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
```

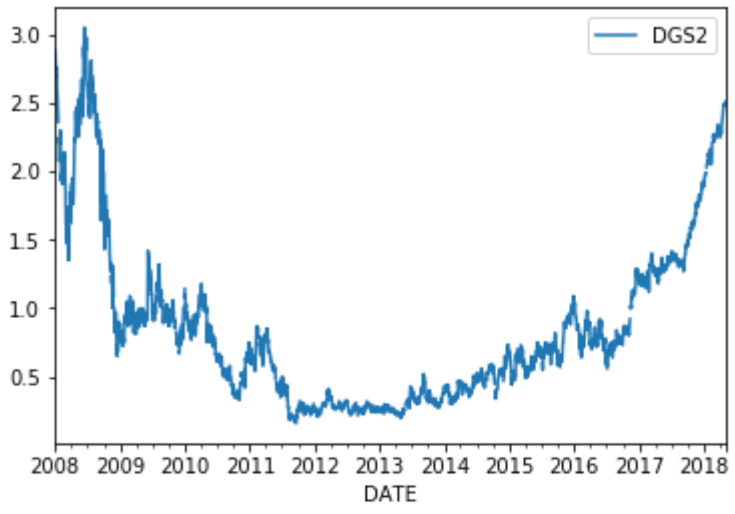
Section 1: Measuring reactions to FOMC announcements

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 0x113665e10>
```



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

Out[8]:

	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 [9]:
```
from pandas import ExcelWriter
from pandas import ExcelFile
from pandas import read_csv
```

In [10]:
```
path = '/Users/simon.ilisevich/Documents/Data_Bootcamp/fomc_dates.csv'
fomc_dates = read_csv(path, index_col='Date', usecols=['Date','Announcem
ents'])
```

In [12]:
```
fomc_dates.index.names = ['DATE']
fomc_dates.head()
```

Out[12]:

	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 [13]:
```
fomc_dates = fomc_dates.join(fred)
```

In [14]:
```
fomc_dates.head()
```

Out[14]:

	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 [15]: fomc_dates.index
```

```
Out[15]: 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 [18]: fred_mean = fred['daily_pct_change'].mean()
         fred_std = fred['daily_pct_change'].std()

         print(fred_mean)
         print(fred_std)
```

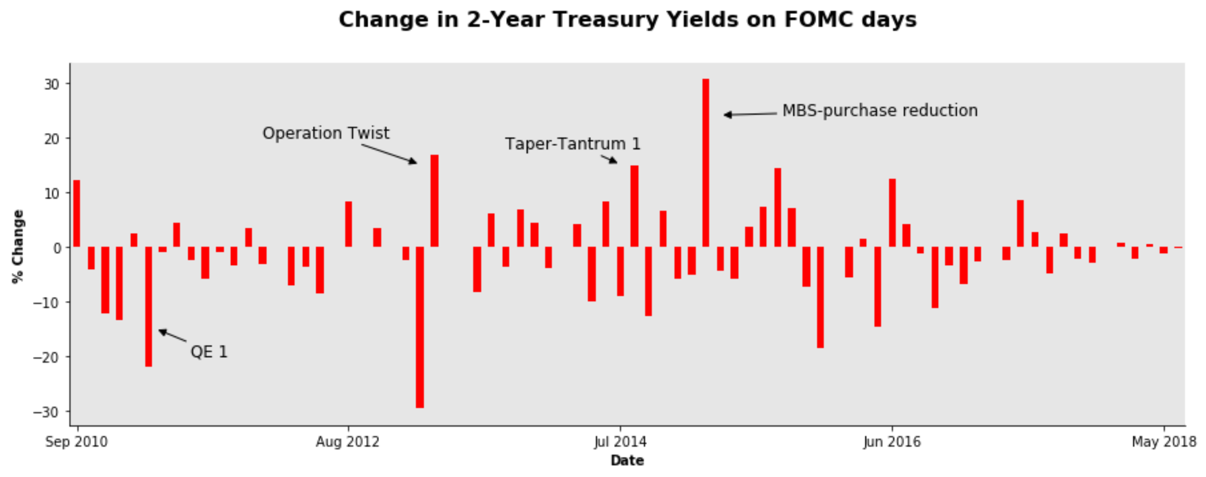
```
0.13556977235635276
5.324606758338174
```

