Do commodity prices affect exchange rate differently in developed and developing countries? 
A comparative study of OECD and ASEAN

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Abstract

In this thesis are compared the relationship between exchange rate and commodity prices between OECD and ASEAN commodity-exporting countries. Based on the similarity between OECD and ASEAN in terms of demographics, commodity export, financial markets, economic performance, and development prospects, the thesis makes some predictions for the relationship between real exchange rate and real commodity prices in ASEAN developing commodity-exporting countries when they reach “developed country” status. Moreover, this thesis gives some policy implications for these countries in the management of commodity prices and exchange rate during the transition period.

The relationship between real exchange rate and real commodity prices in the two groups of countries is examined in terms of cointegration, elasticity of real exchange rate to real commodity prices, and Granger causality by employing both time-series and panel-data techniques. The test results indicate that there is a considerable difference in this relationship between developed and developing commodity-exporting countries. Specifically, in OECD commodity-exporting countries, real commodity prices and real exchange rate move together in the same direction in the long run and changes in real commodity prices will lead to responses of real exchange rate in order to re-establish the equilibrium. Meanwhile, in ASEAN commodity-exporting countries, real commodity prices and real exchange rate do not seem to have long-term relationship.

This thesis also gives explanations for the differences in the relationship between OECD and ASEAN commodity-exporting countries: differences in exchange rate regimes, ability to expand the natural-resource sector, and level of financial openness between the two groups of countries. It is expected that on the way to achieving the “developed country” status, the three factors of ASEAN commodity-exporting countries would be likely to evolve toward the trend currently seen in OECD commodity-exporting countries and the relationship between real commodity prices and real exchange rate would become stronger.
However, a stronger relationship between real exchange rate and real commodity prices might be harmful to the economy, especially when the financial system is underdeveloped. To reduce the negative effects of the relationship on the overall economy in the transition period, this thesis suggests that ASEAN commodity-exporting countries smooth their government spending, diversify export commodities and diversify their economies.
Acknowledgements

Foremost, I would like to say thank you to my supervisory team. My Principal Coordinating Supervisor, Dr. Omar Bashar has provided me with a foundation upon which I built my journey and endless amounts of encouragement as I worked toward completion. He was always there – whenever and whatever I needed – with academic advice and guidance as well as personal care and support. He challenged me to go deeper and further throughout his comments and feedback on my work. My Co-Coordinating Supervisor, A/Prof Malcolm Abbott, with his immense knowledge and research experience, has always given me valuable advice when I had trouble with my thesis. I am blessed to have had A/Prof Malcolm to work with.

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Declaration

This thesis:

- Contains no material that has been accepted for the award to the candidate of any other degree or diploma, except where due reference is made in the text of the examinable outcome;
- To the best of the candidate’s knowledge contains no material previously published or written by another person except where due reference is made in the text of the examinable outcome;
- This thesis is 50,709 words in length exclusive of bibliography and appendices; and
- Ian M. Hoffman, Ph.D. edited this thesis. The editing addressed only style and grammar and not its substantive content.

Thi Anh Thu Tran

Jan 20th, 2016
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<th>Description</th>
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<tr>
<td>ADF</td>
<td>Augmented Dickey – Fuller</td>
</tr>
<tr>
<td>AIA</td>
<td>ASEAN Investment Area</td>
</tr>
<tr>
<td>ARDL</td>
<td>Auto-regressive distributed lag</td>
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<tr>
<td>ASEAN</td>
<td>Association of Southeast Asian Nations</td>
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<tr>
<td>BOG</td>
<td>Bank of Greece</td>
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<tr>
<td>CLMV</td>
<td>Cambodia, Laos, Myanmar and Vietnam</td>
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<tr>
<td>CPI</td>
<td>Consumer price index</td>
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<tr>
<td>DOLS</td>
<td>Dynamic ordinary least squares</td>
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<tr>
<td>FDI</td>
<td>Foreign direct investment</td>
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<tr>
<td>FMOLS</td>
<td>Fully modified ordinary least squares</td>
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<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GMM</td>
<td>Generalized method of moments</td>
</tr>
<tr>
<td>HS</td>
<td>Harmonized system</td>
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<tr>
<td>IFS</td>
<td>International financial statistics</td>
</tr>
<tr>
<td>IGA</td>
<td>Investment guarantee agreement</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>LLC</td>
<td>Levin, Lin, &amp; James Chu</td>
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<tr>
<td>LRE</td>
<td>Long-run elasticity</td>
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<tr>
<td>LSDV</td>
<td>Least square dummy variables</td>
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<tr>
<td>LSDVC</td>
<td>Bias-corrected least square dummy variables</td>
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<tr>
<td>MUV</td>
<td>Manufacturers unit value</td>
</tr>
<tr>
<td>MYR</td>
<td>Malaysia Ringgit</td>
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<tr>
<td>NCOMP</td>
<td>Nominal country-specific commodity prices</td>
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<tr>
<td>NZD</td>
<td>New Zealand Dollar</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
</tr>
<tr>
<td>OLS</td>
<td>Ordinary least squares</td>
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<tr>
<td>PP</td>
<td>Philips – Perron</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<td>---------</td>
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<tr>
<td>PVAR</td>
<td>Panel vector autoregression</td>
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<td>RCOMP</td>
<td>Real commodity prices</td>
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<tr>
<td>REER</td>
<td>Real effective exchange rate</td>
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<tr>
<td>RIR</td>
<td>Real interest rate</td>
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<tr>
<td>SAARC</td>
<td>South Asian Association for Regional Cooperation</td>
</tr>
<tr>
<td>SDR</td>
<td>Special drawing right</td>
</tr>
<tr>
<td>SMEs</td>
<td>Small and medium-size enterprises</td>
</tr>
<tr>
<td>UNCTAD</td>
<td>United Nations Conference on Trade and Development</td>
</tr>
<tr>
<td>UN COMTRADE</td>
<td>United Nations Commodity Trade Statistics</td>
</tr>
<tr>
<td>USD</td>
<td>United States Dollar</td>
</tr>
<tr>
<td>VAR</td>
<td>Vector autoregressive</td>
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<tr>
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<td>Vector error correction</td>
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This chapter provides an overview of the thesis entitled “Do commodity prices affect exchange rate differently in developed and developing countries? A comparative study of OECD and ASEAN.” This chapter is structured as follows: the background and motivation; the objectives and research questions; the contribution of the thesis; and the underlying theory of the study. Lastly, the section on thesis structure will present how the thesis will be organized.

1.1 Background and motivation

According to the literature on “Dutch Disease,” in commodity-dependent countries where primary commodities contribute an important part of their total export value, real exchange rate is the main channel through which commodity-price shocks can influence a country’s economic performance (Bodart, Candelon & Carpentier 2012). This explains why the link between real exchange rate and commodity prices or terms of trade – a relative export prices in terms of import prices – is an interesting topic. In fact, for commodity-dependent countries, commodity prices are used more frequently than terms of trade when exploring the nexus of the exchange rate and commodity prices. There are two reasons for this trend. Firstly, terms of trade is an aggregate index which is a poor measure of the temporary booms and long-lasting troughs usually seen in the

1 For more detail on “Dutch Disease” see Section 5.3
prices of major exports of commodity-dependent countries (Deaton & Laroque 1992). Moreover, according to Chen and Rogoff (2003), a country-specific commodity export price is likely to be better at capturing the exogenous shocks to these countries’ terms of trade than standard terms of trade. For these reasons, the relationship between commodity prices and exchange rate in commodity-exporting countries has become a topic for a substantial number of studies in recent years (e.g., Chen 2002, Chen & Rogoff 2003, Simpson & Evans 2004, and Bashar & Kabir 2013). Gaining insight into the commodity prices – exchange rate nexus will be beneficial for policy makers in commodity-exporting countries in the management of commodity prices and exchange rate.

In line with the literature on “Dutch Disease”, Cashin, Céspedes and Sahay (2004) presents a theory describing that there is a long-run relationship between exchange rate and commodity prices in commodity-exporting countries. Specifically, an increase in commodity prices will lead to a real exchange rate appreciation. However, the relationship between exchange rate and commodity prices varies across commodity-exporting countries (Cashin, Céspedes & Sahay 2004). It is explained by the fact that this relationship depends on many factors. Bodart, Candelon and Carpentier (2011) show that the level of trade openness, the exchange rate regime, the level of export diversification, and the type of the export commodities have a substantial influence on the long-run commodity price elasticity of the real exchange rate in countries focusing on the export of a leading commodity. The impact of exchange rate regime on the relationship between real exchange rates and commodity prices is also described by Chen and Rogoff (2003). Besides, Rickne (2009) concludes that the relationship status between oil price and real exchange rates is highly dependent on political and legal institutions.

It can be inferred from the above findings that basic differences between economic situations in developed and developing countries might lead to different relationships between exchange rate and commodity prices. Since developed countries can be considered as the future of developing countries, realizing the differences in the relation between developed and developing countries will give guidelines for policy makers and investors in developing countries in their transition period to becoming developed ones. This is the topic that motivates us to compare the relationship between real exchange
rate and real commodity prices in developed and developing commodity-exporting countries.

This thesis has a limited scope of the Organization for Economic Cooperation and Development (OECD) and the Association of Southeast Asian Nations (ASEAN). OECD is chosen since it is the largest group of developed countries in the world (31 of its 34 members are developed countries). The reason for selecting ASEAN as representatives for developing countries among other developing groups such as Latin America, the South Asian Association for Regional Cooperation (SAARC), or Sub-Saharan Africa is that this group is generally the most similar one to OECD in terms of demographics, commodities export, financial markets, economic performance and development prospects. Based on this similarity between OECD and ASEAN, the findings of our thesis are expected to provide some prediction for the relationship between real exchange rate and real commodity prices as well as significant policy implications for ASEAN commodity-exporting countries in management of exchange rates and commodity prices on their way to achieving “developed country” status.

1.2 Aims and research questions

This thesis has four objectives. First, this thesis will clarify the real exchange rate – real commodity price nexus in OECD and ASEAN commodity-exporting countries. Specifically, the research will shed light on three important aspects of this relationship. The first aspect is whether there is a relationship between real exchange rate and real commodity prices in the long term. Next, if real exchange rate co-moves with real commodity prices in the long term, then the long-run elasticity of exchange rate to commodity prices will be taken into account. The last aspect is the Granger causality, which determines whether real commodity-price changes cause changes in real exchange rate or vice versa. It is expected that this thesis will provide an insight into the relationship between real exchange rate and real commodity prices in both ASEAN and OECD commodity-exporting countries.

The second objective of this research is to determine if the relationship varies across these two groups of countries. This objective will be achieved on the basis of the findings of the first objective.
Chapter 1 - Introduction

Thirdly, if evidence of differences in the long-run relationship between developed and developing commodity-exporting countries is found, the thesis would clarify factors leading to the differences.

Lastly, based on our findings, some suggestions will be made for the sake of policy makers in ASEAN countries during their transition period.

The research questions that are to be addressed in the thesis are as follows:

1. For OECD and ASEAN commodity-exporting countries: Does a long-run relationship exist between real commodity prices and real exchange rate? If yes, how significant is the long-run elasticity of real exchange rate to real commodity prices? Is there any Granger causality between real commodity prices and real exchange rate?

2. Does the relationship between real commodity prices and real exchange rate differ across the two groups of countries?

1.3 Contributions

The thesis will make significant contributions to existing literature in a number of ways:

First, to the best of our knowledge, this study is the first one that compares the relationship of commodity prices and exchange rate between developed and developing countries. Although there has been much work on the relationship between exchange rate and commodity prices in developed countries as well as in developing countries, there have not been any comparative studies between these two types of countries. In fact, there are some studies that include both developing and developed countries in their samples, but they are not aimed at comparing the commodity price – exchange rate relationship between the two kinds of countries or else do not provide sufficient information for the purpose of such comparison. For example, Chen, Rogoff and Rossi (2010) investigate the relationship for Australia, Canada, New Zealand, Chile and South Africa but only focus on the ability of exchange rates to forecast commodity prices. Likewise, Kohlscheen (2010) and Zhang, Dufour and Galbraith (2013) just clarify only the relation between two variables in Australia, Canada, and Chile. Until now, the study of Cashin, Céspedes and Sahay (2004), which investigates the relationship between
commodity prices and exchange rate in five developed and 53 developing commodity-exporting countries, can be regarded as the most comprehensive research about this relationship. However, this study only focuses on individual countries while neglecting the comparison between developed and developing nations. This thesis will enrich the literature by determine whether the exchange rate – commodity prices relationship differs in developed and developing countries.

Secondly, based on the similarity between OECD and ASEAN, this thesis will provide predictive capabilities on how the relationship between real exchange rate and real commodity prices in ASEAN commodity-exporting countries shall evolve as they achieve “developed nation” status. Moreover, some policy implications will be provided for ASEAN commodity-exporting nations in their transition period.

Lastly, most of the existing studies (e.g., Bodart, Candelon & Carpentier 2012, Cashin, Céspedes & Sahay 2004, and Simpson & Evans 2004) make use of the simple model including only two main variables which are exchange rate and commodity price. In this thesis, apart from the two main variables – real effective exchange rate and real commodity prices – the real interest rate will be added as a control variable as it affects both exchange rate and commodity prices. With a more comprehensive model, the thesis aims to fill in the gap in existing literature.

1.4 Theoretical link between real exchange rate and real commodity prices

The theoretical relation between the real exchange rate and real commodity prices is stated in Cashin, Céspedes and Sahay (2004). To clarify the relationship between the two variables, Cashin, Céspedes and Sahay (2004) consider a small open economy that produces two types of goods: nontradables and tradables (primary commodities).

In a domestic economy, there are two different sectors: one produces tradables and the other one produces nontradables. To be simpler, it is assumed that the production of nontradables and tradables requires only one factor which is labor. The production functions are:

\[
\text{Tradables sector: } Y_x = a_x \cdot L_x
\]
Chapter 1 - Introduction

Nontradables sector: \( Y_n = a_n \cdot L_n \)  \hspace{1cm} (1.2)

where \( x \) represents the tradables sector, \( n \) represents the nontradables sector, \( L \) is the amount of the labor input, and \( a \) is the productivity of labor.

The model assumes that labor can move across sectors without restraint. Accordingly, the labor wage \( w \) is the same in all sectors. The price equations are as follows:

\[
P_x = \frac{w}{a_x} \quad \text{and} \quad P_n = \frac{w}{a_n}
\]

(1.3)

As the labor wage \( w \) is the same across sectors, it can be inferred from (3) that:

\[
P_n = \frac{a_x}{a_n} \cdot P_x
\]

(1.4)

Therefore, the relative price of the nontradables \( P_n \) to the tradables \( P_x \) is determined by technological factors while being not affected by demand factors.

The economy is inhabited by individuals who supply labor inelastically (\( L = L_x + L_n \)) and consume both nontradables and imports. The assumptions imply that the tradables are not consumed domestically. To maximize utility, each individual makes decisions on how to consume the nontradables and imports in order to increase the level of aggregate consumption. The aggregate consumption level (\( C \)) is given by:

\[
C = k \cdot C_n^\gamma \cdot C_t^{1-\gamma}
\]

(1.5)

where \( C_n \) denotes purchases of the nontradables, \( C_t \) represents purchases of the imported goods and \( k \) is a constant (\( k = \frac{1}{[\gamma^\gamma \cdot (1-\gamma)^{(1-\gamma)}]} \))

The lowest unit cost of aggregate consumption (also being defined as the consumer price index) is given by:

\[
P = (P_n)^\gamma \cdot (P_t)^{1-\gamma}
\]

(1.6)

where \( P_t \) is the unit price of imported goods in local currency. According to the law of one price:

\[
P_t = P_t^* \cdot E
\]

(1.7)

where \( E \) is the nominal exchange rate which is the ratio of foreign currency to local currency, and \( P_t^* \) is the price of the imports in foreign currency.
In a foreign economy, there are three different sectors: nontradables, intermediate, and final goods. Similarly, the nontradables sector produces goods for foreigners only. This sector requires labor as the only one factor. The production function of the nontradables sector is:

\[ Y_n^* = a_n^* \cdot L_n^* \] (1.8)

Intermediate goods are used in the production of the final goods. Similar to the nontradables sector, the production function is represented by:

\[ Y_i^* = a_i^* \cdot L_i^* \] (1.9)

Because labor can move freely across foreign sectors, the foreign wage is equal across sectors. Accordingly, the price of foreign intermediate goods is:

\[ P_n^* = a_i^* / a_n^* \cdot P_i^* \] (1.10)

The production of the final goods is dependent upon two inputs. One is the primary commodities, which are tradables produced by the rest of the world, and among them is the domestic economy. Another is intermediate goods produced in foreign economy. The final good is also called the tradables, which are produced by gathering the foreign intermediate input \( Y_i^* \) and the foreign primary commodity \( Y_x^* \):

\[ Y_t^* = v \cdot (Y_i^*)^\beta \cdot (Y_x^*)^{1-\beta} \] (1.11)

Accordingly, the unit cost of a tradable good in foreign currency is given by:

\[ P_t^* = (P_i^*)^\beta \cdot (P_x^*)^{1-\beta} \] (1.12)

Foreign consumers are supposed to consume the foreign nontradables and the final goods. Moreover, they supply labor to the different sectors at the same wage rate. Therefore, the consumer price index for the foreign economy is given by:

\[ P^* = (P_n^*)^Y \cdot (P_t^*)^{1-Y} \] (1.13)

The real exchange rate is understood as “the foreign price of the domestic basket of consumption (EP) relative to the foreign price of the foreign basket of consumption (P*)”, Cashin, Céspedes and Sahay (2004).
Chapter 1 - Introduction

From (4), (6), (10), and (13), the real exchange rate in the domestic economy is determined by:

$$\frac{EP}{P^*} = \left(\frac{a_x a_n^* P_x^*}{a_f a_n P_f^*}\right)^{\gamma} \quad (1.14)$$

It can be inferred from the model that an increase in the international price of the tradables (primary commodities) will make wages in the commodity sector increase. Because wages across sectors are the same, the increase in wages will raise the relative price of the nontradables and, thus, appreciate the real exchange rate.

1.5 Thesis structure

The thesis is divided into seven chapters as follows:

- Chapter 1 (Introduction) provides an overview of the thesis including background and motivation, objectives, research questions, contributions, and underlying theory of the study.
- Chapter 2 (Economic background) explains the reasons for choosing OECD and ASEAN as the representatives for developed and developing countries. In addition, this chapter also provides insight into the economic background of OECD and ASEAN commodity-exporting countries.
- Chapter 3 (Literature review) conducts a review of literature on the link between exchange rate and commodity prices in OECD and ASEAN commodity-exporting countries and other developed and developing countries.
- Chapter 4 (Research methodology) introduces the research methods and data collection procedures used in empirical analysis with the purpose of clarifying the relationship between real effective exchange rate and real commodity prices in the OECD and ASEAN commodity-exporting countries.
- Chapter 5 (Results and discussion) analyses and discusses test results.
- Chapter 6 (Policy implications) makes predictions for the relationship in ASEAN commodity-exporting countries when they achieve “developed country” status and provides suggestions for policy makers of ASEAN commodity-exporting countries during the transition period.
Chapter 1 - Introduction

- Chapter 7 (Conclusion) concludes the work presented in this thesis and discusses limitations of the research as well as suggests future research directions.

1.6 Summary

This introductory chapter provides an overview of thesis. It elucidates the background and motivation for carrying out this study. The four main objectives of this thesis include exploring the relationship between real exchange rate and real commodity prices in OECD and ASEAN commodity-exporting countries, comparing the relationship between the two groups of countries, clarifying factors causing the differences in the relationship (if there are differences in the relationship between the two groups of countries) and giving guidelines for policy makers in ASEAN commodity-exporting countries in their transition to become developed ones. A thesis structure concludes the chapter. In the next chapter, the economic background of OECD and ASEAN commodity-exporting countries is presented.
Chapter 2 – Economic background

In this chapter, we explain the reasons for choosing OECD and ASEAN as the representatives for developed and developing countries, respectively. In addition, some basic information about OECD and ASEAN is given. However, not all countries within these two groups are taken into account. As mentioned in Chapter 1, this thesis only considers commodity-exporting countries when exploring the nexus between exchange rate and commodity prices. This chapter also provides insight into the economic backgrounds of six individual developed commodity-exporting countries in OECD – Australia, Canada, Iceland, New Zealand, Norway and Greece – and six individual developing commodity-exporting countries in ASEAN including Brunei, Laos, Malaysia, Myanmar, Thailand, and Vietnam.

2.1 The OECD

The Organization for Economic Cooperation and Development (OECD) is an economic organization established in 1961 (Wikipedia 2014b). The aims of OECD are “providing a platform to compare policy experiences, seeking answers to common problems, identifying good practices” that will improve the economic and social well being of its member (Wikipedia 2014b). Until now, OECD has 34 members, most of which (31/34)

2 The 34 OECD member countries are: “Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States” (OECD).
are developed economies with a very high Human Development Index. As can be seen from the Figure 2.1, the material living standards (being measured by GDP per capita) of OECD countries are much higher compared to that of other economies over the period 2000 – 2012. Four countries having GDP per capita considerably in excess of USD 40,000 in 2012 are Luxembourg, Norway, the United States and Switzerland (OECD 2015). There are nine OECD countries having GDP per capita just above USD 40,000 and 12 countries having per capita GDP below USD 30,000 in 2012\(^3\) (OECD 2015).

**Figure 2.1 – GDP per capita of OECD, ASEAN and others, 2000–2012**

![Chart](chart.png)

Source: Based on data from OECD Statistics and ASEAN Statistical Yearbook

However, the GDP growth rate of OECD countries in recent years is much lower than that of the non-OECD countries. The average GDP growth rate of OECD in the period 2000 – 2012 is 1.67% while the rate of non-OECD countries is up to 6.48\(^4\). Being affected severely by the recent financial crisis, the annual GDP growth rate for the OECD area fell by 3.5% in 2009, which is the largest decrease on record. The economy of OECD has recovered gradually after the crisis.

---

\(^3\) Countries that had GDP per capita just above USD 40,000 in 2012: Australia, Austria, Ireland, Sweden, Netherlands, Denmark, Canada, Germany, and Belgium. Countries that had GDP per capita below USD 30,000 in 2012: Israel, Slovenia, Czech Republic, Slovak Republic, Greece, Portugal, Estonia, Chile, Poland, Hungary, Mexico, and Turkey (Source: OECD Statistics).

\(^4\) Source: OECD Statistics
Chapter 2 – Economic background

Since its establishment, OECD has considered international trade as an efficient way of raising living standards and boosting economic growth (OECD 2010). With the progressive reduction of trade barriers, international trade in goods expanded dramatically during the period between 2000 and 2008 in most OECD countries. In 2008/2009 the financial crisis resulted in the first huge decline (nearly one fourth) in OECD merchandise trade (see Figure 2.2).

