In [ ]:
```
# Finance Data Project - Solutions

In this data project we will focus on exploratory data analysis of stock prices. Keep in mind, this project is just meant to practice your visualization and pandas skills, it is no
____
[financial crisis](https://en.wikipedia.org/wiki/Financial_crisis_of_2007%E2%80%9308) all the way to early 2016.
```

In [ ]:
```
#importing the libraries first
```

In [1]:
```
from pandas_datareader import data, wb
import pandas as pd
import numpy as np
import datetime
%matplotlib inline
```

In [ ]:
```
## Data

We need to get data using pandas datareader. We will get stock information for the following banks:
*  Bank of America
* CitiGroup
* Goldman Sachs
* JPMorgan Chase
* Morgan Stanley
* Wells Fargo

** Figure out how to get the stock data from Jan 1st 2006 to Jan 1st 2016 for each of these banks. Set each bank to be a separate dataframe, with the variable name for that bank be
1. Use datetime to set start and end datetime objects.
2. Figure out the ticker symbol for each bank.
2. Figure out how to use datareader to grab info on the stock.

** Use [this documentation page](https://pandas-datareader.readthedocs.io/en/latest/remote_data.html) for hints and instructions (it should just be a matter of replacing certain va

    # Bank of America
    BAC = data.DataReader("BAC", 'google', start, end)
```

In [2]:
```
start = datetime.datetime(2006, 1, 1)
end = datetime.datetime(2016, 1, 1)
```

In [3]:
```
# Bank of America
BAC = data.DataReader("BAC", 'google', start, end)

# CitiGroup
C = data.DataReader("C", 'google', start, end)

# Goldman Sachs
GS = data.DataReader("GS", 'google', start, end)

# JPMorgan Chase
JPM = data.DataReader("JPM", 'google', start, end)

# Morgan Stanley
MS = data.DataReader("MS", 'google', start, end)

# Wells Fargo
WFC = data.DataReader("WFC", 'google', start, end)
```

In [4]:
```
# Could also do this for a Panel Object
df = data.DataReader(['BAC', 'C', 'GS', 'JPM', 'MS', 'WFC'],'google', start, end)
```

Create a list of the ticker symbols (as strings) in alphabetical order. Call this list: tickers

In [5]:
```
tickers = ['BAC', 'C', 'GS', 'JPM', 'MS', 'WFC']
```

Use pd.concat to concatenate the bank dataframes together to a single data frame called bank_stocks. Set the keys argument equal to the tickers list. Also pay attention to what axis you concatenate on.

In [6]:
```
bank_stocks = pd.concat([BAC, C, GS, JPM, MS, WFC],axis=1,keys=tickers)
```

Set the column name levels (this is filled out for you):

In [7]:
```
bank_stocks.columns.names = ['Bank Ticker','Stock Info']
```

Check the head of the bank_stocks dataframe.

In [8]:
```
bank_stocks.head()
```

Out[8]:

Bank Ticker	BAC					C					...	MS					WFC				
Stock Info	Open	High	Low	Close	Volume	Open	High	Low	Close	Volume	...	Open	High	Low	Close	Volume	Open	High	Low	Close	Volume
Date																					
2006-01-03	46.92	47.18	46.15	47.08	16296700	490.0	493.8	481.1	492.9	1537660	...	57.17	58.49	56.74	58.31	5377000	31.60	31.98	31.20	31.90	11016400
2006-01-04	47.00	47.24	46.45	46.58	17757900	488.6	491.0	483.5	483.8	1871020	...	58.70	59.28	58.35	58.35	7977800	31.80	31.82	31.36	31.53	10871000
2006-01-05	46.58	46.83	46.32	46.64	14970900	484.4	487.8	484.0	486.2	1143160	...	58.55	58.59	58.02	58.51	5778000	31.50	31.56	31.31	31.50	10158000
2006-01-06	46.80	46.91	46.35	46.57	12599800	488.8	489.0	482.0	486.2	1370250	...	58.77	58.85	58.05	58.57	6889800	31.58	31.78	31.38	31.68	8403800
2006-01-09	46.72	46.97	46.36	46.60	15620000	486.0	487.4	483.0	483.9	1680740	...	58.63	59.29	58.62	59.19	4144500	31.68	31.82	31.56	31.68	5619600

5 rows × 30 columns

EDA

Let's explore the data a bit! Before continuing, I encourage you to check out the documentation on Multi-Level Indexing and Using .xs. Reference the solutions if you can not figure out how to use .xs(), since that will be a major part of this project.

