2.Carry Trade Implementation

November 19, 2019

1 FX Leverage Carry-Trade

[42]:
```
import numpy as np
import pandas as pd
import matplotlib
import matplotlib.pyplot as plt
import carry_trade as ct
import datetime as dt

from date_function_v2 import holiday_adjust

matplotlib.rcParams[ 'figure.figsize' ] = ( 16, 9 )
font = {'family' : 'normal',
        'size'   : 20}

matplotlib.rc('font', **font)
```

1.1 1. Load data

[2]:
```
data_path_new = 'Data/to_send.csv'
final_data_new = pd.read_csv(data_path_new)
```

[3]:
```
final_data_new = final_data_new.set_index('Date')
final_data_new.index = pd.to_datetime(final_data_new.index)
```

[4]:
```
#final_data_new.iloc[324:]
```

1.2 2. Implement Strategy

[5]:
```
# if you want to test single currency or single trading period, just modify the␣
 ↪following list
fx_list = ['USD', 'AUD', 'GBP']
period_list = [7, 30, 60]
```

[6]:
```
# idx, row_row = next(final_data.iterrows())
# ct.find_max_signal(row_row, period_list, fx_list)
```

[7]:
```
results_07 = ct.algo_loop(final_data_new, fx_list, period_list, leverage = 2.0)
results_09 = ct.algo_loop(final_data_new.iloc[324:], fx_list, period_list,␣
↪leverage = 2.0)
```

```
2019-11-19 22:17:09:476546: Beginning Carry-Trade Strategy run
2019-11-19 22:17:23:462677: Algo run complete.
2019-11-19 22:17:23:463248: Beginning Carry-Trade Strategy run
2019-11-19 22:17:36:658169: Algo run complete.
```

[9]:
```
results_07.to_csv('Results/results_07.csv')
results_09.to_csv('Results/results_09.csv')
```

[8]:
```
results_09
```

[8]:
```
                  Signal FX_name Period Foreign_IR Domestic_IR  FX_Rate  \
Date
2009-01-02  0.000484649     GBP     2M    0.02505   0.0075625  133.563
2009-01-05  0.000484649     GBP     2M    0.02445   0.0073875  137.348
2009-01-06  0.000484649     GBP     2M  0.0240875   0.0071875   139.69
2009-01-07  0.000484649     GBP     2M   0.023675    0.007075   139.85
2009-01-08  0.000484649     GBP     2M  0.0230375   0.0069375  138.773
...                 ...     ...    ...        ...         ...      ...
2019-11-05  5.13588e-05     AUD     2M     0.0092   -0.000965   75.247
2019-11-06  5.13588e-05     AUD     2M     0.0093   -0.000935   75.024
2019-11-07  5.13588e-05     AUD     2M   0.009183  -0.0010383   75.385
2019-11-08  5.13588e-05     AUD     2M   0.009216    -0.00109   74.938
2019-11-11  5.13588e-05     AUD     2M     0.0091   -0.001135   74.704

              Equity Asset Pos Unreal_Return Real_Return  Drawdown
Date
2009-01-02    10000      20000     0.0014587           0         0
2009-01-05    10000      20000     0.0591682           0         0
2009-01-06    10000      20000     0.0946591           0         0
2009-01-07    10000      20000      0.096636           0         0
2009-01-08    10000      20000     0.0805256           0         0
...             ...        ...           ...         ...       ...
2019-11-05  16811.8    33623.7     0.0857553    0.681185 -0.301316
2019-11-06  16811.8    33623.7     0.0795475    0.681185 -0.301316
2019-11-07  16811.8    33623.7     0.0895318    0.681185 -0.301316
2019-11-08  16811.8    33623.7     0.0746929    0.681185 -0.301316
2019-11-11  16811.8    33623.7     0.0705299    0.681185 -0.301316

[2713 rows x 11 columns]
```

