Chapter 4

Empirical Results

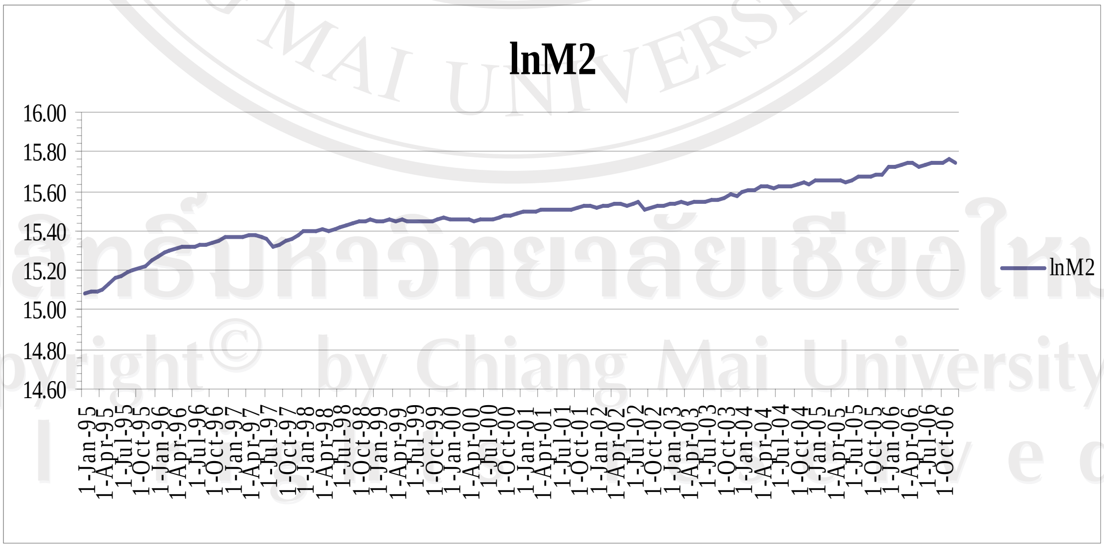
This study use monthly stock market data from SET index over the period 1995 to 2006, while the macroeconomic variables represented by monthly money supply in M2 over the same period. All data is presented in logarithms.

These are 3 parts of results in this chapter as the following Unit Root Test, Cointegration Test and Granger causality test.

4.1 Results of Unit Root Test

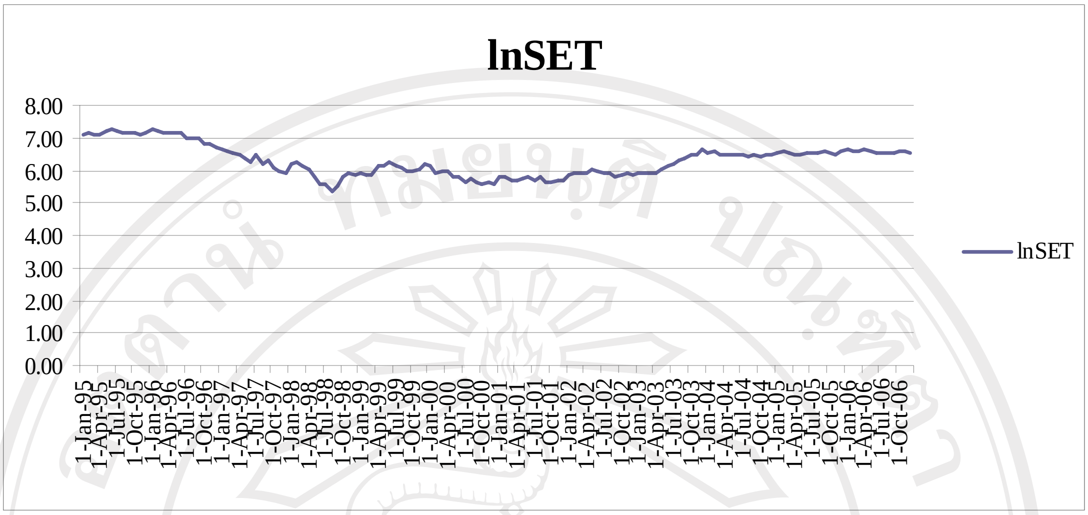
The first step is consideration a drift term or a kink of a time trend in a linear before tests of a unit root. In the results of illustrating the behavior of the M2 and SET index, liners of time trend have neither the kink nor drift term in both sets of data, SET index and M2. As indicated in figure 4.1 and 4.2

