DOLS Assignment

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1 Loading Data

```
data <- read.csv('WARNER.csv') %>% mutate(
  year = YR+1900,
  lx = log(X),
  lwi = log(WI),
  lwc = log(WC),
  lwgnp = log(WGNP),
  lpx = log(PX),
  indexwi = (WI/989.42)*100,
  indexwc = (WC/3496.09)*100
) %>% tsibble(index = year)
```

2 Plotting

As seen in Figure 1, Indexwi follows the data far more closely.

3 Testing

3.1 ADF Results

```
adf_results <- tribble(
  ~variable, ~'t-stat', ~'1pct', ~'5pct', ~'10pct'
)
a <- data %>% select(lx, lwi, lwc, lpx)
for (i in seq(1,4)) {
  g <- get_stat(ur.df(pull(a[i]), type='drift', lags=1))
  g['variable'] = names(a[i])
  adf_results <- rbind(adf_results, g)
}
adf_results
```

t-stat	1pct	5pct	10pct	variable
-0.2244284	-3.75	-3	-2.63	lx
-0.7272847	-3.75	-3	-2.63	lwi
-3.1041147	-3.75	-3	-2.63	lwc
-0.9863677	-3.75	-3	-2.63	lpx

As seen in the table, we can reject the null hypothesis of a unit root for lwc. For all other variables (lx, lwi, lpx), we cannot reject the null hypothesis. Having a unit root means I(1), so we cannot reject the possibility of those three being I(1). We can, however, reject it for lwc, and it is likely that it is I(0). This agrees with Warner.

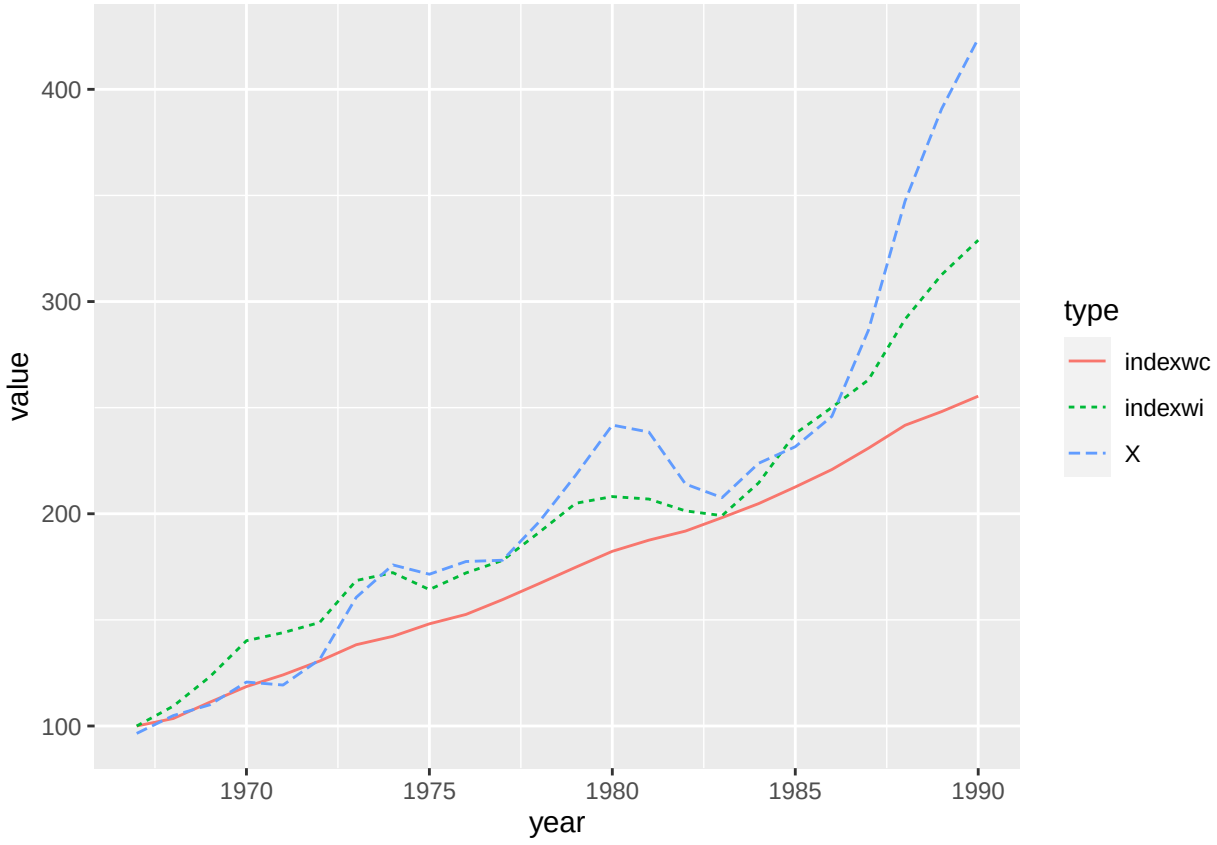

Figure 1: Plot of indexwi and indexwc on x

3.2 Johansen Cointegration Test

Date: 04/12/22 Time: 16:30
Sample: 1967 1990
Included observations: 22
Series: LPX LWC LWI LX
Lags interval: 1 to 1

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	2	3	2	2
Max-Eig	2	2	3	2	2

*Critical values based on MacKinnon-Haug-Michelis (1999)

Figure 2: Johansen Test Result

There is at least one cointegrating vector. As shown in Figure 2, no matter which assumption picked, there is at least one cointegrating vector at a 0.05 level.

4 Dynamic OLS

Results in Figure 3, results are accurate and match Warner exactly.

5 Forecasting

Figure 4 shows the WI Result and Figure 5 shows the GNP result. WI seems to be the better variable.

5.1 Graph

Figure 6 shows the forecast plot for WI. Figure 7 shows the plot for GNP. As you can see, WI seems to be the more accurate estimator.

6 Conclusion

Yes, it seems that global investment is driven by world investment quite a bit.

Dependent Variable: LX
Method: Dynamic Least Squares (DOLS)
Date: 04/13/22 Time: 20:27
Sample (adjusted): 1969 1989
Included observations: 21 after adjustments
Cointegrating equation deterministics: C
Static OLS leads and lags specification
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LWI	1.234285	0.270928	4.555761	0.0008
LWC	-0.162992	0.212240	-0.767960	0.4587
LPX	-0.535145	0.131731	-4.062419	0.0019
DLWI	-0.048455	0.187538	-0.258376	0.8009
DLPX	0.597326	0.092300	6.471596	0.0000
DLWI(1)	0.147596	0.118292	1.247725	0.2380
DLWI(-1)	-0.153595	0.098602	-1.557729	0.1476
DLPX(1)	0.186134	0.100631	1.849664	0.0914
DLPX(-1)	0.238410	0.078154	3.050509	0.0110
C	-0.152095	0.916115	-0.166022	0.8712

R-squared	0.997700	Mean dependent var	5.289194
Adjusted R-squared	0.995819	S.D. dependent var	0.332488
S.E. of regression	0.021499	Sum squared resid	0.005084

Figure 3: DOLS Test Result

Dependent Variable: LX
Method: Least Squares
Date: 04/13/22 Time: 21:21
Sample (adjusted): 1969 1984
Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.762799	1.169784	0.652085	0.5277
LWI	1.005525	0.091049	11.04383	0.0000
LPX	0.037266	0.122652	0.303830	0.7669
LPX(-1)	-0.453213	0.185933	-2.437511	0.0330
LPX(-2)	-0.252382	0.121339	-2.079981	0.0617

R-squared	0.992345	Mean dependent var	5.165438
Adjusted R-squared	0.989561	S.D. dependent var	0.256062
S.E. of regression	0.026162	Akaike info criterion	-4.198680
Sum squared resid	0.007529	Schwarz criterion	-3.957247
Log likelihood	38.58944	Hannan-Quinn criter.	-4.186317
F-statistic	356.4760	Durbin-Watson stat	1.900989
Prob(F-statistic)	0.000000		

Figure 4: WI Result

Dependent Variable: LX
Method: Least Squares
Date: 04/13/22 Time: 21:21
Sample (adjusted): 1969 1984
Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.762799	1.169784	0.652085	0.5277
LWI	1.005525	0.091049	11.04383	0.0000
LPX	0.037266	0.122652	0.303830	0.7669
LPX(-1)	-0.453213	0.185933	-2.437511	0.0330
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Adjusted R-squared	0.989561	S.D. dependent var	0.256062
S.E. of regression	0.026162	Akaike info criterion	-4.198680
Sum squared resid	0.007529	Schwarz criterion	-3.957247
Log likelihood	38.58944	Hannan-Quinn criter.	-4.186317
F-statistic	356.4760	Durbin-Watson stat	1.900989
Prob(F-statistic)	0.000000		

Figure 5: WGNP Result

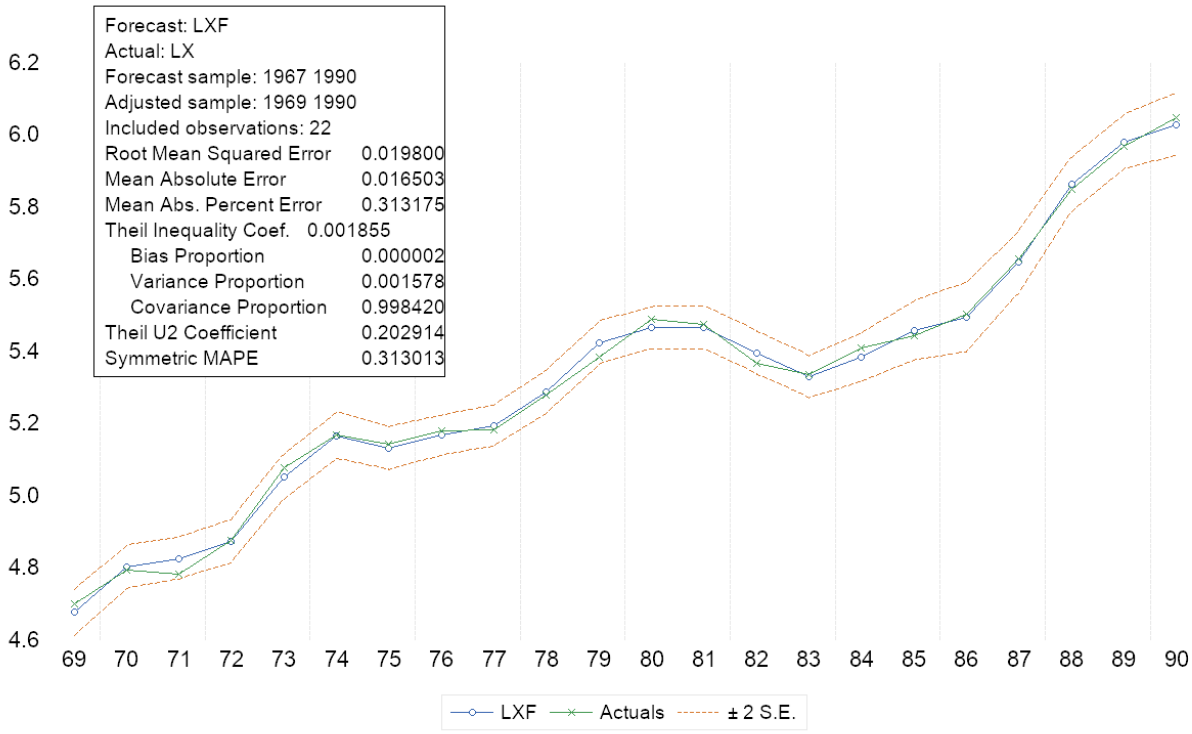

Figure 6: WI Graph

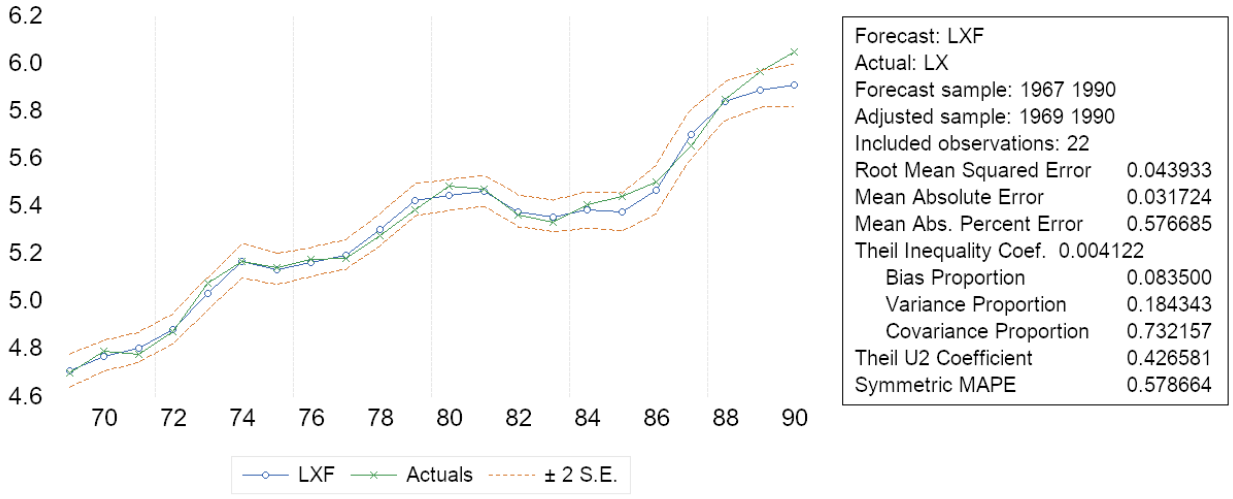

Figure 7: WGNP Graph