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The Role of Financial Development and Economic Misery on Life Expectancy: Evidence from Post Financial Reforms in India

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Abstract This paper examines the impact of financial development and economic misery on life expectancy after the implementation of financial reforms in the case of Indian economy. Economic growth, education expenditure and rural–urban income inequality are included as additional determinants of life expectancy over the period of 1990QI–2013QIV. Our empirical findings from the combined cointegration approach confirm the long-run equilibrium relationship among life expectancy, economic growth, economic misery, education expenditure, financial development and rural–urban income inequality. Further, our results on the long-run impact suggest that financial development, economic growth and education expenditure have a significant and positive impact on life expectancy while economic misery and rural–urban income inequality have a substantial negative impact. Our findings offer a significant contribution to the policy and to the body of knowledge. Policy makers can formulate appropriate policies towards reducing rural–urban income inequality and economic misery so that life expectancy can further increase in India.

Keywords Financial development · Economic misery · Life expectancy · India

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1 Introduction

Life expectancy is an important indicator of a nation's health and it is also often used as one of the measurements of national development by international agencies. The level of life expectancy has significant policy implications on economic growth, fertility behaviour, intergenerational transfers, public finance and social security schemes, and pension plans. Moreover, the size and growth of health care related industries such as insurance, pharmaceuticals and aged care services largely depend on life expectancy. Therefore, determinants of life expectancy for a given country have become a very important issue and a plethora of literature is available that investigates the impact of various economic, social and environmental factors on life expectancy. The economic determinants of a nation's health status may consist of income, health expenditure, food availability, and pharmaceutical expenditure. Social factors or life style measures of life expectancy include cigarette smoking, alcohol consumption, education, the political situation and marital status. Environmental factors of longevity are related to urbanization, wealth, safety, industrialization and regulation. Despite the enormous volume of work that has been carried out to investigate the effect of various factors on life expectancy, there is no empirical study that measures the impact of financial development on life expectancy. Moreover, to date, very little is known about the relationship between economic misery and life expectancy. Hence, this study undertakes to fill these gaps in the existing literature by investigating the impact of financial development and economic misery on life expectancy in India considering economic growth, education expenditure and rural–urban income inequality as important determinants of life expectancy.

Financial development may affect life expectancy by various channels (Claessens and Feijen 2007). The first channel is the *income effect* which refers that financial development stimulates industrialization and other economic activities that generate new employment opportunities and increase the households' income. The increased income helps people to afford better food and nutrition, housing, health care treatment, and invest in better living and working conditions that significantly increase life expectancy. The second channel, *the education effect,* infers that access to financial services improves the level of education of the household which in turn positively influences health and life expectancy. The third channel is the *gender equality effect* which means that financial development helps to empower women in income generating activities. An empowered woman takes better care of her children and spends more on the family welfare than a man does. Therefore, access to financial services by women indirectly improves family health and life expectancy. Finally, financial development increases life expectancy through the *infrastructural effect* as financial development spurs economic growth, facilitating more public and private investment in healthcare infrastructure including hospitals and clinics which may lead to better health outcomes. However, financial development may have a negative impact on life expectancy when a poor household needs high collateral to access financial services. To manage the high collateral, a household is forced to sell its productive assets that eventually decreases its income and adversely affects health and life expectancy. Moreover, when financial access is limited to only elite class of society or mismanaged by the users, then financial development may cause a financial crisis and often a long-lasting slowdown in economic growth (Kindleberger 1978). During a financial crisis, both government and household experience a limited budget to spend on health care, insurance and infrastructure which also negatively affects the health system of a country.

Economic misery, measured by the misery index, is calculated by combining inflation and unemployment rates. Arthur Okun, an American economist, first developed misery index in 1960 by assuming that the rise of inflation with a higher rate of unemployment creates economic misery for a nation. A wide range of literature such as; Treisman (2000), King and Ma (2001), Neyapti (2004), Shah (2006); Thornton (2007) and more recently Shahbaz et al. (2015) used a misery index as a proxy for economic misery. Inflation, *a general increase in the prices of goods and services*, impacts the purchasing power of households during their daily life. This decline in purchasing power of money is connected to a decrease in food and health spending of household which in turn adversely affects life expectancy. For example, Lee et al. (2015) find that food price inflation is one of the important factors causing undernourishment which leads to an increase of infant mortality in the least developing countries (LDCs). Moreover, unemployment also negatively affects life expectancy by affecting the income of individuals (Forbes and McGregor 1984).

India is considered as an interesting case study as the country is one of the most transitional economies in the world which has experienced a significant progress in life expectancy during the last few decades. For example, according to the World Bank (2015), the average life expectancy of an Indian increased about 10 years during 1990–2013. Moreover, Indian financial development in terms of bank loans to the private sector has observed a dramatic growth of six times after the country's financial reforms in early 1990s. Nevertheless, being a developing economy, India has been struggling with unemployment and inflation over the years which might have negative impact on life expectancy in India. Hence, these points help us to consider India as a case study to investigate the impact of financial development and economic misery on life expectancy. We employ robust time series econometric models to achieve the study objectives on data series from 1990QI–2013QIV. Our empirical results show that economic growth, education expenditure and financial development have a significant positive impact on life expectancy while economic misery and rural–urban income inequality have a negative effect on life expectancy.

