Shagun Varma Final Project - The Six-Year Itch

In [1]:
```
import pandas as pd
import numpy as np                          # numerical analysis
import matplotlib as mpl
import matplotlib.pyplot as plt             # plotting
import matplotlib.patches as mpatches       # to make ellipses
import datetime as dt                       # date adjustments
```

In [2]:
```
# Reading in the stock price, VIX, CPI, S&P 500 returns, and President dates f
rom my GitHub repository

path = "https://github.com/shagunvarma27/data_bootcamp_final_project/blob/mast
er/data/"
cpi_path = "CPI-U_base82-84.xlsx?raw=true"
gspc_path = "GSPC.csv?raw=true"
ixic_path = "IXIC.csv?raw=true"
dji_path = "DJI.csv?raw=true"
pres_path = "Presidents.xlsx?raw=true"
gspc_ret_path = "GSPC_ret.csv?raw=true"
vix_path = "VIX.csv?raw=true"

cpi = pd.read_excel(path + cpi_path)                    # CPI, base 1982-84
gspc = pd.read_csv(path + gspc_path)                    # S&P 500
ixic = pd.read_csv(path + ixic_path)                    # NASDAQ Composite
dji = pd.read_csv(path + dji_path)                      # Dow Jones Industrial A
verage
pres = pd.read_excel(path + pres_path)                  # Presidential inaugurat
ion dates
gspc_ret = _path = pd.read_csv(path + gspc_ret_path)  # S&P 500 Annual Returns
vix = pd.read_csv(path + vix_path)                      # VIX
```

In [3]:
```
gspc.head()
```

Out[3]:

	Date	Open	High	Low	Close	Adj Close	Volume	Stock
0	1/3/1961	57.570000	57.570000	57.570000	57.570000	57.570000	2770000	GSPC
1	1/4/1961	58.360001	58.360001	58.360001	58.360001	58.360001	3840000	GSPC
2	1/5/1961	58.570000	58.570000	58.570000	58.570000	58.570000	4130000	GSPC
3	1/6/1961	58.400002	58.400002	58.400002	58.400002	58.400002	3620000	GSPC
4	1/9/1961	58.810001	58.810001	58.810001	58.810001	58.810001	4210000	GSPC

Graph 1 - President Terms and Stock Prices

In [4]:
```
# Only keep the date, close and stock name

stocks = [dji, gspc, ixic]

for df in stocks:
    df.drop(["Open", "High", "Low", "Adj Close", "Volume"], axis = 1, inplace
= True)

gspc.head()
```

Out[4]:

	Date	Close	Stock
0	1/3/1961	57.570000	GSPC
1	1/4/1961	58.360001	GSPC
2	1/5/1961	58.570000	GSPC
3	1/6/1961	58.400002	GSPC
4	1/9/1961	58.810001	GSPC

In [5]:
```
# To check whether my dates for the stock data are in the correct datetime for
mat

gspc.dtypes
```

Out[5]:
```
Date      object
Close    float64
Stock     object
dtype: object
```

In [6]:
```
# Since the date is in the incorrect format, convert it to datetime

for df in stocks:
    df["Date"] = pd.to_datetime(df['Date'])

gspc.dtypes
```

Out[6]:
```
Date     datetime64[ns]
Close           float64
Stock            object
dtype: object
```

In [7]:
```
# Setting the date as the index for the stock data

for df in stocks:
    df.set_index('Date', inplace = True)
```

In [8]:
```
# Resampling stock price data to the first day of the month

gspc_m = gspc.resample('MS').mean()
ixic_m = ixic.resample('MS').mean()
dji_m = dji.resample('MS').mean()

gspc_m.head()
```

Out[8]:

Date	Close
1961-01-01	59.726191
1961-02-01	62.172631
1961-03-01	64.089090
1961-04-01	65.934000
1961-05-01	66.499048

In [9]:
```
# Moving on to cleaning CPI data

cpi.dtypes
```

Out[9]:
```
Date     object
CPI     float64
dtype: object
```

In [10]:
```
# Changing CPI date to datetime format

cpi["Date"] =  pd.to_datetime(cpi['Date'])
cpi.set_index('Date', inplace = True)

cpi.head()
```

Out[10]:

Date	CPI
1961-01-01	29.8
1961-02-01	29.8
1961-03-01	29.8
1961-04-01	29.8
1961-05-01	29.8

In [11]:
```
# Merge CPI and stock data on the same table for inflation-adjustment calculat
ions
# We get NaN because CPI data is unavailable for the most recent months.

gspc_cpi = gspc_m.join(cpi)
ixic_cpi = ixic_m.join(cpi)
dji_cpi = dji_m.join(cpi)

gspc_cpi.tail()
```

Out[11]:

Date	Close	CPI
2019-01-01	2607.389997	251.712
2019-02-01	2754.864206	252.776
2019-03-01	2803.983794	254.202
2019-04-01	2903.799979	NaN
2019-05-01	2928.963298	NaN

In [12]:
```
# Creating the CPI Multiplier, adjusted to 2019-03-01 prices

stocks_cpi = [dji_cpi, gspc_cpi, ixic_cpi]

for df in stocks_cpi:
    df["CPI_Multiplier"] = df["CPI"].iloc[-3]/df["CPI"]

gspc_cpi.tail()
```

Out[12]:

Date	Close	CPI	CPI_Multiplier
2019-01-01	2607.389997	251.712	1.009892
2019-02-01	2754.864206	252.776	1.005641
2019-03-01	2803.983794	254.202	1.000000
2019-04-01	2903.799979	NaN	NaN
2019-05-01	2928.963298	NaN	NaN

In [13]:
```
# Adjusting prices for inflation

for df in stocks_cpi:
    df["infl_adj"] = df["Close"]*df["CPI_Multiplier"]

gspc_cpi.tail()
```

