What was the USA’s birth rate between 1960 and 2015?

Chung-I Huang/2018.11.20

Dataset

- World Development Indicators Dataset

https://www.kaggle.com/worldbank/world-development-indicators

Motivation

- To look into the birth rate trend between 1960 and 2015 in the USA.
- Wondering how the birth rate correlated to the GDP.

Research Question(s)

- Compared to other countries, does the USA have an outlier of birth rate?
- To what happened, what associated to this change?
- Can GDP be regarded as an important factor causing the change?

Findings

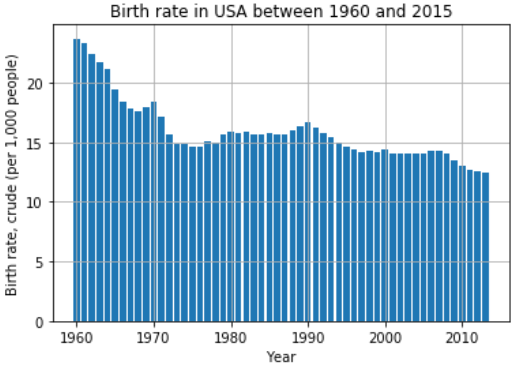


Fig. (a)

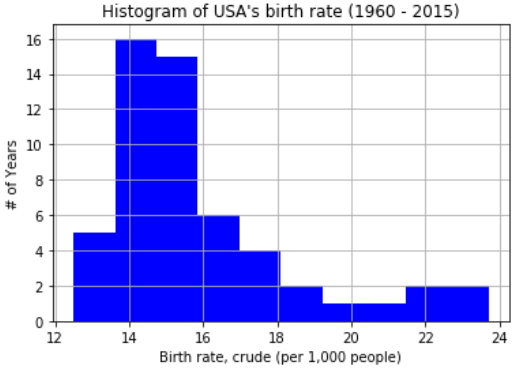


Fig. (b)

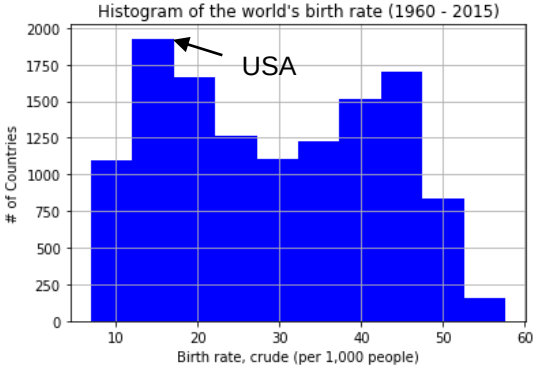


Fig. (c)

Between Fig. (a) and (b), we can see that after 1960, the birth rate decreases over time. The USA has many years where it has a birth rate between ’13’-’15’ (per 1,000 people.

In Fig. (c), the mean of the USA’s birth rate is ‘15.9’ during these years. Although the USA is not an outlier in this result (~1900 countries has about this birth rate), it is still quite low compared to other countries. The mean of the world’s birth rate is ‘29.25’.

Findings

```
array([[ 1.        , -0.79974891],
       [-0.79974891,  1.        ]])
```

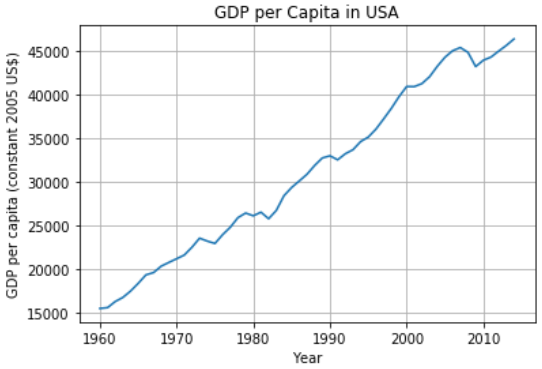


Fig. (d)

