Rapid Rise of Life Expectancy in Bangladesh: Does Financial Development Matter?

Abstract

This paper investigates the role of financial development in the rapid rise of life expectancy in Bangladesh by using the annual data covering the period of 1972–2013. We examine the unit root properties of the variables employing a structural break unit root test. The combined cointegration and ARDL bounds testing approach confirm the long-run association between financial development and life expectancy in the presence of globalization, income inequality, and economic growth. The long-run elasticities indicate that financial development and globalization (income inequality and economic growth) positively (negatively) affect life expectancy in Bangladesh. The VECM Granger causality analysis indicates that the feedback effect exists between financial development and life expectancy, and income inequality and life expectancy. Economic growth and globalization are also found to Granger cause life expectancy. Our findings offer new insights to policy makers which are crucial to improve life expectancy in Bangladesh.

Keywords: Financial development; globalization; life expectancy; income inequality

1. Introduction

Bangladesh, a developing country in South Asia, has achieved significant development in health outcomes since its independence in 1971. During the time of independence, the country was desperately poor and highly populated, with an agrarian economy which was subject to frequent natural disasters. Within four decades, the country has made enormous health advances and now has one of the longest life expectancies in South Asia, with less spending on health care compared to several neighbouring countries. Between 1974 and 2016, life expectancy at birth augmented steadily from 53 years to 72.49 years in Bangladesh, from 55 years to 68.56 years in India, from 54 years to 66.48 years in Pakistan, and from 52 years to 70.25 years in Nepal (World Bank, 2018). Bangladesh presents a puzzling paradox of substantial life expectancy increase and is an example of '*good health at low cost'*. Although life expectancy has rapidly increased, there is no published literature that investigate the factors associated with such rapid life expectancy growth in Bangladesh. Hence, this study is a novel attempt to address this gap, and particularly focuses on the financial development.

Financial development, generally measured by the domestic credit to the private sector as a share of GDP, may affect life expectancy via various direct and indirect channels. Financial development is expected to have positively contributed to public health directly since access to finance helps people make healthier and better choices of foods, accommodation, treatment and overall lifestyle. Likewise, financial development may increase life expectancy through the indirect channels of GDP per capita, education, infrastructure and gender equality (Claessens & Feijen, 2007). First, a large number of theoretical studies such as Schumpeter (1911), McKinnon (1973) and Shaw (1973) argue that financial development stimulates economic growth and poverty alleviation though promoting innovation, mobilizing savings, allocating resources in productive sectors and minimizing transaction cost. Subsequently, these theoretical arguments have been validated by many empirical studies including King and Levine (1993), Levine and Zervos (1996), Levine (1997), Levine (2003), Ferrando and

Ruggieri (2018) and Swami and Dharani (2018) in both single-country and multi-country contexts. If financial development is positively related with economic growth measured by GDP *per capita* (Jalilan and Kirkpatric, 2002, Demetriades and Law, 2006), it then results in positive health outcomes because higher income assists in meeting the expenses of better food and nutrition, health care treatment, and housing.

Second, financial development positively affects health and life expectancy by improving the education level of households. Classens and Feijen (2007) argue that financial development helps to achieve universal primary education. In turn, it can be expected that financial development may lead to positively affect health via access to better education. Third, financial development enhances life expectancy through the *infrastructural effect.* It brings about economic growth and hence facilitates more public and private investment in healthcare infrastructure, including hospitals and clinics, which eventually lead to better health outcomes. Finally, financial development promotes women empowerment which in turn lead to better household health outcome. When women are empowered, they take better care of their children and allocate greater household budget on improving household welfare compared to their men counterparts (Unicef, 2014). Therefore, financial development emancipates women that will indirectly contribute to better household health conditions.

However, in the presence of a higher collateral for accessing financial services, financial development may not have a positive impact on life expectancy of a poor household. This is because the household may be technically forced to sell its productive assets just to manage the high collateral. This in turn decreases the household income and adversely affects health and life expectancy. Moreover, when financial access is exclusively enjoyed by the elites of the society or somehow misused by its users, then financial development may bring about a financial crisis which may lead to a staggeringly long-term slowdown in economic growth (Kindleberger, 1978). During an on-going financial crisis, governments can only allocate a limited budget for health care, insurance, and infrastructure, which in turn may result in poor

health system for the country. Likewise, poor households, who suffer job insecurity and low wages during financial crisis, become more vulnerable and may experience poor nutrition, unstable housing and unmet medical needs.

Along with the financial development, we also consider globalization, income inequality and economic growth as the control variables in our analysis. Globalization is typically understood as a process by which people and places across various countries become more interconnected. This interconnectedness is accomplished through linking the trade, finance, technology, and culture of different societies. Theoretically, globalization may have both positive and negative effects on public health. It has positive effect to health directly by facilitating the movement of nutritional and pharmaceutical goods and services and by transferring technologies related to safe drinking water, proper sanitation, adequate medical treatment, and sufficient pharmaceuticals from advanced countries to emerging countries. This is because pharmaceutical research and development (R&D) is largely conducted by a small group of advanced countries that export these technologies to the rest of the developing world (Papageorgiou et al., 2007). Moreover, modern technology facilitates quick response in the case of emergencies. For instance, a global network coordinated by the World Health Organization (WHO) through international telecommunications which immediately detect and response to transformation in influenza viruses. Nevertheless, globalization can also negatively affect health through faster spread of contagious diseases including HIV/AIDS, tuberculosis, plague, severe acute respiratory syndrome (SARS), and H5N1 avian influenza. Similarly, globalization causes the spread of various unhealthy foods including genetically modified foods and tobacco to developing countries. For example, multinational tobacco companies penetrate to the low- and middle-income countries which are expected to cause 7 million death by 2030 (Lee, 2004).