**Figure 2.2 – International trade in goods of OECD and ASEAN 2000–2012**

![International trade in goods of OECD and ASEAN 2000–2012](image)

Source: Based on data from OECD Statistics and ASEAN Statistical Yearbook

Intra-OECD trade contributes a significant share of the total trade value (more than 70%) over the period. Nevertheless, there has been a gradual decline in this share from 76% in 2000 to 65% in 2012. Regarding non-OECD countries, the Asian area is the largest trading partner of OECD. The trade with this area has risen from 8.3% of the total OECD merchandise trade in 2000 to 14.5% in 2012. The main trade partners of OECD countries are Germany, Japan, USA, UK, Europe and China.

As can be seen from Figure 2.3, OECD is not significantly dependent on commodity export. During the last decade, in average, commodity export contributes about 19.1% of total export.

---

5 All the data relevant to economic growth and trade are sourced from OECD Statistics.
Chapter 2 – Economic background

Figure 2.3 – Commodity export and total export of OECD 1995–2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Total export</th>
<th>Commodity export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>10000000</td>
<td>1000000</td>
</tr>
<tr>
<td>1996</td>
<td>11000000</td>
<td>1100000</td>
</tr>
<tr>
<td>1997</td>
<td>12000000</td>
<td>1200000</td>
</tr>
<tr>
<td>1998</td>
<td>13000000</td>
<td>1300000</td>
</tr>
<tr>
<td>1999</td>
<td>14000000</td>
<td>1400000</td>
</tr>
<tr>
<td>2000</td>
<td>15000000</td>
<td>1500000</td>
</tr>
<tr>
<td>2001</td>
<td>16000000</td>
<td>1600000</td>
</tr>
<tr>
<td>2002</td>
<td>17000000</td>
<td>1700000</td>
</tr>
<tr>
<td>2003</td>
<td>18000000</td>
<td>1800000</td>
</tr>
<tr>
<td>2004</td>
<td>19000000</td>
<td>1900000</td>
</tr>
<tr>
<td>2005</td>
<td>20000000</td>
<td>2000000</td>
</tr>
<tr>
<td>2006</td>
<td>21000000</td>
<td>2100000</td>
</tr>
<tr>
<td>2007</td>
<td>22000000</td>
<td>2200000</td>
</tr>
<tr>
<td>2008</td>
<td>23000000</td>
<td>2300000</td>
</tr>
<tr>
<td>2009</td>
<td>24000000</td>
<td>2400000</td>
</tr>
<tr>
<td>2010</td>
<td>25000000</td>
<td>2500000</td>
</tr>
<tr>
<td>2011</td>
<td>26000000</td>
<td>2600000</td>
</tr>
<tr>
<td>2012</td>
<td>27000000</td>
<td>2700000</td>
</tr>
<tr>
<td>2013</td>
<td>28000000</td>
<td>2800000</td>
</tr>
</tbody>
</table>

Source: Based on data from UNCTAD

Table 2.1 – Top 15 export commodities in OECD 2007–2012

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average share of Total OECD export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude oil</td>
<td>2.107%</td>
</tr>
<tr>
<td>2</td>
<td>Aluminum</td>
<td>1.201%</td>
</tr>
<tr>
<td>3</td>
<td>Fish</td>
<td>0.605%</td>
</tr>
<tr>
<td>4</td>
<td>Coal</td>
<td>0.595%</td>
</tr>
<tr>
<td>5</td>
<td>Iron</td>
<td>0.485%</td>
</tr>
<tr>
<td>6</td>
<td>Wheat</td>
<td>0.307%</td>
</tr>
<tr>
<td>7</td>
<td>Swine meat</td>
<td>0.260%</td>
</tr>
<tr>
<td>8</td>
<td>Copper</td>
<td>0.247%</td>
</tr>
<tr>
<td>9</td>
<td>Platinum</td>
<td>0.187%</td>
</tr>
<tr>
<td>10</td>
<td>Corn</td>
<td>0.174%</td>
</tr>
<tr>
<td>11</td>
<td>Soybeans</td>
<td>0.171%</td>
</tr>
<tr>
<td>12</td>
<td>Coffee</td>
<td>0.126%</td>
</tr>
<tr>
<td>13</td>
<td>Polypropylene</td>
<td>0.116%</td>
</tr>
<tr>
<td>14</td>
<td>Rice</td>
<td>0.098%</td>
</tr>
<tr>
<td>15</td>
<td>Rubber</td>
<td>0.094%</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

The most significant commodity for the OECD is crude oil, which accounts for 2.1% of total export value. Norway, Mexico and the United Kingdom are the three main exporters of this commodity. Among non-oil commodities, metals are one of the most prominent exports. The top five metals exported includes aluminium, iron, copper and platinum. Cereals such as wheat, corn, soybeans and rice are also major exports of this area. Fish ranks in the top three and most of the exports come from Norway, the United States of America, Canada, and the Netherlands.

In respect to exchange rate, before 2006, soft pegs were the least persistent while hard pegs are an absorbing state in the OECD. However after that, hard pegs shrank considerably from approximately 35% in 2006 to 3% in 2007 as most European countries changed from hard pegs to floating regimes (see Figure 2.4). From 2007 until
Chapter 2 – Economic background

now, over 90% of OECD countries have operated flexible exchange rate regimes because of their great benefit in terms of growth performance.

Figure 2.4 – Exchange rate arrangements in OECD 2003–2013

Source: Based on data from Annual Report on Exchange Arrangements and Exchange Restrictions
Note: (1) Hard pegs consisting of (a) exchange arrangements with no separate legal tender and (b) currency board arrangements; (2) Soft pegs consisting of (a) conventional pegged arrangements, (b) pegged exchange rate within horizontal bands, (c) crawling pegs, (d) stabilized arrangements and (e) crawl-like arrangements; (3) Floating regimes comprising (a) managed floating and free-floating

2.2 The ASEAN

The Association of Southeast Asian Nations (ASEAN) was founded in 1967. This organization aims to “accelerate economic growth, promote regional peace and stability, and enhance cooperation on economic, social, cultural, technical, and educational matters of Southeast Asian countries” (ASEANSecretariat 2014). Currently, ASEAN has a total ten members\(^6\). However, these countries differ from each other in level of development. Burma, Cambodia, Laos, and Vietnam, which are the last four countries to join ASEAN, are much less developed than the other six member countries (ASEANSecretariat 2014). Most ASEAN countries are developing economies, except for Singapore and Brunei Darussalam. In 2012, the average GDP per capita of ASEAN is USD 3,748, which is only one tenth of OECD’s (as illustrated in Figure 2.1).

---

\(^6\) The ten ASEAN member countries are: “Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam” (ASEANSecretariat 2014).
The average GDP growth rate of ASEAN in the period 2000 – 2012 is 5.47%, which is nearly three times higher than that of OECD. Being supported by a variety of instruments related to trade in goods, both intra-ASEAN and extra-ASEAN trade has been developing rapidly. Although the global financial crisis led to a dramatic decline in ASEAN trade growth (from 17.78% in 2008 to −18.99% in 2009), the average annual growth rate for the period 2000 – 2012 is still over 12%. In contrast with OECD countries, intra-ASEAN trade only accounts for 25% while extra-ASEAN trade makes up 75%; this proportion has remained relatively stable for the last decade. Among non-ASEAN trading partners, China has contributed the greatest share since 2010. China – ASEAN bilateral trade climbed rapidly at the average rate of 23.6% per year from 2002 to 2012. The other important trading partners of ASEAN are Europe, Japan, USA, and Korean.

**Figure 2.5 – Commodity export and total export of ASEAN 1995–2013**

![Figure 2.5 – Commodity export and total export of ASEAN 1995–2013](image)

Source: Based on data from UNCTAD

ASEAN countries have vast mineral resources including both precious metals and industrial ores (ASEAN 2014b). Similar to OECD, ASEAN is not overly reliant on

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7 ASEAN has various instruments related to trade in goods: “(i) ASEAN Free Trade Area (AFTA, 1992), (ii) the ASEAN Agreement on Customs (1997), (iii) the ASEAN Framework Agreement on Mutual Recognition Arrangements (1998), (iv) the e-ASEAN Framework Agreement (2000); (v) the ASEAN Framework Agreement for the Integration of Priority Sectors (2004); (vi) the Agreement to Establish and Implement the ASEAN Single Windows (2005) and (vii) ASEAN–China Free Trade Area (2010)” (Secretariat 2011).

8 Source: ASEAN Merchandise Trade Statistics

9 Based on ASEAN Finance and Macroeconomics Surveillance Unit Database
Chapter 2 – Economic background

commodity export (except for Brunei). Commodity export accounts for approximately 28.5% of total export for the last decade (for more information, see Figure 2.5). In respect to export commodities, crude oil is still the most important export for the ASEAN area in the period from 2007 – 2012. The second largest commodity is rubber. Fish and shrimp are two kinds of seafood that bring a great export value for the ASEAN. Like OECD nations, such metals as aluminium, iron, copper, and platinum are also on the top lists of exports (see Table 2.2).

Table 2.2 – Top 15 export commodities in ASEAN 2007–2012

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average share of Total ASEAN export</th>
<th>No.</th>
<th>Commodities</th>
<th>Average share of Total ASEAN export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude oil</td>
<td>2.370%</td>
<td>9</td>
<td>Pepper</td>
<td>0.064%</td>
</tr>
<tr>
<td>2</td>
<td>Rubber</td>
<td>1.845%</td>
<td>10</td>
<td>Nickel</td>
<td>0.048%</td>
</tr>
<tr>
<td>3</td>
<td>Fish</td>
<td>1.585%</td>
<td>11</td>
<td>Iron</td>
<td>0.038%</td>
</tr>
<tr>
<td>4</td>
<td>Palm oil</td>
<td>0.882%</td>
<td>12</td>
<td>Tobacco</td>
<td>0.040%</td>
</tr>
<tr>
<td>5</td>
<td>Rice</td>
<td>0.711%</td>
<td>13</td>
<td>Aluminum</td>
<td>0.027%</td>
</tr>
<tr>
<td>6</td>
<td>Shrimp</td>
<td>0.326%</td>
<td>14</td>
<td>Corn</td>
<td>0.018%</td>
</tr>
<tr>
<td>7</td>
<td>Copper</td>
<td>0.208%</td>
<td>15</td>
<td>Platinum</td>
<td>0.015%</td>
</tr>
<tr>
<td>8</td>
<td>Polypropylene</td>
<td>0.130%</td>
<td>-----</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

Figure 2.6 – Exchange rate arrangements in ASEAN 2003–2013

Source: Based on data from Annual Report on Exchange Arrangements and Exchange Restrictions
Note: (1) Hard pegs comprising (a) exchange arrangements with no separate legal tender and (b) currency board arrangements; (2) Soft pegs comprising (a) conventional pegged arrangements, (b) pegged exchange rate within horizontal bands, (c) crawling pegs, (d) stabilized arrangements and (e) crawl-like arrangements; (3) Floating regimes comprising (a) managed floating and free-floating
In contrast to OECD, there is a relatively small number of ASEAN countries freely floating their exchange rate (see Figure 2.6). Hard pegs are not preferred by ASEAN countries. Brunei Darussalam is the only country operating this exchange rate arrangement (currency board arrangements). Most ASEAN countries have adopted soft pegs or else managed floating exchange rate regimes. However, since 2009, soft pegs (mainly crawling pegs and stabilized arrangements) have become more popular than managed floating regimes. Most of the ASEAN countries have witnessed many changes in their exchange rate regimes over the last decade.

2.3 Why pick up OECD and ASEAN

It is well known that OECD is the largest group of developed countries in the world. This organization comprises the 31 most advanced countries out of 49 developed countries over the world. Therefore, OECD can be regarded as a good representative for developed countries.

Regarding developing countries, there are four main areas of developing countries in the world, which are ASEAN, Latin America, the South Asian Association for Regional Cooperation (SAARC), and Sub-Saharan Africa. Among these groups of developing countries, ASEAN becomes the focus of this thesis because it is the most similar to OECD in terms of demographics, commodities export, financial markets, economic performance, and development prospects. The similarity between the two groups of developed and developing countries will be ideal for our purpose – giving helpful

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10 Latin America is a region of America that comprises countries speaking Romance languages. They are “Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, French Guiana, Guatemala, Guadeloupe, Haiti, Honduras, Martinique, Mexico, Nicaragua, Panama, Peru, Puerto Rico, Saint Martin, Saint Barthelme, Uruguay and Venezuela” (Wikipedia).

11 SAARC comprises of eight members “Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka” (Wikipedia).

12 Sub-Saharan Africa is the area of the continent of Africa, in the south of the Sahara Desert. Sub-Saharan Africa consists of 48 countries. They are “Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Brazzaville), Congo (DRC-Kinshasa), Cote d’Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe” (Countriesandcities 2015).
Chapter 2 – Economic background

guidelines for commodity-exporting developing countries in the management of commodity prices and exchange rate in their transition period into developed countries.

With respect to population, SAARC is the most densely populated region among the four developing groups with a population density of 318\textsuperscript{13} people per square kilometer (2012), while the population density of ASEAN, Latin America, and Sub-Saharan Africa are 132,\textsuperscript{14} 30, and 36\textsuperscript{15} respectively. SAARC is by far more populous than OECD, in which the population density in 2012 is merely 37\textsuperscript{16} people per square kilometer.

Although Sub-Saharan Africa’s population density is similar to that of OECD, there is a large difference in the level of commodity export diversification between the two groups. While OECD’s primary commodity export is diversified (see Table 2.1), almost all countries in Sub-Saharan Africa rely particularly on no more than three commodities (Gillon et al. 2004). More than half of Sub-Saharan Africa countries obtain 70\% of their export earnings from only three primary commodities. Another 30\% derive 30 – 69\% of their export revenue from their three leading primary commodities (Ocran & Biekpe 2008). Furthermore, Sub-Saharan Africa is one of the poorest regions in the world and most member countries remain largely underdeveloped (Sahn & Younger 2007).

Compared to Sub-Saharan Africa, the level of commodity export diversification of Latin America and ASEAN is closer to that of OECD. Specifically, a half of Latin America countries obtain more than 50\% of export revenue from no more than three commodities (mainly heavy energy and metal) and ASEAN exports many types of commodities that contribute relatively equally to the total export revenue (see more in Table 2.2). However, between Latin America and ASEAN, ASEAN is much more comparable to OECD in terms of commodity dependence, economic performance, and financial markets. First, for Latin America countries, the average share of commodity exports in total exports in the last decade is much larger than that of OECD (60\%)\textsuperscript{17}

\textsuperscript{13} Source: Statistical yearbook for Asia and Pacific
\textsuperscript{14} Source: Statistical yearbook for Asia and Pacific
\textsuperscript{15} Source: Trading economics
\textsuperscript{16} Source: Trading economics
\textsuperscript{17} Source: (Wagstaff & Trueba 2013)
compared to 19.1%\textsuperscript{18} while the average share of ASEAN is 28.5%,\textsuperscript{19} which is much closer to that of OECD. Second, the economic performance of ASEAN is much better than that of Latin America for the last three decades (Zermeño, Preciado & Vásquez 2011). Specifically, ASEAN had longer periods of macroeconomic stability. The average real growth rate, investment and the exports growth (as a proportion in GDP) in ASEAN are considerably larger than those of Latin America. Lastly, the financial market of ASEAN is much more advanced with substantially higher bank credit to the private sector, liquidity, and stock market capitalization over GDP. In addition, Zermeño, Preciado and Vásquez (2011) show that while the growth of the stock market has had a positive effect in ASEAN, it has had adverse effects in Latin America. Latin America countries now are faced with systematic weaknesses in many of the structural foundations that are needed for growth and are confronted with growing poverty, deindustrialization, and social polarization. It is likely to take a long time for Latin America to solve current problems (Hillebrand 2003).

Moreover, OECD and ASEAN have the same main trade partners, which are China, Europe, Japan, USA and UK. And, both groups have similar main export commodities consisting of crude oil, aluminium, fish, iron, copper, platinum, rice and rubber (for more information see Table 2.1 and Table 2.2).

It is also worth mentioning that ASEAN countries build development prospects that are parallel to current OECD. As mentioned in Section 6.1, ASEAN countries aim to become an ASEAN integrated economic region. This development plan involves developing the financial market, expanding the service industry (for emerging market countries) or boosting industrialization (for CLMV countries\textsuperscript{20}) while shrinking the dependence on the agriculture sector and natural resources, boosting investment and free trade in the region, and developing human resources, technology, and science.

From the above discussion, ASEAN is the most comparable to OECD, with respect to demographics, commodities export, financial markets, economic performance, and development prospects. Based on the similarity between OECD and ASEAN, this thesis

\textsuperscript{18} Source: Being calculated based on UNCTAD
\textsuperscript{19} Source: Being calculated based on UNCTAD
\textsuperscript{20} CLMV countries are Cambodia, Laos, Myanmar and Vietnam
is expected to provide significant policy implications for ASEAN commodity-exporting countries in management of exchange rates and commodity prices on their way to achieving “developed country” status.

2.4 Commodity-exporting countries

This section provides insight into the economic backgrounds of individual OECD and ASEAN commodity-exporting countries. Specifically, basic information about economic structure, economic development in recent decades, trading, export commodities as well as exchange rate is provided for each country.

2.4.1 OECD commodity-exporting countries

2.4.1.1 Australia

Australia is a developed country with a GDP per capita of USD 44,407 as of 2012. Before the 1980s, Australia was a relatively closed and protectionist economy (Economywatch 2015a). Since 1983, the Australian government has carried out such key economic reforms as removing some non-tariff barriers, cutting high tariffs, liberalizing the financial services sector, floating the Australian dollar, enhancing the efficiency of the government system, privatizing government-owned industries, and restructuring the tax system (Economywatch 2015a). Thanks to these reforms, Australia has turned into an open, export-oriented market economy (Economywatch 2015a).

The Australian economy has expanded gradually by an average rate of 3.12% during the period 2000-2012 while maintaining low unemployment, low inflation, and very low public debt (Indexmundi 2014a). Australia has experienced the longest period (21 years) of economic expansion without being affected by global recessions.

The service sector is regarded as the backbone of Australia’s economy, accounting for 68.8% of GDP in 2012 (Economywatch 2015a). Meanwhile, the agriculture sector only makes a small contribution to GDP (4% in 2012) (Economywatch 2015a). In the last decade, the mining industry has been the promoter for Australia’s economic development (Economywatch 2015a). Australia is the largest producer of coal, lead, rutile, zircon, nickel, tantalum, and uranium in the world (Economywatch 2015a).
During the period from 2000 to 2013, the Australia’s exports have increased rapidly (nearly four fold) except for a slight decrease in 2008. This increase is explained by a higher demand for Australia's commodities coming from the rapid urbanization and industrialization of China and India (Atkin & Connolly 2013).

Being rich in natural resources, Australia is one of the largest exporters of commodities in the world. Major export commodities are minerals such as iron, coal, gold, and agricultural products such as wheat, cotton, beef and lamb, and energy in the forms of petroleum gas and coal.

Table 2.3 – Top 20 export commodities in Australia 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron</td>
<td>29,430,855,430</td>
<td>11</td>
<td>Diamond</td>
<td>1,533,009,770</td>
</tr>
<tr>
<td>2</td>
<td>Coal</td>
<td>23,473,211,210</td>
<td>12</td>
<td>Lamb</td>
<td>1,242,899,500</td>
</tr>
<tr>
<td>3</td>
<td>Gold</td>
<td>8,606,424,200</td>
<td>13</td>
<td>Cotton</td>
<td>1,196,165,800</td>
</tr>
<tr>
<td>4</td>
<td>Petroleum gas</td>
<td>6,644,116,410</td>
<td>14</td>
<td>Zinc</td>
<td>1,170,448,000</td>
</tr>
<tr>
<td>5</td>
<td>Crude oil</td>
<td>6,382,390,670</td>
<td>15</td>
<td>Natural gas</td>
<td>1,075,480,810</td>
</tr>
<tr>
<td>6</td>
<td>Titanium</td>
<td>4,467,229,700</td>
<td>16</td>
<td>Barley</td>
<td>878,390,480</td>
</tr>
<tr>
<td>7</td>
<td>Beef</td>
<td>3,906,558,000</td>
<td>17</td>
<td>Nickel</td>
<td>755,629,320</td>
</tr>
<tr>
<td>8</td>
<td>Wheat</td>
<td>3,699,147,020</td>
<td>18</td>
<td>Lead</td>
<td>721,987,850</td>
</tr>
<tr>
<td>9</td>
<td>Copper</td>
<td>3,230,834,600</td>
<td>19</td>
<td>Shrimp</td>
<td>459,644,590</td>
</tr>
<tr>
<td>10</td>
<td>Oil petroleum</td>
<td>2,244,499,874</td>
<td>20</td>
<td>Uranium</td>
<td>306,603,430</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE
The largest export markets of Australia are Japan, China, South Korea, India and the United States (Tradingeconomics 2015a). In recent years, Australia's trade has shifted from traditional destinations such as the United States and Europe toward emerging Asian countries. Beginning in 2009, China has become Australia's largest export destination (Embassy 2011) and in 2014, China accounted for 31.9% of Australia's exports (Tradingeconomics 2015a).

In regard to the exchange rate regime, the development history of the exchange rate regime of Australia has gone through three stages: fixed, then managed floating, and finally the independently floating (Internationaleconomics 2015). Specifically, in the Bretton Woods period (from 1945 to 1973), Australia followed fixed exchange rates. After the breakdown of the Bretton Woods system (1973), Australia began to adopt a managed floating system. In this system, the exchange level was set daily by the Reserve Bank based on a trade-weighted currency basket (Internationaleconomics 2015). Until 1983, Australia decided to float the exchange rate for a few reasons. Firstly, the fixed exchange rate regime impeded the control of the money supply. Secondly, at that time, Australia pursued a “monetary targeting” policy with the aim of increasing the money supply (RBA 2015). Nevertheless, under the fixed and crawling peg arrangements, the Reserve Bank has a duty to meet all requests to exchange foreign currency for Australian dollars and vice versa (RBA 2015). This implied that the supply of Australian dollars was affected by fluctuations in the purchases and sales demand of Australian dollars, which could arise from Australia's international trade and capital flows (RBA 2015). It was difficult for the Reserve Bank of Australia to offset these effects through sterilization. Floating the exchange rate was regarded as a proper solution for this problem (RBA 2015).

2.4.1.2 Canada

Canada is one of the most advanced nations in the world. The growth of Canada’s economy is linked with the economy of the United States (Wikipedia 2014a). After the United States – Canada Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA) were signed (in 1989 and 1994, respectively), trading and economic integration between the two countries has increased dramatically. From 1993 to 2007, Canada had strong economic growth. After being affected significantly by the global economic crisis of in 2008 – 2009, Canada suffered the first fiscal deficit in 2009.
after a long time of surplus (CIA 2012). However, Canada recovered from the crisis quite quickly owing to appropriate monetary and fiscal stimulus, a robust financial system and high commodity prices (OECD 2012). Canada has attained marginal growth since 2010 and expects to balance the budget by 2015 (CIA 2012).

