard errors procedures	openness affects health positively
Martens, Akin, Huynen and Raza (2010)	117 countries	Panel data analysis	openness affects health positively
Herzer and Nunnenkamp (2012)	14 developed countries	Panel co-integration, Dynamic OLS	FDI affects health negatively
Rafat et al. (2013)	18 countries	Panel data analysis	FDI affects health negatively
Stevens, Urbach and Wills (2013)	219 countries	Panel data analysis	openness affects health positively
Lautier (2014)	13 South-Mediterranean countries	Trend analysis and data exploration	openness affects health positively
Jacob and Boateng, (2016)	42 Sub-Saharan countries	Panel data analysis	openness affects health positively
Akyuz, Karul and Demir (2020)	26 Latin American countries	Bootstrap panel granger causality	openness affects health positively
Dithmer and Abdulai (2020)	66 countries	Panel cointegration	openness affects health positively
Theoretical Studies			
Chatterjee and Gupta (2014)		General equilibrium trade model	FDI affects health positively
Chaudhuri and Mukhopadhyay (2014)		General equilibrium trade model	FDI affects health positively
Chatterjee and Gupta (2015)		Neo-Heckscher-Ohlin Trade Model	FDI and openness jointly affect health positively
Gupta and Chatterjee (2016)		Game theoretic trade model	Openness affects health positively

Note: ARDL refers to Autoregressive distributed lag, OLS refers to Ordinary least squares.

3. RESEARCH METHODS AND DATA

3.1. Theoretical Framework

For analytical issue we create a proper theoretical background. It is necessary to adopt a suitable theoretical framework, which endorses the association between health

status and international trade for developing economies. In this connection, we adopt General Equilibrium (hereafter GE) trade structure to give an economic story to our possible quantitative exercises. It may be noted that GE model based on a combination of the Heckscher–Ohlin–Samuelson (HOS hereafter) model and specific-factors model (SFM hereafter) is most suitable structure to explain the presence of international trade on any service or output producing sectors (note, in our case it is health), specifically for developing countries (Jones, 1971; Beladi and Marjit, 1992; Jones and Marjit, 1985). In fact, presence of trade liberalization in terms of FDI inflow and OPN in GE model can be done in two different ways. One way of capturing the impact of FDI is through changes in foreign capital inflow without disturbing other trade parameters and exogenous variables (i.e., interms of traditional comparative statics) and the other way is to capture the impact of FDI is through comparing the regimes of international capital immobility (less openness) and international capital mobility (higher degree of openness). First one is commonly known as infinitesimal changes of trade policy (Jones, 1965; Beladi and Marjit, 1992, 1996; etc.) and the second one referred to as finite changes of trade policy (Jones, 2008; Jones and Findlay, 2000; Beladi, Chakrabarty and Marjit, 2016). In this section we have considered the second option, that is, finite regime change from less openness (and no international capital mobility) to higher degree of openness (and perfect international capital mobility) in case of developing economies.

Let us assume that the economy is endowed with labour (L) and two different types of capital. One kind capital (K) is used directly for production and the other one, health capital (N) is used for betterment and up gradation of health status. We further assume that K and N are internationally mobile. All other factors are mobile across sectors. For simplicity we assume that labour is not internationally mobile. The concerned country produces two goods viz. 1 and 2. Good 1 is a non-health sector which produces a composite product apart from health services. Production function of good 1:

$$X_1 = f(L, K). \tag{1}$$

Here, Good 2 represents the health services of our stylized small open economy. Health services are produced by using L and N (health capital, per se). Therefore production functions for good 2 can be represented by

$$X_2 = f(L, N). \tag{2}$$

Let us consider a standard neo-classical GE production model with n goods and m factors of production. Goods are indexed by $j = 1, \cdots, m$ and factors by $i = 1, \cdots, n$. Competitive equilibrium conditions ensure:

$$\sum_{i=1}^{n} Z_i a_{ij} = P_j, \tag{3}$$

where Z_i and P_j describe input and goods/service prices, respectively. We chose the nth good/service as the numeraire. All markets are assumed to be competitive and by

virtue of small country assumption prices of goods are determined in the international market. Following Jones (1971) the full employment GE structure prescribes the subsequent cost-price equality of goods/services and factor market clearing conditions. Following expression (3) and using unit iso-quant argument in the production functions of good 1 and good 2 (equations (1) and (2)), price equations for composite goods producing sector (sector 1) and health sector (sector 2) can be represented as follow:

$$Wa_{L1} + ra_{K1} = P_1, \tag{4}$$

$$Wa_{L2} + Ra_{N2} = P_2. \tag{5}$$

Here, P_js $(j = 1, 2)$ represent prices, a_{ij}s $(i = L, K, N)$ indicate technology of production; W is the return to labour; r and R are the return to capital (K) and health capital (N), respectively.

Full employment conditions in GE model can be represented as

$$\sum_{j=1}^{m} a_{ij}X_j = V_i. \tag{6}$$

Here, X_j and V_i are output and stock of factors of production, respectively. For two-good, three factors case, expression (9) reduced to following full employment conditions.

$$a_{L1}X_1 + a_{L2}X_2 = LE_L[X_2(Y)]. \tag{7}$$

Equation (7) represents the full employment condition of the labour input with some meaning full insights. For instance, it is quite reasonable to assume that the average efficiency of the workers, E_L, depends on their health conditions. This is particularly true in the developing countries, where dearth of adequate medical facilities and infrastructure impinges severely on the health of workers, leading to deterioration in their efficiency or productivity. Therefore, an expansion in the healthcare sector (in terms of its output or services) is expected to raise its efficiency. We, therefore, consider the average efficiency of the workers, E_L, to be a positive function of the total amount of production (and hence consumption) of commodity, where E_L is given by the following equations:

$$E_L = E_L(X_2), \quad E_L' > 0. \tag{8}$$

Furthermore, we claim that health of developing countries is positively associated with Y, but at a decreasing rate. These empirical outcomes take us to draw the following specification[2]:

[2] Here, we assume the equilibrium of health sector, where $D_2(P_1, P_2, Y) = X_2$. Hence, by assuming

$$X_2 = X_2(Y), \quad X_2' > 0, \; X_2'' < 0. \tag{9}$$

The full-employment conditions of both types of capital are as follows.

$$a_{K1}X_1 = K_D + K_F = K, \tag{10}$$

$$a_{N2}X_2 = N_D + N_F = N. \tag{11}$$

3.2. Health Status and Finite Change

By the term finite change we want to express the process of regime switching. More specifically, within the finite change of trade policy, we describe the movement from a regime of international capital immobility (K or N) to international capital mobility (K or N) and we also want to focus on what happens to health status within the transitional period of switching. As in our model we assume two types of capital, that is, one is K (say, type-1 capital) and the other is N (say, type-2 capital or health capital). Here, we check one by one the impact of FDI inflow in terms of mobility of both type-1 capital and type-2 or health capital to our stylized small open economy.

