Final Project: Medium Age influence on Social Spending in Japan and The United States

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Abstract:

In this project, I will analyze the Social Spending of OECD countries from 1980 to 2015. In particular, I will focus on Japan, who currently has a very high medium age, and the US, whose population medium age is expected to grow. This project will be broken down into three sections. The first section will analyze overall Social Spending trends including the Net Social Spending of Japan and United States, the CAGR of Social Spending by OECD countries, Average Social Spending by OECD countries. The second section will break down the Social Spending of Japan and the United States by sector, and I will specifically focus on Old Age Social Spending trends. The final section will focus on the Medium Age trends in Japan and the United States and how they are correlated to Old Age Social Spending in both countries.

Introduction:

This project is prompted by the idea that social spending in the US is expected to increase as people are living longer and medium age is increasing. Furthermore, social spending will be a key driver in increasing the Fiscal Deficit within the US, which brings the question whether the deficit is sustainable. AS defined by the OECD, Social Expenditures or Social Spending comprise of cash benefits, direct in-kind provision of goods and services, and tax breaks with social purposes. These Social Expenditures comprise of benefits targeted toward low-income households, the elderly, sick, unemployed and young people. In the US, Government spending is projected to grow at an annual rate of 5.5 percent over the next decade, reaching $7.0 trillion in 2028. From this increase, spending from Social Security, Medicare, and Net interest account for more than two-thirds of that increase (CBO (https://www.cbo.gov/publication/53766)). The aging of the population is a large factor in the increase of overall Social Expenditure. The United States stands to learn by analyzing Japan economic decisions to counteract an ageing population.

Data Report

In this project, in order to analyze Social Spending and Medium Age trends, I will need to use public data on social spending provided by the OECD (https://data.oecd.org/). Specifically, I will use both a general social spending database (https://data.oecd.org/socialexp/social-spending.htm) and an aggregated social expenditure database (https://stats.oecd.org/BrandedView.aspx?oecd_bv_id=socx-data-en&doi=data-00166-en) provided by the Organisation for Economic Co-operation and Development(OECD) (https://data.oecd.org/). From the general social spending database, I will extract general social spending trends from a few OECD countries. From the aggreagated social expenditure database, I will extract specific aspects of Japan's and the United States's social expenditures by breaking it down into large components. To analyze Medium Age trends, I will use the United Nations Population Prospects (https://population.un.org/wpp/Download/Standard/Population/) to get a database showing the population trends of Japan and the United States. All these databases will be read into this notebook and cleaned, mergedm and extracted for my use.

Three Sections:

1. Overall Social Spending Analysis

- Net Total Social Spending as a Percentage of GDP by Year
- Average Social Spending from 1980-2015 and CAGR in Social Spending from 1980-2015

2. Japan and United States Break down of Social Spending and focus on Old Age Social Spending

- Breakdown of Japan and USA's Social Spending 1980-2015
- Old Age Social Spending as a % of GDP
- CAGR of Old Age Social Spending

3. Japan and United States Medium Age Trends and Medium Age and Old Age Correlative Analysis

- Medium Age Trend 1980-2015
- Linear Regression of Medium Age and Old Age Social Spending

Conclusion:

Section 1: Overall Social Spending Analysis

In [1]:
```
import pandas as pd # We know this one...
import numpy as np # For performing numerical analysis
import matplotlib.pyplot as plt # Plotting
import os
import weightedcalcs as wc # This allows for "weighted" calculations
```

Here I am importing the Social Spending Indicator from the OECD Social Spending Database

In [2]:
```
url1 = "https://stats.oecd.org/sdmx-json/data/DP_LIVE/.SOCEXP.../OECD?conten
```

In [3]:
```
social = pd.read_csv(url1)
```

In [4]:
```
social.head()
```

Out[4]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	TIME	Value	Flag Codes
0	AUS	SOCEXP	PRIV	PC_GDP	A	1980	1.223	NaN
1	AUS	SOCEXP	PRIV	PC_GDP	A	1981	1.392	NaN
2	AUS	SOCEXP	PRIV	PC_GDP	A	1982	1.678	NaN
3	AUS	SOCEXP	PRIV	PC_GDP	A	1983	1.345	NaN
4	AUS	SOCEXP	PRIV	PC_GDP	A	1984	0.862	NaN

In [5]:
```
social.shape
```

Out[5]: (4106, 8)

In [6]:
```
def netsocialspending(df,country):
    df = df[df["LOCATION"]==country]
    df = df.set_index("TIME")
    df = df[df["MEASURE"] == "PC_GDP"]
    df1 = df[df["SUBJECT"]== "PRIV"]
    df2 = df[df["SUBJECT"] == "PUB"]
    df3 = df1.copy()
    df3["Value"] = df1["Value"] + df2["Value"]
    df3["SUBJECT"] = "Net_Total"

    return df3
```

Here I make a separate dataframe for Japan's Social Spending. Then I make one for Japan's Social Spending in USD per Capita separating the data frame from the Spending in USD per Capita Measure. Finally, I aggregate the Public and Private Social Spending to a yearly data frame from 1980 to 2015 of Total net social spending.

In [7]:
```
JPNSOC = social[social["LOCATION"]=="JPN"]
JPNSOC.head()
```

Out[7]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	TIME	Value	Flag Codes
1658	JPN	SOCEXP	PRIV	PC_GDP	A	1980	0.075	NaN
1659	JPN	SOCEXP	PRIV	PC_GDP	A	1981	0.093	NaN
1660	JPN	SOCEXP	PRIV	PC_GDP	A	1982	0.085	NaN
1661	JPN	SOCEXP	PRIV	PC_GDP	A	1983	0.096	NaN
1662	JPN	SOCEXP	PRIV	PC_GDP	A	1984	0.105	NaN

In [8]:
```
JPNSOC_GDP = JPNSOC[JPNSOC["MEASURE"]== "PC_GDP"]
JPNSOC_GDP.head()
```

Out[8]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	TIME	Value	Flag Codes
1658	JPN	SOCEXP	PRIV	PC_GDP	A	1980	0.075	NaN
1659	JPN	SOCEXP	PRIV	PC_GDP	A	1981	0.093	NaN
1660	JPN	SOCEXP	PRIV	PC_GDP	A	1982	0.085	NaN
1661	JPN	SOCEXP	PRIV	PC_GDP	A	1983	0.096	NaN
1662	JPN	SOCEXP	PRIV	PC_GDP	A	1984	0.105	NaN

In [9]:
```
JPNSOC_GDP.set_index("TIME", inplace = True)
```

In [10]:
```
JPNSOC_GDP.tail(10)
```

Out[10]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
2009	JPN	SOCEXP	PUBNET	PC_GDP	A	20.159	NaN
2011	JPN	SOCEXP	PUBNET	PC_GDP	A	21.481	NaN
2013	JPN	SOCEXP	PUBNET	PC_GDP	A	21.253	NaN
2015	JPN	SOCEXP	PUBNET	PC_GDP	A	20.770	NaN
2005	JPN	SOCEXP	TOTNET	PC_GDP	A	19.204	NaN
2007	JPN	SOCEXP	TOTNET	PC_GDP	A	20.188	NaN
2009	JPN	SOCEXP	TOTNET	PC_GDP	A	23.505	NaN
2011	JPN	SOCEXP	TOTNET	PC_GDP	A	24.768	NaN
2013	JPN	SOCEXP	TOTNET	PC_GDP	A	24.442	NaN
2015	JPN	SOCEXP	TOTNET	PC_GDP	A	23.516	NaN

In [11]:

```
JPNPUB = JPNSOC_GDP[JPNSOC_GDP["SUBJECT"]=="PUB"]
JPNPUB.head()
```

Out[11]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
1980	JPN	SOCEXP	PUB	PC_GDP	A	9.991	NaN
1981	JPN	SOCEXP	PUB	PC_GDP	A	10.427	NaN
1982	JPN	SOCEXP	PUB	PC_GDP	A	10.769	NaN
1983	JPN	SOCEXP	PUB	PC_GDP	A	11.004	NaN
1984	JPN	SOCEXP	PUB	PC_GDP	A	10.871	NaN