The paper is divided into five sections. Section 2 presents a critical review of the literature, including methods and findings. Section 3 introduces data and the empirical methodologies that are adopted in this paper. Section 4 reports the empirical results of the study. Finally, Sect. 5 presents the conclusions and policy implications arising from this study.

2 Literature Review

Since the pioneering study of Auster et al. (1969), a large volume of literature has focused on identifying the determinants of life expectancy in the context of single or multiple countries. The most important and significant determinants of life expectancy found in the existing literature is income. Rodgers (1979) has conducted one of the early studies that provided a theoretical framework on the relationship between absolute level of income (measured by GDP per capita) and life expectancy. The study argues that the relationship between income level and life expectancy is non-linear and logarithmic, and life expectancy increases at a diminishing rate as GDP per capita increases. The World Bank (1993) also supports Rodgers (1979) and claims that lower per capita GDP is one of the important reasons for lower life expectancy in poor countries. Anand and Ravallion (1993) also reveal a significant positive relationship between GNP per capita and life expectancy.

However, Wilkinson (1996) reports that income positively affects life expectancy until a certain threshold level. According to the study, life expectancy and income have positive relationship when GDP per capita is below a threshold of $5000–10,000 and further increase in GDP per capita is no longer appeared to be positively associated with life expectancy. Sen (1999) reveals that the Indian state of Kerala has achieved an impressively high life expectancy despite its low per capita income. Subsequently, Sauvaget et al. (2011) reports a different finding in the Thiruvananthapuram district of Kerala. Based on survey data of 167,331 participants aged 34 years and above, the study finds that high income households with good housing conditions have a 2–3 years higher life expectancy compared to deprived persons. The similar findings are also documented by Gilligan and Skrepnek (2015) in 21 nations of the Eastern Mediterranean Region (EMR). Using panel data set of 1995–2010, the study claims that increase in income has a significant positive influence on life expectancy in the sample countries. However, Sede and Ohemeng (2015) find no relationship between income and life expectancy in the case of Nigeria during 1980–2011.

The positive relationship between education and life expectancy is well established in both the theoretical and empirical literature. From a theoretical point of view, education improves life expectancy as it helps individuals to take better decisions regarding healthcare (Grossman 1972). Moreover, people with a higher education have a better consciousness of health which also helps to increase life expectancy (Kenkel 1991). Furthermore, Sen (1999) argues that education influences life expectancy significantly through affecting health. The author points out that education increases the productivity of labour which helps to raise income of the household. The increasing income of the household allows more spending on health that further improves life expectancy. Kitagawa (1973) is one of the earlier studies providing empirical evidence that educational attainment reduces mortality rate for both men and women. Subsequently, the same finding is also confirmed by a number of other studies including Christenson and Johnson (1995), Deaton and Paxson (2001). Williamson and Boehmer (1997) reveal that educational status increases the life expectancy of female significantly from a wide range data set of 97 developing and developed economies. Veugelers et al. (2001) investigate the influence of education on life expectancy in Canada. Employing multi-level logistic regressions, the authors report that education increases life expectancy of Canadian people considerably. Likewise, Grabauskas and Kalediene (2002) also point out that female education assists to reduce mortality rate and increase life expectancy substantially in Lithuania. Lleras-Muney (2005) examines the relationship between education and life expectancy in the United States. Using standard regression estimation, the study claims that one more year of education increases life expectancy by 1.7 years. More recently, Shahbaz et al. (2015) find that illiteracy reduces life expectancy in the case of Pakistan over the period of 1972–2012.

The role of income inequality on life expectancy has been found to be controversial in previous studies. A number of studies have supported the income inequality hypothesis that higher income differences are associated with lower standards of population health and life expectancy. For example, Wilkinson (1990, 1992) has published a series of papers regarding income inequality and life expectancy where the author claims that income distribution is the most significant determinant of differences in average life expectancy. The Human Development Report (1996) also provides empirical evidence that income difference has an important effect on deteriorating life expectancy and increasing infant mortality in 81 countries. Hales et al. (1999) support the hypothesis by arguing that average measures of population health are influenced by distribution of income within societies. Wilkinson and Pickett (2006) report that the status of people's health tends to be worsen in

more unequal societies. Babones (2008) examines the causality between income inequality and various indicators of health in very broad panel data from more than 100 countries. Using the sample periods of 1970–1995, the study reveals that change in income inequality is significantly related to change in life expectancy. Very recently, Mayrhofer and Schmitz (2014) examine the link between income inequality and life expectancy using aggregated data. From a sample of 136 countries, the study argues that there is evidence for a negative correlation between income inequality and life expectancy. While most studies conclude a significant relationship, some studies such as Judge (1995), Saunders (1996) and Lynch et al. (2004) have found no significant relationship between income inequality and life expectancy.

