Economic Growth Elasticity of Structural Changes: Case of Thailand

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Abstract

Thailand's economic base was gradually shifted from agricultural-based to industrial and service country for the last 30 years. The purpose of this study was to investigate the effect of those structural changes on economic performance using Cochrane - Orcutt and Newey-West Model.

For the result, an incremental employment in agricultural sector yielded the negative effect on economy. Also, an increase in employment in service sector was better than industrial sector in supporting economic growth. Thus, government of Thailand should no longer support agricultural sector but service-based economy instead.

1 Student of Master's Degree of Economics, Chiang Mai University, Thailand. It was self-interesting paper, not part of Thesis or curriculum's assignment.
Background and Introduction

Thailand is, as everyone known, agriculture-based country for a long time. With flourish nature, agriculture is, no need to say, first choice for sufficient living. But the question is "Is Thailand appropriate for being agricultural-based country?". Thai economist should answer some critiques that Thai people did agriculture because they can do it best relative to other economic base or they just have no potentials to do anything else.

However, economic structure in Thailand was dramatically changes for the last 30 years as shown in figure 1.

Figure 1: Structural Changes in Thai Economy

Source: World Bank

According to the figure 1, employment in agriculture started decreasing since 1986 while employment in industry and service began increasing. It represented the structural change from agricultural-based country to be more industrialized and serviced. In 1986, 10.6 percent of employment was in industry while 66.7 and 22.6 were in agriculture and service sector, respectively. In 2012, structure was totally changed. Proportion of employment in agricultural sector decreased to 39.6 percent while increased to 20.9 and 39.4 percent in industry sector and service sector, respectively. However, the majority of employment was still in agricultural sector. Rice, Palm, Cassava, rubber, and kenaf were industrial or economic crop in Thailand. but the poor in Thailand was, by majority, farmer due to unstable price. Always, Thai government would very much like to intervene crop product by price floor or price ceiling. Recently, rice pledging from current government was populism aimed at winning election. With the problem of inefficient administration and corruption, the policy was failed.

Besides the revenue used to promote agriculture market, Thailand has accepted the way of international economic interdependent by encouraging investment and industrial sector. Many institutions were established aimed at managing and operating a flow of funds from multi-enterprise, for example, BOI. Additionally, service sector was dramatically
increasing, for example, financial sector (Banking), tourism (hotel and restaurant), and telecommunication. ADB (2013) studied services sector in Thailand and found that services sector plays a major role to Thailand's economic growth. Policies should be issued in supporting this sector. However, industrial sector is the main source of national prosperity, especially, the developed countries in Europe region. Newly Industrialized Country (NIC) like Thailand should not reject this kind of strategy.

**Objectives**

The purpose of this study was to investigate the effects of changing economic structure in three kinds of pace including agricultural-based economy, industrial-based economy, and service-based economy on economic performance.

**Methodology and Model Specification**

Log-linear model was the main tool in analyzing. The coefficient of regressor in log-linear model was normalized as elasticity. Then, it was economic growth elasticity of an increase in employment in each sector. With time series data of the percentage of employment in agricultural, industrial, and service sector to total employment from 1986 to 2012, stationary test should be implemented firstly before running simple regression. There are three models as written;

\[ \loggdppc = \alpha + \beta \logea \]  \hspace{1cm} (1)

where loggdppc stands for log of per capita GDP, logea stands for log of the proportion of employment in agricultural sector to total employment, and \( \beta \) stands for economic growth elasticity of an increase in agricultural employment.

\[ \loggdppc = \alpha + \delta \logei \]  \hspace{1cm} (2)

where loggdppc stands for log of per capita GDP, logei stands for log of the proportion of employment in industrial sector to total employment, and \( \delta \) stands for economic growth elasticity of an increase in industrial employment.

\[ \loggdppc = \alpha + \varphi \loges \]  \hspace{1cm} (3)

where loggdppc stands for log of per capita GDP, loges stands for log of the proportion of employment in service sector to total employment, and \( \varphi \) stands for economic growth elasticity of an increase in service employment.
Results

For stationary test, employment in industrial sector was stationary at lags(0) by 95% confidence. Employment in agricultural sector was stationary at lags(6) by 95% confidence. Employment in service sector was stationary at lags(4) by 95% confidence. Per capita GDP was stationary at lags(0) by 95% confidence.