Out[13]:

Date	Close	CPI	CPI_Multiplier	infl_adj
2019-01-01	2607.389997	251.712	1.009892	2633.182971
2019-02-01	2754.864206	252.776	1.005641	2770.405383
2019-03-01	2803.983794	254.202	1.000000	2803.983794
2019-04-01	2903.799979	NaN	NaN	NaN
2019-05-01	2928.963298	NaN	NaN	NaN

In [14]:
```
# Setting up President inauguration date table

pres.set_index("President", inplace = True)
pres
```

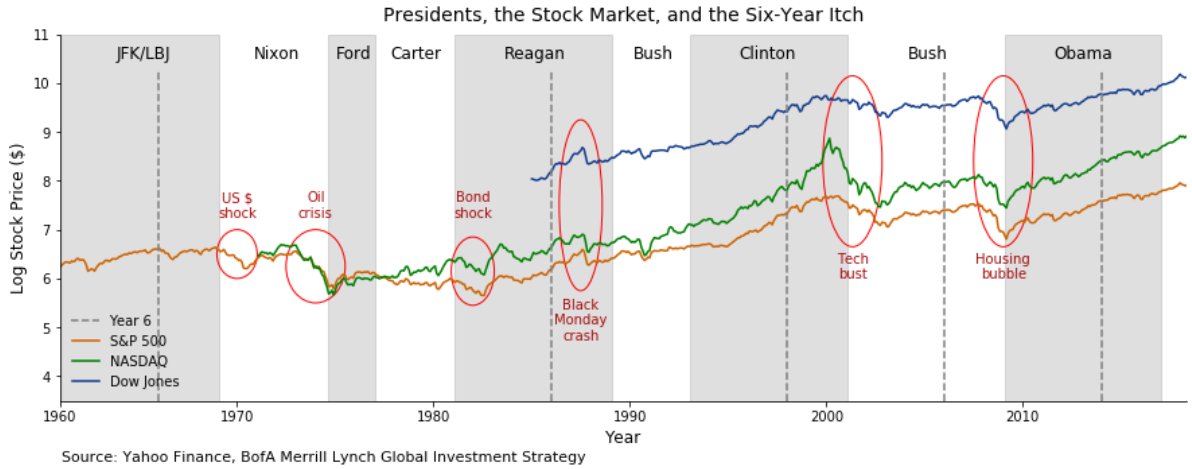
Out[14]:

President	Date
John F. Kennedy	1961-01-20
Lyndon B. Johnson	1963-11-22
Richard M. Nixon	1969-01-20
Gerald R. Ford	1974-08-09
Jimmy Carter	1977-01-20
Ronald Reagan	1981-01-20
George Bush	1989-01-20
William J. Clinton	1993-01-20
George W. Bush	2001-01-20
Barack Obama	2009-01-20
Donald J. Trump	2017-01-20

