On the Persistence of Cointegration in Pairs Trading

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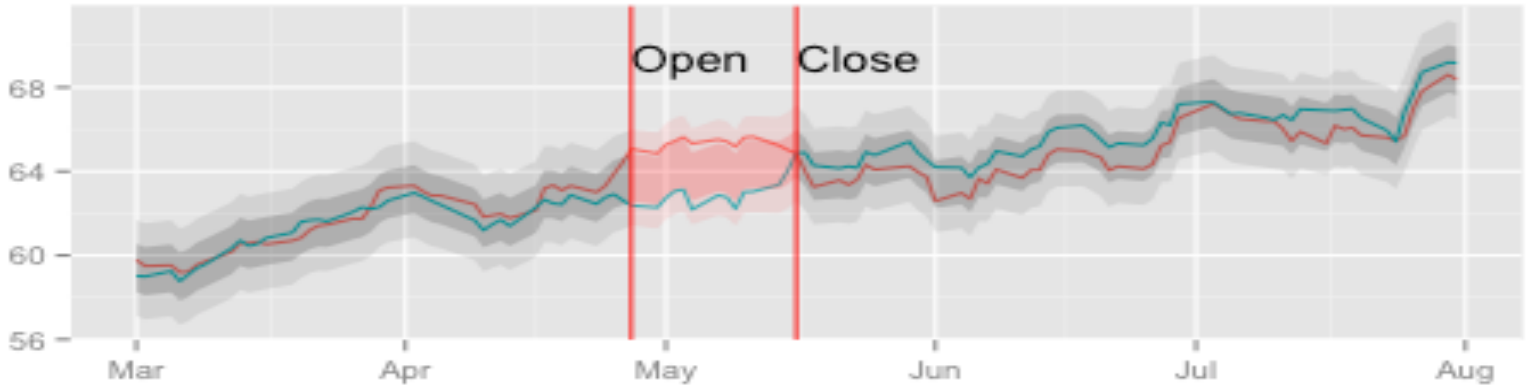
Pairs Trading



Coca-Cola (KO) vs. Pepsi (PEP), 3/1/2013 – 7/13/2013
(source: Yahoo!)

How to Make a Pairs Trade:

1. Identify two securities that tend to travel together.
2. When a gap opens between their prices, buy the cheaper security and sell short the more expensive one.
3. When the gap closes, close the position and collect a profit.

Cointegration

X_t and Y_t are cointegrated if:

(a) Neither series is mean-reverting by itself, and

(b) Some linear combination of X_t and Y_t is mean-reverting

In equations:

$$Y_t = \alpha + \beta X_t + R_t$$
$$R_t = \rho R_{t-1} + \varepsilon_t$$

Engle-Granger two step procedure:

1. Find α and β through a linear fit of Y_t vs. X_t
2. Find ρ through a linear of R_t vs R_{t-1}

Check whether $|\rho| = 1$

Persistence Defined

What a cointegration test distinguishes between:

- H_0 During the formation period, the price series of the two securities were not cointegrated.
- H_1 During the formation period, the price series of the two securities were cointegrated.

What we really want to know:

- H_2 During the trading period, the price series of the two securities will be cointegrated.

The pair is deemed persistent if $H_1 \Rightarrow H_2$

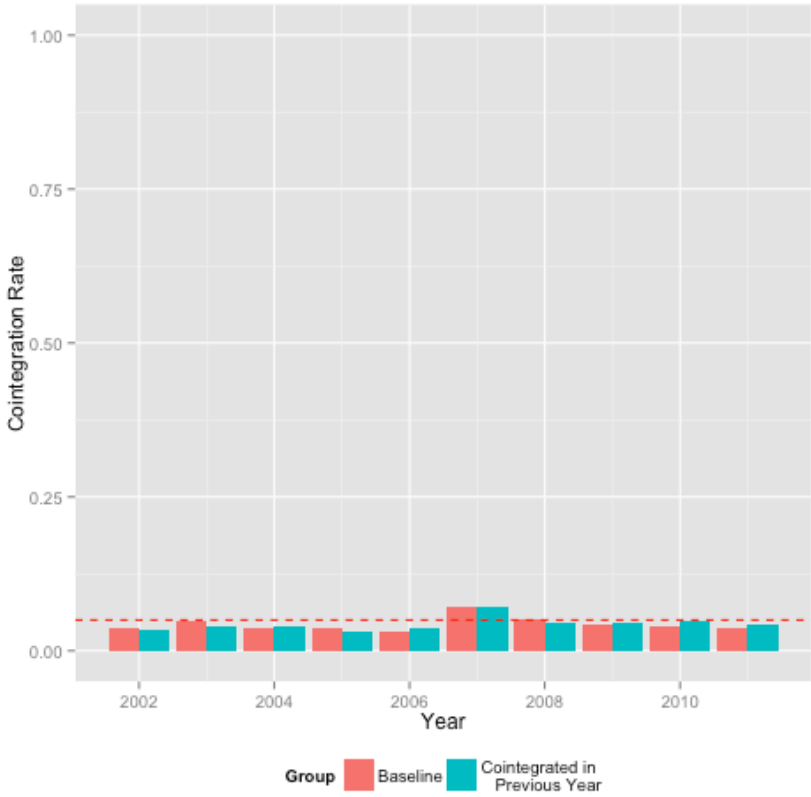
Data Set

- Adjusted closing prices of S&P 500 components as of 8/13/2014 for the period 1/1/2002 – 12/31/2012 were downloaded from Yahoo!.
- Data is divided into one year periods by calendar year.
- Over 860,000 pairs were examined

Main Result:
No Evidence of Persistence Found

Many different combinations were tried:

- 6 different unit root tests
- Logged and unlogged series
- 1-year and 2-year formation periods
- p=0.05 and p=0.01
- False discovery rates tried in place of p-values
- Also looked for evidence of short-term persistence

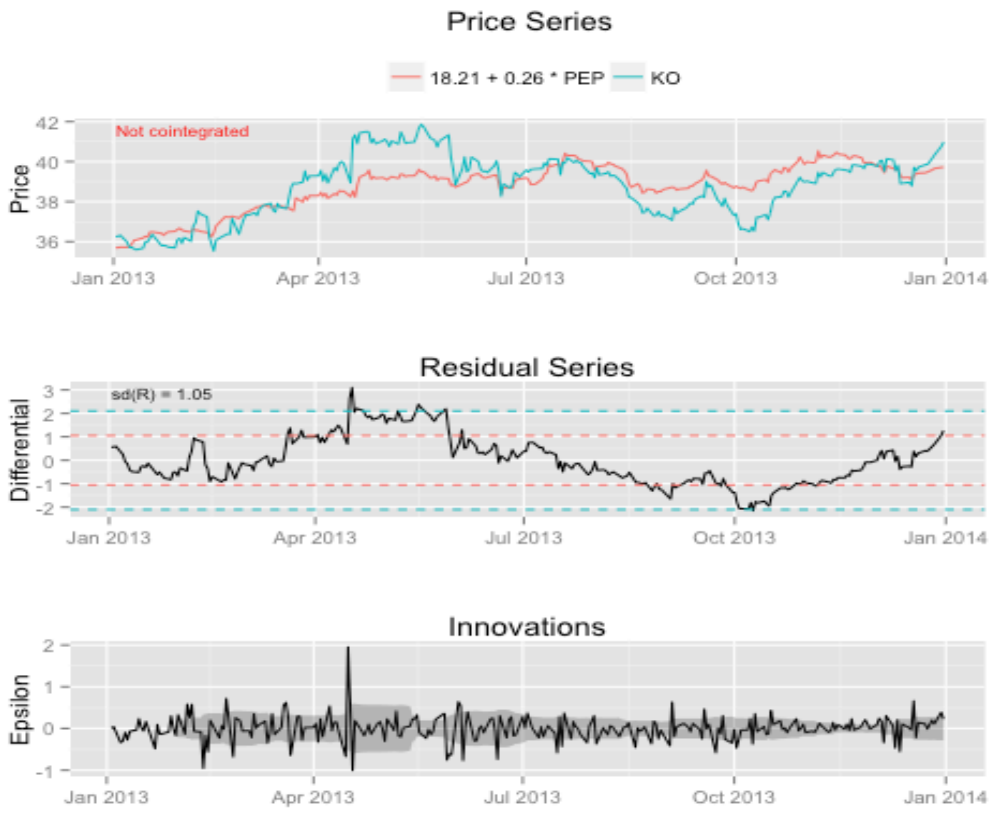


EGCM package
(Engle-Granger Cointegration Models)

```
> library(egcm)
> yegcm("PEP", "KO", 20130101, 20131231)
KO[i] =   0.2611 PEP[i] +  18.2149 + R[i],
         (0.0147)          (1.1702)
R[i] =   0.9857 R[i-1] + eps[i],
        (0.0184)
eps ~ N(0,  0.3064^2)

R[2013-12-31] = 1.2660 (t = 1.204)

WARNING: PEP and KO do not appear to be
cointegrated.
```




```
> plot(yegcm("PEP", "KO", 20130101, 20131231))
```