In [12]:

```
JPNPRIV = JPNSOC_GDP[JPNSOC_GDP["SUBJECT"]=="PRIV"]
```

In [13]:

```
JPNPRIV.head()
```

Out[13]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
1980	JPN	SOCEXP	PRIV	PC_GDP	A	0.075	NaN
1981	JPN	SOCEXP	PRIV	PC_GDP	A	0.093	NaN
1982	JPN	SOCEXP	PRIV	PC_GDP	A	0.085	NaN
1983	JPN	SOCEXP	PRIV	PC_GDP	A	0.096	NaN
1984	JPN	SOCEXP	PRIV	PC_GDP	A	0.105	NaN

In [14]:

```
JPNTOT = JPNPRIV.copy()
```

In [15]:

```
JPNTOT["Value"] = JPNPUB["Value"] + JPNPRIV["Value"]
JPNTOT["SUBJECT"] = "NET_TOTAL"
```

In [16]:

```
JPNTOT
#This is the cleaned up dataframe for Japan
```

Out[16]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
1980	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	10.066	NaN
1981	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	10.520	NaN
1982	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	10.854	NaN
1983	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.100	NaN
1984	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	10.976	NaN
1985	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	10.956	NaN
1986	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.302	NaN
1987	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.357	NaN
1988	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.056	NaN
1989	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	10.909	NaN
1990	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.086	NaN
1991	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.228	NaN
1992	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	11.839	NaN
1993	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	12.575	NaN
1994	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	13.146	NaN
1995	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	13.787	NaN
1996	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	13.792	NaN
1997	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	16.980	NaN
1998	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	17.861	NaN
1999	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	18.808	NaN
2000	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	18.930	NaN
2001	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	19.954	NaN
2002	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	20.447	NaN
2003	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	19.949	NaN
2004	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	20.012	NaN
2005	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	19.951	NaN
2006	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	20.032	NaN
2007	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	20.942	NaN
2008	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	22.005	NaN
2009	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	24.564	NaN
2010	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	24.732	NaN
2011	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	25.891	NaN

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
2012	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	25.931	NaN
2013	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	25.652	NaN
2014	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	25.145	NaN
2015	JPN	SOCEXP	NET_TOTAL	PC_GDP	A	24.950	NaN

In [17]:

```
def netsocialspending(df,country):
    df = df[df["LOCATION"]==country]
    df = df.set_index("TIME")
    df = df[df["MEASURE"] == "PC_GDP"]
    df1 = df[df["SUBJECT"]== "PRIV"]
    df2 = df[df["SUBJECT"] == "PUB"]
    df3 = df1.copy()
    df3["Value"] = df1["Value"] + df2["Value"]
    df3["SUBJECT"] = "Net_Total"

    return df3
#This function takes the dataframe and specific country and then returns the
```

In [18]:
```
USATOT = netsocialspending(social,"USA")
USATOT
```

Out[18]:

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
1980	USA	SOCEXP	Net_Total	PC_GDP	A	17.584	NaN
1981	USA	SOCEXP	Net_Total	PC_GDP	A	18.342	NaN
1982	USA	SOCEXP	Net_Total	PC_GDP	A	19.244	NaN
1983	USA	SOCEXP	Net_Total	PC_GDP	A	19.631	NaN
1984	USA	SOCEXP	Net_Total	PC_GDP	A	18.983	NaN
1985	USA	SOCEXP	Net_Total	PC_GDP	A	19.153	NaN
1986	USA	SOCEXP	Net_Total	PC_GDP	A	19.560	NaN
1987	USA	SOCEXP	Net_Total	PC_GDP	A	19.749	NaN
1988	USA	SOCEXP	Net_Total	PC_GDP	A	19.823	NaN
1989	USA	SOCEXP	Net_Total	PC_GDP	A	20.396	NaN
1990	USA	SOCEXP	Net_Total	PC_GDP	A	21.035	NaN
1991	USA	SOCEXP	Net_Total	PC_GDP	A	22.337	NaN
1992	USA	SOCEXP	Net_Total	PC_GDP	A	23.278	NaN
1993	USA	SOCEXP	Net_Total	PC_GDP	A	23.513	NaN
1994	USA	SOCEXP	Net_Total	PC_GDP	A	23.465	NaN
1995	USA	SOCEXP	Net_Total	PC_GDP	A	23.640	NaN
1996	USA	SOCEXP	Net_Total	PC_GDP	A	23.740	NaN
1997	USA	SOCEXP	Net_Total	PC_GDP	A	23.376	NaN
1998	USA	SOCEXP	Net_Total	PC_GDP	A	23.519	NaN
1999	USA	SOCEXP	Net_Total	PC_GDP	A	23.442	NaN
2000	USA	SOCEXP	Net_Total	PC_GDP	A	23.626	NaN
2001	USA	SOCEXP	Net_Total	PC_GDP	A	24.426	NaN
2002	USA	SOCEXP	Net_Total	PC_GDP	A	25.685	NaN
2003	USA	SOCEXP	Net_Total	PC_GDP	A	26.160	NaN
2004	USA	SOCEXP	Net_Total	PC_GDP	A	26.070	NaN
2005	USA	SOCEXP	Net_Total	PC_GDP	A	25.910	NaN
2006	USA	SOCEXP	Net_Total	PC_GDP	A	26.258	NaN
2007	USA	SOCEXP	Net_Total	PC_GDP	A	26.700	NaN
2008	USA	SOCEXP	Net_Total	PC_GDP	A	27.224	NaN
2009	USA	SOCEXP	Net_Total	PC_GDP	A	29.369	NaN
2010	USA	SOCEXP	Net_Total	PC_GDP	A	30.891	NaN
2011	USA	SOCEXP	Net_Total	PC_GDP	A	30.687	NaN

	LOCATION	INDICATOR	SUBJECT	MEASURE	FREQUENCY	Value	Flag Codes
TIME							
2012	USA	SOCEXP	Net_Total	PC_GDP	A	30.759	NaN
2013	USA	SOCEXP	Net_Total	PC_GDP	A	30.883	NaN
2014	USA	SOCEXP	Net_Total	PC_GDP	A	31.046	NaN
2015	USA	SOCEXP	Net_Total	PC_GDP	A	31.331	NaN

In [19]:

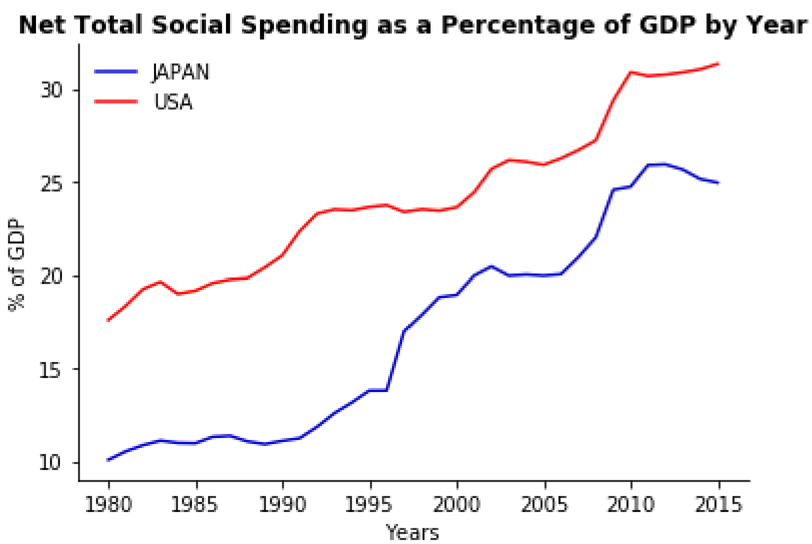
```
USATOT.index
```

Out[19]:

```
Int64Index([1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 199
0,
            1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 200
1,
            2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 201
2,
            2013, 2014, 2015],
           dtype='int64', name='TIME')
```

Section 1: Net Total Social Spending as a Percentage of GDP by Year

In [20]:
```
fig, ax = plt.subplots()
ax.plot(JPNTOT.index, JPNTOT["Value"], color = "mediumblue", label = "JAPAN"
ax.plot(USATOT.index, USATOT["Value"], color = "red", label = "USA")

ax.set_title("Net Total Social Spending as a Percentage of GDP by Year", fon
ax.legend(frameon=False)
ax.spines["top"].set_visible(False)
ax.spines["right"].set_visible(False)

plt.xlabel('Years')
plt.ylabel('% of GDP')
plt.show()
#plt.savefig("SocialSpendingperyear.png", bbox_inches = "tight", dpi = 1200)
```



This graph shows the increase in net total spending on Social Spending of both the United States and Japan from 1980-2015. We can see that around 1980 there was larger gap between the US and Japan in amount of Social Spending as % of GDP. This gap has become smaller in 2015. This smaller gap is due to the increased social spending in Japan that has rapidly caught up with the US.

