The cobb douglas function

This chapter will discuss the estimated techniques theories and the equation, it is include the Unit root test and Autoregressive Distributed Lag (ARDL) Bounds test. And the data sources also discuss in this part.

3. 1 Endogenous growth theory and modeling

In the economic condition, the Cobb-Douglas functional form of production functions is commonly used to represent the relationship of an output to inputs. It was predictable by Knut Wicksell (1851-1926) and tested against statistical evidence by Charles Cobb and Paul Douglas in the years of 1900-1928. The production function is shown as below:

Y = ALÎ±KÎ², (1)

Where the symbol of transformation for the Cobb-Douglas function is:

= Total production (the monetary value of all goods produced in a year)

= Labor input

= Capital input

= Total productivity growth

The and are the output elasticity of labor and capital simultaneously. These values are constant determined by available technology.

For output eleasticity the receptiveness of output to a change in levels of both labor and capital used in production in the condition of ceteris paribus. Such as if = 0. 20, it will show that the 1% increase in labor will lead to a 0. 2% increase in output.

Î± + Î² = 1,

These function indicate that the constant return to scale in production function. That means if L and K are each increase 30%, Y will increase in 30% too.

If the return to scale are decreasing and return to scale are increasing, this will be show as below:

Expect it on the perfect competition, the and can be indicate to be the both labor and capital share of output.

The Cobb-Douglas function are influnced by statistical evidence that come into sight to show that labor and capital shares of total output are constant over time in developed countries, the researchers clarified this by statistical fitting least squares regression in their production function. It is show that having doubt over whether constancy over time exists.

But according to Yao and Wei (2007), through joint ventures local firms have been able to imitate foreign technologies and started to produce their own models or supply parts to foreign industries. There is no doubt that FDI has not only helped improve the production efficiency of domestic firms but also helped to push Korea’s production frontier towards the world’s most advanced levels. Assume that there are two countries in the world: one is an industrialized economy A and the other is a newly industrializing economy (B) and both countries will follow a Cobb-Douglas production technology:

(2)

Where Y, K, L are respectively to GDP, capital and labor, j and t denote country (A, B) and time. And g(z) is a function of various factors affecting production efficiency and the production frontier, including exports, human capital, FDI, institutions and others. As country A is richer and has a higher K/L ratio than country B, country A tends to make investments in B in order to maximize returns to capital, as long as âˆ, YBt /âˆ, KBt > âˆ, YAt /âˆ, KAt holds true.

According to Yao and Wei (2007), in this two-country perspective, both countries should have mutual benefits for cross-border movement of capital to take place. The benefit for A is that it can maximize returns to its capital and has access to B's market. The benefit for B is that it can have access to A's technology and improve per capita income so that the income gap between A and B declines over time. Another assumption is that both countries invest in science and technology to create knowledge and innovation. However, because A has better endowments in both physical and human capital, it is more able to innovate and hence produce a higher level of output given the same level of inputs in comparison with B. The only way for B to decrease this technological gap is through importation of A's technology embedded through FDI.

But again from according Yao and Wei (2007) that the role of FDI can recommend by their two propositions. Firstly, they given the same steady state of B's technology, FDI can improve B's production efficiency because foreign invested firms are front runners in the adoption of GPTs because of their superior human capital, management and organizational structure. Domestic firms can be trained from foreign invested firms through learning

by watching. They also have incentives to become more proficient and competitive because they fear losing out to foreign invested firms.

The moving effect of FDI on production efficiency of B can be illustrated in Figure 1. Production frontier of A and B, denotes the production frontier of B. At a steady state when input is fixed at X0, the actual level of domestic production is Yd0 without the effect of FDI. If FDI has a positive impact on production efficiency at this steady state, or âˆ‚YB/âˆ‚FDIB > 0, the actual level of production will rise to Yf 0. The net moving effect of FDI on country B’s production is (Yf 0 â’ Yd0). Second proposition examine that FDI is a shifter of the domestic production frontier. If FDI does not have a shifting effect, the maximum output of B can never go above PFB. If FDI has a shifting effect, country B’s maximum potential output can be as high as those located on PFA, which is the production frontier of A. (Cobb-Douglas. Wikipedia. Retrieved April 20, 2010, from: http://en. wikipedia. org/wiki/Cobb%E2%80%93Douglas)

Figure 3. 1: Production Frontier of A and B and the role of FDI in B.

Y PFA

Yft

PFB

Ydt

Yf0

Yd0

0 X0 X1

X

For example, without a shifting effect, the actual level of production may move from Yf 0 at the initial steady state to Ydt at the new steady state with a new input mix Xt. The maximum possible output of B at the new level of input will be on PFB or below. If FDI has a shifting effect, the actual level of output can go above PFB, with a maximum potential output to be on PFA. In Fig. 1, if the new actual output is Yf t , which is situated between the two frontiers, it means that the production frontier of B has been shifted towards PFA from PFB. This positive shifting effect can be expressed as âˆ‚YB/âˆ‚FDI = f (t)> 0, implying that the marginal product of FDI is an increasing function of time (Yao and Wei, 2007).

According to Yao and Wei (2007) indicate that with Propositions 1 and 2, country B’s production function can be rewritten as:

(3)

And FDI is part of the multiplier ABt along with a set of other variables Z1 which can also improve production efficiency. Besides, FDI enters the residual term to be a shifter of the production frontier along with other variables, including a time trend t , which captures the Hick’s neutral technological progress in B in the absence of FDI or foreign technologies, t * FDI captures the additional technological progress that is attributed only to FDI. The total effect of FDI on economic growth in country B can be expressed as:

(4)

The first part on the right-hand side of (4) measures the moving effect, and the second part the shifting effect of FDI on YB. If both effects are positive and significant, the above two propositions hold true.

While the traditional growth theory considered only two factors of production, namely capital and labor, this new growth theory adds a third, technology. Endogenous growth theory or new growth theory focuses on the wider concept of technology, which is expressed through ideas, instead of objects or products. It necessitates a different set of institutional arrangements, like pricing systems, taxation or incentives to ensure the efficient allocation of ideas. These types of models are sometimes called Schumpeterian models because Schumpeter emphasized the importance of temporary monopolistic power over discoveries, as a motivating force for continued innovative process.

A great deal of evidence has been produced in recent years casting doubt on endogenous growth theory. Mankiw, Romer and Weil (1992) argue that the neoclassical growth model of Solow and Swan with exogenous technological progress and diminishing returns to capital, explains most of the cross-country variation in output per person. The Schumpeterian variant of endogenous growth theory that emphasizes technological progress, innovation and R&D has come under particularly heavy fire.

Endogenous growth models attempt to explain a greater proportion of observed growth as well as why different countries experience different growth rates. They generally use the neoclassical model but allow the

production function to exhibit increasing returns to scale, focus on externalities and assume that technological change, although important, is not necessary to explain long-run growth. In 1986, paper of Romer ignores physical capital and only considers ‘ knowledge’ but a general form of his model can be written as:

Y = A(R) F (Rj, Kj, Lj) (5)

Where R j, K j and L j are, respectively, stock results from research and development expenditure by firm j, physical capital of firm j and labor of firm j; R is the aggregate stock of knowledge. Any private research effort will have a spillover effect for the public stock of knowledge A(R). This type of model can explain why countries experience different growth rates. A country with an initial higher level of K experiences a higher rate of growth of K leading to a higher rate of growth of per capita income because such a country is more ‘ experienced’ through ‘ learning by doing’. This is an external effect that prevents diminishing returns.

3. 2 Model specification

The previous empirical studies have proved that GDP can be determined by the following variables: labor and capital as basic physical inputs; export, FDI and foreign exchange rate policy as variables of openness. The following model regression will include all these variables.

(6)

Where t (t = 1976, … , 2008) denote year t, k and l capital stock (Gross fixed capital accumulation) and total labor force, fdi = FDI inflow, exp = total

export and exc = real exchange rate. Lastly, the Y is the Gross domestic product in economic growth and the is error term.

Data for GDP are gross domestic product and capital is calibrated below based on investment in fixed assets. All the variables are calculated in 2000 constant prices. GDP is derived from real GDP annual indexes by province. Labor is total labor force in each province. FDI is actually used FDI inflows. Export is the total value of exports.

The description of FDI in the production model needs careful consideration. Because capital stock is the accumulation of fixed asset investment, which includes both domestic and foreign investments, the production function would be mis-specified if FDI, either measured as a flow or stock, were added as another explanatory variable along with capital stock. In the previous literature, export and exchange rate also has been found to be relevant variables in the production function. Like FDI, export is defined as total FDI inflows and total export in Korea therefore can effect to output.

The values of exports and FDI are provided in US dollars (USD) in the official statistics. Since they are measured in US dollars, most economic analysts do not bother to deflate the values in current prices into values in constant prices (e. g. Liu et al., 1997; Liu, 2000). It is important to conduct an appropriate deflation. One relevant deflator is the US consumer price index. The values of trade and FDI in nominal dollars are deflated by this index. Since all the other variables in the model are measured in KRW100, it is useful to change these two variables in KRW as well.

Exchange rate is real exchange rate, which is time-variant but location-invariant as all the provinces faced the same foreign exchange rate. Beside this, real exchange rate should be derived from the exchange rates and price indexes of Korea’s main trading partners. However, since KRW follows the US dollar very closely, albeit not pegged to the dollar, only the dollar exchange rate and the US price index are used to calculate the real exchange rate. Real exchange rate is expected to have a positive sign influence on economic growth because it represents China’s competitiveness in international trade and the extent of market liberalization in the foreign exchange market from Yao and Zhang (2001). The expectation result for the variable of capital stock, labor, human capital, FDI, export and real exchange rate are expect getting the significant and positive relationship to economic growth.

3. 3 Empirical methodology

3. 3. 1 Unit root test

A unit root test is vital in observing the stationery of time series data. It is main to estimate about the variables observed have a tendency to return to the long term trend follow a shock (stationery) or the variables follow a random walk which containing a unit root. If the variables follow a random walk after a temporary or permanent shock, the regression between variables is spurious (Amiruddin, Nor and Ismail 2007). According to the Grauss-Markov’s theorem, in such cases, the series do not have a finite variance. Hence the OLS will not produce consistent parameter estimates.

A stationary series is one whose basic properties, for example it mean and its variance, do not change it over time. In contrast, a non-stationary series has one or more basic properties that do change over time. If the time series variable is stationery,

i) The mean of is constant over time

ii) The variance of is constant over time

iii) The simple correlation coefficient between and depends on the length of the lag (k) but on no other variable (for all k).

The unit root test can separate into 2 test, that is Augmented Dickey Fuller (ADF) test and Phillips Perron (PP) test. This will test for level (original series), first differences and second differences (changes). If stationary at level, then the series are integrated of order zero, I(0) and if stationary at first differences and second differences, the series are integrated of order one and two, I(1) and I(2) respectively.

The Augmented Dickey-Fuller test statistic and Phillips-Perron test statistic to estimate the stationary for the variables. The results are and the hypothesis will indicate as below:

Hypothesis:

Ho: No stationary

Ha: Stationary

Hence, p-value should small tahan 0. 05, then rejected Ho, that is stationary, if failure to reject Ho, that means no stationary].

3. 3. 2 Autoregressive distributed lag (ARDL)-Bound test

The Bound Testing Method can use to estimate the small size sample data in between 30 observations. Therefore, one of the conditions is the dependent variables must be in I(1) and the dependent variables can be mixed in I(0) and I(1), but not the I(2). For example: Y= a+b1X1+b2X2+b3X3+e. The variable Y must stationary at order one or I(1) and the X1, X2 and X3 can be in I(0) or I(1) or mixed. For the simplicity, the Bound testing can be shown as:

(7)

The Autoregressive Distributed Lag (ARDL) method developed by Pesaran et al. (2001) was used to establish co-integration relationships among the variables. And it can use to overcome the stationary problem in the time-series regression. The advantage of the ARDL method is it can be applied to the model whether the independent variables are stationary at I (0) or I (1). The dependent variable must stationary in I (1). As a result, a dynamic model known as the Autoregressive Distributed lag model (ARDL) will be estimated and can be written as:

(8)

This equation shows that output growth is effects by values of explanatory variables as well as the lagged dependent and explanatory variables. The bound test used the conventional F-test compare to the critical value to detect the presence of co-integrating relationship. The critical value is base

on the Narayan (2005) table of critical values for the bounds test case III: Unrestricted intercept and no trend. If the F-test is higher than the upper bound critical value, the hypothesis of no-co-integration is rejected. Beside this, if an F-statistic is lower than the lower bound critical value implies that the absences of the co-integration. If the F-statistic is in between the lower bound and upper bound, there is no clear indication of the absence or existence of co-integration relationship.

Using Wald test to investigate the joint hypothesis is,

Ho:

Ha:

The conclusion for the hypothesis can be separate to three part, that is:

i) If the Wald F-statistic fall above the upper critical value- cointegration exists.

ii) If the Wald F-statistic falls down between the lower bound and upper bound critical value- inconclusive.

iii) If the Wald F-statistic falls below the lower bound critical value-no cointegration exists.

Furthermore, an Error Correlation Model (ECM) also use with the Bound test, the form is:

(9)

Where,

: 1-L is the difference operator

: f(yt, xt)

trend: trend term

: long run multiplier

Therefore, from the ARDL model, we can use the Bewley's (1979) regression approach to obtain the long run model.

(i= 1, 2,……, k) (10)

Where, and , i= 1, 2,……, k are the selected (estimated) values of and , i= 1, 2,….., k.

However, the short run dynamic model is estimated base on the Unrestricted Error Correction Model (UECM) model.

(11)

Where ECT represents as a long run steady point or " partial adjustment" term as below:

(12)

And using the Wald test to compute the long run elasticities and it standard error is:

1-Sum of the dependent coefficients= Sum of the independent coefficients (13)

3. 4 Data

The secondary data set consists of the annually data of the Korea economy for the period of 1976 to 2008 obtained from World Bank database, UC Atlas of Global Inequality, International Monetary Fund (IMF), International Financial Statistic (IFS), Korea National Statistical and United Nations Conference on Trade and Development (UNCTAD). Since the ultimate goal is to perform regression analysis with the data expressed in natural logarithms, it may instead wish to work with the log and proxy for variable as below:

CHAPTER 4

REGRESSION RESULTS

4. 0 Introduction

Augmented Dickey Fuller (ADF) test and Phillips Perron (PP) test and Autoregressive Distributed Lag (ARDL).

4. 1 Unit root test

In this study, two stationary tests on individual stochastic trend are conducted, that is Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) tests which have been used frequently I time series data. The value of ADF t-statistic and PP z-statistic will be compared to the critical value given by MacKinnon (1991). The time series under consideration should be integrated in the same order before we can proceed to cointegration analysis and causality test. The result can be show as below:

4. 1. 1 Augmented Dickey Fuller (ADF) test

Based on the result as below Table 4. 1. 1, it show that result for Augmented Dickey-Fuller test statistic in Unit Root test. This test is function to know the stationary of data for variable. In the result, the dependent variable and all explanatory variables are significant on the first and second differences for the constant with trends and constant without trends. This is because the p-value is small than 0. 05 at significant level. So, we will rejected Ho and conclude that the data is stationary when first difference. Therefore, all series are I(1) process.

Variable

Level

First Differences

Constant with trends

Constant without trends

Constant with trends

Constant without trends

t-stat

p-value

t-stat

p-value

t-stat

p-value

t-stat

p-value

Economic growth (y)

-2. 070027(0)

0. 5421

2. 327602(0)

0. 9999

-5. 756136*(0)

0. 0003

-4. 782721*(0)

0. 0006

Capital stock (k)

-1. 911924(0)

0. 6251

-0. 546014(0)

0. 8689

-4. 515321*(1)

0. 0060

-4. 361648*(0)

0. 0017

Labor force (l)

-0. 459604(0)

0. 9804

-1. 009485(0)

0. 6241

-4. 564489*(0)

0. 0051

-4. 425029*(0)

0. 0014

FDI (fdi)

-4. 190134(1)

0. 0125

-1. 009485(3)

0. 7363

-2. 892944*(8)

0. 1825

-6. 300895*(2)

0. 0000

Export (exp)

2. 708182(0)

1. 0000

5. 784347(0)

1. 0000

-3. 567930*(0)

0. 0495

-2. 184710(0)

0. 2155

Real exchange rate (exc)

-2. 246001(0)

0. 4496

-1. 594207(0)

0. 4739

-5. 035710*(0)

0. 0016

-5. 101766*(0)

0. 0002

Table 4. 1. 1: Result Augmented Dickey-Fuller (ADF) test

Criteria: Schwarz Info Criterion (SIC)

Variable

Level

First Differences

Constant with trends

Constant without trends

Constant with trends

Constant without trends

t-stat

p-value

t-stat

p-value

t-stat

p-value

t-stat

p-value

Economic growth (y)

-2. 815698(18)

0. 2023

3. 136859(7)

1. 0000

-6. 399643*(11)

0. 0000

-4. 778071*(1)

0. 0006

Capital stock (k)

-2. 096298(2)

0. 5282

-0. 519748(5)

0. 8745

-4. 100869*(7)

0. 0153

-4. 204347*(7)

0. 0026

Labor force (l)

-0. 631981(1)

0. 9699

-1. 228256(1)

0. 6498

-4. 564489*(0)

0. 0051

-4. 423468*(1)

0. 0014

FDI (fdi)

-1. 392163(31)

0. 8440

-1. 577055(31)

0. 4824

-4. 828185*(12)

0. 0027

-5. 032975*(13)

0. 0003

Export (exp)

4. 407935(8)

1. 0000

6. 050077(5)

1. 0000

-3. 555909*(1)

0. 0507

-2. 042327(1)

0. 2683

Real exchange rate (exc)

-2. 374756(1)

0. 3848

-1. 615847(1)

0. 4631

-4. 981815*(3)

0. 0018

-5. 068019*(2)

0. 0003Note: The number in parenthesis are lag length. The test employ a null hypothesis of a unit root. All series are log transformed. *Indicate that 5% at significant level.

Table 4. 1. 2: Result Phillips-Perron (PP) test

Criteria: Schwarz Info Criterion (SIC)

Note: The number in parenthesis are lag length. The test employ a null hypothesis of a unit root. All series are log transformed. *Indicate that 5% at significant level.

4. 1. 2 Phillips-Perron (PP) test

Based on the result as above Table 4. 1. 2, it show that result for Phillips-Perron (PP) test statistic in Unit Root test. This test is function to know the stationary of data for variable. In the result, the dependent variable and all explanatory variables are significant on the first and second differences for the constant with trends and constant without trends. This is because the p-value is small than 0. 05 at significant level. So, we will rejected Ho and conclude that the data is stationary when first difference from the result of PP test. Therefore, all variables are integrated of order I(1).

4. 2 Autoregressive Distributed Lag (ARDL) test

The condition of the bound testing is the dependent variable must be in I(1) and the independent variables can be mixed in I(0) and I(1). The y is I(1) and the independent variable is mixed in I(0) and I(1)., the estimation of co-integration can be done by using the Autoregressive Distributed Lag (ARDL). The Bound test technique is applied to examine the long run relationship between the exchange rate and its determinants. The result of the estimated ARDL model for Malaysia is reported as Table 4. 2. The goodness of fit of the model (adjusted R-squared (Adjusted-R2)) and the standard error of regression are higher.

Based on the table 4. 2, includes the diagnostic tests used to confirm the validity of the model. These several important diagnostic test has been carry out in order to strengthen the accuracy of the results. The result of the diagnostic test indicated that the residual of the model is normally distributed. Beside this, there are no heteroskedasticitity and no serial

correlation. However, the model successes to pass the Ramsey RESET test. Since all the probability is larger than 0. 05 (5%) significant level. Thus, hypothesis failed to reject the Ho, hence there are absence of those problem in the model carried out.

Note: The critical values are cited from Narayan(2005).(Table case III: Unrestricted intercept and no trend; pg1988). *,**and *** denote significant at 10%, 5% and 1% significance level, respectively.

Based on the Table 4. 3, the results of bound cointegration test obviously demonstrated that the null hypothesis is, against the alternative hypothesis is easily rejected at 1% significant level. The model shows that the determinant variables are strongly cointegrated with economic growth in Korea. The result showed that the F-statistic compute by Wald test is highly significant at 1% significance level. The F-statistic is 8. 742069, which is greater than the upper critical bound value of 6. 040, so it is showed that cointegration exists. Hence, based on the test result, there exist cointegration or long run relationship among the economic growth, capital stock, labor, foreign direct investment, export and real exchange rate.

(14)

Based on the Table 4. 4 reported the long run elasticity between the variables use the ARDL test. The expected sign of the variables are indicate in this table and the estimated coefficient for capital stock (k) is positive 0. 764333 and has consistent sign with the expected sign. This implies that an increase in the capital stock by 1 billion US Dollar (US$), the gross domestic

product (GDP) will increase 0. 764333 billion US Dollar (US$). The standard error is 1. 594101 and probability 0. 6359 is the p-value in the model.

For the labor force (l), the estimated coefficient is positive sign, it is 25318. 75 and which is consistent with the expected sign. The coefficient means that when 1 unit labor force increase, the GDP will increase 25318. 75 US Dollar (US$). The probability is 0. 4858 and standard error is 35765. 61.

In addition, the foreign direct investment (fdi) in estimated coefficient is positive 5. 627353 and same with the expected sign. This indicate that when increase 1 billion US Dollar (US$) in the foreign direct investment, the GDP will increase 5. 627353 billion US Dollar (US$). The p-value is 0. 4313 and standard error is 7. 032203.

The estimated coefficient for export (exp) is positive 0. 798721, it has consistent sign with the expected sign. This implies that an increase 1 billion US Dollar (US$) in export, the GDP will increase 0. 798721 billion US Dollar (US$). The standard error for export is 0. 204665 and the probability is 0. 0007.

In the case of real exchange rate (exc), the estimated coefficient is positive 173672187. 2 and is similar with the expected sign. The coefficient means that when real exchange rate increase in 1 units of Korea Won 100 (KRW100) per US$ 1, the GDP will leads to increase in 173672187. 2 US Dollar (US$). The p-value for real exchange rate is 0. 1910 and standard error is 1. 29E+18.

4. 5 The Error Correction Model (ECM) test

The result of the Error Correction Model is reported at Table 4. 6 and the Error Correction Term (ECT) is shows as below:

(15)

So, the ECT equation will be generated into short run dynamic model.

Based on the Table 4. 5, the error correction term (ECT) is -0. 090218. This implies that speed of adjustment to the long run stability is very slow which is 0. 09. It is negative sign and rapid adjustment from a short term imbalance. The negative sign of the ECT means when there is a short run shocks occur, the gap is closed towards the adjustment process to the long run stability. This implies that the imbalance of output growth in the short run maybe adjusted with error corrections that resume the long term equilibrium. Approximately a high percentage of 89. 7% of the gross domestic product can be clarify by the capital stock, labor, foreign direct investment, export and real exchange rate selected.

Furthermore, the variable of capital stock (k) is significantly influence the gross domestic product (GDP/y) in the short run. The capital stock represents the gross fixed capital formation to be the most important factor that influences the gross domestic product in Korea. The capital stock, labor (l), foreign direct investment (fdi), export (exp) and real exchange rate (exc) is statistically positive influence in the current year of gross domestic product. As mentioned in literature review, this all explanatory variables should be elastic, portrays a positive sign and is should be a statistically variable in most of the research.

In the short run, capital stock is statistically significant and positive sign to the gross domestic product for Korea. When capital stock is increase 1 billion US Dollar (US$), the gross domestic product will attracts approximately increase 1. 249795 billion US Dollar (US$). Beside this, when the labor is increase 1 unit labor force, the gross domestic product will increase 2308. 908 US Dollar (US$). And if the foreign direct investment increase 1 billion US Dollar (US$), the gross domestic product will increase 0. 508124 billion US Dollar (US$). If export increase in 1 billion US Dollar (US$), gross domestic product will increase 0. 072330 billion US Dollar (US$). Lastly, when the real exchange rate is increase in 1 units of Korea Won 100(KRW100) per US$ 1, the GDP will increase in 15708616 US Dollar (US$).