In [15]:
```
# Creating the first graph

fig, ax = plt.subplots(figsize = (15,5))

# Graph title
ax.set_title("Presidents, the Stock Market, and the Six-Year Itch",
             fontsize = 14, pad = 10)

# Setting graph axis limits
ax.set_xlim((pres["Date"].loc["John F. Kennedy"]), dt.datetime(2018, 5, 1))
ax.set_xticks([dt.datetime(1960,12,30), dt.datetime(1970,1,1), dt.datetime(198
0,1,1),
               dt.datetime(1990,1,1), dt.datetime(2000,1,1), dt.datetime(2010,
1,1)])
ax.set_ylim(3.5,11)

# Axis titles
ax.set_xlabel("Year", fontsize = 12)
ax.set_ylabel("Log Stock Price ($)", fontsize = 12)

# Plotting the log of the three inflation-adjusted stock prices
ax.plot(gspc_cpi.index, np.log(gspc_cpi["infl_adj"]), color = '#CE6300')
ax.plot(ixic_cpi.index, np.log(ixic_cpi["infl_adj"]), color = 'g')
ax.plot(dji_cpi.index, np.log(dji_cpi["infl_adj"]), color = '#133D8D')

# Getting rid of the top and right spines
ax.spines["top"].set_visible(False)
ax.spines["right"].set_visible(False)

# Setting the legend
stock_labels = ["S&P 500", "NASDAQ", "Dow Jones"]
ax.axhline(5.15, xmin = 0.01, xmax = 0.035, linestyle = '--', color = 'grey')
ax.annotate("Year 6", xy=(dt.datetime(1963,7,1), 5.05), xytext=(dt.datetime(19
63,7,1), 5.05))
ax.legend(labels = stock_labels, loc = 3, frameon = False)

# Adding grey shading for President terms
ax.axvspan((pres["Date"].loc["John F. Kennedy"]), pres["Date"].loc["Richard M.
Nixon"],
           alpha = 0.25, color = 'grey')
ax.axvspan((pres["Date"].loc["Gerald R. Ford"]), pres["Date"].loc["Jimmy Carte
r"],
           alpha = 0.25, color = 'grey')
ax.axvspan((pres["Date"].loc["Ronald Reagan"]), pres["Date"].loc["George Bush"
],
           alpha = 0.25, color = 'grey')
ax.axvspan((pres["Date"].loc["William J. Clinton"]), pres["Date"].loc["George
 W. Bush"],
           alpha = 0.25, color = 'grey')
ax.axvspan((pres["Date"].loc["Barack Obama"]), pres["Date"].loc["Donald J. Tru
mp"],
           alpha = 0.25, color = 'grey')

# Dotted line in the 6th year
ax.axvline(dt.datetime(1966,1,1), ymax = 0.9, linestyle = '--', color = 'grey'
)
```

```
ax.axvline(dt.datetime(1986,1,1), ymax = 0.9, linestyle = '--', color = 'grey'
)
ax.axvline(dt.datetime(1998,1,1), ymax = 0.9, linestyle = '--', color = 'grey'
)
ax.axvline(dt.datetime(2006,1,1), ymax = 0.9, linestyle = '--', color = 'grey'
)
ax.axvline(dt.datetime(2014,1,1), ymax = 0.9, linestyle = '--', color = 'grey'
)

# Adding President names
ax.annotate("JFK/LBJ", xy=(dt.datetime(1963,11,1), 10.5), xytext=(dt.datetime(
1963,11,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Nixon", xy=(dt.datetime(1970,11,1), 10.5), xytext=(dt.datetime(19
70,11,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Ford", xy=(dt.datetime(1975,1,1), 10.5), xytext=(dt.datetime(1975
,1,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Carter", xy=(dt.datetime(1977,11,1), 10.5), xytext=(dt.datetime(1
977,11,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Reagan", xy=(dt.datetime(1983,8,1), 10.5), xytext=(dt.datetime(19
83,8,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Bush", xy=(dt.datetime(1990,3,1), 10.5), xytext=(dt.datetime(1990
,3,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Clinton", xy=(dt.datetime(1995,8,1), 10.5), xytext=(dt.datetime(1
995,8,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Bush", xy=(dt.datetime(2004,3,1), 10.5), xytext=(dt.datetime(2004
,3,1), 10.5),
            color = 'k', fontsize = 12)
ax.annotate("Obama", xy=(dt.datetime(2011,8,1), 10.5), xytext=(dt.datetime(201
1,8,1), 10.5),
            color = 'k', fontsize = 12)

# Add circles for market crashes
from matplotlib.patches import Ellipse
    # US $ shock
ax.add_artist(Ellipse((dt.datetime(1970,1,1), 6.5), 750, 1, color = 'r', fill
= False))
ax.annotate("US $\nshock", xy=(dt.datetime(1970,1,1), 7.25), xytext=(dt.dateti
me(1970,1,1), 7.25),
            color = '#A80D0D', ha = 'center')
    # Oil crisis
ax.add_artist(Ellipse((dt.datetime(1974,1,1), 6.25), 1100, 1.5, color = 'r', f
ill = False))
ax.annotate("Oil\ncrisis", xy=(dt.datetime(1974,1,1), 7.25), xytext=(dt.dateti
me(1974,1,1), 7.25),
            color = '#A80D0D', ha = 'center')
    # Bond shock
ax.add_artist(Ellipse((dt.datetime(1982,1,1), 6.15), 800, 1.4, color = 'r', fi
ll = False))
ax.annotate("Bond\nshock", xy=(dt.datetime(1982,1,1), 7.25), xytext=(dt.dateti
me(1982,1,1), 7.25),
```

```
            color = '#A80D0D', ha = 'center')
    # Black Monday crash
ax.add_artist(Ellipse((dt.datetime(1987,7,1), 7.5), 800, 3.5, color = 'r', fil
l = False))
ax.annotate("Black\nMonday\ncrash", xy=(dt.datetime(1987,7,1), 4.75), xytext=(
dt.datetime(1987,7,1), 4.75),
            color = '#A80D0D', ha = 'center')
    # Tech bust
ax.add_artist(Ellipse((dt.datetime(2001,5,1), 8.4), 1100, 3.5, color = 'r', fi
ll = False))
ax.annotate("Tech\nbust", xy=(dt.datetime(2001,5,1), 6), xytext=(dt.datetime(2
001,5,1), 6),
            color = '#A80D0D', ha = 'center')
    # Housing bubble
ax.add_artist(Ellipse((dt.datetime(2009,1,1), 8.4), 1100, 3.5, color = 'r', fi
ll = False))
ax.annotate("Housing\nbubble", xy=(dt.datetime(2000,1,1), 6), xytext=(dt.datet
ime(2009,1,1), 6),
            color = '#A80D0D', ha = 'center')

# Adding text below the graph
ax.text(dt.datetime(1961,1,20), 2.25, "Source: Yahoo Finance, BofA Merrill Lyn
ch Global Investment Strategy",
        fontsize = 11)

plt.savefig("Presidents, the Stock Market, and the Six-Year Itch.jpg", bbox_in
ches = "tight", dpi = 1200)

plt.show()
```



We see that for Reagan, Clinton and Bush, the stock market crashes fall after the 6-Year mark. This is in line with the six-year itch theory. However, there are instances where stock market crashes do not align with the theory. Reagan faced a Bond shock at the start of his presidency, and the stock market prices during the Obama presidency only went up. Moreover, the stock market crashes that "fit" the six-year itch theory are not entirely policy-related.

Furthermore, such a graph can be misleading. For instance, the mild 8-month recession during George H.W. Bush's presidency is not marked here. He did not get a second term because of slow economic growth during his presidency.

It may instead be more helpful to look at stock market returns by year of presidency instead of stock prices.