A large number of theoretical and empirical studies argue that income inequality affects health through three channels: (i) disinvestment in human capital; (ii) erosion of social capital; and

finally, (iii) stressful social comparisons (Lynch & Kaplan, 1997). The high-income disparity may be linked with lower social spending in human, physical and cultural capital, including educational, medical and cultural activities (Beckfield, 2004). This is because the interests of the priviledged is significantly divergent from those of a typical underpriviledged family. This means that the elite class of a society apply constant pressure to the government to lower taxes and reduce social spending. The second channel that income inequality may affect health is participation in egalitarian politics and the introduction of public policies that are unfavourable to the poor. The third and final mechanism through which income inequality may have a detrimental effect on health is the direct psychosocial effect of social comparisons: when the poor cannot afford the better life-style of their rich neighbours, they become frustrated. Dressler (1996) and Dressler et al. (1998) provide evidence that frustration has an adverse effect on health outcomes.

Based on the above background, this paper contributes to the existing literature in the following four ways. First, it is the first study that uses a long time series data to test the dynamic relationship between financial development and life expectancy. Second, we apply both conventional and structural break unit root tests to examine the integration order of the variables. Third, we employ the bounds testing approach to find cointegration while accommodating the possible structural breaks and checking the robustness of cointegration through combined cointegration analysis. Finally, the causal relationship between the variables is investigated using the VECM Granger causality approach. Our results show that there is a long-run association between financial development and life expectancy in the presence of income inequality, economic growth, and globalization. The long-run elasticities show that financial development and globalization positively affect life expectancy, while income inequality and economic growth are negatively associated with life expectancy in Bangladesh.

The rest of the paper is organized into four sections. Section 2 presents a brief review of existing literature with methods and findings. Section 3 provides the description regarding data and the

empirical methodologies used for estimations. Section 4 reports and discusses the empirical findings. And section 5 concludes the study with policy implications.

2. Literature Review

A wide range of literature, from the perspective of single or multiple countries, investigates the determinants of life expectancy following the pioneering study of Auster et al. (1969). This section is designed to provide a brief literature review, particularly focusing on the variables that are considered for the present study.

Income is found to be the most influential determinant of life expectancy in the prevailing literature. The theoretical argument regarding the relationship between income and life expectancy is that income helps to access improved nutritional and medical care, better education and other superior socio-economic facilities, which eventually have a positive impact on health outcomes. The World Bank (1993) report contains pioneering empirical evidence in support of this theoretical argument and claims that the lower per capita GDP is the main obstacle in improving life expectancy in poor countries. However, Wilkinson (1992) finds a non-linear relationship between income and life expectancy; and life expectancy improves, at a diminishing rate, as income grows. The relationship between income and life expectancy is positive until a threshold level of US$5,000–US$10,000. An incremental GDP per capita after this threshold level has no significant relationship with life expectancy. However, some recent studies such as Messias (2003) for Brazil, Bayati et al. (2013) and Gilligan and Skrepnek (2015) for eastern Mediterranean region, and Mahumud (2013) for Bangladesh find significant positive linear relationship between economic growth and life expectancy. Likewise, Fouweather et al. (2015) for European countries, Urbanos-Garrido and Lopez-Valcarcel (2015) for Spain and Johansson et al. (2020) for Finland show that unemployed people who have limited income suffer from various problems relating to their physical and mental health. Nevertheless, Sen (1999) reveals that the Indian state of Kerala has achieved a higher life

expectancy despite its low per capita income. Likewise, Kabir (2008) and Sede and Ohemeng (2015) find no influential relationship between income and life expectancy in the case of developing countries and Nigeria, respectively.

Most of the literature suggests that greater income difference is linked with poor health outcomes and life expectancy. For example, Wilkinson (1990 and 1992) are a few of the earlier studies which provide empirical evidence that income inequality is one of the most important factors for shorter life expectancy in developing countries. Subsequently, considering 81 countries as a sample, the human development report of the United Nations Development Programme (UNDP, 1996) shows that countries experiencing severe income disparity have considerably higher infant mortality and lower life expectancy. Messias (2003) investigates the relationship between income inequality and life expectancy in Brazil. Employing data from all the Brazilian states and the federal capital, the study finds that income inequality is negatively related with life expectancy. With a large panel of more than 100 countries, Babones (2008) inspects the causal relationship between income inequality and public health. Applying various panel data techniques, the study provides evidence that income inequality is negatively correlated with life expectancy. Karlsson et al. (2010) investigate the influence of income inequality on life expectancy in 21 countries and find a negative association between income inequality and individual health. More recently, Mayrhofer and Schmitz (2014) also find that income inequality is negatively correlated with life expectancy in a sample of 136 countries. Whilst most of the existing studies report a negative relationship, some studies find no relationship between income inequality and life expectancy (see for example, Judge (1995), Saunders (1996), and Lynch et al. (2004)).

There is a considerable amount of literature that investigates the impact of globalization on health outcomes where globalization is mainly captured by the degree of trade openness of the economies. For instance, Wei and Wu (2002) is one of the important empirical studies that examines whether openness to international trade improves public health status. The authors

use a lower tariff rate as a proxy for trade openness and provide evidence that higher trade openness reduces infant mortality and improves life expectancy. Levine and Rothman (2006) investigate the association between trade openness and children's health. Employing the cross-sectional data from 130 countries, they show that trade openness plays an important role in reducing infant mortality, child mortality, and malnutrition. Considering economic freedom as a measure of globalization, Ovaska and Takashima (2006) examine whether globalization has any significant impact on life expectancy and find that economic freedom plays a central role in enhancing life expectancy. Afterwards, Owen and Wu (2007) conducted a study with a large panel data set of 219 countries to examine the impact of trade on health outcomes. Measuring openness as a volume-based measure (exports + imports)/GDP, the study concludes that trade openness is significantly correlated with lower rates of infant mortality and higher life expectancy in developing economies. Employing a panel data, the association between the economic freedom index and life expectancy is investigated by Stroup (2007). Using various robust panel techniques, the study reports that economic freedom is positively correlated with life expectancy. However, having a slightly different perspective on the gender issue, Bussmann (2009) fails to report any empirical evidence that trade openness has a significant relationship with women's health and their life expectancy using the data of 134 countries. Recently, Bergh and Nillson (2010) test the effect of globalization on life expectancy using a panel of 92 countries for the period of 1972 to 2010. The study reports a robust impact of globalization on enhancing the life expectancy using various estimation techniques and sample groups.