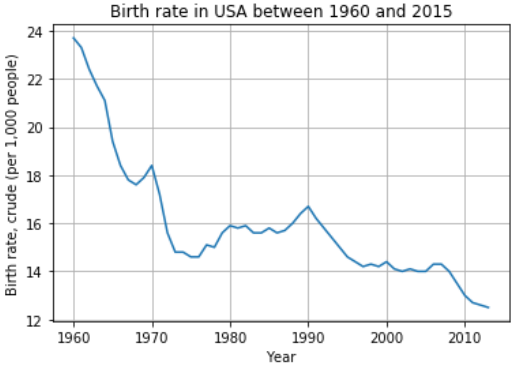


Fig. (e)

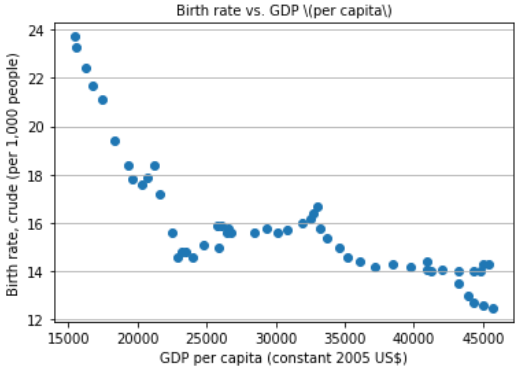


Fig. (f)

With the Fig. (d) chart, we pull out the GDP vs. Years, you can see that the economy increased yearly; however, the birth rate in the Fig. (e) chart decreased between 1960 and 2015 in the USA. This drew my attention to figure out the correlation behind the results.

Therefore, the Fig. (f) chart came out. When we compare GDP vs. Birth rate, we noticed that the GDP is significantly correlated to the Birth rate, the correlation coefficient is -0.799. The result makes sense because once the economy becomes steady, the less the birth rate, as seen in most developed countries. Although I didn't attach the bottom birth rate data here, I noticed that most of the low birth rate countries are the developed countries, such as Japan, Italy, Sweden, and so on.

Acknowledgements

I will give 5 stars to this class. Even those who don’t have experience in statistics and Python, are able to catch up in the courses by following the step by step contents. This makes me more confident in joining the data science field.

References

- All my own work, and I refer to Week 5 – Visualization class slides for most of the analyzation.

In [1]:

```
import numpy as np
import pandas as pd
import random
import matplotlib.pyplot as plt
from matplotlib.ticker import FuncFormatter
%matplotlib inline

data = pd.read_csv('./world-development-indicators/Indicators.csv')
data.shape
```

Out[1]:

```
(5656458, 6)
```

In [2]:

```
data.head()
```

Out[2]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
0	Arab World	ARB	Adolescent fertility rate (births per 1,000 wo...	SP.ADO.TFRT	1960	1.335609e+02
1	Arab World	ARB	Age dependency ratio (% of working-age populat...	SP.POP.DPND	1960	8.779760e+01
2	Arab World	ARB	Age dependency ratio, old (% of working-age po...	SP.POP.DPND.OL	1960	6.634579e+00
3	Arab World	ARB	Age dependency ratio, young (% of working-age ...	SP.POP.DPND.YG	1960	8.102333e+01
4	Arab World	ARB	Arms exports (SIPRI trend indicator values)	MS.MIL.XPRT.KD	1960	3.000000e+06

How many UNIQUE country names and codes are there ?

In [3]:

```
countries = data['CountryName'].unique().tolist()
countrycode = data['CountryCode'].unique().tolist()
print('countries = ', len(countries))
print('countrycode = ', len(countrycode))
```

```
countries =  247
countrycode =  247
```

What is the range of years?

In [4]:

```
years = data['Year'].unique().tolist()
print(min(years), '-', max(years))
```

```
1960 - 2015
```

In [5]:

```
print(len(years)) # total years
```

```
56
```

Checking for null values

In [6]:

```
data.isnull().any()
```

Out[6]:

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

Select birth rate from all countries

In [7]:

```
# Data Selected : Birth rate
brw_stage = data[data['IndicatorName'].str.contains('Birth rate, crude \(per')]
brw_stage.shape
```

Out[7]:

```
(12485, 6)
```

In [8]:

```
brw_stage.head()
```

Out[8]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
6	Arab World	ARB	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1960	47.697888
84	Caribbean small states	CSS	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1960	40.017001
164	Central Europe and the Baltics	CEB	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1960	19.117435
236	East Asia & Pacific (all income levels)	EAS	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1960	26.362350
359	East Asia & Pacific (developing only)	EAP	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1960	26.635950