In 2012, Canada’s GDP composition was as follows: services (66.1%), industry (32%) and agriculture (1.9%). Although the contribution of agriculture to GDP is limited, Canada is one of the largest suppliers of agricultural products in the world (Economywatch 2015b).

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude oil</td>
<td>46,021,519,390</td>
</tr>
<tr>
<td>2</td>
<td>Petroleum gas</td>
<td>21,818,947,410</td>
</tr>
<tr>
<td>3</td>
<td>Oil petroleum</td>
<td>13,023,524,970</td>
</tr>
<tr>
<td>4</td>
<td>Gold</td>
<td>8,603,450,460</td>
</tr>
<tr>
<td>5</td>
<td>Wheat</td>
<td>4,490,557,470</td>
</tr>
<tr>
<td>6</td>
<td>Coal</td>
<td>4,211,238,740</td>
</tr>
<tr>
<td>7</td>
<td>Iron</td>
<td>2,551,291,670</td>
</tr>
<tr>
<td>8</td>
<td>Swine meat</td>
<td>2,029,743,930</td>
</tr>
<tr>
<td>9</td>
<td>Diamond</td>
<td>2,003,987,270</td>
</tr>
<tr>
<td>10</td>
<td>Copper</td>
<td>1,703,806,520</td>
</tr>
<tr>
<td>11</td>
<td>Shrimp</td>
<td>1,637,196,020</td>
</tr>
<tr>
<td>12</td>
<td>Beef</td>
<td>1,019,047,680</td>
</tr>
<tr>
<td>13</td>
<td>Soybeans</td>
<td>966,707,340</td>
</tr>
<tr>
<td>14</td>
<td>Fish</td>
<td>882,731,190</td>
</tr>
<tr>
<td>15</td>
<td>Barley</td>
<td>358,391,540</td>
</tr>
<tr>
<td>16</td>
<td>Oats</td>
<td>331,052,450</td>
</tr>
<tr>
<td>17</td>
<td>Coffee</td>
<td>305,579,870</td>
</tr>
<tr>
<td>18</td>
<td>Zinc</td>
<td>256,329,580</td>
</tr>
<tr>
<td>19</td>
<td>Maize</td>
<td>253,255,270</td>
</tr>
<tr>
<td>20</td>
<td>Tobacco</td>
<td>176,440,130</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

In the past, fishing and forestry were the major industries in Canada (Economywatch 2015b). Although these two industries maintain the important roles in Canada’s economy currently, mineral and energy resources have turned into the main source of income for this country (Economywatch 2015b). Canada is the leading mineral exporter in the world with such commodities as gold, iron, nickel, zinc, and copper (Economywatch 2015b). Besides, unlike most developed countries, this country is a net exporter of energy (mainly coal, oil, natural gas). Canada is also among the world’s top ten largest oil exporters and top three largest natural gas exporters (Economywatch 2015b).

The main trading partners of this country are the United States, China, and the United Kingdom which account for 74.5%, 4.3% and 4.1% of Canada’s total trade in 2012, respectively (OECD 2012). Although Canada has increased energy product exports to
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China dramatically in recent years, the United States is still by far its largest trading partner.

Regarding the exchange rate, Canada is the developed nation that has experienced the longest duration with a floating exchange rate. In 1950, Canada became the first developed nation to float its exchange rate (Thiessen 2000). By floating the exchange rate, the Canadian currency appreciated dramatically. This appreciation discouraged further capital inflows and maintained Canada’s monetary policy autonomy (Thiessen 2000). In 1962, Canadian currency turned back to a fixed exchange rate and pegged it tightly to the USD. This regime had been remained for eight years (Thiessen 2000). In 1970, Canada was the first Western country to move to a free-floating exchange rate again. From that time until now, Canada has continued following a free-floating exchange rate regime (Thiessen 2000). This regime allows Canada to have monetary conditions that are different from the United States and more appropriate to Canada’s own economic situations (Thiessen 2000). Another advantage of this exchange rate regime is that it enables Canada to respond properly to external economic shocks affecting Canada differently from the United States (Thiessen 2000).

2.4.1.3 Iceland

Iceland is an advanced country located in the North Atlantic (Wikipedia 2014b). Although Iceland’s economy is the smallest within the OECD, the GDP per capita of this country is among the highest at about USD 39,097 in 2012. In 2007, Iceland ranks 1st in Human Development Index in the world.

In the past, fishing and agriculture were the major sectors in Iceland (Wikipedia 2014b). In recent years, there has been a dramatic change in economic structure with a large expansion of manufacturing and service industries, particularly within the fields of software production, biotechnology, and tourism (CIA 2014b). These two sectors have exceeded the fishing and agriculture sectors, both in terms of labor and contribution to GDP. In particular, Iceland has experienced tenfold increase in the number of foreign visitors within the last four decades. Besides, there is rapid growth in the software industry; in the last ten years, it has grown by over 50% annually and software exports now account for 5% of Icelandic service exports.
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Prior to the global financial crisis, Iceland achieved a high economic growth rate (the average rate for the period 2000 – 2008 was 4.18%) and low unemployment. In October 2008, the collapse of Iceland’s three major banks brought dramatic changes for Iceland’s economy (ICoC 2012). As a consequence of the banking crisis, Iceland entered a deep recession. Specifically, in 2009, GDP declined 6.8% while the unemployment rate was as high as 9.4% (CIA 2014b). The Icelandic government implemented some measures to overcome these difficulties including “stabilizing the Krona, implementing capital controls, reducing Iceland’s high budget deficit, containing inflation, addressing high household debt, restructuring the financial sector and diversifying the economy” (Indexmundi 2014c). Owing to appropriate reforms, the Icelandic economy has been recovered since late 2010, and achieved an economic growth rate of 1.4% in 2012.21

Iceland's economy is highly export-driven. Although the role of the fishing industry in Iceland’s economy has declined, the fishing industry is still one of the foundations of the Icelandic economy with approximately 70% of its export earnings obtained through fish, shrimp, and fish-related products. Iceland is one of the largest exporters of fish and fishery products to the EU (EuropeanCommission 2015). Besides, Iceland also exports such agricultural commodities as coffee, bananas, beef, cotton, rubber, and orange juice. However, the export value of these commodities is not considerable.

Table 2.5 – Top 20 export commodities in Iceland 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fish</td>
<td>425,980,100</td>
<td>11</td>
<td>Coffee</td>
<td>38,910</td>
</tr>
<tr>
<td>2</td>
<td>Fish meal</td>
<td>358,524,170</td>
<td>12</td>
<td>Bananas</td>
<td>13,140</td>
</tr>
<tr>
<td>3</td>
<td>Oil petroleum</td>
<td>45,341,560</td>
<td>13</td>
<td>Beef</td>
<td>11,450</td>
</tr>
<tr>
<td>4</td>
<td>Shrimp</td>
<td>42,032,800</td>
<td>14</td>
<td>Cotton</td>
<td>7,660</td>
</tr>
<tr>
<td>5</td>
<td>Lamb</td>
<td>10,993,380</td>
<td>15</td>
<td>Rubber</td>
<td>6,410</td>
</tr>
<tr>
<td>6</td>
<td>Rice</td>
<td>8,824,350</td>
<td>16</td>
<td>Orange juice</td>
<td>5,920</td>
</tr>
<tr>
<td>7</td>
<td>Fish</td>
<td>4,764,590</td>
<td>17</td>
<td>Pearl</td>
<td>5,280</td>
</tr>
<tr>
<td>8</td>
<td>Swine meat</td>
<td>58,360</td>
<td>18</td>
<td>Coconut</td>
<td>2,520</td>
</tr>
<tr>
<td>9</td>
<td>Gold</td>
<td>44,870</td>
<td>19</td>
<td>Maize</td>
<td>2,200</td>
</tr>
<tr>
<td>10</td>
<td>Natural gas</td>
<td>39,600</td>
<td>20</td>
<td>Zinc</td>
<td>2,120</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

21 Source: OECD Statistics
Iceland entered into a free trade agreement covering all industrial products with the EU in 1972 and ratified the European Economic Area Agreement (EEA) in the 1990s. These treaties have strengthened foreign trade with the EU. This area is the largest market area for Iceland’s commodities exports. However, there was a slight decline in the share of exports to this area in the last five years. In 2008, exports to the EU accounts for 80.5% of the total exports, then this share decreased to 78.3% in 2012 (Iceland 2013b). The Netherlands is the greatest export partner of Iceland, contributing 24% of Iceland’s total exports (Iceland 2013b). Other major export partners of Iceland are Germany, Spain, Ireland, and the United Kingdom.

Iceland adopted a floating exchange rate rather late (in 2001) compared to other OECD countries. After the Bretton Woods fixed rate system collapsed in 1974, Iceland started following a managed floating exchange rate. This exchange rate regime has been continued until 1983. However, in the mid-1980s, the country employed a more restrictive monetary and exchange rate policy (Gudmundsson 2000). This made the Icelandic Krona devalue dramatically. After this period, Icelandic monetary authorities kept the Krona value stable against the USD and different baskets of trading partner’s currencies (Gudmundsson 2002). In 1900, the Central Bank of Iceland emphasized on price stability (ICoC 2012). As the result, exchange rates had to play the role of a monetary anchor, instead of an adjustment instrument (Gudmundsson 2002). Since 2001, Iceland has floated its exchange rate.

2.4.1.4 New Zealand

New Zealand is a Pacific nation with a relatively high living standard. The GDP per capita of this country in 2012 is USD 32,847 (Economywatch 2015f).

New Zealand is a diversified economy with a wide range of sectors. The agricultural system of New Zealand is well known for its efficiency. Agricultural products are the main exports of New Zealand. However, the agriculture sector makes a humble contribution to GDP (Economywatch 2015f). Like other advanced economies, the service sector is the backbone of New Zealand’s economy. In 2009, the GDP composition of New Zealand was as follows – services (nearly 70%), industry (nearly 26%) and agriculture (about 4%). The main industrial sectors consist of food processing, textiles, machinery, mining and transportation equipment (Economywatch
27

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2015f). Generally, all sectors of the economy have shown growth in recent decades. Among them, petroleum and minerals are the two sectors that have enjoyed the most rapid growth. During the period 2000 – 2012, New Zealand’s economy expanded considerably at an average annual economic growth rate of 2.92%.

New Zealand’s economy had been negatively influenced by the global financial crisis for five uninterrupted quarters in 2008 – 2009 (IBP 2013a). By implementing such measures as cutting interest rates aggressively and developing fiscal stimulus measures, New Zealand recovered its economy in late 2009 (Indexmundi 2014d). The economy continuously achieved approximately 2 – 3% per year growth in the period 2010 – 2013. However, key trade sectors are still lagging behind because of weak external demand (IBP 2013a).

New Zealand is an export-oriented economy (Tradingeconomics 2015b). Most of the exports are primary commodities (75% of total exports in 2012). Among primary commodities, dairy products such as milk powder, butter, and cheese are the leading export commodities for which export value accounts for 25% of the total export (Bancorp 2013). Apart from dairy products, other major agricultural export commodities include lamb, beef, fish, fishmeal, cotton, maize, coffee, tea and barley. Furthermore, oil, gold, and iron are also important export commodities of New Zealand.

Table 2.6 – Top 20 export commodities in New Zealand 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dairy</td>
<td>4,212,446,600</td>
<td>11</td>
<td>Iron</td>
<td>24,634,740</td>
</tr>
<tr>
<td>2</td>
<td>Lamb</td>
<td>1,836,194,670</td>
<td>12</td>
<td>Petroleum gas</td>
<td>8,156,360</td>
</tr>
<tr>
<td>3</td>
<td>Beef</td>
<td>1,334,121,770</td>
<td>13</td>
<td>Fishmeal</td>
<td>6,239,110</td>
</tr>
<tr>
<td>4</td>
<td>Fish</td>
<td>252,066,380</td>
<td>14</td>
<td>Cotton</td>
<td>5,888,610</td>
</tr>
<tr>
<td>5</td>
<td>Crude oil</td>
<td>822,223,530</td>
<td>15</td>
<td>Maize</td>
<td>4,144,860</td>
</tr>
<tr>
<td>6</td>
<td>Gold</td>
<td>270,224,110</td>
<td>16</td>
<td>Coffee</td>
<td>2,066,630</td>
</tr>
<tr>
<td>7</td>
<td>Coal</td>
<td>247,538,770</td>
<td>17</td>
<td>Pearl</td>
<td>1,227,910</td>
</tr>
<tr>
<td>8</td>
<td>Shrimp</td>
<td>137,257,800</td>
<td>18</td>
<td>Platinum</td>
<td>978,000</td>
</tr>
<tr>
<td>9</td>
<td>Diamond</td>
<td>38,036,090</td>
<td>19</td>
<td>Tea</td>
<td>976,860</td>
</tr>
<tr>
<td>10</td>
<td>Tobacco</td>
<td>25,741,340</td>
<td>20</td>
<td>Barley</td>
<td>912,260</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

New Zealand’s export partners are Australia, China, Japan, the United Kingdom, the United States, Singapore, Hong Kong, India, and Germany (Tradingeconomics 2015b).
For the last 40 years, New Zealand’s export markets have undergone a fundamental transition from Northern hemisphere countries to the Asia-Pacific region, making the share of export goods to the Asia-Pacific region increase from 20% in 1966 to 88% in 2011 (Indexmundi 2014d).

Although there has been an increase in trading with China in recent years, Australia is still the most significant importer with the share of export goods to this country of 21.1% in 2012 (Indexmundi 2014d).

After the fall of Bretton Woods, the monetary authorities have used many exchange rate regimes to pursue different objectives. To cope with a series of currency crises around the world in the 1960s and early 1970s, New Zealand temporarily restabilised its currency in 1971 (Sullivan 2013). Following Australia, the New Zealand dollar (NZD) was originally pegged to the USD at its par value (Sullivan 2013). Because of this arrangement, the NZD dramatically depreciated against other currencies. In 1973, this country stopped pegging to the USD and started adopting a fixed exchange rate against a basket of currencies with occasional discrete adjustment (Sullivan 2013).

The adjustment of the NZD is aimed at maintaining competitiveness with Australia. Nonetheless, the changes in the nominal exchange rate unintentionally made the terms of trade as well as inflation rates fluctuate in the 1970s. Moreover, the variations of the nominal exchange rate were also an obstacle for exporters (Sullivan 2013). By 1979, New Zealand recognized that it needed a more flexible system. Therefore, a crawling peg was introduced. Under this system, small adjustments for the NZD were frequently made based on relative inflation in order to maintain trading partners (Sullivan 2013). In 1982, when wage and price freeze was introduced, the Reserve Bank of New Zealand abandoned a crawling peg regime and adopted a fixed exchange rate against its basket (occasionally adjustable). As the NZD devaluates considerably in response to the devaluation of AUD, New Zealand recognized that it is unsustainable to maintain the level of the NZD (Sullivan 2013). Then, New Zealand freely floated its NZD in March 1985.
2.4.1.5 Norway

Among European countries, Norway is a country with a very high standard of living and a developed welfare system (Wikipedia 2015h). The GPD per capita of this nation in 2012 was USD 66,135, ranking second (only behind Luxembourg) in the OECD.

Norway enjoyed solid GDP growth in the period of fifteen years (more than 5% annually in average) before a slowdown in 2008 and 2009. On the whole, Norway’s economy was less impacted by the global crisis than other developed countries. This resilience owes to the petroleum wealth and a sound macroeconomic policy framework. After a negative growth in 2009 (−1.6%), the Norwegian economy has gained positive growth since 2010 (Indexmundi 2014e).

Norway is rich in natural resources. The most valuable natural resources of this country are crude oil and natural gas, hydropower, forests, fish, shrimp, and minerals. Crude oil and natural gas represented the largest share of total exports in 2012 (70%). Norway is the leading supplier of natural gas to Western Europe. Moreover, it is also the third largest oil exporter in the world (Economywatch 2015g).

With a coastline of more than 83,000 km, the fishery industry plays an important role in Norwegian society and economy. Seafood products are the second most important export item in Norway. In 2012, seafood export value reached USD 8.9 billion, making up 6% of total Norwegian goods exports. Moreover, Norway also ranks 1st in fish exports in the world (Economywatch 2015g).

Apart from oil, natural gas and seafood products, minerals including gold, platinum, iron, zinc, and nickel and agricultural products consisting of soybeans, cotton, tobacco, coffee, beef, swine meat, and lamb are the main export commodities of this country during the period 2000 – 2013.

High dependence on natural resources makes the economic growth of Norway vulnerable to fluctuations in the external demand for these commodities as well as their prices (Wikipedia 2015h). Recognizing the problems, since 1970s, the Norwegian government has launched some policies to encourage the development of new industries, especially a high-tech industry, in the private sector (Wikipedia 2015h).
development of small businesses was also encouraged in order to provide employment for the future (IBP 2013b).

Table 2.7 – Top 20 export commodities in Norway 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude oil</td>
<td>48,725,194,240</td>
<td>11</td>
<td>Cotton</td>
<td>17,497,350</td>
</tr>
<tr>
<td>2</td>
<td>Natural gas</td>
<td>29,568,922,260</td>
<td>12</td>
<td>Tobacco</td>
<td>8,844,980</td>
</tr>
<tr>
<td>3</td>
<td>Fish</td>
<td>4,582,427,400</td>
<td>13</td>
<td>Swine meat</td>
<td>7,690,160</td>
</tr>
<tr>
<td>4</td>
<td>Oil petroleum</td>
<td>5,964,275,490</td>
<td>14</td>
<td>Coffee</td>
<td>3,246,650</td>
</tr>
<tr>
<td>5</td>
<td>Fish meal</td>
<td>852,275,700</td>
<td>15</td>
<td>Nickel</td>
<td>2,446,250</td>
</tr>
<tr>
<td>6</td>
<td>Platinum</td>
<td>239,077,560</td>
<td>16</td>
<td>Zinc</td>
<td>1,666,700</td>
</tr>
<tr>
<td>7</td>
<td>Gold</td>
<td>131,644,600</td>
<td>17</td>
<td>Beef</td>
<td>1,644,100</td>
</tr>
<tr>
<td>8</td>
<td>Iron</td>
<td>112,223,540</td>
<td>18</td>
<td>Lamb</td>
<td>476,530</td>
</tr>
<tr>
<td>9</td>
<td>Shrimp</td>
<td>69,526,400</td>
<td>19</td>
<td>Coconut</td>
<td>386,820</td>
</tr>
<tr>
<td>10</td>
<td>Soybean oil</td>
<td>60,343,870</td>
<td>20</td>
<td>Orange juice</td>
<td>354,110</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

The EU is the main trade partner of Norway. In 2001, 75% of Norway’s exports go to this area (Russwurm 2001). The United Kingdom, Germany, and the Netherlands are Norway’s most important export markets in the EU. The shares of Norway’s exports to these countries in 2013 are 28.3%, 13.1% and 11.6%, respectively. Apart from the EU, other main export markets of Norway are the United States and Asia (Russwurm 2001).

Regarding the exchange rate, before 1992, Norway maintained a fixed exchange rate (Kleivset 2009). From 1992 until now, Norway has followed a floating exchange rate regime. After the Bretton Woods system collapsed in 1973, Norway decided to participate in the European Economic Community’s Exchange Rate Mechanism. In this Exchange Rate Mechanism, the Deutsche Mark served as the nominal anchor (Kleivset 2009). However, Norway could not restrain a low level of inflation prevalent in Germany because of oil crisis. As a result, in order to regain a competitive loss, Norway devaluated the Norwegian Krone for four consecutive times. Under those circumstances, the Norwegian authorities decided to maintain a stable exchange rate against a basket of currencies of main trading partners from 1987 to 1989 (Kleivset 2009).

22 Source: Tradingeconomics
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In 1990, the reunification of Germany caused a rise in demand, which led to an increase in interest rates. This interest rate increase had negative impact on participants of the Exchange Rate Mechanism. As a result, Norway was compelled to allow their currency to float in December 1992 (Kleivset 2009). Although going through some changes, the Norway has still maintained a floating exchange rate regime until today.

2.4.1.6 Greece

Greece is a developed country in Southern Europe with a population of 10,993,000 people (Wikipedia 2015f). The Human Development Index of Greece ranks 29th in the world.

Before 2008, Greece had a long period of economic growth. Because of the impact of the Global economic crisis, Greece went into recession in 2008 (Wikipedia 2015f). Since the restoration of democracy in 1974, this is the most severe crisis faced by the Greek economy. In 2009, this country suffered the highest budget deficit and government debt-to-GDP ratios in Europe (Wikipedia 2015f). Moreover, the garment industry, a backbone of the Greek economy, has been the most vulnerable sector in the recession. And, there was a large decline in the retail turnover in 2010 – 2011 (Secretariat 2013). In addition, unemployment rose steeply from 7.2% in 2008 to 27.9% in 2013 (Secretariat 2009b; Secretariat 2013). It is worth noting that youth unemployment in this country amounted to 64.9% in 2013. In 2014, Greece enjoyed its first quarter of economic growth since 2008. Currently, this country can balance its budget and re-entered financial markets.

The services sector is a significant part of Greece’s economy and represents about 80.6% of Greece’s GDP in 2014. The industry sector accounts for about 15.9% of this country’s GDP (CIA 2014a).

Greece mainly exports food and beverages, petroleum products, textiles and chemicals (Economywatch 2015c). The main trading partners are EU countries, the United States and China. In terms of export volume, Greece ranked 65th in the world and far below the EU rankings.
Apart from manufactured products, Greece also exports primary commodities such as olive oil, cotton, fish, dairy, crude oil, wheat, hides, and rice. Among them, olive oil and cotton are the most significant export commodities of Greece (see Table 2.8).

Table 2.8 – Top 20 export commodities in Greece 2000 –2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Olive oil</td>
<td>341,686,800</td>
<td>11</td>
<td>Coffee</td>
<td>9,633,300</td>
</tr>
<tr>
<td>2</td>
<td>Cotton</td>
<td>320,146,890</td>
<td>12</td>
<td>Soybean oil</td>
<td>9,548,770</td>
</tr>
<tr>
<td>3</td>
<td>Fish</td>
<td>215,390,510</td>
<td>13</td>
<td>Banana</td>
<td>8,018,480</td>
</tr>
<tr>
<td>4</td>
<td>Dairy</td>
<td>132,192,710</td>
<td>14</td>
<td>Zinc</td>
<td>6,932,130</td>
</tr>
<tr>
<td>5</td>
<td>Crude oil</td>
<td>61,772,400</td>
<td>15</td>
<td>Poultry</td>
<td>6,872,900</td>
</tr>
<tr>
<td>6</td>
<td>Wheat</td>
<td>54,050,600</td>
<td>16</td>
<td>Hard Sawn</td>
<td>6,865,410</td>
</tr>
<tr>
<td>7</td>
<td>Hides</td>
<td>45,495,460</td>
<td>17</td>
<td>Sugar</td>
<td>5,725,750</td>
</tr>
<tr>
<td>8</td>
<td>Rice</td>
<td>25,268,185</td>
<td>18</td>
<td>Sunflower oil</td>
<td>5,685,225</td>
</tr>
<tr>
<td>9</td>
<td>Aluminium</td>
<td>22,637,850</td>
<td>19</td>
<td>Beef</td>
<td>4,852,433</td>
</tr>
<tr>
<td>10</td>
<td>Corn</td>
<td>13,345,000</td>
<td>20</td>
<td>Wool</td>
<td>4,547,199</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

Regarding imports, the main imported commodities are machinery, transport equipment, fuels and chemicals. Import partners of this country are the EU, Russia, and China.

