



Inter-linkage between Child Health and Income- a comparative Study between India and China

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Abstract

The paper seeks to examine the inter-causality between health and income in the light of a comparative study between India and China. Moreover, attempt has been made to figure out the role played by inequality in health status (as measured by the Life Expectancy at Birth) between these two nations in causation of divergence between the GDP of them. This paper indicates strong health- income inter-causality for China but weaker one for India along but an inverse causal effect of health inequality on inter-country inequality in income. Besides, the study illuminates on the major factors instrumental in giving rise to substantial difference in the health condition between India and China.

Key words: *Per Capita GDP, Per Capita Health Expenditure, Female Literacy Rate, Infant Mortality Rate*

1. Introduction

The interrelationship between health and income deserves to be important issue in view of the role health plays in ensuring self sustained economic growth and development of a nation. The extent a country's economic growth depends on the quality of health enjoyed by its workforce is as much as the status of health of an individual living in the country is determined by his economic wellbeing as measured by his or her income amongst other socio-economic entities. The disparity in health within a nation and among the nations is thus likely to lead to some income inequality across different regions within a nation as well between nations and so is the reverse causality. As neighbouring countries India and China differ widely from each other in terms of socio-political structure and are therefore appropriate for making comparison on basis of different socio-economic variable of which of income and health are two prominent ones. Being the largest populated country when China stands as second largest in GDP size after USA in 2017 (IMF,2017),India is placed in the sixth position and is second largest by population with China having her GDP (in nominal terms) being over 4.8 times that of India(IMF,2017). Thus it

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is quite interesting to look into this scenario of the large income gap between India and China and try to find out the possible reasons for it. In this regard health can constitute a significant dimension due to reason stated at the outset. The present study has been divided into six sections; wherein section 5 reflects on the analysis part and within that section we have first shown the presence of health-income inter-causality in India and China; then the analysis has dealt with a probe into the causal effect of health inequality between the two nations on the income inequality and the last part of that analysis examines the plausible factors responsible for inequality in health conditions of them.

2. Literature review

The income inequality–health hypothesis was originally intended to explain variations in average levels of health among richer countries and was later applied to regional health differences within rich countries. The stronger association between absolute levels of income (GDP) and population health among poorer countries may suggest that there is some threshold below which absolute income is the more important determinant. In the aggregate-level studies, countries are the units of analysis, and the purpose is to see whether differences in levels of income inequality help explain differences in some indicator of population health among countries.

In his seminal paper, Preston (1975) examined the association between per capita national income and life expectancy at birth for three different decades of the 20th century. His study reflected that life expectancy in the 1900s, 1930s, and 1960s exhibited a nonlinear relationship with per capita national income, which had shifted upward during the 20th century. He was of the opinion that the upward ‘shifts’ in the life expectancy/income association were due mainly to exogenous factors that strengthened the public health infrastructure (such as immunization, technological advances, and specific disease-control campaigns) rather than income growth *per se*. In 1979, Rodgers elaborated on how income distribution was associated with population health. In a sample of about 50 countries, he tested a regression model that predicted infant mortality and life expectancy at birth as a function of mean income and income distribution. Rodgers also demonstrated theoretically how a curvilinear individual-level association between income and health was sufficient to produce an aggregate-level association between lower income inequality and better population health.

In a series of papers starting in the mid-1980s, Richard Wilkinson demonstrated important associations between income inequality and differences in mortality among industrialized countries. Wilkinson's widely cited 1992 study used income data on nine countries (Wilkinson, 1989, 1992, 1996, 1997, 2000). That equal societies are healthier is an argument particularly associated with Richard Wilkinson as well as the collection of articles edited by Kawachi, Kennedy and Wilkinson (1999).

Some recent studies (Dabla-Norris et.al, 2015) also indicate that income inequality is increasingly being reflected in lower life expectancy. This is particularly striking in the United States, where income today is a stronger predictor of life expectancy than it was a generation ago

(Murray, Lopez, & Alvarado, 2013). It is noteworthy that the studies by Judge (1995); Judge, Mulligan, and Benzeval (1998); Lynch and colleagues (2001); Gravelle, Wildman, and Sutton (2002); and Wildman, Gravelle, and Sutton (2003) specifically failed to replicate the previous positive findings of Wilkinson (1992), Rodgers (1979), and Waldmann (1992).