[21]:
```
print('Cumulative Return, after crisis:', results_09['Real_Return'][-1])
print('Cumulative Return, before crisis:', results_07['Real_Return'][-1])
print('Max Drawdown, after crisis:', results_09['Drawdown'].min())
print('Max Drawdown, before crisis:', results_07['Drawdown'].min())
```

```
Cumulative Return, after crisis: 0.6811848552276105
Cumulative Return, before crisis: -0.3585947561379189
Max Drawdown, after crisis: -0.3831904787844942
Max Drawdown, before crisis: -0.7247113114426323
```

[11]:
```
# if you want to test single currency or single trading period, just modify the
↪following list
usd_list = ['USD']
aud_list = ['AUD']
gbp_list = ['GBP']
```

[12]:
```
results_usd = ct.algo_loop(final_data_new.iloc[324:], usd_list, period_list,
↪leverage = 2.0)
results_aud = ct.algo_loop(final_data_new.iloc[324:], aud_list, period_list,
↪leverage = 2.0)
results_gbp = ct.algo_loop(final_data_new.iloc[324:], gbp_list, period_list,
↪leverage = 2.0)
```

```
2019-11-19 22:19:26:896856: Beginning Carry-Trade Strategy run
2019-11-19 22:19:38:339608: Algo run complete.
2019-11-19 22:19:38:340064: Beginning Carry-Trade Strategy run
2019-11-19 22:19:45:937960: Algo run complete.
2019-11-19 22:19:45:938454: Beginning Carry-Trade Strategy run
2019-11-19 22:19:54:804058: Algo run complete.
```

[13]:
```
results_usd.to_csv('Results/results_usd_09.csv')
print('Cumulative Return, USD only:', results_usd['Real_Return'][-1])
```

```
Cumulative Return, USD only: 0.015332769349171382
```

[14]:
```
results_aud.to_csv('Results/results_aud_09.csv')
print('Cumulative Return, AUD only:', results_aud['Real_Return'][-1])
```

```
Cumulative Return, AUD only: 0.3883647339032503
```

[15]:
```
results_gbp.to_csv('Results/results_gbp_09.csv')
print('Cumulative Return, GBP only:', results_gbp['Real_Return'][-1])
```

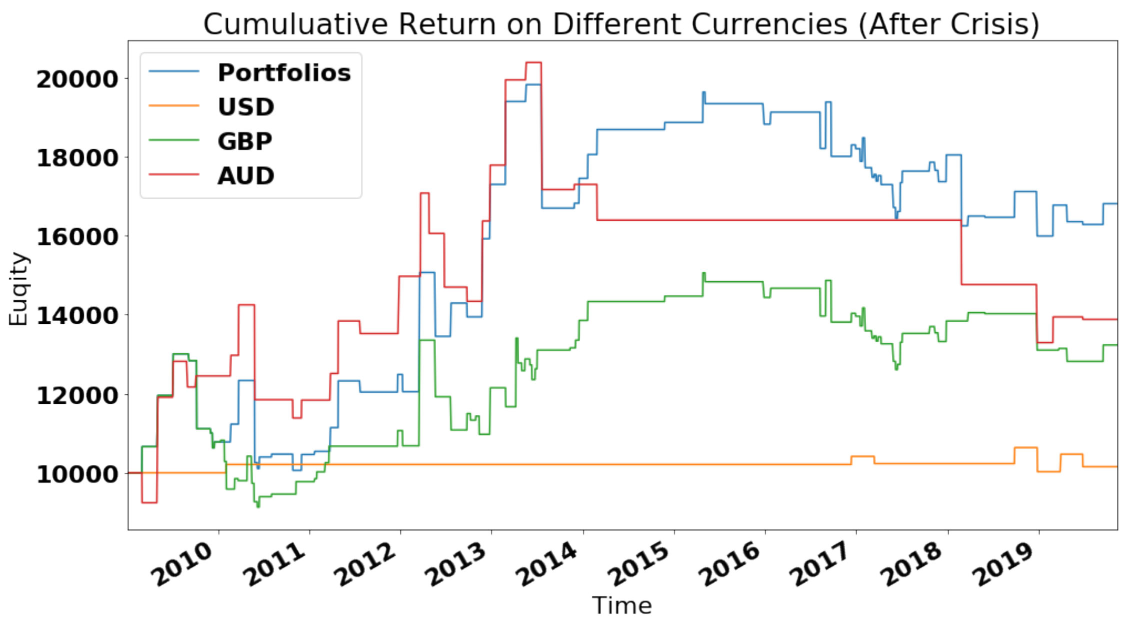
```
Cumulative Return, GBP only: 0.32343472268958107
```