3.1.1. Health Status and Mobility of Type-1 Capital

In developing countries, it is usually assumed that the domestic return to type-1 capital (r) is greater than its international counterpart (r^*), i.e., $r > r^*$. Hence, $\hat{K} > 0$ always implies $\hat{r} < 0$. From equations (4) and (5) we can get a fall in R and an increase in W ($\widehat{W} > 0$) due to the mobility of foreign type-1 capital. Again, Equation (5) tells us that, other things remaining same, non-health sector expands (i.e., $\hat{X}_1 > 0$) as $\widehat{K} > 0$. We can refer this effect as the *Factor Endowment Effect (FEE)* of type-1 capital. Expansion of non-health sector leads to contraction of health sector as more labour move to sector 1 for job, mainly due to the increase in probability of getting job in non-health sector[3]. However, at the same time we can experience the positive effect of type-1 capital by relating X_2 with$Y$, in terms of Equation (9). In fact, we find an increase in Y ($\hat{Y} > 0$) due to the mobility of type-1 capital, following three factors. First, increase in Wdue to increase in type-1 capital leads to increase in Y; second, Y increases due to the expansion of non-health sector ($\hat{X}_1 > 0$)and the third one is due to fall in r (as a result of fall full repatriation of foreign earnings). Once we get positive effect of trade liberalization in the form of mobility of type-1 capital on national income, one can also observe an expansion of health yields ($\hat{X}_2 > 0$) following the specification (9). We can refer this effect as *Demand Driven Effect (DDE)* of type-1 capital. Apart from this we experience another way through which health outcomes have been affected due to the

equilibrium we can write the specification of Equation (14).

[3] Though, in this framework we can't observe the Rybczynski effect.

presence nutritional efficiency factor of health. Actually, an expansion of health due to *NIE* leads to a rise in labour availability in terms of nutritional factor and hence the negative effect of *FEE* on health sector can be suppressed by some extent. We call this effect as *Nutritional Efficiency Effect (NEE)* of type-1 capital. Therefore, at conclusion we can say that if the joint effect of *DDE* and *NEE* dominate over *FEE*, we can find a rise in the overall health yields in developing countries due to the mobility of type-1 capital.

3.1.2. Health Status and Mobility of Type-2 Capital or Health Capital

Similarly, we start with $\widehat{N} > 0$, which leads to a reduction in R, i.e., $\hat{R} < 0$. Moreover, similar to the earlier section, here, from equations (4) and (5) we find a fall in r and an increase in W ($\widehat{W} > 0$) due to the mobility of foreign type-2 capital. Furthermore, equation (11) tells us that, other things remaining same, health sector expands (i.e., $\hat{X}_2 > 0$) as $\widehat{N} > 0$. We can refer this effect as the *Factor Endowment Effect (FEE)* of type-2 capital. Inflow of FDI in the health sector leads to an increase in the supply of health to the economy. To expand health yields Sector 2 uses more labour to maintain (N/L) ratio and hence we expect a contraction of Sector 1. However, we can also describe an increase in Y due to the mobility of type-2 capital in the similar fashion of earlier subsection. Therefore, we can again claim, $\hat{X}_2 > 0$due to $\hat{Y} > 0$. We call this effect *Demand Driven Effect (DDE)* of type-2 capital. The intuition and sign of the *Nutritional Efficiency Effect (NEE)* on health remains same in case of mobility of type-2 capital. Overall, we get unambiguous effects of mobility of health capital on health yields.

The theoretical results that we have obtained by using GE framework lead to a couple of important empirically examinable and arguable hypotheses. Hence, we have to create an empirical environment to get exact economic pictures behind the following theoretically tested hypothesis. For instance, our theory suggests the following; i) openness (OPN hereafter) and FDI inflow are complement, and ii) complementarity between OPN and FDI claims positive impact on health. The econometric validations of the above-mentioned hypotheses are crucial from the perspective of policymaking and consequently, the following section of our study precisely endorses this task.

4. EMPIRICAL MODEL

4.1. Estimation

Any impact of trade liberalization on health in our theoretical model works through commercial presence via the channel of complementarity between OPN and FDI inflow. A priori, we do not know whether the association is conditional on the level and volume

of openness and GDP of countries or the availability of foreign capital, for which the relationship between health status and international trade changes sign. The following functional form addresses both these problems:

$$Health_{it} = f\{GDP_{it}, OPN_{it}, FDI_{it}, (OPN * FDI)_{it}\}. \quad (12)$$

Our objective in this paper is to aim at the investigation of how international trade affects population health status in developing countries. We begin by adopting a standard linear panel regression model, incorporating both observed and unobserved heterogeneity. We introduce other significant macroeconomic variable, $\ln PCGDP$, in order to account for its significant influence on health status. Therefore we assume and estimate the following equation. More specifically, the above-mentioned function can be written as:

$$Health_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it}. \quad (13)$$

Here, $Health_{it}$ represents the health indicator and ε_{it} is the error term. More specifically, ε_{it} can be further explored in the following manner:

$$\varepsilon_{it} = \mu_i + v_t + e_{it}. \quad (13.1)$$

Insertion of Equation (13.1) in Equation (13) gives us,

$$Health_{it} = \alpha_i + \beta_i X_{it} + \mu_i + v_t + e_{it}, \quad (13.2)$$

where X_{it} represents the j^{th} variable for the cross-section i at time t and here μ_i is country-specific fixed effects. Note, v_t represents time fixed effects and e_{it} represents the unobservable error term.

If we consider LER as an indicator of population health status, Equation (13.2) can be rewritten as below:

$$LER_{it} = \alpha_i + \beta_1 \ln PCGDP_{it} + \beta_2 OPN_{it} + \beta_3 PCFDI_{it} + \beta_4 OPPCFDI_{it} + \mu_i + v_t + e_{it}, \quad (14)$$

where LER_{it} is the measure of health status in country i at time t; $\ln PCGDP_{it}$ is the log of per capita GDP of country i at time t; OPN_{it} is the measure of trade openness in country i at time t; $PCFDI_{it}$ is the per capita FDI in country i at time t; and $OPPCFDI_{it}$ is the interaction between OPN and PCFDI in country i at period t. If more trade is associated with better health status, then the statistical priors are $\beta_2 > 0$, $\beta_3 > 0$. However, if OPN and $PCFDI$ are complement, then statistical priors may change to either one of the following:

i) $\beta_2 < 0,\ \beta_3 > 0,\ \beta_4 > 0,$

ii) $\beta_2 > 0,\ \beta_3 < 0,\ \beta_4 > 0,$

iii) $\beta_2 < 0,\ \beta_3 < 0,\ \beta_4 > 0.$

Again, consideration of IMR as an alternative measure of health status in the place of LER gives us the following specification:

$$IMR_{it} = \alpha_i + \beta_1 \ln P\,CGDP_{it} + \beta_2 OPN_{it} + \beta_3 PCFDI_{it} + \beta_4 OPPCFDI_{it} + \mu_i + v_t + e_{it}, \quad (15)$$

where IMR_{it} is the measure of health status in country i at time t and rest of the exogenous variables remain same as it was in Equation (15). However, statistical priors shall modify. If more trade is associated with better health status, then the statistical priors are $\beta_2 < 0,\ \beta_3 < 0$. However, if OPN and PCFDI are complement, then statistical priors may change to either one of the following:

i) $\beta_2 < 0,\ \beta_3 > 0,\ \beta_4 < 0,$

ii) $\beta_2 > 0,\ \beta_3 < 0,\ \beta_4 < 0,$

iii) $\beta_2 < 0,\ \beta_3 < 0,\ \beta_4 < 0.$

4.2. Robustness Checks

To check the robustness of our baseline estimations, here, we have implemented several robustness checks[4]. Moreover, to check the robustness of the same within a dynamic specification is also crucial and thereby we adopt the following specifications for both LER and IMR respectively:

$$LER_{it} = \alpha LER_{it-1} + \beta_1 \ln P\,CGDP_{it} + \beta_2 OPN_{it} + \beta_3 PCFDI_{it} + \beta_4 OPPCFDI_{it} + \mu_i + v_t + e_{it}, \quad (14.1)$$

$$IMR_{it} = \alpha IMR_{it-1} + \beta_1 \ln P\,CGDP_{it} + \beta_2 OPN_{it} + \beta_3 PCFDI_{it} + \beta_4 OPPCFDI_{it} + \mu_i + v_t + e_{it}. \quad (15.1)$$

[4] We have checked the robustness of our baseline estimations in the following ways; i) by incorporating the $\ln PCGDP$ squared as an additional explanatory variable; ii) by incorporating Unemployment rate (UR) and Population Growth rate ($POPGR$) as two additional explanatory variables; iii) by employing income Inequality (INQ) along with UR and $POPGR$ as additional explanatory variables and iv) by using per capita government health expenditure as a percentage of GDP ($PCGHE$) as an additional regressor (Gyimah-Brempong, 1998) along with INQ, UR, $POPGR$.