Despite little support for a direct effect of income inequality on health *per se*, some of the studies indicated that reducing income inequality by raising the incomes of the most disadvantaged would improve their health, help reduce health inequalities, and generally improve population health (Lynch John et al. 2004).

The nonlinearity argument for income redistribution which is common with almost all of the literature in epidemiology and public health, takes it for granted that a rise in income causes improvements in health and reductions in mortality. One such recent study made by Pickett and Wilkinson (2015) also shows a strong association between income inequality and health. But in economics much of the research studies on this issue have been skeptical about any causal link from income to health; instead most of these studies tend to emphasize causality in the opposite direction, viz. from good health to higher earnings, and from poor health to the inability to work and even inadequate assets to pay for health care.

Indeed, many studies today take it for granted that differences in health care are the primary and obvious reason for disparities in incomes (Brian Smedley, Adrienne Stith, and Alan Nelson, 2002).

The most difficult issue of all is sorting out the dual causality between income and health. A more sophisticated approach, closely related to Granger causality testing, is employed by Peter Adams et al. (2003) using data from HRS (Health and Retirement Survey/HRS in US); they find no causal link from wealth to health. It is clear that there are influences between income and health that runs in both directions, and that, in some cases, the lags can be as long as a human lifetime. In such circumstances, establishing clear causal patterns is a matter of great difficulty.

Deaton (2003), in his study, shows that there is no robust correlation between life expectancy and income inequality among the rich countries. The conclusions made are not also different from those of earlier commentators, particularly Judge (1995); Judge, Mulligan, and Benzeval (1997); Wagstaff and Eddy Van Doorslaer (2000); Judge and Iain Patterson (2001).

3. Objective of study

The primary objectives of the present study are noted below:

- a) To overhaul into a potential causality between child health and income for India and China
- b) To find out how far the inequality in health status across the nations is capable of explaining income disparity between them and vice-versa
- c) To figure out the primary factor(s) contributing to Health Inequality between these two nations.

4. Methodology

The present analysis is based on the time series data for India and China over the period 1990 - 2015. The status of child health of China and India have enumerated by Mortality Rate of Children under 5 Years while the income status of each country has been evaluated with respect to Constant GNP at PPP, 2015. Moreover variables like Per Capita GNP, Per Capita Health Expenditure, Female Literacy Rate as a proxy of mothers' education and Immunization for Children Aged 12 to 23 Months against Measles have been considered to explain the causation of disparity in the child health between India and China.

The gap between India and China with respect each of the variables being talked about so far has been evaluated using the formula given below:

$$D_i = \left(\frac{\text{Value of the } i^{\text{th}} \text{ variable recorded for China}}{\text{Value of the } i^{\text{th}} \text{ variable recorded for India}} \right), \text{ for all } i = 1, 2, \dots, 5$$

and D_1, D_2, D_3, D_4, D_5 are gap indicators for Mortality Rate of Children Under 5 Years, Per Capita GNP, Per Capita Health Expenditure, Female Literacy Rate and Immunization for Children Aged 12 to 23 Months Against Measles respectively.

Now to confirm the two way causality between child health inequality and inequality income for each of India and China we take resort to Granger Causality Test. This test enable us to confirm for any two variables Y and X whether or not Y causes X and X causes Y by running two separate regressions; where for causality of Y by X, Y is regressed on the past value of itself and on the past values of X while for the causality of X by Y, X is regressed on the past values of itself and on that of Y. Thus regression model used to test for causality of Y by X is given by

$$Y_t = \beta_1 X_t + \dots + \beta_m X_{t-m} + \delta_1 Y_t + \dots + \delta_n Y_{t-n},$$

where (m, n) denote the lags for Y and that for X. Now regarding the determination of lags we can refer to the Akaike Information Criterion or Final Prediction Error and while enumerating the optimal value for lag m other lag n is kept fixed at some value. Then given the optimal value of lag m, the optimal value of lag n is determined is for minimum model having minimum Akaike Information metric or minimum Final Prediction Error.