Graph 2 - President Terms and Stock Returns

In [16]:
```
# Moving on to S&P 500 returns

gspc_ret.head()
```

Out[16]:

	Year	Return
0	2018	-4.38
1	2017	21.83
2	2016	11.96
3	2015	1.38
4	2014	13.69

In [17]:
```
# Converting year to datetime format

gspc_ret.set_index("Year", inplace = True)
gspc_ret.index = pd.to_datetime(gspc_ret.index, format = '%Y')
gspc_ret.index = gspc_ret.index.to_period('A').to_timestamp('A')
gspc_ret.sort_values(by = "Year", ascending = True, inplace = True)

gspc_ret.head()
```

Out[17]:

	Return
Year	
1926-12-31	11.62
1927-12-31	37.49
1928-12-31	43.61
1929-12-31	-8.42
1930-12-31	-24.90

In [18]:
```
# Drop data points before 1961

gspc_ret = gspc_ret.loc[(gspc_ret.index > dt.datetime(1960,12,31))]
gspc_ret.head()
```

Out[18]:

Year	Return
1961-12-31	26.89
1962-12-31	-8.73
1963-12-31	22.80
1964-12-31	16.48
1965-12-31	12.45

In [19]:
```
# Adjusting CPI dates to make them annual and end of year

cpi.index = cpi.index.to_period('M').to_timestamp('M')
cpi_annual = cpi.resample('A').last()
cpi_annual.head()
```

Out[19]:

Date	CPI
1961-12-31	30.0
1962-12-31	30.4
1963-12-31	30.9
1964-12-31	31.2
1965-12-31	31.8

In [20]:
```
# Merge CPI and return data into one table

gspc_ret_cpi = gspc_ret.join(cpi_annual)
gspc_ret_cpi.head()
```

Out[20]:

Year	Return	CPI
1961-12-31	26.89	30.0
1962-12-31	-8.73	30.4
1963-12-31	22.80	30.9
1964-12-31	16.48	31.2
1965-12-31	12.45	31.8

In [21]:
```
# Calculating the inflation rate

gspc_ret_cpi["infl_rate"] = gspc_ret_cpi["CPI"].diff()/gspc_ret_cpi["CPI"].shi
ft()

# Adjust returns for inflation using formula
# Formula from: https://www.investopedia.com/terms/i/inflation_adjusted_retur
n.asp

gspc_ret_cpi['infl_adj'] = ((1 + gspc_ret_cpi["Return"])/(1 + gspc_ret_cpi["in
fl_rate"])) - 1
gspc_ret_cpi.tail()
```

Out[21]:

Year	Return	CPI	infl_rate	infl_adj
2014-12-31	13.69	234.812	0.007565	13.579706
2015-12-31	1.38	236.525	0.007295	1.362763
2016-12-31	11.96	241.432	0.020746	11.696594
2017-12-31	21.83	246.524	0.021091	21.358442
2018-12-31	-4.38	251.233	0.019102	-4.316647

In [22]:
```
# Making President data end of year to match with returns dates

pres2 = pres.copy()
pres2.reset_index(inplace = True)
pres2.set_index("Date", inplace = True)
pres2.index = pres2.index.to_period('A').to_timestamp('A')
pres2
```

Out[22]:

Date	President
1961-12-31	John F. Kennedy
1963-12-31	Lyndon B. Johnson
1969-12-31	Richard M. Nixon
1974-12-31	Gerald R. Ford
1977-12-31	Jimmy Carter
1981-12-31	Ronald Reagan
1989-12-31	George Bush
1993-12-31	William J. Clinton
2001-12-31	George W. Bush
2009-12-31	Barack Obama
2017-12-31	Donald J. Trump

In [23]:
```
# Merging President and returns data

year1 = pres2.join(gspc_ret_cpi)
year1.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year1
```

Out[23]:

Date	President	infl_adj
1961-12-31	John F. Kennedy	NaN
1963-12-31	Lyndon B. Johnson	22.414887
1969-12-31	Richard M. Nixon	-8.062334
1974-12-31	Gerald R. Ford	-23.672717
1977-12-31	Jimmy Carter	-6.791884
1981-12-31	Ronald Reagan	-4.589713
1989-12-31	George Bush	30.238263
1993-12-31	William J. Clinton	9.783621
2001-12-31	George W. Bush	-11.723599
2009-12-31	Barack Obama	25.732520
2017-12-31	Donald J. Trump	21.358442

In [24]:
```
# Creating a dates table for year 2

year2_dates = pres2.copy()
year2_dates.reset_index(inplace = True)

# Adding a year to the year 1 date for year 2

year2_dates["Date_2"] = year2_dates["Date"] - pd.DateOffset(years=-1)
year2_dates.set_index("Date_2", inplace = True)
year2_dates.drop(["Date",], axis = 1, inplace = True)
year2_dates
```

Out[24]:

Date_2	President
1962-12-31	John F. Kennedy
1964-12-31	Lyndon B. Johnson
1970-12-31	Richard M. Nixon
1975-12-31	Gerald R. Ford
1978-12-31	Jimmy Carter
1982-12-31	Ronald Reagan
1990-12-31	George Bush
1994-12-31	William J. Clinton
2002-12-31	George W. Bush
2010-12-31	Barack Obama
2018-12-31	Donald J. Trump

In [25]:
```
# Merge with returns data

year2 = year2_dates.join(gspc_ret_cpi)
year2.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year2
```

Out[25]:

Date_2	President	infl_adj
1962-12-31	John F. Kennedy	-8.628289
1964-12-31	Lyndon B. Johnson	16.311923
1970-12-31	Richard M. Nixon	3.745653
1975-12-31	Gerald R. Ford	34.722162
1978-12-31	Jimmy Carter	5.934653
1982-12-31	Ronald Reagan	20.718238
1990-12-31	George Bush	-2.979148
1994-12-31	William J. Clinton	1.259559
2002-12-31	George W. Bush	-21.610116
2010-12-31	Barack Obama	14.823327
2018-12-31	Donald J. Trump	-4.316647

In [26]:
```
# Creating a table for year 3

year3_dates = year2_dates.copy()
year3_dates.reset_index(inplace = True)
year3_dates["Date_3"] = year3_dates["Date_2"] - pd.DateOffset(years=-1)
year3_dates.set_index("Date_3", inplace = True)
year3_dates.drop(["Date_2",], axis = 1, inplace = True)

# Remove rows for JFK and Trump because they didn't/have yet to have a third y
ear

year3_dates.drop([dt.datetime(1963,12,31), dt.datetime(2019,12,31)], axis = 0,
inplace = True)

# Merge with returns data

year3 = year3_dates.join(gspc_ret_cpi)
year3.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year3
```