Unemployment is found to be another influential factor to determine life expectancy. Unemployment negatively affects health as it reduces the income of households. A low level of income reduces access to food and nutrition, housing, and health benefits (Brenner and Mooney 1983). Miles (1987) reports that unemployment is strongly associated with ill health and reduced psychological well-being. Jin et al. (1995) investigate the association between unemployment and adverse health outcomes. Evaluated on an epidemiologic basis, the study suggests a strong and positive association between unemployment and many adverse health outcomes. Bellaby and Bellaby (1999) investigate the relationship between local unemployment rates and individual ill health in Britain. Gerdtham and Johannesson (2003) test whether unemployment has an effect on mortality using a large individual level data set of nearly 30,000 individuals in Sweden aged between 20 and 64 years. In an analysis of cause-specific mortality, the authors find that unemployment significantly increases the risk of suicides and the risk of dying by suffering various diseases.

Stuckler et al. (2009) examine the public health effect of economic crises, particularly the effect of unemployment on health. Employing data from 26 European Union (EU) countries between 1970 and 2007, the study reveals that rises in unemployment are associated with significant short-term increases in premature deaths from intentional violence. Rosa et al. (2014) estimate the impact of (particularly long-term) unemployment on the overall and mental health of the Spanish working-age population. The study applies a matching technique to cross-sectional micro-data from the Spanish Health Survey for the years 2006 and 2012, and finds that unemployment has a significant negative impact on both physical and mental health. Considering 275 regions in 29 countries in Europe, Breuer (2014) investigates the influence of unemployment on suicide mortality. The study employs data over the period 1999–2010 and provides empirical evidence that unemployment significantly increases suicides in the European countries. More recently, Sede and Ohemeng (2015) examine the socio-economic determinants of life expectancy in Nigeria using time series data from 1980 to 2011. The study argues that unemployment adversely affects the proportion of the total disposable income received by low income households and tends to create economic circumstances that adversely affect life expectancy. Fouweather et al. (2015) address the impact of macro-level-socio-economic indicators on healthy life years at age 50 (HLY50) in Europe. Using meta-regression approach, the study claims that unemployment has a considerable influence on HLY50 between 2005 and 2010.

In summary of the above literature review, we find that several studies have been undertaken to investigate the determinants of life expectancy using time series and panel econometric techniques. The empirical results of these studies mostly vary across countries, periods and methods. Moreover, none of the studies above investigate the impact of financial development on life expectancy. The relationship between economic misery and

life expectancy is also largely ignored in the prevailing literature. Furthermore, most of the existing studies use shorter time period data. Hence, the current study is undertaken to address these limitations and contributes to the advancement of literature as well as policy implications.

3 Data and Estimation Strategy

3.1 Data and Model Specification

We use a time series dataset for the period of 1990Q1–2013Q4. We have used the *Interpolation Method* to convert annual series into quarterly frequency. The quarterly interpolation data technique has been commonly used in many empirical studies (e.g. Baxter and King 1999; Tang and Chua 2012; Shahbaz et al. 2014). Increasing the frequency of the series in the sample will increase the power of statistical tests and provide more reliable and robust results (Zhou 2001).

Life expectancy is measured the average number of years of life (female and male), economic growth is measured by real GDP per capita, economic misery is measured using the combination of inflation and unemployment rates, education expenditure is measured as real education expenditure per capita, financial development is measured using real domestic credit to the private sector per capita and finally rural–urban income inequality is measured by ratio between (agriculture value-added to GDP/industry value-added to GDP). All the required data on the selected variables is collected from the World Development Indicators (WDI) online data source maintained by the World Bank.

Following the existing literature, we define life expectancy as a function of economic growth, economic misery, education expenditure, financial development and rural–urban income inequality. The functional form of this model is as follows:

$$\mathrm{F_t} = \mathrm{f(Y_t,\ EM_t,\ E_t,\ FD_t,\ R_t)} \tag{1}$$

where, F, *Y*, *EM*, *E*, *FD* and *R* are life expectancy, economic growth, economic misery, education expenditure, financial development and rural–urban income inequality, respectively. Following the prevailing literature (e.g. Shahbaz et al. 2015), we transform all of the variables into natural logarithms. The log form of the equation is as follows:

$$\ln(F_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 \ln(EM_t) + \beta_3 \ln(E_t) + \beta_4 \ln(FD_t) + \beta_5 \ln(R_t) + \varepsilon_t \tag{2}$$

In Eq. (2), β_s denotes elasticities of respective variables with respect to life expectancy, *t* denotes for time period and a random error term is ε. The empirical analysis is carried out using Eq. (2).

