Basic programs I'll for sure need, more will be added as needed

```
In [1]: import pandas as pd
        import matplotlib.pyplot as plt
        import os
        import numpy as np

        %matplotlib inline
```

```
In [2]: import pandas_datareader.data as web
        import datetime
```

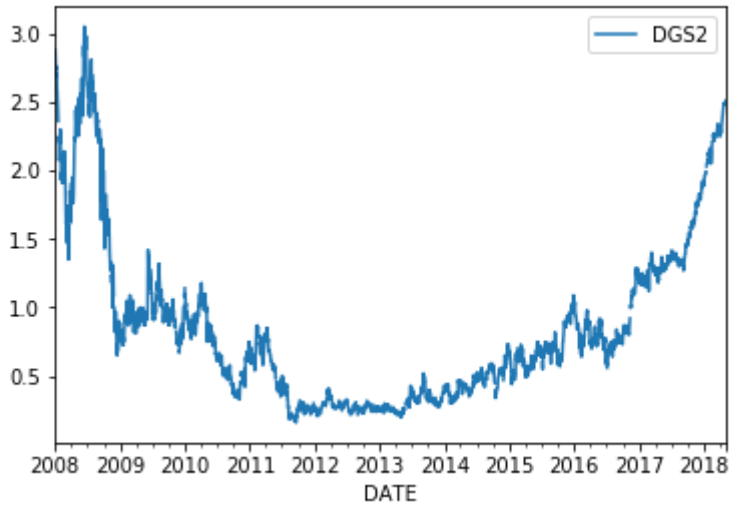
Section 1: Measuring reactions to FOMC announcements

There's no real way to tell how expected or unexpected an FOMC announcement is, but one common practice is to measure changes in U.S. Treasury yields in the days following announcements. There is some disagreement over how many days post-announcement to track, but this analysis will use changes in yields on FOMC days.

I first imported daily 2-year U.S. Treasury yields since January 1, 2008 via the FRED API.

```
In [3]: start = datetime.datetime(2008, 1, 1)
        end = datetime.datetime(2018, 5, 4)
        codes = ['DGS2'] #DGS2 = 2-Year Treasury Constant Maturity Rate, daily f
        requency
        fred = web.DataReader(codes, 'fred', start, end)

        fred.plot()
```

```
Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x10dc52e10>
```



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

Out[4]:

	DGS2
DATE	
2008-01-01	NaN
2008-01-02	2.88
2008-01-03	2.83
2008-01-04	2.74
2008-01-07	2.76

I want the daily change in yields, so I add that column

```
In [5]: fred = fred.assign(delta = 100*fred.pct_change())
        fred.head()
```

Out[5]:

	DGS2	delta
DATE		
2008-01-01	NaN	NaN
2008-01-02	2.88	NaN
2008-01-03	2.83	-1.736111
2008-01-04	2.74	-3.180212
2008-01-07	2.76	0.729927

```
In [6]: fred = fred.rename(columns = {'DGS2' : '2yr_yield', 'delta' : 'daily_pct
        _change'})
        fred.head()
```

Out[6]:

	2yr_yield	daily_pct_change
DATE		
2008-01-01	NaN	NaN
2008-01-02	2.88	NaN
2008-01-03	2.83	-1.736111
2008-01-04	2.74	-3.180212
2008-01-07	2.76	0.729927

I only want to know this data on FOMC announcement days. Unfortunately, there isn't an API for these dates, so I had to manually enter the dates from the FOMC's website (https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm) calendar into an Excel sheet (available in my GitHub repository).

In [7]:
```
from pandas import ExcelWriter
from pandas import ExcelFile
from pandas import read_csv
```

In [8]:
```
path = '/Users/simon.ilisevich/Documents/Data_Bootcamp/fomc_dates.csv'
fomc_dates = read_csv(path, index_col='Date', usecols=['Date','Announcem
ents'])
```

In [9]:
```
fomc_dates.index.names = ['DATE']
fomc_dates.head()
```

Out[9]:

	Announcements
DATE	
2008-10-08	FFR target decrease *intermeeting
2008-10-29	FFR target decrease
2008-11-25	MBS and agency debt purchase *intermeeting
2008-12-16	FFR target decrease
2009-01-28	NaN

Using the FOMC dates, I create a new dataframe that only includes yields and daily changes in yield on FOMC days

In [10]:
```
fomc_dates = fomc_dates.join(fred)
```

In [11]:
```
fomc_dates.head()
```

Out[11]:

	Announcements	2yr_yield	daily_pct_change
DATE			
2008-10-08	FFR target decrease *intermeeting	1.65	12.244898
2008-10-29	FFR target decrease	1.58	-4.242424
2008-11-25	MBS and agency debt purchase *intermeeting	1.15	-12.213740
2008-12-16	FFR target decrease	0.65	-13.333333
2009-01-28	NaN	0.89	2.298851

```
In [12]: fomc_dates.index
```

```
Out[12]: DatetimeIndex(['2008-10-08', '2008-10-29', '2008-11-25', '2008-12-16',
                        '2009-01-28', '2009-03-18', '2009-04-29', '2009-06-24',
                        '2009-08-12', '2009-09-23', '2009-11-04', '2009-12-16',
                        '2010-01-27', '2010-03-16', '2010-04-28', '2010-06-23',
                        '2010-08-10', '2010-09-21', '2010-11-03', '2010-12-14',
                        '2011-01-26', '2011-03-15', '2011-04-27', '2011-06-22',
                        '2011-08-09', '2011-09-21', '2011-11-02', '2011-12-13',
                        '2012-01-25', '2012-03-13', '2012-04-25', '2012-06-20',
                        '2012-08-01', '2012-09-13', '2012-10-24', '2012-12-12',
                        '2013-01-30', '2013-03-20', '2013-05-01', '2013-06-19',
                        '2013-09-18', '2013-10-30', '2013-12-18', '2014-01-29',
                        '2014-03-19', '2014-04-30', '2014-06-18', '2014-07-30',
                        '2014-09-17', '2014-10-29', '2014-12-17', '2015-01-28',
                        '2015-03-18', '2015-04-29', '2015-06-17', '2015-07-29',
                        '2015-09-17', '2015-10-28', '2015-12-16', '2016-01-27',
                        '2016-03-16', '2016-04-27', '2016-06-15', '2016-07-27',
                        '2016-09-21', '2016-11-02', '2016-12-14', '2017-02-01',
                        '2017-03-15', '2017-05-03', '2017-06-14', '2017-07-26',
                        '2020-09-20', '2017-11-01', '2017-12-13', '2018-01-31',
                        '2018-03-21', '2018-05-02'],
                       dtype='datetime64[ns]', name='DATE', freq=None)
```

```
In [13]: fred_mean = fred['daily_pct_change'].mean()
         fred_std = fred['daily_pct_change'].std()

         print(fred_mean)
         print(fred_std)
```

```
         0.13556977235635276
         5.324606758338174
```

```
In [14]: a = 2*fred_std + fred_mean
         a
```

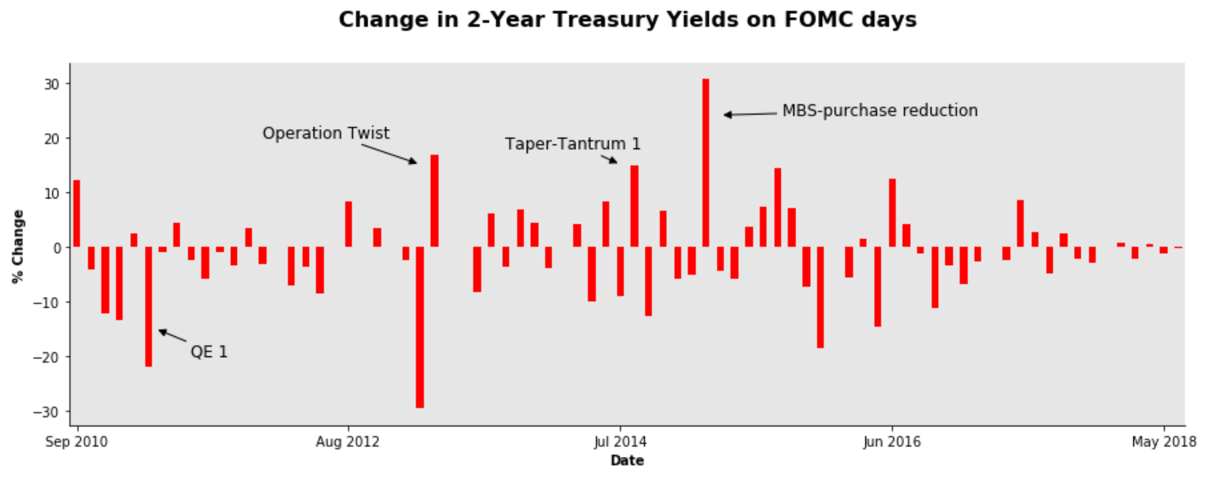
```
Out[14]: 10.784783289032701
```

```
In [15]: type(a)
```

```
Out[15]: float
```

