

Healthy India, Wealthy India

Chinmay Sawant

Dataset(s)

- World Development Indicators Dataset

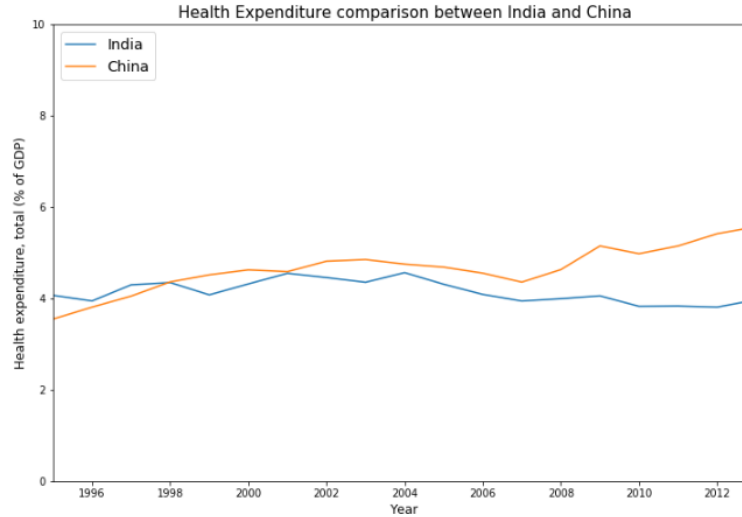
Motivation

- Health is a key component of individual and social wellbeing. On the healthcare front, things don't look too good for India. The investment in healthcare is inadequate.
- The country's healthcare system is characterised by inadequate infrastructure and limited resources.
- Global evidence on health spending shows that unless a country spends at least 5-6% of its GDP on health, basic healthcare needs are seldom met.
- Furthermore, the health of a population is a key driver of labour and capital investment and consequent economic growth.

Research Question(s)

1. What effects the health status of the population have had on the economic growth of India? Does increase in health investment have lead to faster economic growth?

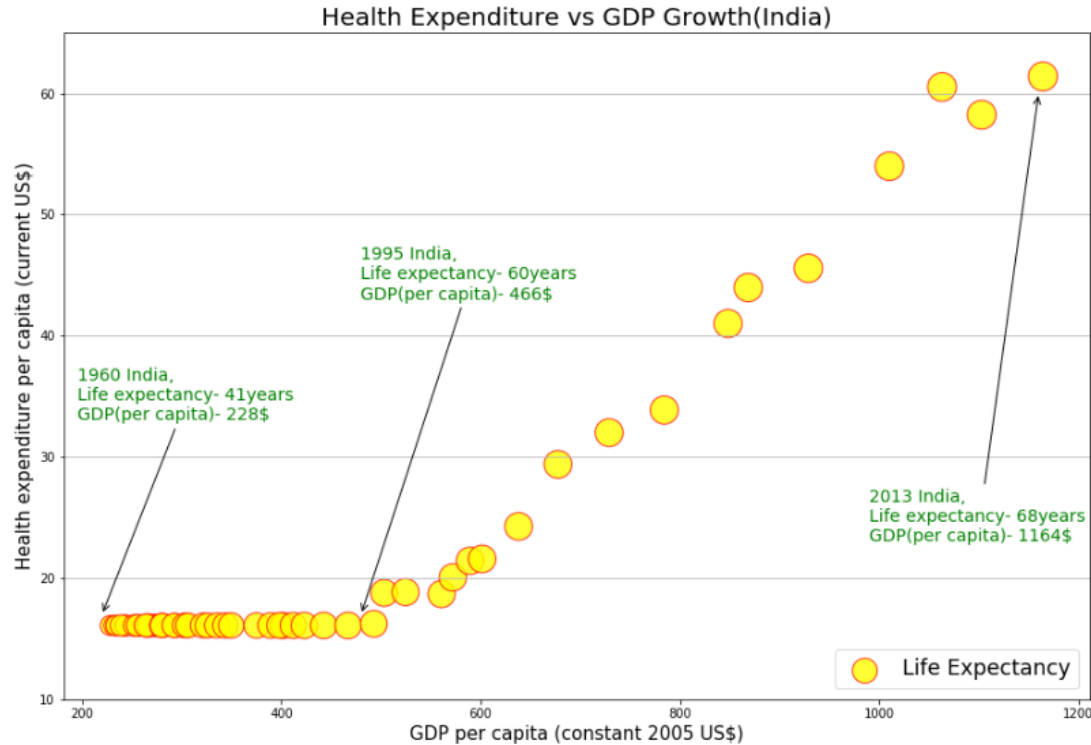
Findings



In 1995, India's health expenditure(% of GDP) was 4.06% compared to China's 3.5% but India's health expenditure have rather decreased over the years with 3.9% of GDP in 2013 compared to China's 5.56%.

Correlation value of 0.95 between the Health expenditure and Life expectancy clearly suggests increase in health expenditure have lead to proportional increase in the life expectancy in India in the past.

Findings



Above scatterplot clearly shows the correlation between the Health expenditure and GDP growth of India with slight increase in the size of the bubbles suggesting the steady increase in Life expectancy over the years.

Findings

1. In 1960 with health expenditure less than \$60 per capita and life expectancy of 41 year, India had a low GDP per capita of \$228.
2. Minimal increase in health expenditure for next three decades clearly reflects in the slow growth in the GDP with \$466 GDP per capita in 1995.
3. In next three decades with bit more importance towards health-care, health expenditure per capita increased from \$18 to \$61 leading to a substantial growth in GDP with \$1164 GDP per capita in 2013.