To achieve the objectives of the study, we employ various econometric techniques. For instance, to understand the distributional properties of the data series we employ descriptive statistics on each of the data series. Similarly, to identify the order of integration of the variables, we use two robust time series unit root tests such as, augmented Dicky–Fuller (ADF) (1979) and Philipps–Perron (PP) (1988). To explore the long-run equilibrium relationship we undertake recently developed combined cointegration test of Bayer and Hanck (2013). Furthermore, the long-run and short-run impact of selected variables on life expectancy is investigated using the autoregressive distributed lag (ARDL) model. Finally, to examine the shocks and responses of each variable on life

expectancy, we make use of variance decomposition approach and impulse response function.

3.2 Combined Cointegration Approach

There are several cointegration techniques exist to explore the long-run equilibrium relationship among the given variables. The first and foremost of such approaches is the Engle–Granger (1987) two-step procedure. Authors argue that if two time series variables are assumed to be same order of integration then there may be a long-run cointegration relationship between these variables. However, this approach cannot be applied on the model which has more than two variables. To overcome this weakness, Johansen (1991) has developed multivariate cointegration technique which allows for using more than two variables in the model. This model also relies on the assumption that all of the variables have to be same order of integration at level data series. Similarly, there are also some other models to address this issue in the applied economics literature.

It is important to mention that the conclusions which are drawn based on the findings of various cointegration tests are not always comparable. Therefore, to address this issue and increase the power of cointegration test using the unique generating process, a joint test-statistics for the null hypothesis no cointegration is proposed by Bayer and Hanck (2013). This approach is developed based on Engle–Granger (1987), Johansen (1991), Boswijk (1994) and Banerjee et al. (1998) tests. The major advantage of this technique is that it allows us to combine various individual cointegration approaches to provide more robust and reliable results.

Using the newly developed approach of Bayer and Hanck (2013), we explore the long-run equilibrium relationship among the variables of life expectancy, economic growth, economic misery, education expenditure, financial development and rural–urban income inequality in India. The following is the combination of computed significance level (*p-values*) of individual cointegration tests in Fisher's formula is as follows:

$$EG - JOH = -2[\ln(pEG) + (pJOH)] \tag{3}$$

$$EG - JOH - BO - BDM = -2[\ln(pEG) + (pJOH) + (pBO) + (PBDM)] \tag{4}$$

where, *pEG*, *pJOH*, *pBO* and *pBDM* are the *p* values of given individual cointegration tests, respectively. The null hypothesis of no cointegration can be rejected if the estimated Fisher statistics exceed the critical values that are provided by Bayer and Hanck (2013).

3.3 Long-Run and Short-Run Analysis Using ARDL Approach

To examine the long-run and short-run effect of economic growth, economic misery, education expenditure, financial development and rural–urban income inequality on life expectancy in India, we use the ARDL approach developed by Pesaran et al. (2001). Using this approach, we can also identify the long-run equilibrium relationship among the variables. The main advantage of this methodology is that it allows us to estimate short-run and long-run parameters simultaneously. Further, this approach can be applied on the data series which are integrated of order I (0) or I (1). Furthermore, this method has small sample properties.[1]

[1] Detail discussions and equations of all the models are excluded from the paper due to space limitation.

4 Empirical Results and Discussion

4.1 Preliminary Statistics

The results of descriptive statistics and unconditional correlations of life expectancy, economic growth, economic misery, education expenditure, financial development and rural–urban inequality are presented in Table 1. The empirical results show that, based on Jarque–Bera test, the null hypothesis of normal distribution cannot be rejected for all of the selected variables. This indicates that all the considered variables follow the normal distribution properties. Similarly, the unconditional correlation results show that life expectancy is positively correlated with economic growth, education expenditure and financial development while it is negatively correlated with economic misery and rural–urban income inequality. These correlations suggest that economic growth, education expenditure and financial development are the significant factors for increasing life expectancy in India. On the other hand, both economic misery and rural–urban income inequality are adversely affecting life expectancy.

To examine the order of integration of the variables, we employ two unit root tests such as; augmented Dickey–Fuller (1979) (ADF) and Phillips–Perron (1988) (PP). It is a prerequisite to identify the order of integration of the variables before the application of cointegration methodology to explore the long-run equilibrium relationship among the variables. Both of these (ADF and PP) tests assume that the null hypothesis of unit root (non-stationary) against the alternative hypothesis of no unit root (stationary). Table 2 presents the results of ADF and PP unit root tests. The results show that the null hypothesis of unit root cannot be rejected at 5 % significance levels for all of the variables at level data. However, at first order differences, the null hypothesis is rejected for all of the variables. This indicates that all of the variables are integrated of order I (1). The unit root test results advise that there may be a cointegration relationship among the selected variables in the long-run. This is explored in the flowing section.