The drachma had been the currency of Greece for the period from 1832 to 2001. For every working day, the Bank of Greece had to organize a Fixing session in order to set the official exchange rate of the drachma against foreign currencies. This session took place under the control of the Bank of Greece as well as the participation of authorized representatives of all authorities in foreign exchange transactions banks (Greece 2000). Greece officially joined the Eurozone in 2001. At that time, Greece adopted the Euro at the fixed exchange rate of 340.75 Drachma to 1 Euro (Wikipedia 2015f). However, only until January 2002 there was a physical exchange from Drachma to Euro (Wikipedia 2015f).

At the time when Greece joined the Eurozone officially (2001), Greece decided to abandon a managed floating exchange rate to in order to adopt a free-floating one.
2.4.2 ASEAN commodity-exporting countries

2.4.2.1 Brunei

Brunei is a small but wealthy economy. With a population of 417,784, Brunei people have a high-quality life with GDP per capita of USD 38,563 in 2013. The GDP per capita of Brunei ranks 2\textsuperscript{nd} in ASEAN, after only Singapore (Embassy). Different from other countries in ASEAN, the economic growth of Brunei is slow and steady (Embassy).

Brunei’s economy is totally dependent on the exports of crude oil (Wikipedia 2015b). As can be seen from Table 2.9, during the period from 2000 – 2013, the export revenue from crude oil is by far larger than other commodities. It is the third largest oil exporter in ASEAN. On average, Brunei produces about 180,000 barrels per day (Wikipedia 2015b).

![Figure 2.8 – GDP per capita of Brunei, Laos, Malaysia, Myanmar, Thailand, and Vietnam 2000–2013](image)

Source: ASEAN Statistic Yearbook

Apart from petroleum products, Brunei only produces some kinds of products locally (IBP 2011). Most of main manufactured products and foods are imported from other countries. Brunei imports around 80% of its total food requirements (DFAT 2013).
Table 2.9 – Top 20 export commodities in Brunei 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude oil</td>
<td>1,677,926,830</td>
<td>11</td>
<td>Coconut oil</td>
<td>6,030</td>
</tr>
<tr>
<td>2</td>
<td>Hides</td>
<td>282,040</td>
<td>12</td>
<td>Banana</td>
<td>5,410</td>
</tr>
<tr>
<td>3</td>
<td>Sunflower oil</td>
<td>151,250</td>
<td>13</td>
<td>Soybeans</td>
<td>4,480</td>
</tr>
<tr>
<td>4</td>
<td>Fish</td>
<td>105,710</td>
<td>14</td>
<td>Tea</td>
<td>1,560</td>
</tr>
<tr>
<td>5</td>
<td>Beef</td>
<td>94,310</td>
<td>15</td>
<td>Aluminum</td>
<td>890</td>
</tr>
<tr>
<td>6</td>
<td>Hard sawn</td>
<td>75,550</td>
<td>16</td>
<td>Hard log</td>
<td>770</td>
</tr>
<tr>
<td>7</td>
<td>Chicken</td>
<td>71,260</td>
<td>17</td>
<td>Coffee</td>
<td>700</td>
</tr>
<tr>
<td>8</td>
<td>Dairy</td>
<td>52,670</td>
<td>18</td>
<td>Corn</td>
<td>640</td>
</tr>
<tr>
<td>9</td>
<td>Shrimp</td>
<td>28,820</td>
<td>19</td>
<td>Sugar</td>
<td>475</td>
</tr>
<tr>
<td>10</td>
<td>Pork</td>
<td>24,010</td>
<td>20</td>
<td>Natural gas</td>
<td>425</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

Singapore is the largest import partner of Brunei. Brunei’s imports from Singapore amounted to 20.5% of its total imports. Other import partners are China, Japan, Malaysia and the United States (Wordsrichestcountries 2014). Main imported goods are construction, electronic, medical and technical equipment, pharmaceuticals and household appliances (Wordsrichestcountries 2014).

Although being highly reliant on energy products, this sector employs only 3% of Brunei’s labor force. The public sector is the sector that provides most of the employment for this country. More than half of the workforce is employed by this sector (DFAT 2013).

Brunei has a long-term plan to reduce the over reliance on fossil fuels and diversify its economy. To achieve this goal, this country will develop a private non-energy sector, promote investment, increase food self-sufficiency and encourage the participation of women in workforce (Cooke 2012).

The Brunei dollar has been the currency of Brunei since 1967. Brunei has adopted a currency boards arrangement since independence. Brunei Darussalam ties its currency to the Singapore dollar. Brunei adopted a currency board arrangement partly because of their limited central banking expertise (IMF 1997). Moreover, the largest benefit of this exchange rate regime is that the Brunei dollar is always backed by sufficient foreign exchange reserves. The market and official exchange rates are equated owing to the interchangeability arrangement between authorities of Brunei and Singapore. According
to the interchangeability arrangement, banks of both countries accept and allow both Brunei and Singapore dollars at parity (IMF 1997).

2.4.2.2 Laos

Laos is one of the poorest countries in ASEAN. The GDP of this country in 2013 is 11.24 billion USD (Wikipedia).

Since 1986, the economy of Laos has grown rapidly. This rapid development is attributed to significant reforms in 1986, such as decentralizing control and encouraging private enterprise (CIA 2014c). From 1988 to 2008, the average annual growth rate of Laos was 6% and from 2008 to 2013 this rate increased to 7% (CIA 2014c).

Although the economy has grown rapidly in recent decades, Laos is still a poor country. The main problems of Laos are a lack of infrastructure, corruption, and a largely unskilled workforce (CIA 2014c). The government plans to solve these problems in the future.

The economy of Laos still remains dependent on an unproductive agricultural sector. This sector employs 75% of the workforce. In addition, such industries as handicrafts, beer, coffee and tourism also play important roles in the economy (Wikipedia).

Laos’ economy is extremely reliant on international aid (CIA 2014c). Foreign direct investment (FDI) is essential for large-scale infrastructure projects in Laos such as Mekong river hydropower dams, copper and gold mining, logging, and construction (CIA 2014c). Major sources of FDI are from China, Vietnam and Thailand. During the period from 2001 to 2011, FDI from the three countries make up 78.26% of total FDI (Phommahaxay 2013).

In 2013, after a 15-year negotiation process, Laos became a member of the World Trade Organization (WTO). The export commodities are mainly agricultural products and natural resources. Copper, wood, coffee, tin, gold, and cassava are Laos’s leading exports (CIA 2014c). The main export partners are China (35% of total exports in 2013), Thailand (31%) and India (31%) (Economywatch 2015d). Laos imports mainly machinery, equipment, vehicles, fuel and consumer goods (Economywatch 2015d). Laos’ the largest import partner is Thailand. Imports from this country make up 56% of
the total imports. Other main import partners are China, Vietnam, South Korea and Germany (CIA 2014c).

The Lao kip has been the currency of Laos since 1953. The Lao kip is fixed to the USD. Before 1988, the system of exchange controls was complicated. As a result, there were four official exchange rates for official transactions (IMF 2000a). In addition, there was a large difference between official and parallel market rates. In 1988, “the four official exchange rates were unified simultaneously with price liberalization” (IMF 2000a). Under the new system, the buying and selling rates for the Lao kip against the USD are set by the Central Bank. This change was accompanied by the adoption of a managed float exchange system. Under this exchange rate regime, authorities often make small and regular adjustments to the official rate in line with parallel market developments (IMF 2000b).

2.4.2.3 Malaysia

Malaysia is a newly industrial economy. Its economy is the third largest one in ASEAN after Indonesia and Thailand (Wikipedia 2015d). The state plays a significant role in the economy. However, the role of the state in guiding economic activity is declining over time (Wikipedia 2015d). The GDP per capita of this nation in 2012 is about USD 10,338. In the last 20 years, Malaysia enjoyed an annual growth of 7% together with low inflation (ASEAN 2014a).

Before 1970, Malaysia’s economy was based on raw materials. Through policies aimed at encouraging value-added production, Malaysia has become as a multi-sector economy in recent years (ASEAN 2014a). The service sector accounts for over half of Malaysia’s GDP, followed by the manufacturing sector (25%) (ASEAN 2014a).

Malaysia was severely impacted by the Asian financial crisis in 1997 (Wikipedia 2015d). The impacts of this crisis are as follows: FDI reduced dramatically, the value of the Ringgit (MYR) declined noticeably and the GDP contracts sharply in 1998 (Wikipedia 2015d). However, compared to other Asian countries, the recovery of Malaysia’s economy was much faster (Wikipedia 2015d). In 1999, the GDP increases again at a rate of 5.6%. This recovery is explained by a strong growth in exports, especially of manufactured goods.
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In 2008, the global financial crisis also made the GDP growth rate of Malaysia decline significantly from 4.8% in 2008 to −1.5% in 2009. The Central Bank managed the financial sector effectively to recover the economy. In 2010, the GDP rebounded to increase by 7.2%.

Crude oil and petroleum gas are the most significant export commodities of Malaysia (see Table 2.8). Other export commodities of this country are agricultural, namely rubber, shrimp, fish, tobacco, gold, cotton, palm oil, soybean oil, and coconut oil; and minerals such as gold, tin, coal, and diamond.

Malaysia’s production of tin, rubber, and palm oil ranks 1st in the world. In addition, Malaysia is also the greatest exporter in the world of such manufactured products as semiconductor components and devices and electrical products (IBP 2007).

Table 2.10 – Top 20 export commodities in Malaysia 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Petroleum gas</td>
<td>11,772,734,070</td>
<td>11</td>
<td>Fish</td>
<td>124,012,115</td>
</tr>
<tr>
<td>2</td>
<td>Crude oil</td>
<td>8,946,786,170</td>
<td>12</td>
<td>Iron</td>
<td>111,396,190</td>
</tr>
<tr>
<td>3</td>
<td>Oil petroleum</td>
<td>8,024,087,780</td>
<td>13</td>
<td>Coconut oil</td>
<td>96,764,560</td>
</tr>
<tr>
<td>4</td>
<td>Rubber</td>
<td>2,172,996,250</td>
<td>14</td>
<td>Pepper</td>
<td>62,461,390</td>
</tr>
<tr>
<td>5</td>
<td>Palm oil</td>
<td>541,902,630</td>
<td>15</td>
<td>Cocoa</td>
<td>51,988,270</td>
</tr>
<tr>
<td>6</td>
<td>Shrimp</td>
<td>343,805,020</td>
<td>16</td>
<td>Diamond</td>
<td>25,602,540</td>
</tr>
<tr>
<td>7</td>
<td>Tobacco</td>
<td>304,599,330</td>
<td>17</td>
<td>Coconut</td>
<td>25,260,850</td>
</tr>
<tr>
<td>8</td>
<td>Gold</td>
<td>268,743,560</td>
<td>18</td>
<td>Coal</td>
<td>14,731,130</td>
</tr>
<tr>
<td>9</td>
<td>Cotton</td>
<td>237,448,140</td>
<td>19</td>
<td>Soy beans</td>
<td>10,162,330</td>
</tr>
<tr>
<td>10</td>
<td>Soybean oil</td>
<td>130,248,270</td>
<td>20</td>
<td>Coconut</td>
<td>8,715,170</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

Malaysia’s major exports partners are China, Singapore, the United States and Japan (Wikipedia 2015d). China is a rapidly growing export market of Malaysia. The shares of total exports of Singapore and China were about 13% each in 2012 (Wikipedia 2015d).

Before August 1975, the currency of Malaysia was the Malaysian Dollar (Wanaset 2010). In August 1975, the Malaysian currency was officially renamed Malaysian Ringgit (MYR). During the period from 1986 to 1997, the Central Bank of Malaysia ran

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23 Source: World Bank

24 Source: World Bank
a managed floating exchange rate. The value of the MYR was maintained at around Ringgit 2.60 against the USD. During this period, the Central Bank can intervene to adjust the exchange rate. After the Asian Financial Crisis in 1997, Malaysia adopted a fixed exchange rate system in which the Ringgit was pegged to the USD at MYR 3.80 per 1 USD (Internationaleconomics 2015). In July 2005, Malaysia officially abandoned the fixed exchange rate and adopted a managed floating system again at the same time with China (Wikipedia 2015c). This regime has been maintained until now.

2.4.2.4 Myanmar

Myanmar has a developing economy with a nominal GDP per capita of USD 861 (2012) (Wikipedia). Although being rich in natural resources, Myanmar is among the least developed countries. Nearly 33% of the country’s population lives below the poverty line (Indexmundi 2014b). Myanmar’s undeveloped economy and society is attributed to “poor government planning, ineffective economic policies, limited foreign investment, trade deficit and internal unrest” (Economywatch 2015e). Although there are impediments to development, Myanmar achieved an annual economic growth rate of 9.3% in the period 1998 – 2012.

In general, Myanmar is an agricultural country. The agricultural sector contributed 42.9% to GDP and provided employment to 70% of the workforce. Among agricultural products, rice is the leading one covering more than 90% of the total production. Apart from rice, beans, sugarcane, sesame, teak, groundnut, and fish are also main agricultural products of this country (Wikipedia 2015a). Myanmar is well known for its large source of teak (Steinberg 2015). However, indiscriminate and illegal logging are serious issues in this country (Steinberg 2015).

The service sector’s contribution in GDP grew from 32% in 1990 to 42% in 2011. Among the service sub-sectors, tourism is the most potential one owing to the country’s natural and cultural richness (Intracen 2012). However, there are many barriers to the development of tourism such as restricted access to visitors, poor tourism infrastructure and political instability (Intracen 2012). Other main services consist of trade-related services, operational leasing, and professional and technical services (Intracen 2012).

Myanmar’s industry sector has developed slowly. Myanmar mainly export primary commodities such as hard log, fish, rubber, rice, and shrimp. Minerals such as gold,
copper, tin, and zinc are also major exports of Myanmar. Hard log and fish are the two export commodities that earn the highest export revenue for Myanmar (see Table 2.11).

Apart from natural resources, this country also produces manufactured goods including “tobacco, food and beverages, electronics, electrical products, chemicals, garment, metal and machine products” (Intracen 2012).

Table 2.11 – Top 18 export commodities in Myanmar 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hard log</td>
<td>340,439,250</td>
<td>10</td>
<td>Hides</td>
<td>3,433,577</td>
</tr>
<tr>
<td>2</td>
<td>Fish</td>
<td>113,103,960</td>
<td>11</td>
<td>Copper</td>
<td>2,041,929</td>
</tr>
<tr>
<td>3</td>
<td>Rubber</td>
<td>103,205,450</td>
<td>12</td>
<td>Tin</td>
<td>2,030,650</td>
</tr>
<tr>
<td>4</td>
<td>Rice</td>
<td>98,346,390</td>
<td>13</td>
<td>Coconut oil</td>
<td>511,440</td>
</tr>
<tr>
<td>5</td>
<td>Shrimp</td>
<td>46,841,540</td>
<td>14</td>
<td>Zinc</td>
<td>472,650</td>
</tr>
<tr>
<td>6</td>
<td>Hard sawn</td>
<td>23,711,520</td>
<td>15</td>
<td>Soybeans</td>
<td>280,620</td>
</tr>
<tr>
<td>7</td>
<td>Sugar</td>
<td>9,450,170</td>
<td>16</td>
<td>Coffee</td>
<td>106,130</td>
</tr>
<tr>
<td>8</td>
<td>Corn</td>
<td>8,269,040</td>
<td>17</td>
<td>Soft sawn</td>
<td>77,780</td>
</tr>
<tr>
<td>9</td>
<td>Lead</td>
<td>4,401,940</td>
<td>18</td>
<td>Tea</td>
<td>1,350</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

Since 2011, under the governance of the President Thein Sein government, Myanmar has instituted many reforms to reduce corruption, boost trading, and encourage foreign investment. Owing to the reforms, foreign investment increased strongly from USD 0.3 billion in 2010 to USD 20 billion in 2011. However, living standards in rural areas have not been improved (CIA 2014d).

The main trading partners of Myanmar are adjacent countries including India, Thailand and China, and Singapore. Different from other ASEAN countries, Myanmar does not have good trading relations with the United States and Europe.

The major exports of this country are natural gas, wood, fish, rice and clothing. Besides, Myanmar imported such commodities as transports, machinery, construction materials, fabric and energy products.

From 1988 to 2011, the government of Myanmar implemented different administrative controls on foreign exchange. This leads to an abnormal dual exchange rate system. In this exchange rate system, an official exchange rate in the public sector parallels with an exchange rate in the private sector (Koji 2012). In 1977, the official exchange rate was
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pegged at around 8.51 Kyat per special drawing right (SDR), which had lasted for more than 30 years. In contrary, the parallel market rate had depreciated constantly in the past because of unstable macroeconomic conditions (Koji 2012). Since 2006, the parallel market exchange rate appreciated against the USD, which is regarded as a harm to export (Koji 2012).

In April 2012, the Central Bank of Myanmar has adopted a managed floating exchange rate. Under this regime, the currency’s value is determined by the market forces and the Central Bank has the ability to influence the market by announcing a daily reference exchange rate (Pontines 2012). This regime also allows occasional interventions in the market to adjust the currency when necessary (BBC 2013).

2.4.2.5 Thailand

Thailand is the second largest economy in Southeast Asia, after Indonesia. In addition, with the GPD per capita of USD 5,390 in 2012, the country was behind only Singapore, Brunei and Malaysia in the region (Wikipedia 2015i). Besides, Thailand is among the countries with the lowest unemployment rate in the world (only 1% of the labor force).

Agriculture has a critical role in the Thai economy. In fact, the country’s move to an industrialized economy was largely driven by the its agricultural development (Wikipedia 2015i). In 2012, the agriculture sector contributed 8.4% to GDP. Besides, this sector supplies half of the employment in rural areas.

In recent years, the service sector is the largest contributor to growth of Thailand. This sector contributed about 52.4% to Thailand's GDP and employed 37.9% of the total workforce in 2012. Tourism is leading the growth in the service sector. According to Thailand's Department of Tourism, the country welcomed a total of 26.7 million visitors in 2013, representing a 19.6% increase over 22.3 million international tourists in 2012 (Wikipedia 2015i).

The major industries in the manufacturing sector are computers and electronics, wood products, canned food, plastic products, gems and jewellery (USADepartmentState 2008). High-technology products – for instance, integrated circuits, electrical appliances, vehicles, and vehicle part – are the main exported commodities of Thailand (USADepartmentState 2008). In 2012, the manufacturing sector contributed 39.2% to
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the country's GDP and employed 19.7% of the total workforce. One of its most important industries is the automobile, which produces about 2.45 million cars in 2012. This made Thailand the 7th largest motor vehicle exporter in the world.

The country’s economy of Thailand has grown dramatically since 1980. Statistics showed that the Thai economy in 2012 was eleven times larger than it was in 1980 (Wikipedia 2015i).

Generally, Thai economy was not affected much by the global financial crisis. After a negative economic growth of 2.3% in 2009, Thailand’s economy marked a recovery in 2010, with an economic growth rate of 7.8%. This quick recovery is attributed to the strength of its exports (Wikipedia 2015i).

<table>
<thead>
<tr>
<th>Table 2.12 – Top 20 export commodities in Thailand 2000–2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

The Thai economy is export-dependent country. The total export value in 2013 is USD 228.5 billion. Agricultural products are the main export commodities of Thailand. Rice is the leading export of Thailand. Thailand is the world's largest exporter of rice. Following are petroleum gas, oil petroleum, and crude oil (see Table 2.9). Apart from rice, agricultural commodities such as rubber, shrimp, maize, cotton, and tobacco are also a major export commodities of this country (USADepartmentState 2008). In addition to primary commodities, Thailand is also a large exporter of industrial products

25 Source: ASEAN statistics
consisting of processed foods, textiles and footwear, jewellery, computers and electrical appliances, and automobiles (Vtaide 2006).

Regarding Thailand’s export markets, China is the largest market with the share of total export in 2012 of 11.7%. The second largest market is Japan (10.2% of total export) followed by the United States (9.9%). In recent years, there has been a slight change in export markets from traditional markets (the United States, Japan, and Europe) to emerging markets (China, Hong Kong, and India) (Wikipedia 2015i).

In 1978, the Bank of Thailand decided to change the exchange rate regime from one being pegged to the USD to one being pegged to a weighted currency basket of major trading partners (Internationaleconomics 2015). Afterward, the effective rate was allowed to float within a limited range. Until 1984, the Baht value was pegged against the USD. This arrangement remained until 1997 (Internationaleconomics 2015).

In July 1997, Thailand started adopting a managed float exchange rate regime. In this regime, the value of the Baht will be decided by market forces (Internationaleconomics 2015). The Bank of Thailand could control the exchange rate when necessary, in order to avoid excessive volatilities and attain a certain policy objective (Internationaleconomics 2015).

2.4.2.6 Vietnam

Through the “Doi Moi” political and economic reforms, the Vietnamese economy has transformed from a poor economy (GDP per capita below USD 100) to a lower-middle income one (GDP per capita greater than USD 2,000 in 2014) (Heritage 2015).

In the past ten years, GDP grew at a rapid rate of 8.4% annually. In 2013, Vietnam’s GDP reached 170.565 billion USD, with GDP per capita of US$1,902. Similar to Laos and Myanmar, Vietnam depends largely on FDI to support its development (Wikipedia 2015e).

There have been large shifts in sectoral composition of GDP in Vietnam. The share of the agriculture sector in GDP subsequently reduced from 34% in 1986 to 17% in 2009.

26 Source: ASEAN Trade Statistics Database
27 Source: ASEAN Trade Statistics Database
Chapter 2 – Economic background

On the other hand, the manufacturing sector subsequently expanded (increasing from 17% in 1986 to 25% in 2009) (McCaig & Pavcnik 2013).

In spite of a declining role in the economy, the agriculture sector employs for 60% of the labor force (in 2005) (McCaig & Pavcnik 2013). Together with a change in economic structure, there is a reallocation in employment toward the service and manufacture sectors (McCaig & Pavcnik 2013).

In Vietnam, the state plays the leading role in the economy. State-owned companies cover important areas such as electricity, power, telecommunication, and mining. However, these state-owned companies are well known for being ineffective (Sjöholm 2006). In the private sector, most Vietnamese enterprises are small and medium-sized enterprises (Wikipedia 2015e).