Now I want to compare how Japan and US's Social Spending compares to other OECD Countries. I want to plot two graphs one that shows the Compounded Annual Growth Rate(CAGR) compared to the the rest of the world and another that shows the mean Social Spending from 1980 to 2015.

To do this I will adjust the first function to give me the mean of several OECD countries Social Spending. Then I will adjust this equation to give me the CAGR of a select number of countries.

In [21]:
```
def meansocialspending(df,country):
    df = df[df["LOCATION"]==country]
    df = df.set_index("TIME")
    df = df[df["MEASURE"] == "PC_GDP"]
    df1 = df[df["SUBJECT"]== "PRIV"]
    df2 = df[df["SUBJECT"] == "PUB"]
    df3 = df1.copy()
    df3["Value"] = df1["Value"] + df2["Value"]
    df3["SUBJECT"] = "Net_Total"

    return df3["Value"].mean()
```

This function will return the mean social spending from 1980 to 2015.

In [22]:
```
meansocialspending(social, "USA")
```

Out[22]:
```
24.189861111111114
```

In [23]:
```
meansocialspending(social, "JPN")
```

Out[23]:
```
16.924583333333334
```

In [24]:
```
meansocialspending(social, "DNK")
```

Out[24]:
```
28.605972222222217
```

In [25]:
```
meansocialspending(social, "FRA")
```

Out[25]:
```
27.9645
```

In [26]:
```
meansocialspending(social, "IRL")
```

Out[26]:
```
19.66063888888889
```

In [27]:
```
meansocialspending(social, "DEU")
```

Out[27]:
```
27.36961111111111
```

In [28]:
```
meansocialspending(social, "CAN")
```

Out[28]:
```
20.910305555555553
```

In [29]:
```
meansocialspending(social, "AUS")
```
Out[29]: 18.26262162162162

In [30]:
```
meansocialspending(social, "ESP")
```
Out[30]: 20.69825

Now I want to adjust this function to give me the CAGR for each of these countries from 1980 to 2015

In [31]:
```
def CAGRsocialspending(df,country, startyr, endyr):
    df = df[df["LOCATION"]==country]
    df = df.set_index("TIME")
    df = df[df["MEASURE"] == "PC_GDP"]
    df1 = df[df["SUBJECT"]== "PRIV"]
    df2 = df[df["SUBJECT"] == "PUB"]
    df3 = df1.copy()
    df3["Value"] = df1["Value"] + df2["Value"]
    df3["SUBJECT"] = "Net_Total"

    CAGR = ((df3.loc[endyr,"Value"]/df3.loc[startyr,"Value"])**(1/(endyr-sta
    # here is my CAGR equation

    return CAGR
```

In [32]:
```
CAGRsocialspending(social,"USA", 1980, 2015)
```
Out[32]: 1.6640322467138091

In [33]:
```
CAGRsocialspending(social,"JPN", 1980, 2015)
```
Out[33]: 2.6273810782927454

In [34]:
```
CAGRsocialspending(social,"DNK", 1980, 2015)
```
Out[34]: 0.8062150325409911

In [35]:
```
CAGRsocialspending(social,"FRA", 1980, 2015)
```
Out[35]: 1.5457587745081103

In [36]:
```
CAGRsocialspending(social,"IRL", 1980, 2015)
```
Out[36]: 0.14298078333527808

In [37]:
```
CAGRsocialspending(social,"DEU", 1980, 2015)
```
Out[37]: 0.3368367392410532

In [38]:
```
CAGRsocialspending(social,"CAN", 1980, 2015)
```
Out[38]: 1.1673487337151567

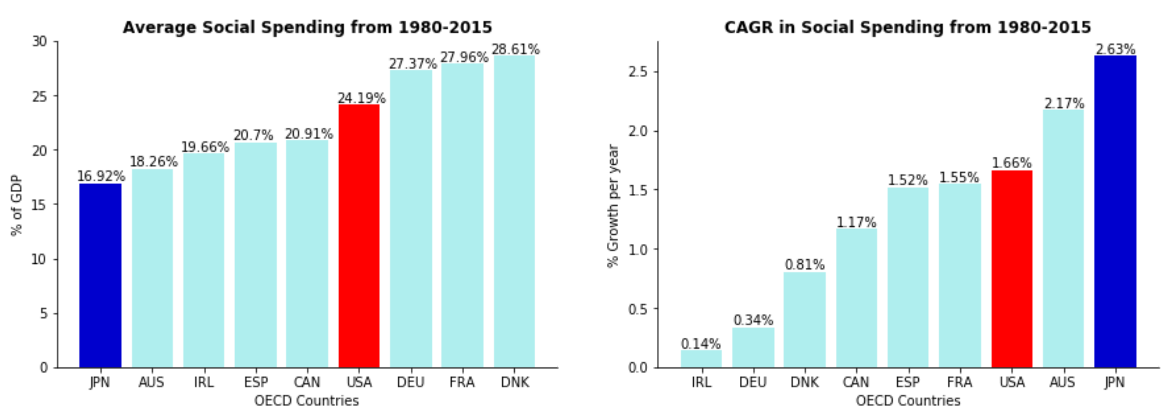
In [39]:
```
CAGRsocialspending(social,"AUS", 1980, 2015)
```
Out[39]: 2.1729377186900045

In [40]:
```
CAGRsocialspending(social,"ESP", 1980, 2015)
```
Out[40]: 1.5216337832978821

Section 1: Social Spending CAGR and Mean Social Spending Among OECD Countries

In [41]:

```
fig = plt.figure(figsize= (15,10))


countriesmean = [meansocialspending(social, "JPN"),meansocialspending(social
numcountries = [1,2,3,4,5,6,7,8,9]
LABELS = ["JPN","AUS","IRL","ESP","CAN","USA","DEU","FRA","DNK"]

ax1 = plt.subplot(2,2,1)
plt.bar(numcountries,countriesmean,color = ["mediumblue","paleturquoise", "p
plt.xticks(numcountries, LABELS)

ax1.set_title("Average Social Spending from 1980-2015", fontsize = 12, fontw
ax1.spines["top"].set_visible(False)
ax1.spines["right"].set_visible(False)

for i, v in enumerate(countriesmean):
    plt.text(numcountries[i] - 0.45, v + 0.19, str(round(v, 2))+"%")
plt.xlabel('OECD Countries')
plt.ylabel('% of GDP')


countries2015 = [CAGRsocialspending(social,"IRL", 1980, 2015),CAGRsocialspen
LABELS2 = ["IRL","DEU","DNK","CAN","ESP","FRA","USA","AUS","JPN"]

ax2 = plt.subplot(2,2,2)
plt.bar(numcountries,countries2015,color = ["paleturquoise", "paleturquoise"
plt.xticks(numcountries, LABELS2)

ax2.set_title("CAGR in Social Spending from 1980-2015",fontsize = 12, fontwe
ax2.spines["top"].set_visible(False)
ax2.spines["right"].set_visible(False)
for i, v in enumerate(countries2015):
    plt.text(numcountries[i] - 0.40, v + 0.02, str(round(v, 2))+"%")
plt.xlabel('OECD Countries')
plt.ylabel('% Growth per year')
#plt.savefig("AVG_SOC.png", bbox_inches = "tight", dpi = 1200)
plt.show()
```



From the graph on the left, we can observe that Japan has had lower average social spending compared to other OECD countries. This is because of Japan's smaller focus on social spending before 2000. The US is around the average of OECD Countries in mean social spending between

1980 and 2015.