We choose the dynamic panel estimation specifications espoused in Equations (14.1) and (15.1) are intended to address the endogeneity issues provoked by unobserved country-specific effects and joint endogeneity of the explanatory variables in lagged dependent variable models. Basically, we have used the difference generalized method of moments (GMM) estimator for dynamic panels developed by Arellano and Bond (1991) for the above-specified specifications. Again, following Roodman (2009), here, we have also adopted the orthogonal deviation form of the estimator proposed by Arellano and Bover (1995) for unbalanced panels.

5. DATA AND METHODOLOGY

For our study, we use annual data for economic variables such as per capita GDP ($PCGDP$ hereafter), Life Expectancy Rate at Birth (hereafter LER), Infant Mortality Rate (hereafter IMR), Net inflow of per capita FDI (hereafter $PCFDI$) and Openness (hereafter OPN) as measured by the ratio of exports plus imports to GDP. All the data collected from the World Development Indicators (hereafter WDI) of World Bank[5]. Taking those economic variables we compile a panel data set for selected 51 developing countries for the period of 1980-2019[6].

In this section, we precisely want to analyse the general way to look at a panel data and thereafter we shall try to proceed with our present estimation strategy. The data used in this study cover 51 developing economies between 1980 and 2015 which represent 35 years of observations for each economy. The purpose of this choice is to enlarge the study to all the developing countries for which we have an acceptable data length. Moreover, to overcome the shortcomings of both cross-sectional and time series analysis, here we have used this panel data set as this type of data enable us to combine time series and cross-sectional features and offer a variety of estimation approaches (Dawson, 2010).

To give further insight, we can use country fixed-effects by differencing or by including fixed- effects or random-effects in the panel estimation. In order to cater this issue, we can compare fixed-effect model with a first-difference panel specification. It may be noted that fixed-effect models are preferred over first-difference models. As a reason of this preference we can list the following: i) differencing reduces the sample size and decreases statistical power and ii) if both the error term and the regressors are

[5] The datasets generated during and/or analysed during the current study are available in the WDI repository, available at: http://data.worldbank.org/data-catalog/world-development-indicators. See Table 2 for this purpose. The summary statistics of the variables of our interest have been reported in Table 3 of this paper.

[6] The list of selected countries is portrayed in Appendix A1.

serially correlated, and the latter correlation is stronger, the first-difference estimator will worsen the asymptotic bias due to the measurement error (Wooldridge, 2001). Again, estimation results of fixed-effects (hereafter FE) and random-effect (hereafter RE) models give us more or less same conclusions. Hence, we have to compare between FE model and RE model and to do this we perform the Hausman test. The test statistic suggests that FE model is better than RE. Further, we have employed FE regression using only country fixed effects and also using both country and time fixed effects separately.

Table 2. Description of Variables and Data Sources

Variable	Description	Data Source
LER	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	World Development Indicators (WDI) of World Bank Data
IMR	Infant mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.	WDI
ln$PCGDP$	logarithm GDP per capita	WDI
$Openness$	imports of goods and services (% of GDP) + Exports of goods and services (% of GDP))	WDI
$PCFDI$	Per capita foreign direct investment, net inflows (% of GDP)	WDI
$OPPCFDI$	Openness×PCFDI	Developed by the authors

However, before going to the main course of panel estimation, we shall focus on the issue of presence of stationarity of the variables our interest. With an unbalanced panel, in this study, we use only with the IPS test (Im and Pesaran, 2003), PP-Fisher chi-square (Maddala and Wu, 1999) and Fisher-type ADF unit root test on our panel data. As the selected data series shows a p-value less than five percent and therefore we reject the presence of unit root[7]. Again, rejection of unit root exhibits the absence of panel co-integration. Further, to check other major econometric issues like autocorrelation and multicollinearity, here we have used D-W test and VIF measure respectively. Outcomes of these econometric measures give us the license to perform FE regression without any technical wary.

[7] Here, we have found that all the variables of our interest follow stationary series. The results of several panel unit root test are reported in Table A2.

Table 3. Summary Statistics of Major Variables of Uur Panel Data Set

Variable		Mean	Std. Dev.	Min	Max	Observations
Life Expectancy at Birth (LER)	Overall	67.23238	7.48834	45.54781	82.34634	N = 1734
	Between		6.947923	47.53101	77.15904	n = 51
	Within		2.953105	53.71689	77.28638	T = 34
Infant Mortality Rate (IMR)	Overall	38.79927	29.41711	2.2	133.7	N = 1784
	Between		26.33199	4.937143	109.6714	n = 51
	Within		13.61399	-6.920731	101.4393	T-bar =34.98
Log of per capita GDP (ln$PCGDP$)	Overall	7.781161	1.259537	4.935259	11.4797	N = 1687
	Between		1.117776	5.89672	10.40214	n = 51
	Within		0.5975582	5.89005	9.975204	T-bar = 33.07
FDI	Overall	4.80e+09	1.89e+10	-2.09e+10	2.91e+11	N = 1668
	Between		1.18e+10	6.95e+07	7.83e+10	n = 50
	Within		1.49e+10	-7.30e+10	2.17e+11	T-bar = 33.36
Openness (OP)	Overall	3.90e-08	3.80e-07	4.01e-12	8.45e-06	N = 1620
	Between		1.71e-07	3.95e-11	1.19e-06	n = 50
	Within		3.37e-07	-1.09e-06	7.29e-06	T-bar = 32.4

Source: Author(s) own calculation.

6. EMPIRICAL RESULTS

6.1. Analysis

Table 4 presents results from the determination of LER and IMR. Regarding the goodness-of-fit statistics, the fit explains at least 55 percent of the total variation in the LER and almost explains 65 percent of the total variation in the IMR. Moreover, with the aim of determining the specifications and forming the model which minimises the drainage of information, we employ the fitted specification corresponding to the minimum values of SIC, AIC and HQC. We start with the FE estimator and modify it step-by-step to address the endogeneity issues and other econometric concerns. First, we regress LER (or IMR) on ln$PCGDP$, OPN and $PCFDI$ in order to detect the impact of international trade on population health status.

