Project 5 - Equilibrium Foreign Exchange in Python

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Contents

1 Objectives

The project is aimed at explanation of macroeconomic factors influence on FX evolution.

1.1 Definitions

1. **Cointegration** is an econometric technique for testing the correlation between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated.

2. The **equilibrium foreign exchange** represents the foreign exchange indicated by macroeconomic indicators (basically the results of a regression in our case)

1.2 Algorithm

- Choose macroeconomic factors
- Implement a regression
- Analyze how accurate are regression results

2 Data

- For the project USD/JPY currency pair was chosen.
- Macroeconomic factors:
  - Consumer Price Index
  - 10-Year Treasury Constant Maturity Rate (I will call it just Interest Rate)

2.1 Data Source

The historical data of CPI is downloaded from the FRED

3 Implementation Details

Python code in the project is fairly not so difficult, so I do not pay big attention to it here.

3.1 Data Download

As was mentioned before the data was downloaded from FRED using **python pandas_datereader** package:

```
from pandas_datareader import data as pdr
pdr.DataReader()
```

I decided to analyze data for 30 last months. Moreover, as a first parameter I consider a fraction: $\frac{CPI\_USA}{CPI\_JPN}$, the second parameter is mentioned USA interest rate.

3.2 Regression in Python

To implement a regression in python **statsmodels** package can be used:

```
import statsmodels.api as sm
sm.add_constant()
model =sm.OLS()
model.fit()
```

4 Results

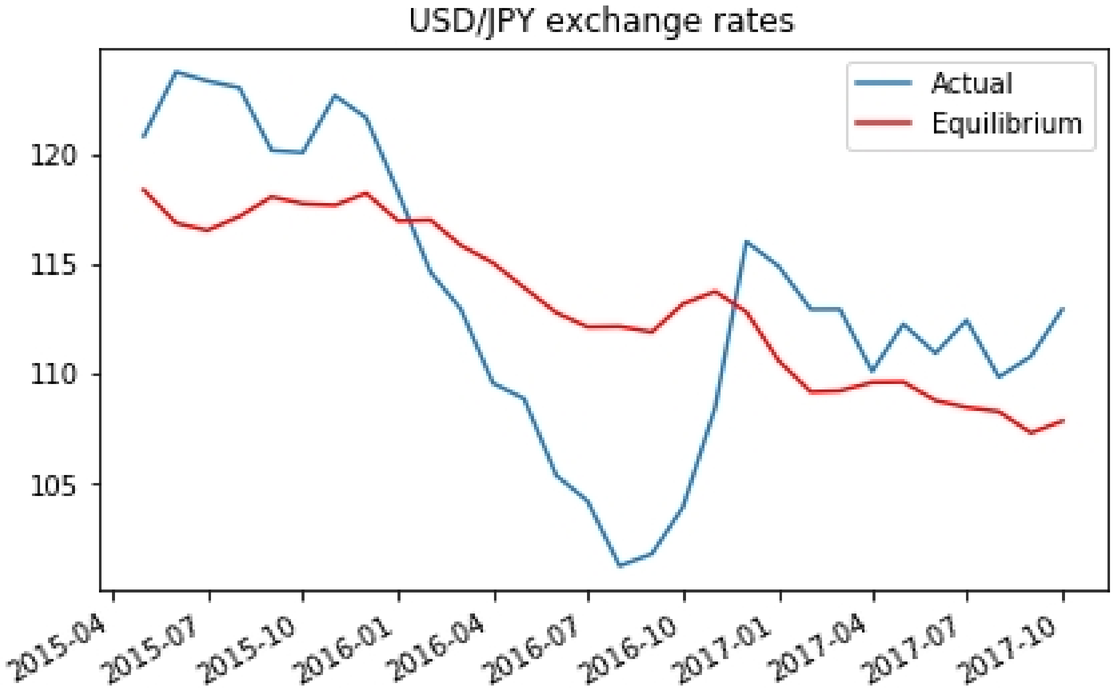
```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 EXJPUS   R-squared:                       0.315
Model:                            OLS   Adj. R-squared:                  0.291
Method:                 Least Squares   F-statistic:                     12.88
Date:                Tue, 13 Feb 2018   Prob (F-statistic):            0.00125
Time:                        01:33:16   Log-Likelihood:                 48.954
No. Observations:                  30   AIC:                            -93.91
Df Residuals:                      28   BIC:                            -91.10
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          4.9046      0.050     98.483      0.000       4.803       5.007
0             -2.7399      0.764     -3.588      0.001      -4.304      -1.176
==============================================================================
Omnibus:                        4.434   Durbin-Watson:                   0.240
Prob(Omnibus):                  0.109   Jarque-Bera (JB):                3.964
Skew:                          -0.827   Prob(JB):                        0.138
Kurtosis:                       2.338   Cond. No.                         85.7
==============================================================================
```

As we can see both coefficients are significant, moreover, we can see that increase in $\frac{CPI\_USA}{CPI\_JPN}$ ratio leads to appreciation of JPY (decrease in ratio $\frac{USD}{JPY}$). This works as expected, however $R^2 = 0.315$ that means that approximately 30% are explained by the model. The result of the model fairly is not reliable.

We can be even more precise. Log-level regression coefficients (except of the intercept) may be interpreted as a percentage. (see this link)

As a result we can conclude that change in CPI ratio by 1% leads to 2.74% change in exchange rate.

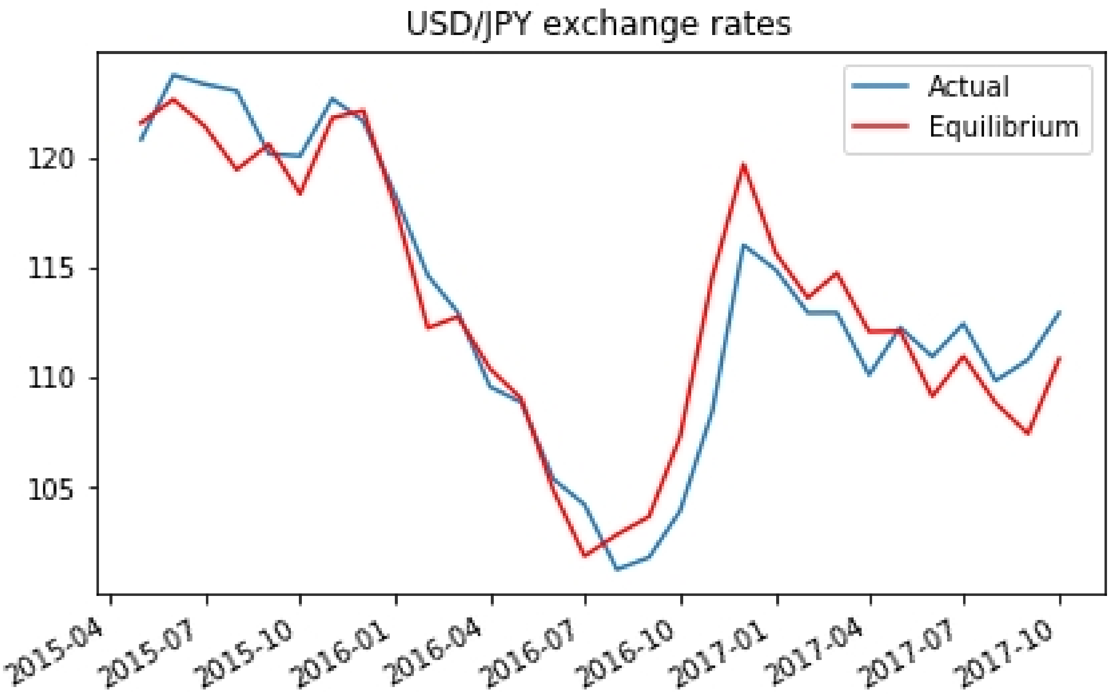
However, when we use 2 factors the result is really great! All coefficients are significant and $R^2 = 0.892$ that means that approximately 90% changes in exchange rate can be explained by this model! The interpretation above (with percentage) may be applied here as well.



As we can see on the graph our modeling is not so accurate.

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 EXJPUS   R-squared:                       0.892
Model:                            OLS   Adj. R-squared:                  0.884
Method:                 Least Squares   F-statistic:                     111.3
Date:                Tue, 13 Feb 2018   Prob (F-statistic):           9.13e-14
Time:                        01:33:16   Log-Likelihood:                 76.639
No. Observations:                  30   AIC:                            -147.3
Df Residuals:                      27   BIC:                            -143.1
Df Model:                           2
Covariance Type:            nonrobust
=================================================================================
                    coef    std err          t      P>|t|      [0.025      0.975]
---------------------------------------------------------------------------------
const             4.6234      0.031    149.599      0.000       4.560       4.687
0                -3.4491      0.315    -10.964      0.000      -4.095      -2.804
USACPIALLMINMEI   0.1553      0.013     11.999      0.000       0.129       0.182
==============================================================================
Omnibus:                        4.870   Durbin-Watson:                   0.746
Prob(Omnibus):                  0.088   Jarque-Bera (JB):                3.269
Skew:                          -0.742   Prob(JB):                        0.195
Kurtosis:                       3.643   Cond. No.                         204.
==============================================================================
```

Graph shows how actually close model results and actual data are.


USD/JPY exchange rates
Actual
Equilibrium
120
115
110
105
2015-04
2015-07
2015-10
2016-01
2016-04
2016-07
2016-10
2017-01
2017-04
2017-07
2017-10