Relation between economic growth and self employment rate

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Dataset

In order to analyze the relationship between economic growth and self employment rate the World Development Indicators Dataset have been used.

From all data two key variables have been filtred:

- GDP per capita (constant 2005 US$)
- Self-employed, total (% of total employed)

As for some years the data are missing only the range of years from 1994-2013 have been considered.

Motivation

The wealthy economy should be a great environment in fostering an increase in running your own company. Higher incomes, many governmental programs for startups and people with essential skills and knowledge, what do we need more? In this project I have checked if such correlation between GDP per capita and self employment rate exist or maybe is totally different?

The results of this study should be essential for governments as self employments help to promote invention and innovation in the countries. The inverse correlation between economic growth and self employment rate should push governments to explore new ideas how to encourage people to start their own businesses, improve loans conditions or prepare governmental programs.

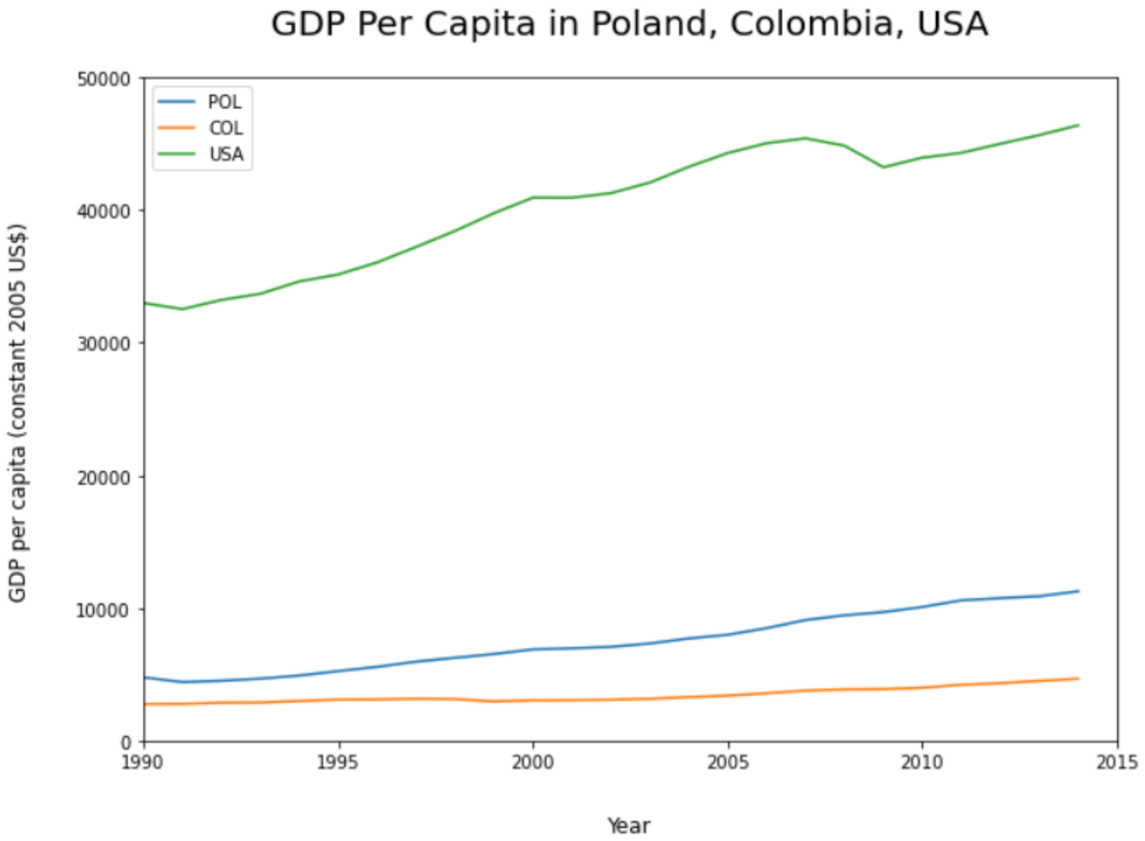
Research Questions

Is the wealthy society a great environment for running your own business?

What is the correlation between the GDP and self employment rate?

How it differ depending on the country development stage?

Findings

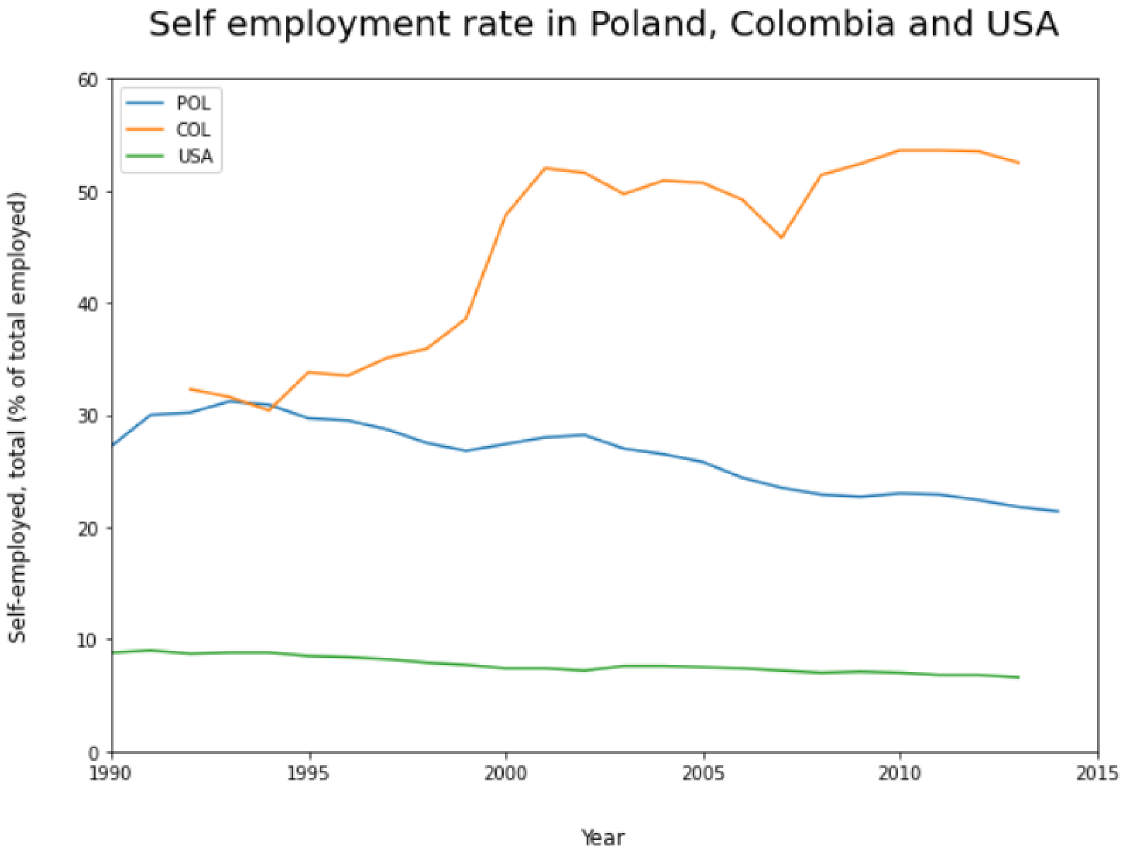


I have compared 3 different countries in different development stage in age range 1994-2013.