In [16]:
```
fig, ax = plt.subplots(figsize=(15,5))

ax.set_facecolor('0.9')

import matplotlib.ticker as ticker

clr1 = 'r'
clr2 = 'g'
clrs = [clr1 if var >= a else clr2 for var in fomc_dates['daily_pct_chan
ge']]

fomc_dates.daily_pct_change.plot(kind='bar',
                                 ax=ax,
                                color = clrs)

ax.spines["right"].set_visible(False)
ax.spines["top"].set_visible(False)

ax.set_title("Change in 2-Year Treasury Yields on FOMC days", fontsize=1
6, fontweight = "bold", y=1.08)
ax.set_ylabel("% Change", fontweight="bold")
ax.set_xlabel("Date", fontweight='bold')

labels = ['Oct 2008', 'Sep 2010', 'Aug 2012', 'Jul 2014', 'Jun 2016', 'M
ay 2018']
plt.gca().set_xticklabels(labels, rotation=0)

ax.xaxis.set_major_locator(ticker.MultipleLocator(19))

ax.annotate("QE 1", xy=(5.5, -15.0), xycoords="data", xytext=(8.0, -20.0
), horizontalalignment="left",
arrowprops={"arrowstyle": "-|>",  "color": "black"}, fontsize=12,)

ax.annotate("Operation Twist", xy=(24, 15.0), xycoords="data", xytext=(1
3.0, 20.0), horizontalalignment="left",
arrowprops={"arrowstyle": "-|>", "color": "black"},fontsize=12,)

ax.annotate("Taper-Tantrum 1", xy=(38, 15.0), xycoords="data", xytext=(3
0.0, 18.0), horizontalalignment="left",
arrowprops={"arrowstyle": "-|>", "color": "black"},fontsize=12,)

ax.annotate("MBS-purchase reduction", xy=(45, 24.0), xycoords="data", xy
text=(63.0, 24.0), horizontalalignment="right",
arrowprops={"arrowstyle": "-|>", "color": "black"},fontsize=12,)
```

```
Out[16]: Text(63,24,'MBS-purchase reduction')
```



Section 2: Importing and Combining Chinese, Indian, and Russian market reactions

The next step is to measure changes in equity prices, exchange rates, and bond yields among three of the four largest emerging market economies. Data for this entire section came from the Stooq Index Data API. While not the easiest API to work with, it was the only API I could find that provided data for all three categories across the entire test period.

The same importing, cleaning, and merging process is repeated for all three categories. It's explained in the equities section.

Equities

These are the largest equity indeces for each country from the Stooq Index Data API

China - Shanghai Composite Index

In [17]:
```
start = datetime.datetime(2008, 1, 1)
end = datetime.datetime(2018, 5, 4)
ch_equities = web.DataReader('^SHC', 'stooq', start, end)
ch_equities.head()
```

Out[17]:

	Open	**High**	**Low**	**Close**	**Volume**
Date					
2018-05-15	3181.20	3192.27	3164.79	3192.12	4.292036e+09
2018-05-14	3168.87	3183.71	3163.55	3174.03	1.290184e+10
2018-05-11	3179.84	3180.42	3162.87	3163.26	1.303172e+10
2018-05-10	3172.07	3175.71	3155.93	3174.41	1.326845e+10
2018-05-09	3160.30	3163.90	3145.66	3159.15	1.222572e+10

India - BSE SENSEX

In [18]:
```
start = datetime.datetime(2008, 1, 1)
end = datetime.datetime(2018, 5, 4)
in_equities = web.DataReader('^SNX', 'stooq', start, end)
in_equities.head()
```

Out[18]:

	Open	**High**	**Low**	**Close**	**Volume**
Date					
2018-05-15	35580.67	35992.98	35498.32	35543.94	NaN
2018-05-14	35555.83	35642.72	35457.71	35556.71	9279750.0
2018-05-11	35301.23	35579.82	35262.67	35535.79	9210202.0
2018-05-10	35419.01	35500.02	35205.42	35246.27	8732699.0
2018-05-09	35166.24	35393.72	35138.22	35319.35	9689521.0

Russia - RTS Index

```
In [19]: start = ['2008-01-01']
         end = ['2018-05-04']
         ru_equities = web.DataReader('^RTS', 'stooq', start, end)
         ru_equities.head()
```

Out[19]:

	Open	High	Low	Close	Volume
Date					
2018-05-15	1198.64	1198.64	1171.48	1178.76	NaN
2018-05-14	1193.53	1203.99	1185.94	1202.56	NaN
2018-05-11	1183.40	1200.21	1181.76	1193.98	2.237898e+10
2018-05-10	1154.23	1182.14	1154.00	1179.63	1.828950e+10
2018-05-08	1146.88	1146.88	1131.77	1142.13	2.169624e+10

Getting rid of unecessary columns

```
In [20]: ch_equities = ch_equities.drop(ch_equities.columns[[0, 1, 2, 4]], axis=1
         )
         in_equities = in_equities.drop(in_equities.columns[[0, 1, 2, 4]], axis=1
         )
         ru_equities = ru_equities.drop(ru_equities.columns[[0, 1, 2, 4]], axis=1
         )
```