1.3 3. Analysis

1.4 3.1 After Crisis

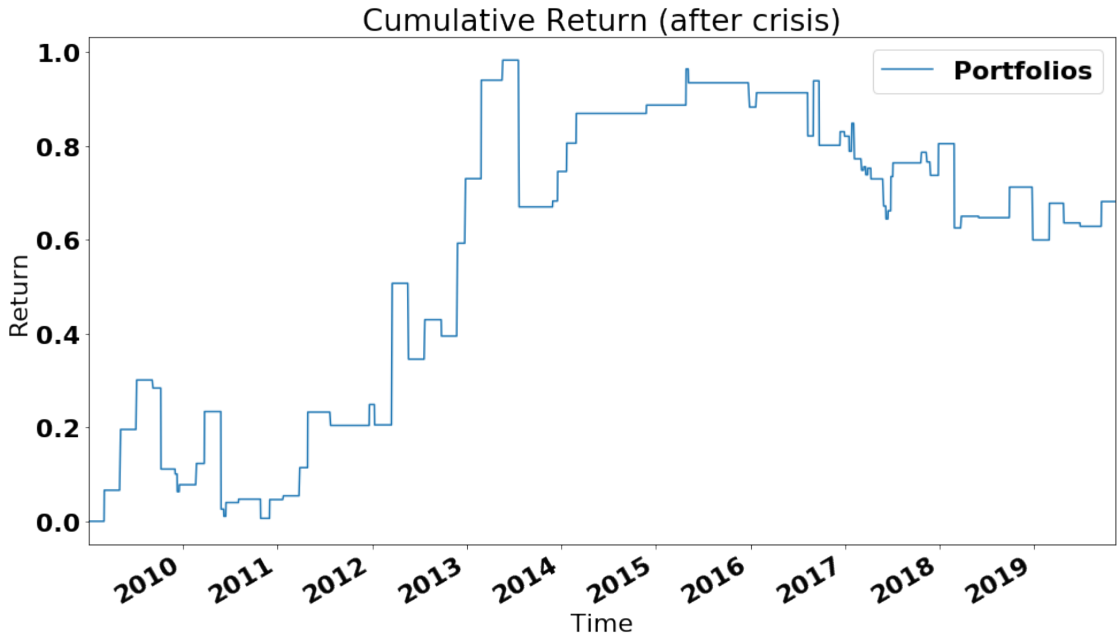
[USD, GBP, AUD]
put in one time series graph: [USD], [GBP], [AUD]

[29]:
```
results_09['Equity'].plot(label='Portfolios')
results_usd['Equity'].plot(label='USD')
results_gbp['Equity'].plot(label='GBP')
results_aud['Equity'].plot(label='AUD')
plt.legend()
plt.xlabel('Time')
plt.ylabel('Euqity')
plt.title('Cumulative Return on Different Currencies (After Crisis)')
plt.savefig('Results/Real_Return_4comb_post_crisis.jpg')
```