Stevens et al. (2013) take a large set of countries to test the relationship between trade openness and health. Using the fixed-effect model, the study conclude that in low-income countries trade has a significant positive impact on health. However, they find the relationship between income and health is nonlinear. When income level increases, the effect of trade openness on health decreases and the relationship becomes negative at high levels of income. Trade openness is

positively associated with health until a certain threshold level, and after that it has no significant impact. This finding is justified with the argument that trade openness could be harmful to health in the high-income countries where higher income is associated with long working hours, more mental pressure, less sleep, and increased consumption of unhealthy products. In a recent paper, using US data from 1960 to 2011, Herzer (2015) analyses the long-run impact of trade openness on population health by applying cointegration techniques. Using various time series techniques, the study suggests that trade has a positive and significant long-run impact on population health measured by life expectancy. Very recently, Alam et al. (2015b) examine the impact of trade openness on life expectancy using time series data over the period of 1972—2013 in Pakistan. The empirical evidence confirms that trade openness increases life expectancy. However, Lin et al. (2015), having data on the least developing countries (LDC) for the period of 1995 to 2012, investigate whether trade reduces infant mortality. From a panel of 48 LDCs, they find that trade does not help decrease child mortality. Indeed, the study reports that trade could even increase child mortality through raising environmental pollution. The same finding is also revealed by Miljkovic et al. (2015) who report that social globalization increases the obesity in developing countries. Nevertheless, Elmawazini et al. (2017) find no significant impact of globalization on the health gap between OECD and Sub-Saharan African countries.

From the above literature review, we find some studies that examine the impact of trade openness and foreign direct investment on life expectancy. However, in most of the cases, these studies vary in terms of their across countries, periods and methods. Moreover, none of these studies investigate the dynamic relationship among financial development, income inequality, globalization and life expectancy using long time series data in the case of Bangladesh. Furthermore, most of the existing studies did not employ the structural breaks in the time series data. Consequently, the current study addresses these limitations and contribute towards the advancement of literature with some policy implications.

3. Methodology

We collect the data on income inequality, measured by Gini-coefficient, from the Standardized World Income Inequality Database (SWIID, 2015)[1]. Data regarding life expectancy[2] (measured by the average number of years of life for both female and male), domestic credit to private sector as share of GDP and real GDP (constant prices) are collected from the world development indicators (CD-ROM, 2015). We use the globalization index from Dreher (2006), who generated an overall globalization index from three sub-indices, that is, economic globalization, social globalization, and political globalization. Economic globalization involves two sub-indices that are (i) actual economic flows (trade, foreign direct investment and portfolio investment) and (ii) restrictions to trade and capital (which include restrictions on trade and capital using hidden import barriers, mean tariff rates, taxes on international trade as a share of current revenue, and an index of capital controls). For political globalization, Dreher (2006) used the number of embassies in a country, membership in international organizations, participation in the UN secretary council, and international treaties. We model the relationship between financial development and life expectancy by incorporating income inequality, economic growth, and globalization in life expectancy function. The general form of life expectancy function is designed as follows:

$$E_t = f(I_t, Y_t, F_t, G_t) \tag{1}$$

where E_t is life expectancy, I_t is income inequality, Y_t is real GDP per capita, F_t is financial development and G_t stands for globalization. In order to have an efficient, consistent and empirical analysis, as well as to reduce the sharpness in the time series, we transform all the

[1]See Frederick (2015) for more details.
[2] We use the series of total population to transform domestic credit to private sector and real GDP into per capita terms.

time series variables into logarithmic form. The empirical equation of the model is given as follows:

$$\ln E_t = \alpha_1 + \alpha_2 \ln I_t + \alpha_3 \ln Y_t + \alpha_4 \ln F_t + \alpha_5 \ln G_t + \mu_t \quad (2)$$

where, $\ln E_t$ is natural log of life expectancy, $\ln I_t$ is natural log income inequality, $\ln Y_t$ is real GDP per capita, $\ln F_t$ is natural log of financial development, $\ln G_t$ is natural log of globalization, and μ_i is the error term, with the assumption of normal distribution.

3.1. The Bayer-Hanck cointegration approach

The existing econometric literature documents that a linear combination of series has a lower order of integration when the time series are integrated at I(1) or I(2). The cointegration approach pioneered by Engle and Granger (1987) examines the presence of long-run relationship between the variables. Their cointegration approach requires all time series to be integrated of same order, that is, stationarity at the same level. Further, Engle-Granger cointegration approach is appropriate for finite sample sizes. In the late 1980s, Johansen (1988) introduced a new test of cointegration, the *Johansen maximum eigen value test*, which is considered more appropriate because it allows examination of more than one cointegrating relationship between the series. Additionally, the Error Correction Model (ECM)-based F-test by Boswijk (1995) and the ECM based *t*-test by Banerjee et al. (1998) are also commonly used approaches to ascertain cointegration.