Adding in daily percentage change

```
In [21]: ch_equities = ch_equities.assign(ch_equity_change = 100*ch_equities.pct_
         change())
         in_equities = in_equities.assign(in_equity_change = 100*in_equities.pct_
         change())
         ru_equities = ru_equities.assign(ru_equity_change = 100*ru_equities.pct_
         change())
```

Each DataFrame has a slightly different index, so I need to create a common index among all three in order to make merging them easier

```
In [22]: idx = pd.date_range('2008-01-01', '2018-05-04')
```

```
In [23]: ch_equities.index = pd.DatetimeIndex(ch_equities.index)
         ch_equities = ch_equities.reindex(idx, fill_value='NaN')

         in_equities.index = pd.DatetimeIndex(in_equities.index)
         in_equities = in_equities.reindex(idx, fill_value='NaN')

         ru_equities.index = pd.DatetimeIndex(ru_equities.index)
         ru_equities = ru_equities.reindex(idx, fill_value='NaN')
```

Dropping now unecessary Close prices

```
In [24]: ch_equities = ch_equities.drop('Close', 1)
         in_equities = in_equities.drop('Close', 1)
         ru_equities = ru_equities.drop('Close', 1)
```

New table with emerging market equity reactions included

```
In [25]: market_response = fomc_dates.join(ch_equities, how='left', lsuffix='_lef
         t', rsuffix='_right').join(in_equities, how='left', lsuffix='_left', rsu
         ffix='_right').join(ru_equities, how='left', lsuffix='_left', rsuffix='_
         right')
         market_response.head()
```

Out[25]:

	Announcements	**2yr_yield**	**daily_pct_change**	**ch_equity_change**	**in_equity_change**
DATE					
2008-10-08	FFR target decrease *intermeeting	1.65	12.244898	0.850293	7.60374
2008-10-29	FFR target decrease	1.58	-4.242424	-2.48354	-7.5965
2008-11-25	MBS and agency debt purchase *intermeeting	1.15	-12.213740	-0.482644	-3.669
2008-12-16	FFR target decrease	0.65	-13.333333	-0.0915612	2.69359
2009-01-28	NaN	0.89	2.298851	NaN	0.229421

Exchange Rates

CNY/USD

```
In [26]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         ch_fx = web.DataReader('CNYUSD', 'stooq', start, end)
```

INR/USD

```
In [27]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         in_fx = web.DataReader('INRUSD', 'stooq', start, end)
```

RUB/USD

```
In [28]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         ru_fx = web.DataReader('RUBUSD', 'stooq', start, end)
```

```
In [29]: ch_fx.head()
```

Out[29]:

	Open	High	Low	Close
Date				
2018-05-15	0.15774	0.15781	0.15746	0.15748
2018-05-14	0.15796	0.15810	0.15787	0.15788
2018-05-11	0.15792	0.15813	0.15758	0.15813
2018-05-10	0.15702	0.15763	0.15696	0.15759
2018-05-09	0.15704	0.15710	0.15668	0.15692

```
In [30]: ch_fx = ch_fx.drop(ch_fx.columns[[0, 1, 2]], axis=1)
         in_fx = in_fx.drop(in_fx.columns[[0, 1, 2]], axis=1)
         ru_fx = ru_fx.drop(ru_fx.columns[[0, 1, 2]], axis=1)
```

```
In [31]: ch_fx = ch_fx.assign(ch_fx_change = 100*ch_fx.pct_change())
         in_fx = in_fx.assign(in_fx_change = 100*in_fx.pct_change())
         ru_fx = ru_fx.assign(ru_fx_change = 100*ru_fx.pct_change())
```

```
In [32]: ch_fx.index = pd.DatetimeIndex(ch_fx.index)
         ch_fx = ch_fx.reindex(idx, fill_value='NaN')

         in_fx.index = pd.DatetimeIndex(in_fx.index)
         in_fx = in_fx.reindex(idx, fill_value='NaN')

         ru_fx.index = pd.DatetimeIndex(ru_fx.index)
         ru_fx = ru_fx.reindex(idx, fill_value='NaN')
```

```
In [33]: ch_fx = ch_fx.drop('Close', 1)
         in_fx = in_fx.drop('Close', 1)
         ru_fx = ru_fx.drop('Close', 1)
```

```
In [34]: market_response = market_response.join(ch_fx, how='left', lsuffix='_lef
         t', rsuffix='_right').join(in_fx, how='left', lsuffix='_left', rsuffix=
         '_right').join(ru_fx, how='left', lsuffix='_left', rsuffix='_right')
         market_response.head()
```

Out[34]:

	Announcements	2yr_yield	daily_pct_change	ch_equity_change	in_equity_change
DATE					
2008-10-08	FFR target decrease *intermeeting	1.65	12.244898	0.850293	7.60374
2008-10-29	FFR target decrease	1.58	-4.242424	-2.48354	-7.5965
2008-11-25	MBS and agency debt purchase *intermeeting	1.15	-12.213740	-0.482644	-3.669
2008-12-16	FFR target decrease	0.65	-13.333333	-0.0915612	2.69359
2009-01-28	NaN	0.89	2.298851	NaN	0.229421

Bond Prices

Chinese 10-Year

```
In [35]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         ch_bond = web.DataReader('10CNY.B', 'stooq', start, end)
```

Indian 10-Year

```
In [36]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         in_bond = web.DataReader('10INY.B', 'stooq', start, end)
```

Russian 10-Year

```
In [37]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         ru_bond = web.DataReader('10RUY.B', 'stooq', start, end)
```

```
In [38]: ru_bond.head()
```

```
Out[38]:
```

	Open	High	Low	Close
Date				
2018-05-15	7.32	7.37	7.31	7.36
2018-05-14	7.32	7.36	7.31	7.32
2018-05-11	7.35	7.38	7.29	7.31
2018-05-10	7.38	7.42	7.34	7.35
2018-05-09	7.40	7.42	7.38	7.38

```
In [39]: ch_bond = ch_bond.drop(ch_bond.columns[[0, 1, 2]], axis=1)
         in_bond = in_bond.drop(in_bond.columns[[0, 1, 2]], axis=1)
         ru_bond = ru_bond.drop(ru_bond.columns[[0, 1, 2]], axis=1)
```

```
In [40]: ch_bond = ch_bond.assign(ch_bond_change = 100*ch_bond.pct_change())
         in_bond = in_bond.assign(in_bond_change = 100*in_bond.pct_change())
         ru_bond = ru_bond.assign(ru_bond_change = 100*ru_bond.pct_change())
```

```
In [41]: ch_bond.index = pd.DatetimeIndex(ch_bond.index)
         ch_bond = ch_bond.reindex(idx, fill_value='NaN')

         in_bond.index = pd.DatetimeIndex(in_bond.index)
         in_bond = in_bond.reindex(idx, fill_value='NaN')

         ru_bond.index = pd.DatetimeIndex(ru_bond.index)
         ru_bond = ru_bond.reindex(idx, fill_value='NaN')
```

```
In [42]: ch_bond = ch_bond.drop('Close', 1)
         in_bond = in_bond.drop('Close', 1)
         ru_bond = ru_bond.drop('Close', 1)
```

In [43]:
```
market_response = market_response.join(ch_bond, how='left', lsuffix='_le
ft', rsuffix='_right').join(in_bond, how='left', lsuffix='_left', rsuffi
x='_right').join(ru_bond, how='left', lsuffix='_left', rsuffix='_right')
market_response.head()
```

Out[43]:

	Announcements	2yr_yield	daily_pct_change	ch_equity_change	in_equity_change
DATE					
2008-10-08	FFR target decrease *intermeeting	1.65	12.244898	0.850293	7.60374
2008-10-29	FFR target decrease	1.58	-4.242424	-2.48354	-7.5965
2008-11-25	MBS and agency debt purchase *intermeeting	1.15	-12.213740	-0.482644	-3.669
2008-12-16	FFR target decrease	0.65	-13.333333	-0.0915612	2.69359
2009-01-28	NaN	0.89	2.298851	NaN	0.229421

In [44]:
```
equity_response = market_response[['ch_equity_change', 'in_equity_chang
e', 'ru_equity_change']].copy()
equity_response.head()
```

Out[44]:

	ch_equity_change	in_equity_change	ru_equity_change
DATE			
2008-10-08	0.850293	7.60374	-9.8396
2008-10-29	-2.48354	-7.5965	-15.1191
2008-11-25	-0.482644	-3.669	5.14401
2008-12-16	-0.0915612	2.69359	-1.7032
2009-01-28	NaN	0.229421	2.95647

In [45]:
```
fx_response = market_response[['ch_fx_change', 'in_fx_change', 'ru_fx_ch
ange']].copy()
fx_response.head()
```

Out[45]:

	ch_fx_change	in_fx_change	ru_fx_change
DATE			
2008-10-08	4.45312	0	-0.634524
2008-10-29	4.62331	0	-1.33835
2008-11-25	2.46002	-1.20136	-0.30892
2008-12-16	-1.03809	-0.499905	-0.621887
2009-01-28	NaN	0.205842	4.96925

In [46]:
```
bond_response = market_response[['ch_bond_change', 'in_bond_change', 'ru
_bond_change']].copy()
bond_response.head()
```

Out[46]:

	ch_bond_change	in_bond_change	ru_bond_change
DATE			
2008-10-08	10.6061	3.59758	NaN
2008-10-29	2.2508	1.03342	NaN
2008-11-25	-1.88679	1.26511	NaN
2008-12-16	3.16901	2.55754	NaN
2009-01-28	NaN	-2.59488	NaN

Section 3: Summarizing market reactions

As I was creating my first graph I came across an error in the first line of my for loop stating that 'z' (a list of each column from the "market_response" dataframe to be graphed) couldn't be read because it was a list of objects, and needed to be in a number form. The next few lines fixed that.