After Unitroot test, the next was to find the relationship between economic growth and employment in each sector. Firstly, the relationship between per capita GDP and employment in industrial sector. The result suggested that an increase in employment in industrial sector by 1 percents can create an increase in per capita GDP by 2.1017. R-squared was 85.71%. There was no heteroskedasticity. However, there was autocorrelation tested by durbin watson method. Then, the model was solved by using cochrance - Orcutt Model. The result shown that an increase in employment in industrial sector by 1 percent can create an increase in per capita GDP by 0.3890 percent. The result was statistically significant.

Secondly, the relationship between per capita GDP and employment in agricultural sector. The result suggested that an increase in employment in agricultural sector by 1 percent can create a decrease in per capita GDP by 2.4913. R-squared was 93.56 which shows the strong relationship. However, there were heteroskedasticity and autocorrelation. The model was solve by using Newey-West method. The result shown that an increase in employment in agricultural sector by 1 percent can lead to a decrease in per capita GDP by 2.4913 percent. The result was statistically significant.

Thirdly, the relationship between per capita GDP and employment in service sector. The result suggested that an increase in employment in service sector by 1 percent can create an increase in per capita GDP by 2.043 percent. R-squared was 87.67%. However, there were autocorrelation and heteroskedasticity. The model was solved by using Newey-West. The result shown that an increase in employment in service sector by 1 percent can create per capita GDP by 2.043 percent. The result was statistically significant.

Conclusion

With the reliable econometric method and data availability in the sense of time series, any increase in employment in agricultural sector in Thailand yields the negative effect on economy. However, an increase in other sectors positively affect economic performance, especially service sector.

Policy Suggestion

1. Government should cut any programs that supports an expand in agricultural sector, especially market intervention, for example, rice pledging which can create an artificial incentive for people to be a new farmer so as to get the benefit from the program.
2. Thailand should reform to be service-based country like many developed countries. Service sector requires high quality of labor. Then, an improvement in education and health system should be policy priority.

3. Industrial sector also yields the positive effects to economy but its effect is statistically smaller than service sector. However, infrastructure and political stability are together an important factors in supporting this sector. Besides, a cut in tax (Tax holiday) or red tape should be more encouraged throughout economy.

References


Regression Results (Stata)

1. Unitroot Test

```stata
tset year

time variable: year, 1 to 27

delta: 1 unit

.dfuller logei

Dickey-Fuller test for unit root      Number of obs = 26

---------- Interpolated Dickey-Fuller ----------

Test    1% Critical    5% Critical    10% Critical
```
<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Z(t)</td>
<td>-2.970</td>
<td>-3.743</td>
<td>-2.997</td>
<td>-2.629</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for $Z(t) = 0.0378$

```
dfuller logea
```

Dickey-Fuller test for unit root
Number of obs = 26

--------------- Interpolated Dickey-Fuller ---------------
Test    1% Critical  5% Critical  10% Critical
Statistic  Value   Value   Value

| Z(t) | -1.020 | -3.743 | -2.997 | -2.629 |

MacKinnon approximate p-value for $Z(t) = 0.7458$

```
dfuller logea, lag(1)
```

Augmented Dickey-Fuller test for unit root
Number of obs = 25

--------------- Interpolated Dickey-Fuller ---------------
Test    1% Critical  5% Critical  10% Critical
Statistic  Value   Value   Value

| Z(t) | -0.857 | -3.750 | -3.000 | -2.630 |
MacKinnon approximate p-value for $Z(t) = 0.8018$

```
.dfuller logea, lag(2)
```

Augmented Dickey-Fuller test for unit root  
Number of obs = 24

```
---------- Interpolated Dickey-Fuller ----------
Test 1% Critical 5% Critical 10% Critical
Statistic Value Value Value

Z(t) -1.342 -3.750 -3.000 -2.630
```