Table 4 contains the outcomes. More specifically, columns (a) and (c) of Table 4 illustrate the FE estimation results with both country and time dummies to control for time-invariant omitted-variable bias and common time effects. As reported in columns (a) and (c) of Table 4, ln$PCGDP$ and OPN are found to be statistically significant. Increase in per capita GDP in developing countries seems to improve population health status in terms of LER and IMR, which confirms previous findings (Fogel, 1994; Barro, 1996; Grossman, 1972; Alsan, Bloom, and Canning, 2006). A 1% increase in developing countries' ln$PCGDP$ leads to 0.45%to 2.31% improvement in the LER, while same reduces IMR by 10.21%. From the angle of international trade, columns (a) and (c) of Table 4 present negative effects of increased trade openness on health status,

and Figures A1(c) and A1(g) are also reflecting the same. Moreover, column (c) reflects some adverse effects of trade liberalization in terms of $PCFDI$ on IMR and such observations are already endorsed in the existing literature (Azémar and Desbordes, 2009; Jorgenson, 2009). Figure A1(h) also illustrates negative relationship between $PCFDI$ and IMR, and thereby reconfirms our estimation result. Again, column (a) is showing the effects of $PCFDI$ on LER positive in sign, however, remain insignificant statistically (see figure A1 (d)). Therefore, the present specification gives us negative sign (or positive in case of IMR) of the coefficient associated with OPN (β_2) and remains ambiguous regarding the sign of the coefficient associated with $PCFDI$ (β_3). In simple words, $\ln PCGDP$ has shown positive effect on health status, however, either negative or ambiguous effects of international trade has been claimed so far and this is against the conventional literature[8]. As a reason of such ambiguity we can put hold the following simple economic intuitions. Open economies often attract foreign investors in order to invest and produce in the host economy and as a response to this environmental degradation occur via massive expansion of industrial production (Levine and Rothman, 2006). Such environmental degradation throws serious challenges in front of health status. Proper infrastructure with reference to optimum allocation of capital in health is needed to make sure exit from the adverse environmental impact on health. In fact, open developing economies usually face a common constraint in their way of development mainly via capital constraint. Hence, without FDI an open developing economy may not be able to build efficient infrastructure to health and consequently population health status may deteriorate. Again, FDI inflow without implementation of proper openness cannot generate the confidence among the foreign investors and hence FDI allocation may be biased towards non-health sector. Therefore following our theoretical outcomes and to solve this ambiguity we include the interaction term between OPN and $PCFDI$ ($OPPCFDI$) as an additional explanatory variable. As reported in columns (b) and (d) of Table 4, $OPPCFDI$ is found to be statistically significant. In fact, we find positive effect of $OPPCFDI$ on health status and aforementioned specifications give us positive sign (or negative in case of IMR) of the coefficient associated with $OPPCFDI$ (β_4), while the effects of OPN and $PCFDI$ are almost remain same as it was in the earlier case (see Figures A1(b) and A1(f)). These results show that there is a nonlinear relationship between health status and international trade and also describing that OPN and $PCFDI$ are complement. The impact of $OPPCFDI$ on health status can also be explained intuitively. Following the fact that neither OPN nor FDI can solely remove the burden of liberalization on population health status, rather we expect the simultaneous presence of both OPN and FDI with significant volume. More specifically, economy with proper liberalization can attract ample amount of FDI and hence state can allocate the fund in an unbiased manner towards health sector. Higher investment claims better infrastructure which in turn generates positive effect of trade on health by offsetting the adverse effect of such liberalization (Chatterjee and Gupta,

[8] It has been briefed in Section 2.

2015)[9].

Table 4. Results of Panel Regression of LER and IMR in Developing Countries (1980-2015)

	LER(1) *(a)*	**LER(2)** *(b)*	**IMR(1)** *(c)*	**IMR(2)** *(d)*
ln$PCGDP$	0.45* (0.08)	0.45* (0.08)	-10.21* (0.38)	-0.62*** (0.38)
OPN	-14.42* (1.34)	-13.54* (1.47)	58.33* (5.81)	52.80* (6.37)
$PCFDI$	-6.25E-05 (7.22E-05)	5.11E-05 (7.26E-05)	0.002* (0.0002)	0.002* (0.0002)
$OPPCFDI$		11.65* (3.91)		-7.12** (3.38)
Constant	63.93* (0.69)	63.89* (0.69)	41.62* (3.01)	41.82* (3.01)
R-squared	0.54	0.54	0.63	0.63
Adj R-squared	0.54	0.54	0.62	0.62
F-statistic	336.30 [0.00]	332.74 [0.00]	262.50 [0.00]	260.10 [0.00]
Country fixed effects	yes	yes	yes	Yes
Year fixed effects	yes	yes	Yes	Yes
AIC	4.04	4.04	6.97	6.97
SIC	4.32	4.32	7.25	7.25
HQC	4.14	4.14	7.07	7.07
D-W stat	1.89	2.19	1.55	2.17
VIF range	1.31-1.39	1.26-2.38	2.15-3.59	2.02-3.73
Observations	1691	1691	1741	1741

Note: We represent estimation results of the specifications (14) and (15). We report the results of panel estimations with the coefficient values marked with significance levels in the first row followed by the standard errors (in the parentheses) in the second row. Asterisks ***, ** and * indicate levels of significance at 10%, 5%, and 1%, respectively.

To make the matter more critical and policy oriented, we have also performed the same empirical exercise for three different regions, namely, Asia, Africa and Latin America and try to prescribe proper trade policies which shall be implemented by the corresponding developing nations.

[9] For further economic intuition one can refer our theoretical outcomes derived in Section 3.

Table 5. Results of panel Regression for Asian, African and Latin American Developing Economies

	LER (2) 1980-2015 *(a)*	**IMR(2) 1980-2015** *(b)*	**LER (2) 1980-2015** *(c)*	**IMR(2) 1980-2015** *(d)*	**LER (2) 1980-2015** *(e)*	**IMR(2) 1980-2015** *(f)*
Ln$PCGDP$	-0.24* (0.08)	0.39* (0.07)	3.10* (0.53)	-14.59* (1.50)	0.33*** (0.17)	0.41 (0.71)
OPN	-11.19* (1.79)	42.50* (7.82)	18.25 (16.87)	-41.38* (4.76)	7.47* (1.30)	-97.80*** (53.80)
$PCFDI$	-5.31E-05 (7.16E-05)	0.002* (0.0003)	-0.01*** (0.007)	-0.01*** (0.008)	-3.10E-05 (0.0001)	0.0008*** (0.0004)
$OPPCFDI$	39.04* (10.61)	-20.02* (5.50)	28.08* (2.35)	-17.76* (6.76)	32.78* (7.94)	-55.46*** (33.34)
Constant	69.06* (0.70)	29.86* (3.75)	36.94* (3.88)	171.60* (11.01)	68.00* (1.23)	22.79* (5.17)
R-squared	0.53	0.62	0.51	0.54	0.56	0.62
Adj R-squared	0.52	0.61	0.50	0.53	0.55	0.61
F-statistic	144.2 [0.00]	133.1 [0.00]	74.52 [0.00]	120.31 [0.00]	237.4 [0.00]	119.19 [0.00]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	yes	Yes	yes
AIC	3.79	7.13	4.83	6.97	3.05	5.93
SIC	4.19	7.52	5.33	7.47	3.46	6.34
HQC	3.95	7.28	5.03	7.17	3.21	6.09
D-W stat	1.57	2.31	2.08	2.03	1.57	2.31
VIF range	2.13-2.97	1.76-3.38	2.13-2.97	1.76-2.38	2.13-2.97	1.76-3.38
Observations	648	668	385	396	583	598

Notes: Standard errors are in brackets. Asterisks ***, ** and * indicate levels of significance at 10%, 5%, and 1%, respectively.