Vietnam is on the way to integrating into the global economy. In January 2007, Vietnam became the member of the WTO (Wikipedia 2015e). Joining the WTO has been an important boost to the Vietnamese economy, especially trade expansion (Wikipedia 2015e).

Table 2.13 – Top 20 export commodities in Vietnam 2000–2013

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
<th>No.</th>
<th>Commodities</th>
<th>Average export value 2000-2013 (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crude oil</td>
<td>4,460,564,210</td>
<td>11</td>
<td>Groundnuts</td>
<td>39,948,990</td>
</tr>
<tr>
<td>2</td>
<td>Rice</td>
<td>849,359,860</td>
<td>12</td>
<td>Pork</td>
<td>26,089,820</td>
</tr>
<tr>
<td>3</td>
<td>Shrimp</td>
<td>834,508,070</td>
<td>13</td>
<td>Hides</td>
<td>20,406,910</td>
</tr>
<tr>
<td>4</td>
<td>Coffee</td>
<td>516,915,400</td>
<td>14</td>
<td>Hard sawn</td>
<td>17,130,080</td>
</tr>
<tr>
<td>5</td>
<td>Rubber</td>
<td>362,632,430</td>
<td>15</td>
<td>Palm oil</td>
<td>16,849,260</td>
</tr>
<tr>
<td>6</td>
<td>Coconut oil</td>
<td>282,303,780</td>
<td>16</td>
<td>Sugar</td>
<td>13,322,650</td>
</tr>
<tr>
<td>7</td>
<td>Coal</td>
<td>262,304,510</td>
<td>17</td>
<td>Iron</td>
<td>11,246,720</td>
</tr>
<tr>
<td>8</td>
<td>Fish</td>
<td>192,397,520</td>
<td>18</td>
<td>Zinc</td>
<td>7,041,210</td>
</tr>
<tr>
<td>9</td>
<td>Dairy</td>
<td>90,776,400</td>
<td>19</td>
<td>Hard log</td>
<td>4,805,900</td>
</tr>
<tr>
<td>10</td>
<td>Tea</td>
<td>80,864,470</td>
<td>20</td>
<td>Gold</td>
<td>3,405,170</td>
</tr>
</tbody>
</table>

Source: Based on data from United Nations COMTRADE

Crude oil is the leading commodity of Vietnam. The next most significant export commodity is rice. Vietnam is among the leading rice exporters in the world (Wikipedia 2015e). Other main agricultural commodities are shrimp, fish, coffee, rubber, tea, coconut oil, and groundnuts. Vietnam is still the top exporter of coconuts, nuts, cashews, and pepper.
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Regarding imports, the key import commodities of Vietnam are steel, petroleum products, electronics, machinery, and equipment (Economywatch 2015h). In the last 20 years, Vietnam always ran a trade deficit. In 2012, Vietnam marked its first trade surplus since 1993 (Wikipedia 2015e).

The Vietnamese dong is the currency of Vietnam. Vietnam always considers the USD a key nominal anchor. Exchange rate policies are administered by the State Bank of Vietnam. Vietnam has undergone various exchange rate regimes. Prior to 1988, Vietnam followed the system of multiple exchange rates. In 1988, this regime was changed into a single exchange rate regime (Phuc et al. 2014). In this system, the State Bank of Vietnam has announced an official exchange rate as well as a band of allowable variations around this rate (Phuc et al. 2014). Since 1992, the official exchange rate has been announced daily.

After 2009, the Vietnamese dong stabilized at the lowest edge of the official trading band. Since then, the dong has been lowered for several times. Therefore, the exchange rate regime is reclassified by the IMF as a stabilized arrangement against the USD.

2.5 Summary

In this chapter, the basic information about OECD and ASEAN is presented. This chapter also explains why OECD and ASEAN are chosen as samples for this research. Moreover, this chapter also provides insight into the economic performance, economic development in past decades, commodities export, as well as exchange rate of six individual developed commodity-exporting countries – Australia, Canada, Iceland, New Zealand, Norway, and Greece, and six individual developing commodity-exporting countries – Brunei, Laos, Malaysia, Myanmar, Thailand and Vietnam. In the next chapter, the literature review will be conducted.
Chapter 3 – Literature review

This chapter reviews the literature relevant to the relationship between exchange rate and commodity prices not only in OECD and ASEAN commodity-exporting countries but also in developed and developing countries with the aim of providing a comprehensive picture of what has been studied on this topic.

Because of the great importance of the oil commodity towards economies, the relationship between oil prices and exchange rate has been considered by many studies and the number of studies on this relationship even outweigths the number of studies on the relation between non-oil commodity prices and exchange rate. In order to provide a clear-cut overview of the existing studies, the literature can be divided into two strands. The first strand is the literature on the relationship between non-oil commodity prices and exchange rate. The second strand is the literature on the relationship between oil prices and exchange rate. For each strand, the literature is arranged into three groups including developed countries, developing countries, and both developed and developing countries for the purpose of comparison. More specifically, a relationship is investigated in three main aspects which are cointegration, long-run elasticity, and Granger causality.
3.1 Non-oil commodity prices and exchange rate

3.1.1 Non-oil commodity prices and exchange rate in developed countries

There is an extensive volume of literature on the relationship between non-oil commodity prices and exchange rate in OECD developed countries. It is interesting that most of the research is carried out in three commodity exporting countries Australia, Canada and New Zealand. However, the findings of these studies are hardly consistent.

3.1.1.1 Cointegration

There are a large number of papers concerning the long-run impact of commodity prices on real exchange in developed countries. Chen (2002) examines the impact of commodity prices on exchange rate in three countries Australia, New Zealand and Canada. However, in this study, the nominal exchange rates relative to three anchor currencies (including the USD, the British pound, and the Japanese Yen) are preferred rather than the real exchange rate. The cointegration between commodity prices and exchange rate is examined by Engle and Granger (1987) test and Johansen (1988) test. In addition, to improve the reliability of these tests, the two other tests for cointegration including Horvath and Watson (1995) and Jansson (2005) are utilized for rechecking the result. Distinctively, the study focuses on the four regression models with different sets of fundamentals. The findings indicate that for Australia and New Zealand, the commodity prices affect the value of their currencies consistently. Specifically, an increase in commodity prices goes along with an appreciation of the currency. However, the correlation between exchange rate and commodity prices for Canada is negative and less consistent, with the average elasticity coefficient of around −0.3. Moreover, Canadian coefficient estimates are quite sensitive to the sample period considered.

As stated in Chen and Rogoff (2003), commodity prices and exchange rate are also cointegrated for Australia, New Zealand, and Canada. Instead of using typical unit root tests to test the stationarity of variables, Chen and Rogoff (2003) consider both alternatives I(0) and I(1) as robustness for the result. This is explained by the concern that the study’s short sample period will preclude any meaningful unit root tests. In
addition, the long-run relationship is not confirmed based on typical cointegration tests but depending on the significance of dynamic ordinary least squares (DOLS) estimates under the assumption that exchange rates and commodity prices are cointegrated. As the result of estimation, the long-run commodity price elasticity of real exchange rate is 0.39 for Australia, 0.40 for Canada, and 0.58 for New Zealand. This result is quite different compared to that of (Chen 2002), especially for the case of Canada.

In line with findings for Australia, Bashar and Kabir (2013) also find that in the long-term nominal USD/Australian exchange rate is determined by two factors: commodity prices and interest rate. It is interesting that the global financial crisis is included as a possible factor affecting the relationship between commodity prices and exchange rates since the global financial crisis can impact the Australian currency negatively through impacting the purchasing power of Australia’s major trading partners. Being similar to the aforementioned findings, commodity prices have a positive impact on exchange rate with a coefficient of commodity prices in the exchange rate equilibrium model is 0.64.

Simpson and Evans (2004) shows a contradictory finding that the existence of a long-term relationship between commodity prices and the nominal Australian/USD exchange rate in Australia cannot be concluded. It is because the level data do not exhibit cointegration while the first-differenced data do.

This long-term relationship is considered in Canada by some studies. Choudhri and Schembri (2014) explore the role of real commodity prices and productivity relative to foreign manufacturing in determining the long-run behaviour of the Canada–US real exchange rate since the early 1970s. In order to test for a level relation, this paper uses a bounds testing procedure proposed by Pesaran, Shin and Smith (2001). The advantage of this approach is that it can avoid pre-testing variables by unit root tests which are notorious for having low power, especially for small time series data. The findings show that both real commodity prices and productivity relative to foreign manufacturing variables affect the real exchange rate in the long run. Moreover, this relation has shifted since 1990 following the trend that the impact of each factor has become stronger and positive.

While examining determinants of the real exchange rate in Canada, Kia (2013b) also explores the cointegration between commodity prices and the CAD – USD real
exchange rate for the period 1972 – 2010. This finding is the result of the Johansen (1988) cointegration test. It is the first study that builds a model that can clarify the influence of both fiscal and monetary variables, including all related macro-fundamental variables on real exchange rate. Specifically, the model includes “real money supply, domestic and foreign interest rate, real GDP, real government expenditure, deficit per GDP, domestic and foreign outstanding debt per GDP, domestic and foreign externally financed debt per GDP and commodity prices” (Kia 2013b). Another contribution of the study is that it allows for such short-run dynamics of the system as financial crises, economic crises, or policy changes to adjust for the factors when estimating the long-run relationships. This makes the findings more reliable as the result would be biased if we overlooked this point, according to Kia (2006).

In addition to Kia (2013a) and Choudhri and Schembri (2014), Sephton (1992) also discovers the relationship between exchange rate and commodity prices in Canada, but by focusing on agricultural commodities. To test this relation, the daily data on the closing spot prices of the three agricultural commodities (feed wheat, feed barley, and canola) and the daily data on spot and thirty-day forward exchange rates between CAD and USD are examined. The results of cointegration tests proposed by Johansen (1988) show that there is no long-run relationship between the two series in Canada.

3.1.1.2 Long-run elasticity

As can be seen in Table 3.1, the estimation of long-run elasticity of exchange rate to non-oil commodity prices is lightly different among studies. On the whole, this long-run elasticity in New Zealand is highest, ranging from 0.58 – 1.40. Australia comes next with the long-run elasticity being from 0.39 to 0.80. For Canada, there is a large difference in the long-run elasticity between existing studies. It is even impossible to summarize the sign of elasticity for this country.
Chapter 3 – Literature review

Table 3.1 – Long-run elasticity of exchange rate to non-oil commodity prices in developed countries

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Regression model</th>
<th>Long-run elasticity (LRE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Chen 2002)</td>
<td>Australia, New Zealand, Canada</td>
<td>Nominal exchange rates:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quarterly, 1991-2001</td>
<td>Australia: AUD/USD, AUD/GBP,</td>
<td>LRE Australia ≈ 0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUD/JPY New Zealand: NZD/USD,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NZD/GBP, NZD/JPY Canada: CAD/USD,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAD/GBP, CAD/JPY</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model 1: Commodity prices; Relative CPI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model 2: Commodity prices; relative real GDP; relative money stock</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model 3: Commodity prices; relative real GDP; relative money stock; relative interest rate</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model 4: Commodity prices; relative real GDP; relative money stock; relative interest rate; relative inflation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LRE New Zealand ≈ 1.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LRE Canada ≈ -0.30</td>
<td></td>
</tr>
<tr>
<td>(Chen &amp; Rogoff 2003)</td>
<td>Australia, New Zealand, Canada</td>
<td>Real exchange rate</td>
<td>LRE Australia = 0.39</td>
</tr>
<tr>
<td></td>
<td>Quarterly, 1984-2001</td>
<td>Real commodity prices</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Model 1: Commodity prices index; nominal interest rate; dummy variable for the global financial crisis</td>
<td>LRE New Zealand = 0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LRE Canada = 0.40</td>
<td></td>
</tr>
<tr>
<td>(Bashar &amp; Kabir 2013)</td>
<td>Australia Quarterly, 1982-2013</td>
<td>Nominal USD/AUD exchange rate</td>
<td>LRE = 0.64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commodity prices index; nominal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>interest rate; dummy variable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>for the global financial crisis</td>
<td></td>
</tr>
<tr>
<td>(Kia 2013b)</td>
<td>Canada Quarterly, 1972-2010</td>
<td>Real exchange rate</td>
<td>LRE = -0.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commodity prices; real money</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>supply; domestic and foreign</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>interest rate; real GDP; real</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>government expenditure; real</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>government deficit per GDP;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>domestic and foreign outstanding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>debt per GDP; domestic and foreign</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>externally financed debt per GDP.</td>
<td></td>
</tr>
<tr>
<td>(Choudhri &amp; Schembri</td>
<td>Canada Quarterly, 1972-2007</td>
<td>Real exchange rate</td>
<td>LRE 1972-1989 = -0.31</td>
</tr>
<tr>
<td>2014)</td>
<td></td>
<td>Commodity prices index; productivity index</td>
<td>LRE 1990-2007 = 0.51</td>
</tr>
</tbody>
</table>

3.1.1.3 Granger causality

The Granger causality between exchange rate and commodity prices is only studied in Australia and the findings appear to be contradictory to each other. Trezzi (2014) investigates the Granger causality between exchange rate and commodity prices in Australia by relying on the monthly data covering the period 1982 – 2002. By employing wavelet coherency – a measure of Granger causality – the study confirms that the Granger causality runs from the exchange rate to commodity prices in Australia.
Bashar and Kabir (2013), however, indicate a two-way Granger causality between commodity prices and exchange rate in this developed country. This finding is the result of the Granger causality test within the ECM (error correction model) on quarterly data over 30 years (from 1983 to 2013). Following the same methodology, Simpson and Evans (2004) claim that causality runs from commodity price changes to exchange rate changes.

3.1.2 Non-oil commodity prices and exchange rate in developing countries

While researches on the commodity prices – exchange rate relationship in developed countries are conducted for individual countries, the majority of studies in developing countries are carried out for a large set of countries. Besides, most of existing studies are aimed at Sub-Saharan Africa and Latin America developing countries that specialize in one particular commodity. There are only some ASEAN countries being taken into account as most of ASEAN countries have more diversified export.

3.1.2.1 Cointegration

Among studies in the commodity prices – exchange rate relationship in developing countries, the study of Bodart, Candelon and Carpentier (2012) can be considered as the most typical one when focusing on 68 developing countries in which exports are specialized on one main commodity. Among these 68 countries, there are four ASEAN countries including Indonesia, Malaysia, Myanmar and Thailand. By utilizing the panel cointegration test proposed by Fachin (2007) which is robust to cross-sectional dependence, the paper finds that the leading commodity’s price affects the real exchange rate significantly in the long run. Following the result of robustness checks, the cointegration between the two variables is robust in nations where a primary commodity contributes at least 20% of the total exports. On the other hand, the existence of cointegration cannot be confirmed for the group of countries in which the share of a primary commodity accounts for less than 20%.
Based on this finding, Bodart, Candelon and Carpentier (2011) consider 33 developing commodity exporting countries in which the main commodity contributes not less than 20% of its total export when finding out how structural factors affect the long term relationship between real exchange rate and commodity prices. After finding the evidence of a long-run relationship between the two variables by the panel cointegration test (Fachin 2007), the paper finds that four factors – the exchange rate regime, the level of trade openness, the level of export diversification and the type of export commodities – can influence the long-run response of real exchange rate to commodity price.

Also being aimed at analysing the long-term relationship between commodity prices and exchange rate, Kohlscheen (2010) does not consider this relation in commodity exporting countries in the same manner as the preceding papers. Rather, eight emerging countries that have floated their exchange rates for more than a decade including Brazil, Czech, Indonesia, Mexico, South Korea, South Africa, Thailand, and the Philippines are taken into account. Instead of using the international prices of the leading export commodity, Kohlscheen (2010) uses the IMF commodity index calculated based on the prices of 40 major non-fuel primary commodities. This index is preferred as it is less likely to be affected by the individual exporting market. Regarding methodology, this study uses the Gregory and Hansen (1996) method to test the cointegration with a single unknown break point. The study clarifies that for most emerging floaters there is no evidence of a long-run relationship between exchange rate and commodity prices. However, there are some exceptions which are the Mexican Peso, the Indonesian Rupiah, and the Thai Baht. For the Indonesian Rupiah and the Thai Baht, the cointegrating vectors have been stable during the time of floating exchange rate.

Besides researches carried out in a large set of developing countries, there are three studies on the commodity prices – exchange rate relationship in individual developing countries. Byambasuren (2013) examines the relation in Mongolia based on monthly data over the period 2000 to 2011. According to the result of the Engle and Granger

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28 33 countries consist of “Algeria, Bahrain, Burundi, Cameroon, Chile, Colombia, Cote d’Ivoire, Dominica, Ecuador, Ethiopia, Gabon, Ghana, Honduras, Iran, Kenya, Kuwait, Malawi, Mali, Mauritania, Niger, Nigeria, Pakistan, Papua N. G., Paraguay, Qatar, Saudi Arabia, Sudan, Syria, Tanzania, United Arab Emirates, Uganda, Venezuela, and Zambia”.
cointegration test, real exchange rates and real commodity prices move together in the long-term. However, a main drawback of this study is that the real commodity prices are substituted by terms of trade because of difficulties in calculation. This replacement to some extent will reduce the reliability of the findings.

The relationship between exchange rate and commodity prices in South Africa is also clarified by Dumitrescu et al. (2012), although the main objective of this study is investigating factors explaining the long-run behaviour of real effective exchange rate in South Africa. Therefore, the regression model is much more complicated compared to other studies. Apart from commodity prices, explanatory variables consist of real interest rate relative to trading partners, real GDP per capita relative to trading partners, openness, fiscal balance, and net foreign assets. Based on the Johansen (1988) cointegration test, there is a long-term relationship between exchange rate and commodity prices. More specifically, when real commodity prices increase by 1%, real effective exchange rate also appreciates by approximately 0.5%.

Ahumada and Cornejo (2014) also show the existence of a long-run relationship between commodity prices and exchange rate in Argentina, a well-known commodity exporter. Because the main objective of this research is studying the effects of commodity prices on the economy of Argentina, it considered a five-dimensional VAR model including real commodity prices, natural resources export volume, real exchange rate, real domestic consumption, and agricultural sector gross domestic product. By applying the Johansen (1995) maximum-likelihood cointegration system approach, the research jointly estimates two long-run relationships of integrated variables. Based on the estimation result, the research also finds out that in the long run, an increase in international commodity prices leads to the appreciation of real exchange rate. A great advantage of this approach is the invariance of the cointegration property to the extension of the information set (Juselius 2006).

### 3.1.2.2 Long-run elasticity

As summarized in Table 3.2, for developing countries, long-run elasticity of exchange rate to non-oil commodity prices ranges from 0.125 to 0.50. However, it is worth noticing that when employing FMOLS to estimate the long-run elasticity of 33
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individual countries, Bodart, Candelon and Carpentier (2011) show a large difference between the estimation results for these countries (ranging from $-0.17$ to $10.39$).

Table 3.2 – Long-run elasticity of exchange rate to non-oil commodity prices in developing countries

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Regression model</th>
<th>Long-run elasticity (LRE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacDonald and Ricci (2004)</td>
<td>South Africa Quarterly, 1970-2001</td>
<td>Real effective exchange rate</td>
<td>LRE = 0.50</td>
</tr>
<tr>
<td>Bodart, Candelon and Carpentier (2011)</td>
<td>33 developing countries Annual, 1980-2007</td>
<td>Real exchange rate</td>
<td>Cointegration for 17 out of 33, LRE = -0.17 ~ 10.39 Mean = 0.21 LRE panel = 0.125</td>
</tr>
<tr>
<td>Bodart, Candelon and Carpentier (2012)</td>
<td>68 developing countries Monthly, 1980-2009</td>
<td>Real effective exchange rate</td>
<td>LRE = 0.34</td>
</tr>
<tr>
<td>Ahumada and Cornejo (2014)</td>
<td>Argentina Quarterly, 1993-2011</td>
<td>Real Peso/USD exchange rate</td>
<td>LRE = 0.23</td>
</tr>
</tbody>
</table>

3.1.2.3 Granger causality

The Granger causality between commodity prices and exchange rate receives little attention in studies in developing countries. There are only two papers, Kohlscheen (2010) and Byambasuren (2013) that investigate this aspect. Kohlscheen (2010) tests the Granger causality in eight developing countries and only finds a Granger causality in Indonesia and Thailand, with the direction from commodity prices to exchange rate. Byambasuren (2013) determines that the Granger causality in Mongolia also runs in the same direction.

3.1.3 Non-oil commodity prices and exchange rate in both developed and developing countries

3.1.3.1 Cointegration

Regarding the link between non-oil commodity prices and exchange rate in both developed and developing countries, Cashin, Céspedes and Sahay (2004) can be regarded as the most comprehensive research. This study examines the relationship in
total 53 developing countries and five OECD developed countries namely Australia, Canada, Iceland, New Zealand and Norway. Among 53 developing countries, there are four ASEAN commodity-exporting countries consisting of Indonesia, Malaysia, Myanmar and Thailand. Apart from Engle and Granger (1987) cointegration test, the study also applies the Gregory and Hansen (1996) cointegration test. This cointegration is utilized as it allows for unknown structural shifts in relationship between series. It is believed to be suitable for the study as in the period from 1980 to 2002 there are some substantial changes in the policy regarding exchange rate and in the prices of various primary commodities. According to the result of the tests, the long-run relationship of real commodity prices and real exchange rate is seen in about one third of the commodity-exporting countries. This proportion (one third) is the same for both developed and developing countries. For OECD countries, real exchange rate and real commodity prices are found to be cointegrated in Australia and Iceland. For ASEAN countries, Indonesia is the only country where the two variables are cointegrated.

Ricci, Milesi-Ferretti and Lee (2013) confirm the existence of a long-run relationship between commodity prices and exchange rates in a group of 48 industrial and emerging countries. The main purpose of this paper is to explore the role of economic fundamentals in explaining movements in real exchange rate. As the result of the panel cointegration test of Kao (1999), there is a long-run co-movement between real effective exchange rate and economic fundamentals. According to the result of DOLS estimation, “real exchange rates are found to co-move positively with a country’s net external position, the productivity of tradables versus nontradables relative to trading partners, the commodity terms of trade, the extent of trade restrictions, and government consumption; and negatively with the share of administered prices” (Ricci, Milesi-Ferretti & Lee 2013).

While admitting the existence of a long-run relationship between commodity prices and exchange rate in large commodity-dependent countries such as Australia, Canada,

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29 48 countries includes “Australia, Canada, Denmark, Japan, New Zealand, Norway, Sweden, Switzerland, United Kingdom, United States, Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain, Argentina, Brazil, Chile, China, Colombia, Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, Singapore, Slovak Republic, Slovenia, South Africa, Taiwan Province of China, Thailand, Turkey and Venezuela”.

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Chile, and South Africa, Kato (2012) investigates if there are any changes in the relationship between the two series in recent years by checking the statistical data. This study stems from a phenomenon that financial investors’ participation in commodity-related financial markets has grown significantly since the mid-2000s which may drive up commodity indexes to a higher level than that suggested by the fundamentals. This study suggests that since the mid-2000s, in large commodity-exporting countries, exchange rates tend to have a stronger relationship with major commodity indexes compared to the unique commodities (off-indexed commodities).