Filter for USA's birth rate between 1960 and 2015

In [9]:

```
# Select birth rate for the World
hist_indicator = 'Birth rate, crude \(per '
hist_country = 'USA'

mask1 = data['IndicatorName'].str.contains(hist_indicator)
#mask2 = data['Year'].between(2000, 2015)
mask3 = data['CountryCode'].str.contains(hist_country)

usa_stage = data[mask1 & mask3]
```

In [10]:

```
usa_stage.head()
```

Out[10]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
22227	United States	USA	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1960	23.7
48701	United States	USA	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1961	23.3
77080	United States	USA	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1962	22.4
105696	United States	USA	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1963	21.7
134734	United States	USA	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	1964	21.1

In [11]:

```
type(usa_stage)
```

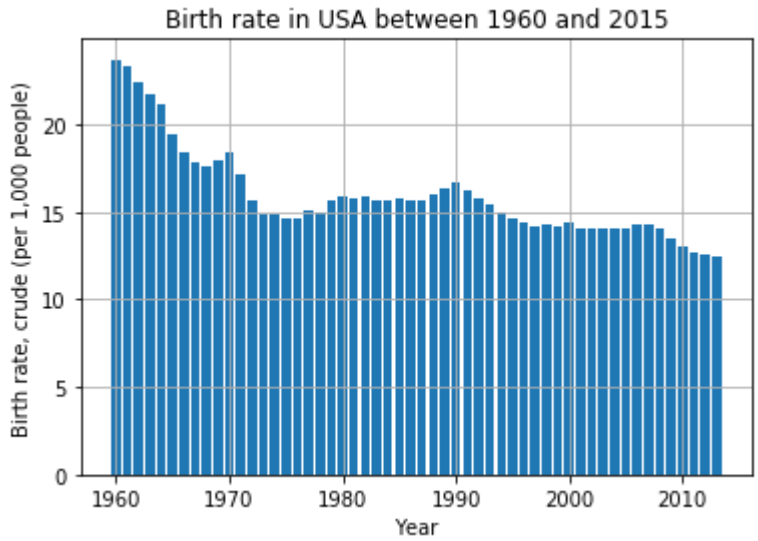
Out[11]:

```
pandas.core.frame.DataFrame
```

Bar chart of yearly USA birth rate

In [12]:

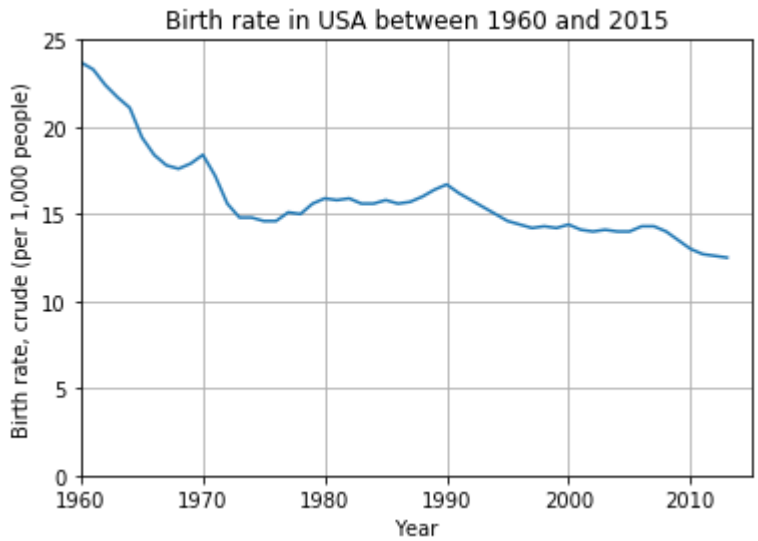
```
# get the years
years = usa_stage['Year'].values

# get the values
birth_rate = usa_stage['Value'].values

# Create plot
plt.bar(years, birth_rate)
plt.title('Birth rate in USA between 1960 and 2015')
plt.xlabel('Year')
plt.ylabel(usa_stage['IndicatorName'].iloc[0])



plt.grid(True)
plt.show()
```