Table 1 Descriptive statistics and correlation matrix

Variable	ln F_t	ln Y_t	ln EM_t	ln E_t	ln FD_t	ln R_t
Mean	4.13674	10.2155	4.5573	3.4986	9.0852	4.3143
Median	4.1392	10.1501	4.6025	3.4940	8.9422	4.3580
Maximum	4.1967	10.7947	4.8462	3.7780	10.142	4.6813
Minimum	4.0695	9.7386	4.2568	3.0257	8.2867	3.9300
SD	0.0409	0.3481	0.1840	0.2236	0.6669	0.2684
Skewness	−0.1299	0.2524	−0.2006	−0.2281	0.3090	−0.1405
Kurtosis	1.6992	1.7726	1.8011	1.8535	1.5473	1.5659
Jarque–Bera	1.7593	1.7613	1.5981	1.5225	2.4924	2.1356
Probability	0.4149	0.4145	0.4497	0.4670	0.2875	0.3437
ln F_t	1.0000					
ln Y_t	0.0345	1.0000				
ln EM_t	−0.1522	−0.1585	1.0000			
ln E_t	0.2400	−0.2780	0.3200	1.0000		
ln FD_t	0.1831	0.5466	−0.0601	−0.2011	1.0000	
ln R_t	−0.200	0.1221	−0.1234	−0.1400	−0.1700	1.0000

Table 2 Unit root analysis

Variable	ADF test		PP test	
	t-statistic	Prob. value	t-statistic	Prob. value
ln F_t	−2.6225 (2)	0.2699	2.2556 (3)	1.0000
ln Y_t	−1.9031 (4)	0.6447	−3.1767 (3)	0.0975
ln EM_t	−1.9417 (3)	0.6244	−2.1315 (3)	0.5215
ln E_t	−0.6179 (2)	0.9747	−2.9451 (6)	0.1534
ln FD_t	−1.7614 (1)	0.7152	−3.1527 (3)	0.1011
ln R_t	−2.6767 (2)	0.2486	−1.9467 (3)	0.6222
Δ ln F_t	−3.7694(4)**	0.0225	−3.7694 (3)**	0.0225
Δ ln Y_t	−3.6340 (4)**	0.0325	−4.6234 (6)*	0.0017
Δ ln EM_t	−6.6134 (2)*	0.0018	−5.9042 (3)*	0.0000
Δ ln E_t	−4.8292 (1)*	0.0009	−5.1725 (3)*	0.0003
Δ ln FD_t	−4.5409 (3)*	0.0088	−5.1078 (6)*	0.0003
Δ ln R_t	−5.0641(2)*	0.0004	−6.1912 (3)*	0.0000

*, ** Significance at 1 and 5 % levels, respectively. Values in parenthesis are selected lag length for respective variables

4.2 Findings of Combined Cointegration Approach

The long-run equilibrium relationship of life expectancy with economic growth, economic misery, education expenditure, financial development and rural–urban income inequality is explored using the recently developed combined cointegration methodology of Bayer and Hanck (2013). The empirical results of EG–JOH and EG–JOH–BO–BDM tests are demonstrated in Table 3. The results suggest that Fisher-statistics for EG–JOH and EG–JOH–BO–BDM tests are greater than 5 % critical values when life expectancy is served as dependent variable. This indicates that there is a significant long-run equilibrium relationship. Similarly, when economic growth, economic misery and financial development are treated as dependent variables then there is also an evidence of long-run equilibrium relationship among the variables. However, when education expenditure and rural–urban income inequality are served as dependent variables then there is no evidence of long-run relationship among these variables.

Table 3 The results of Bayer and Hanck cointegration analysis

Estimated models	EG–JOH	EG–JOH–BO–BDM	Cointegration
$F_t = f(Y_t, EM_t, E_t, FD_t, R_t)$	55.279*	73.707*	Exists
$Y_t = f(F_t, EM_t, E_t, FD_t, R_t)$	55.299*	128.981*	Exists
$EM_t = f(F_t, Y_t, E_t, FD_t, R_t)$	45.488*	110.146*	Exists
$E_t = f(F_t, Y_t, EM_t, FD_t, R_t)$	15.571	16.095	No
$FD_t = f(F_t, Y_t, EM_t, E_t, R_t)$	35.181*	119.109*	Exists
$R_t = f(F_t, Y_t, EM_t, FD_t, E_t)$	10.055	22.565	No

* Significance at 1 % level. Critical values at 1 % level are 15.701 (EG–JOH) and 29.85 (EG–JOH–BO–BDM). Lag length is based on minimum value of AIC

4.3 Findings of Long-Run and Short-Run Analysis Using ARDL Approach

We further explore the long-run and short-run impact of economic growth, economic misery, education expenditure, financial development and rural–urban income inequality on life expectancy in India using ARDL approach. The results of short-run and long-run analysis are documented in Table 4. The results on long-run analysis show that a 1 % increase in economic growth, education expenditure and financial development lead to increase life expectancy by 0.1145, 0.0465 and 0.1215 %, respectively. On the other hand, a 1 % increase in economic misery and rural–urban income inequality cause to decrease the life expectancy by −0.1155 and −0.1164 %, respectively. All the variables are statistically significant at 1 % levels except rural–urban income inequality which is significant at 10 % level. This suggests that a significant expansion in economic growth, education expenditure and financial development play an important role for promoting life expectancy in India. However, increasing economic misery and rural–urban income inequality have substantial adverse effect on life expectancy.