Table 6. Continent-Wise Economic Explanations and Corresponding Policy Measure Proposals

Asian Developing Countries		
Effects of Trade on Health	Economic arguments for the Period (1980-2015)	Policy Proposals/Remarks
ln$PCGDP$ →Health Status	- ve DDE	i) Adaptation of Health augmented growth policy; ii) Overall trade liberalization should be more health sector inclusive.
$PCFDI$ →Health Status	-ve FEE of type-1 capital (FEE1)	
$OPPCFDI$ →Health Status	+ve NEE & NEE>DDE+FEE1	
African Developing Countries		
Effects of Trade on Health	Period (1980-2015)	Policy Proposals/Remarks
ln$PCGDP$ →Health Status	+ve DDE	i) Overall trade liberalization should be more health sector inclusive; ii) Health specific liberalization, and iii) implementation of health augmented growth policy is also necessary as 2nd sub-period (2000-2015) shows negative impact on health
$PCFDI$ →Health Status	-ve FEE1 & +ve FEE2	
$OPPCFDI$ →Health Status	+ve NEE & NEE+FEE2+DDE>FEE1	
Latin American Developing Countries		
Effects of Trade on Health	Period (1980-2015)	Policy Proposals/Remarks
ln$PCGDP$ →Health Status	+ve DDE	i) Overall trade liberalization should be more health sector inclusive; ii) Health specific liberalization
$PCFDI$ →Health Status	-ve FEE1	
$OPPCFDI$ →Health Status	+ve NEE & NEE+DDE>FEE1	

The estimation outcomes for three different continents are described in Table (5). Columns (a)-(b), (c) – (d) and (e)- (f) are reflecting the estimation results for Asian, African and Latin American countries respectively. Table (6) has summarized the outcomes of table (5) and also describes the possible economic explanation behind the association between health status and trade estimated for the corresponding panel.

6.2. Robustness Tests

To confirm the benchmark results, we run several robustness checks. First, we incorporate the square of ln$PCGDP$ as a new regressor to examine the robustness of our basic results owing to the presence of the new variable, since square of ln$PCGDP$ has been previously dubbed as an important predictor for health status (Preston, 1975; Deaton, 2003; Leigh and Jencks, 2007).

Table 7. Results of Robustness Tests (1980-2015)

	LER (2) *(a)*	**LER(2)** *(b)*	**LER(2)** *(c)*	**LER (2)** *(d)*	**IMR(2)** *(e)*	**IMR(2)** *(f)*	**IMR(2)** *(g)*	**IMR(2)** *(h)*
ln$PCGDP$	2.83*	0.80*	2.79*	1.54*	-13.76*	-5.28*	-12.51*	-3.13*
	(0.35)	(0.16)	(0.15)	(0.39)	(1.27)	(0.66)	(0.36)	(0.32)
OPN	-13.24*	-7.11*	-6.26*	-3.29**	57.22*	24.83*	23.54*	7.94**
	(1.82)	(1.02)	(1.13)	(1.58)	(6.18)	(4.25)	(4.72)	(3.13)
$PCFDI$	-0.0001	7.15E-06	6.49E-05	3.47E-05	0.0012*	0.001*	0.001*	0.002**
	(9.58E-05)	(5.87E-05)	(6.49E-05)	(3.26E-05)	(0.0003)	(0.0002)	(0.0002)	(0.0009)
$OPPCFDI$	28.33*	44.71*	44.96*	36.57*	-57.92***	-19.20	-18.93*	-12.03*
	(9.83)	(7.23)	(8.00)	(6.23)	(32.78)	(30.03)	(3.33)	(3.39)
ln$PCGDP^2$	-0.05**				1.10*			
	(0.02)				(0.10)			
UR		0.042*	0.075*	0.009*		-0.34*	-0.49*	-0.05**
		(0.01)	(0.021)	(0.001)		(0.07)	(0.08)	(0.02)
$POPGR$		0.007	0.009	-0.27		-0.01	-0.01	-3.59
		(0.006)	(0.007)	(0.21)		(0.02)	(0.03)	(3.20)
INQ			-0.07**	-0.17*			-1.15***	0.09**
			(0.02)	(0.05)			(0.61)	(0.04)
$PCGHE$				0.41**				-0.02**
				(0.20)				(0.008)
Constant	66.10*	61.92*	45.73*	54.77*	75.23*	76.43*	135.54*	83.33*
	(1.27)	(1.32)	(0.79)	(2.57)	(4.26)	(5.50)	(3.24)	
R-squared	0.54	0.57	0.56	0.57	0.63	0.65	0.64	0.65
Adj R-squared	0.54	0.57	0.56	0.57	0.63	0.65	0.64	0.65
F-statistic	329.8	535.86	603.73	533.89	276.40	347.21	391.82	373.71
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Country fixed effects	Yes	yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	yes	Yes	Yes	yes	Yes	Yes	Yes
AIC	4.04	3.34	3.54	3.07	6.90	6.23	6.44	5.01
SIC	4.33	3.68	3.78	3.91	7.19	6.56	6.67	6.75
HQC	4.14	3.47	3.63	3.57	7.01	6.36	6.53	6.31
D-W stat	1.93	1.72	2.15	2.05	2.67	2.10	2.13	2.03
VIF range	1.37-2.08	1.31-2.39	1.15-2.79	1.27-2.83	1.36-2.88	1.01-3.59	1.15-3.39	1.13-3.51
Observations	1691	1197	1088	1052	1741	1247	1138	1102

Notes: Standard errors are in brackets. Asterisks ***, ** and * indicate levels of significance at 10%, 5%, and 1%, respectively.

Second, we introduce measures of socio-economic indicators in the form of UR and $POPGR$ obtained from WDI in the regressions to find out whether the hypothesized relationship between health status and international trade is suspected to vary due to the socio-economic changes. Third, following Deaton (2003) and Herzer and Nunnenkamp (2015), here we incorporate INQ as an additional regerssor along with UR and $POPGR$ to establish our baseline estimation outcomes. Fourth, to examine the direct involvement of government in health we incorporate $PCGHE$ as an additional explanatory variable along with INQ, UR, $POPGR$ and claim the robustness of our baseline estimation. Apart from these robustness tests, we have also carried out dynamic panel data estimation with slide modification to our baseline specifications (equations (14.1) and (15.1)) to make the approach more robust.

Table 8. Results of Dynamic Panel Regression of LER and IMR

	LER(2) *Difference GMM (1980-2015)* *(a)*	**LER(2)** *Orthogonal deviation GMM (1980-2015)* *(b)*	**IMR(2)** *Difference GMM (1980-2015)* *(c)*	**IMR(2)** *Orthogonal deviation-GMM (1980-2015)* *(d)*
$LER(-1)$	0.92* (0.0009)	0.94* (0.0007)		
$IMR(-1)$			0.95* (0.0006)	0.95* (0.01)
ln$PCGDP$	0.28* (0.003)	0.15* (0.0001)	-0.14* (0.01)	-0.70 (0.54)
OPN	-24.56* (4.56)	-10.90* (3.78)	72.54* (10.37)	-15.33 (15.55)
$PCFDI$	4.38E-06* (1.46E-06)	1.64E-05* (5.78E-07)	3.97E-05 (4.32E-05)	0.0006 (0.001)
$OPPCFDI$	22.46** (9.98)	43.85* (10.49)	-20.88* (3.06)	-27.78 (57.48)
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes
J-statistic	49.10 [0.31]	44.65 [0.48]	49.67 [0.32]	851.30 [0.00]
Second order serial correlation test p-value	1.01 [0.31]		0.55 [0.57]	
Observations	1489	1489	1586	1586

The estimation results described in Table 7 endorse our results of the baseline specification (reported in Table 4). Our estimations reveal that $OPPCFDI$ has a positive and significant effect on population health status. Our results also notice that as the OPN rises, it has a negative and significant association with health status in developing countries and reclaim the OPN and $PCFDI$ as complement with each other. In short

these results endorse that the inclusion of the controls does not impact our baseline outcomes in order to cater association between Trade and health status across countries. The results for the difference GMM regressions and orthogonal-deviation GMM regressions reported in columns (a), (c) and (b), (d) respectively in Table 8 indicate that the dynamic regression also endorses the results of static regressions. In short, explanatory variables reveal more or less similar results as that of the baseline specification.