Line Graph of USA birth rate annual

In [13]:

```
# Switch to a line plot
plt.plot(usa_stage['Year'].values, usa_stage['Value'].values)

# Label the axes
plt.xlabel('Year')
plt.ylabel(usa_stage['IndicatorName'].iloc[0])

# Label the figure
plt.title('Birth rate in USA between 1960 and 2015')

# to make more honest, start the y axis at 0
plt.axis([1960, 2015, 0, 25])
plt.grid(True)
plt.show()
```



In [14]:

```
# Look at all of data
hist_data = usa_stage['Value'].values
hist_data
```

Out[14]:

```
array([23.7, 23.3, 22.4, 21.7, 21.1, 19.4, 18.4, 17.8, 17.6, 17.9, 18.
4,
       17.2, 15.6, 14.8, 14.8, 14.6, 14.6, 15.1, 15. , 15.6, 15.9, 15.
8,
       15.9, 15.6, 15.6, 15.8, 15.6, 15.7, 16. , 16.4, 16.7, 16.2, 15.
8,
       15.4, 15. , 14.6, 14.4, 14.2, 14.3, 14.2, 14.4, 14.1, 14. , 14.
1,
       14. , 14. , 14.3, 14.3, 14. , 13.5, 13. , 12.7, 12.6, 12.5])
```

In [15]:

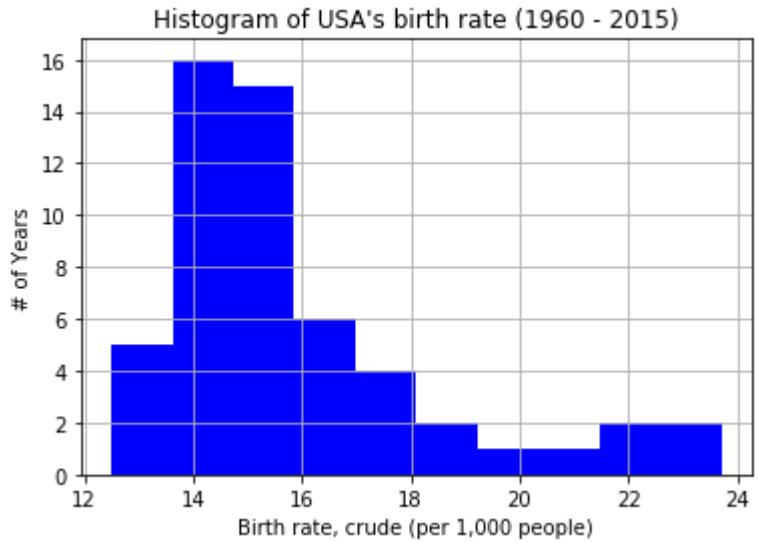
```
# How many of data
print(len(hist_data))
```

```
54
```

Histogram of USA birth rate annual

In [16]:

```
# Create the histogram of the data
plt.hist(usa_stage['Value'].values, color = 'blue')

# Label the axes
plt.xlabel(usa_stage['IndicatorName'].iloc[0])
plt.ylabel('# of Years')

# Label the figure
plt.title("Histogram of USA's birth rate (1960 - 2015)")


plt.grid(True)
plt.show()
```



So the USA has many years where it has birth rate between 13-15 per 1,000 people.

In [17]:

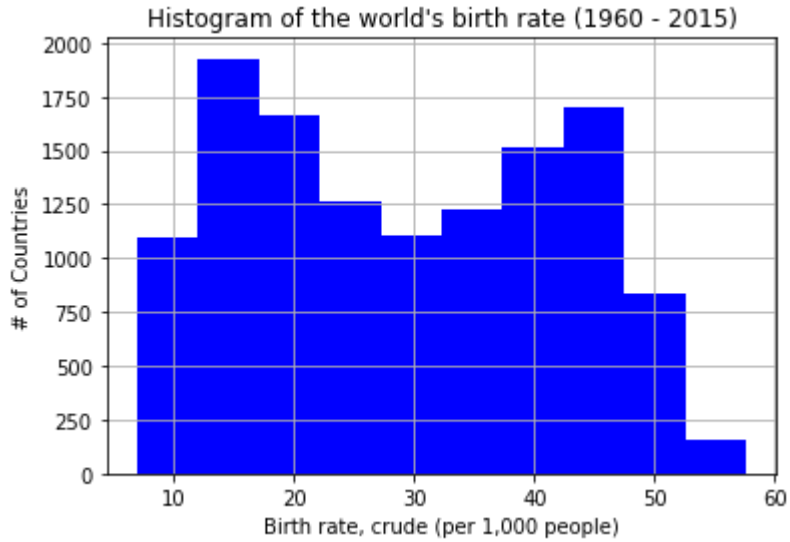
```
usa_stage['Value'].describe()
```

Out[17]:

```
count    54.000000
mean     15.918519
std       2.579679
min      12.500000
25%      14.300000
50%      15.500000
75%      16.350000
max      23.700000
Name: Value, dtype: float64
```

In [18]:

```
fig, ax = plt.subplots()
plt.hist(brw_stage['Value'].values, color = 'blue')


plt.xlabel(brw_stage['IndicatorName'].iloc[0])
plt.ylabel('# of Countries')
plt.title('Histogram of the world\'s birth rate (1960 - 2015)')

plt.grid(True)
plt.show()
```



In [19]:

```
brw_stage['Value'].describe()
```

Out[19]:

```
count    12485.000000
mean        29.259449
std         12.939121
min          6.900000
25%         17.400000
50%         28.671000
75%         41.174000
max         57.637000
Name: Value, dtype: float64
```

From 1960 to 2015, the mean of USA's birth rate is 15.9, which is quite low compared to other countries.

In [20]:

```
# Look into the countries that has a lower birth rate
brw_stage.sort_values(by = 'Value', ascending = True)[:10]
```

...

Most of them are the developed countries.

How many countries in the list?

In [21]:

```
brw_stage['Value'].values
```

Out[21]:

```
array([47.6978881 , 40.01700054, 19.11743513, ..., 32.947     ,
       40.471     , 35.715     ])
```

How does the birth rate for every countries in 2012?

In [22]:

```
# Select birth rate for all countries in 2012
hist_indicator = 'Birth rate, crude \(per'
hist_year = 2012

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


#apply our mask
brw_2012 = data[mask1 & mask2]
brw_2012.head(10)
#or wirite in another way
#brw_2012.sort_values(by = 'Value', ascending = False)[:5]
```

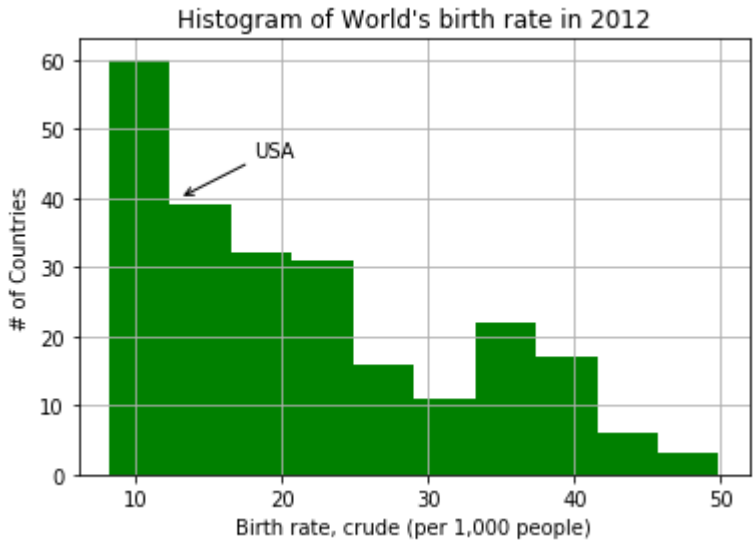
Out[22]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
5202330	Arab World	ARB	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	26.917208
5202834	Caribbean small states	CSS	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	15.945389
5203313	Central Europe and the Baltics	CEB	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	9.940011
5203898	East Asia & Pacific (all income levels)	EAS	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	13.860501
5204485	East Asia & Pacific (developing only)	EAP	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	14.391727
5205273	Euro area	EMU	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	9.998520
5205846	Europe & Central Asia (all income levels)	ECS	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	12.554209
5206520	Europe & Central Asia (developing only)	ECA	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	16.169430
5207397	European Union	EUU	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	10.371996
5207978	Fragile and conflict affected situations	FCS	Birth rate, crude (per 1,000 people)	SP.DYN.CBRT.IN	2012	33.916045