Out[26]:

Date_3	President	infl_adj
1965-12-31	Lyndon B. Johnson	12.196226
1971-12-31	Richard M. Nixon	13.825742
1976-12-31	Gerald R. Ford	22.687629
1979-12-31	Jimmy Carter	16.158905
1983-12-31	Ronald Reagan	21.699467
1991-12-31	George Bush	29.534344
1995-12-31	William J. Clinton	36.624925
2003-12-31	George W. Bush	28.132458
2011-12-31	Barack Obama	2.020520

In [27]:
```
# Creating a table for year 4

year4_dates = year3_dates.copy()
year4_dates.reset_index(inplace = True)
year4_dates["Date_4"] = year4_dates["Date_3"] - pd.DateOffset(years=-1)
year4_dates.set_index("Date_4", inplace = True)
year4_dates.drop(["Date_3",], axis = 1, inplace = True)

# Remove rows for Ford because he didn't have a fourth year

year4_dates.drop([dt.datetime(1977,12,31)], axis = 0, inplace = True)

# Merge with returns data

year4 = year4_dates.join(gspc_ret_cpi)
year4.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year4
```

Out[27]:

Date_4	President	infl_adj
1966-12-31	Lyndon B. Johnson	-9.757082
1972-12-31	Richard M. Nixon	18.321835
1980-12-31	Jimmy Carter	28.702364
1984-12-31	Ronald Reagan	5.993837
1992-12-31	George Bush	7.377012
1996-12-31	William J. Clinton	22.189533
2004-12-31	George W. Bush	10.505434
2012-12-31	Barack Obama	15.709091

In [28]:
```
# Creating a table for year 5

year5_dates = year4_dates.copy()
year5_dates.reset_index(inplace = True)
year5_dates["Date_5"] = year5_dates["Date_4"] - pd.DateOffset(years=-1)
year5_dates.set_index("Date_5", inplace = True)
year5_dates.drop(["Date_4",], axis = 1, inplace = True)

# Remove rows for Carter and George HW Bush because they didn't have a fifth y
ear

year5_dates.drop([dt.datetime(1981,12,31), dt.datetime(1993,12,31)], axis = 0,
inplace = True)

# Merge with returns data

year5 = year5_dates.join(gspc_ret_cpi)
year5.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year5
```

Out[28]:

Date_5	President	infl_adj
1967-12-31	Lyndon B. Johnson	23.243127
1973-12-31	Richard M. Nixon	-13.566017
1985-12-31	Ronald Reagan	30.532196
1997-12-31	William J. Clinton	32.784848
2005-12-31	George W. Bush	4.714802
2013-12-31	Barack Obama	31.895989

In [29]:
```
# Creating a table for year 6

year6_dates = year5_dates.copy()
year6_dates.reset_index(inplace = True)
year6_dates["Date_6"] = year6_dates["Date_5"] - pd.DateOffset(years=-1)
year6_dates.set_index("Date_6", inplace = True)
year6_dates.drop(["Date_5",], axis = 1, inplace = True)

# Remove rows for Nixon because he didn't have a sixth year

year6_dates.drop([dt.datetime(1974,12,31)], axis = 0, inplace = True)

# Merge with returns data

year6 = year6_dates.join(gspc_ret_cpi)
year6.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year6
```

Out[29]:

Date_6	President	infl_adj
1968-12-31	Lyndon B. Johnson	10.516451
1986-12-31	Ronald Reagan	18.456389
1998-12-31	William J. Clinton	28.110763
2006-12-31	George W. Bush	15.373994
2014-12-31	Barack Obama	13.579706

In [30]:
```
# Creating a table for year 7

year7_dates = year6_dates.copy()
year7_dates.reset_index(inplace = True)
year7_dates["Date_7"] = year7_dates["Date_6"] - pd.DateOffset(years=-1)
year7_dates.set_index("Date_7", inplace = True)
year7_dates.drop(["Date_6",], axis = 1, inplace = True)

# Remove rows for LBJ because he didn't have a seventh year

year7_dates.drop([dt.datetime(1969,12,31)], axis = 0, inplace = True)

# Merge with returns data

year7 = year7_dates.join(gspc_ret_cpi)
year7.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year7
```

Out[30]:

Date_7	President	infl_adj
1987-12-31	Ronald Reagan	4.984619
1999-12-31	William J. Clinton	20.463791
2007-12-31	George W. Bush	5.235512
2015-12-31	Barack Obama	1.362763