The Bayer and Hanck (2013) cointegration approach combines different tests[3] into a single framework and provides the most comprehensive conclusion. The null of no cointegration is tested based on a combination of the four test statistics. In particular, the Bayer and Hanck test jointly determines test statistics of the Banerjee et al. (1998), Boswijk (1995), Engle and

[3] Notably, different cointegration techniques offer different conclusions.

Granger, and Johansen (1988) tests. The combination of the estimated significance level (*p*-value) of each cointegration test in Fisher's formulas is presented as follows:

$$EG - JOH = -2[\ln(p_{EG}) + (p_{JOH})] \quad (3)$$

$$EG - JOH - BO - BDM = -2[\ln(p_{EG}) + (p_{JOH}) + (p_{BO}) + (p_{BDM})] \quad (4)$$

where p_{EG}, p_{JOH}, p_{BO} and p_{BDM} are the *p*-values of the Engle and Granger, Johansen, Boswijk and Banerjee et al. tests, respectively. Accordingly, if the computed Fisher-statistic is more than the critical values generated by Bayer and Hanck (2013), we can reject the null hypothesis of no cointegration.

3.2. ARDL Bounds Testing Approach

The auto-regressive distributed lag (ARDL) bounds testing procedure proposed by Pesaran et al. (2001) offers several advantages over the traditional cointegration tests. The method is relatively simple to implement and performs better, even for the small sample sizes (Ghatak and Siddiki, 2001; Narayan, 2005). The procedure can be implemented irrespective of the order of integration, that is, the series can have a mixed order of integration. However, the series should have a maximum integration order of one, that is, all the series are at most I(1). Although most of the economic time series are I(I), for the purpose of rigor, the unit root properties must be examined to ensure, at most, the I(1) condition before applying the ARDL bounds procedure. For our purpose, we use the conventional unit root test; namely, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test. Another important point of this unit root testing is that it allows for identifying the maximum order of integration (without assuming it) at the outset, and this information is useful when applying causality tests. Moreover, the outcome further validates the use of ARDL procedure against other methods. Importantly, with the use of relatively advanced unit root tests, it is possible to examine at least a single structural break in

series. The inclusion of structural break periods is likely to influence the cointegration estimation and hence the conclusion regarding the presence of a long-run association. To examine the break in series, we use Zivot and Andrews' (1992) single break tests.

The ARDL bounds approach is applied to examine the cointegration relationship among $\ln E_t$, $\ln I_t$, $\ln Y_t$, $\ln F_t$, and $\ln G_t$. It is worth noting that ARDL specification also enables us to simultaneously estimate both long- and short-run dynamics. The following specification shows the primary equation of interest:

$$\Delta \ln E_t = \beta_{10} + \beta_{11}E_{t-1} + \beta_{12}I_{t-1} + \beta_{13}Y_{t-1} + \beta_{14}F_{t-1} + \beta_{15}G_{t-1}$$
$$\theta TB_E + \sum_{i=1}^{p} \alpha_{11i}\Delta \ln E_{t-i} + \sum_{i=1}^{p} \alpha_{12i}\Delta \ln I_{t-i} + \sum_{i=1}^{p} \alpha_{13i}\Delta \ln Y_{t-i}$$
$$+ \sum_{i=1}^{p} \alpha_{14i}\Delta \ln F_{t-i} + \sum_{i=1}^{p} \alpha_{15i}\Delta \ln G_{t-i} + \varepsilon_{1t} \quad (5)$$

where TB_E = structural break in the life expectancy [4]. The cointegration between the variable can be identified in a two-step procedure. In the first step, equation 5 is estimated using the ordinary least squares technique. The second step involves testing the null hypothesis of no cointegration $(H_0: \beta_{i1} = \beta_{i2} = \beta_{i3} = \beta_{i4} = \beta_{i5} = 0)$ against the alternative, that is, the presence of long run relationship $(H_a: \beta_{i1} \neq \beta_{i2} \neq \beta_{i3} \neq \beta_{i4} \neq \beta_{i5} \neq 0)$. The presence of a long run association is confirmed by equating the coefficients of the level variables to zero and examining F- statistic. Therefore, the null hypothesis of no cointegration is rejected when F-statistics is above the upper bound $\{F - stat > I(1)_{critical}\}$. However, when the F-statistic is within the upper and lower bounds, $\{I(0)_{critical} < F - stat < I(1)_{critical}\}$, the outcome is

[4] In a case where the CUSUMQ plot and the diagnostic results of normality biasness are present, this can be corrected by including pulse-dummy variables.

inconclusive.[5] Moreover, the critical bounds of Narayan (2005) are used since the sample size is small ($30 \leq n \leq 80$).

3.2.3. VECM Granger Causality Approach

Granger (1969) postulates that at least a unidirectional causality exists between the variables when there is a long-run relationship between those variables. Hence, the confirmation of cointegration suggests the possible short-run and long-run causal relationships between the variables. The Granger causality is implied from Y_t to X_t when the past values of Y_t can predict the changes in X_t and, similarly, X_t Granger causes Y_t if and only if the deviations in Y_t can be predicted through the past values of X_t. Granger (1969) also suggests use of the Vector Error Correction Model (VECM) when the variables are integrated at I(1). The empirical equation for causality tests is hence modelled as follows:

$$(1-L)\begin{bmatrix} \ln E_t \\ \ln I_t \\ \ln Y_t \\ \ln F_t \\ \ln G_t \end{bmatrix} = \begin{bmatrix} \phi_1 \\ \phi_2 \\ \phi_3 \\ \phi_4 \\ \phi_5 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} & \beta_{14i} & \beta_{15i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} & \beta_{24i} & \beta_{25i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} & \beta_{34i} & \beta_{35i} \\ \beta_{41i} & \beta_{42i} & \beta_{43i} & \beta_{44i} & \beta_{45i} \\ \beta_{51i} & \beta_{52i} & \beta_{53i} & \beta_{54i} & \beta_{55i} \end{bmatrix} + \begin{bmatrix} \theta \\ \chi \\ \delta \\ \lambda \\ \vartheta \end{bmatrix} ECM_{t-1} + \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \\ \eta_{3t} \\ \eta_{4t} \\ \eta_{5t} \end{bmatrix} \quad (6)$$