If we look at the graph on the right, we observe immediately that Japan's social spending has the largest Compounded Annual Growth Rate. I want to now venture into why Japan's social spending CAGR is so high. The US is again around average for these OECD Countries.

Section 2: Japan and United States Break down of Social Spending and focus on Old Age Social Spending

Now I want to look at what specific factors are affecting the growth in Social Spending. I am now going to use the [Aggregated Social Expenditures Database (https://stats.oecd.org/BrandedView.aspx?oecd_bv_id=socx-data-en)](https://stats.oecd.org/BrandedView.aspx?oecd_bv_id=socx-data-en) from the OECD. I am going to make a pie chart showing what makes up the social expenditures in the United States and Japan.

Here I will directly import the file from my computer.

In [42]:
```
url2 = r"C:\Users\DNRK1\Desktop\DATABOOTCAMP\SOCIAL_EXPENDITURE.csv"
```

In [43]:
```
soc_exp = pd.read_csv(url2)
```

```
C:\Users\DNRK1\Anaconda3\lib\site-packages\IPython\core\interactiveshell.p
y:3020: DtypeWarning: Columns (0) have mixed types. Specify dtype option on
import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
```

In [44]:
```
soc_exp["Source"].unique()
#we need to add Public and Private
```

Out[44]:
```
array(['Public', 'Mandatory private', 'Voluntary private', 'Net Public',
       'Net Total', 'Private (Mandatory and Voluntary)'], dtype=object)
```

In [45]:
```
soc_exp["Measure"].unique()
# We need in percentage of GDP
```

Out[45]:
```
array(['At current prices in national currency, in millions',
       'At constant prices (2010) in national currency, in millions',
       'Per head, at current prices and current PPPs, in US dollars',
       'In percentage of Gross Domestic Product',
       'In percentage of Gross National Income',
       'In percentage of Total General Government Expenditure',
       'Per head, at constant prices (2010) and constant PPPs (2010), in US
dollars',
       'In percentage of Net National Income'], dtype=object)
```

In [46]:
```
soc_exp["Branch"].unique()
```

Out[46]:
```
array(['Old age', 'Survivors', 'Incapacity related', 'Health', 'Family',
       'Active labour market programmes', 'Unemployment', 'Housing',
       'Other social policy areas', 'Total'], dtype=object)
```

Now I am going to clean the database to include only Japan, set index to years, set units to percentage of GDP, filter by total expenditure and total programme.

In [47]:
```
soc_exp.set_index("Year", inplace = True)
```

In [48]:
```
#soc_exp = soc_exp.fillna(0)
```

In [49]:
```
jpnsoc_exp = soc_exp[soc_exp["Country"]=="Japan"]
```

In [50]:
```
jpnsoc_exp_gdp = jpnsoc_exp[jpnsoc_exp["Measure"]=="In percentage of Gross D
jpnsoc_exp_gdp
```

2000	10	Public	1	Old age	1	Cash benefits	112	retire pe
2005	10	Public	1	Old age	1	Cash benefits	112	Old retire pe
2010	10	Public	1	Old age	1	Cash benefits	112	Old retire pe
2015	10	Public	1	Old age	1	Cash benefits	112	Old retire pe

In [51]:
```
jpn1 = jpnsoc_exp_gdp[jpnsoc_exp_gdp["Type of Expenditure"] == "Total"]
```

In [52]:
```
jpn2 = jpn1[jpn1["Type of Programme"]=="Total"]
```

Here I isolate one branch so that I can later scale this process into a function.

In [53]:
```
jpnage= jpn2[jpn2["Branch"] == "Old age"]
```

In [54]:
```
jpn3 = jpnage[jpnage["Source"]== "Public"]
jpn3["Value"].mean()
```

Out[54]: 6.222250000000001

In [55]:
```
jpn4 = jpnage[jpnage["Source"]=="Private (Mandatory and Voluntary)"]
jpn4["Value"].mean()
```

Out[55]: 1.53025

In [56]:
```
jpn5 = jpn3.copy()
```

In [57]:
```
jpn5["Value"] = jpn4["Value"] + jpn3["Value"]
jpn5["Source"] = "Net Total"
jpn5
```

Out[57]:

	SOURCE	Source	BRANCH	Branch	TYPEXP	Type of Expenditure	TYPROG	Type of Programme
Year								
1980	10	Net Total	1	Old age	0	Total	0	Total
1985	10	Net Total	1	Old age	0	Total	0	Total
		Net		Old				

Now I'm going to write a function that inputs a dataframe, a country, a branch of social expenditures('Old age', 'Survivors', 'Incapacity related', 'Health', 'Family','Active labour market programmes', 'Unemployment', 'Housing','Other social policy areas'), and then outputs the average contribution of each Social Expenditure Branch toward the total average social expenditure.

In [58]:
```
def meanbranch(df, country, branch):
    df1 = df[df["Country"]==country]
    df2 = df1[df1["Measure"] == "In percentage of Gross Domestic Product"]
    df3 = df2[df2["Type of Expenditure"] == "Total"]
    df4 = df3[df3["Type of Programme"]== "Total"]
    df5 = df4[df4["Branch"] == branch]
    if branch == "Active labour market programmes":
        df6 = df5[df5["Source"]== "Public"]
        return df6["Value"].mean()
    elif branch == "Unemployment":
        df6 = df5[df5["Source"]== "Public"]
        return df6["Value"].mean()
    elif branch == "Housing":
        df6 = df5[df5["Source"]== "Public"]
        return df6["Value"].mean()
    #there are a lot of else if's because the OECD is missing a lot of data
    #the public domain will suffice.
    elif branch == "Survivors":
        df6 = df5[df5["Source"]== "Public"]
        return df6["Value"].mean()
    elif branch == "Family":
        df6 = df5[df5["Source"]== "Public"]
        return df6["Value"].mean()
    else:
        df6 = df5[df5["Source"]== "Public"]
        df7 = df5[df5["Source"] == "Private (Mandatory and Voluntary)"]

        df8 = df6.copy()
        df8["Value"] = df6["Value"] + df7["Value"]
        df8["Source"] = "Net_Total"
        return df8.iloc[0:8]["Value"].mean()
```

In [59]:
```
meanbranch(soc_exp, "Japan", "Old age")
```

Out[59]: 7.752500000000001

In [60]:
```
meanbranch(soc_exp, "Japan", "Survivors")
```

Out[60]: 1.1155

In [61]:
```
meanbranch(soc_exp, "Japan", "Incapacity related")
```

Out[61]: 0.8533333333333334

In [62]:
```
meanbranch(soc_exp, "Japan", "Health")
```

Out[62]: 6.516

In [63]:
```
meanbranch(soc_exp, "Japan", "Family")
```
Out[63]: 0.71225

In [64]:
```
meanbranch(soc_exp, "Japan", "Active labour market programmes")
```
Out[64]: 0.23433333333333337

In [65]:
```
meanbranch(soc_exp, "Japan", "Unemployment")
```
Out[65]: 0.369

In [66]:
```
meanbranch(soc_exp, "Japan", "Housing")
```
Out[66]: 0.054875

In [67]:
```
meanbranch(soc_exp, "Japan", "Other social policy areas")
```
Out[67]: 0.241

In [68]:
```
branchlist = ['Old age', 'Survivors', 'Incapacity related', 'Health', 'Famil
```

In [69]:
```
jap_mean_list = [meanbranch(soc_exp, "Japan", "Old age"),meanbranch(soc_exp,
```

In [70]:
```
japsummean = meanbranch(soc_exp, "Japan", "Old age")+meanbranch(soc_exp, "Ja
```