What is the max Close price for each bank's stock throughout the time period?

In [9]:
```
bank_stocks.xs(key='Close',axis=1,level='Stock Info').max()
```

Out[9]:
```
Bank Ticker
BAC     54.90
C      564.10
GS     247.92
JPM     70.08
MS      89.30
WFC     58.52
dtype: float64
```

Create a new empty DataFrame called returns. This dataframe will contain the returns for each bank's stock. returns are typically defined by:

$$r_t = \frac{p_t - p_{t-1}}{p_{t-1}} = \frac{p_t}{p_{t-1}} - 1$$

In [10]:
```
returns = pd.DataFrame()
```

We can use pandas pct_change() method on the Close column to create a column representing this return value. Create a for loop that goes and for each Bank Stock Ticker creates this returns column and set's it as a column in the returns DataFrame.

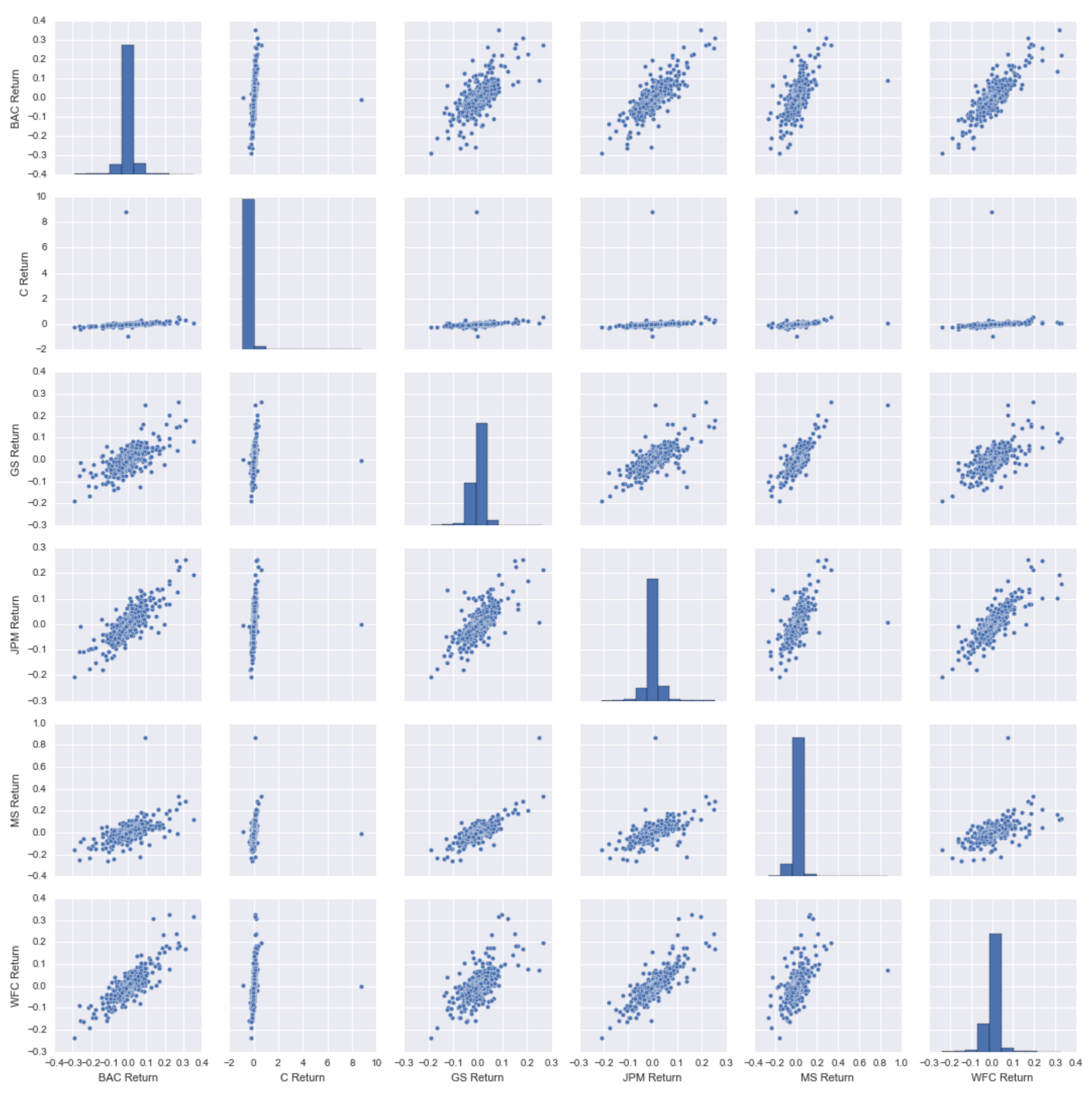
In [11]:
```
for tick in tickers:
    returns[tick+' Return'] = bank_stocks[tick]['Close'].pct_change()
returns.head()
```