Next to this we move on to test for causality of inequality in child health status by the inequality in income status and vice-versa by performing the regressions:

$$(1) D_1 = \beta_1 + \beta_2 D_2 + u,$$

$$(2) D_2 = \alpha_1 + \alpha_2 D_1 + v, \text{ where } u \text{ and } v \text{ are the corresponding error terms.}$$

Lastly, we seek to investigate into the potential roles being played by Per Capita GDP, Per Capita Health Expenditure, Female Literacy rate (as a proxy for mother's education) and

Immunization against Measles for the Children Aged between 12 to 23 Months. To this end, we estimate a linear regression model with D_1 as the dependent variable and D_2, D_3, D_4, D_5 as the independent variables. Besides, charts and diagrams have been used to make comparative appraisal of India and China on income health inter-linkage and to highlight all plausible implications. Moreover, to avoid the possibility of spurious regression unit root test has been performed using *augmented Dickey- Fuller methodology* and besides, we have used the *Johanson's co-integration test* to confirm the presence of long-run relationship among the aforesaid variables [the results of these tests have been reported in the Appendix].

5. Result and its Interpretation

This section contains the illustration of the results obtained from the analysis as described in Methodology. First we look at Table 1(a) concerned with the Granger test of Causality from child health to income and vice-versa in case of China.

Table 1(a). Child Health verses Income inter causality in China

Null Hypothesis	F-Stat
Health Granger does not cause Income	18.1722***
Income Granger does not causes Health	4.9269***

*** significant at 1 per cent

Source: *Compiled from the Data on World Development Indicators, 2015 by World Bank*

The significant F statistics as observed for causality both from health to income and from income to health reveal a strong inter-causality between child health and income in China.

Table 1(b). Child Health verses Income inter causality in India

Null Hypothesis	F-Stat
Health Granger does not cause Income	2.9676**
Income Granger does not cause Health	101.0282***

**significant at 5 percent

Source: *Compiled from the Data on World Development Indicators, 2015 by World Bank*

However as evident from Table 1(b), for India the F-statistic showing the causality from health to income is significant at 5 per cent as against 1 per cent in case of China hinting at weaker magnitude of causality in India as compared to China. Now coming to case of causality from income to health, it emergent alike China India also register a strong causal effect of income on the child health as the corresponding F statistic has come significant at 1 percent.

Next to analysing the existent of causality from child health to per capita income (as measured by Per Capita GNP) and from income to child health, we seek to contemplate into the role income inequality in causing inequality in child health and the role of inequality in child health in causing inequality in child by performing the two separate regressions – one with D_1 on D_2 (shown in Table 2(a)) and the other with D_2 on D_1 (shown in Table 2(b))

Table 2(a). Causality from Per Capita income Gap to Child Health Gap

Dependent Variable: D_1

F-statistic = 228.26*** Adjusted $R^2 = 0.9389$

Independent Variable	Coefficient
Intercept	3.7211 *** (0.0021)
D_2	1.3345 *** (0.0039)

*** significant at 1 per cent

Source: *Compiled from the Data on World Development Indicators, 2015 by World Bank*

As evident from the Table 2(a), there is a significant role being played by inequality in child health in explaining the divergence income between the two nations as the coefficient on D_2 is significant at 1 percent .

The intuition behind the inequality in child health being caused by per capita income inequality is that low income country is supposed to have it most of its people having low purchasing power and thereby low potential to afford the measure necessary to protect the child health. Moreover, poor income condition acts as a barrier to having access to proper education which in turn causes a poor level of awareness among the people regarding what are needed to immunizing infants and the precautions to be taken for protecting the children against diseases along with measures required to have remedy from any disease. This apart, due to the low income, people might not be able to live in healthy environment with access to safe drinking water and proper sanitation facilities making the children more susceptible to health disorders.