In [71]:
```
japsummean
```
Out[71]: 17.848791666666667

Here I add each componenet of social spending into "jap_mean_list" and then sum it

In [72]:
```
meanbranch(soc_exp, "Japan", "Old age")/japsummean
```
Out[72]: 0.4343431278027692

In [73]:
```
jap_pie_list = []

for x in jap_mean_list:
    z = (x/japsummean)
    jap_pie_list.append(z)
#this for loop inputs the mean of the each social spending branch then compu
```

In [74]:
```
jap_pie_list
```

Out[74]:
```
[0.4343431278027692,
 0.06249722787023398,
 0.04780902535419065,
 0.3650667295405151,
 0.03990466208029955,
 0.013128806571873448,
 0.020673668385581656,
 0.003074437812083451,
 0.01350231458245306]
```

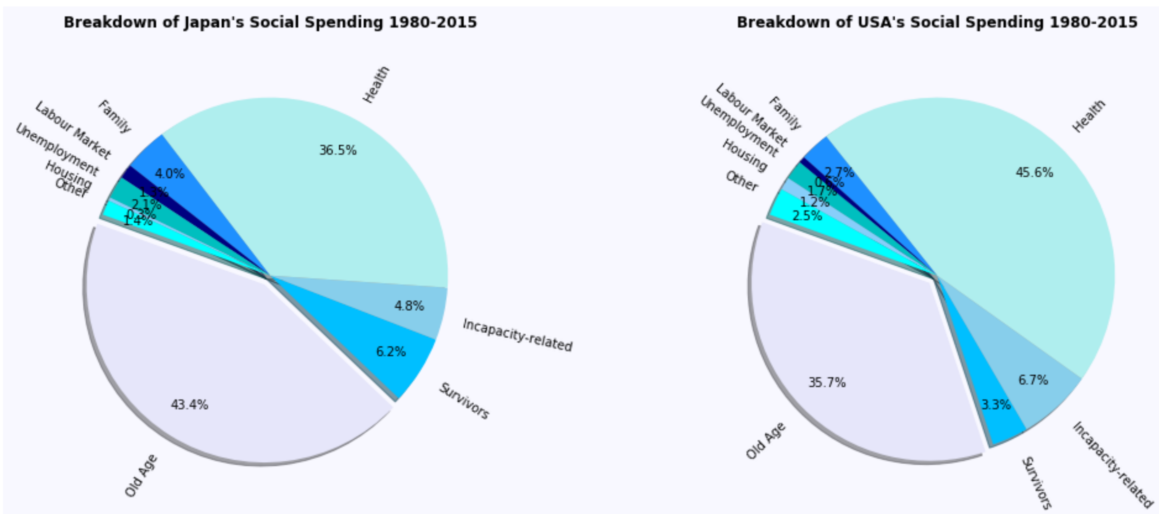
In [75]:
```
USA_mean_list = [meanbranch(soc_exp, "United States", "Old age"),meanbranch(
```

In [76]:
```
USA_mean_list
```

Out[76]:
```
[8.593,
 0.7931999999999999,
 1.6247500000000001,
 10.981375,
 0.6586666666666666,
 0.14125000000000001,
 0.4211111111111116,
 0.2799999999999999,
 0.601875]
```

Section 2: Breakdown of Japan and US's Social Spending 1980-2015

In [77]:
```
fig = plt.figure(figsize= (15,10))
fig.patch.set_facecolor('ghostwhite')
ax1 = fig.add_axes([0, 0, .5, .5], aspect=1)
branches = 'Old Age', 'Survivors', 'Incapacity-related', 'Health', 'Family',
size1 = jap_pie_list
piecolors = ["lavender","deepskyblue","skyblue","paleturquoise","dodgerblue"
pieexplode = (0.06,0,0,0,0,0,0,0,0)
plt.pie(size1 ,explode = pieexplode ,labels = branches,colors = piecolors, a
plt.title("Breakdown of Japan's Social Spending 1980-2015\n", fontsize = 12,

ax2 = fig.add_axes([.5, .0, .5, .5], aspect=1)
size2 = USA_mean_list
plt.pie(size2 ,explode = pieexplode ,labels = branches,colors = piecolors, a
plt.title("Breakdown of USA's Social Spending 1980-2015\n", fontsize = 12, f
#plt.savefig("BreakdownSocialSpending.png", bbox_inches = "tight", dpi = 120

plt.show()
```



From this pie chart, we can see that Social Spending on Old Age programs is the largest part of Japan's social spending at 43.4%. The United States also has high spending on Old Age but Health related social spending is higher. This could be a reason to why Japan's social spending has risen so much.

I now am going to isolate the Old Age related social spending to see how it has moved from 1980-2015.

In [78]:

```
def oldagebranch(df, country, branch):
    df1 = df[df["Country"]==country]
    df2 = df1[df1["Measure"] == "In percentage of Gross Domestic Product"]
    df3 = df2[df2["Type of Expenditure"] == "Total"]
    df4 = df3[df3["Type of Programme"]== "Total"]
    df5 = df4[df4["Branch"] == branch]

    df6 = df5[df5["Source"]== "Public"]
    df7 = df5[df5["Source"] == "Private (Mandatory and Voluntary)"]

    df8 = df6.copy()
    df8["Value"] = df6["Value"] + df7["Value"]
    df8["Source"] = "Net_Total"
    df8 = df8.iloc[0:8]
    return df8
```

In [79]:
```
ja_df = oldagebranch(soc_exp, "Japan", "Old age")
ja_df
```

Out[79]:

	SOURCE	Source	BRANCH	Branch	TYPEXP	Type of Expenditure	TYPROG	Type of Programme	
Year									
1980	10	Net_Total	1	Old age	0	Total	0	Total	PC
1985	10	Net_Total	1	Old age	0	Total	0	Total	PC
1990	10	Net_Total	1	Old age	0	Total	0	Total	PC
1995	10	Net_Total	1	Old age	0	Total	0	Total	PC
2000	10	Net_Total	1	Old age	0	Total	0	Total	PC
2005	10	Net_Total	1	Old age	0	Total	0	Total	PC
2010	10	Net_Total	1	Old age	0	Total	0	Total	PC
2015	10	Net_Total	1	Old age	0	Total	0	Total	PC

8 rows × 22 columns

In [80]:
```
ja_df["Value"]
```

Out[80]:
```
Year
1980     2.934
1985     3.787
1990     4.105
1995     5.313
2000     9.783
2005    10.547
2010    12.929
2015    12.622
Name: Value, dtype: float64
```

In [81]:
```
us_df = oldagebranch(soc_exp, "United States", "Old age")
```

In [82]:
```
us_df["Value"]
```

Out[82]:
```
Year
1980     6.327
1985     7.512
1990     7.566
1995     8.173
2000     8.532
2005     8.663
2010    10.320
2015    11.651
Name: Value, dtype: float64
```

In [83]:
```
jpnCAGR = ((ja_df.iloc[-1]["Value"]/ja_df.iloc[0]["Value"])**(1/35) - 1)*100
jpnCAGR
```

Out[83]:
```
4.256898686837585
```

In [84]:
```
USCAGR = ((us_df.iloc[-1]["Value"]/us_df.iloc[0]["Value"])**(1/35) - 1)*100
USCAGR
```