Additional Findings

- Low public spending in the health care sector is another concern for India. Only 29% of the total health expenditure was funded by public funds in 2011.
- Over dependency on private investments in health care will in turn affect the access to health care for the poorer, with 22% of the population below poverty line.

Conclusion

Good health can lead to higher gross domestic product (GDP) per capita in the long run due to its impact on health of labour force leading to more participation, and productivity.

Acknowledgements

No feedback from the peer.

References

No references.

Mini-project

June 29, 2018

```
In [305]: import pandas as pd
import numpy as np
import random
import matplotlib.pyplot as plt
from matplotlib.offsetbox import (TextArea, DrawingArea, OffsetImage,
AnnotationBbox)
```

```
In [306]: data = pd.read_csv('./world-development-indicators/Indicators.csv')
data.shape
```

```
Out[306]: (5656458, 6)
```

Lets explore the health expenditure of India compared to other developing countries like China.

```
In [308]: health_filter='Health expenditure, total \(% of GDP\)'
india_code = 'IND'
china_code = 'CHN'
```

```
india_mask = data['CountryCode'].str.contains(india_code)
china_mask = data['CountryCode'].str.contains(china_code)
health_mask = data['IndicatorName'].str.contains(health_filter)
```

```
india_health_exp = data[india_mask & health_mask]
china_health_exp = data[china_mask & health_mask]
```

```
In [310]: india_health_exp.head(20)
```

```
Out[310]:
```

	CountryName	CountryCode	IndicatorName \
2550719	India	IND	Health expenditure, total (% of GDP)
2685740	India	IND	Health expenditure, total (% of GDP)
2821173	India	IND	Health expenditure, total (% of GDP)
2958149	India	IND	Health expenditure, total (% of GDP)
3097445	India	IND	Health expenditure, total (% of GDP)
3245806	India	IND	Health expenditure, total (% of GDP)
3398139	India	IND	Health expenditure, total (% of GDP)
3550764	India	IND	Health expenditure, total (% of GDP)

3705004	India	IND	Health expenditure, total (% of GDP)
3860366	India	IND	Health expenditure, total (% of GDP)
4029881	India	IND	Health expenditure, total (% of GDP)
4208428	India	IND	Health expenditure, total (% of GDP)
4387273	India	IND	Health expenditure, total (% of GDP)
4567586	India	IND	Health expenditure, total (% of GDP)
4746720	India	IND	Health expenditure, total (% of GDP)
4929535	India	IND	Health expenditure, total (% of GDP)
5111336	India	IND	Health expenditure, total (% of GDP)
5287013	India	IND	Health expenditure, total (% of GDP)
5453181	India	IND	Health expenditure, total (% of GDP)

	IndicatorCode	Year	Value
2550719	SH.XPD.TOTL.ZS	1995	4.064824
2685740	SH.XPD.TOTL.ZS	1996	3.942175
2821173	SH.XPD.TOTL.ZS	1997	4.294396
2958149	SH.XPD.TOTL.ZS	1998	4.343979
3097445	SH.XPD.TOTL.ZS	1999	4.075596
3245806	SH.XPD.TOTL.ZS	2000	4.314108
3398139	SH.XPD.TOTL.ZS	2001	4.546835
3550764	SH.XPD.TOTL.ZS	2002	4.454388
3705004	SH.XPD.TOTL.ZS	2003	4.350801
3860366	SH.XPD.TOTL.ZS	2004	4.561793
4029881	SH.XPD.TOTL.ZS	2005	4.307127
4208428	SH.XPD.TOTL.ZS	2006	4.085378
4387273	SH.XPD.TOTL.ZS	2007	3.940753
4567586	SH.XPD.TOTL.ZS	2008	3.991911
4746720	SH.XPD.TOTL.ZS	2009	4.053157
4929535	SH.XPD.TOTL.ZS	2010	3.824004
5111336	SH.XPD.TOTL.ZS	2011	3.829788
5287013	SH.XPD.TOTL.ZS	2012	3.806117
5453181	SH.XPD.TOTL.ZS	2013	3.967993

In [311]: china_health_exp.head(20)

Out[311]:

	CountryName	CountryCode	IndicatorName \
2523687	China	CHN	Health expenditure, total (% of GDP)
2658660	China	CHN	Health expenditure, total (% of GDP)
2794266	China	CHN	Health expenditure, total (% of GDP)
2930960	China	CHN	Health expenditure, total (% of GDP)
3069205	China	CHN	Health expenditure, total (% of GDP)
3215461	China	CHN	Health expenditure, total (% of GDP)
3368744	China	CHN	Health expenditure, total (% of GDP)
3520209	China	CHN	Health expenditure, total (% of GDP)
3675129	China	CHN	Health expenditure, total (% of GDP)
3829429	China	CHN	Health expenditure, total (% of GDP)
3994434	China	CHN	Health expenditure, total (% of GDP)
4174223	China	CHN	Health expenditure, total (% of GDP)