MacKinnon approximate p-value for $Z(t) = 0.6099$

```
.dfuller logea, lag(3)
```

Augmented Dickey-Fuller test for unit root  
Number of obs = 23

```
---------- Interpolated Dickey-Fuller ----------
Test 1% Critical 5% Critical 10% Critical
Statistic Value Value Value

Z(t) -1.922 -3.750 -3.000 -2.630
```

MacKinnon approximate p-value for $Z(t) = 0.3218$
. dfuller logea, lag(4)

Augmented Dickey-Fuller test for unit root  Number of obs = 22

---------- Interpolated Dickey-Fuller -------
Test 1% Critical 5% Critical 10% Critical
Statistic Value Value Value

Z(t) -2.218 -3.750 -3.000 -2.630

MacKinnon approximate p-value for Z(t) = 0.1998

. dfuller logea, lag(5)

Augmented Dickey-Fuller test for unit root  Number of obs = 21

---------- Interpolated Dickey-Fuller -------
Test 1% Critical 5% Critical 10% Critical
Statistic Value Value Value

Z(t) -1.956 -3.750 -3.000 -2.630

MacKinnon approximate p-value for Z(t) = 0.3060

. dfuller logea, lag(6)

Augmented Dickey-Fuller test for unit root  Number of obs = 20
<table>
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<tr>
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<th>5% Critical</th>
<th>10% Critical</th>
</tr>
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<tbody>
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<td>Value</td>
</tr>
<tr>
<td>Z(t)</td>
<td>-2.995</td>
<td>-3.750</td>
<td>-3.000</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.0353

. dfuller loges

Dickey-Fuller test for unit root
Number of obs = 26

<table>
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<th>5% Critical</th>
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<tbody>
<tr>
<td>Statistic</td>
<td>Value</td>
<td>Value</td>
<td>Value</td>
</tr>
<tr>
<td>Z(t)</td>
<td>-0.835</td>
<td>-3.743</td>
<td>-2.997</td>
</tr>
</tbody>
</table>

MacKinnon approximate p-value for Z(t) = 0.8087

. dfuller loges, lag(1)

Augmented Dickey-Fuller test for unit root
Number of obs = 25
Augmented Dickey-Fuller test for unit root

Number of obs = 24

---------- Interpolated Dickey-Fuller ----------

Test | 1% Critical | 5% Critical | 10% Critical | Statistic | Value | Value | Value

Z(t) | 1.193 | -3.750 | -3.000 | -2.630 |

MacKinnon approximate p-value for Z(t) = 0.6765

. dfuller loges, lag(3)

Augmented Dickey-Fuller test for unit root

Number of obs = 23

---------- Interpolated Dickey-Fuller ----------

Test | 1% Critical | 5% Critical | 10% Critical | Statistic | Value | Value | Value

Z(t) | 2.305 | -3.750 | -3.000 | -2.630 |

MacKinnon approximate p-value for Z(t) = 0.6765
MacKinnon approximate p-value for $Z(t) = 0.1703$

```
dfuller loges, lag(4)
```

Augmented Dickey-Fuller test for unit root  

```
Augmented Dickey-Fuller test for unit root  
Number of obs   =        22

--------- Interpolated Dickey-Fuller ---------
Test         1% Critical       5% Critical      10% Critical
Statistic           Value             Value             Value

Z(t)             -3.520            -3.750            -3.000            -2.630

MacKinnon approximate p-value for $Z(t) = 0.0075$

```
dfuller loggdppc
```

Dickey-Fuller test for unit root  

```
Dickey-Fuller test for unit root  
Number of obs   =        26

--------- Interpolated Dickey-Fuller ---------
Test         1% Critical       5% Critical      10% Critical
Statistic           Value             Value             Value