Out[11]:

	BAC Return	C Return	GS Return	JPM Return	MS Return	WFC Return
Date						
2006-01-03	NaN	NaN	NaN	NaN	NaN	NaN
2006-01-04	-0.010620	-0.018462	-0.013812	-0.014183	0.000686	-0.011599
2006-01-05	0.001288	0.004961	-0.000393	0.003029	0.002742	-0.000951
2006-01-06	-0.001501	0.000000	0.014169	0.007046	0.001025	0.005714
2006-01-09	0.000644	-0.004731	0.012030	0.016242	0.010586	0.000000

In [13]:
```
#returns[1:]
import seaborn as sns
sns.pairplot(returns[1:])
```

Out[13]: <seaborn.axisgrid.PairGrid at 0x113fb4da0>



Citigroup had a stock split.

In [15]:
```
# Best Single Day Gain
# citigroup stock split in May 2011, but also JPM day after inauguration.
returns.idxmax()
```

Out[15]:
```
BAC Return   2009-04-09
C Return     2011-05-09
GS Return    2008-11-24
JPM Return   2009-01-21
MS Return    2008-10-13
WFC Return   2008-07-16
dtype: datetime64[ns]
```

Take a look at the standard deviation of the returns, which stock would you classify as the riskiest over the entire time period? Which would you classify as the riskiest for the year 2015?

In [16]:
```
returns.std() # Citigroup riskiest
```

Out[16]:
```
BAC Return    0.036650
C Return      0.179969
GS Return     0.025346
JPM Return    0.027656
MS Return     0.037820
WFC Return    0.030233
dtype: float64
```

In [17]:
```
returns.ix['2015-01-01':'2015-12-31'].std() # Very similar risk profiles, but Morgan Stanley or BofA
```

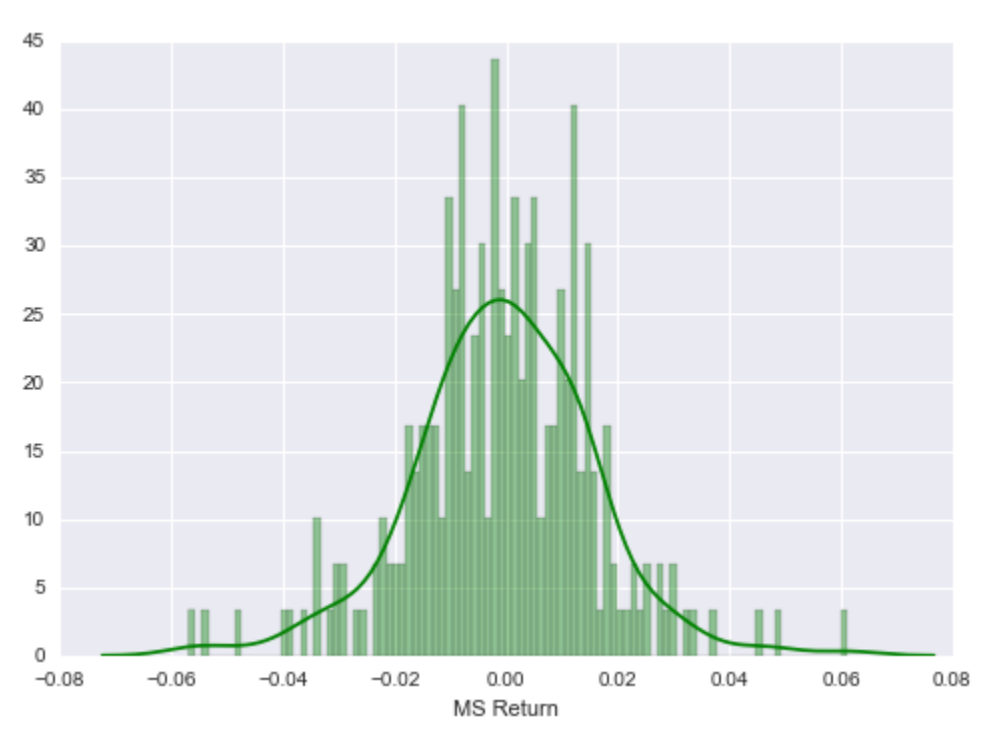
Out[17]:
```
BAC Return    0.016163
C Return      0.015289
GS Return     0.014046
JPM Return    0.014017
MS Return     0.016249
WFC Return    0.012591
dtype: float64
```