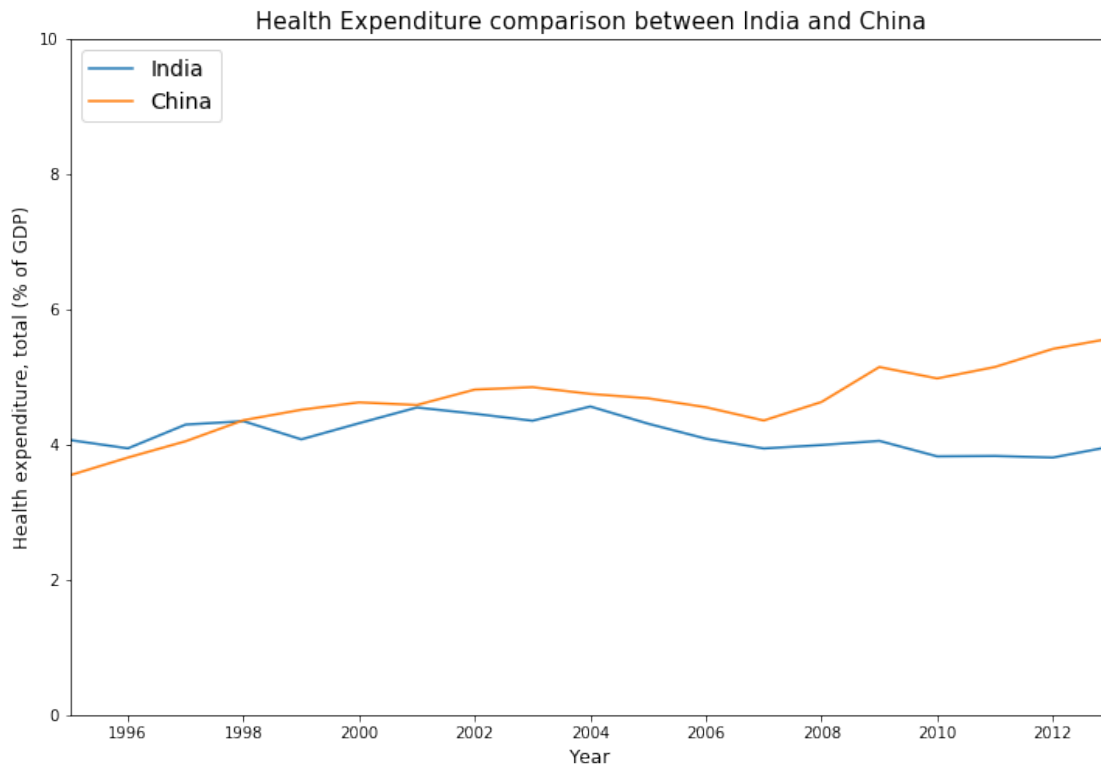
4352416	China	CHN	Health expenditure, total (% of GDP)
4532834	China	CHN	Health expenditure, total (% of GDP)
4712383	China	CHN	Health expenditure, total (% of GDP)
4893608	China	CHN	Health expenditure, total (% of GDP)
5077193	China	CHN	Health expenditure, total (% of GDP)
5252940	China	CHN	Health expenditure, total (% of GDP)
5422999	China	CHN	Health expenditure, total (% of GDP)

	IndicatorCode	Year	Value
2523687	SH.XPD.TOTL.ZS	1995	3.544976
2658660	SH.XPD.TOTL.ZS	1996	3.806619
2794266	SH.XPD.TOTL.ZS	1997	4.047860
2930960	SH.XPD.TOTL.ZS	1998	4.358571
3069205	SH.XPD.TOTL.ZS	1999	4.513426
3215461	SH.XPD.TOTL.ZS	2000	4.622937
3368744	SH.XPD.TOTL.ZS	2001	4.583395
3520209	SH.XPD.TOTL.ZS	2002	4.811688
3675129	SH.XPD.TOTL.ZS	2003	4.847566
3829429	SH.XPD.TOTL.ZS	2004	4.747541
3994434	SH.XPD.TOTL.ZS	2005	4.682612
4174223	SH.XPD.TOTL.ZS	2006	4.550478
4352416	SH.XPD.TOTL.ZS	2007	4.354222
4532834	SH.XPD.TOTL.ZS	2008	4.628598
4712383	SH.XPD.TOTL.ZS	2009	5.145722
4893608	SH.XPD.TOTL.ZS	2010	4.976277
5077193	SH.XPD.TOTL.ZS	2011	5.145995
5252940	SH.XPD.TOTL.ZS	2012	5.413016
5422999	SH.XPD.TOTL.ZS	2013	5.567502

Lets plot these dataframe together on line plot to visualize it better

```
In [312]: fig,ax = plt.subplots(figsize=(12,8))
line1, = ax.plot(india_health_exp['Year'].values, india_health_exp['Value'].values, )
line2, = ax.plot(china_health_exp['Year'].values, china_health_exp['Value'].values, )

ax.set_xlabel('Year', fontsize='12')
ax.set_ylabel(india_health_exp['IndicatorName'].iloc[0], fontsize='12')
ax.set_title('Health Expenditure comparison between India and China',fontsize='15')
ax.legend(handles=[line1, line2], loc='upper left', fontsize='14')
ax.set_ylim([0,10])
ax.set_xlim([india_health_exp['Year'].min(),india_health_exp['Year'].max()])
plt.show()
```



In 1995, India's health expenditure(% of GDP) was 4.06% compared to China's 3.5% but India's health expenditure have rather decreased over the years with 3.9% of GDP in 2013 compared to China's 5.56%.