- Poland - rather developed
- Colombia - developing
- USA - highly developed

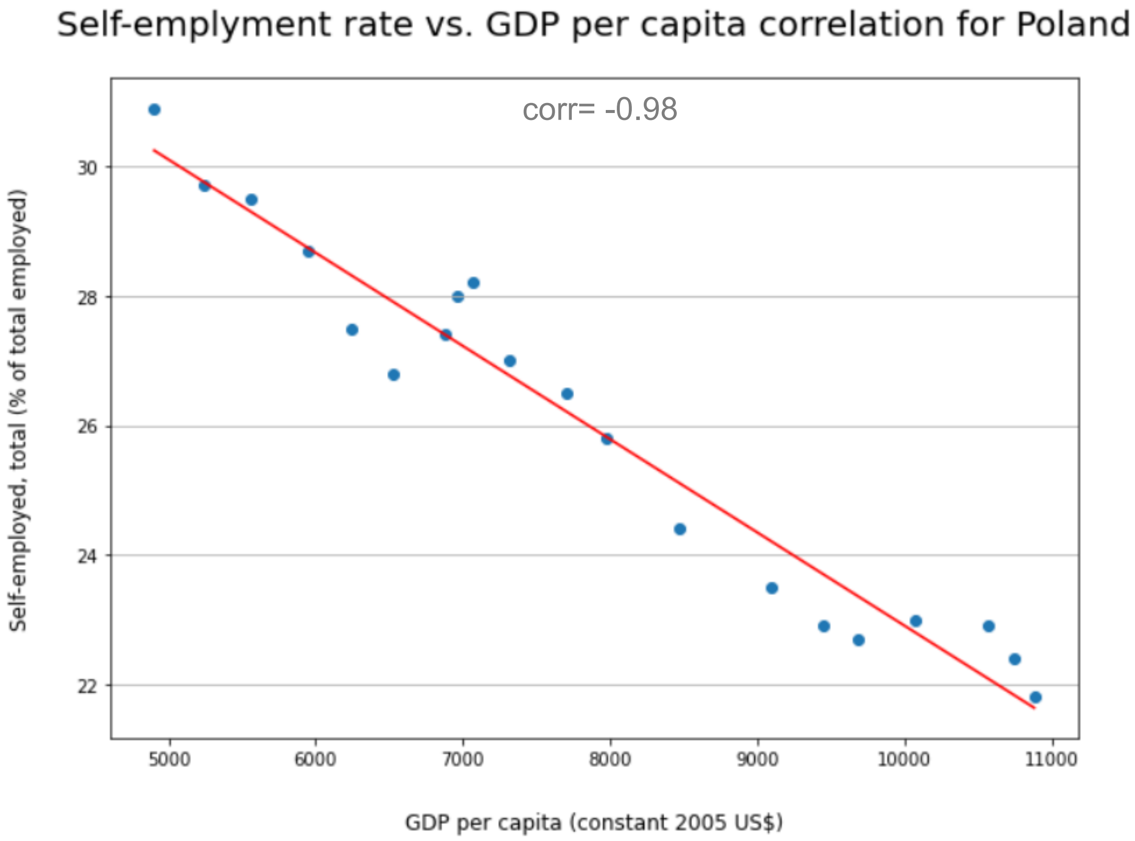
For all of them we can observe the increase in GDP per capita.

Findings



The self-employment rate depends on the country development stage. We can notice it is more stable for USA and quite highly decreasing in Poland (after a short time increase following the fall of communism). For Colombia, on the other hand, is quite unstable but with a increasing tendency.

Findings

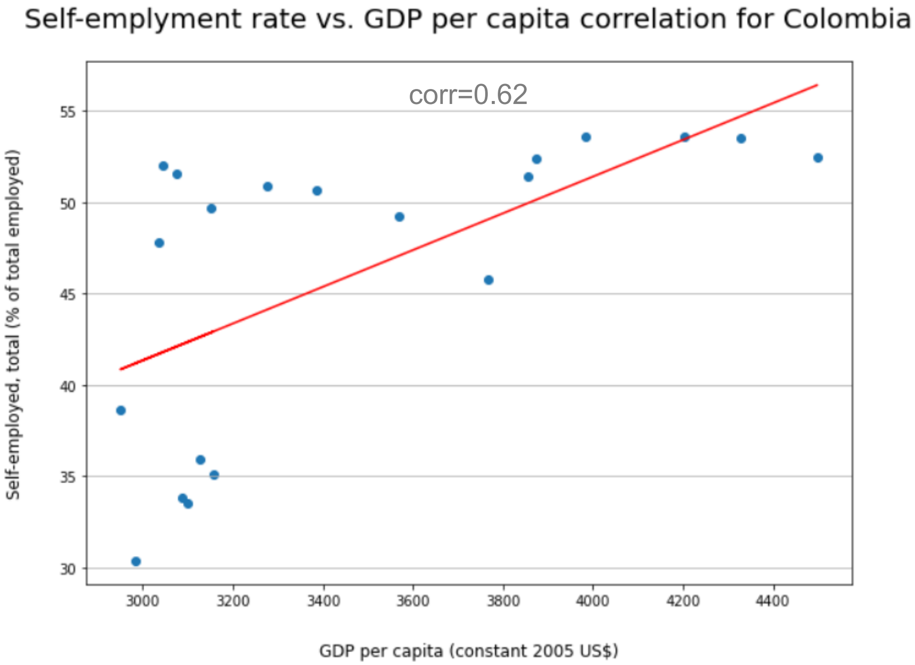


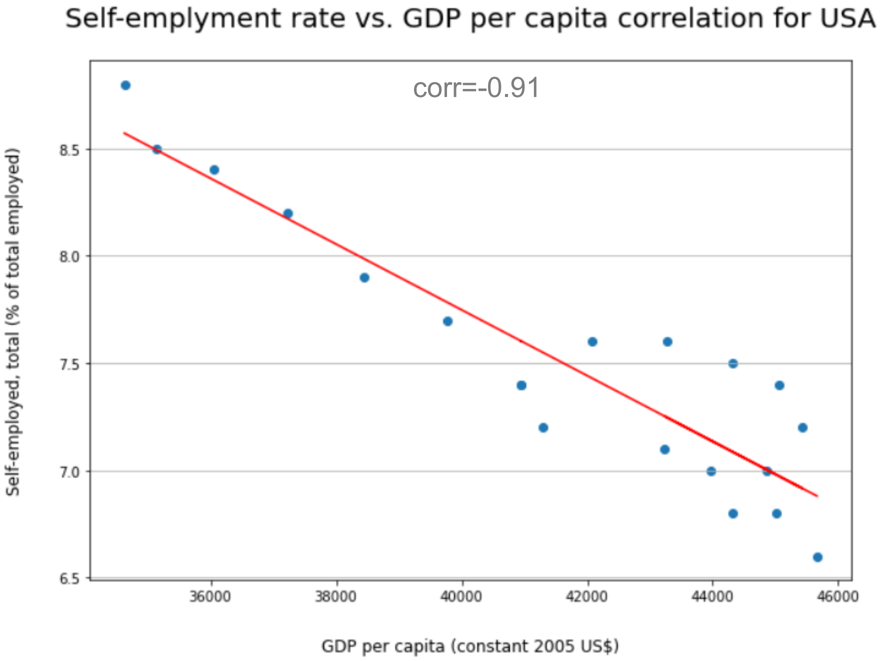
There is a very strong negative correlation -0.97 between GDP and Self-employment rate for Poland. There might be few reasons for that:

- many new international companies opening new positions
- government regulations for new companies

Findings

As is was mentioned before, there is a possitive correlation between GDP per capita and self-employment rate for developing countries (Colombia) and negative one for a developed one (USA).