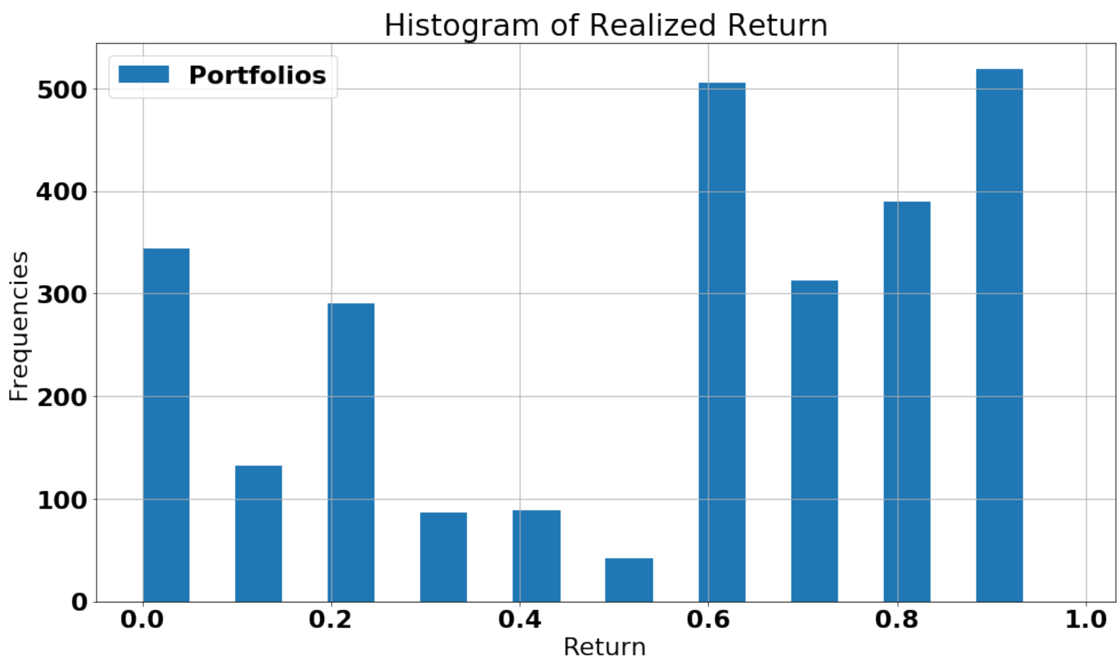
1.4.1 3.1.1 Realized Return Time Series

[22]:
```
results_09['Real_Return'].plot(label='Portfolios')
plt.legend()
plt.xlabel('Time')
plt.ylabel('Return')
plt.title('Cumulative Return (after crisis)')
plt.savefig('Results/Real_Return_post_crisis.jpg')
```