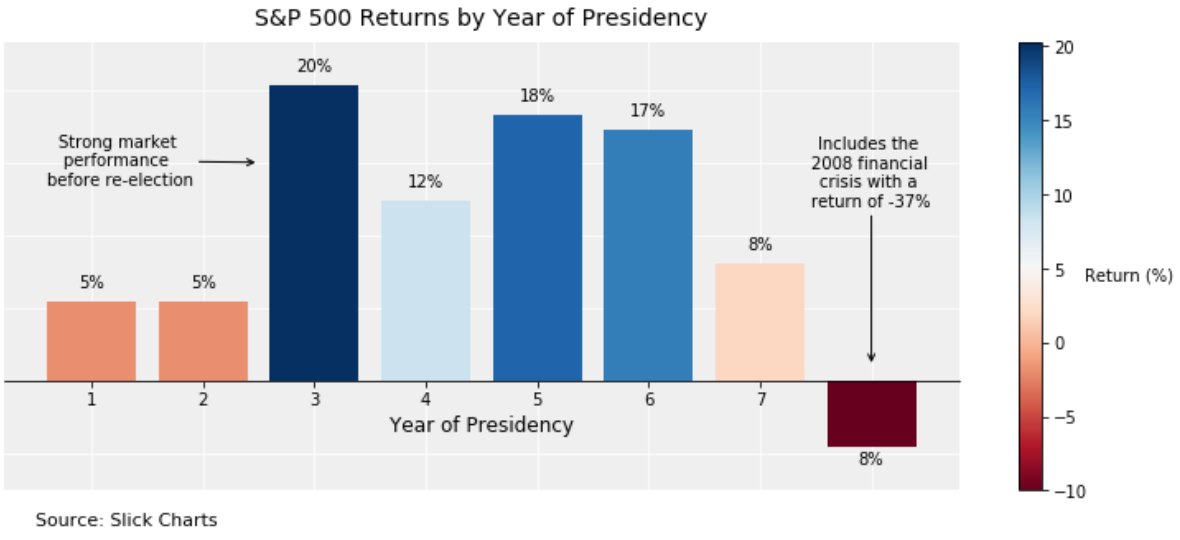
In [33]:
```
# Creating a table for year 8

year8_dates = year7_dates.copy()
year8_dates.reset_index(inplace = True)
year8_dates["Date_8"] = year8_dates["Date_7"] - pd.DateOffset(years=-1)
year8_dates.set_index("Date_8", inplace = True)
year8_dates.drop(["Date_7",], axis = 1, inplace = True)

# Merge with returns data

year8 = year8_dates.join(gspc_ret_cpi)
year8.drop(["CPI", "Return", "infl_rate"], axis = 1, inplace = True)
year8
```

Out[33]:

Date_8	President	infl_adj
1988-12-31	Ronald Reagan	15.864680
2000-12-31	William J. Clinton	-8.834655
2008-12-31	George W. Bush	-36.967121
2016-12-31	Barack Obama	11.696594

In [34]:
```
# Creating the second graph

fig, ax = plt.subplots(figsize = (13,5))

# Set grid lines and background color
ax.grid(color = 'white')
ax.set_axisbelow(True)
ax.set_facecolor('#EFEFEF')

# Graph title
ax.set_title("S&P 500 Returns by Year of Presidency", fontsize = 14, pad = 10)

# Axis titles
ax.set_xlabel("Year of Presidency", fontsize = 12)

# Creating a list with mean returns per year
infl_adj = [year1["infl_adj"].mean(), year2["infl_adj"].mean(), year3["infl_ad
j"].mean(),
            year4["infl_adj"].mean(), year5["infl_adj"].mean(), year6["infl_ad
j"].mean(),
            year7["infl_adj"].mean(), year8["infl_adj"].mean()]

# Axis limits
ax.set_ylim(min(infl_adj)-3, max(infl_adj)+3)

# Shading in bars by value
# Source: https://stackoverflow.com/questions/51204505/python-barplot-with-col
orbar

data_color = [x / max(infl_adj) for x in infl_adj]
my_cmap = plt.cm.get_cmap('RdBu')
colors = my_cmap(data_color)

from matplotlib.cm import ScalarMappable
sm = ScalarMappable(cmap = my_cmap, norm = plt.Normalize(-10, max(infl_adj)))
sm.set_array([])

cbar = plt.colorbar(sm)
cbar.set_label('Return (%)', rotation = 360, labelpad = 25)

# Plotting the inflation-adjusted stock return
counter = 1

for mean in infl_adj:
    ax.bar(counter, mean, color = colors[counter-1])
    counter = counter + 1

# Adding data labels over plot
counter2 = 1

for mean in infl_adj[0:-1]:
    ax.annotate(str(round(mean))+'%', xy=(counter2, mean+1), xytext=(counter2,
mean+1),
            color = 'k', fontsize = 10, ha = 'center')
    counter2 = counter2 + 1
```

```
ax.annotate(str(round(mean))+'%', xy=(counter2, year8["infl_adj"].mean()-1.2),
            xytext=(counter2, year8["infl_adj"].mean()-1.2),
            color = 'k', fontsize = 10, ha = 'center')

# Adding arrow and annotation for year 3
ax.annotate("Strong market \nperformance \nbefore re-election",
    xy = (2.5, 15), xycoords = "data", xytext = (1.25, 13.45), horizontalalign
ment = "center",
    arrowprops={"arrowstyle": "->","color": "black"})

# Adding arrow and annotation for year 8
ax.annotate("Includes the \n2008 financial \ncrisis with a \nreturn of -37%",
    xy = (8, 1), xycoords = "data", xytext = (8, 12), horizontalalignment = "c
enter",
    arrowprops={"arrowstyle": "->", "color": "black"})

# Getting rid of the top, right and left spines
ax.spines["top"].set_visible(False)
ax.spines["right"].set_visible(False)
ax.spines["left"].set_visible(False)
ax.tick_params(left = False)
ax.set_yticklabels([])

# Moving bottom axis to y = 0
ax.spines['bottom'].set_position(('data', 0))

# Adding text below the graph
ax.text(0.5, -10, "Source: Slick Charts", fontsize = 11)

plt.savefig("S&P 500 Returns by Year of Presidency", bbox_inches = "tight", dp
i = 1200)

plt.show()
```



The data in this graph tells a completely different story, but makes logical sense. We see that in year 3, stock market performance is the strongest. This is because when presidents face re-election, they push for economic growth so that the public is in their favor and they are re-elected.

In year 6, we do not see a big drop in returns as would be expected with the six-year itch.

Interestingly in year 8, we see negative returns. We could explain this with the logic that in year 8, the president does not need to worry about re-election and therefore is not too concerned with economic growth. However, the reason that the returns in year 8 are this low is because the average includes the 2008 financial crisis with a return of -37%.