We will next look into the causation of per capita income inequality by disparity in the child health in context of India and China. In this regard we refer to Table 2(b) which shows the health inequality indicator D_1 has its coefficient significant at 1 per cent implying the existence of a strong causality from child health inequality to income inequality. Moreover the positive coefficient is unequivocally indicative of increase in inequality in child health being a reason behind widening income gap of India from China.

Table 2(b). Causality from Child Health Gap to Per capital income Gap

Dependent Variable: D_2

F-statistic = 183.25*** Adjusted $R^2 = 0.9251$

Independent Variable	Coefficient
Intercept	- 2.4410 *** (0.0238)
D_1	4.8078*** (0.2410)

*** significant at 1 per cent

Source: Compiled from the Data on World Development Indicators, 2015 by World Bank

One plausible explanation behind the presence of causality from health inequality to per capita income inequality is that the worsening child health condition is likely to reduce the scope for demographic dividend by adversely altering the age structure of the population in future. Moreover, the poor health status is a strong impediment to the acquisition of human capital in terms of skill by the today's young cohort which is the reason why it reduces the quality of future work force and thereby destroys the country's growth potential (endogenous growth premise). Besides, the deterioration of child health condition is also responsible for the devaluation of a country in terms of Physical Quality of Life Index (David Morris) which in turn jeopardises the country's capability of income generation.

Figure 1(a). Child Health Gap between China and India over the period 1990-2014

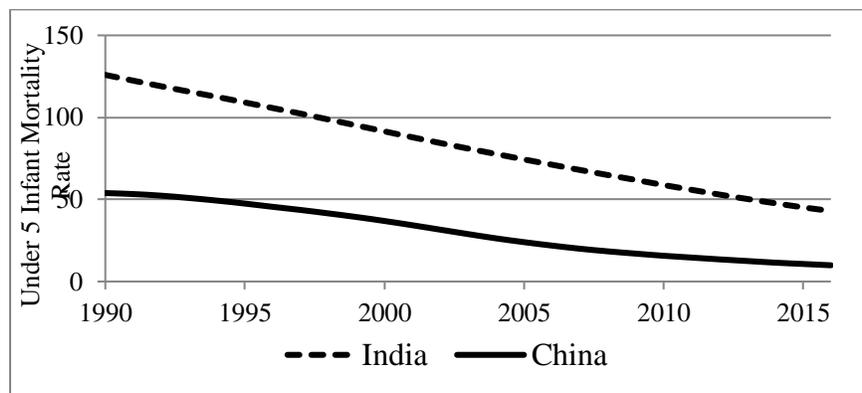
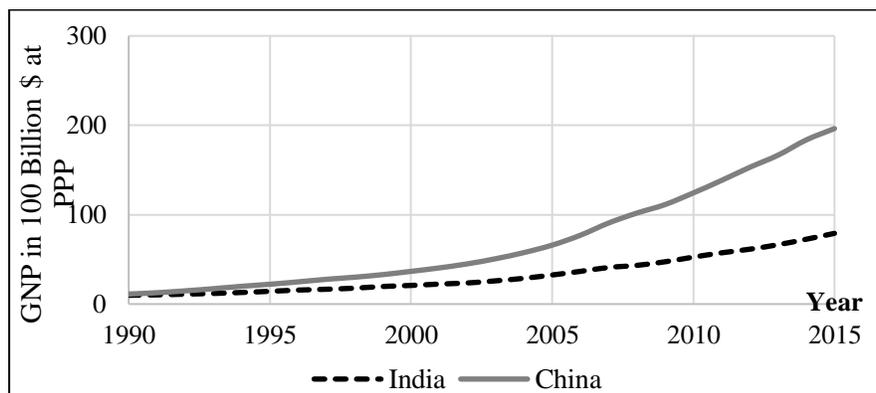


Figure 1(b). GNP Gap between China and India over the period 1990-2014



The evolution of GNP at PPP and Mortality Rate for Children under 5 in China and India as evinced in Figure 1(a) and Figure 1(b) is indicative of the yawning gap in terms of income and child health between these two nations with India lagging behind China in both fronts.

