Fund of Funds

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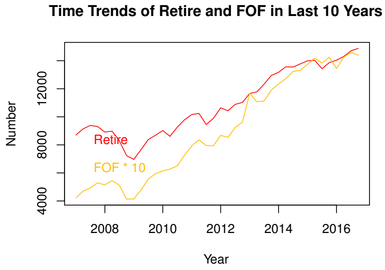
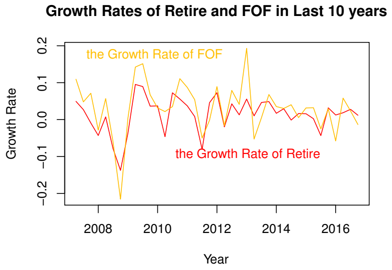
- In this part, we would explore the relationship between the fund market and the retirement market.
- The Fund of Funds is favoured by risk averter, especially for those who have retired.
- There might be cointegration relationships bewteen the two markets.





Unit Root Test

3 tests are employed here: ADF-Test, KPSS-Test, and PP-Test (Phillips-Perron Test).

Unit Root Test of Retire

Test Method	Statistics	10pct	5pct	1pct
ADF	1.64	-1.61	-1.95	-2.62
KPSS	1.01	0.35	0.46	0.74
PP	0.23	*	0.26	*

Unit Root Test of the Difference of Retire

Test Method	Statistics	10pct	5pct	1pct
ADF	-2.31	-1.61	-1.95	-2.62
KPSS	0.18	0.35	0.46	0.74
PP	1.55	*	0.26	*

Unit Root Test of FOF

Test Method	Statistics	10pct	5pct	1pct
ADF	2.53	-1.61	-1.95	-2.62
KPSS	1.07	0.35	0.46	0.74

Unit Root Test

3 tests are employed here: ADF-Test, KPSS-Test, and PP-Test (Phillips-Perron Test).

TEST Method	ADF	KPSS	PP
FOF	2.53	1.07	-0.16
diff(FOF)	-3.40	0.11	40
Retire	1.64	1.01	0.23
diff(Retire)	-2.31	0.18	1.55
10pct	-1.61	0.35	*
5pct	-1.95	0.46	0.26
1pct	-2.62	0.74	*

Cointegration Relationship 1

First, estimate relationship between FOF and Retire.
$FOF_t = \alpha + \beta * Retire_t + \mu_t$

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -7.552e+02  5.632e+01  -13.41 5.51e-16 ***
retire       1.524e-01  5.042e-03   30.22  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 74.18 on 38 degrees of freedom
Multiple R-squared:  0.9601,    Adjusted R-squared:  0.959
F-statistic: 913.5 on 1 and 38 DF,  p-value: < 2.2e-16
```

Next, do unit root test on μ_t. The results show that μ_t is white noise sequence. So two $I(1)$ processes combines to one $I(0)$ process. It indicates the cointegration relationship between FOF and Retire. And the cointegration vector is $(1, -0.15)$.

Error Correction Model 1

Establish Error Correction Model use lags of FOF and Retire, and the residuals got before. Let $y = diff(FOF)$ and $x = diff(Retire)$. And set the ecm equation as
$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \alpha_3 y_{t-3} + \alpha_4 y_{t-4} + \beta_0 x_t + \beta_1 x_{t-1} + \gamma r_{t-1} + \epsilon_t$.
The results are as follows.

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 22.13335   11.14436   1.986   0.0573 .
L(y, 1)     -0.46108    0.19994  -2.306   0.0290 *
L(y, 2)     -0.01601    0.12908  -0.124   0.9022
L(y, 3)     -0.03563    0.12999  -0.274   0.7861
L(y, 4)     -0.02875    0.13862  -0.207   0.8373
L(x, 1)      0.05842    0.02549   2.292   0.0300 *
L(x, 0)      0.09517    0.01852   5.138  2.1e-05 ***
L(r, 1)     -0.38373    0.16855  -2.277   0.0309 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 40.94 on 27 degrees of freedom
Multiple R-squared:  0.5683,    Adjusted R-squared:  0.4564
F-statistic: 5.078 on 7 and 27 DF,  p-value: 9e-04
```

Cointegration in Log

The $\log$ function is usually employed when dealing with macro-data. The Unit Root Test of $\log(FOF)$ and $\log(Retire)$ are as follows.

TEST Method	ADF	KPSS	PP
log(FOF)	2.28	1.07	-1.04
diff(log(FOF))	-3.74	0.10	-28.59
log(Retire)	1.39	1.00	-0.41
diff(log(Retire))	-2.67	0.12	-25.56
10pct	-1.61	0.35	*
5pct	-1.95	0.46	0.26
1pct	-2.62	0.74	*

Cointegration Relationship 2

Repeat the process before.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -10.93630    0.76678  -14.26   <2e-16 ***
log(retire)   1.90423    0.08264   23.04   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1122 on 38 degrees of freedom
Multiple R-squared:  0.9332,    Adjusted R-squared:  0.9315
F-statistic: 530.9 on 1 and 38 DF,  p-value: < 2.2e-16
```

Error Correction Model 2

Let $y = diff(log(FOF))$ and $x = log(diff(Retire))$
$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \alpha_3 y_{t-3} + \alpha_4 y_{t-4} + \beta_0 x_t + \beta_1 x_{t-1} + \gamma r_{t-1} + \epsilon_t$.

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.01921    0.01097   1.750   0.0915 .
L(y, 1)     -0.27010    0.19590  -1.379   0.1793
L(y, 2)     -0.03732    0.11204  -0.333   0.7416
L(y, 3)     -0.02120    0.11345  -0.187   0.8532
L(y, 4)     -0.01700    0.11327  -0.150   0.8818
L(x, 0)      1.21439    0.19466   6.238 1.13e-06 ***
L(x, 1)      0.56210    0.30853   1.822   0.0796 .
L(r, 1)     -0.16838    0.13785  -1.221   0.2325
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04489 on 27 degrees of freedom
Multiple R-squared:  0.688,     Adjusted R-squared:  0.6071
F-statistic: 8.506 on 7 and 27 DF,  p-value: 1.717e-05
```

Cointegration Relationship Three

Error Correction Model Three