Figure 4.1 M2 in log form over the period of monthly from 1995 to 2006.



Source: Econ Data, Bank of Thailand (2007).

Figure 4.2 SET Index in log form over the period of monthly from 1995 to 2006.



Source: Statistics Information, Stock Exchange of Thailand (2007).

Thus ADF methods are conducted including constant and trend, just constant and without constant and trend, (None), while tests for a unit root in first differences level are also conducted in constant and trend, just constant and without constant and trend, (None), by the unit root testing. Lag lengths for the ADF tests are automatic determined by the SIC. The lag lengths so determined zero for the both of sets data, SET index and M2.

Table 4.1 Result of a Unit Root by ADF test for M2 at log level, I(0).

Variable			None	Constant	Constant and Trend
lnM2	Lag Order		0	0	0
	Level (Test-Statistic)		5.443394	-2.939934**	-3.933371**
	MacKinnon Critical Value	1%	-2.581233	-3.476472	-4.023506
		5%	-1.943074	-2.881685	-3.441552
		10%	-1.615231	-2.577591	-3.145341

Source: Calculated.

Note Automatic selecting the minimum lag length (p-lag) under SIC condition.

*** Significant at 1% critical value.

** Significant at 5% critical value.

* Significant at 10% critical value.

Table 4.2 Result of a Unit Root by ADF test for M2 at log first differences level, I(1).

Variable			None	Constant	Constant and Trend
lnM2	Lag Order		0	0	0
	1^{st} differences (Test-Statistic)		-9.17097***	-10.75108***	-11.0036***
	MacKinnon Critical Value	1%	-2.581349	-3.476805	-4.023975
		5%	-1.943090	-2.881830	-3.441777
		10%	-1.615220	-2.577668	-3.145474

Source: Calculated.

Note Automatic selecting the minimum lag length (p-lag) under SIC condition.

*** Significant at 1% critical value.

** Significant at 5% critical value.

* Significant at 10% critical value.

The result of unit root test for M2 is presented in Table 4.1 and 4.2 The ADF tests reject the null hypothesis of a unit root when log level (I(0)) in both of constant and trend and constant at 5% and 10% significant level. Test statistic values are following -3.933 and -2.940 that smaller than MacKinnon critical value which are -3.441 and -2.882 at 5% significant level and -3.145 and -2.578 at 10% significant level. But fail to reject the null hypothesis at 1% significant level which MacKinnon critical values are -4.024 and -3.476. Another series, None, is accepted the null hypothesis at all significant levels. The test statistic value is -0.629 and MacKinnon critical values are -1.615 at 10% significant level, -1.943 at 5% significant level and -2.581 at 1% significant level.

After getting the results from the test I(0), the test at log first differences level, (I(1)), is considered. The result of tests is stationary for constant and trend, constant and none at all significant levels. The test statistic values are following -11.003, -10.751 and -9.171. MacKinnon critical values are the same log level testing.

Table 4.3 Result of a Unit Root by ADF test for SET index at log level, I(0).

Variable			None	Constant	Constant and Trend
lnSET	Lag Order		0	0	0
	Level (Test-Statistic)		-0.629485	-1.753226	-1.438981
	MacKinnon Critical Value	1%	-2.581233	-3.476472	-4.023506
		5%	-1.943074	-2.881685	-3.441552
		10%	-1.615231	-2.577591	-3.145341

Source: Calculated.