There is an also another observation worth noting in this regard while the income gap is has been on the rise in secular manner from 1990 to 2015, the lag in the child health status is bit declining which implies a betterment in the performance of India over non-income factors related to the disparity in child health like improvement in paediatric science, degree of awareness regarding the remedies of diseases suffered by children as Polio and conduct of vaccination programmes with government subvention etc.

Thus, at this juncture it is worth examining the role income and non income factors influencing the condition of child health. In the present endeavour, we have considered the income factors viz Per Capita GNP, Per Capita Health Expenditure and non income elements such as Immunization of Children Aged 12 to 23 Months Against Measles and Female Literacy Rate. The potential roles of these income and non-income factors underlying the gap in child health status between China and India are evident from the regression analysis as depicted in Table 3.

Table 3. Factors responsible for the Child Health Inequality between China and India

Dependent Variable: D_1

F-statistic = 89.31 *** Adjusted $R^2 = 0.9671$

Independent Variable	Coefficient
D_2 (taken at first difference level)	-1.1293*** (0.0787)
D_3	-2.0234*** (0.1354)
D_4	-0.3879** (0.2346)
D_5	-0.1954*** (0.1676)

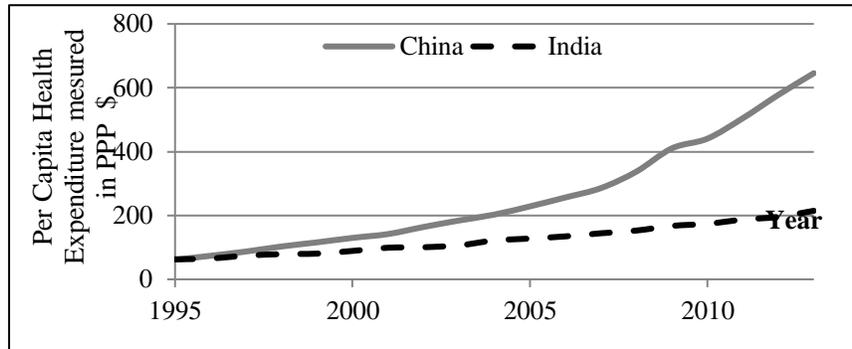
*** (**) significant at 1 per cent (5 per cent)

Source : Compiled from the Data on World Development Indicators, 2015 by World Bank

The coefficients of D_2 , D_3 , D_4 and D_5 being negative indicate that an increase in the gap respect in each of Per Capita GNP, Per Capital Health Expenditure female literacy rate and immunization against measles leads to the widening of the disparity in the child status between China and India. The reason being that a fall in D_1 implies an increment in gap since China is lying below India in child-mortality rate so that fall in D_1 can be brought about by either rise in intensity child-mortality India or fall in the same in case of China. At the same time, a comparison among the absolute values of the coefficients reveals that the widening inequality in child health from the income based factors to relatively greater extent compared to the non-income factors. However, among the non income factors the level of Female Literacy Rate turns out to more prominent than the Immunization factor. It has to be mentioned that the variable D_2 has been taken at the first difference since it has been found to have one unit root. The gap

between China and India with respect to the aforementioned income and non income factors have been illustrated in Figure 2(a) – Figure 2(d)

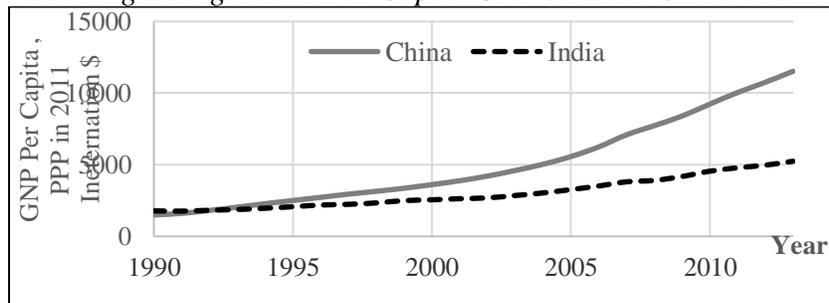
Figure 2(a). Divergence in Per Capita Health Expenditure between China and India