Out[84]:
```
1.7597785906666719
```

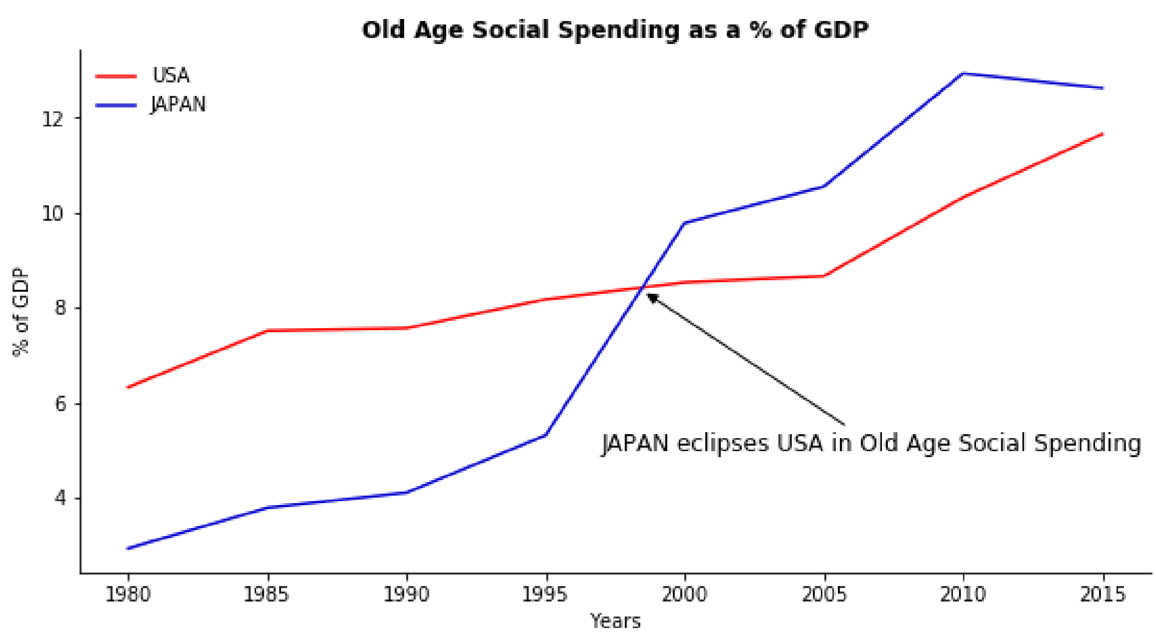
In [85]:
```
CAGRLIST = [USCAGR,jpnCAGR]
CAGRLIST
```

Out[85]:
```
[1.7597785906666719, 4.256898686837585]
```

Section 2: Old Age Social Spending as a % of GDP

In [86]:

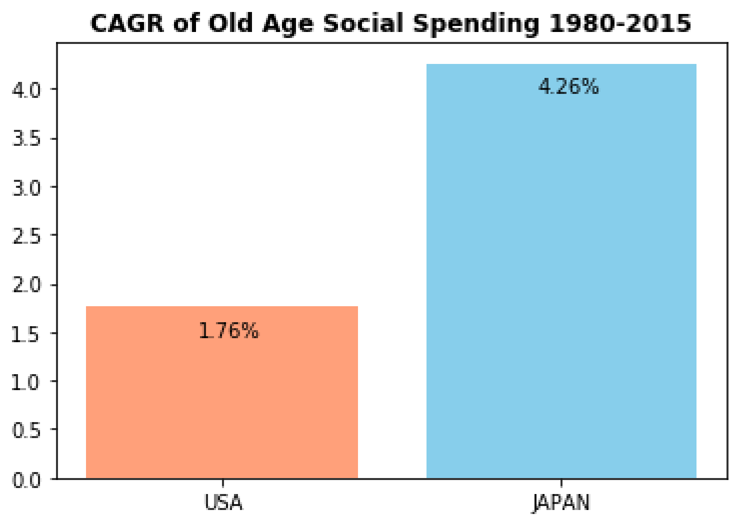
```
fig, ax = plt.subplots(figsize = (10,5))
ax.plot(us_df.index, us_df["Value"], color = "red", label = "USA")
ax.plot(ja_df.index, ja_df["Value"], color = "mediumblue", label = "JAPAN")

ax.set_title("Old Age Social Spending as a % of GDP", fontsize = 12, fontwei
ax.legend(frameon=False)
ax.spines["top"].set_visible(False)
ax.spines["right"].set_visible(False)
plt.xlabel('Years')
plt.ylabel('% of GDP')

ax.annotate(
    "JAPAN eclipses USA in Old Age Social Spending",
    xy=(1998.5, 8.35), # This is where we point at...
    xycoords="data", # Not exactly sure about this
    xytext=(1997, 5), # This is about where the text is
    horizontalalignment="left", # How the text is alined
    arrowprops={
        "arrowstyle": "-|>", # This is stuff about the arrow

        "color": "black"
    },
    fontsize=12,
)

#plt.savefig("OldageSS.png", bbox_inches = "tight", dpi = 1200)
plt.show()
```



We can see that between 1995 and 2000, Japan surpassed the US in Old Age Social Spending. The Japanese Old age social spending has increased from below 4% to over 12% since 1980.

Section 2: CAGR of Old Age Social Spending 1980-2015

In [87]:
```
CAGRLABEL = ["USA","JAPAN"]
num = [1,2]
plt.bar(num,CAGRLIST, color = ["lightsalmon", "skyblue"])
plt.xticks(num, CAGRLABEL)
plt.title("CAGR of Old Age Social Spending 1980-2015", fontsize = 12, fontwe
for i, v in enumerate(CAGRLIST):
    plt.text(num[i] - 0.07, v - 0.3, str(round(v, 2))+"%")
#plt.savefig("CAGROldageSS.png", bbox_inches = "tight", dpi = 1200)
plt.show()
```



The CAGR in Old Age Social Spending was far larger for Japan than the US between 1980 and 2015. This may be a sign that population age increase has caused a large rise in social spending for Japan.

I want to now see how the average medium population at these times have a correlation to the increase in Old Age Social Spending.`

Section 3: Japan and United States Medium Age Trends and Medium Age and Old Age Correlative Analysis

Here I am importing the medium population age dataframe from the [United Nations Population Prospects (https://population.un.org/wpp/Download/Standard/Population/)](https://population.un.org/wpp/Download/Standard/Population/)

In [88]:
```
url3 = "https://population.un.org/wpp/DVD/Files/1_Indicators%20(Standard)/EX
```

In [89]:
```
mediumage = pd.read_excel(url3)
mediumage
```

Out[89]:

	Unnamed: 0	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unn
0	NaN	NaN	NaN	NaN	NaN	
1	NaN	NaN	NaN	NaN	NaN	
2	United Nations	NaN	NaN	NaN	NaN	
3	Population Division	NaN	NaN	NaN	NaN	
4	Department of Economic and Social Affairs	NaN	NaN	NaN	NaN	
5	NaN	NaN	NaN	NaN	NaN	
6	World Population Prospects: The 2017 Revision	NaN	NaN	NaN	NaN	
7	File POP/5: Median age by region, subregion an...	NaN	NaN	NaN	NaN	

In [90]:
```
medium = mediumage.drop([0,1,2,3,4,5,6,7,8,9,10,11,12,13])
medium
```

Out[90]:

	Unnamed: 0	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6
14	Index	Variant	Region, subregion, country or area *	Notes	Country code	1950	1955.000000
15	1	Estimates	WORLD	NaN	900	23.5898	23.143139
16	2	Estimates	More developed regions	a	901	28.4823	28.975673
17	3	Estimates	Less developed regions	b	902	21.452	20.696901
18	4	Estimates	Least developed countries	c	941	19.3646	19.080937

In [91]:
```
medium.columns = medium.iloc[0]
medium
```

Out[91]:

14	Index	Variant	Region, subregion, country or area *	Notes	Country code	1950	1955.0	1960.0
14	Index	Variant	Region, subregion, country or area *	Notes	Country code	1950	1955.000000	1960.000000
15	1	Estimates	WORLD	NaN	900	23.5898	23.143139	22.689060
16	2	Estimates	More developed regions	a	901	28.4823	28.975673	29.536944
17	3	Estimates	Less developed regions	b	902	21.452	20.696901	20.035858
			Least					

In [92]:
```
medium.set_index("Index",inplace = True)
```

In [93]:
```
japmedage = medium[medium["Region, subregion, country or area *"]=="Japan"]
japmedage
```

Out[93]:

14	Variant	Region, subregion, country or area *	Notes	Country code	1950	1955.0	1960.0	1965.0	1970.0	1975.0
Index										
83	Estimates	Japan	NaN	392	22.349	23.582	25.389	27.175	28.776	30.264