The findings from short-run analysis display that only education expenditure and financial development have the positive impact while rural–urban income inequality has

Table 4 Long-run and short-run analysis

Dependent variable = ln F_t			
Variable	Coefficient	t-statistic	Prob. value
Long run analysis			
Constant	0.7884*	33.3139	0.0000
ln Y_t	0.1145*	16.2455	0.0000
ln EM_t	−0.1155*	−10.6000	0.0000
ln E_t	0.0465*	9.3687	0.0000
ln FD_t	0.1215*	4.0234	0.0000
ln R_t	−0.1164**	−1.9500	0.05344
Short run analysis			
Constant	0.0003*	22.4769	0.0000
Δ ln Y_t	0.0373	1.2650	0.2092
Δ ln EM_t	−0.0032	−0.9343	0.3527
Δ ln E_t	0.0281**	2.3868	0.0191
Δ ln FD_t	0.0424*	3.8367	0.0002
Δ ln R_t	−0.0205**	−1.9951	0.0491
ECM_{t-1}	−0.0698*	−7.0828	0.0000
R^2	0.4459		
F−statistic	11.8049*		
Stability checks			
Test	F−statistic	Prob. value	
$\chi^2 SERIAL$	1.3375	0.6789[a]	
$\chi^2 ARCH$	3.1948	0.1110	
$\chi^2 WHITE$	1.6135	0.2345	
$\chi^2 REMSAY$	1.3730	0.1733	
CUSUM	Stable	0.0500	
CUSUMsq	Stable	0.0500	

*, ** Significance at 1 and 5 % levels, respectively

[a] The results of CUSUM and CUSUMsq are available upon request from authors

negative influence on life expectancy in India. Particularly, a 1 % increase in education expenditure and financial development lead to increase 0.0281 and 0.0424 % of life expectancy while a 1 % raise in rural–urban income inequality decreases life expectancy by −0.0205. Further, results advise that economic growth and economic misery have positive and negative impact on life expectancy, respectively, though these two variables are statistically insignificant. Furthermore, our results show that error correction term (−0.0698) is negative and significant at 1 % level. This confirms our findings of long-run equilibrium relationship among the variables. Further, this error correction term suggests that if the long-run equilibrium deviates in the short-run then the lagged value of error correction term shows the speed of adjustment from short-run disequilibrium to the long-run equilibrium. The error correction term lagged values indicate that the disequilibrium is corrected by 7 % per quarter. This reveals that all most 14 quarters it takes to restore the long-run equilibrium.

The short-run diagnostic tests results indicate that there is no issue of serial correlation in the model. Further, our results display that there is no problem of serial correlation, autoregressive conditional heteroskedisticity and white heteroskedisticity in the model. Based on the results of REMSAY's test we confirm that our model is free from misspecification of functional form. Further, our findings on cumulative sum (CUSUM) and cumulative sum of squares ($CUSUM_{sq}$) indicate the stability of long-run and short-run parameters.

4.4 Findings of Variance Decomposition and Impulse Response Functions

In the empirical literature, several researchers have applied various time series causality tests to explore the direction of causal relationship between the variables. Among them, the most popular causality test is based on the vector error correction model (VECM) for identifying short-run and long-run causalities. Researchers also extensively applied conventional Granger (1969) causality test and Toda and Yamamoto (1995) causality test to explore the short-run and long-run causalities among the variables, respectively. The main drawback of these causality tests is that they only able to capture the relative strength of causation within a sample period and will not be able to capture out-of-sample period. Another weakness of these tests is that they only confirm whether there is a causal relationship between the variables or not but will not be able to tell the exact magnitude of feedback affect from one variable to the other (Shan 2005). To overcome from these weaknesses of causality tests, Shan (2005) has proposed two new approaches to addresses these issues such as, variance decomposition and impulse response function.

The advantage of variance decomposition approach is that it identifies the magnitude of the predicted error variance for a series accounted for by innovations from each of the independent variables over different time periods in out-of-sample period. In addition, the generalized forecast error variance decomposition approach estimates the simultaneous shock affects. The empirical results of variance decomposition approach for ten periods are displayed in Table 5. The results show that 81.70 % of life expectancy is explained by its own shocks in India. Similarly, the shocks of economic growth, economic misery, education expenditure, financial development and rural–urban income inequality explain 0.50, 2.94, 3.13, 9.57 and 2.16 % to the life expectancy, respectively. This indicates that almost 82 % of life expectancy is caused by its own shocks and other major shock is from financial development i.e. about 10 % and the lowest is from economic growth which is less than 1 %.