Histogram of World's Birth rate in 2012

In [23]:

```
# subplots returns a touple with the figure, axis attributes.
fig, ax = plt.subplots()

ax.annotate('USA',
            xy = (13, 40), xycoords = 'data',
            xytext = (18, 46), textcoords = 'data',
            arrowprops = dict(arrowstyle = '->',
                              connectionstyle = 'arc3'),
           )
plt.hist(brw_2012['Value'], color = 'green')

plt.xlabel(brw_2012['IndicatorName'].iloc[0])
plt.ylabel('# of Countries')
plt.title('Histogram of World\'s birth rate in 2012')

plt.grid(True)

plt.show()
```



The USA, at ~13 birth rate (per 1,000 people) is in a low birth rate among all countries.

In [24]:

```
brw_2012['Value'].describe()
```

Out[24]:

```
count    237.000000
mean      21.353315
std       10.371229
min        8.200000
25%       12.282000
50%       18.777000
75%       28.753000
max       49.869000
Name: Value, dtype: float64
```

Relationship between GDP and birth rate in USA

In [25]:

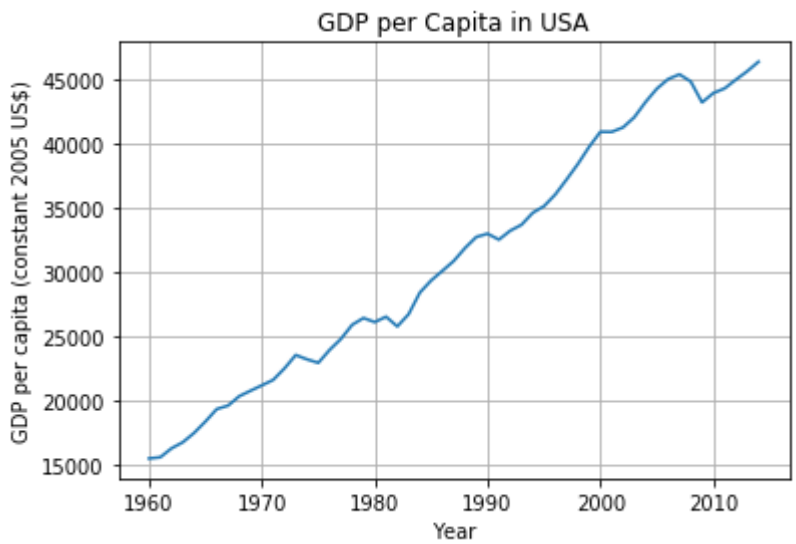
```
# Select GDP per capita for the United States
hist_indicator = 'GDP per capita \(constant 2005'
hist_country = 'USA'

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

gdp_stage = data[mask1 & mask2]
gdp_stage.head()
```

Out[25]:

	CountryName	CountryCode	IndicatorName	IndicatorCode	Year	Value
22282	United States	USA	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1960	15482.707760
48759	United States	USA	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1961	15578.409657
77142	United States	USA	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1962	16276.426685
105760	United States	USA	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1963	16749.789436
134798	United States	USA	GDP per capita (constant 2005 US$)	NY.GDP.PCAP.KD	1964	17476.822248

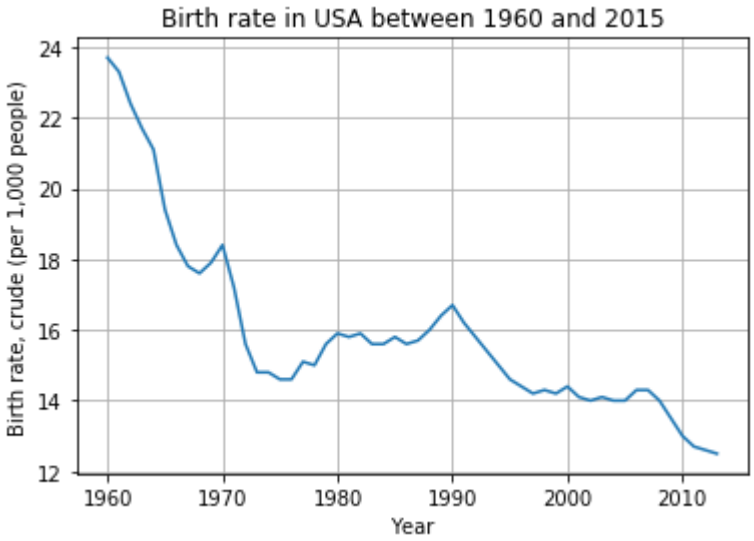
In [26]:

```
# Switch to the line plot
plt.plot(gdp_stage['Year'].values, gdp_stage['Value'].values)

# Label the axes
plt.xlabel('Year')
plt.ylabel(gdp_stage['IndicatorName'].iloc[0])

# Label the figure
plt.title('GDP per Capita in USA')

plt.grid(True)
plt.show()
```