The difference operator is shown by $1-L$. The lagged error term i.e., ECM_{t-1} is generated using the long-run OLS regression. The η_{1t} and η_{2t} are error terms which are assumed to have normal distributions with zero mean and constant variance. The presence of the long-run causality is validated by the statistical significance of *t*-statistic of the lagged error term, that is, ECM_{t-1}. The significance of the first differenced of the variables show the presence of the short-run causality. I_t Granger causes E_t if $\beta_{12i} \neq 0 \forall_i$ and E_t Granger causes I_t if $\beta_{11i} \neq 0 \forall_i$.

[5] However, this may be overcome by using different cointegration techniques and/or using theoretical justification to support the conclusion.

4. Empirical Results and Discussion

4.1. Descriptive Statistics

Table 1 reports the descriptive statistics and pair-wise correlation between life expectancy, income inequality, economic growth, financial development, and globalization. We fail to reject the null hypothesis of Jarque-Bera test, i.e., the time series is normally distributed and hence the transformed series are normally distributed. The correlation analysis indicates that income inequality and economic growth have negative correlation with life expectancy, e.g., -0.082 and -0.373, respectively. Financial development (0.239) and globalization (0.081) are positively correlated with life expectancy. Income inequality is negatively correlated with financial development and globalization. The correlation between financial development and globalization is positive. Finally, globalization is negatively correlated with economic growth. The correlation analysis only provides initial information on the degree of association between the variables but does not necessarily imply cointegration. Therefore, testing cointegration between the level variables is necessary.

[Insert Table 1 here]

4.2. Unit Root Tests

Testing the unit root properties of the variables is necessary for the reliability of statistical inference. A stationary time series has constant mean and variance over time; thus, any shock to the time series is temporary. On the contrary, when the time series follow a unit root process, i.e., time varying mean and variance, any shock results in a permanent change in the time series. We apply the unit root tests such as ADF (Dickey-Fuller, 1981) and PP (Philips and Perron, 1988) without structural breaks and Zivot and Andrews (ZA,1992) with a single unknown structural break in the series. The combination of the unit root tests with and without structural breaks is important because unit root tests without breaks may be biased when a time series has a structural break over the sample period. The presence of structural breaks in time series may result in wrongly failing to reject the null hypothesis of the unit root.

[Insert Table 2 here]

Table 2 reports ADF and PP unit root tests results. We note that life expectancy, income inequality, financial development, economic growth, and globalization contain unit root problem. After the first difference, all the variables are found stationary. This indicates that variables have a unique order of integration and are integrated at I(1). The results of ZA unit root test with single unknown structural break are shown in Table 3. As can be seen, life expectancy, income inequality, financial development, economic growth, and globalization are non-stationary and have structural breaks in 1976, 1988, 1989, 1994, and 1999, respectively. One of the reasons for structural breaks is that Bangladesh experienced political instability and natural calamities such as cyclones and floods in these years and these may have had a direct and indirect impact on the public health in Bangladesh.

[Insert Table 3 here]

The empirical evidence by ZA unit root test also confirms that life expectancy ($\ln E_t$), income inequality ($\ln I_t$), financial development ($\ln F_t$), economic growth ($\ln Y_t$), and globalization ($\ln G_t$) are characterized as I(1) variables. The unique order of integration of the variables leads us to apply the combined cointegration approach developed by Bayer and Hanck (2013). The combined cointegration is suitable for examining the cointegrating relationship between the variables for small sample data. The results of combined cointegration tests, namely the EG-JOH and the EG-JOH-BO-BDM tests, are reported in Table 4. The Fisher-statistics for both EG-JOH and EG-JOH-BO-BDM tests are more than critical values at 1% level of significance when we use income inequality, financial development, and economic growth as dependent variables. Further, the presence of three cointegrating vectors indicates the long-run relationship among the variables over the period 1972–2013 in the case of Bangladesh.

[Insert Table 4 here]

4.3. Cointegration Tests

While the investigation of cointegration between variables, using the Bayer and Hanck (2013) combined cointegration framework, provides efficient empirical results, it fails to accommodate the structural breaks stemming in time series. The structural breaks in life expectancy can be incorporated into the modelling framework (see Eq. 5) by applying the ARDL bounds testing approach. Since our sample size is small, we utilize the critical bounds from Narayan (2005) to test the null hypothesis of no cointegration between life expectancy and its determinants. Table 5 reports the results of ARDL bound testing approach to cointegration. We note that F-statistic is greater than upper critical bound when we use income inequality, economic growth, financial development and globalization as dependent variables. In particular, the ARDL bounds testing analysis supports the findings of the Bayer and Hanck (2013) combined cointegration approach. This confirms the reliability of empirical results and it validates the long-run association between the variables in the presence of structural breaks. The suitability and model specification issues are addressed through a series of diagnostic tests. Normality of model residuals is tested using Jarque-Bera test and the results (χ^2_{NORMAL}) show that residuals are normally distributed. Further, neither serial correlation (χ^2_{ARCH}) nor heteroskedasticity (χ^2_{ARCH}) is present in the model residuals. Finally, the models are well specified (χ^2_{RESET}) in their function forms.