Source: Adopted from the Data on World Development Indicators, 2015 by World Bank

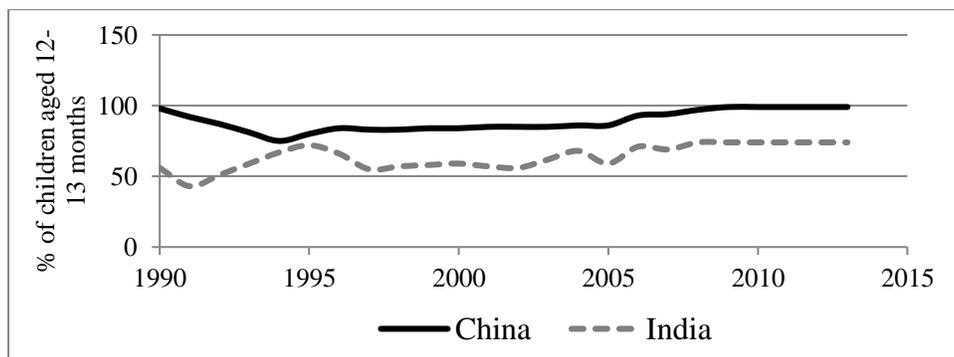
A reason behind this might be that an educated mother is always more aware of the measures that will complement the immunization in making a child healthier. This apart, an educated mother is better cognizant of the kind of life style she needs to adhere in the prenatal stage.

Figure 2(b). The widening divergence in Per Capita GNP between China and India



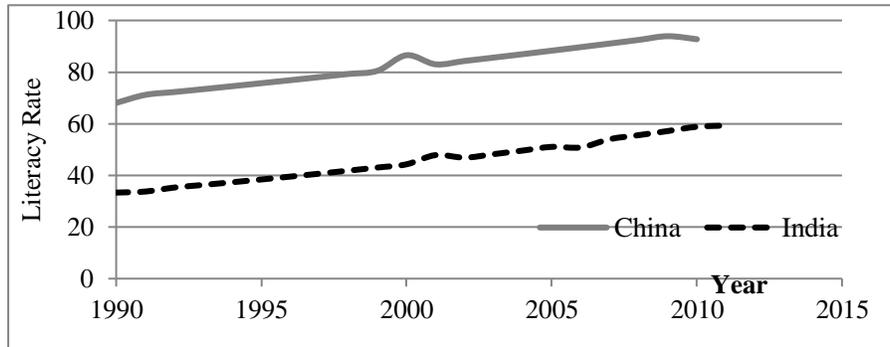
Source: Adopted from the Data on World Development Indicators, 2015 by World Bank

Figure 2(c). Trend of Immunization against Measles (as percentage of children aged 12-13 month) in China and India



Source: Adopted from the Data on World Development Indicators, 2015 by World Bank

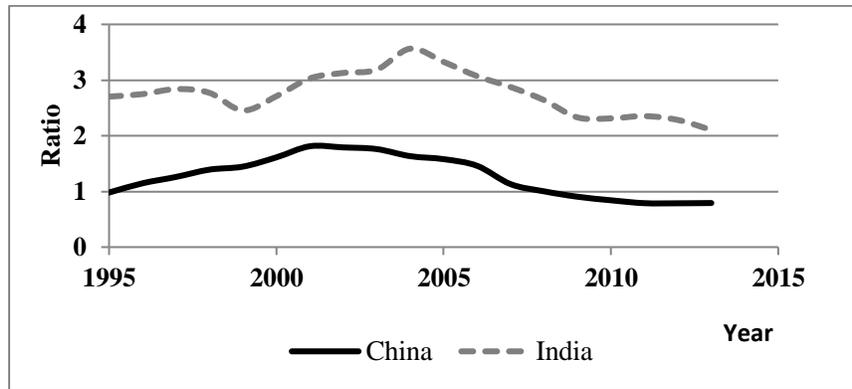
Figure 2(b). Trend in Female Literacy Rate (above 15 years) in between China and India



Source: Adopted from the Data on World Development Indicators, 2015 by World Bank

There is also an emphatic evidence for relatively poor quality of Public Expenditure in India compared to China as illustrated in Fig.2(c) where the Public-Private Ratio for health expenditure in India (red line) is always above that in China.