```
In [132]: z = 2*fred_std + fred_mean
          z
```

```
Out[132]: 10.784783289032701
```

```
In [231]: 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 >= z 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[231]: Text(63,24,'MBS-purchase reduction')
```



Section 2: Importing 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 [229]: start = datetime.datetime(2008, 1, 1)
          end = datetime.datetime(2018, 5, 4)
          ch_equities = web.DataReader('^SHC', 'stooq', start, end)
          ch_equities.head()
```

```
Out[229]:
```

Exceeded the daily hits limit

India - BSE SENSEX

```
In [21]: start = datetime.datetime(2008, 1, 1)
         end = datetime.datetime(2018, 5, 4)
         in_equities = web.DataReader('^SNX', 'stooq', start, end)
         in_equities.head()
```

```
Out[21]:
```

Exceeded the daily hits limit

Russia - RTS Index

```
In [22]: start = ['2008-01-01']
         end = ['2018-05-04']
         ru_equities = web.DataReader('^RTS', 'stooq', start, end)
         ru_equities.head()
```

```
Out[22]:
```

Exceeded the daily hits limit

Getting rid of unecessary columns

```
In [23]: 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
         )
```

```
------------------------------------------------------------------------
----
IndexError                                Traceback (most recent call l
ast)
<ipython-input-23-0009dd8e348b> in <module>()
----> 1 ch_equities = ch_equities.drop(ch_equities.columns[[0, 1, 2, 4]
], axis=1)
      2 in_equities = in_equities.drop(in_equities.columns[[0, 1, 2, 4]
], axis=1)
      3 ru_equities = ru_equities.drop(ru_equities.columns[[0, 1, 2, 4]
], axis=1)

/anaconda3/lib/python3.6/site-packages/pandas/core/indexes/base.py in _
_getitem__(self, key)
   1698
   1699         key = _values_from_object(key)
-> 1700         result = getitem(key)
   1701         if not is_scalar(result):
   1702             return promote(result)

IndexError: index 0 is out of bounds for axis 1 with size 0
```

Adding in daily percentage change

```
In [27]: 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())
```

```
---------------------------------------------------------------------------
----
KeyError                                  Traceback (most recent call l
ast)
/anaconda3/lib/python3.6/site-packages/pandas/core/indexes/base.py in g
et_loc(self, key, method, tolerance)
   2441             try:
-> 2442                 return self._engine.get_loc(key)
   2443             except KeyError:

pandas/_libs/index.pyx in pandas._libs.index.IndexEngine.get_loc()

pandas/_libs/index.pyx in pandas._libs.index.IndexEngine.get_loc()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObj
ectHashTable.get_item()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObj
ectHashTable.get_item()

KeyError: 'ch_equity_change'

During handling of the above exception, another exception occurred:

KeyError                                  Traceback (most recent call l
ast)
/anaconda3/lib/python3.6/site-packages/pandas/core/internals.py in set
(self, item, value, check)
   3714         try:
-> 3715             loc = self.items.get_loc(item)
   3716         except KeyError:

/anaconda3/lib/python3.6/site-packages/pandas/core/indexes/base.py in g
et_loc(self, key, method, tolerance)
   2443             except KeyError:
-> 2444                 return self._engine.get_loc(self._maybe_cast_in
dexer(key))
   2445

pandas/_libs/index.pyx in pandas._libs.index.IndexEngine.get_loc()

pandas/_libs/index.pyx in pandas._libs.index.IndexEngine.get_loc()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObj
ectHashTable.get_item()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObj
ectHashTable.get_item()

KeyError: 'ch_equity_change'

During handling of the above exception, another exception occurred:

ValueError                                Traceback (most recent call l
ast)
<ipython-input-27-1b20f483c711> in <module>()
----> 1 ch_equities = ch_equities.assign(ch_equity_change = 100*ch_equi
ties.pct_change())
      2 in_equities = in_equities.assign(in_equity_change = 100*in_equi
ties.pct_change())
      3 ru_equities = ru_equities.assign(ru_equity_change = 100*ru_equi
ties.pct_change())

/anaconda3/lib/python3.6/site-packages/pandas/core/frame.py in assign(s
elf, **kwargs)
   2499         # ... and then assign
   2500         for k, v in sorted(results.items()):
-> 2501             data[k] = v
   2502 
   2503         return data

/anaconda3/lib/python3.6/site-packages/pandas/core/frame.py in __setite
m__(self, key, value)
   2329         else:
   2330             # set column
-> 2331             self._set_item(key, value)
   2332 
   2333     def _setitem_slice(self, key, value):

/anaconda3/lib/python3.6/site-packages/pandas/core/frame.py in _set_ite
m(self, key, value)
   2396         self._ensure_valid_index(value)
   2397         value = self._sanitize_column(key, value)
-> 2398         NDFrame._set_item(self, key, value)
   2399 
   2400         # check if we are modifying a copy

/anaconda3/lib/python3.6/site-packages/pandas/core/generic.py in _set_i
tem(self, key, value)
   1757 
   1758     def _set_item(self, key, value):
-> 1759         self._data.set(key, value)
   1760         self._clear_item_cache()
   1761 

/anaconda3/lib/python3.6/site-packages/pandas/core/internals.py in set
(self, item, value, check)
   3716         except KeyError:
   3717             # This item wasn't present, just insert at end
-> 3718             self.insert(len(self.items), item, value)
   3719             return
   3720 

/anaconda3/lib/python3.6/site-packages/pandas/core/internals.py in inse
rt(self, loc, item, value, allow_duplicates)
   3817 
   3818         block = make_block(values=value, ndim=self.ndim,
-> 3819                            placement=slice(loc, loc + 1))
   3820 
   3821         for blkno, count in _fast_count_smallints(self._blknos[
loc:]):

/anaconda3/lib/python3.6/site-packages/pandas/core/internals.py in make
_block(values, placement, klass, ndim, dtype, fastpath)
```

```
   2717                          placement=placement, dtype=dtype)
   2718
-> 2719     return klass(values, ndim=ndim, fastpath=fastpath, placemen
t=placement)
   2720
   2721 # TODO: flexible with index=None and/or items=None

/anaconda3/lib/python3.6/site-packages/pandas/core/internals.py in __in
it__(self, values, placement, ndim, fastpath)
    113             raise ValueError('Wrong number of items passed %d,
 placement '
    114                              'implies %d' % (len(self.values),
--> 115                                              len(self.mgr_loc
s)))
    116
    117     @property

ValueError: Wrong number of items passed 0, placement implies 1
```