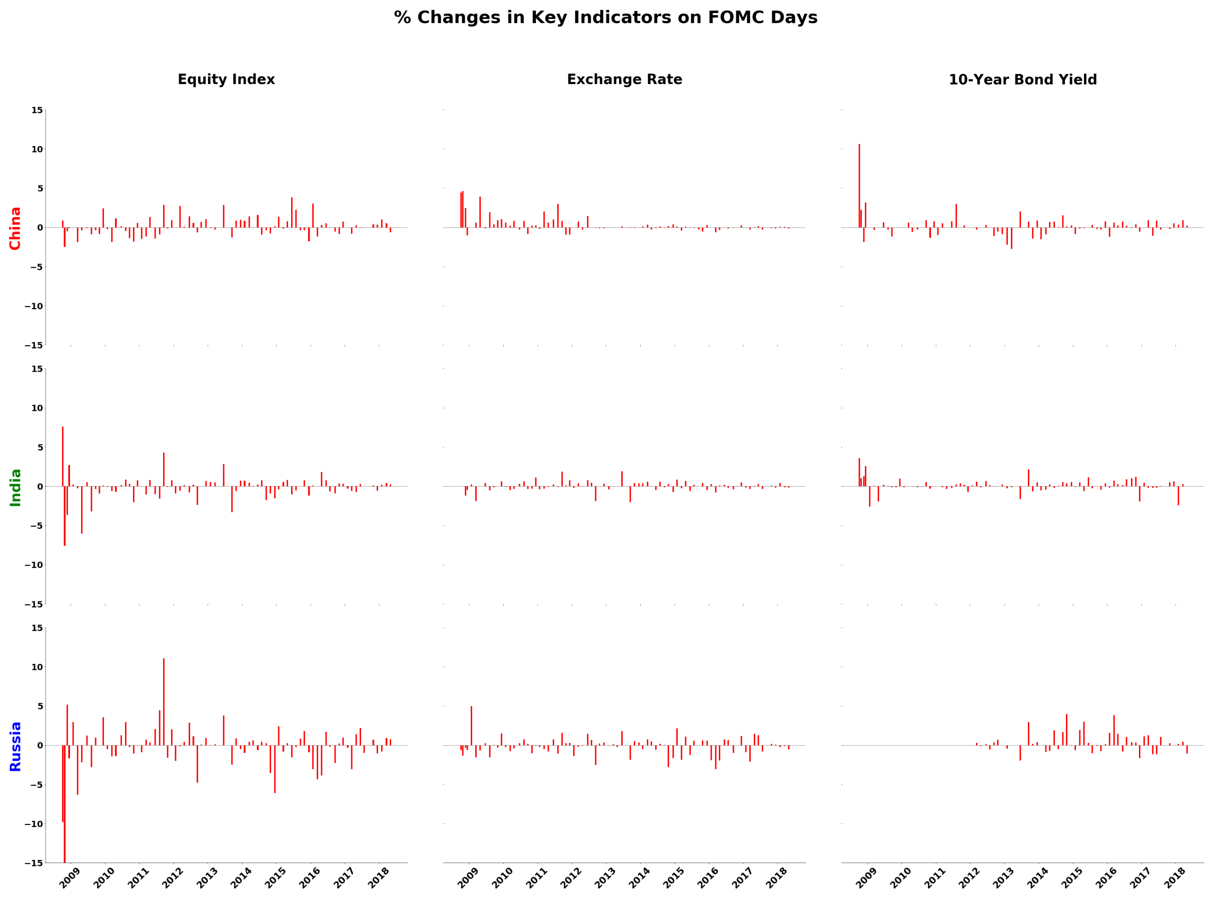
In [47]:
```
z = ['ch_equity_change','ch_fx_change', 'ch_bond_change', 'in_equity_cha
nge', 'in_fx_change', 'in_bond_change', 'ru_equity_change', 'ru_fx_chang
e', 'ru_bond_change']
```