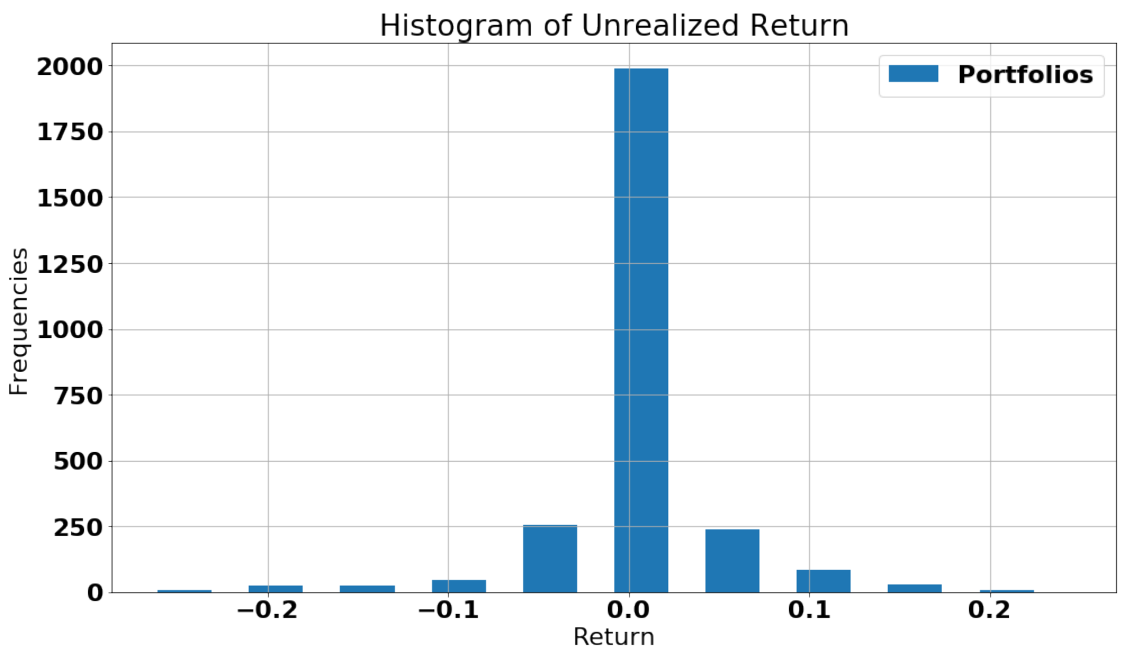
1.4.2 3.1.2 Realized Return Histogram

[23]:
```
results_09['Real_Return'].hist(width=0.05, label='Portfolios')
plt.legend()
plt.xlabel('Return')
plt.ylabel('Frequencies')
plt.title('Histogram of Realized Return')
plt.savefig('Results/Real_Return_hist_post_crisis.jpg')
```



1.4.3 3.1.3 Unrealized Return Histogram

[24]:
```
results_09['Unreal_Return'].hist(width=0.03, label='Portfolios')
plt.legend()
plt.xlabel('Return')
plt.ylabel('Frequencies')
plt.title('Histogram of Unrealized Return')
plt.savefig('Results/Unreal_Return_post_crisis.jpg')
```



1.4.4 3.1.4 Value at Risk

- sort return from smallest to largest
- calculate quantile(0.05) = 95%

[25]:
```
return_09 = results_09['Unreal_Return'].sort_values()
print('VaR at 90%:', return_09.quantile(0.1))
print('VaR at 95%:', return_09.quantile(0.05))
print('VaR at 99%:', return_09.quantile(0.01))
#return_09
```

```
VaR at 90%: -0.017924809982412096
VaR at 95%: -0.046255385546317449
VaR at 99%: -0.1626349052729469
```

1.4.5 3.1.5 Sharpe Ratio

mu / sigma

[26]:
```
sharpe_09 =  results_09['Unreal_Return'].mean()/results_09['Unreal_Return'].
 ↪std()
print('Sharpe Ratio each day:', sharpe_09)
print('Sharpe Ratio each year:', sharpe_09 * np.sqrt(251))
```

```
Sharpe Ratio each day: 0.15823949102082854
Sharpe Ratio each year: 2.5069850151429405
```

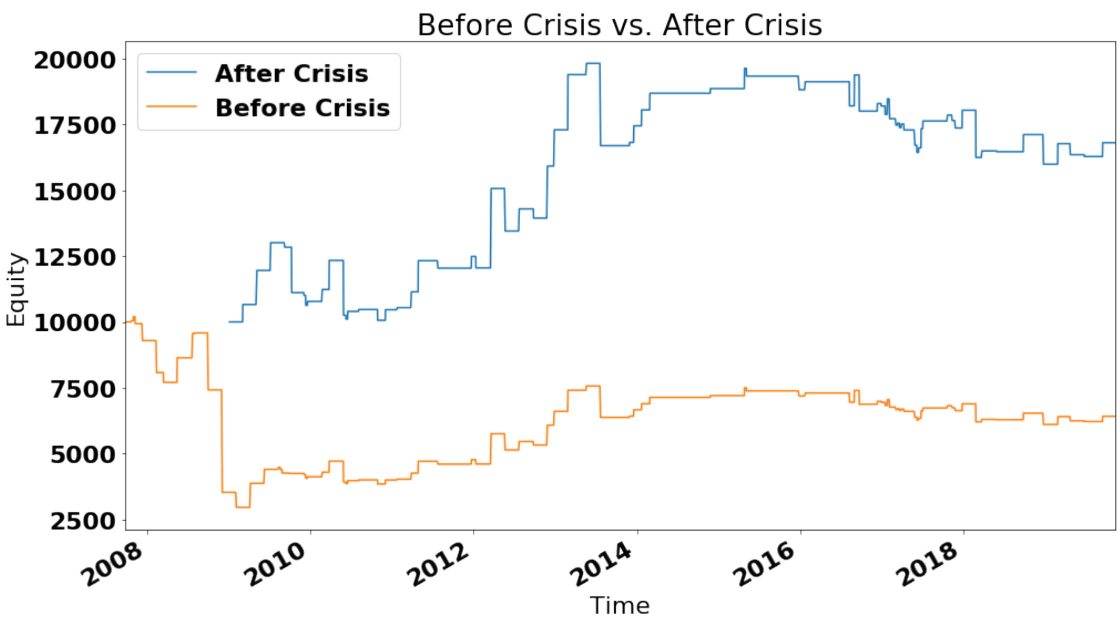
[27]:
```
volatility_09 = results_09['Real_Return'].std()
print('Volatility, after crisis:', volatility_09)
```

```
Volatility, after crisis: 0.31550667123808457
```

1.5 3.2 Before Crisis vs. After Crisis

time series graph; sharpe ratio

[30]:
```
results_09['Equity'].plot(label='After Crisis')
results_07['Equity'].plot(label='Before Crisis')
plt.legend()
plt.xlabel('Time')
plt.ylabel('Equity')
plt.title('Before Crisis vs. After Crisis')
plt.savefig('Results/Real_Return_before&post_crisis.jpg')
```



[37]:
```
sharpe_07 =  results_07['Unreal_Return'].mean()/results_07['Unreal_Return'].
 ↪std()
print('Sharpe Ratio each day, before crisis:', sharpe_07)
print('Sharpe Ratio each year, before crisis:', sharpe_07 * np.sqrt(251))
```

```
Sharpe Ratio each day, before crisis: 0.011846622873341955
Sharpe Ratio each year, before crisis: 0.18768580353692282
```

[28]:
```
volatility_07 = results_07['Real_Return'].std()
print('Volatility, after crisis:', volatility_09)
```

```
print('Volatility, before crisis:', volatility_07)
```

```
Volatility, after crisis: 0.31550667123808457
Volatility, before crisis: 0.1516022133265221
```

1.5.1 3.2.1 Value at Risk

[38]:
```
return_09 = results_09['Unreal_Return'].sort_values()
print('VaR at 90%, after crisis:', return_09.quantile(0.1))
print('VaR at 95%, after crisis:', return_09.quantile(0.05))
print('VaR at 99%, after crisis:', return_09.quantile(0.01))
#return_09
```

```
VaR at 90%, after crisis: -0.017924809982412096
VaR at 95%, after crisis: -0.046255385546317 49
VaR at 99%, after crisis: -0.1626349052729469
```

[39]:
```
return_07 = results_07['Unreal_Return'].sort_values()
print('VaR at 90%, before crisis:', return_07.quantile(0.1))
print('VaR at 95%, before crisis:', return_07.quantile(0.05))
print('VaR at 99%, before crisis:', return_07.quantile(0.01))
#return_09
```

```
VaR at 90%, before crisis: -0.03720340479002022
VaR at 95%, before crisis: -0.09568580250763162
VaR at 99%, before crisis: -0.23524271427766016
```