Note Automatic selecting the minimum lag length (p-lag) under SIC condition.

*** Significant at 1% critical value.

** Significant at 5% critical value.

* Significant at 10% critical value.

Table 4.4 Result of a Unit Root by ADF test for SET index at log first differences level, I(1).

Variable			None	Constant	Constant and Trend
lnSET	Lag Order		0	0	0
	1st differences (Test-Statistic)		-11.90165***	-11.88401***	-12.07411***
	MacKinnon Critical Value	1%	-2.581349	-3.476805	-4.023975
		5%	-1.943090	-2.881830	-3.441777
		10%	-1.615220	-2.577668	-3.145474

Source: Calculated.

Note Automatic selecting the minimum lag length (p-lag) under SIC condition.

*** Significant at 1% critical value.

** Significant at 5% critical value.

* Significant at 10% critical value.

Table 4.3 and 4.4 represent the result of unit root test for SET index. The ADF tests fail to reject the null hypothesis of a unit root when the log level, (I(0)), for constant and trend, constant and none at all significant levels. The test statistic values are following -1.439, -1.753 and -0.629 which greater than MacKinnon critical value are following -3.145, -2.578 and -1.615 at 10% significant level, -3.442, -2.882 and -1.943 at 5% significant level and -4.024, -3.477 and -2.581 at 1% significant level. But reject the same null hypothesis at log first differences level, (I(1)), for constant and trend, constant and none at all significant levels. The test statistic values are following -12.074, -11.884 and -11.902.

From these results can be concluded that both sets of data, M2 and SET index, contain a single unit root which would require first differencing to achieve stationarity at 1% significant level.

4.2 Results of Cointegration Test

The Cointegration test which based on Johansen approach is applied in this research. Find optimal lag length in the VAR is the first step which determined by Akaike Information Criterion (AIC), Schwartz Bayesian Criterion (SBC) and Likelihood Ration Test (LR), AIC and SBC values that highest values are chosen for optimal lag length. After that consideration for VAR model has 5 models

1. No Intercept or Trends
2. Restricted Intercepts, NoTrends
3. Unrestricted Intercepts, NoTrends
4. Unrestricted Intercepts, Restricted Trends
5. Unrestricted Intercepts, Unrestricted Trends

The last step is find number of cointegrating vectors based on Johansen approach by conducted 2 method, eigenvalue trace statistic (trace test) and maximal eigenvalue statistic (max test).

Table 4.5 Result of lag length between M2 and SET index which determined by AIC, SBC and LR method.

Order	AIC	SBC	LR test[prob]	Adjust LR test[prob]
23	455.3575	326.7512	----------	----------
22	458.6839	335.6691	1.3473[.853]	.83509[.934]
21	461.9203	344.4971	2.8744[.942]	1.7816[.987]
20	461.0849	349.2533	12.5452[.403]	7.7759[.802]
19	462.6054	356.5653	17.5043[.354]	10.8498[.819]
18	464.4331	363.7847	21.8488[.349]	13.5426[.853]
17	464.7599	369.7031	29.1952[.213]	18.0962[.798]
16	466.9803	377.5150	32.7544[.245]	20.3023[.853]
15	469.2600	385.3862	36.1952[.279]	22.4350[.895]
14	469.9064	391.6242	42.9023[.199]	26.5923[.873]
13	472.9105	400.2199	44.8941[.274]	27.8269[.927]
12	473.9101	406.8111	50.8949[.221]	31.5464[.920]
11	475.3003	413.7929	56.1146[.197]	34.7817[.923]
10	478.2212	422.3054	58.2727[.256]	36.1194[.954]
9	480.8919	430.5677	60.9313[.303]	37.7673[.971]
8	484.2949	439.5622	62.1253[.400]	38.5074[.986]
7	485.4949	446.3538	67.7253[.351]	41.9785[.985]
6	486.5547	453.0052	73.6057[.300]	45.6234[.983]
5	485.0985	457.1406	84.5181[.148]	52.3873[.960]
4	487.4594	465.0931	87.7962[.167]	54.4191[.971]
3	488.2136	471.4389	94.2879[.131]	58.4429[.967]
2	489.9550	478.7718	98.8051[.129]	61.2428[.971]
1	**493.1965**	**487.6050**	**100.3220[.174]**	**62.1831[.983]**
0	-540.5277	-540.5277	2175.8[.000]	1348.6[.000]

Source: Calculated.