Lets explore the Health expenditure per capita and it's correlation with the Life expectancy of polulation of India.

```
In [313]: health_exp_filter = 'Health expenditure per capita \ (current US\$)'
          country_filter = 'IND'
```

```
mask1 = data['CountryCode'].str.contains(country_filter)
mask2 = data['IndicatorName'].str.contains(health_exp_filter)
```

```
health_exp_data = data[mask1 & mask2]
```

```
In [314]: health_exp_data.head()
```

```
Out [314]:
```

	CountryName	CountryCode	IndicatorName \
2550713	India	IND	Health expenditure per capita (current US\$)
2685734	India	IND	Health expenditure per capita (current US\$)
2821167	India	IND	Health expenditure per capita (current US\$)
2958143	India	IND	Health expenditure per capita (current US\$)
3097439	India	IND	Health expenditure per capita (current US\$)

IndicatorCode	Year	Value
---------------	------	-------

2550713	SH.XPD.PCAP	1995	16.088374
2685734	SH.XPD.PCAP	1996	16.226104
2821167	SH.XPD.PCAP	1997	18.774171
2958143	SH.XPD.PCAP	1998	18.840850
3097439	SH.XPD.PCAP	1999	18.683437

```
In [315]: life_exp_filter = 'Life expectancy at birth, total \ (years\)'
```

```
mask3 = data['IndicatorName'].str.contains(life_exp_filter)
```

```
life_exp_data = data[mask1 & mask3]
```

```
In [316]: life_exp_data.head()
```

```
Out[316]:
```

	CountryName	CountryCode	IndicatorName	\
11684	India	IND	Life expectancy at birth, total (years)	
36635	India	IND	Life expectancy at birth, total (years)	
64177	India	IND	Life expectancy at birth, total (years)	
92622	India	IND	Life expectancy at birth, total (years)	
121419	India	IND	Life expectancy at birth, total (years)	

	IndicatorCode	Year	Value
11684	SP.DYN.LE00.IN	1960	41.171951
36635	SP.DYN.LE00.IN	1961	41.790488
64177	SP.DYN.LE00.IN	1962	42.417415
92622	SP.DYN.LE00.IN	1963	43.052732
121419	SP.DYN.LE00.IN	1964	43.698415

Before calculating the correlation between the life expectancy and health expenditure we need to slice the data further since health expenditure data is only available between 1995 to 2013.

```
In [317]: filtered_life_exp_data = life_exp_data[life_exp_data['Year'].isin(health_exp_data['Y
```

```
In [318]: filtered_life_exp_data.shape
```

```
Out[318]: (19, 6)
```

```
In [319]: health_exp_data.shape
```

```
Out[319]: (19, 6)
```

```
In [320]: np.corrcoef(health_exp_data['Value'],filtered_life_exp_data['Value'])
```

```
Out[320]: array([[1.          , 0.95656092],
                  [0.95656092, 1.          ]])
```

Finding: Correlation value of 0.95 between the Health expenditure and Life expectancy clearly suggests growth in health expenditure have lead to proportional growth in life expectancy in India.

Lets explore the GDP per capita data for India

```
In [321]: gdp_filter = 'GDP per capita \ (constant 2005'

mask4 = data['IndicatorName'].str.contains(gdp_filter)

gdp_data = data[mask1 & mask4]
```

```
In [323]: gdp_data.describe()
```

```
Out[323]:
```

	Year	Value
count	55.00000	55.000000
mean	1987.00000	472.921846
std	16.02082	272.215645
min	1960.00000	228.304470
25%	1973.50000	273.019022
50%	1987.00000	349.639894
75%	2000.50000	580.708296
max	2014.00000	1233.949344

Exploring the changes in GDP per capita of India by plotting it on line plot

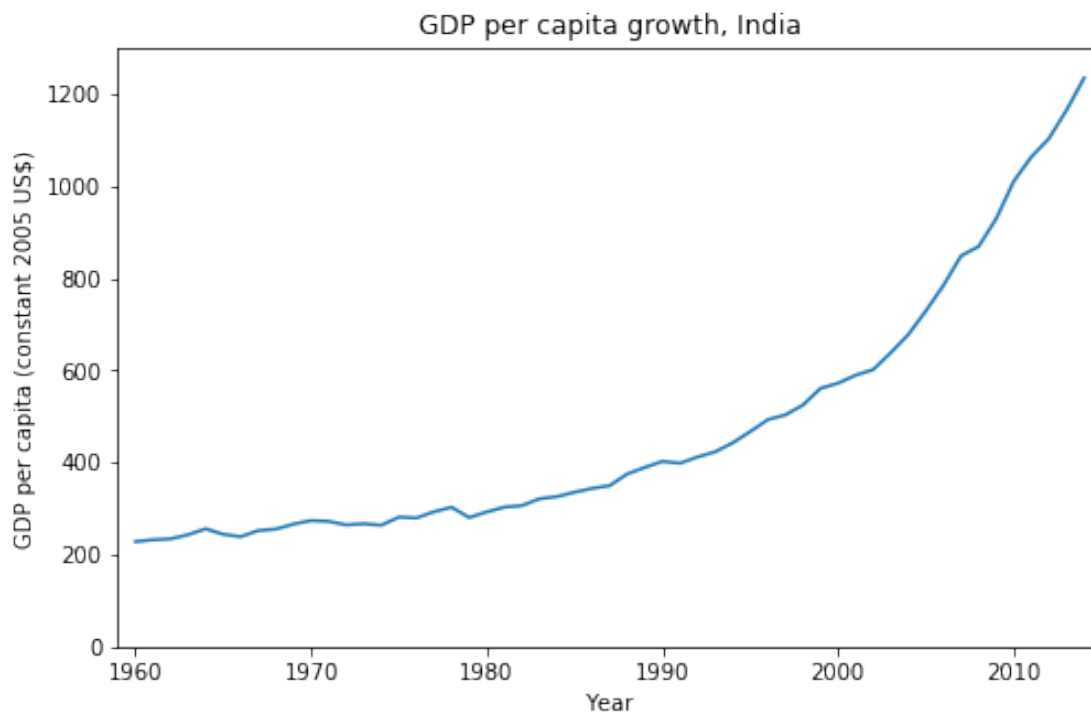
```
In [324]: plt.figure(figsize=(8,5))
plt.plot(gdp_data['Year'].values, gdp_data['Value'].values)

plt.xlabel('Year')
plt.ylabel(gdp_data['IndicatorName'].iloc[0])

plt.title('GDP per capita growth, India')

plt.axis([1959,2015,0,1300])

plt.show()
```