In [48]:
```
for var in z:
    market_response[var] = pd.to_numeric(market_response[var], errors =
'force')
```

```
In [49]: market_response.dtypes
```

```
Out[49]: Announcements        object
         2yr_yield           float64
         daily_pct_change    float64
         ch_equity_change    float64
         in_equity_change    float64
         ru_equity_change    float64
         ch_fx_change        float64
         in_fx_change        float64
         ru_fx_change        float64
         ch_bond_change      float64
         in_bond_change      float64
         ru_bond_change      float64
         dtype: object
```

```
In [124]: from pylab import *
          import matplotlib.colors as cl

          fig, ax = plt.subplots(nrows = 3, ncols = 3, sharex = 'col', sharey = 'r
          ow', figsize = (60,40))

          ax = ax.ravel()

          count = 0

          colors = ['red' if count < 3 else 'blue']

          for graph in ax:

              #basic graph
              graph.bar(market_response.index, market_response[z[count]], width=15
          , color = colors)


              #adjusting xticks
              for tick in graph.xaxis.get_major_ticks():
                  tick.label1.set_fontsize(27)
                  tick.label1.set_fontweight('bold')
                  tick.label.set_rotation(45)

              for tick in graph.yaxis.get_major_ticks():
                  tick.label1.set_fontsize(25)
                  tick.label1.set_fontweight('bold')

              graph.axhline(y=0, color='k', linewidth=0.5)

              graph.set_ylim(-15,15)

              #spines
              graph.spines["right"].set_visible(False)
              graph.spines["top"].set_visible(False)

              if count < 6:
                  graph.spines['bottom'].set_visible(False)

              key_values = [0, 3, 6]

              for x in key_values:
                  if count is x:
                       graph.spines['left'].set_visible(True)
                  else:
                      graph.spines['left'].set_visible(False)

              if count is 0:
                  graph.spines['left'].set_visible(True)

              if count is 3:
                  graph.spines['left'].set_visible(True)

              #row labels
              if count is 0:
                  graph.set_ylabel('China', fontsize=40, color='r', fontweight='bo
ld')
    if count is 3:
        graph.set_ylabel('India', fontsize=40, color = 'g', fontweight=
'bold')
    if count is 6:
        graph.set_ylabel('Russia', fontsize=40, color = 'b', fontweight=
'bold')

    count = count + 1

ax[0].set_title('Equity Index', fontsize=40, y = 1.1, fontweight = "bol
d")
ax[1].set_title('Exchange Rate', fontsize=40, y = 1.1, fontweight = "bol
d")
ax[2].set_title('10-Year Bond Yield', fontsize=40, y = 1.1, fontweight =
 "bold")

fig.suptitle("% Changes in Key Indicators on FOMC Days", fontsize = 50,
fontweight = "bold", y=0.98)

fig.subplots_adjust(hspace=0.1, wspace=0.1)
```



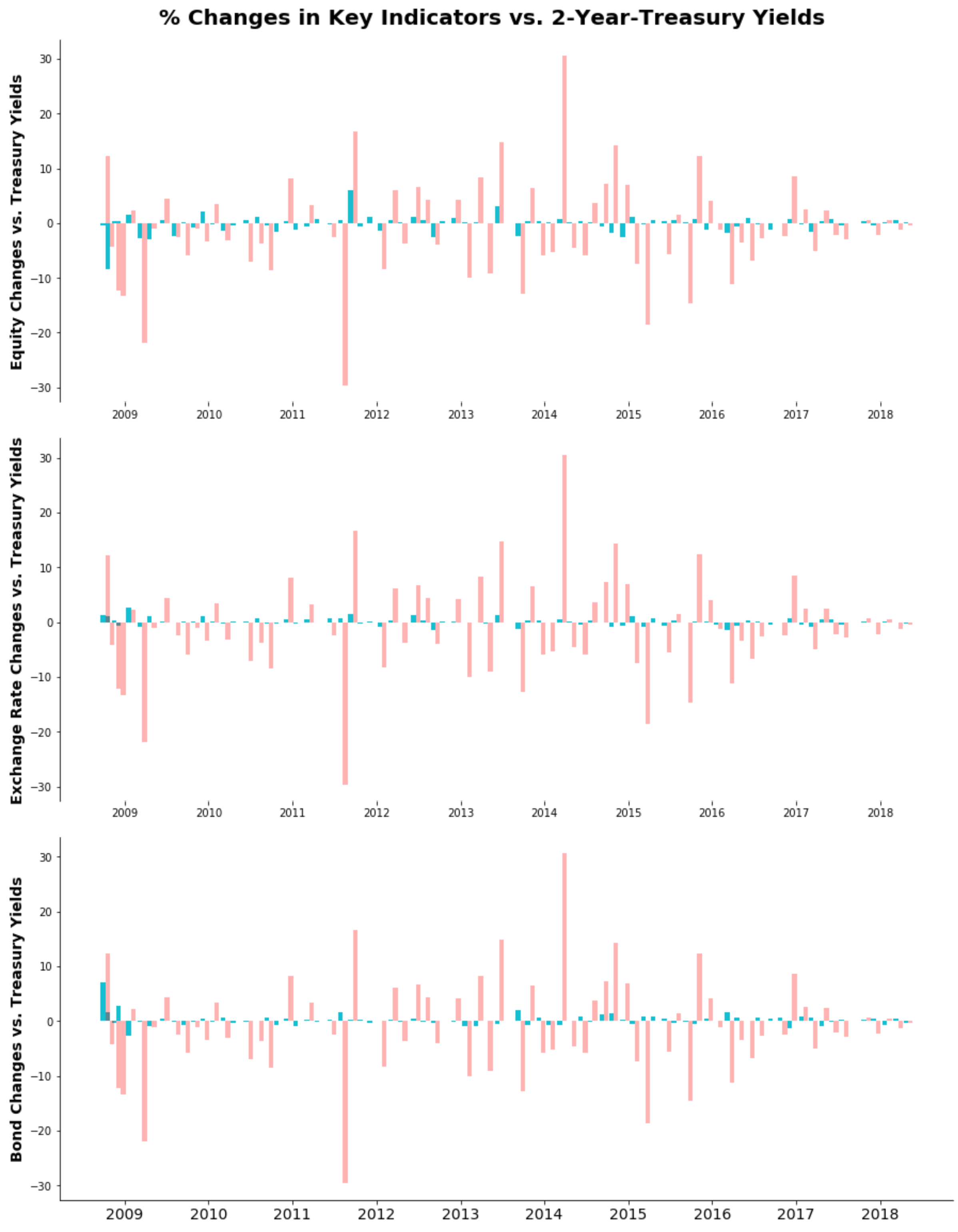
Now that we have changes in asset prices in each country, we can collapse them by indicator and compute their average.