3.1.3.2 Long-run elasticity

Long-run elasticity of exchange rate to non-oil commodity prices in the data set of both developed and developing countries is summarized in Table 3.3. According to Cashin, Céspedes and Sahay (2004) and Ricci, Milesi-Ferretti and Lee (2013), the long-run elasticity estimates for the two different sets of countries are nearly equal.

Table 3.3 – Long-run elasticity of exchange rate to non-oil commodity prices in both developed and developing countries

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Regression model</th>
<th>Long-run elasticity (LRE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cashin, Céspedes and Sahay (2004)</td>
<td>53 developing &amp; 5 developed countries</td>
<td>Real exchange rate</td>
<td>Real commodity prices</td>
</tr>
<tr>
<td></td>
<td>Monthly, 1980-2002</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ricci, Milesi-Ferretti and Lee (2013)</td>
<td>27 developing &amp; 21 developed countries</td>
<td>Real exchange rate</td>
<td>Commodity prices; net foreign assets; productivity differential; government consumption; trade restriction index; price controls</td>
</tr>
<tr>
<td></td>
<td>Annual, 1980-2004</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.3.3 Granger causality

Apart from testing the cointegration between commodity prices and exchange rate, Cashin, Céspedes and Sahay (2004) also examines the Granger causality between the two variables. For those countries where there is cointegration between real exchange rates and real commodity prices, the result the Engle and Granger (1987) test indicates that there is Granger causality running from real commodity prices to real exchange rate.

In addition, Zhang, Dufour and Galbraith (2013) examine high-frequency causal
relationships between the exchange rates of three commodity-exporting countries – Canada, Australia, and Chile – and the prices of their dominant exporting commodities (crude oil for Canada, gold for Australia, and copper for Chile) as the authors claim that “commodity prices and exchange rates are set in highly active financial markets” and it is hard to capture casual links between them by low-frequency data as movements in such markets are so short-lived. For that reason, this study uses daily and 5-minute data. Moreover, this study also employs multi-horizon causality measures to compare the strength of causal relationships and examine how long the causal effects will last. In contrast with other studies, this paper suggests that “the causality running from commodity prices to exchange rates is stronger than that in the opposite direction across multiple horizons”.

3.2 Oil prices and exchange rate

There is much work on the relationship between oil prices and exchange rate in OECD countries such as (Chaudhuri & Daniel 1998), (Chen & Chen 2007) and (Amano & Van Norden 1998). Meanwhile, there is only one study examining the link between oil prices and exchange rate in several ASEAN countries, which is (Narayan 2013).

3.2.1 Oil prices and exchange rate in developed countries

3.2.1.1 Cointegration

Among studies on the relationship between oil prices and exchange rate in developed countries, Chaudhuri and Daniel (1998) is the largest-scale research when considering 16 OECD countries. Using the Engle and Granger (1987) cointegration test on monthly data in the period 1973 – 1996, this study finds out the long-term relationship between real USD exchange rate and real oil prices for all but three namely Canada, Ireland, and Spain. In the cases where the cointegration is found, an increase in real price of oil leads to the appreciation of real USD exchange rate.

In line with this finding, Chen and Chen (2007) confirm the long-term relationship between real oil prices and real exchange rate in the United States of America, 30

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30 16 OECD countries consisting of “Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Ireland, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom” (Chaudhuri & Daniel 1998).
Germany, and Japan according to the result of Johansen (1988) cointegration test applied for individual G7 countries. This result is also in line with the findings of Amano and Van Norden (1998). In more specifics, Amano and Van Norden (1998) find that an increase in oil prices of 10% is associated with a depreciation of the Mark of 0.9%, depreciation of the Yen of 1.7%, and an appreciation of the USD of 2.4%.

However, Chen and Chen (2007) claim that the individual country-by-country tests for unit root and cointegration have notoriously low power and therefore they pool the data of G7 countries31 and investigate the long-run relationship one more time by panel-data method. The results from two panel cointegration tests including Pedroni (2004) and Larsson, Lyhagen and Löthgren (2001) show that for G7 countries, oil prices co-move with real exchange rate in the long run. Another strength of this study is that it considers various measures of oil prices including the world price, the United Arab Emirates price, the British price, and the US West Texas Intermediate price while in previous works, only one of these oil prices has been used.

While the findings about exchange rate – oil prices long-run relation of most studies appear to be consistent, there are still some exceptions. For example, there is a cointegration between real USD exchange rate and real oil prices in Italy and the United Kingdom according to Chaudhuri and Daniel (1998). Moreover, by applying (Johansen 1988) test for each individual country, Chen and Chen (2007) finds no evidence of cointegration between real exchange rate and real oil prices in these two developed countries. Likewise, although Chaudhuri and Daniel (1998) also indicate a long-run relationship between real USD exchange rate and real oil prices in Norway, Akram (2004) reports that non-linear oil price effects are only significant in the short run. In the long run, oil prices are found to have no effect on the exchange rate in this country.

3.2.1.2 Long-run elasticity

For the group of developed countries, there is only one study considering the long-run elasticity of exchange rate to oil prices (Table 3.4).

31 G7 countries consisting of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States of America
Chapter 3 – Literature review

### Table 3.4 – Long-run elasticity of exchange rate to oil prices in developed countries

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Regression model</th>
<th>Long-run elasticity (LRE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen and Chen (2007)</td>
<td>G7 countries Monthly, 1972-2005</td>
<td>Real exchange rate, Real oil prices</td>
<td>LRE(_{panel}) = 0.31</td>
</tr>
</tbody>
</table>

#### 3.2.1.3 Granger causality

For developed countries, the Granger causality runs from oil prices to exchange rate whereas there is no evidence of the reverse. Specifically, there are two studies concerning the Granger causality of oil prices and exchange rate. The study of Chaudhuri and Daniel (1998) indicates a strong evidence that in all 16 OECD countries studied, the real price of oil Granger causes real USD exchange rate. Amano and Van Norden (1998) also show that the United States of America, Germany, and Japan have the same direction of causality.

#### 3.2.2 Oil prices and exchange rate in developing countries

For developing countries, most of current studies on the relationship between oil prices and exchange rate are carried out in individual oil-exporting country such as Algeria, Nigeria, Congo, Turkey and Russia. Narayan (2013) is the only study regarding the relationship between oil prices and exchange rate in a group of 14 Asian countries. However, this study only considers the predictability of exchange rate returns based on oil prices.

##### 3.2.2.1 Cointegration

In most developing oil-exporter countries, real exchange rate movements are dependent on the fluctuation of real oil prices in the long term. However, the direction and magnitude of the impact of oil prices on exchange rate are quite different for each developing oil exporters. Koranchelian (2005) finds the evidence of cointegration between real effective exchange rate and real oil prices in oil exporter Algeria based on the result of the Johansen (1988) cointegration test. This study uses a simple model to estimate the long-run real exchange rate equilibrium including the real GDP per capita relative to trading partners and real price of oil as explanatory variables. As the result of regression analysis, it is found that an increase in real oil prices of 1% is associated with an appreciation of the REER of about 0.25%. Following the same methodology,
Oriavwote and Eriemo (2012) also emphasizes the existence of long-run relationship between oil prices and exchange rate in Nigeria, which is a member of OPEC. However, the relationship between the two variables is negative with the long-run elasticity being about –0.04.

Suseeva (2010) finds a positive long-run relationship between real oil price and real exchange rate in Russia, the largest oil exporter. In this paper, apart from real effective exchange rate, the real bilateral exchange rate of Russia against the Euro is also considered in order to clarify whether the change of monetary policy has an impact on the relationship. This change happened in 2005 when the Russian monetary authorities covered the Euro in the bi-currency basket. By splitting the sample of the real exchange rate against the Euro based on the policy change (before and after) and conducting the regression, the result shows that the change in policy made the long-run link between the real price of oil and the real bilateral exchange rate even stronger.

The long-run relationship between exchange rate and oil prices is also found in Venezuela where oil export accounts for 95% of export earnings Zalduendo (2006). In more specifics, a 1% increase in oil prices has almost a one-to-one effect on the real effective exchange rate. Bhattacharya and Ghura (2006) show the same result when exploring the effect of oil on the economic growth of Congo, a heavily oil-dependent country. The study shows that real effective exchange rate is cointegrated with world oil prices. More specifically, higher oil prices lead to an appreciation of real effective exchange rate over the long run. Furthermore, the Johansen (1988) cointegration test provides much stronger evidence of a cointegrating relationship between real effective exchange and world price of oil than between real effective exchange rate and terms of trade.

The nexus between oil price and exchange rate in developing OPEC countries is also examined by Nikbakht (2010). Based on monthly data of seven OPEC countries from 2000 to 2007, the study applies two different methodologies and receives contradictory results. While using the Johansen (1988) cointegration test for individual countries, the result shows that real exchange rate and real oil prices are not cointegrated in all cases.

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32 Nikbakht (2010) focuses on seven OECD countries which are “Algeria, Indonesia, Iran, Kuwait, Nigeria, Saudi Arabia, and Venezuela”.

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The results are consistent with the findings of Amano and Van Norden (1998), Chen and Chen (2007) and Chaudhuri and Daniel (1998). However, while pooling the data and conducting the panel cointegration tests, there is a long-run relationship between real oil prices and real exchange rates. Because traditional unit root tests and cointegration tests are notorious for low power, the study has a final conclusion that real oil prices and real exchange rates are cointegrated.

In addition to researches about the long-run relationship in developing oil-exporting countries, there are two researches carried out in developing oil-importing countries including Tiwari, Mutascu and Albulescu (2013) and Jain and Ghosh (2013). Both confirm the existence of a long-run relationship between oil prices and exchange rate in two oil-importing countries. Tiwari, Mutascu and Albulescu (2013) access the influence of oil prices on the real effective exchange rate in Romania, an oil-importing country in Eastern Europe. Instead of applying classical approaches, this study uses the wavelet correlation and covariance and the wavelet cross-correlation to explore whether the international oil price has impact on the real exchange rate in Romania. This is the solution for the problem related to time series non-stationarity of classical approaches. This paper finds that oil price has a strong influence on the real effective exchange rate both in the short run and the long run. Furthermore, Jain and Ghosh (2013) examines the cointegration among global oil prices, precious metal (gold, platinum and silver) prices, and the Indian Rupee – USD exchange rate in India, the 4th largest oil importer in the world. The study uses the auto-regressive distributed lag (ARDL) bounds testing approach of cointegration developed by Pesaran and Shin (1998). The result indicates that the series are cointegrated.

3.2.2.2 Long-run elasticity

There are many studies determining long-run elasticity of exchange rate to oil prices in developing oil-exporting countries. According to the statistics (Table 3.5), the difference in long-run elasticity between countries is not significant. Long-run elasticity is in the range of 0.20 – 1.02.
Table 3.5 – Long-run elasticity of exchange rate to oil prices in developing countries

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Regression model</th>
<th>Long-run elasticity (LRE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatafora and Stavrev (2003)</td>
<td>Russia Quarterly, 1995-2002</td>
<td>Real effective exchange rate</td>
<td>LRE = 0.31</td>
</tr>
<tr>
<td>Bhattacharya and Ghura (2006)</td>
<td>Congo Annual, 1972-2004</td>
<td>Real effective exchange rate</td>
<td>LRE = 0.20</td>
</tr>
<tr>
<td>Zalduendo (2006)</td>
<td>Venezuela Annual, 1950-2004</td>
<td>Real effective exchange rate</td>
<td>LRE = 1.02 (REER based on official rates)</td>
</tr>
<tr>
<td>Oomes and Kalcheva (2007)</td>
<td>Russia Monthly, 1997-2005</td>
<td>Real effective exchange rate</td>
<td>LRE = 0.50</td>
</tr>
<tr>
<td>Korhonen, Juurikkala and Pankki (2007)</td>
<td>9 OPEC &amp; 3 CIS developing countries Annual, 1975-2005</td>
<td>Real effective exchange rate</td>
<td>LRE_{panel} = 0.4 ~ 0.5</td>
</tr>
<tr>
<td>Nikbakht (2010)</td>
<td>7 OPEC developing countries Monthly, 2000-2007</td>
<td>Real exchange rate</td>
<td>LRE_{panel} = 0.35</td>
</tr>
<tr>
<td>Oriavwote and Eriemo (2012)</td>
<td>Nigeria Annual, 1980-2010</td>
<td>Real effective exchange rate</td>
<td>LRE = 0.04</td>
</tr>
</tbody>
</table>

3.2.2.3 Granger causality

In contrast with the cointegration, the Granger causality between exchange rate and oil prices received much less attention. To the author’s knowledge, there are only two existing studies considering this aspect in developing oil-exporting countries and both are carried out in Nigeria. However, the findings are quite contradictory. While Oriavwote and Eriemo (2012) imply that the Granger causality runs from oil prices to the real effective exchange rate in Nigeria, Yinusa and Adedokun (2014) find that there exists two-way causality between real exchange rate and oil prices. This conflict may be explained by the differences in the data span and the measure of exchange rate.
In developing oil-importing countries, there are three studies exploring Granger causality between oil prices and exchange rate. Both Tiwari, Dar and Bhanja (2013) and Jain and Ghosh (2013) examine this Granger causality in India. For this purpose, Tiwari, Dar and Bhanja (2013) use many methodologies including the classical Granger causality approach, the wavelet methodology, as well as non-linear causality tests in the time and the frequency domain in an effort to provide the most comprehensive result. Based on the test results, the study confirms that there are linear and nonlinear causal relationships between the oil price and the real effective exchange rate only at high time scales. In particular, there is evidence of unidirectional causality from exchange rates to oil prices at scale corresponding to 16 to 32 months, and bidirectional causality corresponding to a time horizon of 32 to 64 months. Jain and Ghosh (2013) employ the Toda–Yamamoto version of Granger causality to investigate the Granger causality directions. This methodology is preferred because of the fact that it can avoid the bias associated with unit roots and cointegration tests (Zapata & Rambaldi 1997; Clarke & Mirza 2006) as the pre-testing of cointegration between variables is not required. The tests indicate that there is a Granger causality running from exchange rate to oil prices and precious metals prices. To explore the Granger causality between oil prices and exchange rate in Romania, Tiwari, Mutascu and Albulescu (2013) apply a methodology that is similar to that of Tiwari, Dar and Bhanja (2013). According to the classical Granger causality approach, no causality can be found between these two variables. On the other hand, the results of Granger causality tests across frequencies confirm that international oil price Granger-causes the real exchange rate in Romania.

3.2.3 Relationship between oil prices and exchange rate in both developed and developing countries

3.2.3.1 Cointegration

Jahan-Parvar and Mohammadi (2011) find a stable long-run relationship between real oil prices and real exchange rates in 14 oil exporting countries including both developed and developing ones. Different from other studies, the cointegration between

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33 The 14 oil exporting countries consist of “Algeria, Angola, Bahrain, Bolivia, Colombia, Gabon, Indonesia, Kuwait, Mexico, Nigeria, Norway, Russia, Saudi Arabia, and Venezuela”, (Jahan-Parvar & Mohammadi 2011).
the two series is detected based on autoregressive distributed lag (ARDL) bounds test. This is explained that such typical cointegration tests as Engle and Granger (1987) and Johansen (1988) cointegration tests require the underlying time series to have a unit root. Meanwhile, unit root tests have low power and are sensitive to the existence of structural breaks (Perron 1997). In addition to cointegration testing, this paper also finds out that real exchange rate responds to equilibrium errors at a normal to slow rate.

Similarly, Aziz (2009) also explores the existence of cointegration between oil price and real exchange rate for the whole sample of eight countries consisting of four developing countries (Malaysia, Côte d'Ivoire, Pakistan, South Africa) and four developed countries (Canada, Denmark, Japan, Switzerland). In this study, apart from real oil price and real exchange rate, real interest rate differential is also included in the model. This work utilizes three panel cointegration tests consisting of Kao (1999), Maddala and Wu (1999), and Pedroni (1999). According to the Pedroni (1999) test results, there are no cointegration between variables. Meanwhile, the Kao (1999) and Maddala and Wu (1999) cointegration test results show the long-run co-movement between real exchange rate, real oil price, and real interest rate differential.

While Aziz (2009) adds the real interest rate differential as an explanatory variable into the equilibrium real exchange rate model, Habib and Kalamova (2007) include the productivity differentials as the determinant of exchange rate based on the theoretical framework developed by Cashin, Cèspedes and Sahay (2004). Moreover, the study controls the so-called Balassa – Samuelson effect by building its own measures of real effective exchange rates and productivity differentials against the 15 OECD main trading partners. According to the findings, among three oil-exporting countries – Russia, Saudi Arabia and Norway, there is a positive long-run relationship between the real oil price and the real exchange rate only in Russia.

Another study carried out in both developed and developing countries is Mohammadi and Jahan-Parvar (2012) which investigates the relationship between oil prices and exchange rate in thirteen oil exporting countries. However, developing countries outnumber developed ones by twelve to one. The threshold autoregressive Juselius

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34 Thirteen oil exporting countries consisting of “Columbia, Indonesia, Gabon, Nigeria, Mexico, Venezuela, Algeria, Angola, Bolivia, Kuwait, Russia, Saudi Arabia and Norway” (Mohammadi & Jahan-Parvar 2012).
(2006) and momentum threshold autoregressive (MTAR) models are applied in this study. The advantage of these methods is that they can allow for possibility of asymmetries in the dynamics of the oil price – exchange rate relationship. This study finds that there is long-run co-movement between oil prices and exchange rates only in three out of thirteen countries namely Bolivia, Mexico and Norway.

### 3.2.3.2 Long-run elasticity

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Regression model</th>
<th>Long-run elasticity (LRE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habib and Kalamova (2007)</td>
<td>Russia, Norway, Saudi Arabia</td>
<td>Real effective exchange rate</td>
<td>LRE Russia = 0.29</td>
</tr>
<tr>
<td></td>
<td>Quarterly, 1980-2006</td>
<td>Real oil prices; productivity differential</td>
<td></td>
</tr>
</tbody>
</table>

After determining the cointegration between oil prices and real exchange rate in Russia, Habib and Kalamova (2007) found out that the long-run elasticity of exchange rate to oil prices in this country is 0.29, which is lower than the estimation result of Spatafora and Stavrev (2003) and Oomes and Kalcheva (2007) (0.31 and 0.35, respectively).

### 3.2.3.3 Granger causality

For most studies conducted in both developed and developing countries which oil accounts for a large share of either import or export, the Granger causality runs from oil prices to exchange rate. According to Mohammadi and Jahan-Parvar (2012), there is long-run causality from real oil prices to real exchange rates in Bolivia, Mexico, and Norway. Similarly, Aziz (2009) implies that the eight countries Malaysia, Côte d'Ivoire, Pakistan, South Africa, Canada, Denmark, Japan, and Switzerland have the same direction of Granger causality. Jahan-Parvar and Mohammadi (2011) also find out that long-run Granger causality going from oil prices to exchange rate for the sample of 14 oil-exporting countries.

### 3.3 Summary

Chapter 3 provides a comprehensive overview of existing studies on the relationship between exchange rate and commodity prices. While there are much work on the relationship between exchange rate and commodity prices in OECD countries, the
number of studies regarding this relationship on ASEAN is very limited. Generally, there is evidence of cointegration between the two variables in most of the sample countries, both developed and developing ones. Apart from cointegration, conclusive results about long-run elasticity of exchange rate to oil prices as well as Granger causality in developed and developing countries cannot be derived from the existing literature since the findings are inconsistent, or even contradictory in some cases. Nonetheless, there seems to be a tendency that Granger causality runs from commodity prices to exchange rate for both developed and developing countries. While long-run elasticity of exchange rate to non-oil commodity prices of developed countries are likely to be larger than that of developing countries, long-run elasticity of exchange rate to oil has a tendency to show the opposite.

In the next chapter, we will explore the research methodology for our work.
In order to investigate the relationship between real effective exchange rate and real commodity prices in developed and developing countries, both panel-data technique and time series techniques are employed. Apart from the two main variables, real interest rate is also included in our models. The variables, data collection method as well as the testing process are described below.

4.1 Variables

In order to investigate the relationship between exchange rate and commodity prices, most studies use simple models including only two variables: exchange rate and commodity prices (see for example Bodart, Candelon & Carpentier 2012; Cashin, Céspedes & Sahay 2004; and Simpson & Evans 2004).

In our thesis, we use the real effective exchange rate (REER) and the real commodity prices (RCOMP) as our two main variables. In addition, the real interest rate (RIR) is also considered as it affects both exchange rate and commodity prices. The effects of real interest rate on commodity prices and exchange rate are explained as follows:

**Real interest rate and commodity prices**

Real interest rate affects commodity prices through three main mechanisms (Frankel 2014). Firstly, a higher real interest rate raises the cost of holding inventories. Most of inventory holders are quite conscious of the costs of carrying inventory. A higher cost of carrying inventory will lower the demand for inventories and consequently lower the
total demand for commodities. The second effect of a higher interest rate is that it creates the incentive for commodity-producing countries to extract their commodities, which are non-interest earning, and liquidate them in order to earn interest on the proceeds from the sale instead of preserving them. A higher rate of extraction leads to an increase in supply. Both lower demand and higher supply contribute to a fall in commodity prices. The third mechanism relates to financial speculation in commodity markets. Commodities have become an asset of the portfolio for hedge funds and portfolio managers. When real interest rates are very low, these investors will look for other things to buy. Apart from stocks and bonds, commodities are also popular choices of many investors. This leads to higher demand for commodities. As the result, the commodity prices will be lower. To sum up, the real interest rate affects commodity prices negatively.

**Real interest rate and exchange rate**

An increase in real interest rate, holding all else constant, will increase demand for that country’s currency. The reason is that when real interest rate is up, many investors will want to capitalize high returns and it will become more attractive to buy financial assets in that country. As a result, the demand for that currency will rise. It can be concluded that a higher real interest rate will cause an appreciation of currency and vice versa, a lower real interest rate will cause a depreciation of currency. In addition, the influence of interest rate on exchange rate is confirmed in such studies as Kearns and Manners (2006), Zettelmeyer (2004), and Faust et al. (2003).

In order to get more precise results in testing for the direction of Granger causality, RIR is included in the VAR or VECM as a control variable as it affects both RCOMP and REER. It is common that Granger tests are performed in bivariate setting, following the direct Granger test proposed by Granger (1969). However, bivariate models for testing Granger causality are likely to suffer from omitted variable bias (Justesen 2008). Our VAR or VEC models are presented in details in Section 4.3.1.4 and 4.3.2.4.
4.2 Data source

4.2.1 Selection of countries

In this thesis, we only focus on commodity-exporting countries where the commodity share is higher than 20% of total commodity export. This rate is recommended by Bodart, Candelon and Carpentier (2012) as they claim that the long-run impact of primary commodity prices on exchange rate is only significant when the share of that commodity on total export is at least 20%.