[Insert Table 5 here]

Since the long-run association between the variables is now confirmed, we next investigate the long- and short-run impact of income inequality, financial development, economic growth and globalization on life expectancy. The results of long-run estimates are reported in Table 6 (upper segment). We find that the income inequality has a negative (-0.142) impact on the life expectancy and is statistically significant at 1% level. It shows that a 1% rise in the income inequality decreases the life expectancy by 0.142%, keeping other things constant. Our findings are in line with Karlsson et al. (2010) and Mayrhofer and Schmitz (2014). The impact of

financial development on life expectancy is positive (0.084) and statistically significant at the 1% level. Keeping other things constant, a 1% increase in financial development improves life expectancy by 0.084%. A similar finding is also reported in the case of India by Alam et al. (2015a). The relationship between life expectancy and economic growth is significantly negative (-0.048). A 1% increase in economic growth will hamper the life expectancy by 0.048%, all else constant. This finding suggests that although Bangladesh has rapid economic growth in recent years, the essence of this growth may not have been equally distributed. The presence of the high income inequality may be crowding out the positive outcomes of economic growth on health. The impact of globalization on life expectancy is also positive and statistically significant. Keeping other things constant, life expectancy can be improved by 0.110% with 1% increase in globalization. Many recent studies, such as Herzer (2015) and Alam et al. (2015b), also provide similar evidence in the cases of the US and Pakistan respectively.

4.4. Short-run and Long-run Causality

The short-run results are reported in Table 6 (lower segment). We find that income inequality has a negative but statistically insignificant impact on life expectancy. Financial development has a positive and significant impact on life expectancy. Economic growth declines life expectancy in the short-run while globalization increases life expectancy insignificantly. The structural break dummy (D_{1999}) is not significant under both short-run and long-term specifications, suggesting that changes in life expectancy are mainly driven by the chosen macro-economic variables, that is, income inequality, financial development, economic growth, and globalization. The error correction term (ECM_{t-1}) is negative (-0.187) and statistically significant, which further supports the established long-run association between life expectancy and its determinant. It also implies that any short-run deviations in life expectancy function are corrected by 18.7% towards the long-run equilibrium path each year.

The diagnostic tests show that there is no problem of heteroskedasticity or serial correlation, and the model residuals are normally distributed. The Ramsey's reset test demonstrates that the functional form for the specifications of the short-run model is adequate. Finally, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMsq), shown in Figure 1 and 2, respectively, indicate the stability of long-run and short-run parameters.

[Insert Table 6 here]

[Insert Figure 1 and 2 here]

[Insert Table 7 here]

The existence of cointegration among series only implies the presence of causality; it does not provide the information on the direction of causality among the variables. Once the cointegration is established, we can ascertain the direction of both short-run and long-run causality between the variables through Granger causality test. We examine the temporal causality using the Vector Error Correction Model (VECM). The VECM-based causality is important mainly because it provides the direction of both short-run and long-run causalities. The short-run causal effects are examined through the significance of a joint test on the sum of the lagged differenced explanatory variables. We test the joint statistical significance of each differenced explanatory variable through F-statistic, and Table 7 reports the results. We follow Masih and Masih (1996) for the interpretation of short-run, long-run, and joint causality in VECM framework.

We note that in the long-run, income inequality causes life expectancy and in return, life expectancy causes income inequality, i.e., feedback effect. The causality between financial development and life expectancy is bidirectional. Economic growth Granger causes life expectancy. Life expectancy is Granger caused by globalization. In the short-run, financial development and life expectancy Granger causes each other, that is, the so-called feedback effect. The unidirectional causality is found running from economic growth to life expectancy.

Globalization causes life expectancy but the same is not true from the opposite side. Income inequality is caused by financial development in Granger sense. Economic growth Granger causes economic growth confirming the demand-side hypothesis.

5. Conclusion and Policy Implications

The life expectancy function is examined for Bangladesh by incorporating income inequality, financial development, economic growth and globalization as potential determinants of life expectancy using annual data from 1972 to 2013. In doing so, we applied the combined cointegration approach, and robustness of cointegration analysis is established through bounds testing approach with structural breaks. The cause and effect relationship between the variables is investigated by using the VECM Granger causality test.

The empirical results confirm the presence of cointegration for long run association. The long run elasticities suggest that income inequality lowers life expectancy. Financial development helps to improve life expectancy. Economic growth is inversely linked with life expectancy but globalization increases it. The causality analysis reveals the bidirectional causal relationship between income inequality and life expectancy. The 'feedback effect' exists between financial development and life expectancy. Therefore, the government of Bangladesh should recognise the financial services sector as one of the major influential platforms to push for improving the public health conditions. Contemporary policies that regulate the financial services sector are heavily biased to the rich and elites of the society and less favourable to uplift the poorer segment of the society. Due to a higher perceived risk, a poor household has to arrange a relatively larger collateral and accept higher interest rates in obtaining credit from a bank. However, in most of the cases, they are eventually denied access to the loans due to high cost of debt servicing. We argue that policy makers should take this perceived gap between the rich and the poor into a serious consideration and accordingly formulate financial policies and regulations via the central bank directives and through the Finance Acts that mandate the

commercial banks to offer easier, faster and cheaper loans to the poor in both rural and urban areas.

We also suggest that policy makers should formulate financial policies that force commercial banks to provide loans at a cheaper rate to the poor in both urban and rural areas. We argue that loans with softer terms and conditions such as simpler bureaucratic processes for loan applications and approvals, lower cost of debt servicing, removal of all hidden costs, open options to get incremental loans following the initial approvals and so on would reduce income inequality. This would eventually improve life expectancy. Second, globalization is positively correlated with life expectancy in Bangladesh. Hence, the Bangladesh government should introduce globalization policies that encourage free trade and movement of medical accessories and technologies, and medicines and health specialists. More simplified tariff structures for imports and exports, improved and business friendly corporate environment for foreign health and medicine firms, benefits of double-taxation treaties for foreign firms, attractive terms on the WTO agreements with partnering countries, specialized business zones for foreign companies, and easier access for foreign firms to get listed on the stock markets would work positively for enhanced trade openness and would make Bangladesh a truly global country. This would then contribute to longer life expectancy.