Create a distplot using seaborn of the 2015 returns for Morgan Stanley

In [18]:
```
sns.distplot(returns.ix['2015-01-01':'2015-12-31']['MS Return'],color='green',bins=100)
```

```
/Users/marci/anaconda/lib/python3.5/site-packages/statsmodels/nonparametric/kdetools.py:20: VisibleDeprecationWarning: using a non-integer number instead of an integer will result
in an error in the future
  y = X[:m/2+1] + np.r_[0,X[m/2+1:],0]*1j
```

Out[18]: <matplotlib.axes._subplots.AxesSubplot at 0x11cc84828>

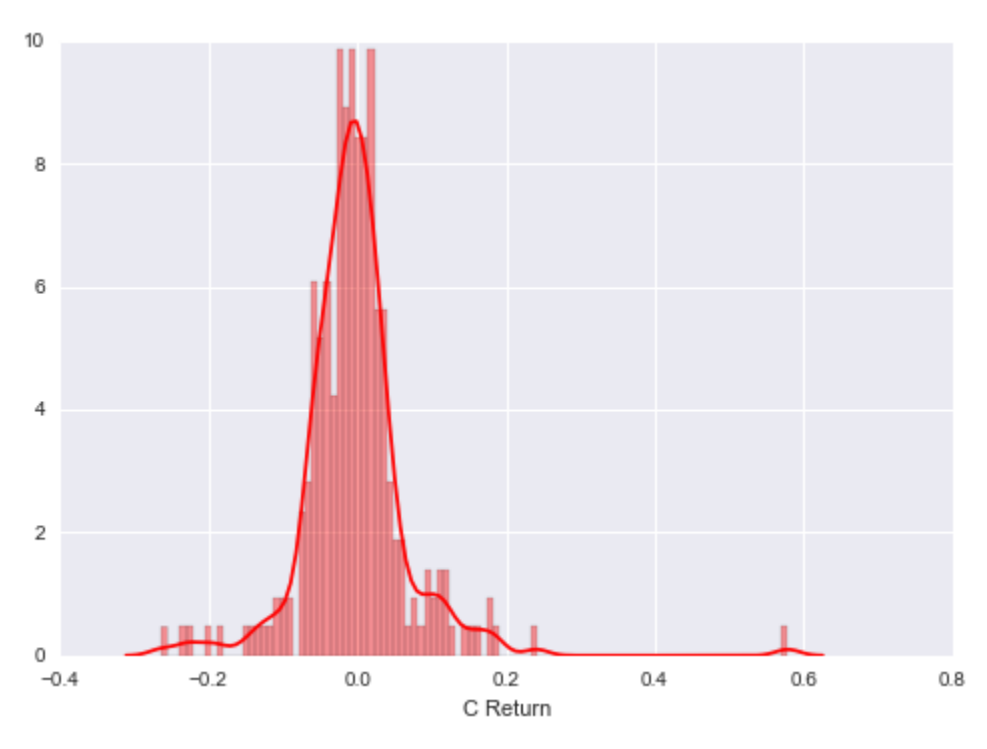


Create a distplot using seaborn of the 2008 returns for CitiGroup

In [19]:
```
sns.distplot(returns.ix['2008-01-01':'2008-12-31']['C Return'],color='red',bins=100)
```

```
/Users/marci/anaconda/lib/python3.5/site-packages/statsmodels/nonparametric/kdetools.py:20: VisibleDeprecationWarning: using a non-integer number instead of an integer will result