In [157]:
```
for var in equity_response:
    equity_response[var] = pd.to_numeric(equity_response[var], errors =
'force')
for var in fx_response:
    fx_response[var] = pd.to_numeric(fx_response[var], errors = 'force')
for var in bond_response:
    bond_response[var] = pd.to_numeric(bond_response[var], errors = 'for
ce')
```

In [93]:
```
equity_response['avg'] = equity_response.mean(axis=1)
fx_response['avg'] = fx_response.mean(axis=1)
bond_response['avg'] = bond_response.mean(axis=1)
```

In [156]:
```
fig, ax = plt.subplots(nrows = 3, ncols = 1, figsize = (15,20))

ax[0].bar(equity_response.index, equity_response['avg'], width=-20, alig
n='edge', color='C9', alpha=1)
ax[0].bar(equity_response.index, fomc_dates['daily_pct_change'], width=+
20, align='edge', color='red', alpha=0.3)

ax[0].spines['top'].set_visible(False)
ax[0].spines['right'].set_visible(False)
ax[0].spines['bottom'].set_visible(False)
ax[0].set_ylabel('Equity Changes vs. Treasury Yields', fontsize=14, font
weight='bold')


ax[1].bar(fx_response.index, fx_response['avg'], width=-20, align='edge'
, color='C9')
ax[1].bar(fx_response.index, fomc_dates['daily_pct_change'], width=+20,
align='edge', color='red', alpha=0.3)

ax[1].spines['top'].set_visible(False)
ax[1].spines['right'].set_visible(False)
ax[1].spines['bottom'].set_visible(False)
ax[1].set_ylabel('Exchange Rate Changes vs. Treasury Yields', fontsize=1
4, fontweight='bold')

ax[2].bar(bond_response.index, bond_response['avg'], width=-20, align='e
dge', color='C9')
ax[2].bar(bond_response.index, fomc_dates['daily_pct_change'], width=+20
, align='edge', color='red', alpha=0.3)

ax[2].spines['top'].set_visible(False)
ax[2].spines['right'].set_visible(False)
ax[2].set_ylabel('Bond Changes vs. Treasury Yields', fontsize=14, fontwe
ight='bold')

for tick in ax[2].xaxis.get_major_ticks():
    tick.label1.set_fontsize(14)

fig.subplots_adjust(hspace=0.1)

fig.suptitle("% Changes in Key Indicators vs. 2-Year-Treasury Yields", f
ontsize = 20, fontweight = "bold", y=0.9)
```

```
Out[156]: Text(0.5,0.9,'% Changes in Key Indicators vs. 2-Year-Treasury Yields')
```



These final graphs suggest there isn't a strong correlation between the expectedness of FOMC policy announcements and emerging market financial conditions, at least under the assumption that sudden changes in U.S. treasury yields signify surprise. That being said, there are a number of obvious reasons to question this conclusion, given the limit of the study.

Ways to improve/expand on this study are:

- Most significantly would be to incorporate more emerging countries, especially since China, India, and Brazil are three of the four largest emerging market economies, and as such have more developed financial systems that make them less vulnerable to schocks than other smaller economies
- Compensating for noise and/or country-specific factors that inevitably affect the data
- Using a different metric for determing "surprise" to FOMC announements, especially as the Great Recesion becomes further away and unconventional policy becomes the norm