Finally, economic growth and income inequality are negatively associated with life expectancy. From a policy perspective, we argue that the Bangladeshi government should initiate effective redistribution policies. For instance, taxes could be increased on the income of the wealthy and high-income people. These additional revenues could then be redistributed among the low-income earning communities through various social welfare schemes. Further, we also suggest that the government of Bangladesh should generate employment opportunities for the unemployed poor that will eventually decrease income inequality and improve overall life expectancy in Bangladesh. Bangladesh benefits from a large human capital of 163 million people with the median age of 26.1 years. Beside creating the regular employment

opportunities, the Bangladesh government may replicate the Chinese model of supporting university graduates for innovative start-ups that helped create companies like Alibaba. Bangladesh government should also offer the vocational training and entrepreneurship platforms to these young people to help them establish their own start-ups that would create employment for themselves and for others. This would generate significant economic growth throughout the country and reduce the income inequality to a great extent and eventually deliver an enhanced life expectancy for people in Bangladesh. The success of enhanced life expectancy may be translated into other countries if these factors are taken care of. Therefore, our study could be used as a reference for other countries in this respect.

While this study contributes to knowledge creation and policy formulation significantly, it also provides some important future research direction in the context of health-finance nexus. Due to the data limitation, we restricted our analysis to one of the indicators of health — life expectancy. Therefore, future studies may consider infant mortality and child mortality as proxies for health along with life expectancy. Moreover, to our best knowledge, there is no study available in the existing literature which investigates the effect of finance on health by using panel framework. Hence, future studies may consider this issue by making comparison between developed and developing countries since the level of economic development, health education, health infrastructure and other health related provisions are significantly different from developing to developed ones.

References

Alam, M.S., Shahbaz, M., & Paramati, S.R. (2015a) The role of financial development and economic misery on life expectancy: Evidence from post financial reforms in india. *Social Indicators Research*, 1–17.

Alam, M.S., Raza, S.A., Shahbaz, M., & Abbas, Q. (2015b). Accounting for contribution of trade openness and foreign direct investment in life expectancy: The long-run and short-run analysis in Pakistan. *Social Indicators Research*, 1-16.

Auster, R., Leveson, I. and Sarachek, D. (1969). The production of health, an exploratory study. *Journal of Human Resources*, *4*, 411-436.

Babones, S.J. (2008). Income inequality and population health: Correlation and causality. *Social Science & Medicine, 66*(7), 1614-1626.

Bayati, M., Akbarian, R., & Kavosi, Z. (2013). Determinants of life expectancy in e*astern Mediterranean region: A health production function. *International journal of health policy and management, 1*(1), 57-61.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of Time Series Analysis*, *19*(3), 267-283.

Bayer, C., & Hanck, C. (2013). Combining non-cointegration tests. *Journal of Time Series Analysis*, *34*(1), 83-95.

Beckfield, J. (2004). Does income inequality harm health? New cross-national evidence. *Journal of Health and Social Behavior*, *45*(3), 231-248.

Bergh, A., & Nilsson, T. (2010). Good for living? On the relationship between globalization and life expectancy. *World Development, 38*(9), 1191-1203.

Boswijk, H. P. (1995). Efficient inference on cointegration parameters in structural error correction models. *Journal of Econometrics*, *69*(1), 133-158.

Bussmann, M. (2009). The effect of trade openness on women's welfare and work life. *World Development, 37*(6), 1027-1038.

Claessens, S., & Feijen, E. (2007). *Financial sector development and the millennium development goals* (No. 89). World Bank Publications.

Demetriades, P., & Hook Law, S. (2006). Finance, institutions and economic development. *International Journal of Finance & Economics,* 11(3), 245-260.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, 1057-1072.

Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, *38*(10), 1091-1110.

Dressler, W.W. (1996). Hypertension in the African american community: Social, cultural, and psychological factors. *Seminars in nephrology, 16* (2), 71–82.

Dressler, W.W., Balieiro, M.C., & Santos, J.E.D. (1998). Culture, socioeconomic status, and physical and mental health in brazil. *Medical anthropology quarterly, 12*(4), 424-446.

Elmawazini, K., Manga, P., Nwankwo, S., & AlNaser, B. (2019). Health gap between developed and developing countries: Does globalization matter?. *Economic Change and Restructuring*, *52*(2), 123-138.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 251-276.

Ferrando, A., & Ruggieri, A. (2018). Financial constraints and productivity: evidence from euro area companies. *International Journal of Finance & Economics*, *23*(3), 257-282.

Fouweather, T., Gillies, C., Wohland, P., Van Oyen, H., Nusselder, W., Robine, J. M., ... & JA: EHLEIS Team. (2015). Comparison of socio-economic indicators explaining inequalities in Healthy Life Years at age 50 in Europe: 2005 and 2010. *The European Journal of Public Health*, *25*(6), 978-983.

Frederick, S. (2015). The standardized world income inequality database. Working paper, SWIID Version 5.0, October 2015.

Gilligan, A. M., & Skrepnek, G. H. (2014). Determinants of life expectancy in the Eastern Mediterranean Region. *Health Policy and Planning*, *30*(5), 624-637.

Ghatak, S., & Siddiki, J. U. (2001). The use of the ARDL approach in estimating virtual exchange rates in India. *Journal of Applied Statistics*,*28*(5), 573-583.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society*, 424-438.