The shocks in economic misery and rural–urban income inequality have larger contributions to economic growth which are about 36.93 and 23.66 %, respectively, along with its own shocks of 31.43 %. In the case of economic misery, it has its own shocks of 55.07

Table 5 Variance decomposition analysis

Period	ln F_t	ln Y_t	ln EM_t	ln E_t	ln FD_t	ln R_t
Variance decomposition of ln F_t						
1	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	99.3758	0.0067	0.1084	0.0111	0.4215	0.0762
3	98.2651	0.0305	0.2797	0.0724	1.1579	0.1938
4	96.8711	0.0646	0.3941	0.2645	2.1145	0.2909
5	94.8562	0.0811	0.6785	0.5355	3.3964	0.4521
6	92.4369	0.1082	1.0887	0.9114	4.7808	0.6736
7	89.7564	0.1611	1.5906	1.3758	6.1482	0.9676
8	86.9762	0.2394	2.1223	1.9163	7.4207	1.3249
9	84.2652	0.3517	2.5877	2.5117	8.5545	1.7288
10	81.7033	0.4955	2.9391	3.1309	9.5716	2.1592
Variance decomposition of ln Y_t						
1	9.0667	90.9332	0.0000	0.0000	0.0000	0.0000
2	11.6424	85.1781	1.4318	0.3402	0.7732	0.6340
3	12.6841	78.8099	4.5149	0.7019	1.2219	2.0670
4	11.3386	72.2316	9.3759	1.2078	0.9701	4.8757
5	9.1597	61.9364	17.8744	1.4978	0.7012	8.8302
6	7.0702	51.772	26.2134	1.4384	0.6662	12.838
7	5.5463	43.5413	32.1874	1.2431	1.1203	16.361
8	4.5608	37.5495	35.6700	1.0541	1.9315	19.233
9	3.9587	33.7145	36.9253	0.9197	2.8532	21.6283
10	3.6060	31.4310	36.9270	0.8348	3.5415	23.6595
Variance decomposition of ln EM_t						
1	0.2901	7.0384	92.6713	0.0000	0.0000	0.0000
2	0.4588	4.1305	93.6322	0.0256	0.6062	1.1465
3	0.5602	2.7216	90.7433	0.0490	1.7086	4.2170
4	0.6207	2.1641	85.3832	0.0631	3.4763	8.2924
5	0.6132	1.9056	76.9326	0.1176	5.5955	14.8352
6	0.5633	1.8476	68.6809	0.1910	6.8188	21.8982
7	0.5144	2.0383	62.8791	0.2886	6.9164	27.3628
8	0.4989	2.7614	59.3134	0.3951	6.5447	30.4862
9	0.5454	4.1870	57.0116	0.4906	6.4349	31.3299
10	0.6649	6.3340	55.0743	0.5608	6.9006	30.4651
Variance decomposition of ln E_t						
1	0.0522	1.3780	2.2437	96.3259	0.0000	0.0000
2	0.0995	1.9349	1.8121	91.1702	4.2381	0.7449
3	0.6223	1.5803	1.3426	83.4597	11.1520	1.8429
4	1.2922	1.2130	1.0851	75.1722	17.9388	3.2984
5	2.4605	1.0634	1.0715	64.4896	25.2076	5.7070
6	3.9177	1.2777	1.0428	56.2311	29.8357	7.6947
7	5.4771	1.7730	0.9305	50.9106	32.2256	8.6830
8	6.6697	2.3204	0.8123	48.0634	33.4796	8.6542

Table 5 continued

Period	ln F_t	ln Y_t	ln EM_t	ln E_t	ln FD_t	ln R_t
9	7.3415	2.9095	0.9090	46.6016	34.1966	8.0414
10	7.5607	3.3076	1.4918	45.3406	34.8305	7.4685
Variance decomposition of ln FD_t						
1	2.9852	10.3474	3.2320	2.4912	80.9440	0.0000
2	5.8082	17.6616	2.8680	1.4139	72.1743	0.0733
3	8.5707	21.6279	2.5366	3.4903	63.7239	0.0504
4	10.2907	22.5430	2.4157	8.1210	56.5600	0.0692
5	11.2841	23.7311	1.8551	12.6367	50.3433	0.1494
6	12.1008	23.6668	1.5198	15.4130	46.8723	0.4271
7	13.1445	22.6778	1.3121	16.5449	45.3257	0.9948
8	14.6798	21.1457	1.1955	16.5439	44.5374	1.8973
9	16.7236	19.2490	1.4086	15.9880	43.6968	2.9338
10	19.0741	17.4122	2.02497	15.3787	42.3608	3.7489
Variance decomposition of ln R_t						
1	5.1771	8.0779	0.0067	3.0385	1.9925	81.7070
2	8.3426	4.7928	0.4896	6.7565	0.9977	78.6205
3	10.5626	3.0238	1.8417	9.4929	0.6439	74.4348
4	10.0626	2.5846	4.4850	11.3814	0.5081	70.9781
5	9.1314	4.3459	6.3871	12.3322	0.4532	67.3499
6	8.7168	7.4422	7.7403	12.0408	0.5334	63.5262
7	9.0775	10.4832	8.4143	11.3214	0.9771	59.7263
8	9.5360	12.8115	8.4733	10.8033	1.8355	56.5401
9	9.6060	14.0230	8.4204	10.5014	3.0257	54.4233
10	9.4284	14.5274	8.3489	10.2680	4.1806	53.2464