In order to pick up commodity-exporting countries in each group OECD and ASEAN, we calculate the average share of primary commodities in total exports of all OECD and ASEAN countries for the period from 1995 to 2005 (see Table 4.1 and 4.2).

Table 4.1 – Average share of primary commodities on total exports (1995–2005) – ASEAN

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>Average share of primary commodities export on total export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brunei</td>
<td>91.86%</td>
</tr>
<tr>
<td>2</td>
<td>Myanmar</td>
<td>65.82%</td>
</tr>
<tr>
<td>3</td>
<td>Laos</td>
<td>60.20%</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>45.22%</td>
</tr>
<tr>
<td>5</td>
<td>Vietnam</td>
<td>42.52%</td>
</tr>
<tr>
<td>6</td>
<td>Malay</td>
<td>22.15%</td>
</tr>
<tr>
<td>7</td>
<td>Thailand</td>
<td>22.13%</td>
</tr>
<tr>
<td>8</td>
<td>Singapore</td>
<td>13.87%</td>
</tr>
<tr>
<td>9</td>
<td>Cambodia</td>
<td>12.71%</td>
</tr>
<tr>
<td>10</td>
<td>Philippines</td>
<td>12.35%</td>
</tr>
</tbody>
</table>

Source: Being calculated based on data from UNCTAD

Table 4.2 – Average share of primary commodities on total exports (1995–2005) – OECD

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>Average share of primary commodities export on total export</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iceland</td>
<td>84.17%</td>
</tr>
<tr>
<td>2</td>
<td>Chile</td>
<td>83.31%</td>
</tr>
<tr>
<td>3</td>
<td>Norway</td>
<td>78.05%</td>
</tr>
<tr>
<td>4</td>
<td>Australia</td>
<td>65.72%</td>
</tr>
<tr>
<td>5</td>
<td>New Zealand</td>
<td>60.26%</td>
</tr>
<tr>
<td>No</td>
<td>Country</td>
<td>Average share of primary commodities export on total export</td>
</tr>
<tr>
<td>----</td>
<td>-----------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>6</td>
<td>Greece</td>
<td>38.23%</td>
</tr>
<tr>
<td>7</td>
<td>Canada</td>
<td>32.14%</td>
</tr>
<tr>
<td>8</td>
<td>Estonia</td>
<td>19.81%</td>
</tr>
<tr>
<td>9</td>
<td>Netherlands</td>
<td>18.17%</td>
</tr>
<tr>
<td>10</td>
<td>Denmark</td>
<td>17.69%</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>16.80%</td>
</tr>
<tr>
<td>12</td>
<td>Poland</td>
<td>16.25%</td>
</tr>
<tr>
<td>13</td>
<td>Mexico</td>
<td>16.13%</td>
</tr>
<tr>
<td>14</td>
<td>Belgium</td>
<td>15.44%</td>
</tr>
<tr>
<td>15</td>
<td>Turkey</td>
<td>15.03%</td>
</tr>
<tr>
<td>16</td>
<td>France</td>
<td>14.58%</td>
</tr>
<tr>
<td>17</td>
<td>Germany</td>
<td>14.08%</td>
</tr>
<tr>
<td>18</td>
<td>UK</td>
<td>13.50%</td>
</tr>
<tr>
<td>19</td>
<td>Portugal</td>
<td>13.12%</td>
</tr>
<tr>
<td>20</td>
<td>Finland</td>
<td>12.46%</td>
</tr>
<tr>
<td>21</td>
<td>United States</td>
<td>12.07%</td>
</tr>
<tr>
<td>22</td>
<td>Sweden</td>
<td>11.75%</td>
</tr>
<tr>
<td>23</td>
<td>Hungary</td>
<td>11.07%</td>
</tr>
<tr>
<td>24</td>
<td>Slovakia</td>
<td>10.58%</td>
</tr>
<tr>
<td>25</td>
<td>Austria</td>
<td>10.44%</td>
</tr>
<tr>
<td>26</td>
<td>Luxembourg</td>
<td>10.20%</td>
</tr>
<tr>
<td>27</td>
<td>Ireland</td>
<td>9.49%</td>
</tr>
<tr>
<td>28</td>
<td>Italy</td>
<td>9.06%</td>
</tr>
<tr>
<td>29</td>
<td>Czech</td>
<td>8.55%</td>
</tr>
<tr>
<td>30</td>
<td>Slovenia</td>
<td>8.15%</td>
</tr>
<tr>
<td>31</td>
<td>Korean</td>
<td>7.88%</td>
</tr>
<tr>
<td>32</td>
<td>Switzerland</td>
<td>7.53%</td>
</tr>
<tr>
<td>33</td>
<td>Israel</td>
<td>6.83%</td>
</tr>
<tr>
<td>34</td>
<td>Japan</td>
<td>4.94%</td>
</tr>
</tbody>
</table>

Source: Being calculated based on data from UNCTAD

For ASEAN, we pick up 6 developing countries that satisfy the criteria (the share of commodity export is at least 20%). They are: Brunei, Laos, Malaysia, Myanmar, Vietnam, and Thailand. Although Indonesia satisfies the criteria, this country is not chosen since it is extremely populous compared to other ASEAN countries and OECD countries.
For OECD, we pick up six developed countries, which the share of commodity export is more than 20% of the total export. They are: Iceland, Norway, Australia, New Zealand, Canada and Greece. Chile is excluded because of the fact that it is not a developed country.

Quarterly data over the period from 1986 to 2014 have been used.

4.2.2 Commodity prices

Commodities (or primary commodities) and differentiated products are two classes of goods. While differentiated products are distinguishable among manufacturers, commodities are supplied without quantitative differentiation across a market. Commodities are fungible. This means that the market treats commodities as equivalent without regard to who produced them. As commodities are fungible, commodity exporters have little control over its commodity prices. They must follow the international prices, which are determined by supply and demand in commodity markets. That is the reason why commodity exporters are referred to as price takers (Hofstrand 2007).

In fact, there are some countries exerting much influence on the world supply in some specific commodities. In our sample, it is worth noticing that Australia has a larger market power in the international trade of coal and iron, New Zealand influences the international prices of dairy and lamb, and Canada is prominent in the barley and softwood markets. Furthermore, Malaysia has a strong impact in the international palm oil and hardwood markets while Thailand strongly affects the world rice market. However, as the number of primary products that can influence the world market is limited, commodity-exporting countries are essentially price takers (Chan et al. 2000).

Most existing studies of the relationship between commodity prices and exchange rate have used either the prices of a specific commodity, terms of trade indices or country-specific commodity prices indices (Cashin, Céspedes & Sahay 2004). For studies carried out in developed commodity-exporting countries like Australia, New Zealand, and Canada, country-specific commodity prices indices have been utilized as they are
Chapter 4 – Research Methodology

published by major banks. For studies on developing countries where country-specific commodity prices indices are unlikely to be available, individual commodity prices (see for example Bodart, Candelon and Carpentier (2012), Bodart, Candelon and Carpentier (2011)) and terms of trade indices (see for example Byambasuren (2013), Ricci, Lee and Milesi-Ferretti (2008)) are preferable. However, according to Dehn (2000), these two approaches are unsatisfactory for the following reasons. Firstly, only a few oil-producing countries are specialized in exporting only a single commodity. Thus, for the majority of developing countries, the movement of commodity prices cannot be reflected completely in the price of just a single commodity. On the contrary, terms of trade indices arguably capture too much information. Specifically, terms of trade refers to “the relative price of exports in terms of imports” (Obstfeld & Rogoff 1996) and can be interpreted as the amount of import goods an economy can purchase per unit of export goods. Apart from information about commodity prices, terms of trade indices also reflect various non-commodity and non-export price influences. Therefore, terms of trade indices are also not suggested as a measure of commodity prices. Among the three measures of commodity prices mentioned above, country-specific commodity prices indices are claimed to be the best one (Dehn 2000). One of the main advantages of building commodity prices indices for individual countries is the consistency of the data.

In this thesis, country-specific commodity prices will be constructed following Deaton and Miller (1995). This approach is also utilized in Cashin, Céspedes and Sahay (2004), which investigates the link between exchange rate and commodity prices in five developed and 53 developing countries. However, when being applied in our thesis, this approach will be adjusted to be suitable for our thesis and provide better data.

Following Deaton and Miller (1995), we construct the nominal country-specific commodity prices index (NCOMP) as “a geometrically weighted index of the nominal prices” of 21 individual commodities. The NCOMP is given by:

\[ \text{NCOMP}_t = \prod_{i=1}^{n} p_{it}^{W_i} \]  

List of banks publishing commodity prices indices in Australia, New Zealand and Canada:

- Australia: Reserve Bank of Australia (RBA);
- New Zealand: Australia and New Zealand Banking (ANZ);
- Canada: The Bank of Canada
where:

\(a. \ n\)

\(n\) is the number of commodities utilized when building country-specific commodity prices. There are a total of 21 commodities selected \((n=21)\). These 21 commodities are chosen, partly on the grounds of importance and partly on the data availability.

Commodities selected are the top primary exports of our 12 countries. Based on the availability of international commodity prices \(P_i\), in the process of selecting commodities we consider 45 commodities. Among them, 44 commodities (as listed in Table 4.3) are chosen as they are not only common commodities but their international prices are also published by the International Financial Statistics (IFS) of the International Monetary Fund (IMF). Apart from these 44 commodities, dairy is included in the list as it is the leading export commodity of New Zealand and among the top export commodities of Norway and Greece. An important thing is that the data of dairy prices are also available (being published by the United States Department of Agriculture).

The process of selecting commodities is as follows: Firstly, for each country, the export values of the 45 commodities are obtained from the United Nations Commodity Trade Statistics (UN Comtrade) database for the base period. The base period is chosen to be 1995–2005 as it is in the middle of our timespan from 1986 to 2014.

More specifically, each commodity has harmonized system (HS) codes (see in Table 4.3) following the HS2007 classification in the database of UN Comtrade. Based on these HS codes, we can find and collect the export values of 45 commodities in the period 1995 – 2005. However, the data of export values are not available for Laos in the UN Comtrade database. We have to collect the export values for this country from the Atlas of economic complexity (see for more information in (Hausmann & Hidalgo 2011)).
### Table 4.3 – 45 commodities with HS2007 codes used in the UN Comtrade database

<table>
<thead>
<tr>
<th>No.</th>
<th>Commodity name</th>
<th>Associated HS2007 code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminum</td>
<td>2606</td>
<td>Aluminum ores/concentrates</td>
</tr>
<tr>
<td>2</td>
<td>Bananas</td>
<td>0803</td>
<td>Bananas plantains/fresh/dried</td>
</tr>
<tr>
<td>3</td>
<td>Barley</td>
<td>1003</td>
<td>Barley</td>
</tr>
<tr>
<td>4</td>
<td>Beef</td>
<td>0201, 0202</td>
<td>Beef fresh/chilled/frozen</td>
</tr>
<tr>
<td>5</td>
<td>Chicken</td>
<td>0207</td>
<td>Chicken fresh/chilled/frozen</td>
</tr>
<tr>
<td>6</td>
<td>Coal</td>
<td>2701</td>
<td>Coal coke/briquettes</td>
</tr>
<tr>
<td>7</td>
<td>Cocoa</td>
<td>1801</td>
<td>Cocoa whole/broken, raw/roasted</td>
</tr>
<tr>
<td>8</td>
<td>Coconut oil</td>
<td>0801</td>
<td>Coconut oil</td>
</tr>
<tr>
<td>9</td>
<td>Coffee</td>
<td>0901</td>
<td>Coffee roasted/not roasted, coffee husks and skins, coffee substitute</td>
</tr>
<tr>
<td>10</td>
<td>Copper</td>
<td>2603</td>
<td>Copper ores/concentrates</td>
</tr>
<tr>
<td>11</td>
<td>Corn</td>
<td>1005</td>
<td>Corn seed</td>
</tr>
<tr>
<td>12</td>
<td>Cotton</td>
<td>5201</td>
<td>Cotton, not carded/combed</td>
</tr>
<tr>
<td>13</td>
<td>Crude oil</td>
<td>2709</td>
<td>Crude petroleum oils/oils from minerals</td>
</tr>
<tr>
<td>14</td>
<td>Dairy</td>
<td>0401, 0402, 0403, 0404, 0405, 0406</td>
<td>Milk and cream, buttermilk, cream, whey, cheese and curd</td>
</tr>
<tr>
<td>15</td>
<td>Fish</td>
<td>0301, 0302 and 0303</td>
<td>Fish live/fresh/chilled/frozen</td>
</tr>
<tr>
<td>16</td>
<td>Fish meal</td>
<td>230120</td>
<td>Fish meal fodder</td>
</tr>
<tr>
<td>17</td>
<td>Gold</td>
<td>7108</td>
<td>Gold semi-manufactured/powder/unwrought</td>
</tr>
<tr>
<td>18</td>
<td>Groundnuts</td>
<td>1202</td>
<td>Groundnuts not roasted/cooked</td>
</tr>
<tr>
<td>19</td>
<td>Hard log</td>
<td>4403 (Except for 440320)</td>
<td>Harwood, rough, untreated</td>
</tr>
<tr>
<td>20</td>
<td>Hard sawn</td>
<td>4407, 4408 (Except for 440710 and 440810)</td>
<td>Harwood sawn &gt; 6mm thick</td>
</tr>
<tr>
<td>21</td>
<td>Hides</td>
<td>41</td>
<td>Raw hides</td>
</tr>
<tr>
<td>22</td>
<td>Iron</td>
<td>2601</td>
<td>Iron ores/concentrates</td>
</tr>
<tr>
<td>23</td>
<td>Lamb</td>
<td>0204</td>
<td>Sheep/goat meat fresh/chilled/frozen</td>
</tr>
<tr>
<td>24</td>
<td>Lead</td>
<td>2607</td>
<td>Lead ores/concentrates</td>
</tr>
<tr>
<td>25</td>
<td>Natural gas</td>
<td>2705</td>
<td>Natural gas</td>
</tr>
<tr>
<td>26</td>
<td>Rubber</td>
<td>4001</td>
<td>Natural rubber</td>
</tr>
<tr>
<td>27</td>
<td>Nickel</td>
<td>2604</td>
<td>Nickel ores/concentrates</td>
</tr>
<tr>
<td>28</td>
<td>Olive oil</td>
<td>1509</td>
<td>Olive oil crude/fractions</td>
</tr>
<tr>
<td>29</td>
<td>Palm oil</td>
<td>1511</td>
<td>Palm oil crude/fractions</td>
</tr>
<tr>
<td>30</td>
<td>Pork</td>
<td>0203</td>
<td>Pork fresh/chilled/frozen</td>
</tr>
<tr>
<td>No.</td>
<td>Commodity name</td>
<td>Associated HS2007 code</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------</td>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>31</td>
<td>Rapeseed oil</td>
<td>151410</td>
<td>Rapeseed oil</td>
</tr>
<tr>
<td>32</td>
<td>Rice</td>
<td>1006</td>
<td>Rice</td>
</tr>
<tr>
<td>33</td>
<td>Shrimp</td>
<td>030613</td>
<td>Shrimp/prawn frozen</td>
</tr>
<tr>
<td>34</td>
<td>Soft log</td>
<td>440320</td>
<td>Wood, conifer, rough, untreated</td>
</tr>
<tr>
<td>35</td>
<td>Soft sawn</td>
<td>440710 and 440810</td>
<td>Softwood, simply worked</td>
</tr>
<tr>
<td>36</td>
<td>Soya-bean oil</td>
<td>1507</td>
<td>Soya-bean oil</td>
</tr>
<tr>
<td>37</td>
<td>Soya-bean meal</td>
<td>230400</td>
<td>Oil-cake/other solid residues from extraction of soya-bean oil</td>
</tr>
<tr>
<td>38</td>
<td>Soya-bean</td>
<td>1201</td>
<td>Soya-bean broken/not broken</td>
</tr>
<tr>
<td>39</td>
<td>Sugar</td>
<td>1701</td>
<td>Cane/beet sugar, chemically pure sucrose, solid form</td>
</tr>
<tr>
<td>40</td>
<td>Sunflower oil</td>
<td>151211 and 151219</td>
<td>Sunflower oil crude/fractions</td>
</tr>
<tr>
<td>41</td>
<td>Tea</td>
<td>0902</td>
<td>Tea flavored/not flavored</td>
</tr>
<tr>
<td>42</td>
<td>Uranium</td>
<td>2612</td>
<td>Uranium ores/concentrates</td>
</tr>
<tr>
<td>43</td>
<td>Wheat</td>
<td>1001</td>
<td>Wheat ores/concentrates</td>
</tr>
<tr>
<td>44</td>
<td>Wool</td>
<td>5101</td>
<td>Wool, not carded/combed</td>
</tr>
<tr>
<td>45</td>
<td>Zinc</td>
<td>2608</td>
<td>Zinc ores/concentrates</td>
</tr>
</tbody>
</table>

Source: The International Financial Statistics (IFS)

Secondly, for individual countries, we compute the average export value of each commodity for the base period 1995 – 2005. Based on the result, we find out the top five commodity exports of each country in the base period (see Table 4.4).

As can be seen from Table 4.4, there are a total of 24 commodities. To limit the number of commodities while guaranteeing the accuracy of country-specific commodity prices, commodities that are not in the top three and appear less than two times will be excluded. According to this, sunflower oil, sugar, and pork are excluded from the list.

Finally, our commodity list includes 21 commodities. They are beef, coal, coffee, cotton, dairy, fish, gold, hard log, hard sawn, hides, iron, lamb, crude oil, olive oil, palm oil, rice, rubber, shrimp, soft sawn, wheat, and wool.
### Table 4.4 – Top five commodity exports by countries in the period 1995–2005

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Australia</td>
<td>Coal</td>
</tr>
<tr>
<td>2</td>
<td>Canada</td>
<td>Crude oil</td>
</tr>
<tr>
<td>3</td>
<td>Iceland</td>
<td>Fish</td>
</tr>
<tr>
<td>4</td>
<td>New Zealand</td>
<td>Dairy</td>
</tr>
<tr>
<td>5</td>
<td>Norway</td>
<td>Crude oil</td>
</tr>
<tr>
<td>6</td>
<td>Greece</td>
<td>Olive oil</td>
</tr>
<tr>
<td>7</td>
<td>Brunei</td>
<td>Crude oil</td>
</tr>
<tr>
<td>8</td>
<td>Laos</td>
<td>Hard sawn</td>
</tr>
<tr>
<td>9</td>
<td>Malaysia</td>
<td>Crude oil</td>
</tr>
<tr>
<td>10</td>
<td>Myanmar</td>
<td>Hard log</td>
</tr>
<tr>
<td>11</td>
<td>Thailand</td>
<td>Rubber</td>
</tr>
<tr>
<td>12</td>
<td>Vietnam</td>
<td>Crude oil</td>
</tr>
</tbody>
</table>
## Table 4.5 – The export weights of 21 primary commodities by countries (by percentage)

<table>
<thead>
<tr>
<th></th>
<th>BEF</th>
<th>COA</th>
<th>COF</th>
<th>COT</th>
<th>DAI</th>
<th>FIS</th>
<th>GOL</th>
<th>HLO</th>
<th>HSA</th>
<th>HID</th>
<th>IRO</th>
<th>LAM</th>
<th>COI</th>
<th>OOI</th>
<th>PAL</th>
<th>RIC</th>
<th>RUB</th>
<th>SHR</th>
<th>SSA</th>
<th>WHT</th>
<th>WOO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>8.3</td>
<td>27.1</td>
<td>0.1</td>
<td>2.9</td>
<td>5.3</td>
<td>0.6</td>
<td>13.3</td>
<td>0</td>
<td>0.1</td>
<td>2.5</td>
<td>11.9</td>
<td>2.1</td>
<td>9.8</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
<td>0</td>
<td>0.5</td>
<td>0.1</td>
<td>8.5</td>
<td>6.4</td>
</tr>
<tr>
<td>Canada</td>
<td>4.4</td>
<td>6.7</td>
<td>0.4</td>
<td>0</td>
<td>1</td>
<td>2.6</td>
<td>9.4</td>
<td>0.4</td>
<td>2.8</td>
<td>1.1</td>
<td>3.6</td>
<td>0</td>
<td>52.2</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.7</td>
<td>2.8</td>
<td>11.7</td>
<td>0</td>
</tr>
<tr>
<td>Iceland</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
<td>90.3</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
<td>1.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6.6</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>13.1</td>
<td>1.3</td>
<td>0</td>
<td>0</td>
<td>39.7</td>
<td>3.2</td>
<td>2.1</td>
<td>0.1</td>
<td>0.2</td>
<td>5.7</td>
<td>2.1</td>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
<td>0.7</td>
<td>6.1</td>
<td>0</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>7.3</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
<td>91.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>0.4</td>
<td>0.1</td>
<td>0.8</td>
<td>25.9</td>
<td>10.7</td>
<td>17.4</td>
<td>0.1</td>
<td>0.1</td>
<td>0.6</td>
<td>3.7</td>
<td>0</td>
<td>0.3</td>
<td>5</td>
<td>27.7</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0.3</td>
<td>0.1</td>
<td>4.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Brunei</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Laos</td>
<td>1.6</td>
<td>1.2</td>
<td>16.5</td>
<td>0</td>
<td>0.6</td>
<td>0</td>
<td>0.8</td>
<td>24</td>
<td>48.5</td>
<td>0.8</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0.9</td>
<td>1.7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.6</td>
<td>0.6</td>
<td>0.8</td>
<td>6.1</td>
<td>10</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
<td>35.9</td>
<td>0</td>
<td>34.3</td>
<td>0</td>
<td>9.6</td>
<td>1.5</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Myanmar</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15.5</td>
<td>0</td>
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<td>13.5</td>
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<td>6.4</td>
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<td>2.2</td>
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<td>6.8</td>
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<td>2.5</td>
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<td>4.7</td>
<td>10.9</td>
<td>0</td>
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</tr>
</tbody>
</table>

Notes:

COA: Coal  FIS: Fish  HID: Hides  OOI: Olive oil  SHR: Shrimp  
COT: Cotton  HLO: Hard log  LAM: Lamb  RIC: Rice  WHT: Wheat
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\( b. \ W_i \)

\( W_i \) is the export weight for commodity \( i \). The export weight for commodity \( i \) is the ratio of the average export value of commodity \( i \) to the average total export of all 21 commodities for the base period (1995–2005):

\[
W_i = \frac{\text{Average export value of commodity } i \text{ in the base period}}{\text{Average total export of } n \text{ commodities in the base period}} \tag{4.2}
\]

The export weights are kept fixed for two reasons. The first reason is that we are aimed at constructing a potentially exogenous variable. Moreover, keeping the weights constant helps exclude changes in export volume from changes in commodity prices.

While Deaton and Miller (1995) calculate the export weights based on data in 1975, this thesis works out the export weights using the average data of a long base period (ten years) in order to ensure the stability of the export weights.