Self-emplyment rate vs. GDP per capita correlation for Colombia


Self-emplyment rate vs. GDP per capita correlation for USA

Conclusion

The study has shown very strong inverse correlation between GPD per capita and self employment rate for developed countries such as USA. This means that for economically stable country the prosperity is not a key driver for accelerating the development of new companies. The situation is opposite for currently developing countries such as Colombia, where the correlation is positive.

The results should be a good starting point for governments to think about the ideas how to encourage people for running own complanies to keep the market more innovative.

Further research should consider various government regulations regarding self employment which can have a significant impact on understanding the results.

References

All the work have been done by myself using the materials provided in the course.

However, I have used a research paper listed below in odrer to better understand the self employment drivers and obstacles.

- "Self-employment in OECD countries": https://www.sciencedirect.com/science/article/pii/S0927537100000117

In [1]:

```
# Data Source: https://www.kaggle.com/worldbank/world-development-indicators
```

MiniProject

World Development Incicators

Step 1: Initial exploration of the Dataset

In [2]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

In [3]:

```
data = pd.read_csv('./world-development-indicators/Indicators.csv') #in the same folder
data.shape
```

Out[3]:

```
(5656458, 6)
```

Are there any Null values?

In [4]:

```
# Check if there are NaN values
data.isnull().any()
```

Out[4]:

```
CountryName      False
CountryCode      False
IndicatorName    False
IndicatorCode    False
Year             False
Value            False
dtype: bool
```

Explore what data set holds in

In [5]:

```
data.head(3)
```

Out[5]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
0	Arab World	ARB	Adolescent fertility rate (births per 1,000 wo...	SP.ADO.TFRT	1960	133.560907
1	Arab World	ARB	Age dependency ratio (% of working-age populat...	SP.POP.DPND	1960	87.797601
2	Arab World	ARB	Age dependency ratio, old (% of working-age po...	SP.POP.DPND.OL	1960	6.634579

How many UNIQUE indicator names are there ?

In [6]:

```
country = data['CountryName'].unique().tolist()
len(country)
```

Out[6]:

```
247
```

Are there many indicators or few ?

In [7]:

```
# How many unique indicators are there ? (should be the same #)
indicators = data['IndicatorName'].unique().tolist()
len(indicators)
```

Out[7]:

```
1344
```

How many years of data do we have ?

In [8]:

```
# How many years of data do we have ?
years = data['Year'].unique().tolist()
len(years)
```

Out[8]:

```
56
```

What's the range of years?

In [9]:

```
print(min(years)," to ",max(years))
```

```
1960  to  2015
```

Step 2: Initial plot to for better understanding the data

Lets pick a country and an indicator to explore: Water annual consumption in Poland

In [10]:

```
hist_indicator = 'Self-employed, total \(%'
hist_country = 'POL'
hist_country_2 = 'COL'
hist_country_3 = 'USA'

mask1 = data['IndicatorName'].str.contains(hist_indicator)
mask2 = data['CountryCode'].str.contains(hist_country)
mask3 = data['CountryCode'].str.contains(hist_country_2)
mask4 = data['CountryCode'].str.contains(hist_country_3)

# combine mask 1 and 2
stage = data[mask1 & mask2]
stage2 = data[mask1&mask3]
stage3 = data[mask1&mask4]
```

In [11]:

```
stage.head(3)
```

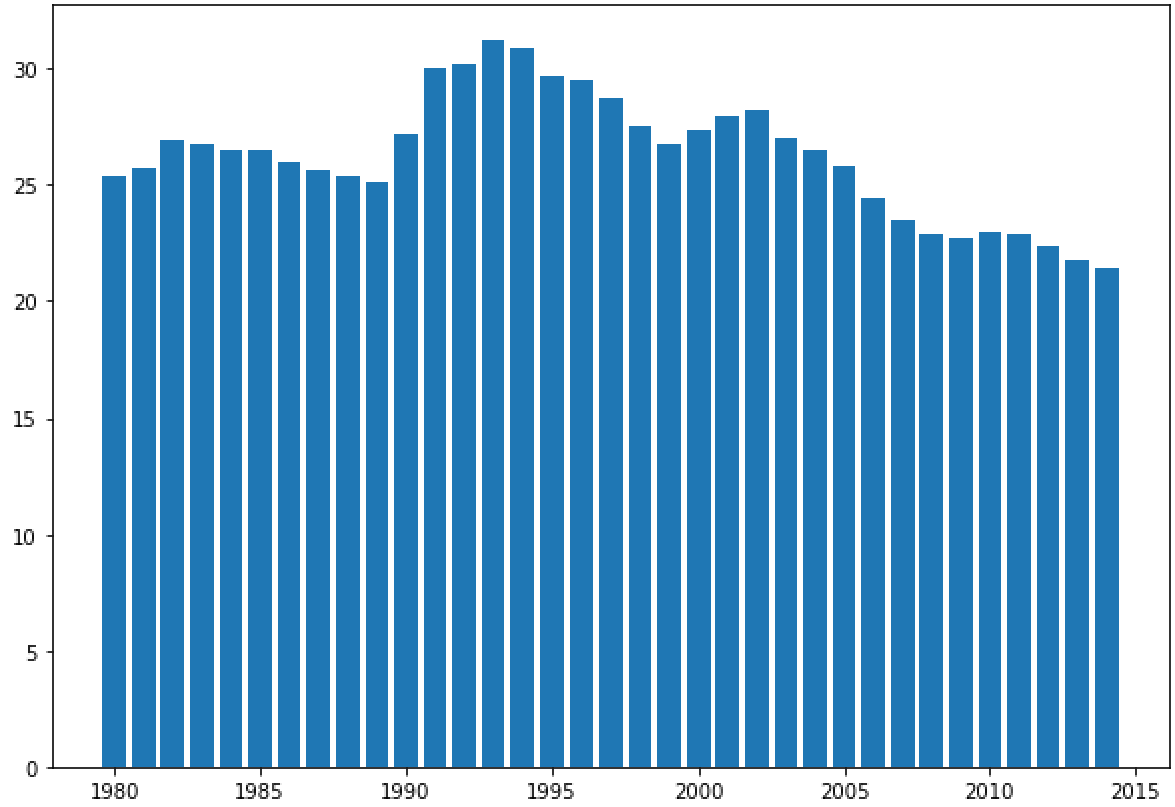
Out[11]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
1074047	Poland	POL	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	1980	25.400000
1157619	Poland	POL	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	1981	25.700001
1242583	Poland	POL	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	1982	26.900000

Let's see self employment have changed over time using MatplotLib

In [12]:

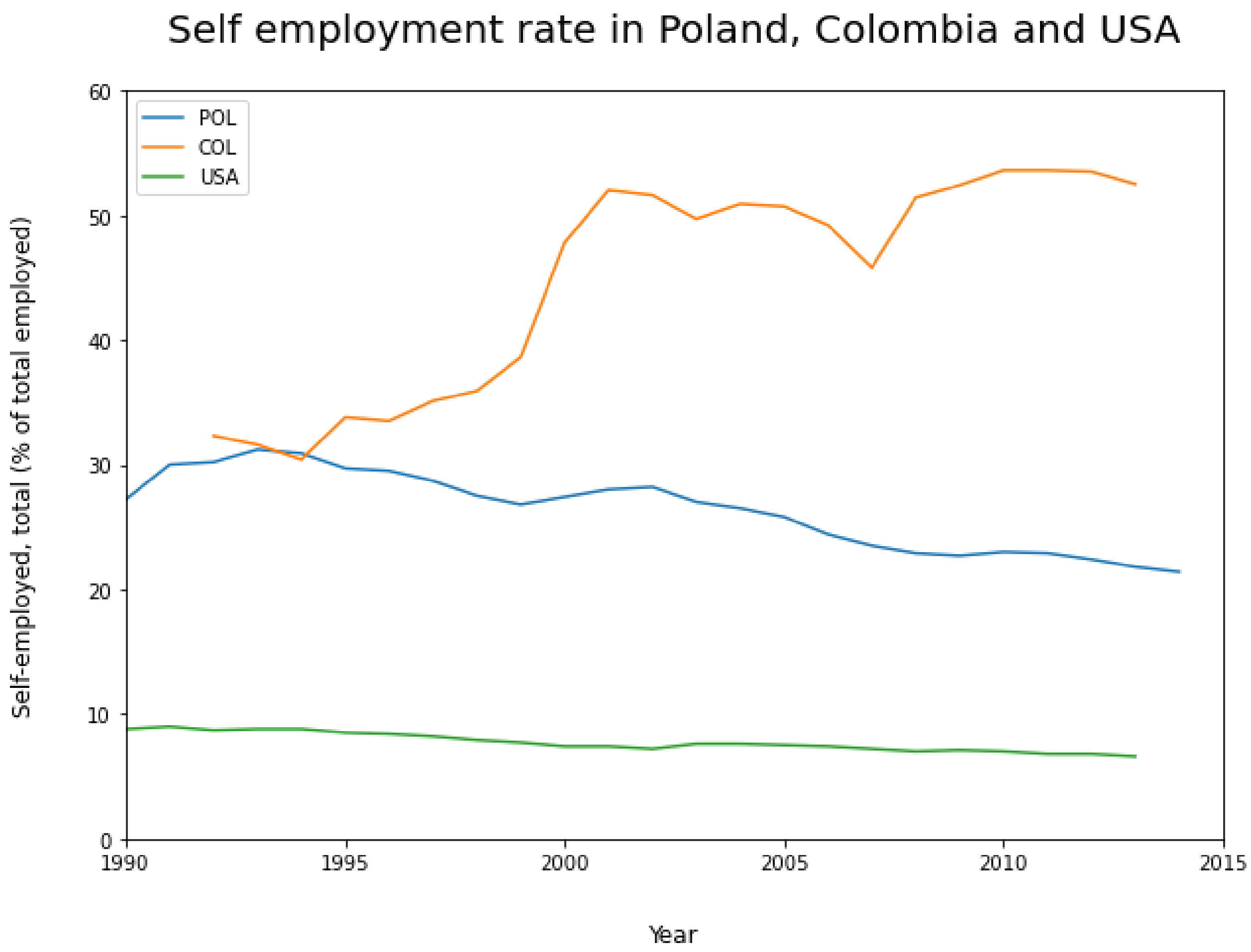
```
# get the years
years = stage['Year'].values
# get the values
empl = stage['Value'].values

fig, axis = plt.subplots(figsize=(10,7))
# create
plt.bar(years,empl)
plt.show()
```



Change the graph for a line plot

In [13]:

```
# switch to a line plot
fig, axis = plt.subplots(figsize=(10,7))

plt.plot(stage['Year'].values, stage['Value'].values)
plt.plot(stage2['Year'].values, stage2['Value'].values)
plt.plot(stage3['Year'].values, stage3['Value'].values)

# Label the axes and title
axis.set_title('Self employment rate in Poland, Colombia and USA',fontsize=20, pad=25)
axis.set_xlabel('Year',fontsize=12, labelpad=25)
axis.set_ylabel(stage['IndicatorName'].iloc[0],fontsize=12, labelpad=25)

# to make more honest, start they y axis at 0
plt.axis([1990, 2015,0,60])

plt.gca().legend(('POL','COL','USA'))

plt.show()
```



Using Histograms to explore the distribution of values

In [14]:

```
hist_data = stage['Value'].values
```

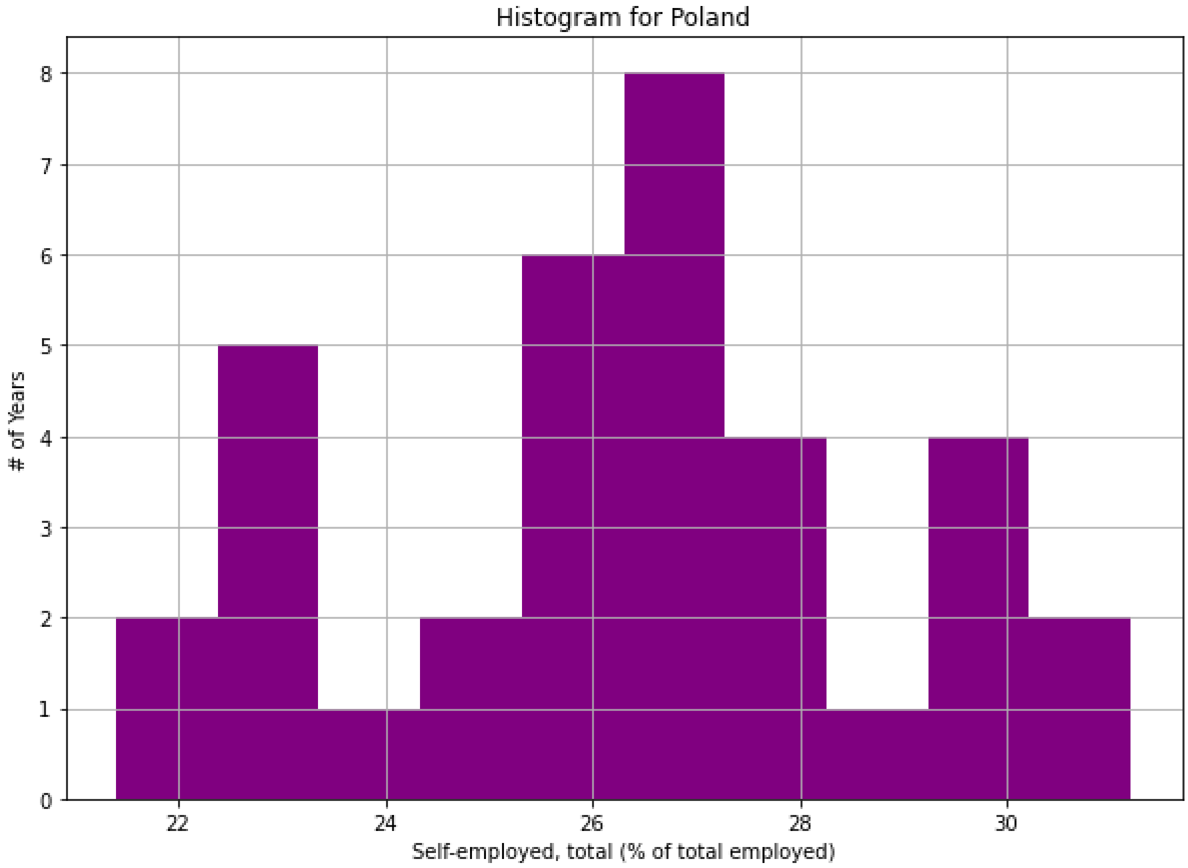
In [15]:

```
print(len(hist_data))
```

```
35
```

In [16]:

```
# the histogram of the data
fig, axis = plt.subplots(figsize=(10,7))

plt.hist(hist_data, 10, density=False, facecolor='purple')

plt.xlabel(stage['IndicatorName'].iloc[0])
plt.ylabel('# of Years')
plt.title('Histogram for Poland')
plt.grid(True)
plt.show()
```



The employment rate in Poland vary from 21-31%.