7. CONCLUSION

This paper presents a model based on both theory and empirics, in order to capture the effects of international trade on health status of developing countries. In addition, we have attempted to overcome several limitations of previous research by considering FDI inflow and trade openness as complement to each other at least in the context health status of developing nations. In particular, this paper assesses joint interaction between trade and health status in developing countries when they are fetching with growth status. Moreover, our main focus is to improve our understanding of such connections, and in particular to assess whether increase in FDI inflow and openness of developing countries can be effective at improving population health status. Under this backdrop, utilizing a dataset of 51 developing countries over the period of 1980-2015, this paper examines the efficacy of international trade on population health status and also examines whether the previously used trade measures like openness and FDI inflow have any robust role in this association.

First we adopt a theoretical model to establish the economic relationship between trade and health. To derive this here, we have employed a GE trade model and also tried to find out the policy implications from the same. The model shows that OPN and PCFDI are complement to each other, and claims that the health status can improve due to the changes in any one of the following effects; i) demand driven effect, ii) factor endowment effect and iii) nutritional efficiency effect. Following the theoretical exposition we get couple of empirically tested hypotheses and to perform this we perform empirical exercise. From our empirical study we find positive association between $PCGDP$ and health status, while OPN creates an adverse impact on health status. However, trade measure like FDI inflow (or $PCFDI$) reveals ambiguous relationship with population health status. Interestingly, we find positive association between health status and the interaction between OPN and $PCFDI$. It also claims that OPN and $PCFDI$ are complement at least in the context of health status of developing economies. Several robustness checks including dynamic panel estimation also reveal the same conclusion.

These findings have some policy implications. Most importantly, the narrative of our study owing to complementarity issue suggests that policy making in the context of

liberalization in terms of foreign direct investment inflow with stringency and stringent health sector should not be entertained any more for better health status at least for developing economies. Further, policymakers should in mind the fact that proper health inclusive growth is to be carried out in the background to achieve proper effectiveness of liberalization on health status. More specifically, our estimation outcomes suggest that the policymakers of developing regions can implement policies in three different ways to get better health status, namely, health augmented growth policy, health sector inclusive trade liberalization and health specific liberalization, and simultaneous implementation of these policies are recommended for our selected group of developing countries. However, for continent-specific case, it suggests that growth policy should be more health oriented especially in Asian and African continents. Moreover, the same exercise also recommends all the three continents to adopt trade liberalization policy in such a way that it should be more health inclusive, although health specific liberalization is advised only for African and Latin American developing countries.

APPENDIX

Appendix 1. Appendix to Empirical Analysis

Table A1. List of Developing Countries

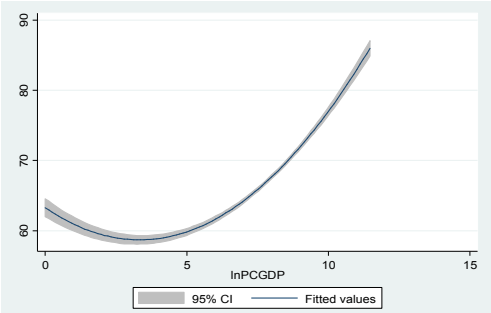
Asia	Africa	Latin America
India	South Africa	Ecuador
China	Nigeria	Jamaica
Bangladesh	Cote d'Ivoire	Chile
Indonesia	Cameroon	Papua New Guinea
Kazakhstan	Congo, Rep	Colombia
Korea, Rep.	Mauritius	Costa Rica
Uzbekistan	Ghana	Cuba
Maldives	Egypt	Brazil
Myanmar	Senegal	Fiji
Jordan	Algeria	Guyana
Malaysia	Morocco	Hungary
United Arab Emirates	Uganda	Paraguay
Philippines	Zimbabwe	Argentina
Singapore	Sudan	Trinidad and Tobago
Pakistan		Uruguay
Qatar		Venezuela RB
Kuwait		Mexico
Saudi Arabia		
Thailand		
Sri Lanka		

Table A2. Panel Unit Root Tests

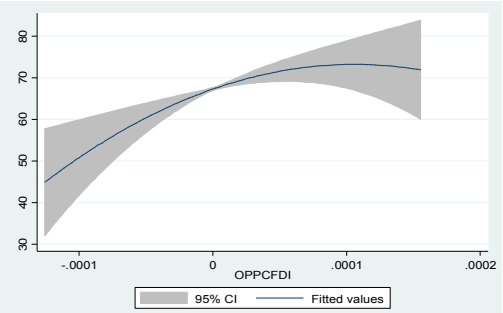
Variable	At level		
	IPS test	ADF test	PP test
LER	-5.24	-19.01	-19.01
	(0.00)	(0.00)	(0.00)
IMR	-16.94	-28.47	-28.35
	(0.00)	(0.00)	(0.00)
lnPCGDP	-8.60	-8.13	-8.10
	(0.05)	(0.07)	(0.07)
OPN	-3.54	-8.64	-8.60
	(0.09)	(0.05)	(0.05)
PCFDI	-4.56	-6.68	-6.35
	(0.02)	(0.002)	(0.05)
OPPCFDI	-5.76	-10.63	-10.63
	(0.00)	(0.00)	(0.00)

Notes: This table reports the test statistic followed by the probability values in parentheses for the three tests performed in ascertaining the stationarity of the variables. IPS test: The Im, Pesaran and Shin (IPS) test; ADF test: The augmented Dickey–Fuller (ADF)test; PP test: the Phillips-Perron -Fisher chi-square.