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

In [ ]:
```
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 [ ]:
```
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 [24]: 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[24]:

	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

Exchange Rates

CNY/USD

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

INR/USD

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

RUB/USD

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

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

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

```
In [ ]: 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()
```

Bond Prices

Chinese 10-Year

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

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

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

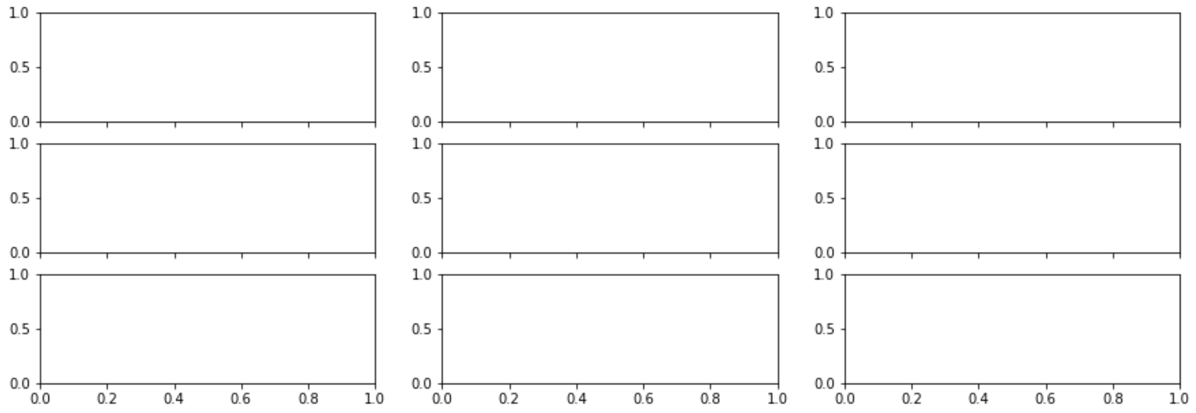
In [ ]:
```
market_response = market_response.join(ch_bond, how='left', lsuffix='_le
ft', rsuffix='_right').join(in_bond, how='left', lsuffix='_left', rsuffi
x='_right').join(ru_bond, how='left', lsuffix='_left', rsuffix='_right')
market_response.head()
```

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

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

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

In [232]:
```
fig, ax = plt.subplots(nrows = 3, ncols = 3, sharex = True, figsize = (1
5,5))

ax = ax.ravel()
```


1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0