But how do Poland numbers relate to those of other countries?

In [17]:

```
# select CO2 emissions for all countries in 2011
hist_indicator = 'Self-employed, total \(%'
hist_year = 2011

mask1 = data['IndicatorName'].str.contains(hist_indicator)
mask2 = data['Year'].isin([hist_year])

# apply our mask
empl_2011 = data[mask1 & mask2]
empl_2011.head()
```

Out[17]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
5027728	Central Europe and the Baltics	CEB	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	2011	21.422639
5029656	Euro area	EMU	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	2011	15.887826
5030300	Europe & Central Asia (all income levels)	ECS	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	2011	17.945656
5031157	Europe & Central Asia (developing only)	ECA	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	2011	32.870729
5031751	European Union	EUU	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	2011	16.645202

For how many countries do we have Self employment % in 2011

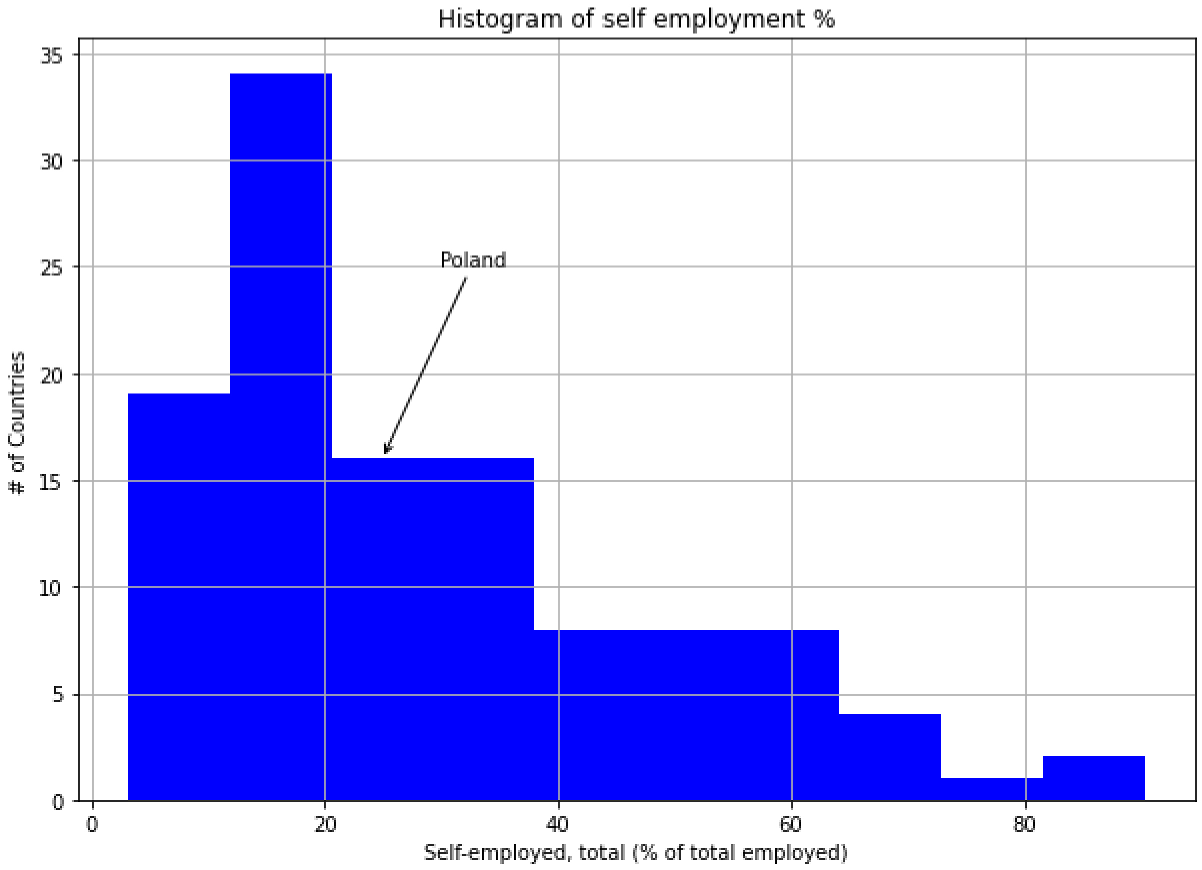
In [18]:

```
print(len(empl_2011))
```

```
116
```

In [19]:

```
# let's plot a histogram of the self employment % by country

# subplots returns a touple with the figure, axis attributes.

fig, ax = plt.subplots(figsize=(10,7))

ax.annotate("Poland",
            xy=(25, 16), xycoords='data',
            xytext=(30, 25), textcoords='data',
            arrowprops=dict(arrowstyle="->",
                            connectionstyle="arc3"),
            )

plt.hist(empl_2011['Value'], 10, density=False, facecolor='blue')

plt.xlabel(stage['IndicatorName'].iloc[0])
plt.ylabel('# of Countries')
plt.title('Histogram of self employment %')

plt.grid(True)

plt.show()
```



So Poland, at ~25% self employment is among the average of all countries

An interesting next step, would be to explore how this relates to other industrialized nations and to look at the outliers with those values in the 40s!

Step 3: Analyze the correlation between two indicators

Relationship between GPD and Self employment % in Poland, Colombia and USA

In [20]:

```
# select GDP Per capita emissions for Poland
hist_indicator = 'GDP per capita \(constant 2005'
hist_country = 'POL'
hist_country_2 = 'COL'
hist_country_3 = 'USA'

mask1 = data['IndicatorName'].str.contains(hist_indicator)
mask2 = data['CountryCode'].str.contains(hist_country)
mask3 = data['CountryCode'].str.contains(hist_country_2)
mask4 = data['CountryCode'].str.contains(hist_country_3)


# combine mask 1 and 2
gdp_stage = data[mask1 & mask2]
gdp_stage2 = data[mask1&mask3]
gdp_stage3 = data[mask1&mask4]
```

In [21]:

```
gdp_stage.head(3)
```

Out[21]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
1969896	Poland	POL	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1990	4761.075493
2086226	Poland	POL	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1991	4411.384448
2206480	Poland	POL	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1992	4508.481926

In [22]:

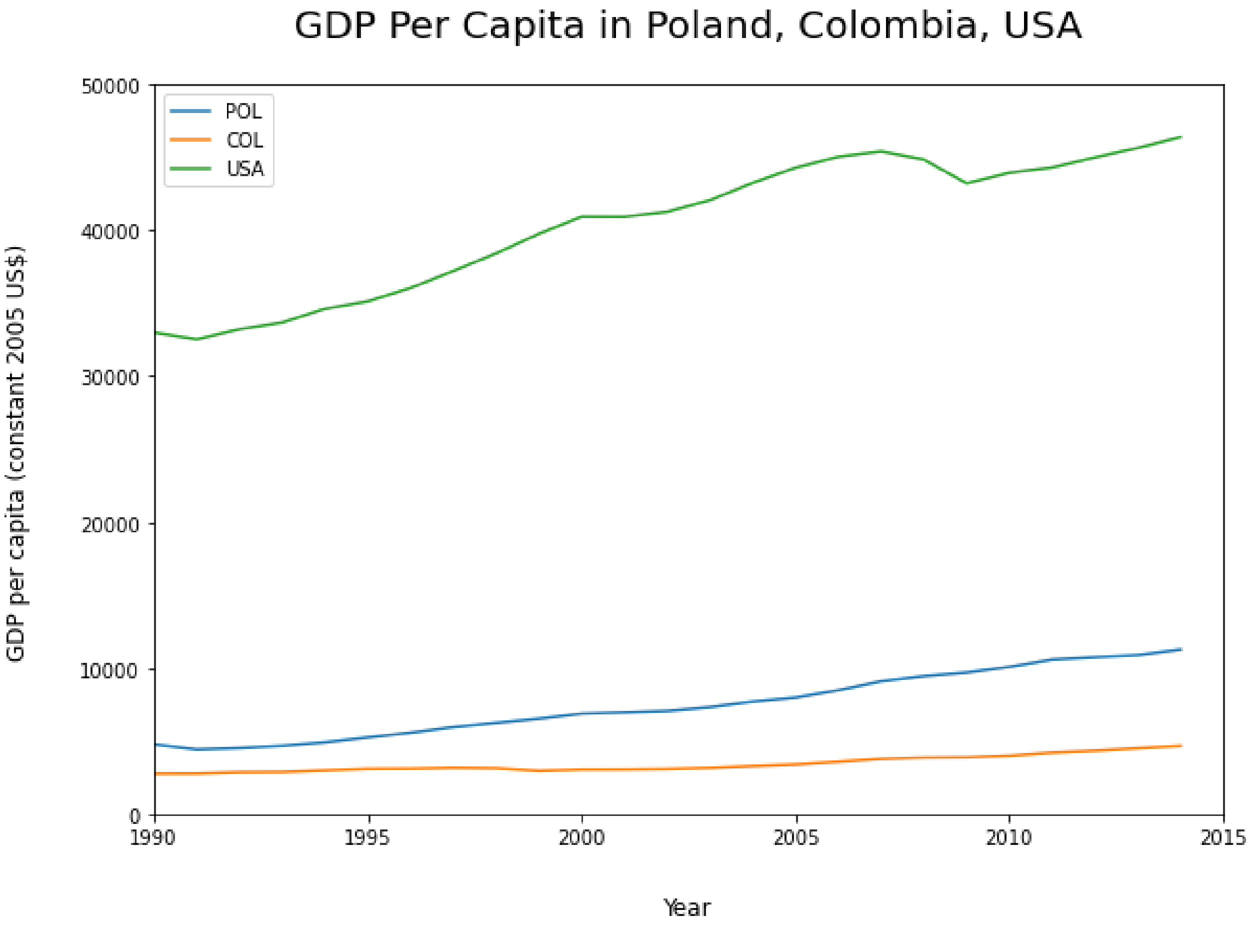
```
stage.head(3)
```

Out[22]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
1074047	Poland	POL	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	1980	25.400000
1157619	Poland	POL	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	1981	25.700001
1242583	Poland	POL	Self-employed, total (% of total employed)	SL.EMP.SELF.ZS	1982	26.900000

In [23]:

```
# switch to a line plot

fig, axis = plt.subplots(figsize=(10,7))

plt.plot(gdp_stage['Year'].values, gdp_stage['Value'].values)
plt.plot(gdp_stage2['Year'].values, gdp_stage2['Value'].values)
plt.plot(gdp_stage3['Year'].values, gdp_stage3['Value'].values)

# Label the axes and title
axis.set_title('GDP Per Capita in Poland, Colombia, USA',fontsize=20, pad=25)
axis.set_xlabel('Year',fontsize=12, labelpad=25)
axis.set_ylabel(gdp_stage['IndicatorName'].iloc[0],fontsize=12, labelpad=25)

plt.gca().legend(('POL','COL','USA'))

# to make more honest, start they y axis at 0
plt.axis([1990, 2015,0,50000])

plt.show()
```



So although we've seen a decline in the self employment, it does not seem to translate to a decline in GDP per capita

ScatterPlot for comparing GDP against Self employment in Poland in age range 1994-2013

First, we'll need to make sure we're looking at the same time frames

In [24]:

```
print("GDP Min Year = ", gdp_stage['Year'].min(), "max: ", gdp_stage['Year'].max())
print("Self-employment Min Year = ", stage['Year'].min(), "max: ", stage['Year'].max())
```

```
GDP Min Year =  1990 max:  2014
Self-employment Min Year =  1980 max:  2014
```

Trim the data to year range 1994-2013 so the scatterplot has equal length arrays to compare

In [25]:

```
gdp_stage_trunc_1 = gdp_stage[gdp_stage['Year'] > 1993]
gdp_stage_trunc = gdp_stage_trunc_1[gdp_stage_trunc_1['Year'] < 2014]
stage_1 = stage[stage['Year'] > 1993]
stage = stage_1[stage_1['Year'] < 2014]
print(len(gdp_stage_trunc))
print(len(stage))
```