in an error in the future
  y = X[:m/2+1] + np.r_[0,X[m/2+1:],0]*1j
```

Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x11efb9518>



More Visualization

A lot of this project will focus on visualizations. Feel free to use any of your preferred visualization libraries to try to recreate the described plots below, seaborn, matplotlib, plotly and cufflinks, or just pandas.

Imports

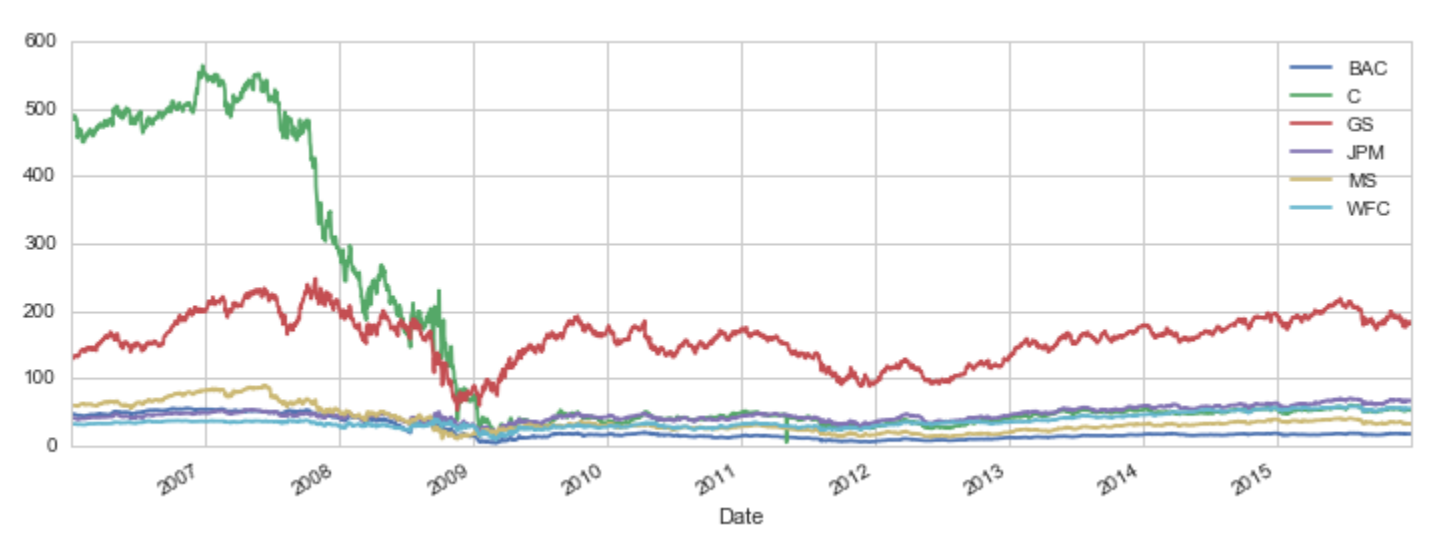
In [20]:
```
import matplotlib.pyplot as plt
import seaborn as sns
sns.set_style('whitegrid')
%matplotlib inline

# Optional Plotly Method Imports
import plotly
import cufflinks as cf
cf.go_offline()
```

Create a line plot showing Close price for each bank for the entire index of time. (Hint: Try using a for loop, or use .xs to get a cross section of the data.)