We can see there has been a substantial growth in GDP since 1990.

Lets see if we can find a correlation between the Health expenditure, Life expectancy and GDP per capita by plotting it on the scatterplot.

First, we will merge the three dataframes based on years into new dataframe 'country_data'

```
In [325]: country_data = pd.merge(gdp_data, health_exp_data[['IndicatorName', 'Year', 'Value']],
```

```
In [326]: country_data.head()
```

```
Out[326]:
```

	CountryName	CountryCode	IndicatorName_x	IndicatorCode	\
0	India	IND	GDP per capita (constant 2005 US\$)	NY.GDP.PCAP.KD	
1	India	IND	GDP per capita (constant 2005 US\$)	NY.GDP.PCAP.KD	
2	India	IND	GDP per capita (constant 2005 US\$)	NY.GDP.PCAP.KD	
3	India	IND	GDP per capita (constant 2005 US\$)	NY.GDP.PCAP.KD	
4	India	IND	GDP per capita (constant 2005 US\$)	NY.GDP.PCAP.KD	

	Year	Value_x	IndicatorName_y	Value_y
0	1960	228.304470	NaN	NaN
1	1961	232.142053	NaN	NaN
2	1962	234.166685	NaN	NaN
3	1963	243.176418	NaN	NaN
4	1964	255.963668	NaN	NaN

```
In [328]: country_data.tail()
```

```

Out [328]: CountryName CountryCode IndicatorName_x \
50      India      IND GDP per capita (constant 2005 US$)
51      India      IND GDP per capita (constant 2005 US$)
52      India      IND GDP per capita (constant 2005 US$)
53      India      IND GDP per capita (constant 2005 US$)
54      India      IND GDP per capita (constant 2005 US$)

      IndicatorCode Year      Value_x \
50 NY.GDP.PCAP.KD 2010 1010.309221
51 NY.GDP.PCAP.KD 2011 1063.159868
52 NY.GDP.PCAP.KD 2012 1102.910323
53 NY.GDP.PCAP.KD 2013 1164.342834
54 NY.GDP.PCAP.KD 2014 1233.949344

      IndicatorName_y      Value_y
50 Health expenditure per capita (current US$) 53.995063
51 Health expenditure per capita (current US$) 60.544216
52 Health expenditure per capita (current US$) 58.246599
53 Health expenditure per capita (current US$) 61.408213
54                                     NaN          NaN

```

```

In [329]: country_data.isnull().any()

```

```

Out [329]: CountryName      False
CountryCode      False
IndicatorName_x    False
IndicatorCode      False
Year              False
Value_x           False
IndicatorName_y     True
Value_y           True
dtype: bool

```

We can see there are NaN values for IndicatorName_y and Value_y since the health expenditure per capita is not available for years 1960 to 1994 and 2014. We can fill the NaN value with last known values using fillna method assuming health expenditure (1960 to 1994) less than equal to health expenditure (1995).

```

In [330]: country_data = country_data.fillna(method='backfill')

```

```

In [331]: country_data = country_data.fillna(method='ffill')

```

```

In [332]: country_data.isnull().any()

```

```

Out [332]: CountryName      False
CountryCode      False
IndicatorName_x    False
IndicatorCode      False
Year              False

```

```
Value_x      False
IndicatorName_y  False
Value_y      False
dtype: bool
```

```
In [333]: country_data.tail()
```

```
Out [333]:   CountryName CountryCode      IndicatorName_x \
50      India      IND  GDP per capita (constant 2005 US$)
51      India      IND  GDP per capita (constant 2005 US$)
52      India      IND  GDP per capita (constant 2005 US$)
53      India      IND  GDP per capita (constant 2005 US$)
54      India      IND  GDP per capita (constant 2005 US$)

      IndicatorCode  Year      Value_x \
50  NY.GDP.PCAP.KD  2010  1010.309221
51  NY.GDP.PCAP.KD  2011  1063.159868
52  NY.GDP.PCAP.KD  2012  1102.910323
53  NY.GDP.PCAP.KD  2013  1164.342834
54  NY.GDP.PCAP.KD  2014  1233.949344

      IndicatorName_y      Value_y
50  Health expenditure per capita (current US$)  53.995063
51  Health expenditure per capita (current US$)  60.544216
52  Health expenditure per capita (current US$)  58.246599
53  Health expenditure per capita (current US$)  61.408213
54  Health expenditure per capita (current US$)  61.408213
```

```
In [334]: country_data = pd.merge(country_data, life_exp_data[['IndicatorName', 'Year', 'Value']])
```

```
In [335]: country_data.isnull().any()
```

```
Out [335]: CountryName      False
CountryCode      False
IndicatorName_x    False
IndicatorCode      False
Year              False
Value_x           False
IndicatorName_y    False
Value_y           False
IndicatorName      False
Value              False
dtype: bool
```

```
In [336]: country_data.tail()
```

```
Out [336]:   CountryName CountryCode      IndicatorName_x \
49      India      IND  GDP per capita (constant 2005 US$)
50      India      IND  GDP per capita (constant 2005 US$)
```