In [94]:
```
japtrans = japmedage.T
japtrans
```

Out[94]:

Index	83
14	
Variant	Estimates
Region, subregion, country or area *	Japan
Notes	NaN
Country code	392
1950	22.349
1955.0	23.582
1960.0	25.389
1965.0	27.175
1970.0	28.776
1975.0	30.264
1980.0	32.55
1985.0	35.004
1990.0	37.282
1995.0	39.397
2000.0	41.205
2005.0	43.004
2010.0	44.655
2015.0	46.348

In [95]:
```
japtrans.reset_index(inplace = True)
```

In [96]:
```
japtrans.columns = japtrans.iloc[1]
```

In [97]:
```
japtrans
```

Out[97]:

1	Region, subregion, country or area *	Japan
0	Variant	Estimates
1	Region, subregion, country or area *	Japan
2	Notes	NaN
3	Country code	392
4	1950	22.349
5	1955	23.582
6	1960	25.389
7	1965	27.175
8	1970	28.776
9	1975	30.264
10	1980	32.55

In [98]:
```
japr = japtrans.drop([0,1,2,3,4,5,6,7,8,9])
```

In [99]:
```
japr
```

Out[99]:

1	Region, subregion, country or area *	Japan
10	1980	32.55
11	1985	35.004
12	1990	37.282
13	1995	39.397
14	2000	41.205
15	2005	43.004
16	2010	44.655
17	2015	46.348

In [100]:
```
japr.columns = ["Years","Mediumage"]
```

In [101]:
```
japr.set_index("Years",inplace = True)
```

In [102]:
```
japr["Country"] = "Japan"
```

In [103]:
```
japr.index = japr.index.map(int)
```

In [104]:
```
japr["Mediumage"]
```

Out[104]:
```
Years
1980     32.55
1985    35.004
1990    37.282
1995    39.397
2000    41.205
2005    43.004
2010    44.655
2015    46.348
Name: Mediumage, dtype: object
```

In [105]:
```
def cleanpop(df,Country):
    df = df.drop([0,1,2,3,4,5,6,7,8,9,10,11,12,13])
    df.columns = df.iloc[0]
    df.set_index("Index", inplace = True)
    df1 = df[df["Region, subregion, country or area *"]==Country]
    df2 = df1.T
    df2.reset_index(inplace = True)
    df2.columns = df2.iloc[1]
    df3 = df2.drop([0,1,2,3,4,5,6,7,8,9])
    df3.columns = ["Years","Mediumage"]
    df3.set_index("Years", inplace = True)
    df3.index = df3.index.map(int)
    df3["Country"] = Country
    df3["Mediumage"] = df3.Mediumage.astype(float)

    return df3
```

In [106]:
```
USMED = cleanpop(mediumage, "United States of America")
USMED
```

Out[106]:

	Mediumage	Country
Years		
1980	29.997	United States of America
1985	31.427	United States of America
1990	32.826	United States of America
1995	34.027	United States of America
2000	35.186	United States of America
2005	36.113	United States of America
2010	36.907	United States of America
2015	37.621	United States of America

In [107]:
```
#pretty cool equation to find any medium age from just the name!
JPMED = cleanpop(mediumage, "Japan")
JPMED
```

Out[107]:

	Mediumage	Country
Years		
1980	32.550	Japan
1985	35.004	Japan
1990	37.282	Japan
1995	39.397	Japan
2000	41.205	Japan
2005	43.004	Japan
2010	44.655	Japan
2015	46.348	Japan

In [108]:
```
JPMED["Mediumage"] = JPMED.Mediumage.astype(float)
JPMED["Mediumage"].dtypes
```

Out[108]:
```
dtype('float64')
```

In [109]:
```
JP_MA_ARRAY = np.array(JPMED["Mediumage"])
JP_MA_ARRAY
```

Out[109]:
```
array([32.55 , 35.004, 37.282, 39.397, 41.205, 43.004, 44.655, 46.348])
```

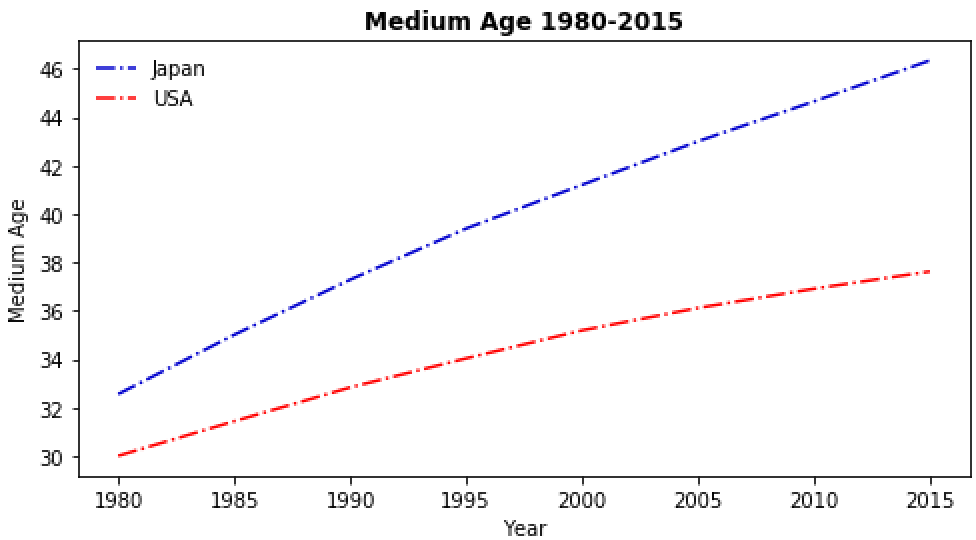
In [110]:
```
US_MA_ARRAY = np.array(USMED["Mediumage"])
US_MA_ARRAY
```

Out[110]:
```
array([29.997, 31.427, 32.826, 34.027, 35.186, 36.113, 36.907, 37.621])
```

Section 3: Medium Age from 1980 to 2015

In [111]:

```
ax1 = plt.figure(figsize = (8,4))
ax1 = fig.add_axes([0, 0, .6, .5], aspect= 1)
plt.plot(JPMED.index ,JP_MA_ARRAY, color = "mediumblue", label = "Japan", li
plt.plot(USMED.index, US_MA_ARRAY, color = "red", label = "USA", linestyle =
plt.legend(frameon=False)
plt.title("Medium Age 1980-2015", fontsize = 12, fontweight = "bold")
ax1.spines["top"].set_visible(False)
ax1.spines["right"].set_visible(False)
plt.xlabel('Year')
plt.ylabel('Medium Age')
#plt.savefig("medage.png", bbox_inches = "tight", dpi = 1200)
plt.show()
```



This shows that Japan's medium age has steadily increased since 1980 at a pace afaster than the US. Japan has had a sharp increase in Medium age, beginning over 32 years old in 1980 and now over 46 years old in 2015. The US has also increased from around 30 years old to over 36 in 2015.

I now want to see how the increase in medium age correlates to social spending for the countries.