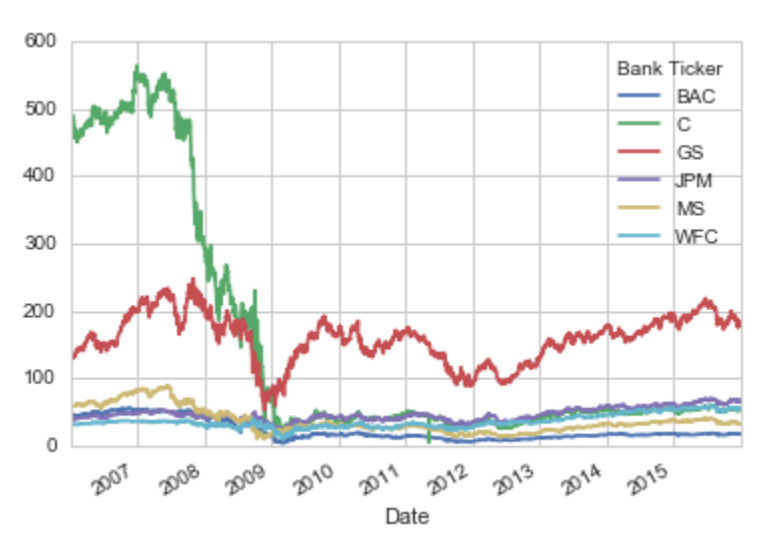
In [21]:
```
for tick in tickers:
    bank_stocks[tick]['Close'].plot(figsize=(12,4),label=tick)
plt.legend()
```

Out[21]: <matplotlib.legend.Legend at 0x116137748>



In [22]:
```
bank_stocks.xs(key='Close',axis=1,level='Stock Info').plot()
```

Out[22]: <matplotlib.axes._subplots.AxesSubplot at 0x11f7bd908>



Moving Averages

Let's analyze the moving averages for these stocks in the year 2008.

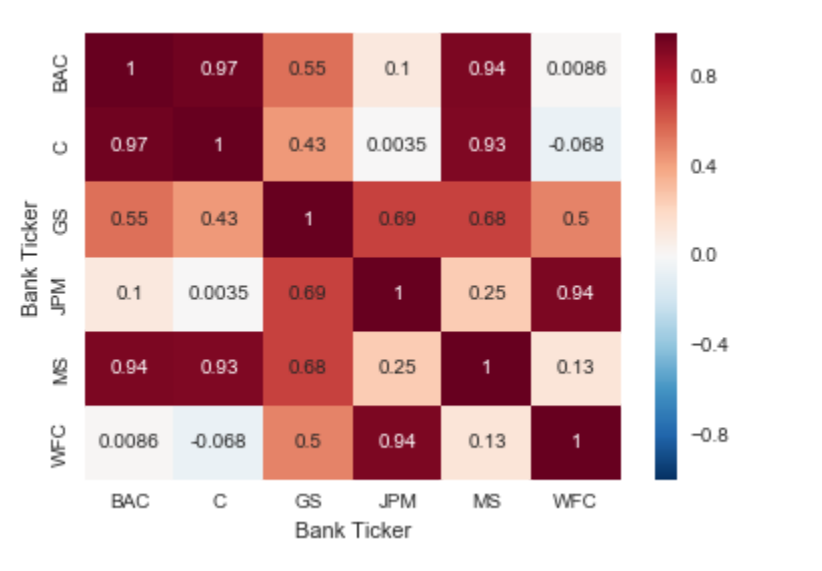
Plot the rolling 30 day average against the Close Price for Bank Of America's stock for the year 2008

In [ ]:
```
plt.figure(figsize=(12,6))
BAC['Close'].ix['2008-01-01':'2009-01-01'].rolling(window=30).mean().plot(label='30 Day Avg')
BAC['Close'].ix['2008-01-01':'2009-01-01'].plot(label='BAC CLOSE')
plt.legend()
```

Create a heatmap of the correlation between the stocks Close Price.

In [25]:
```
sns.heatmap(bank_stocks.xs(key='Close',axis=1,level='Stock Info').corr(),annot=True)
```

Out[25]: <matplotlib.axes._subplots.AxesSubplot at 0x12045e2b0>



Optional: Use seaborn's clustermap to cluster the correlations together:

In [26]:
```
sns.clustermap(bank_stocks.xs(key='Close',axis=1,level='Stock Info').corr(),annot=True)
```

Out[26]: <seaborn.matrix.ClusterGrid at 0x1204755c0>