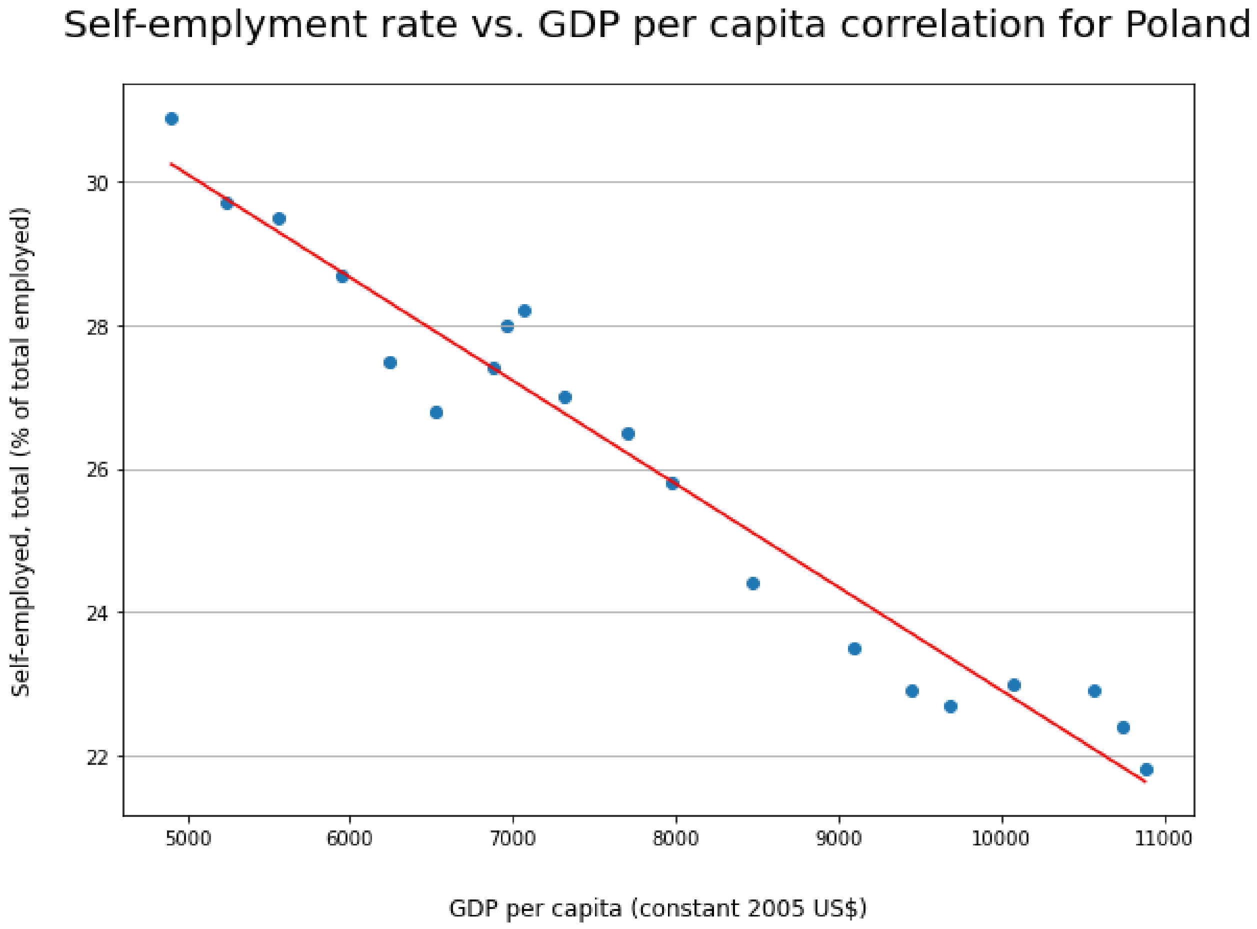
```
20
20
```

In [26]:

```
%matplotlib inline
import matplotlib.pyplot as plt

fig, axis = plt.subplots(figsize=(10,7))

# Grid lines, Xticks, Xlabel, Ylabel

axis.yaxis.grid(True)
axis.set_title('Self-emplyment rate vs. GDP per capita correlation for Poland',fontsize
axis.set_xlabel(gdp_stage_trunc['IndicatorName'].iloc[0],fontsize=12, labelpad=25)
axis.set_ylabel(stage['IndicatorName'].iloc[0],fontsize=12, labelpad=25)


X = gdp_stage_trunc['Value']
Y = stage['Value']

axis.scatter(X, Y)

m, b = np.polyfit(X, Y, 1)
plt.plot(X, m*X + b, "red")
```

Out[26]:

```
[<matplotlib.lines.Line2D at 0x2ba8f73c190>]
```



This look like there is a strong relationship. We can test this by looking at correlation.

In [27]:

```
np.corrcoef(gdp_stage_trunc['Value'],stage['Value'])
```

Out[27]:

```
array([[ 1.        , -0.97554446],
       [-0.97554446,  1.        ]])
```

A correlation of -0.97 is very strong negative correlation.

ScatterPlot for comparing GDP against Self employment in Colombia in age range 1994-2013

First, we'll need to make sure we're looking at the same time frames

In [28]:

```
print("GDP Min Year = ", gdp_stage2['Year'].min(), "max: ", gdp_stage2['Year'].max())
print("Self-employment Min Year = ", stage2['Year'].min(), "max: ", stage2['Year'].max(
```

```
GDP Min Year =  1960 max:  2014
Self-employment Min Year =  1992 max:  2013
```

Trim the data to year range 1994-2013 so the scatterplot has equal length arrays to compare

In [29]:

```
gdp_stage_trunc_1 = gdp_stage2[gdp_stage2['Year'] > 1993]
gdp_stage_trunc = gdp_stage_trunc_1[gdp_stage_trunc_1['Year'] < 2014]
stage2 = stage2[stage2['Year'] > 1993]
print(len(gdp_stage_trunc))
print(len(stage2))
```