Z(t)             -2.907            -3.743            -2.997            -2.629

MacKinnon approximate p-value for $Z(t) = 0.0445$
2. Regression Result

2.1 Test relationship between per capita GDP and employment in industrial sector

```
. reg logdppc logei
```

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>Number of obs = 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>F( 1, 25)</td>
<td>5.10407605</td>
<td>1</td>
<td>5.10407605</td>
<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td>Model</td>
<td>.851297796</td>
<td>25</td>
<td>.034051912</td>
<td>R-squared = 0.8571</td>
</tr>
<tr>
<td>Residual</td>
<td>5.95537385</td>
<td>26</td>
<td>.22905284</td>
<td>Root MSE = .18453</td>
</tr>
</tbody>
</table>

```
logdppc    Coef.   Std. Err.  t     P>|t|  [95% Conf. Interval]
```

| logei       | 2.101672   | .1716632 | 12.24 | 0.000  | 1.748125    | 2.455219  |

| _cons       | 2.448931   | .4936044 | 4.96  | 0.000  | 1.432333    | 3.465528  |

. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of logdppc

```
chi2(1) = 1.97
Prob > chi2 = 0.1609
```
Durbin-Watson d-statistic( 2, 27) = .314803

. prais logdppc logei, corc

Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.8941
Iteration 2:  rho = 0.9152
Iteration 3:  rho = 0.9252
Iteration 4:  rho = 0.9314
Iteration 5:  rho = 0.9357
Iteration 6:  rho = 0.9389
Iteration 7:  rho = 0.9414
Iteration 8:  rho = 0.9434
Iteration 9:  rho = 0.9451
Iteration 10: rho = 0.9464
Iteration 11: rho = 0.9476
Iteration 12: rho = 0.9486
Iteration 13: rho = 0.9494
Iteration 14: rho = 0.9502
Iteration 15: rho = 0.9508
Iteration 16: rho = 0.9514
Iteration 17: rho = 0.9519
Iteration 18: rho = 0.9524
Iteration 19: rho = 0.9528
Iteration 20:  \( \rho = 0.9532 \)
Iteration 21:  \( \rho = 0.9535 \)
Iteration 22:  \( \rho = 0.9538 \)
Iteration 23:  \( \rho = 0.9541 \)
Iteration 24:  \( \rho = 0.9543 \)
Iteration 25:  \( \rho = 0.9545 \)
Iteration 26:  \( \rho = 0.9547 \)
Iteration 27:  \( \rho = 0.9549 \)
Iteration 28:  \( \rho = 0.9551 \)
Iteration 29:  \( \rho = 0.9552 \)
Iteration 30:  \( \rho = 0.9554 \)
Iteration 31:  \( \rho = 0.9555 \)
Iteration 32:  \( \rho = 0.9556 \)
Iteration 33:  \( \rho = 0.9557 \)
Iteration 34:  \( \rho = 0.9558 \)
Iteration 35:  \( \rho = 0.9559 \)
Iteration 36:  \( \rho = 0.9560 \)
Iteration 37:  \( \rho = 0.9561 \)
Iteration 38:  \( \rho = 0.9562 \)
Iteration 39:  \( \rho = 0.9562 \)
Iteration 40:  \( \rho = 0.9563 \)
Iteration 41:  \( \rho = 0.9563 \)
Iteration 42:  \( \rho = 0.9564 \)
Iteration 43:  \( \rho = 0.9564 \)
Iteration 44:  \( \rho = 0.9565 \)
Iteration 45:  \( \rho = 0.9565 \)
Iteration 46:  \( \rho = 0.9566 \)
Iteration 47: rho = 0.9566
Iteration 48: rho = 0.9566
Iteration 49: rho = 0.9567
Iteration 50: rho = 0.9567
Iteration 51: rho = 0.9567
Iteration 52: rho = 0.9567
Iteration 53: rho = 0.9568
Iteration 54: rho = 0.9568
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Iteration 57: rho = 0.9568
Iteration 58: rho = 0.9569
Iteration 59: rho = 0.9569
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Iteration 61: rho = 0.9569
Iteration 62: rho = 0.9569
Iteration 63: rho = 0.9569
Iteration 64: rho = 0.9569
Iteration 65: rho = 0.9569
Iteration 66: rho = 0.9569
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Iteration 88: rho = 0.9570
Iteration 89: rho = 0.9570
Iteration 90: rho = 0.9570
Iteration 91: rho = 0.9570
Iteration 92: rho = 0.9570
Iteration 93: rho = 0.9570
Iteration 94: rho = 0.9570