Figure 3. Public to Private Ratio in Health Expenditure in China vis-a-vis India



Source : Adopted from the Data on World Development Indicators, 2015 by World Bank

Although all the BRICS countries have devoted increased resources to health, the biggest increase has been in China, which was probably facilitated by China’s rapid economic growth. However, despite being the country with second highest economic growth within BRICS, India has had the least improvement in public funding for health (Marten Robert et.al, 2014).

6. Conclusion

This analysis therefore has enabled us to arrive at the following inferences:

- (1) The causality from income to health has been found significant in China as well as India. But the causality from health to income appears to be less emphatic for India as compared to China.
- (2) The growing income inequality in per capita income between India and China can be attributed to the disparity in the health status of children .This has therefore lead to a doubly retarding impact on the degree of economic development in case of India in comparison to China.
- (3) The persistence health inequality between China and India over time is relatively more due to the divergent trends in Per Capita GDP ,Per Capita Health Expenditure and Out-of-pocket Expenditure than that in case of non-income factors. Besides, the health gap in part is also attributable to relatively inferior quality of Public Health Expenditure in India compared to China

Appendix

Table A1. Unit root test and Order of Integration

<i>Variables</i>	<i>Unit root#</i>	<i>Order of Integration [I(.)]</i>
D_1	Has no unit root (Trend and Intercept are significant)	I(0)
D_2	Has unit root (Trend and Intercept are significant)	I(1)
D_3	Has no unit root (Trend is significant)	I(0)
D_4	Has no unit root (Trend and Intercept are significant)	I(0)
D_5	Has no unit root (Trend and Intercept are significant)	I(0)

Source: Authors' computation from World Bank data, 2017, #level of significance is 5%

Table A2. Test of Co-integration

<i>Variables: D_1, D_2, D_3, D_4, D_5</i>			
<i>Trend assumption: Linear deterministic trend has been allowed for in the data</i>			
<i>No. of Co-integrating equations</i>	<i>Trace statistic</i>	<i>Critical value (at 5%)</i>	<i>p-value**</i>
None	71.52081	27.58434	0.0032
At most 1	35.39514	21.13162	0.0541*
At most 2	14.51200	14.26460	0.0460*

At most 3	0.015771	3.841466	0.8999*
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Note: Test has been performed using Johanson's methodology

**MacKinnon-Haug-Michelis (1999) p-values

*significant at 5%

The co-integration test (illustrated in **Table A2**) indicates that there is significant co-integration among the aforementioned variables since the hypothesis that number of co-integrating equations being 'None' is statistically insignificant.