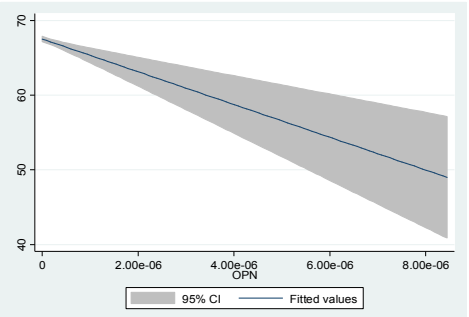
(a). LER and lnPCGDP



(b). LER and OPPCFDI



(c) LER and OPN



(d). LER and PCFDI

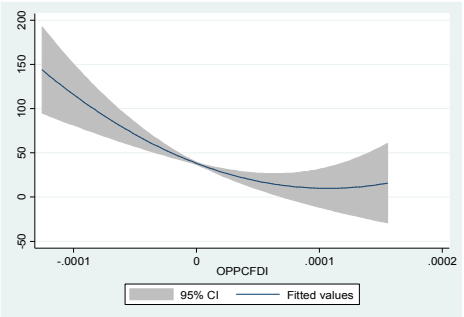
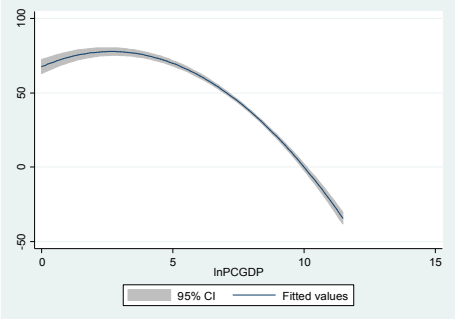
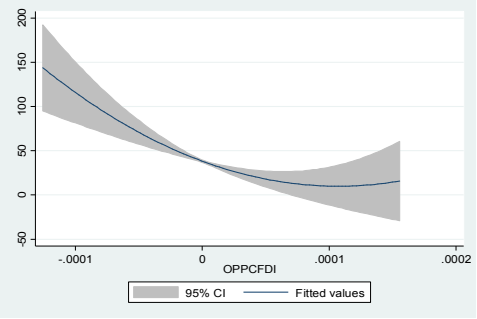


Figure A1. Interactions of LER (or IMR)-lnPCGDP and OPPCFDI, for Collective countries

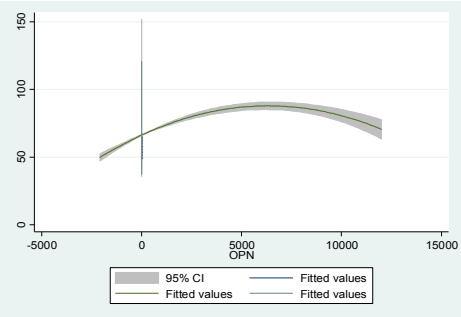
(e). IMR and lnPCGDP



(f). IMR and OPPCFDI



(g). IMR and OPN



(h). IMR and PCFDI

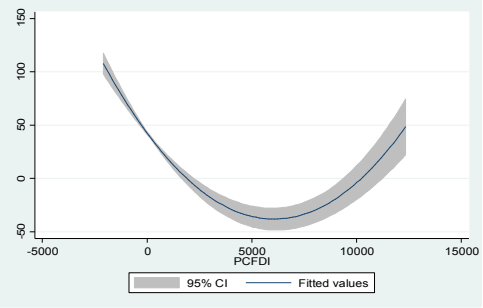


Figure A1. Interactions of LER (or IMR)-lnPCGDP and OPPCFDI, for Collective countries (cont')

Appendix 2. Appendix to Theoretical Analysis

Differentiation of Equation (9) and (10) give us,

$\theta_{L1}\widehat{W} + \theta_{K1}\hat{r} = 0,$

$\theta_{L2}\widehat{W} + \theta_{N2}\hat{R} = 0.$

From the above expressions we get,

$$\widehat{W} = -(\theta_{K1}/\theta_{L1})\hat{r}, \quad \text{(A1)}$$

$$\widehat{W} = -(\theta_{N2}/\theta_{L2})\hat{R}. \quad \text{(A2)}$$

Combining (A1) and (A2)

$$\hat{r} = (\theta_{N2}.\theta_{L1}/\theta_{L2}.\theta_{K1})\hat{R}. \quad \text{(A3)}$$

Differentiation of Equation (12)

$$\lambda_{L1}\hat{a}_{L1} + \lambda_{L1}\hat{X}_1 + \lambda_{L2}\hat{a}_{L2} + \lambda_{L2}\hat{X}_2 = \varepsilon_L\hat{X}_2.$$

By using the concepts of elasticity of substitution and envelope condition one can obtain

$$\lambda_{L1}\hat{X}_1 + (\lambda_{L2} - \varepsilon_L)\hat{X}_2 = (\lambda_{L1}\sigma_1\theta_{K1}/\theta_{L1})\hat{r} + (\lambda_{L2}\sigma_2\theta_{N2}/\theta_{L2})\hat{R}. \quad \text{(A4)}$$

From Equations (15) and (16) we can get

$$\hat{X}_1 = (1/\lambda_{K1})\hat{K} + (\lambda_{K1}\sigma_1\theta_{L1}/\theta_{K1})\hat{r}, \quad \text{(A5)}$$

$$\hat{X}_2 = (1/\lambda_{N2})\hat{N} + (\lambda_{N2}\sigma_2\theta_{L2}/\theta_{N2})\hat{R}. \quad \text{(A6)}$$

REFERENCES

Akyuz M., C. Karul and I. Demir (2020), "Life Expectancy and Trade Openness: Causality in Latin America," *International Journal of Social Economics*, 47(10), 1265-1281.

Alam S., S. Islam, S.J.H. Sahazad and S. Bilal (2020), "Rapid Rise of Life Expectancy in Bangladesh: Does Financial Development Matter?" *International Journal of Finance and Economics*, 1-14.

Ali A. and M. Audi (2016), "The Impact of Income Inequality, Environmental Degradation and Globalization on Life Expectancy in Pakistan: An Empirical Analysis," MPRA 71112.

Alsan M., D.E. Bloom and D. Canning (2006), "The Effect of Population Health on Foreign Direct Investment Inflows to Low- and Middle-Income Countries," *World Development*, 34, 613-630.

Arellano M. and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58, 277-297.

Arellano M. and O. Bover (1995), "Another Look at the Instrumental Variables Estimation of Error Components Models," *Journal of Econometrics*, 68, 29-51.

Azémar C. and R. Desbordes (2009), "Public Governance, Health and Foreign Direct Investment in Sub Saharan Africa," *Journal of African Economies*, 18, 667-709.

Barro R.J. (1996), *Health and Economic Growth*, Mimeo.

Beladi H., A. Chakrabarti and S. Marjit (2016), "Competitive General Equilibrium with

Finite Change and Theory of Policy Making," *Economics and Politics,* 28 (1), 1-7.
Beladi, H. and S. Marjit (1992), "Foreign Capital and Protectionism," *Canadian Journal of Economics,* 25(1), 233-238.
Beladi, H. and S. Marjit (1996), "An Analysis of Rural-Urban Migration and Protection," *Canadian Journal of Economics,* 29, 930-940.
Bergh A. and T. Nilsson (2010), "Good for Living? On the Relationship between Globalization and Life Expectancy," *World Development*, 38(9), 1191-1203.
Bhagwati J.N. (1984), "Why are Services Cheaper in the Poor Countries?" *Economic Journal*, 94(374), 279-286.
Blonigen B. and C. O'Fallon (2011), "Foreign Firms and Local Communities," NBER Working Paper 17282, Cambridge, MA.
Burns D.K., A.P. Jones and S. Marc (2016), "The Relationship between International Trade and Non-Nutritional Health Outcomes: A Systematic Review of Quantitative Studies," *Social Science and Medicine*, 152, 9-17.
Bussmann M. (2009), "The Effect of Trade Openness on Women's Welfare and Work life," *World Development*, 37, 1027-1038.
Chanda R. (2001), "Trade in Health Services," Working Chapter, No.70, Indian Council for Research on International Economic Relations (ICRIER), India.
Chatterjee T. and S. Dinda (2022), "What Determines the Health Status in Developing Countries? Evidence from a Dynamic Panel," *Journal of Economic Development*, 47(4), 1-38.
Chatterjee T. and K. Gupta (2014), "Trade Liberalization, Health Care and International Fragmentation: The Role of Health Capital Mobility," *Pakistan Development Review*, 53, 1.
_____ (2015), "Quality and Finite Changes of Trade Policy: A General Equilibrium Analysis," *Foreign Trade Review*, 50(1), Sage.
Chaudhuri S. and U. Mukhopadhyay (2014), *Foreign Direct Investment in Developing Countries: A Theoretical Evolution,* Springer, India.
Dawson, P.J. (2010), "Financial Development and Economic Growth: A Panel Approach," *Applied Economics Letters*, 17(8), 741-745.
Deaton, A. (2003), "Health, Inequality and Economic Development," *Journal of Economic Literature*, 41, 113-158.
Dithmer, J. and A. Abdulai (2020), "Trade Openness and Child Health: A Heterogeneous Panel Cointegration Analysis," *Applied Economics*, 52(23), 2508-2525.
Fogel, R.W. (1994), "Economic Growth, Population Theory, and Philosophy: The Bearing of Long-Term Processes on the Making of Economic Policy," *American Economic Review*, 84(3), 369-395.
Grossman, M. (1972): "On the Concept of Health Capital and the Demand for Health," *Journal of Political Economy*, 80(2), 223-255.
Gupta K. and T. Chatterjee (2016), "A Theoretical Model of Trade, Quality of Health Services and Signalling," in M. Roy and S.S. Roy (Eds), *International Trade and*