It would be interesting to take a look at what happened during 2008.

Graph 3 - Volatility during the George W. Bush Presidency

In [35]:
```
# Moving on to VIX data

vix.head()
```

Out[35]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	1990-01-02	17.240000	17.240000	17.240000	17.240000	17.240000	0
1	1990-01-03	18.190001	18.190001	18.190001	18.190001	18.190001	0
2	1990-01-04	19.219999	19.219999	19.219999	19.219999	19.219999	0
3	1990-01-05	20.110001	20.110001	20.110001	20.110001	20.110001	0
4	1990-01-08	20.260000	20.260000	20.260000	20.260000	20.260000	0

In [36]:
```
# Converting date to datetime
# Set date as index

vix["Date"] = pd.to_datetime(vix['Date'])
vix.set_index("Date", inplace = True)
vix.head()
```

Out[36]:

Date	Open	High	Low	Close	Adj Close	Volume
1990-01-02	17.240000	17.240000	17.240000	17.240000	17.240000	0
1990-01-03	18.190001	18.190001	18.190001	18.190001	18.190001	0
1990-01-04	19.219999	19.219999	19.219999	19.219999	19.219999	0
1990-01-05	20.110001	20.110001	20.110001	20.110001	20.110001	0
1990-01-08	20.260000	20.260000	20.260000	20.260000	20.260000	0

In [37]:
```
# Choosing VIX data only for the Bush and Obama presidency

vix_bush = vix.loc[pres["Date"].loc["George W. Bush"] : pres["Date"].loc["Donald J. Trump"]]
vix_bush.tail()
```

Out[37]:

Date	Open	High	Low	Close	Adj Close	Volume
2017-01-13	11.45	11.62	10.94	11.23	11.23	0
2017-01-17	12.20	12.75	11.79	11.87	11.87	0
2017-01-18	11.79	12.81	11.69	12.48	12.48	0
2017-01-19	12.58	13.28	12.17	12.78	12.78	0
2017-01-20	12.58	12.59	11.53	11.54	11.54	0

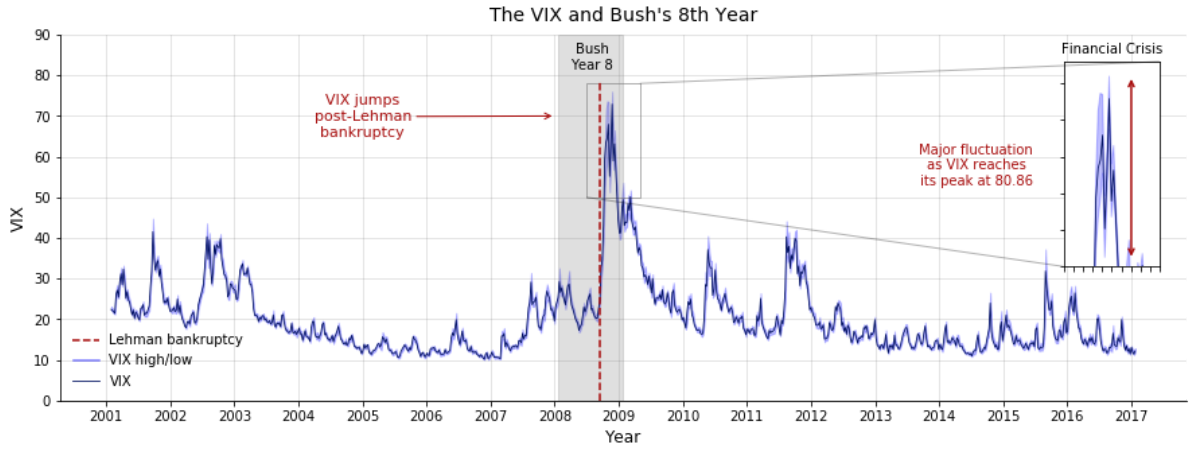
In [38]:
```
# Resample VIX data to weekly

vix_w = vix_bush.resample('W').mean()
vix_w.head()
```

Out[38]:

Date	Open	High	Low	Close	Adj Close	Volume
2001-01-28	22.842	23.156000	22.258	22.4120	22.4120	0
2001-02-04	22.414	22.792000	21.886	22.1620	22.1620	0
2001-02-11	21.910	22.268001	21.424	21.8660	21.8660	0
2001-02-18	21.940	22.310000	21.224	21.4400	21.4400	0
2001-02-25	25.345	27.400000	25.075	26.1025	26.1025	0