In [27]:

```
# Make line plot again for the USA's birth rate between 1960 and 2015
# Switch to a line plot
plt.plot(usa_stage['Year'].values, usa_stage['Value'].values)

# Label the axes
plt.xlabel('Year')
plt.ylabel(usa_stage['IndicatorName'].iloc[0])

# Label the figure
plt.title('Birth rate in USA between 1960 and 2015')

# to make more honest, start the y axis at 0
#plt.axis([1959, 2015, 0, 25])
plt.grid(True)
plt.show()
```



These two charts gave us an opposite result yearly. We can explain that the economy stronger year by year in USA, which led to lower birth rate demand. This result makes sense in the developed countries.

0.10 ScatterPlot for comparing GDP against birth rate (per 1,000 people)

In [28]:

```
print('GDP min Year :', gdp_stage['Year'].min(), 'Max :', gdp_stage['Year'].max())
print('Birth rate min Year :', usa_stage['Year'].min(), 'Max :', usa_stage['Year'].r
```

```
GDP min Year : 1960 Max : 2014
Birth rate min Year : 1960 Max : 2013
```

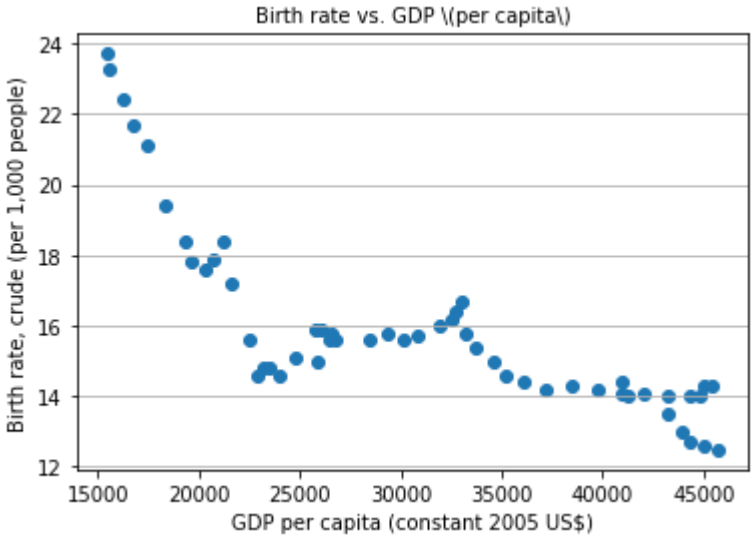
We have 1 extra year of GDP data, so, let's trim this off so the scatterplot has equal length arrays to compare.

In [29]:

```
# To do the trimming, let's ask for the year before 2014
gdp_stage_trunc = gdp_stage[gdp_stage['Year'] < 2014]
```

In [30]:

```
fig, axis = plt.subplots()

axis.set_xlabel(gdp_stage_trunc['IndicatorName'].iloc[0], fontsize = 10)
axis.set_ylabel(usa_stage['IndicatorName'].iloc[0], fontsize = 10)
axis.set_title('Birth rate vs. GDP \(per capita\)', fontsize = 10)

# grid open only for y-axis
axis.yaxis.grid(True)

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

axis.scatter(X, Y)

plt.show()
```



0.11 Correlation between bith rate and GDP

In [31]:

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

Out[31]:

```
array([[ 1.        , -0.79974891],
       [-0.79974891,  1.        ]])
```

We can confindently say the GDP and birth rate has a strong correlation.