References

- Adams, P.; Hurd, M. D., McFadden, D., Merrill, A. & Ribeiro, T. (2003). 'Healthy, Wealthy, and Wise?' *Journal of Econometrics*, 112, pp. 3–56.
- Dabla-Norris, E., Kalpana, K., Frantisek, R., Nujin, S. & Evridiki, T. (2015). 'Causes and Consequences of Income Inequality: A Global Perspective', IMF Staff Discussion Note, June, SDN/15/13, pp. 17-18
- Deaton A. (2003). 'Health, Inequality, and Economic Development', *Journal of Economic Literature*, 41, March, pp. 113–158
- Dua. B S., Tom A. M., Fengying, Z. & Barry P. M. (2004). 'Rapid income growth adversely affects diet quality in China— particularly for the poor!' *Social Science & Medicine*, Elsevier, 59 ,pp. 1505–1515
- IMF (2017). 'IMF Annual Report': Promoting Inclusive Growth, IMF
- Jain-Chandra S., Tidiane, K., Kalpana, K., Shi, P. & Johanna, S. (2016). 'Sharing the Growth Dividend: Analysis of Inequality in Asia, IMF Working Paper, March, WP/16/48, pp-11-12
- Judge, K. (1995). 'Income Distribution and Life Expectancy: A Critical Appraisal,' *Brit. Med. J.* 311, pp. 1282–85.
- Judge, K., Mulligan, J-A. & Benzeval, M. (1997). 'Income Inequality and Population Health,' *Soc. Sci. Med.* 46, pp. 567–79.
- Judge, K. & Patterson, I. (2001). 'Poverty, Income Inequality, and Health,' work. paper No. 01/29, New Zealand Treasury.
- Kawachi, I., Kennedy, B. P. & Wilkinson R. G. (1999). *The Society and Population Health Reader: Volume 1: Income Inequality and Health*. NY: New Press.
- Lynch J., Smith George Davey, Harper Sam, Hillemeier Marianne, Ross Nancy, Kaplan George A & Wolfson Michael (2004). 'Is Income Inequality a Determinant of Population Health? Part 1. A Systematic Review', *The Milbank Quarterly*. March; 82(1): pp 5–99.
- Marten R., McIntyre Diane, Travassos Claudia, Shishkin Sergey, Longde Wang, Reddy Srinath, Vega Jeanette (2014). 'An assessment of progress towards universal health coverage in Brazil, Russia, India, China, and South Africa (BRICS)', *Lancet*, April, 384: 2164–71
- Murray, C., A. Lopez, and M. Alvarado (2013). 'The State of US Health, 1990–2010: Burden of

- Diseases, Injuries, and Risk Factors,' *The Journal of the American Medical Association*, 310 (6), pp.591–606.
- Pickett K. E. & Richard W. G. (2015). 'Income inequality and health: A Causal Review', *Social Science & Medicine*, 128, March, Elsevier, pp 316–326
- Preston S. H. (1975). 'The Changing Relation between Mortality and Level of Economic Development', *Population Studies*, 175; 29:pp231–48
- Rodgers, G. B. (1979). Income and Inequality as Determinants of Mortality: An International Cross-Section Analysis, *Population Studies*, 33:343–51. reprinted in *International Journal of Epidemiology* 31[2002]: 533–8.
- Smedley, B. D.; Adrienne Y. Stith and Alan R. Nelson, eds. (2002). '*Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*'. Institute of Medicine, Washington, DC: National Academy Press.
- Wagstaff, A. & van Doorslaer, E. (2000). 'Income Inequality and Health: What Does the Literature Tell Us?' *Annual Rev. Public Health* 21, pp.543–67.
- Waldmann RJ. (1992)- 'Income-Distribution and Infant-Mortality', *Quarterly Journal of Economics*, 107(4):1283–302.
- Wilkinson, Richard G. (1989)-'Class Mortality Differentials, Income Distribution and Trends in Poverty 1921–1981,' *J. Soc. Policy* 18, pp. 307–35.
- . (1992). "Income Distribution and Life- Expectancy," *Brit. Med. J.* 304, pp. 165–68.
- . (1996). *Unhealthy Societies: The Affliction of Inequality*. London: Routledge.
- . (1997). "Commentary: Income Inequality Summarizes the Health Burden of Individual Relative Deprivation," *Brit. Med. J.* 314, pp. 1727–28.
- . (2000). *Mind the Gap: Hierarchies, Health, and Human Evolution*. London: Weidenfeld and Nicolson.
- Wolfson, M. C.; Kaplan, G. A., Lynch, J. W., Ross, N. A. & Backlund, E. (1999). 'Relationship between Income Inequality and Mortality: Empirical Demonstration,' *Brit. Med. J.* 319, pp. 953–55.
- Yip W. & Ajay, M. (2008). 'The Health Care Systems of China And India: Performance and Future Challenges', *Health Affair*, July, vol. 27 no. 4, pp 921-932