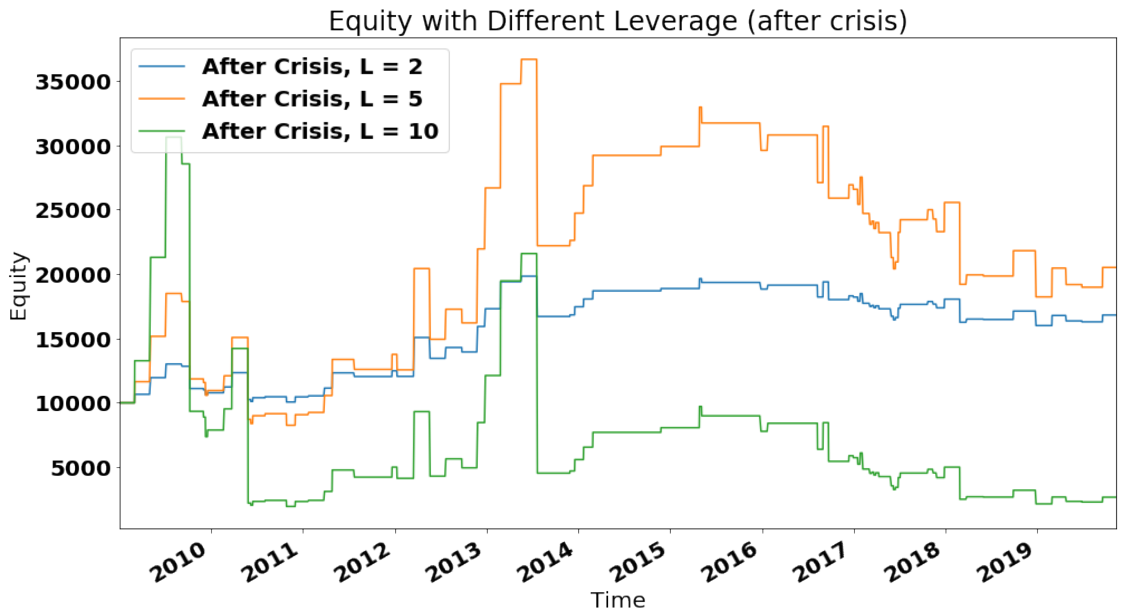
1.6 3.3 Leverage Analysis

[31]:
```
results_09_l5 = ct.algo_loop(final_data_new.iloc[324:], fx_list, period_list,␣
 ↪leverage = 5.0)
results_09_l10 = ct.algo_loop(final_data_new.iloc[324:], fx_list, period_list,␣
 ↪leverage = 10.0)
```

```
2019-11-19 22:29:35:299234: Beginning Carry-Trade Strategy run
2019-11-19 22:29:49:360151: Algo run complete.
2019-11-19 22:29:49:360672: Beginning Carry-Trade Strategy run
2019-11-19 22:30:03:264973: Algo run complete.
```

[44]:
```
results_09['Equity'].plot(label='After Crisis, L = 2')
results_09_l5['Equity'].plot(label='After Crisis, L = 5')
results_09_l10['Equity'].plot(label='After Crisis, L = 10')
plt.legend()
plt.xlabel('Time')
plt.ylabel('Equity')
plt.title('Equity with Different Leverage (after crisis)')
```

```
plt.savefig('Results/Real_Return_leverages_post_crisis.jpg')
```