In [112]:

```
def anybranch(df, country, branch):
    df1 = df[df["Country"]==country]
    df2 = df1[df1["Measure"] == "In percentage of Gross Domestic Product"]
    df3 = df2[df2["Type of Expenditure"] == "Total"]
    df4 = df3[df3["Type of Programme"]== "Total"]
    df5 = df4[df4["Branch"] == branch]

    df6 = df5[df5["Source"]== "Public"]
    df7 = df5[df5["Source"] == "Private (Mandatory and Voluntary)"]

    df8 = df6.copy()
    df8["Value"] = df6["Value"] + df7["Value"]
    df8["Source"] = "Net_Total"
    df8 = df8.iloc[0:8]
    df9 = df8.drop(columns=["COUNTRY","SOURCE","BRANCH","TYPEXP","Type of Ex
    return df9
```

In [113]:

```
JPSS = anybranch(soc_exp, "Japan", "Old age")
JPSS
```

Out[113]:

	Source	Branch	UNIT	Country	Value
Year					
1980	Net_Total	Old age	PCT_GDP	Japan	2.934
1985	Net_Total	Old age	PCT_GDP	Japan	3.787
1990	Net_Total	Old age	PCT_GDP	Japan	4.105
1995	Net_Total	Old age	PCT_GDP	Japan	5.313
2000	Net_Total	Old age	PCT_GDP	Japan	9.783
2005	Net_Total	Old age	PCT_GDP	Japan	10.547
2010	Net_Total	Old age	PCT_GDP	Japan	12.929
2015	Net_Total	Old age	PCT_GDP	Japan	12.622

In [114]:
```
USSS = anybranch(soc_exp, "United States", "Old age")
USSS
```

Out[114]:

Year	Source	Branch	UNIT	Country	Value
1980	Net_Total	Old age	PCT_GDP	United States	6.327
1985	Net_Total	Old age	PCT_GDP	United States	7.512
1990	Net_Total	Old age	PCT_GDP	United States	7.566
1995	Net_Total	Old age	PCT_GDP	United States	8.173
2000	Net_Total	Old age	PCT_GDP	United States	8.532
2005	Net_Total	Old age	PCT_GDP	United States	8.663
2010	Net_Total	Old age	PCT_GDP	United States	10.320
2015	Net_Total	Old age	PCT_GDP	United States	11.651

In [115]:
```
us_va_array = np.array(USSS["Value"])
us_va_array
```

Out[115]:
```
array([ 6.327,  7.512,  7.566,  8.173,  8.532,  8.663, 10.32 , 11.651])
```

I make Arrays here so I can run the Numpy correlation coefficient equation

In [116]:
```
jp_va_array = np.array(JPSS["Value"])
jp_va_array
```

Out[116]:
```
array([ 2.934,  3.787,  4.105,  5.313,  9.783, 10.547, 12.929, 12.622])
```

In [117]:
```
np.corrcoef(JP_MA_ARRAY,jp_va_array)
```

Out[117]:
```
array([[1.        , 0.95505619],
       [0.95505619, 1.        ]])
```

In [118]:
```
np.corrcoef(US_MA_ARRAY,us_va_array)
```

Out[118]:
```
array([[1.        , 0.91846898],
       [0.91846898, 1.        ]])
```

Now, I need an equation to plot a linear regression of these two data points. I use this [source (https://stackoverflow.com/questions/22239691/code-for-best-fit-straight-line-of-a-scatter-plot-in-python)](https://stackoverflow.com/questions/22239691/code-for-best-fit-straight-line-of-a-scatter-plot-in-python) to help me

In [119]:
```
def linearreg(dataX, dataY):
    #ybar = m(xbar) + b
    xbar = sum(dataX)/len(dataX)
    ybar = sum(dataY)/len(dataY)
    n = len(dataX)
    top = 0
    top = sum([xi*yi for xi,yi in zip(dataX,dataY)]) - n*xbar*ybar
    bot = sum([xi**2 for xi in dataX]) - n * xbar**2
    m = top/bot
    b = ybar - m * xbar
    return m, b
```

In [120]:
```
j_m,j_b = linearreg(JP_MA_ARRAY,jp_va_array)
```

In [121]:
```
u_m, u_b = linearreg(US_MA_ARRAY,us_va_array)
```

In [122]:
```
j_yfit = [j_b + j_m*xi for xi in JP_MA_ARRAY]
j_yfit
```

Out[122]:
```
[1.643508063786964,
 3.674700030790678,
 5.560215638302683,
 7.310815071967259,
 8.807308583109357,
 10.296352734959267,
 11.662896311782067,
 13.064203565301742]
```

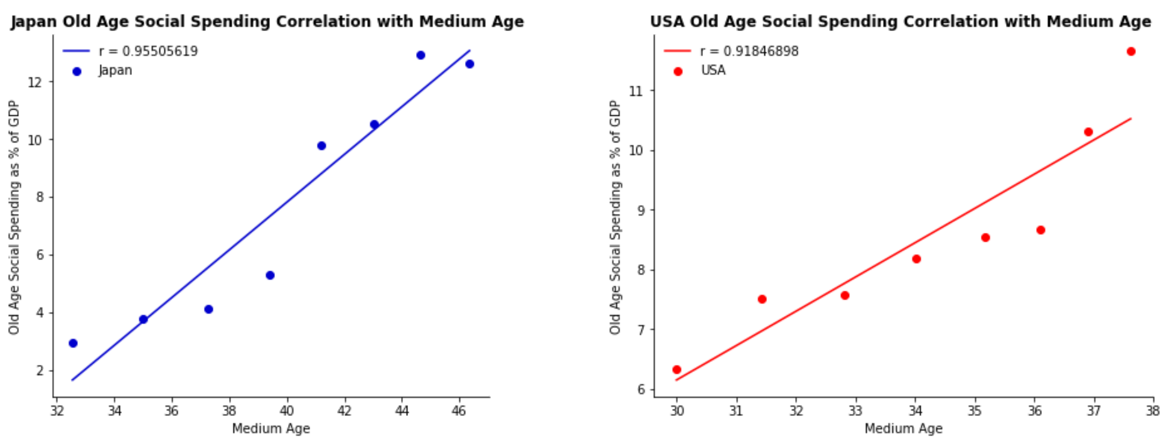
In [123]:
```
u_yfit = [u_b +u_m*xi for xi in US_MA_ARRAY]
u_yfit
```

Out[123]:
```
[6.14458022197465,
 6.965311652489476,
 7.768251003042096,
 8.45755061706189,
 9.122744832423205,
 9.6547854170996,
 10.11049223935748,
 10.5202840165516]
```

Section 3: Linear Regression of Medium Age and Old Age Social Spending

In [124]:

```
fig= plt.figure(figsize = (10,8))


ax1 = fig.add_axes([0, 0, .6, .5], aspect=1)
plt.scatter(JP_MA_ARRAY, jp_va_array, color = "mediumblue", label = "Japan")
plt.plot(JP_MA_ARRAY,j_yfit, color = "mediumblue",label = "r = 0.95505619")
plt.title("Japan Old Age Social Spending Correlation with Medium Age ", font
ax1.spines["top"].set_visible(False)
ax1.spines["right"].set_visible(False)
plt.xlabel('Medium Age')
plt.ylabel('Old Age Social Spending as % of GDP')
plt.legend(frameon=False)

ax2 = fig.add_axes([.7,.0,.6,.5], aspect = 1)
plt.scatter(US_MA_ARRAY, us_va_array, color = "red", label = "USA")
plt.plot(US_MA_ARRAY,u_yfit, color = "r", label  = "r = 0.91846898")
plt.title("USA Old Age Social Spending Correlation with Medium Age ", fontsi
ax2.spines["top"].set_visible(False)
ax2.spines["right"].set_visible(False)
plt.xlabel('Medium Age')
plt.ylabel('Old Age Social Spending as % of GDP')
plt.legend(frameon=False)
#plt.savefig("OldageregressionSS.png", bbox_inches = "tight", dpi = 1200)
plt.show()
```



The correlation for increasing Medium Age with Old Age Social spending in Japan is incredibly high at a correlation coefficient of r = 0.955. From this basic information, we can begin making a hypothesis about increasing medium age as a factor of social spending. The US similarly has a large correlation coefficient at r = 0.918. Although we do not have enough data to make a solid claim about medium age as a coefficient for increased Old Age Social Spending, we can at least hypothesize that it is a large factor.

Conclusion:

In this project, I analyzed the general social spending behavior of OECD countries to narrow down large factors within social spending. I learned that Old Age related social spending is the largest social spending component for Japan and the second largest for the US. From this, I hypothesized that Japan's Old Age Social Spending may be higher because of a higher medium age. I tested this in a linear regression and it turns out the Japan's old age social spending has a higher correlation with a higher medium age than does the US's. This report functions as an initial insight into a larger issue stemming from the projected growth of social spending. In the future, social spending in the US is expected to run the US into a deep Fiscal Deficit. This report hopefully provided an initial insight into how the US could potentially learn from Japan's population issue, which is expected to become an issue for the US.