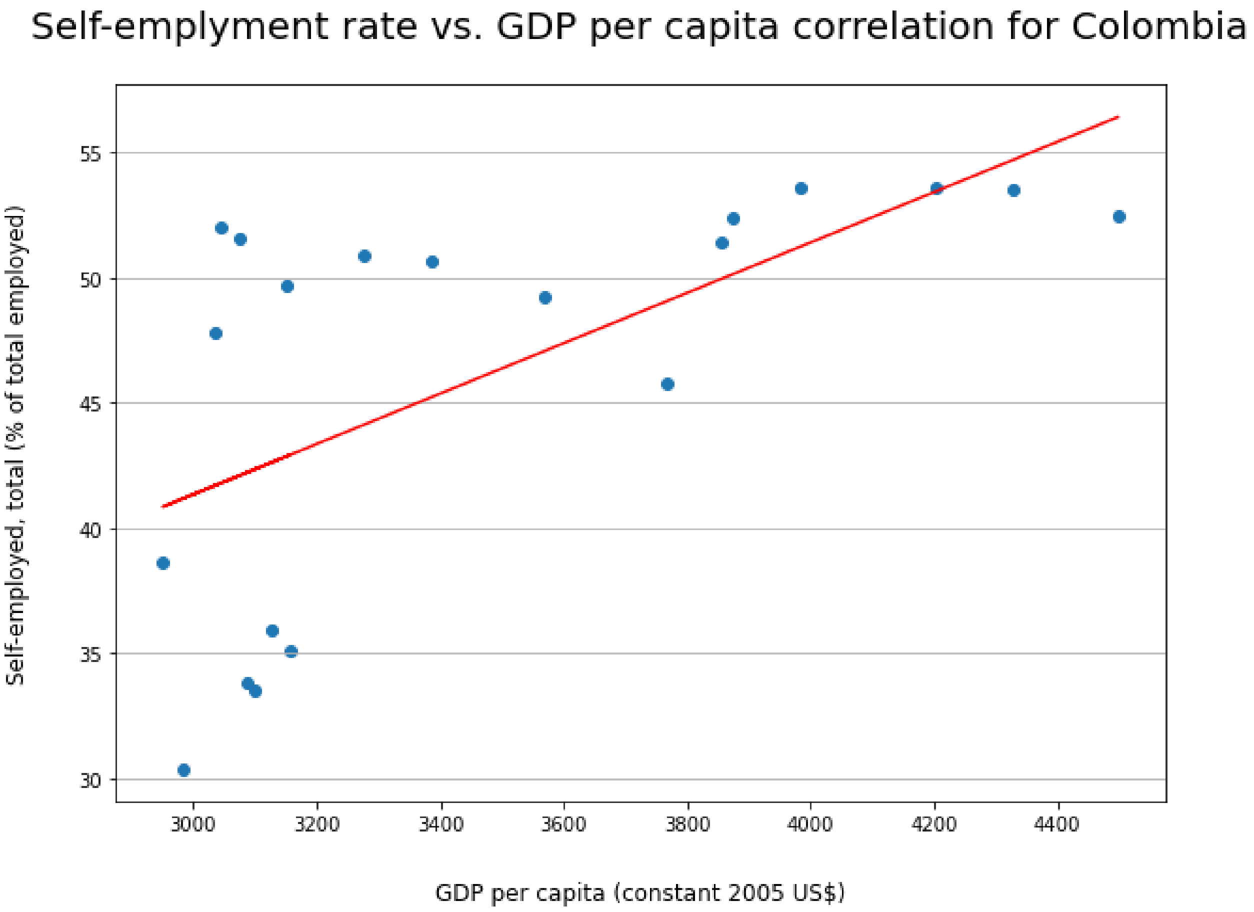
```
20
20
```

In [30]:

```
%matplotlib inline
import matplotlib.pyplot as plt

fig, axis = plt.subplots(figsize=(10,7))

# Grid lines, Xticks, Xlabel, Ylabel

axis.yaxis.grid(True)
axis.set_title('Self-emplyment rate vs. GDP per capita correlation for Colombia',fontsi
axis.set_xlabel(gdp_stage_trunc['IndicatorName'].iloc[0],fontsize=12, labelpad=25)
axis.set_ylabel(stage2['IndicatorName'].iloc[0],fontsize=12, labelpad=25)


X = gdp_stage_trunc['Value']
Y = stage2['Value']

axis.scatter(X, Y)

m, b = np.polyfit(X, Y, 1)
plt.plot(X, m*X + b, "red")
```

Out[30]:

```
[<matplotlib.lines.Line2D at 0x2ba8ffd5e50>]
```



In [31]:

```
np.corrcoef(gdp_stage_trunc['Value'],stage2['Value'])
```

Out[31]:

```
array([[1.       , 0.6160888],
       [0.6160888, 1.       ]])
```

ScatterPlot for comparing GDP against Self employment in USA in age range 1994-2013

First, we'll need to make sure we're looking at the same time frames

In [32]:

```
print("GDP Min Year = ", gdp_stage3['Year'].min(), "max: ", gdp_stage3['Year'].max())
print("Self-employment Min Year = ", stage3['Year'].min(), "max: ", stage3['Year'].max(
```

```
GDP Min Year =  1960 max:  2014
Self-employment Min Year =  1980 max:  2013
```

Trim the data to year range 1994-2013 so the scatterplot has equal length arrays to compare

In [33]:

```
gdp_stage_trunc_1 = gdp_stage3[gdp_stage3['Year'] > 1993]
gdp_stage_trunc = gdp_stage_trunc_1[gdp_stage_trunc_1['Year'] < 2014]
stage3 = stage3[stage3['Year'] > 1993]
print(len(gdp_stage_trunc))
print(len(stage3))
```

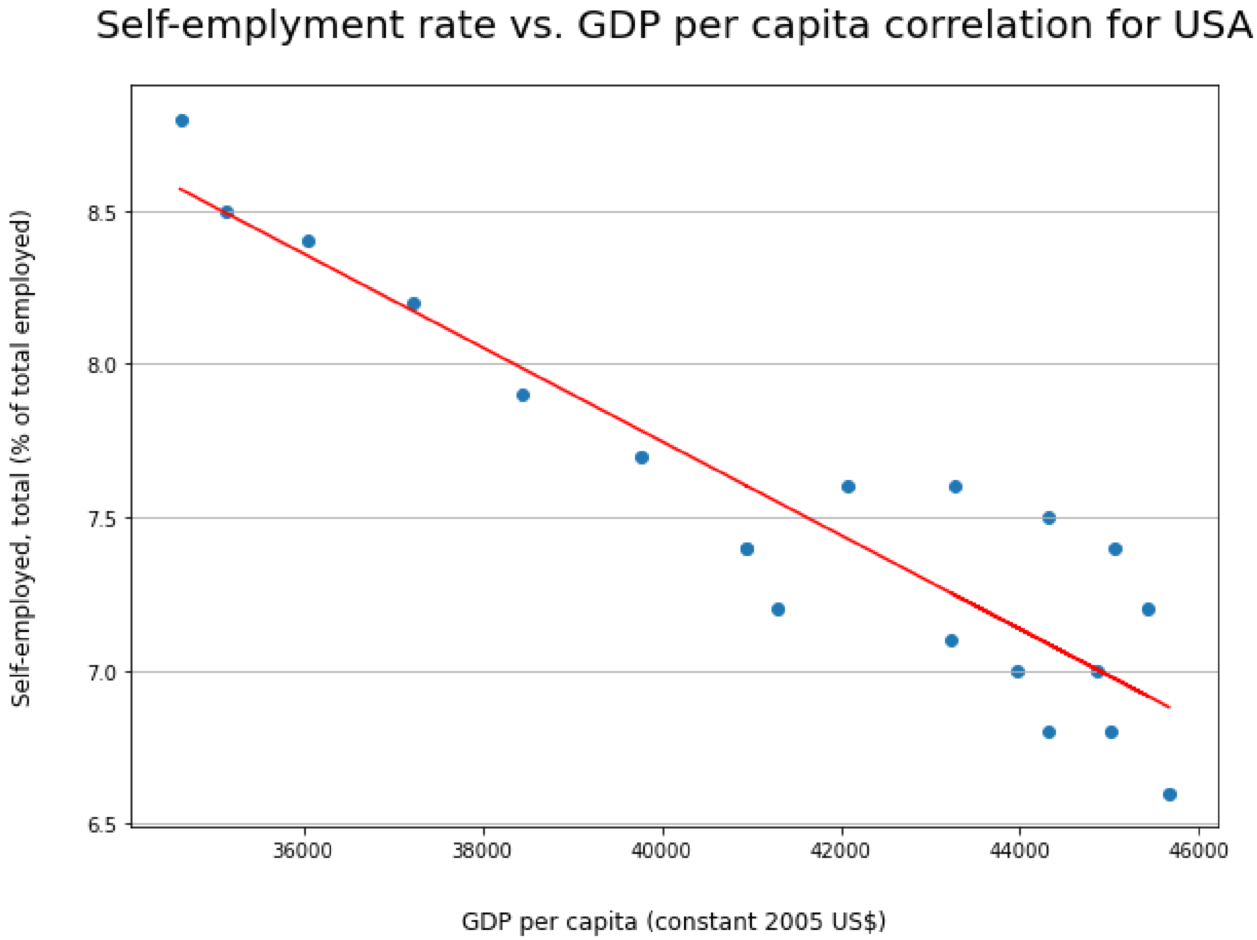
```
20
20
```

In [34]:

```
%matplotlib inline
import matplotlib.pyplot as plt

fig, axis = plt.subplots(figsize=(10,7))

# Grid lines, Xticks, Xlabel, Ylabel
axis.yaxis.grid(True)
axis.set_title('Self-emplyment rate vs. GDP per capita correlation for USA',fontsize=20
axis.set_xlabel(gdp_stage_trunc['IndicatorName'].iloc[0],fontsize=12, labelpad=25)
axis.set_ylabel(stage3['IndicatorName'].iloc[0],fontsize=12, labelpad=25)


X = gdp_stage_trunc['Value']
Y = stage3['Value']

axis.scatter(X, Y)

m, b = np.polyfit(X, Y, 1)
plt.plot(X, m*X + b, "red")
```

Out[34]:

```
[<matplotlib.lines.Line2D at 0x2ba90039d30>]
```



```
In [35]: np.corrcoef(gdp_stage_trunc['Value'],stage3['Value'])
```

```
Out[35]: array([[ 1.        , -0.91665104],
               [-0.91665104,  1.        ]])
```