Cochrane-Orcutt AR(1) regression -- iterated estimates

<table>
<thead>
<tr>
<th>Source</th>
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<th>Number of obs = 26</th>
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</thead>
<tbody>
<tr>
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<td>.01122296</td>
<td>1</td>
<td>.01122296</td>
<td>Prob &gt; F = 0.0186</td>
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</table>

F( 1, 24) = 6.37
Residual .04226208  24  .00176092           R-squared =  0.2098
Adj R-squared = 0.1769
Total .05348504  25  .002139402           Root MSE = .04196

| Variable | Coef.   | Std. Err. | t    | P>|t|  | [95% Conf. Interval] |
|----------|---------|-----------|-----|-----|----------------------|
| loggdppc | .3890272 | .1540977  | 2.52| 0.019| .0709852    .7070691 |
| _cons    | 8.634735 | .5678476  | 15.21| 0.000| 7.462755    9.806715 |

rho .9570315

Durbin-Watson statistic (original) 0.314803
Durbin-Watson statistic (transformed) 1.707667

2.2 Test relationship between per capita GDP and employment in agricultural sector

. reg loggdppc logea

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
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<th>Number of obs = 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
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<td>Prob &gt; F = 0.0000</td>
</tr>
<tr>
<td>Residual</td>
<td>.383469649</td>
<td>25</td>
<td>.015338786</td>
<td>R-squared = 0.9356</td>
</tr>
<tr>
<td>Adj R-squared = 0.9330</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.95537385</td>
<td>26</td>
<td>.22905284</td>
<td>Root MSE = .12385</td>
</tr>
</tbody>
</table>
loggdpc | Coef. Std. Err. t P>|t| [95% Conf. Interval]  
--- | ---: | ---: | --- | ---: | ---: |
logea | -2.491307 | .1307136 | -19.06 | 0.000 | -2.760517 | -2.222097 |
_cons | 18.21089 | .5113003 | 35.62 | 0.000 | 17.15784 | 19.26393 |

.hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of loggdpc

\[ \chi^2(1) = 6.36 \]
Prob > chi2 = 0.0116

.dwstat

Durbin-Watson d-statistic( 2, 27) = 0.6208789

.newey loggdppc logea, lag(0)

Regression with Newey-West standard errors Number of obs = 27
maximum lag: 0 F( 1, 25) = 245.90
Prob > F = 0.0000

Newey-West
2.3 Test relationship between per capita GDP and employment in service sector

```
. reg loggdppc loges

Source       SS       df       MS              Number of obs =      27
             F(  1,    25) =  177.83
Model   5.22132485     1  5.22132485           Prob > F      =  0.0000
Residual   .734048991    25   .02936196           R-squared     =  0.8767
         Adj R-squared =  0.8718
Total   5.95537385    26   .22905284           Root MSE      =  .17135

loggdppc       Coef.   Std. Err.      t    P>t     [95% Conf. Interval]
   loges    2.042983   .1532029    13.34   0.000     1.727456     2.35851
   _cons    1.48272   .5254955     2.82   0.009     .4004416    2.564998
```

`. hettest`
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of loggdppc

\[
\text{chi2}(1) = 6.57 \\
\text{Prob} > \text{chi2} = 0.0104
\]

\[. dwstat\]

Durbin-Watson d-statistic( 2, 27) = .4648503

\[. newey loggdppc loges, lag(0)\]

Regression with Newey-West standard errors Number of obs = 27

maximum lag: 0 F( 1, 25) = 142.18

Prob > F = 0.0000

Newey-West

loggdppc Coef. Std. Err. t P>|t| [95% Conf. Interval]

loges  2.042983  .1713343 11.92 0.000 1.690114  2.395853

_cons  1.48272  .6076503 2.44 0.022  .2312406  2.734199

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