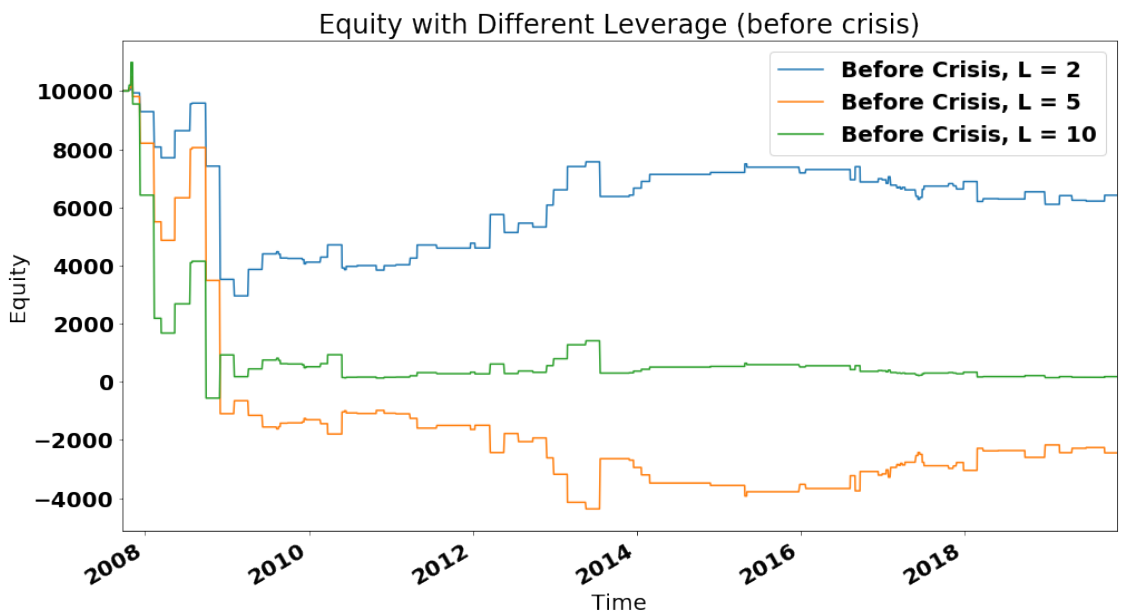
[34]:
```
sharpe_09 =  results_09['Unreal_Return'].mean()/results_09['Unreal_Return'].
 ↪std()
sharpe_09_l5 =  results_09_l5['Unreal_Return'].mean()/
 ↪results_09_l5['Unreal_Return'].std()
sharpe_09_l10 =  results_09_l10['Unreal_Return'].mean()/
 ↪results_09_l10['Unreal_Return'].std()
print('L2, Sharpe Ratio each year:', sharpe_09 * np.sqrt(251))
print('L5, Sharpe Ratio each year:', sharpe_09_l5 * np.sqrt(251))
print('L10, Sharpe Ratio each year:', sharpe_09_l10 * np.sqrt(251))
```

```
L2, Sharpe Ratio each year: 2.5069850151429405
L5, Sharpe Ratio each year: 2.4878586178373836
L10, Sharpe Ratio each year: 2.481475446063007
```

[33]:
```
results_07_l5 = ct.algo_loop(final_data_new, fx_list, period_list, leverage = 5.
 ↪0)
results_07_l10 = ct.algo_loop(final_data_new, fx_list, period_list, leverage =␣
 ↪10.0)
```

```
2019-11-19 22:30:29:470253: Beginning Carry-Trade Strategy run
2019-11-19 22:30:44:457826: Algo run complete.
2019-11-19 22:30:44:458072: Beginning Carry-Trade Strategy run
2019-11-19 22:30:58:631277: Algo run complete.
```

[45]:
```
results_07['Equity'].plot(label='Before Crisis, L = 2')
results_07_l5['Equity'].plot(label='Before Crisis, L = 5')
results_07_l10['Equity'].plot(label='Before Crisis, L = 10')
plt.legend()
plt.xlabel('Time')
plt.ylabel('Equity')
plt.title('Equity with Different Leverage (before crisis)')
plt.savefig('Results/Real_Return_leverage_before_crisis.jpg')
```



[36]:
```
sharpe_07 =  results_07['Unreal_Return'].mean()/results_07['Unreal_Return'].
 ↪std()
sharpe_07_l5 =  results_07_l5['Unreal_Return'].mean()/
 ↪results_07_l5['Unreal_Return'].std()
sharpe_07_l10 =  results_07_l10['Unreal_Return'].mean()/
 ↪results_07_l10['Unreal_Return'].std()
print('L2, Sharpe Ratio each year:', sharpe_07 * np.sqrt(251))
print('L5, Sharpe Ratio each year:', sharpe_07_l5 * np.sqrt(251))
print('L10, Sharpe Ratio each year:', sharpe_07_l10 * np.sqrt(251))
```

```
L2, Sharpe Ratio each year: 0.18768580353692282
L5, Sharpe Ratio each year: 0.15795741508622746
L10, Sharpe Ratio each year: 0.14805875981358932
```

[ ]: