

The relationship between Consumption expenditure, Net national income and CPI: A VAR approach with an application to Singapore

Phan Hong Phuc, University of Economics and Law, 04/2021

Abstract

When participating in a market economy, everyone must consider their financial ability to ensure a balance between spending and income. This provides an opportunity to examine the relationship between expenditure and income. In addition, these factors are also influenced by the annual inflation index. To study this, author used Singapore's data about consumption expenditure (US\$ trillion), net national income (US\$ trillion) and consumer price index (%) from 2000 until 2019, providing 20 observations per series. For first analysis, author use descriptive statistics of the relationship between consumption expenditure, income and CPI. The second, author checks for stationary with ADF test of all series, results show that all variables is stationary at one difference. The third, find out optimal lag length and estimate VAR(1) model. The results show that Income and CPI really effect to Expenditure at a lag.

I. Descriptive statistics

Table 1 presents the summary results of the data series studied.

Table 1: Summarizes the data for the series

| | mean | median | sd | min | max | 25% | 75% | skew | kurtosis |
|-------------|------|--------|----|-----|-----|-----|-----|-------|----------|
| expenditure | 107 | 104 | 43 | 50 | 172 | 63 | 147 | 0.01 | -1.7 |
| income | 182 | 182 | 81 | 75 | 309 | 99 | 251 | -0.06 | -1.7 |
| cpi | 100 | 99 | 12 | 85 | 114 | 88 | 113 | 0.00 | -1.9 |

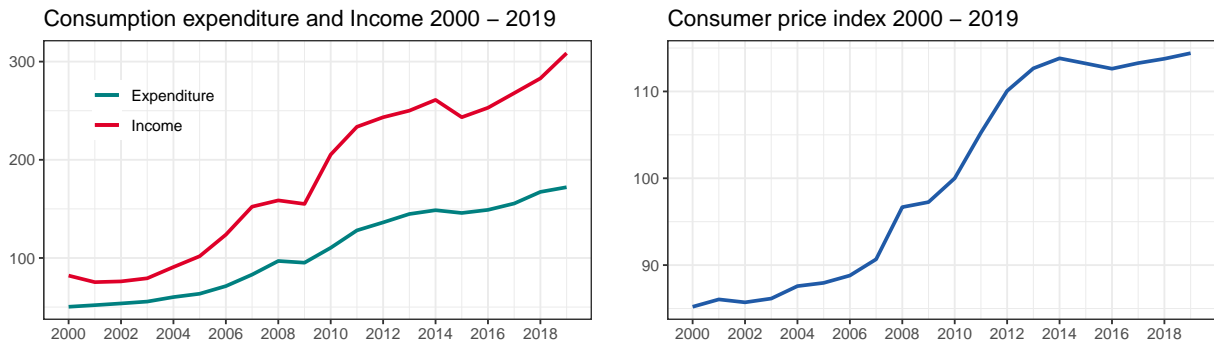


Figure 1 left - side provides a time-series for the value of Consumption expenditure, Net national income. It can be observed that there is a disparity between the spending and income of Singaporeans. In recent years, this difference has become more and more pronounced, showing that people are more likely to save money. In addition, comparing the levels and trend with CPI series in right - side, it is evident that expend and income follow CPI. In particular, Net National Income and CPI has a strong relationship, for Consumption Expenditure and CPI, the relationship is weaker.

II. Results Analysis

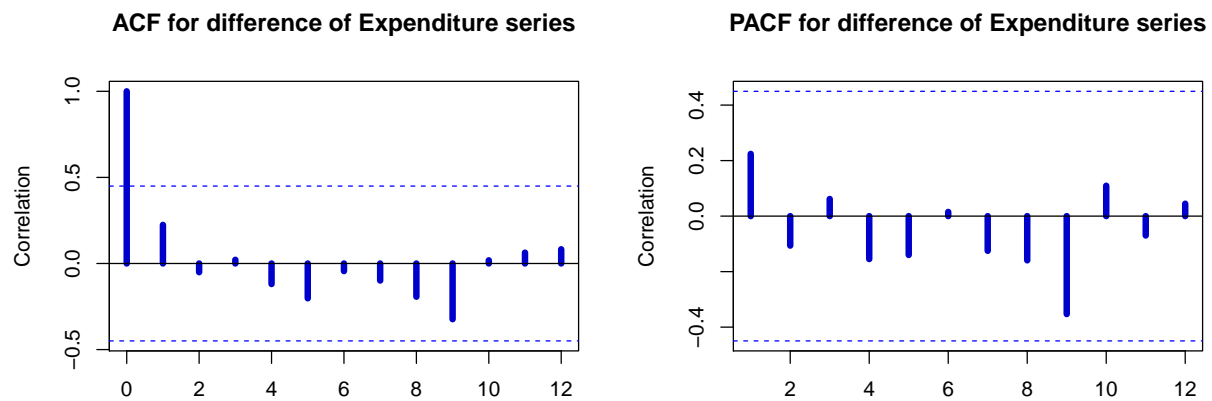
1. Checks for stationary

- Consumption Expenditure is stationary at one difference

Augmented Dickey-Fuller Test

```
data: expenditure
Dickey-Fuller = -2, Lag order = 2, p-value = 0.5
alternative hypothesis: stationary
```

The test statistics value is -2 and p_value is 0.5, this suggests that can accept the null hypothesis with a significance level if greater 5%, it means that the process has a unit root and in turn that the time series is non-stationary. So, processing take difference time series is necessary to make stationary:



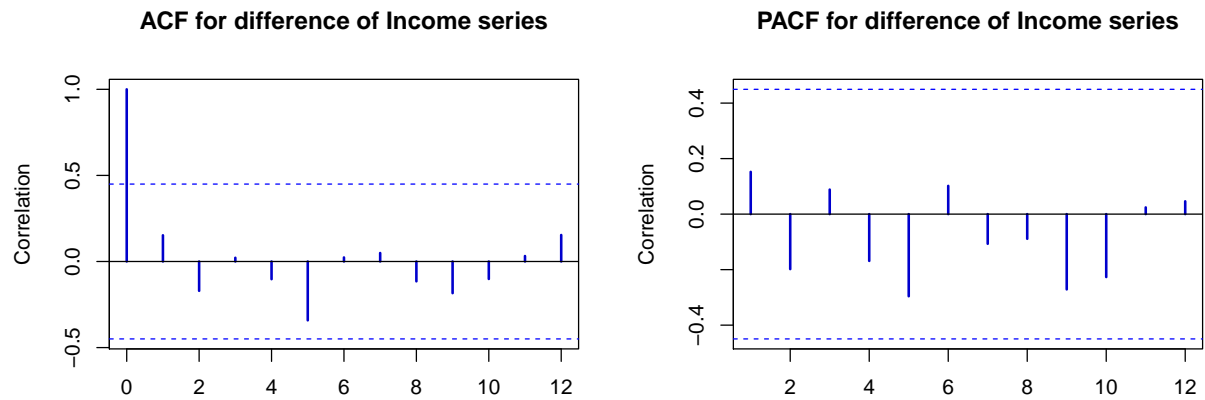
Based on the graph of ACF and PACF, can see that one difference of expenditure is stationary or does not have time-dependent structure.

- Net National Income is stationary at one difference

Augmented Dickey-Fuller Test

```
data: income
Dickey-Fuller = -2, Lag order = 2, p-value = 0.6
alternative hypothesis: stationary
```

The test statistics value is -2 and p_value is 0.6, this suggests that can accept the null hypothesis with a significance level if greater 5%, it means that the process has a unit root and in turn that the time series is non-stationary. Similar to Expenditure, can take difference time series to make stationary:



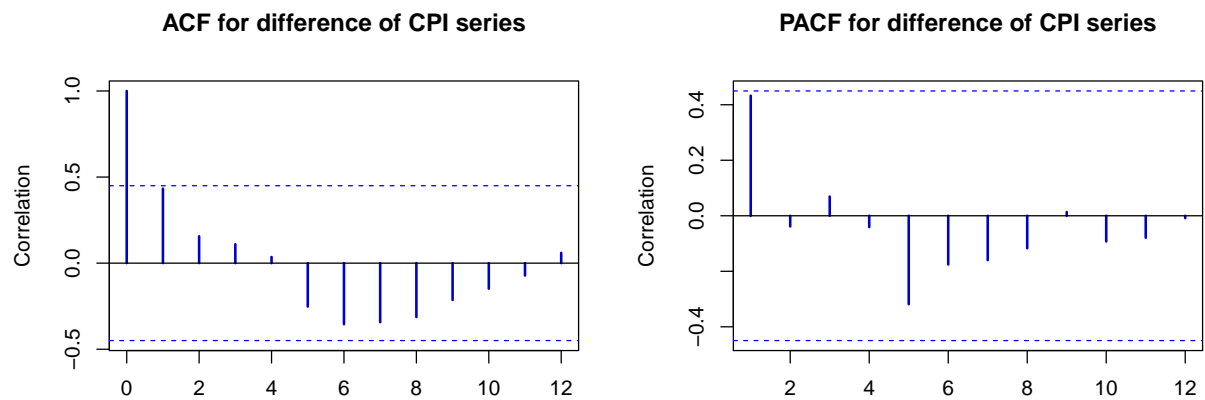
The results show that the one difference of income is stationary.

- **Consumer Price Index is stationary at one difference**

Augmented Dickey-Fuller Test

```
data: cpi
Dickey-Fuller = -2, Lag order = 2, p-value = 0.7
alternative hypothesis: stationary
```

Similar to above, CPI is non-stationary, so take difference to stationary:



The results show that the one difference of CPI is stationary.

2. Optimal lag length

| AIC(n) | HQ(n) | SC(n) | FPE(n) |
|--------|-------|-------|--------|
| 1 | 1 | 1 | 1 |

With results above, optimal lag length is 1, that VAR(1) is applied.

3. Estimate VAR(1)

- Consumption expenditure series:

| | Estimate | Std. Error | t value | Pr(> t) |
|----------------|----------|------------|---------|----------|
| expenditure.l1 | 0.32 | 0.280 | 1.2 | 0.267 |
| income.l1 | 0.35 | 0.146 | 2.4 | 0.028 |
| cpi.l1 | 0.15 | 0.055 | 2.7 | 0.017 |

- Net National Income series:

| | Estimate | Std. Error | t value | Pr(> t) |
|----------------|----------|------------|---------|----------|
| expenditure.l1 | 0.069 | 0.86 | 0.08 | 0.937 |
| income.l1 | 0.959 | 0.45 | 2.13 | 0.049 |
| cpi.l1 | 0.119 | 0.17 | 0.70 | 0.494 |

- Consumer Price Index

| | Estimate | Std. Error | t value | Pr(> t) |
|----------------|----------|------------|---------|----------|
| expenditure.l1 | -0.36 | 0.069 | -5.2 | 9.2e-05 |
| income.l1 | 0.18 | 0.036 | 5.1 | 9.9e-05 |
| cpi.l1 | 1.06 | 0.014 | 78.1 | 4.3e-22 |

The author apply VAR(1) model to find out relationship between the series. The results are satisfactory:

$$\begin{cases} Expenditure_t = 0.322Expenditure_{t-1} + 0.3531Income_{t-1} + 0.147CPI_{t-1} \\ Income_t = 0.9588Income_{t-1} + 0.0693Expenditure_{t-1} + 0.1195CPI_{t-1} \\ CPI_t = 1.0602CPI_{t-1} + 0.1842Income_{t-1} - 0.3553Expenditure_{t-1} \end{cases}$$

4. Granger causality test

- Consumption expenditure

Granger causality H0: expenditure do not Granger-cause income cpi

data: VAR object var1
F-Test = 21, df1 = 2, df2 = 48, p-value = 2e-07

Conclusion, expenditure has Granger - cause with income and CPI.

- Net national income

Granger causality H0: income do not Granger-cause expenditure cpi

data: VAR object var1
F-Test = 14, df1 = 2, df2 = 48, p-value = 2e-05

Conclusion, income has Granger - cause with expenditure and CPI.

- Consumer price index

Granger causality H0: cpi do not Granger-cause expenditure income

data: VAR object var1
F-Test = 11, df1 = 2, df2 = 48, p-value = 1e-04

Conclusion, CPI has Granger - cause with expenditure and income.

5. Predict

- Fitted model VAR(1) with time series:

