CHAPTER 3

Methodology

3.1 Scope of the Study

In this study, its consideration about Total Factor Productivity for Top three international port in ASEAN was selected by the annual cargo and container throughput statistics consists of ASEAN is Thailand, Malaysia and Singapore. The period data was chosen for this investigation from 2007 to 2015 Secondary data analysis may be based on the published data following an output variable which is cargo throughput (tons) and four inputs that are number of vessel (ship), vessel handled capacity (DWT), labor (person), and terminal area (m^2). Details inputs and outputs data are constructed by using weighted aggregative method. Since there are various studies evaluating the difference scale and size of ports according to Yeo (2010), Sang Hyun Cheon, and Dong-Wook Song (2010), and Ancor Suárez-Alemán, Javier Morales Sarriera, Tomás Serebrisky, Lourdes Trujillo (2016)

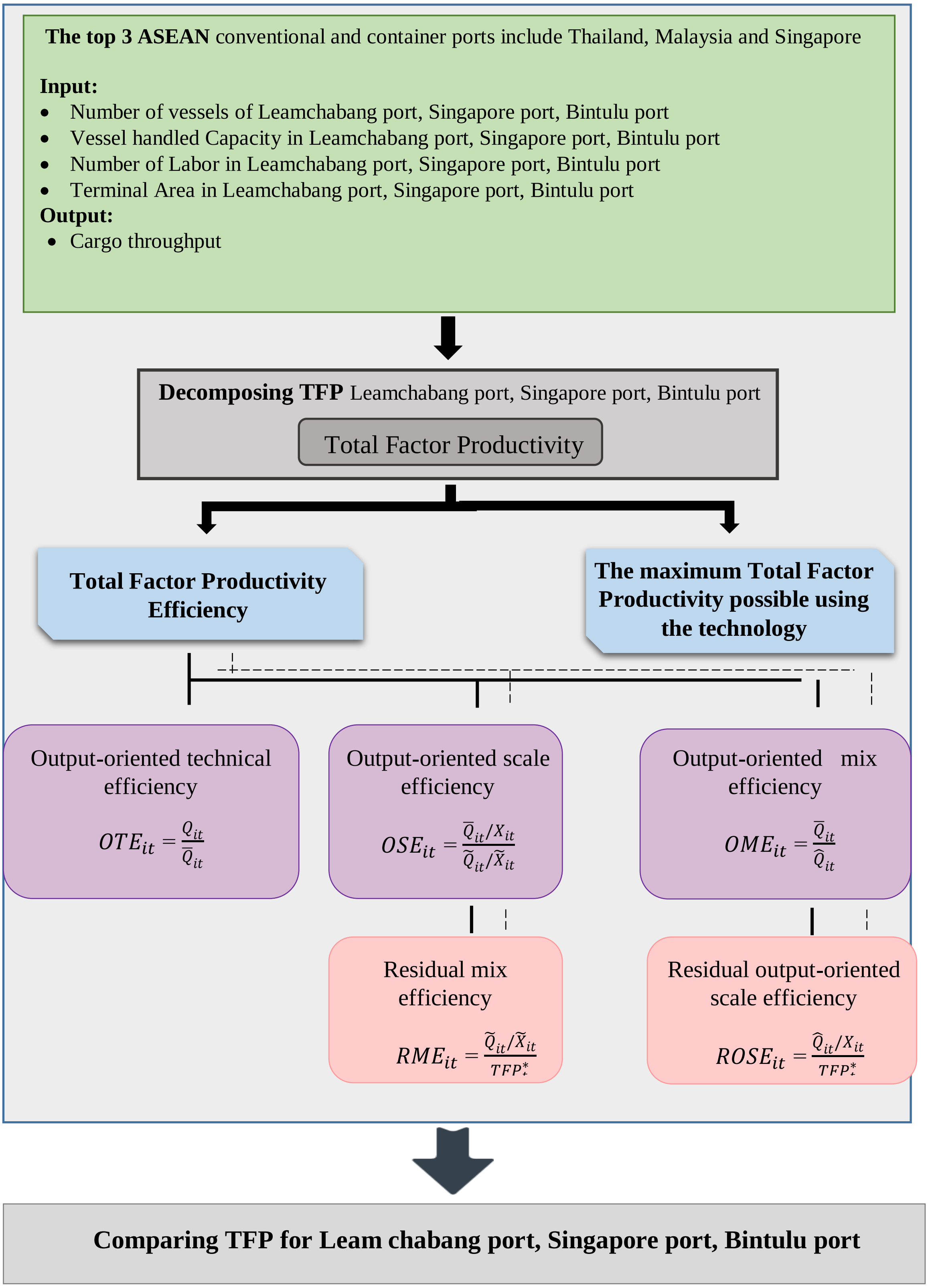
3.2 Data collection

The selected ports are Top three countries in ASEAN in the period 2007 to 2015. According to World Bank (2014) MIT Atlas of Economics, CIA world Fact book *Cargo throughput (tons)*, *Number of vessel (ship)* and *Terminal area (m^2)* were obtained from Marine Department under the Ministry of Transport (MOT) compiled by Information Technology & Communication Centre, Office of the Permanent Secretary for all study continental ports throughout the study period

The major data sources were supplemented by a number of other sources. *The average vessel capacity* was constructed from deadweight tonnage per docking (DWT)

data by summarizing total DWT in each port.Detail data on labor (person) obtain direct from port Authorities of each port in every years from annual report

3.3 Conceptual framework / Model



According variable in conceptual frame work

$Q_{it} = Q(q_{it})$ **:** an aggregate output in Leamchabang port, Singapore port, Bintulu port

$X_{it} = X(x_{it})$ **:** an aggregate input in Leamchabang port, Singapore port, Bintulu port

$\bar{Q}_{it}$ **:** The maximum aggregate output possible using x_{it} to produce a scalar multiple of q_{it}

$\hat{Q}_{it}$ **:** The maximum aggregate output possible using x_{it} to produce output vector;

$\tilde{Q}_{it}$ and $\tilde{X}_{it}$ **:** the aggregate output and input at the point where TFP is maximized subject to the constraint that the output and input vectors are scalar multiples of q_{it} and x_{it}

TFP_t^* **:** Denotes the maximum TFP possible using the technology available in period *t*.(2007 to 2015)

3.4 Research Methodologies / Data Calculating Method

A measure of the change in TFP can be defined as the ratio of outputs over inputs. Let x_{it} = *Number of vessels$_{it}$*, *Vessel handled capacity$_{it}$*, *Labor$_{it}$*, *Terminal area$_{it}$* , and q_{it} = *Cargo throughput$_{it}$* denote the input and output quantity of i= Leamchabang port, Singapore port, Bintulu port in period *t* period 2007 to 2015; TFP is defined as

$$TFP_{it} = \frac{Q_{it}}{X_{it}} \qquad \text{Total factor productivity} \qquad (3.1)$$

Where $Q_{it} = Q(q_{it})$ is an aggregate output in Leamchabang port, Singapore port, Bintulu port, $X_{it} = X(x_{it})$ is an aggregate input in Leamchabang port, Singapore port, Bintulu port and Q(.) and X(.) are non-negative, non-decreasing and linearly homogenous aggregator function (O'Donnell, 2011).

For more delicate, let consider a set of Leamchabang port, Singapore port, Bintulu port in this study that the set of time of each port in period *2007 to 2015*. With this definition, the index number that measures the TFP of i = Leamchabang port, Singapore port, Bintulu port in period *t* relative to another port *h* in period *s* is:

$$TFP_{hs,it} = \frac{TFP_{it}}{TFP_{hs}} = \frac{Q_{it}/X_{it}}{Q_{hs}/X_{hs}} = \frac{Q_{hs,it}}{X_{hs,it}} \qquad \text{TFP index} \qquad (3.2)$$

Where $Q_{hs,it} = Q_{it}/Q_{hs}$ is an output quantity index and $X_{hs,it} = X_{hs}/X_{it}$ is an input quantity index. O'Donnell (2008) referred to TFP indexes that can be expressed in terms of aggregate quantities as being *multiplicatively-complete*.

There are several ways to decompose TFP efficiency. The easiest way to decompose TFP indexes is to rewrite equation $TFP_{it}= TFP_t^* \times TFPE_{it}$ for Leamchabang port, Singapore port, Bintulu port = *i* in period *t = 2007 to 2015*. It follows that

$$TFPE_{it} = \frac{TFP_{it}}{TFP_t^*} \quad \text{TFP efficiency} \tag{3.3}$$

Where TFP_t^* is the maximum possible TFP using the technology available in period *t 2007 to 2015*. Hence, TFP efficiency is a measure of overall productive performance.

The measures of efficiency denote from O'Donnell (2010) that

$$TFPE_{it} = OTE_{it} \times OME_{it} \times ROSE_{it} \tag{3.4}$$

$$TFPE_{it} = OTE_{it} \times OSE_{it} \times RME_{it} \tag{3.5}$$

Where

$$OSME_{it} = OME_{it} \times ROSE_{it} = OSE_{it} \times RME_{it} \tag{3.6}$$

More detail of equation (3.4), (3.5) and (3.6) can be found in O'Donnell (2010). Alternatively, TFP efficiency could write the previous expression as follows

$$TFPE_{it} = OTE_{it} \times OSME_{it} \tag{3.7}$$

When substitution equation (3.7) in (3.3), total factor productivity of *i* in period *t 2007 to 2015* is:

$$TFP_{it} = TFP_t^* \times (OTE_{it} \times OSME_{it}) \tag{3.8}$$

Finally, the index that compares the TFP of Leamchabang port, Singapore port, Bintulu port = *i* in period *t* = 2007to 2015 with the TFP of port *h* in period *s* can be written

$$TFP_{hs,it} = \frac{TFP_{it}}{TFP_{hs}} = \left(\frac{TFP_t^*}{TFP_s^*}\right)\left(\frac{OTE_{it}}{OTE_{hs}}\right)\left(\frac{OSME_{it}}{OSME_{hs}}\right) \tag{3.9}$$

In term of TFP_t^*/TFP_s^* measures the change in the maximum possible TFP using the technology available in period *s* and *t*, which is a technical change. While OTE_{it}/OTE_{hs} and $OSME_{it}/OSME_{hs}$ measure overall efficiency change.