51	India	IND	GDP per capita (constant 2005 US\$)
52	India	IND	GDP per capita (constant 2005 US\$)
53	India	IND	GDP per capita (constant 2005 US\$)

	IndicatorCode	Year	Value_x \
49	NY.GDP.PCAP.KD	2009	928.977520
50	NY.GDP.PCAP.KD	2010	1010.309221
51	NY.GDP.PCAP.KD	2011	1063.159868
52	NY.GDP.PCAP.KD	2012	1102.910323
53	NY.GDP.PCAP.KD	2013	1164.342834

	IndicatorName_y	Value_y \
49	Health expenditure per capita (current US\$)	45.575644
50	Health expenditure per capita (current US\$)	53.995063
51	Health expenditure per capita (current US\$)	60.544216
52	Health expenditure per capita (current US\$)	58.246599
53	Health expenditure per capita (current US\$)	61.408213

	IndicatorName	Value
49	Life expectancy at birth, total (years)	66.102634
50	Life expectancy at birth, total (years)	66.506146
51	Life expectancy at birth, total (years)	66.904171
52	Life expectancy at birth, total (years)	67.289878
53	Life expectancy at birth, total (years)	67.660415

```
In [337]: fig, axis = plt.subplots(figsize=(15,10))
          # Grid lines, Xticks, Xlabel, Ylabel

          axis.yaxis.grid(True)
          axis.set_title('Health Expenditure vs GDP Growth(India)',fontsize=20)
          axis.set_xlabel(country_data['IndicatorName_x'].iloc[0],fontsize=15)
          axis.set_ylabel(country_data['IndicatorName_y'].iloc[0],fontsize=15)
          axis.set_ylim(10,65)

          axis.annotate("1960 India, \nLife expectancy- 41years \nGDP(per capita)- 228$",
                        xy=(220, 17),
                        xycoords='data',
                        xytext=(195, 33),
                        textcoords='data',
                        arrowprops=dict(arrowstyle="->",
                                       connectionstyle="arc3"),fontsize=14, color='green'
                        )

          axis.annotate("1995 India, \nLife expectancy- 60years \nGDP(per capita)- 466$",
                        xy=(480, 17),
                        xycoords='data',
                        xytext=(480, 43),
                        textcoords='data',
```

```

        arrowprops=dict(arrowstyle="->",
        connectionstyle="arc3"),fontsize=14, color='green'
    )

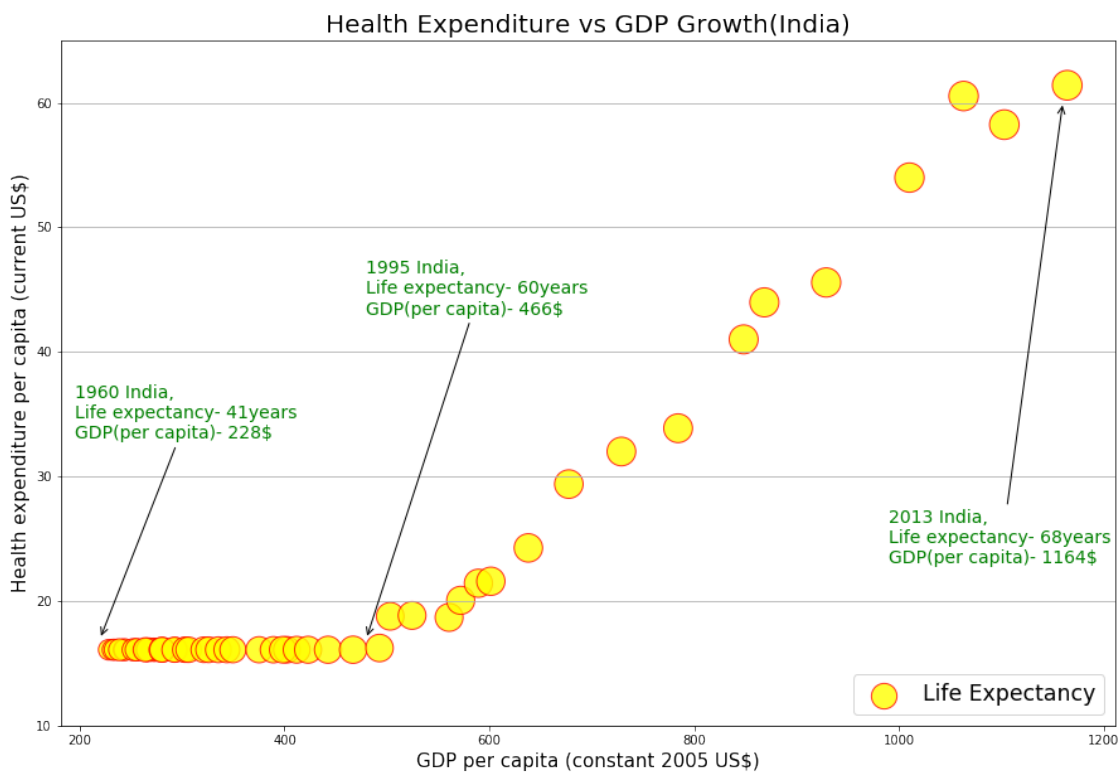
    axis.annotate("2013 India, \nLife expectancy- 68years \nGDP(per capita)- 1164$",
        xy=(1160, 60),
        xycoords='data',
        xytext=(990, 23),
        textcoords='data',
        arrowprops=dict(arrowstyle="->",
        connectionstyle="arc3"),fontsize=14, color='green'
    )

    X = country_data['Value_x']
    Y = country_data['Value_y']
    S = country_data['Value']**1.5

    axis.scatter(X, Y, s=S,label='Life Expectancy',
        alpha=0.8, color='yellow', edgecolors='Red')
    axis.legend(loc='lower right',prop={'weight':'roman','size':'xx-large'})

    plt.show()

```



```
In [338]: country_data[['Value_x', 'Value_y']].corr()
```

```
Out [338]:
```

	Value_x	Value_y
Value_x	1.000000	0.938328
Value_y	0.938328	1.000000

Scatterplot and correlation value of 0.93 clearly shows there is strong relationship between the Health expenditure and GDP growth. Now lets verify these findings by analysing the data for similar developing economies.

```
In [339]: china_health_exp = data[mask2 & china_mask]
          china_gdp_data = data[mask4 & china_mask]
```

```
In [340]: china_health_exp.head()
```

```
Out [340]:
```

	CountryName	CountryCode	IndicatorName	\
2523681	China	CHN	Health expenditure per capita (current US\$)	
2658654	China	CHN	Health expenditure per capita (current US\$)	
2794260	China	CHN	Health expenditure per capita (current US\$)	
2930954	China	CHN	Health expenditure per capita (current US\$)	
3069199	China	CHN	Health expenditure per capita (current US\$)	

	IndicatorCode	Year	Value
2523681	SH.XPD.PCAP	1995	20.742711
2658654	SH.XPD.PCAP	1996	25.975256
2794260	SH.XPD.PCAP	1997	30.511171
2930954	SH.XPD.PCAP	1998	34.926572
3069199	SH.XPD.PCAP	1999	38.195679

```
In [341]: china_gdp_data.head()
```

```
Out [341]:
```

	CountryName	CountryCode	IndicatorName	\
7187	China	CHN	GDP per capita (constant 2005 US\$)	
31484	China	CHN	GDP per capita (constant 2005 US\$)	
58684	China	CHN	GDP per capita (constant 2005 US\$)	
87069	China	CHN	GDP per capita (constant 2005 US\$)	
115795	China	CHN	GDP per capita (constant 2005 US\$)	

	IndicatorCode	Year	Value
7187	NY.GDP.PCAP.KD	1960	121.191585
31484	NY.GDP.PCAP.KD	1961	89.005585
58684	NY.GDP.PCAP.KD	1962	83.334735
87069	NY.GDP.PCAP.KD	1963	89.605409
115795	NY.GDP.PCAP.KD	1964	103.571525

```
In [342]: china_data = pd.merge(china_health_exp, china_gdp_data[['IndicatorName', 'Year', 'Value']])
```

```
In [343]: china_data.head()
```

```
Out [343]:
```

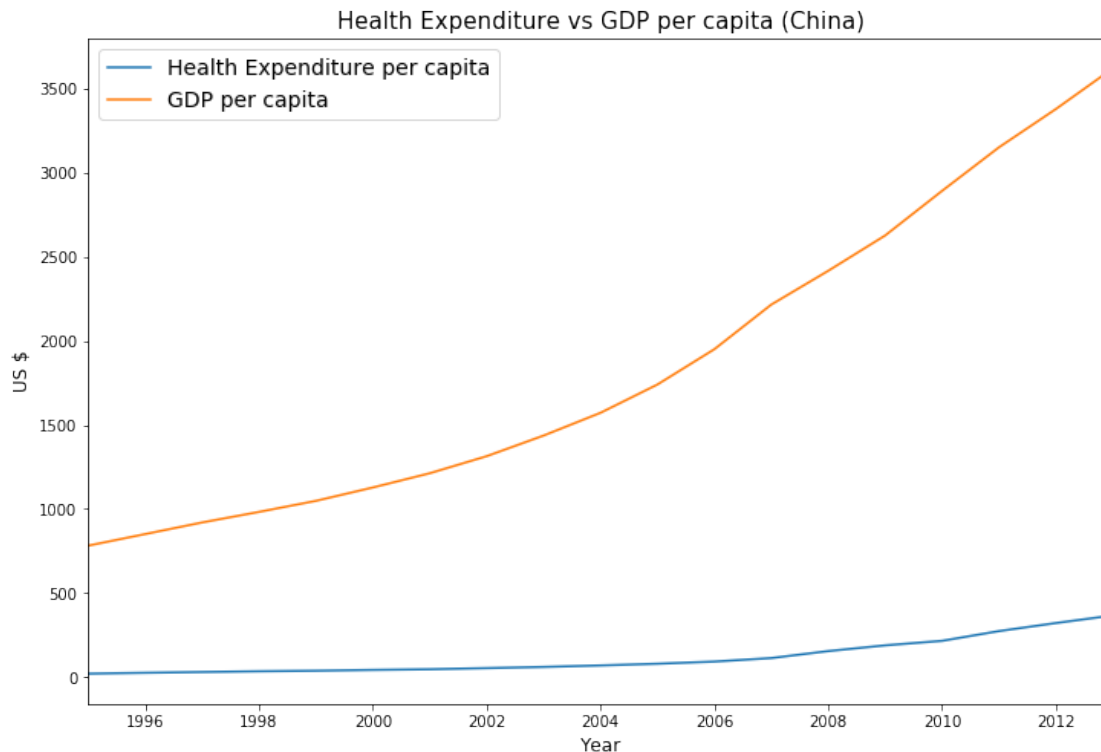
	CountryName	CountryCode	IndicatorName_x	\
0	China	CHN	Health expenditure per capita (current US\$)	
1	China	CHN	Health expenditure per capita (current US\$)	
2	China	CHN	Health expenditure per capita (current US\$)	
3	China	CHN	Health expenditure per capita (current US\$)	
4	China	CHN	Health expenditure per capita (current US\$)	