In [56]:
```
# Creating the third graph

fig, ax = plt.subplots(figsize = (15,5))

# Graph title
ax.set_title("The VIX and Bush's 8th Year", fontsize = 14, pad = 10)

# Axis titles
ax.set_xlabel("Year", fontsize = 12)
ax.set_ylabel("VIX", fontsize = 12)

# Set graph limits and ticks
ax.set_ylim(0,90)
ax.set_xticks([dt.datetime(2001,1,1), dt.datetime(2002,1,1), dt.datetime(2003,
1,1),
               dt.datetime(2004,1,1), dt.datetime(2005,1,1), dt.datetime(2006,
1,1),
               dt.datetime(2007,1,1), dt.datetime(2008,1,1), dt.datetime(2009,
1,1),
               dt.datetime(2010,1,1), dt.datetime(2011,1,1), dt.datetime(2012,
1,1),
               dt.datetime(2013,1,1), dt.datetime(2014,1,1), dt.datetime(2015,
1,1),
               dt.datetime(2016,1,1), dt.datetime(2017,1,1)])

# Show grid lines
ax.grid(color = 'grey', alpha = 0.25)

# Plot the VIX data
ax.plot(vix_w.index, vix_w["Close"], color = '#001060', linewidth = 0.8)

# Fill high/low VIX data
ax.fill_between(vix_w.index, vix_w["High"], vix_w["Low"], alpha = 0.25, color
= 'b')

# Zoomed inset

from mpl_toolkits.axes_grid1.inset_locator import zoomed_inset_axes
from mpl_toolkits.axes_grid1.inset_locator import mark_inset

    # Create inset box
axins = zoomed_inset_axes(ax, 1.8, loc = 1, borderpad = 2)
# bbox_to_anchor=(705,310)

    # Data to plot on inset
axins.plot(vix_w.index, vix_w["Close"], color = '#001060', linewidth = 0.8)
axins.fill_between(vix_w.index, vix_w["High"], vix_w["Low"], alpha = 0.25, col
or = 'b')

    # Set inset axis and ticks
axins.set_xlim(dt.datetime(2008,7,1), dt.datetime(2009,5,1))
axins.set_ylim(50, 78)
axins.set_xticklabels('')
axins.set_yticklabels('')

    # Inset title
```

```
axins.set_title("Financial Crisis", fontsize = 10)

    # Lines to mark where inset data came from
mark_inset(ax, axins, loc1 = 3, loc2 = 1, fc="none", alpha = 0.3, color = 'k')

# Getting rid of the top and right spines
ax.spines["top"].set_visible(False)
ax.spines["right"].set_visible(False)

# Fill Bush's eigth year in grey
ax.axvspan(pres["Date"].loc["Barack Obama"] - pd.DateOffset(years=1),
           pres["Date"].loc["Barack Obama"], alpha = 0.25, color = 'grey')

# Label Bush's eight year
ax.annotate("Bush\nYear 8", xy=(dt.datetime(2008,8,1), 81.5),
            xytext=(dt.datetime(2008,8,1), 81.5), ha = 'center')

# Dotted line for Lehman collapse
ax.axvline(dt.datetime(2008,9,15), ymax = 0.87, linestyle = '--', color = '#A8
0D0D')

# Adding arrow and annotation for VIX jump
ax.annotate("VIX jumps\npost-Lehman\nbankruptcy",
            xy = (dt.datetime(2008,1,1), 70), xycoords = "data",
            xytext = (dt.datetime(2005,1,1), 65), ha = "center", color = '#A80
D0D',
            fontsize = 11, arrowprops={"arrowstyle": "->","color": '#A80D0D'})

# Adding arrow and annotation for VIX peak
ax.annotate("Major fluctuation\nas VIX reaches\nits peak at 80.86",
            xy = (dt.datetime(2013,9,1), 53.5), xycoords = "data",
            xytext = (dt.datetime(2014,8,1), 53), ha = "center", color = '#A80
D0D')

axins.annotate(s='', xy=(dt.datetime(2009,2,1),51), xycoords = "data",
               xytext=(dt.datetime(2009,2,1),76),ha = 'center',
               arrowprops={"arrowstyle":"<->","color":"#A80D0D", "linewidth":
1.5})

# Setting Legend
ax.legend(labels = ["VIX"], loc = 3, frameon = False)

    # Legend for Lehman Bankruptcy
ax.axhline(15, xmin = 0.011, xmax = 0.035, linestyle = '--', color = '#A80D0D'
)
ax.annotate("Lehman bankruptcy", xy=(dt.datetime(2001,1,15), 14), xytext=(dt.d
atetime(2001,1,15), 14))

    # Legend for High, Low
ax.axhline(10, xmin = 0.012, xmax = 0.035, color = 'b', alpha = 0.5)
ax.annotate("VIX high/low", xy=(dt.datetime(2001,1,15), 9), xytext=(dt.datetim
e(2001,1,15), 9))

plt.savefig("The VIX and Bush's 8th Year", bbox_inches = "tight", dpi = 1200)

plt.show()
```



We see a major spike in the VIX in the eighth year of George W. Bush's presidency, right after Lehman Brothers filed for bankruptcy.

Economists are divided on the extent to which Bush is to blame, however, there is general agreement that Bush's lack of financial regulation lead to banks taking riskier choicesthat ultimately lead to the Lehman bankruptcy.

(Source: https://www.nytimes.com/2008/09/20/business/worldbusiness/20iht-prexy.4.16321064.html (https://www.nytimes.com/2008/09/20/business/worldbusiness/20iht-prexy.4.16321064.html))

We see the economic effects in the major fluctuation of the VIX during Bush's eigth year. The VIX reached its peak at 80.86 - an all time high.

While we do not see the effects of the six-year itch here, the data from the three graphs demands more research into the eighth year of a president's term.

Bibliography

Data Sources:

- Stock price and VIX data: Yahoo Finance
- CPI: Bureau of Labor Statistics
- President dates: https://historyinpieces.com/research/presidential-inauguration-dates (https://historyinpieces.com/research/presidential-inauguration-dates)
- S&P 500 returns: https://www.slickcharts.com/sp500/returns (https://www.slickcharts.com/sp500/returns)

Other:

- Graph inspiration: https://www.affiancefinancial.com/node/147682 (https://www.affiancefinancial.com/node/147682)
- Inflation-adj return formula: https://www.investopedia.com/terms/i/inflation_adjusted_return.asp (https://www.investopedia.com/terms/i/inflation_adjusted_return.asp)
- Shading in bar chart: https://stackoverflow.com/questions/51204505/python-barplot-with-colorbar (https://stackoverflow.com/questions/51204505/python-barplot-with-colorbar)
- Analysis of Bush's role in the 2008 financial crisis: https://www.nytimes.com/2008/09/20/business/worldbusiness/20iht-prexy.4.16321064.html (https://www.nytimes.com/2008/09/20/business/worldbusiness/20iht-prexy.4.16321064.html)