The lag lengths in the VAR are indicated in Table 4.5 which AIC, SBC and LR decide at one lag for optimal lag length in the VAR between M2 and SET index.

Table 4.6 Result of AIC and SBC of VAR model in 5 models at one lag length.

Cointegrating Equation (CE) and VAR specification	AIC	SBC
No Intercept or Trends	129.7480	128.2666
Restricted Intercepts, NoTrends	**129.8210**	**128.3396**
Unrestricted Intercepts, NoTrends	129.4841	126.5213
Unrestricted Intercepts, Restricted Trends	128.0201	125.0573
Unrestricted Intercepts, Unrestricted Trends	128.3414	123.8971

Source: Calculated.

Table 4.6 represent VAR model consideration in 5 model by Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC), Restricted Intercepts and NoTrends model is suitable model to find the number of cointegrating vectors because AIC and SBC values are highest values, which represented by 129.8210 and 128.3396, when compare with AIC and SBC value in other model. Thus, Restricted Intercepts and NoTrends model at one lag is appropriate for find the number of cointegrating vectors in the next step which the results are shown in Table 4.7 and 4.8

Table 4.7 Result of finding the number of cointegrating vectors by max test.

Null	Alternative	Statistic	95% Critical	90% Critical
r=0	r=1	47.1549	15.87	13.81
r<1	r=2	1.5722	9.16	7.53

Source: Calculated.

Table 4.8 Result of finding the number of cointegrating vectors by trace test.

Null	Alternative	Statistic	95% Critical	90% Critical
r=0	r>1	48.7271	20.18	17.88
r<1	r>2	1.5722	9.16	7.53

Source: Calculated.

Cointegration test results based on Johansen approach by conduct 2 method, eigenvalue trace statistic (trace test) and maximal eigenvalue statistic (max test), suggest a single cointegrating vector between M2 and SET index at all significant level.

Furthermore, a cointegrating vector is presented significant relationship between M2 and SET index in Table 4.9

Table 4.9 Result of estimated a cointegrating vector between M2 and SET index.

Estimated Cointegrating Vector

Variables	Vector
lnSET	-0.069343 (-1.0000)
lnM2	0.18795 2.7105
Intercept	-2.5398 (-36.6270)

Source: Calculated.

Table 4.9 represents a single cointegrating vector has negative relationship between SET index and M2. It means that M2 will change 2.7105 % when SET index change 1 % in the negative side.

4.3 Results of Granger Causality Test

As money supply (M2) and stock prices (SET) has cointegrating vector, the Granger causality tests are performed. The Granger causality tests determine the predictive content of one variable beyond that inherent in the explanatory variable itself by considers probability.

Table 4.10 Result of causality tests between M2 and SET index.

Null Hypothesis	F-Statistic	Probability
lnM2 does not Granger Cause lnSET	0.34336	0.55884
lnSET dose not Granger Cause lnM2	4.86819	0.02899

Source: Calculated.

From the result of the Granger causality tests are given in Table 4.10, M2 does not granger cause SET index accept the null hypothesis at 5% significant level which probability values greater than 0.05. On another, there is agreement of direction of causality from SET index to M2 at 5% significant level. Because probability less than 0.05 reject the null hypothesis, SET index dose not granger cause M2.

Therefore, Granger causality tests suggest that it had one way direction of causality from SET index to M2 at 5% significant level.