	IndicatorCode	Year	Value_x	IndicatorName_y	\
0	SH.XPD.PCAP	1995	20.742711	GDP per capita (constant 2005 US\$)	
1	SH.XPD.PCAP	1996	25.975256	GDP per capita (constant 2005 US\$)	
2	SH.XPD.PCAP	1997	30.511171	GDP per capita (constant 2005 US\$)	
3	SH.XPD.PCAP	1998	34.926572	GDP per capita (constant 2005 US\$)	
4	SH.XPD.PCAP	1999	38.195679	GDP per capita (constant 2005 US\$)	

	Value_y
0	782.093690
1	850.750357
2	919.786248
3	982.548142
4	1048.284370

```
In [344]: fig,ax = plt.subplots(figsize=(12,8))
line1, = ax.plot(china_data['Year'].values, china_data['Value_x'].values, label="Health expenditure per capita (China)")
line2, = ax.plot(china_data['Year'].values, china_data['Value_y'].values, label="GDP per capita (China)")

ax.set_xlabel('Year', fontsize='12')
ax.set_ylabel('US $', fontsize='12')
ax.set_title('Health Expenditure vs GDP per capita (China)',fontsize='15')
ax.legend(handles=[line1, line2], loc='upper left', fontsize='14')
#ax.set_ylim([0,10])
ax.set_xlim([china_data['Year'].min(),china_data['Year'].max()])
plt.show()
```



```
In [345]: np.corrcoef(china_data['Value_x'], china_data['Value_y'])
```

```
Out[345]: array([[1.          , 0.9727291],
                  [0.9727291, 1.          ]])
```

With correlation value of 0.97 for China it confirms our previous findings that increase in Health expenditure inturn leads to economic growth.

Now that we know the importance of Health care, let explore it further to find the public contribution to health expenditure and what effects it will have on the Indian population?

```
In [347]: mask5 = data['IndicatorName'].str.contains('Health expenditure, public \(\% of total
mask6 = data['IndicatorName'].str.contains('Poverty headcount ratio at national pove

public_health_exp_data = data[mask1 & mask5]
poverty_data = data[mask1 & mask6]
```

```
In [348]: public_health_exp_data.tail()
```

```
Out[348]:
```

	CountryName	CountryCode	\
4746719	India	IND	
4929534	India	IND	
5111335	India	IND	
5287012	India	IND	
5453180	India	IND	

		IndicatorName	IndicatorCode	\
4746719	Health expenditure, public (% of total health ...	SH.XPD.PUBL		
4929534	Health expenditure, public (% of total health ...	SH.XPD.PUBL		
5111335	Health expenditure, public (% of total health ...	SH.XPD.PUBL		
5287012	Health expenditure, public (% of total health ...	SH.XPD.PUBL		
5453180	Health expenditure, public (% of total health ...	SH.XPD.PUBL		

	Year	Value
4746719	2009	30.034031
4929534	2010	30.195803
5111335	2011	29.826705
5287012	2012	30.455623
5453180	2013	32.215077

In [349]: public_health_exp_data.describe()

Out [349]:

	Year	Value
count	19.000000	19.000000
mean	2004.000000	26.878575
std	5.627314	2.809142
min	1995.000000	21.912007
25%	1999.500000	24.691476
50%	2004.000000	26.682532
75%	2008.500000	29.390584
max	2013.000000	32.215077

In [350]: poverty_data.tail()

Out [350]:

	CountryName	CountryCode	\
2296334	India	IND	
3860676	India	IND	
4747049	India	IND	
5111668	India	IND	

		IndicatorName	IndicatorCode	\
2296334	Poverty headcount ratio at national poverty li...	SI.POV.NAHC		
3860676	Poverty headcount ratio at national poverty li...	SI.POV.NAHC		
4747049	Poverty headcount ratio at national poverty li...	SI.POV.NAHC		
5111668	Poverty headcount ratio at national poverty li...	SI.POV.NAHC		

	Year	Value
2296334	1993	45.3
3860676	2004	37.2
4747049	2009	29.8
5111668	2011	21.9