Finance, Springer**,** 2016, 295-314.

Gupta, I. and B. Goldar (2004), "Commercial Presence in the Hospital Sector Under GATS: A Case Study of India," *Journal of International and Area Studies*, 11(2), 17-43.

Gyimah-Brempong, K. (1998), "The Political Economy of Budgeting in Africa: 1971-1991," *Public Budgeting and Fiscal Management*, 4(4), 590-616.

Herzer, H. and P. Nunnenkemp (2012), "FDI and Health in Developed Economies: A Panel Cointegration Analysis," Working Chapter No.1756, Kiel Institute for the World Economy.

Herzer, H. and P. Nunnenkemp (2015), "Income Inequality and Health: Evidence from Developed and Developing Countries," *Economics*, 9(4), 1-56.

Im, K.S. and M.H. Pesaran (2003), "On the Panel Unit Root Tests using Nonlinear Instrumental Variables," Cambridge Working Papers in Economics No.0347, University of Cambridge.

Jacob, N. and A.Y. Boateng (2016), "How Does the Health Sector Benefit from Trade Openness? Evidence form Panel Data Across Sub-Saharan Africa Countries," MPRA Paper 72258, University Library of Munich, Germany.

Jones, R.W. (1965), "The Structure of Simple General Equilibrium Models," *Journal of Political Economy*, 73, 557-572.

_____ (1971), "A Three-Factor Model in Theory, Trade and History," in Bhagwati, J., R.W. Jones, R.A. Mundell and J. Vanek (Eds.), *Trade, Balance of Payments and Growth*, North-Holland, Amsterdam, 3–21.

_____ (2008), "Key International Trade Theorems and Large Shocks," *International Review of Economics and Finance*, 17, 103–112.

Jones R.W. and R. Findlay (2000), "Factor Bias and Technological Progress," *Economics Letters*, 68, 303-308.

Jones R.W. and S. Marjit (1985) "A Simple Production Model with Stolper–Samuelson Properties," *International Economic Review*, 19, 565-567.

Jorgenson A.K. (2009), "Foreign Direct Investment and the Environment, the Mitigating Influence of Institutional and Civil Society Factors, and Relationships Between Industrial Pollution and Human Health A Panel Study of Less-Developed Countries," *Organization and Environment*, 22, 135-157.

Khatun F. and M.G. Ahamad (2012), "*Liberalising Health Services in South Asia: Implications for Bangladesh,*" CPD Working Paper 96, Centre for Policy Dialogue, Bangladesh.

Lautier M. (2008), "Export of Health Services from Developing Countries: The Case of Tunisia," *Social Science and Medicine*, 67(1), 101-110.

_____ (2014), "International Trade of Health Services: Global Trends and Local Impact," *Health Policy*, 118(1), 115-113.

Leigh A. and C. Jencks (2007), "Inequality and Mortality: Long-Run Evidence from a Panel of Countries," *Journal of Health Economics*, 26(1), 1-24.

Levine D.I. and R. Rothman (2006), "Does Trade Affect Child Health?" *Journal of*

Health Economics, 25(3), 538-554.

Lynch, J., G.D. Smith, S. Harper, M. Hillemeier, N. Ross, G.A. Kaplan and M. Wolfson (2004), "Is Income Inequality A Determinant of Population Health? Part 1. A Systematic Review," *Milbank Quarterly*, 82(1), 5-99.

Maddala, G. and S. Wu (1999), "A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test," *Oxford Bulletin of Economics and Statistics*, 61(S1), 631-652.

Martens, P., S. Akin, M. Huynen and M. Raza (2010) "Is Globalization Healthy: A Statistical Indicator Analysis of the Impacts of Globalization on Health," *Globalization and Health*, 6, 371- 389.

Mirza, Z. (2004), "Trade in Health Services in Pakistan – A Country Case Study: Key Findings and Reflections," Paper presented at the International Workshop on Trade and Health, World Health Organization (WHO) Southeast Asia Regional Office (SEARO), 12-13 October, New Delhi, India.

Mudu, G. (2004), "Hospitals in India woo Foreign Patients," *British Medical Journal*, 328(7452), 1338.

Mushkin, S.J. (1962), "Health as an Investment," *Journal of Political Economy*, 70(5), 129-157.

Nilsson, T. and A. Bergh (2012), "Income Inequality and Individual Health: Exploring the Association in a Developing Country," IFN Working Paper No. 899, Research Institute of Industrial Economics.

Outreville, J.F. (2007), "FDI in the Health Care Sector and Most Favoured Location in Developing Countries," *European Journal of Health Economics*, 8(4), 305-312.

Owen A.L. and S. Wu (2007), "Is Trade Good for Your Health?" *Review International Economics*, 15, 660-682.

Preston, S.H. (1975), "The Changing Relation Between Mortality and Level of Economic Development," *Population Studies*, 29(2), 231-248.

Rafat, B., M. Emadzadeh and K. Ahmadi (2013), "Economic, Social and Political Aspect of Globalization on Health in Developing Countries," *International Journal Academic Research Business Social Science*, 3, 384-402.

Roodman, D. (2009), "A Note on the Theme of Too Many Instruments," *Oxford Bulletin of Economics and Statistics*, 71, 135-158.

Sampson, G.P. and R.H. Snape (1985), "Identifying the Issues in Trade in Services," *World Economy,* 8, 171-181.

Smith, R.D. (2004), "Foreign Direct Investment and Trade in Health Services: A Review of the Literature," *Social Science and Medicine*, 59(11), 2313-2323.

Stevens, P., J. Urbach and G. Wills (2013), "Healthy Trade: The Relationship between Open Trade and Health," *Foreign Trade Review*, 48(1), 125-135.

Turner, L. (2007), "First World Health Care at Third World Prices: Globalization, Bioethics and Medical Tourism," *BioSocieties*, 2, 303-325.

Woodward, D., N. Drager, R. Beaglehole and R. Lipson (2001), "Globalization and Health: A Framework for Analysis and Action," *Bulletin of the World Health*

Organization, 79, 875-881.
Wooldridge, J. (2001), "Econometric Analysis of Cross Section and Panel Data," MIT Press, World Economic Outlook Database, International Monetary Fund.

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