Herzer, D. (2015). The long-run effect of trade on life expectancy in the united states: An empirical note. *Applied Economics Letters, 22*(5), 416-420.

Jalilian, H., & Kirkpatrick, C. (2002). Financial development and poverty reduction in developing countries. International Journal of Finance & Economics, 7(2), 97-108.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2), 231-254.

Johansson, E., Böckerman, P., & Lundqvist, A. (2020). Self-reported health versus biomarkers: does unemployment lead to worse health?. *Public Health*, *179*, 127-134.

Judge, K. (1995). Income distribution and life expectancy: A critical appraisal. *BMJ: British Medical Journal, 311*(7015), 1282.

Kabir, M. (2008). Determinants of life expectancy in developing countries. *The journal of Developing areas, 41*(2), 185-204.

Karlsson, M., Nilsson, T., Lyttkens, C.H., & Leeson, G. (2010). Income inequality and health: Importance of a cross-country perspective. *Social science & medicine, 70*(6), 875-885.

Kawachi, I., & Wamala, S. (2006). *Globalization and health*: Oxford University Press.

Kindleberger, C.P. (1978). *Economic response: Comparative studies in trade, finance, and growth*: Harvard University Press.

Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*,*54*(1), 159-178.

Lee, K. (2004). Globalisation: what is it and how does it affect health?. *Medical Journal of Australia*, *180*(4), 156-158.

Levine, R. (1997). Financial Development and Economic Growth: Views and Agenda, *Journal of Economic Literature*, 35.

Levine, R. (2003). More on finance and growth: more finance, more growth?. *Review-Federal Reserve Bank of Saint Louis*, *85*(4), 31-46.

Levine, D.I., & Rothman, D. (2006). Does trade affect child health? *Journal of Health Economics, 25*(3), 538-554.

Lin, F., Sim, N.C., & Pham, N. (2015). Child mortality in the ldcs: The role of trade, institutions and environmental quality. *Working Paper No. 2015-15,* School of Economics, The University of Adelaide.

Lynch, J., Smith, G.D., Harper, S.A., Hillemeier, M., Ross, N., Kaplan, G.A., & Wolfson, M. (2004). Is income inequality a determinant of population health? Part 1. A systematic review. *Milbank Quarterly, 82*(1), 5-99.

Lynch, J.W., Kaplan, G.A., & Salonen, J.T. (1997). Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse. *Social science & medicine, 44*(6), 809-819.

Mahumud, R. A., Hossain, G., Hossain, R., Islam, N., & Rawal, L. (2013). Impact of life expectancy on economics growth and health care expenditures in bangladesh. *Universal Journal of Public Health, 1*(4), 180-186.

Masih, A. M., & Masih, R. (1996). Energy consumption, real income and temporal causality: results from a multi-country study based on cointegration and error-correction modelling techniques. *Energy Economics*, 18(3), 165-183.

Mayrhofer, T., & Schmitz, H. (2014). Testing the relationship between income inequality and life expectancy: A simple correction for the aggregation effect when using aggregated data. *Journal of Population Economics, 27*(3), 841-856.

Messias, E. (2003). Income inequality, illiteracy rate, and life expectancy in brazil. *American Journal of Public Health, 93*(8), 1294-1296.

Miljkovic, D., Shaik, S., Miranda, S., Barabanov, N., & Liogier, A. (2015). Globalisation and obesity. *The World Economy*, *38*(8), 1278-1294.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics*, *37*(17), 1979-1990.

Ovaska, T., & Takashima, R. (2006). Economic policy and the level of self-perceived well-being: An international comparison. *The Journal of Socio-Economics, 35*(2), 308-325.

Owen, A.L., & Wu, S. (2007). Is trade good for your health?. *Review of International Economics, 15*(4), 660-682.

Papageorgiou, C., Savvides, A., & Zachariadis, M. (2007). International medical technology diffusion. *Journal of International Economics, 72*(2), 409-427.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Saunders, P. (1996). *Poverty, income distribution and health: An australian study*: University of New South Wales.

Sede, P.I., & Ohemeng, W. (2015). Socio-economic determinants of life expectancy in nigeria (1980–2011). *Health economics review, 5*(1), 1-11.

Sen, A. (1999). Economics and health. *The Lancet, 354*, SIV20.

Stevens, P., Urbach, J., & Wills, G. (2013). Healthy trade: The relationship between open trade and health. *Foreign Trade Review, 48*(1), 125-135.

Stroup, M.D. (2007). Economic freedom, democracy, and the quality of life. *World Development, 35*(1), 52-66.

Swamy, V., & Dharani, M. (2018). An alternate approach in exploring the causal link between financial development and economic growth—Evidence from advanced economies. *International Journal of Finance & Economics*, *23*(1), 55-76.

United Nations Development Programme (UNDP, 1996). Human Development Report. Oxford University Press, New York, NY.

United Nations Children's Fund (Unicef, 2014). Ending Child Marriage: Progress and prospects, UNICEF, New York, NY.

Urbanos-Garrido, R. M., & Lopez-Valcarcel, B. G. (2015). The influence of the economic crisis on the association between unemployment and health: an empirical analysis for Spain. *The European Journal of Health Economics*, *16*(2), 175-184.

Wilkinson, R. G. (1990). Income distribution and mortality: A 'natural'experiment. *Sociology of health & illness, 12*(4), 391-412.

Wilkinson, R. G. (1992). Income distribution and life expectancy. *Bmj, 304*(6820), 165-168.
Wei, S.-J., & Wu, Y. (2002). The life-and-death implications of globalization. IMF Working Paper.
World Bank. (2015). *World development indicators*. Washington, DC.
Zivot, E., & Andrews, D. W. (1992). Further evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root. *Journal of Business & Economic Statistics*, *10*(3), 251-270.