and 30.47 % comes from rural–urban income inequality. The shocks in financial development has significant contributions to education expenditure that is, 34.83 % while shocks in economic growth has larger contributions to financial development which is 17.41 %. Finally, the shocks in rural–urban income inequality are explained by 9.43, 14.53, 8.35 and 10.27 % of life expectancy, economic growth, economic misery and education expenditure, respectively. Overall, we find that financial development has significant contribution to life expectancy in India.

Figure 1 shows the results of impulse response function. We find that forecast error stems in economic growth, contributes to life expectancy. Economic misery declines life expectancy due to forecast error stemming in economic misery after fifth time horizon. Education expenditure and financial development contribute to life expectancy positively. The contribution of rural–urban income inequality to life expectancy is negative.

5 Conclusion and Policy Implications

In this study, we aim to examine the impact of financial development and economic misery on life expectancy in India for the period of 1990Q1–2013QIV. The combined cointegration approach of Bayer and Hanck (2013) is applied to test whether there is an evidence

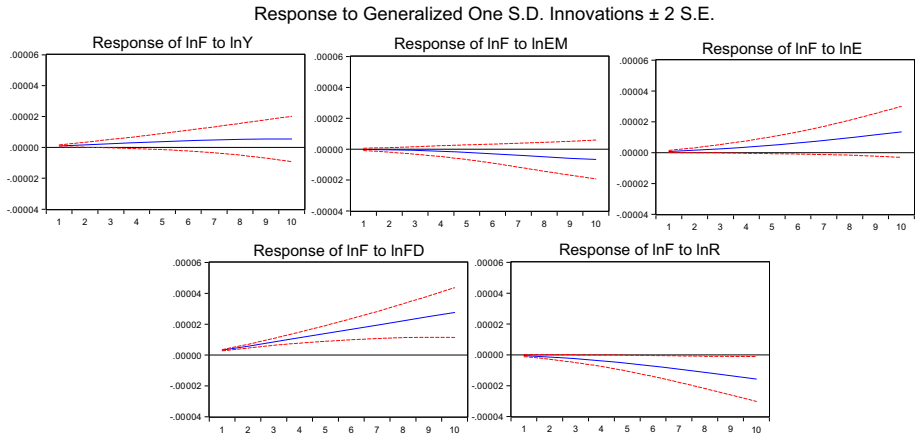

Fig. 1 Impulse response function

of long-run equilibrium relationship among the variables. In addition, we use the ARDL approach to investigate the long-run and short-run impact of financial development, economic growth, economic misery, education expenditure and rural–urban income inequality on life expectancy.

The empirical results from the cointegration test suggest that a significant long-run equilibrium relationship exists among life expectancy, financial development, economic misery, economic growth, education expenditure and rural–urban income inequality. The findings from long-run analysis display that financial development, economic growth and education expenditure have significant positive impact on life expectancy while economic misery and rural–urban income inequality have substantial negative impact. Further, our results on short-run analysis suggests that financial development and education expenditure have the positive impact while rural–urban income inequality has negative influence on life expectancy in India. Furthermore, variance decomposition approach indicates that life expectancy is mainly caused by its own shocks and other major shocks come from financial development. Finally, impulse response function indicates that financial development, economic growth and economic expenditure positively contribute to the life expectancy in India.

The results of our study bear some policy implications. The key findings reveal that economic growth, education expenditure and financial development contributes to life expectancy but their impacts are nullified by the presence of other economic fundamentals, such as economic misery and rural–urban income inequality. In this line, Indian government should enhance primary education spending and use it as an economic tool to improve the financial literacy and life expectancy. To further reduce economic misery, central government of India should control rising food prices by directing implementation of price regulatory body in the country and generate investment activities for employment opportunities and human capital formation. As a result, this will not only enhance domestic production but also keep the overall price level under controlled as well as lower the unemployment rate. In addition, we find that financial development also increases life expectancy in India, indicating that government should use financial sector as a tool to improve education and health indicators by introducing new financial sector reforms. Particularly, we argue that policy makers should formulate policies to enforce commercial

banks to provide loans at cheaper cost not only for education purpose but also for health related issues for both urban as well as rural population. Finally, the rural–urban income inequality is negatively associated with life expectancy. From a policy perspective, our study suggests that Indian government should generate employment opportunities in rural areas which eventually decreases rural–urban income inequalities and improves overall life expectancy in India. We recommend that the future research should also consider the impact of global factors on life expectancy in India such as; foreign direct investment (FDI) inflows, personal remittance inflows and trade (exports and imports) openness. These factors may potentially contribute to life expectancy in India.

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