The export weights of commodities for each country are given in Table 4.5. Because the composition of each country’s export is different from one country to another, each country’s export weights also differed between different countries. That is the reason why each country’s nominal commodity prices will be unique.

According to Bodart, Candelon and Carpantier (2012), in order to capture the link between exchange rate and commodity prices properly, the two variables exchange rate and commodity prices should be used in real terms. To obtain a real country-specific commodity prices index (RCOMP), Deaton and Miller (1995) deflate each country’s NCOMP by the manufacturers unit value (MUV). MUV is “an index of prices for manufactured exports from the major developed and emerging economies to low- and middle-income economies, valued in USD” (WorldBank). However, the data of MUV are only available on an annual basis while our NCOMP data are quarterly. Thus, we use the US consumer price index (CPI) (base 2000Q1=100) as deflator instead since its quarterly data can be collected from the IFS database. The use of US CPI as a commodity prices deflator is recommended by many studies such as Ghoshray (2011), Fernandez (2012) and Cuddington (2010).
The RCOMP of each individual country in the period 1986 – 2014 has been shown in Figure 4.1 to Figure 4.12.

c. $P_i$

$P_i$ is the international commodity prices index for commodity $i$. The international commodity prices are sourced from the IFS. From the international prices of commodity $i$, we calculate $P_i$ at time $t$ (base 2000Q1 = 100) as follows:

$$P_{it} = \frac{\text{Price of commodity } i \ (t)}{\text{Price of commodity } i \ (2000Q1)} \times 100$$  \hspace{1cm} (4.3)

It is worth noting that there are three kinds of oil prices, which are Dated Brent, Dubai Fateh and West Texas Intermediate. Oil prices used in our study are the average of these three kinds. Similarly, the coffee prices are the average prices of Robusta and Mild Arabica coffee.

In fact, while prices of most commodities are determined by commodity markets, in some countries commodity prices are controlled by home-country. For example, rice price in Malaysia is totally controlled by its government. However, the collection of data for a specific commodity in developing countries for a large span of time is impossible. Although international prices are able to capture the trend of commodity prices controlled by home-country to some extent, this replacement might lead to the bias of the nominal country-specific commodity prices index.

4.2.3 Exchange rate

As mentioned in 4.2.2, exchange rate is measured in real terms. Furthermore, we prefer using real effective exchange rate to using real bilateral exchange rate as real effective exchange rate can reflect the global competitiveness of a country compared with its trade partners. Moreover, using real effective exchange rate can help avoiding possible biases linked to the selection of base country in bilateral real exchange rate (Cashin, Céspedes & Sahay 2004).

Real effective exchange rate (REER) is “the weighted average of a country's currency relative to an index or basket of other major currencies adjusted for the effects of inflation. The weights are determined by comparing the relative trade balances, in terms of one country's currency, with each other country within the index” (Investopedia). In
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this thesis, we use REER based on consumer price index (CPI-based REER), which is an index normally used in the literature on real exchange rate’s determinants.

The data are sourced from the IMF’s Information Notice System database (Collins, Meyers & Bredahl 1980). According to Zanello and Desruelle (1997), the REER of country $i$ is given by:

$$\text{REER}_i = \frac{P_i R_i}{\prod_j (P_j R_j) W_{ij}}$$  \hspace{1cm} (4.4)

Where

- $j$ refers to country $i$’s trade partners;
- $W_{ij}$ is the trade weight of country $j$ to country $i$. The trade weight is reliant on the proportion of trade in manufacturing, non-oil primary commodities and tourism services. Specifically,

$$W_{ij} = a_{M_i} W_{ij}(M) + a_{P_i} W_{ij}(P) + a_{T_i} W_{ij}(T)$$  \hspace{1cm} (4.5)

where $W_{ij}(M)$, $W_{ij}(P)$, $W_{ij}(T)$ are trade weights of country $j$ to country $i$ in manufacturing, primary commodities and tourism services and $a_{M_i}$, $a_{P_i}$, $a_{T_i}$ are the shares of trade in the three sectors in country $i$’s total trade.
- $P_i$ and $P_j$ are CPI of countries $i$ and $j$
- $R_i$ and $R_j$ are the nominal exchange rates of countries $i$ and $j$’s currencies in terms of USD.

The CPI-based REER series are also normalized with the base period 2000Q1=100. The normalized REER of each individual country in the period 1986Q1 – 2014Q1 is show in Figure 4.1 to Figure 4.12.
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Figure 4.1 – REER and RCOMP in Australia

Figure 4.2 – REER and RCOMP in Canada
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Figure 4.3 – REER and RCOMP in Iceland

![Graph showing REER and RCOMP in Iceland from 1986 to 2014. The x-axis represents the years from 1986 to 2014, and the y-axis represents the REER and RCOMP values from 0 to 350. The base for 2000Q1 is set at 100.]

Figure 4.4 – REER and RCOMP in New Zealand

![Graph showing REER and RCOMP in New Zealand from 1986 to 2014. The x-axis represents the years from 1986 to 2014, and the y-axis represents the REER and RCOMP values from 0 to 200. The base for 2000Q1 is set at 100.]

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Figure 4.5 – REER and RCOMP in Norway

Figure 4.6 – REER and RCOMP in Greece
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Figure 4.7 – REER and RCOMP in Brunei

BRUNEI

Figure 4.8 – REER and RCOMP in Laos

LAOS
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Figure 4.9 – REER and RCOMP in Malaysia

![Graph showing REER and RCOMP in Malaysia from 1986 to 2014.]

Figure 4.10 – REER and RCOMP in Myanmar

![Graph showing REER and RCOMP in Myanmar from 1986 to 2014.]

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Figure 4.11 – REER and RCOMP in Thailand

Figure 4.12 – REER and RCOMP in Vietnam
4.2.4 Real interest rate

The real interest rate (RIR) is the rate of interest an investor expects to receive after allowing for inflation. RIR is still regarded as the growth rate of purchasing power derived from an investment.

To get the real interest rate, we take the nominal interest rate and subtract the anticipated inflation rate. However, because the anticipated inflation rate cannot be observed, we replace it by the inflation rate.

\[
RIR_t = i_t - \pi_t \quad (4.6)
\]

where \(i\) is the nominal interest rate and \(\pi\) is the inflation rate.

The data of the nominal interest rates \((i)\) are obtained from the IFS. Among the several categories of interest rates available in the IFS database, we choose three-month Deposit Rates because of data availability. Although the risk-free Treasury Bill Rates are the most widely used interest rate, they are not chosen as the data are not available for some countries in the period from 1986Q1 to 2014Q1.

The inflation rate \((\pi)\) is the growth rate of the Consumer Price Index (CPI). The formula for calculating the inflation rate is:

\[
\pi_t = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}} \quad (4.7)
\]

The quarterly data of CPI is sourced from the IFS database.

The two variables REER and RCOMP are employed with their natural logarithm form. For RIR, the logarithm form is only used if they are positive (their original forms are used otherwise). Using the logarithm transformation can be a good approach to reduce heteroskedasticity. Moreover, OLS regression assumes that the errors, as estimated by the residuals, are normally distributed. When they are positively skewed (long right tail), taking the logarithm is able to help solve this problem.
4.3 Methodology

In this thesis, we employ both time-series and panel-data techniques to investigate the relationship between REER and RCOMP. While the time-series technique helps provide insight into the relationship of individual countries, the panel-data technique enables us to achieve common findings about the relationship between REER and RCOMP for each group of developed and developing countries, which facilitate the comparison between the two groups. Moreover, panel-data technique can overcome limitations of time series technique. The combination of the two techniques is necessary for our comparison.

4.3.1 Time-series technique

A three-stage procedure was followed to examine the relationship between REER and RCOMP for each country.

4.3.1.1 Unit root tests

We first check whether the data series used in our model are stationary or not. There are several reasons why the stationary of data series is of great importance. Firstly, the use of non-stationary data can lead to spurious regressions. The phenomenon of spurious regression might occur when we make regression of a non-stationary variable on another non-stationary variable. The result looks good under standard measures (significant coefficient estimates and a high $R^2$) even though the two variables may be totally unrelated. Misspecification can also arise when only one of the two variables has a unit root. Secondly, as we will use either VAR model or VECM model to explore the relationship between exchange rate, commodity prices, and interest rate, all variables to be included in the VAR model or VEC model are required to be stationary in order to carry out joint significance tests on the lags of the variables. Finally, if both series contain unit roots but are cointegrated then the OLS estimation method is not appropriate. For these reasons, it is important to check for unit roots in the series before estimating a model. Augmented Dickey – Fuller (ADF) and Philips – Perron (PP) unit root tests were adopted for this analysis.
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a. Augmented Dickey – Fuller (ADF)

The Augmented Dickey – Fuller test (ADF) is a unit root test proposed for time series data. This test is an augmented version of the Dickey – Fuller test (Eviews 2013). The Dickey – Fuller test is only applicable if variables are correlated at order one.

The Dickey – Fuller test uses a simple AR(1) model:

\[ \Delta y_t = \alpha y_{t-1} + x_t \delta + v_t \] (4.8)

Dickey – Fuller test constructs a parametric autoregression for order 1. In the case when variables are correlated at higher order lags, the Dickey – Fuller test is not valid since the assumption of white noise disturbances is violated (Eviews 2013).

The ADF test uses a parametric autoregression for higher order by including p lagged difference terms to the regression. In this study, we specify the lag length (p) according to Akaike’s information criterion (AIC). The ADF test is carried out by estimating the following regression:

\[ \Delta y_t = \alpha y_{t-1} + x_t \delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \cdots + \beta_n \Delta y_{t-n} + v_t \] (4.9)

The null hypothesis: \( \alpha = 0 \)

The alternative hypothesis: \( \alpha < 0 \)

To test the hypothesis, the test statistic DF value is calculated:

\[ DF = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \] (4.10)

If the test statistic DF is less than the relevant critical value for the ADF test, the null hypothesis is rejected. It can be concluded that the variable has no unit root. And, vice versa, if the test statistic DF is larger than the relevant critical value, the null hypothesis cannot be rejected and the variable has a unit root. For more information about ADF unit root test, see Said and Dickey (1984).

b. Philips–Perron (PP)

The Phillips – Perron (PP) test is also based on the Dickey – Fuller test which tests the null hypothesis \( \alpha = 0 \) in Equation (4.8). Similar to the ADF unit root test, the PP test also solves the problem of low order of autocorrelation in Dickey – Fuller test (Eviews 2013).
While the ADF test addresses the problem by adding lags of first difference to the regression, the PP test modifies the t-test statistic of a coefficient in the Dickey–Fuller test so that serial correlation does not affect the asymptotic distribution of the test statistic. The modified t-test statistic of PP test:

$$
\tilde{t}_\alpha = t_\alpha \left( \frac{\gamma_0}{f_0} \right)^{\frac{1}{2}} - \frac{T(f_0 - \gamma_0)}{2 f_0^{1/2} s_e(\hat{\alpha})^{2/2}}
$$

(4.11)

$s_e(\hat{\alpha})$ is coefficient standard error, $s$ is the standard error of test regression, $\gamma_0$ is a consistent estimate of the error variance, and $f_0$ is an estimator of the residual spectrum at frequency zero (Eviews 2013). For more details about PP test see Phillips and Perron (1988).

### 4.3.1.2 Johansen (1988) cointegration test

It is widely known that nonstationary time-series should not be used in regression models to avoid the problem of spurious regression (Gujarati 2009). However, if variables are nonstationary but integrated of the same order and the linear combination of variables integrated of a lower order, their regression model is still meaningful. In this case, variables are cointegrated. In other words, variables are cointegrated if there is a long-run or equilibrium relationship between them (Gujarati 2009).

Based on the result of unit root tests, we conduct a Johansen (1988) cointegration test to check for cointegration between the two variables (REER an RCOMP) of the same integration order. This is the superior test for cointegration as it has all desirable statistical properties (Sjö 2008). The Johansen (1988) test approaches the testing for cointegration by examining the number of independent linear combinations ($k$) for an m time series variables set that yields a stationary process. The Johansen (1988) test has two forms: the trace test and the maximum eigenvalue test.

It is worth noticing that when using Eviews software to run a Johansen (1988) cointegration test, the lag length for Johansen (1988) cointegration testing is the lag length for VAR model between REER and RCOMP minus one.

#### a. Trace Test

The trace test examines the quantity of linear combinations $k$ to be equal to a given value $k_0$, and the alternative hypothesis for $k$ to be greater than $k_0$.  

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Null hypothesis $H_0: k = k_0$

Alternative hypothesis $H_1: k > k_0$

To test whether the cointegration exists using the trace test, we set $k_0 = 0$ (no cointegration) and examine whether the null hypothesis can be rejected. If this is the case, then we conclude there is at least one cointegration relationship.

**b. Maximum Eigenvalue Test**

For the maximum eigenvalue test, the difference is in an alternate hypothesis:

Null hypothesis $H_0: k = k_0$

Alternative hypothesis $H_1: k = k_0 + 1$

So, starting with $k_0 = 0$ and rejecting the null hypothesis implies that there is only one possible combination of the non-stationary variables to yield a stationary process. What if we have more than one? The test may be less powerful than the trace test for the same $k_0$ values. A special case for using the maximum eigenvalue test is when $k_0 = m - 1$, where rejecting the null hypothesis implies the existence of $m$ possible linear combinations. This is impossible, unless all input time series variables are stationary to start with.

**4.3.1.3 Cointegrating equation**

If there is evidence of cointegration between REER and RCOMP we estimate the long-run equilibrium relationship between them (Equation (4.12)) by using the OLS method.

$$REER_{it} = \alpha + \beta RCOMP_{it} + \varepsilon_{it} \quad (4.12)$$

The coefficient $\beta$ measures the long-run elasticity of REER with respect to RCOMP. It can be understood that a 1% increase in RCOMP is associated with $\beta \%$ change in REER.

**4.3.1.4 Granger causality**

Granger causality is a statistical concept which is based on prediction. The starting point of the Granger causality test is that the future cannot cause the past or present, whereas the past may cause the present or the future (Granger 1969). Granger causality between
two variables cannot be interpreted as a real causal relationship. If $X_t$ is said to Granger-cause $Y_t$, then past values of $X_t$ should contain information that helps predict $Y_t$ better and beyond the information contained in past values of $Y_t$ alone.

Granger causality was developed by Granger in 1969 and has been widely used in the literature on economics. Our thesis will investigate the Granger causality between REER and RCOMP in developing commodity-exporting countries and developed ones in order to identify the direction of Granger causality between REER and RCOMP.

To examine the Granger causality between REER and RCOMP, we use a three-step procedure. The first step is building a suitable model for the purpose of Granger causality testing, the second step is estimating the model, and the final step is testing the hypotheses to determine the existence as well as the direction of Granger causality between the two series in our model.

**a. Building model for Granger causality testing**

As mentioned in section 4.1, in order to get more precise results, we consider including a control variable, which is RIR, when investigating the Granger causality between REER and RCOMP.

As the direct Granger test only assumes two variables, in order to control for the effect of another variable, we can use either a VAR or VEC model instead. The selection is determined by the cointegration between REER and RCOMP.

- **REER and RCOMP are not cointegrated**

In case REER and RCOMP are not cointegrated, a vector autoregression (VAR) model is estimated to test for Granger causality between REER and RCOMP. In our thesis, we employ the Toda and Yamamoto (1995) augmented VAR model instead of the traditional VAR model. The reason is that in the Toda and Yamamoto (1995) augmented VAR model, all variables are used in level, regardless of their orders of integration. We must not take the difference of the variables even when variables are not stationary. Meanwhile, in a traditional VAR model, all variables are required to be stationary. In the case that there is any variable not stationary (i.e., I(1) or I(2)), we must differentiate that variable to make sure it is stationary in the VAR model. However,
using variables in difference makes the results become not intuitively interpretable. Moreover, the Granger causality between differenced variables is not what we expect.

Apart from REER and RCOMP, we also include the control variable RIR in the Toda and Yamamoto (1995) augmented VAR model when investigating the Granger causality between REER and RCOMP. The model is as follows:

\[
\begin{align*}
\text{REER}_t &= \alpha_1 + \sum_1^k \beta_{11k} \text{REER}_{t-k} + \sum_1^m \beta_{11(k+m)} \text{REER}_{t-(k+m)} + \sum_1^k \beta_{12k} \text{RIR}_{t-k} + \sum_1^k \beta_{11(k+m)} \text{RIR}_{t-(k+m)} + u_{1t} \\
\text{RCOMP}_t &= \alpha_2 + \sum_1^k \beta_{21k} \text{REER}_{t-k} + \sum_1^m \beta_{21(k+m)} \text{REER}_{t-(k+m)} + \sum_1^k \beta_{22k} \text{RCOMP}_{t-k} + \sum_1^m \beta_{22(k+m)} \text{RCOMP}_{t-(k+m)} + \sum_1^k \beta_{23k} \text{RIR}_{t-k} + u_{2t}
\end{align*}
\]

where \( i=1,2,...,N; \ t=1,2,...,T; \) \( \alpha \) is the intercepts; \( \beta \) is the parameters; \( k \) is the lag length; \( m \) is the maximum order of integration of REER and RCOMP; and \( u \) denotes white-noise error terms.

Lag length \( (k) \) is the number of lagged values of the series included in the model. It is critical to select a correct lag length for VAR. While too short a lag length fails to reflect the system’s dynamics and leads to omitted variable bias, too long a lag length suffers from a loss of degrees of freedom which results in over-parameterization (Gujarati 2009). Rather than randomly selecting a lag length, it is better to depend on selection criteria to decide the number of lags. In our model, we employ the most common criteria – Akaike Information Criterion (AIC) – to select the appropriate lag length \( k \).

Based on the result of ADF and PP unit root tests, we can determine the order of integration of each variable – REER and RCOMP. From the integration results, the maximum order of integration of the two variables \( (m) \) is specified. For example, if one is found to be integrated of order two (I(2)), and the other is integrated of order one I(1), than the maximum order of integration will be two \( (m=2) \).

It must be guaranteed that there is no serial correlation in the residuals of the VAR model. In case there is serial correlation, the lag length \( k \) should be increased until the serial correlation disappears.
- REER and RCOMP are cointegrated

According to Engle and Granger (1987), if there is cointegration between the two variables, then Granger causality must exist between them in at least one direction. Once we determine that REER and RCOMP are cointegrated, we perform a vector error correction model (VEC) to clarify the Granger causality direction. In the presence of cointegration between variables, although the Toda and Yamamoto (1995) augmented VAR model can be used to specify the Granger causality, a VEC model is believed to be superior to a VAR model. Specifically, a VAR model is only able to determine short-run Granger causality. Meanwhile, VEC model which is capable of identifying both short-run and long-run relationships among variables as well as determining the sources of causation\(^{36}\) (Oh & Lee 2004). In line with this finding, Asafu-Adjaye (2000) also claims that the a VEC model has created a long-run causality channel that is overlooked by the traditional Granger causality test (Granger 1969).

We also include the control variable RIR in the VEC model when investigating the Granger causality between REER and RCOMP. The following VEC model is considered:

\[
\Delta \text{REER}_t = \alpha_1 + \beta_{10} \text{ECT}_{1,t-1} + \sum_k \beta_{11k} \Delta \text{RCOMP}_{t-k} + \sum_k \beta_{12k} \Delta \text{REER}_{t-k} + \sum_k \beta_{13k} \Delta \text{RIR}_{t-k} + u_{1t}
\]  
\[
\Delta \text{RCOMP}_t = \alpha_2 + \beta_{20} \text{ECT}_{2,t-1} + \sum_k \beta_{21k} \Delta \text{REER}_{t-k} + \sum_k \beta_{22k} \Delta \text{RCOMP}_{t-k} + \sum_k \beta_{23k} \Delta \text{RIR}_{t-k} + u_{2t}
\]

where ECT is an error correction term. ECT\(_{1,t-1}\) is “the measure of the extent by which the observed values in time \(t-1\) deviate from the long-run equilibrium relationship” Costantini and Martini (2010). ECT\(_{1,t-1}\) and ECT\(_{2,t-1}\) are both stationary.

ECT\(_{1,t-1}\) is the first lagged value of the residuals derived from the cointegration regression of the two variables REER and RCOMP for which REER is a dependent variable (see Equation (4.17)). And, ECT\(_{2,t-1}\) is the first lagged value of the residuals from the cointegration regression of the two variables RCOMP and REER for which RCOMP is a dependent variable (see Equation (4.18)).

\(^{36}\) The term “Granger causality” always implies a short-term relationship (Gujarati 2009). The term “short-run Granger causality” is only used to easily distinguish “Granger causality” from “long-run Granger causality”.

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In order to obtain ECT_{1,t-1} and ECT_{2,t-1}, we prefer using an OLS to estimate Equations (4.17) and (4.18). The coefficients $\beta_{10}, \beta_{20}$ of the ECTs represent the deviation of the dependent variables from the long-run equilibrium.

### b. Estimating models

In order to estimate the Toda and Yamamoto (1995) augmented VAR model and VEC model, we use the ordinary least square (OLS) equation by equation.

### c. Checking for serial correlation

Before testing hypotheses to specify the Granger causality between variables, we should test for serial correlation of VAR or VEC model. According to Giles (2011), a serial correlation test should be a pre-test for Granger causality, while heteroskedasticity and normality testing are not really necessary.

In the presence of serial correlation, coefficients estimated by OLS are still unbiased but are inefficient, even at large sample sizes. As a result, the standard error will be wrong which in turn leads to incorrect Granger causality test results.

In order to test for serial correlation of our VAR and VECM models, we apply the Breusch – Godfrey Lagrange multiplier test (LM test). This is because a LM test is able to test for autocorrelation of any order and suitable for the models with lagged dependent variables.

To guarantee the reliability of a Granger test result, there should be no serial correlation in the VAR or VEC model. In case there is serial correlation in the model, lag length will be increased until the serial correlation disappears.

### d. Testing Granger causality

We determine the direction of Granger causality by testing for the significance of the dependent variables’ coefficients in the equations of the VAR or VEC model.
- **REER and RCOMP are not cointegrated**

In the case where there is no cointegration between REER and RCOMP, short-run causality between REER and RCOMP is investigated based on the estimation result of the Toda and Yamamoto (1995) augmented VAR model.

In order to detect whether there is Granger causality running from RCOMP and RIR to REER, we test the joint significance of the coefficients of $k$ lagged values of RCOMP ($\beta_{111}, \beta_{112}, ..., \beta_{11k}$) and RIR ($\beta_{131}, \beta_{132}, ..., \beta_{13k}$) in Equation (4.13). It is worth noting that the extra $m$ lags of RCOMP are not included when performing the test for joint significance of coefficients.

Similarly, to determine if there is Granger causality running from REER and RIR to RCOMP, we test the joint significance of the coefficients of $k$ lagged values of REER ($\beta_{211}, \beta_{212}, ..., \beta_{21k}$) and RIR ($\beta_{231}, \beta_{232}, ..., \beta_{23k}$) in Equation (4.14).

Specifically, to determine whether the causality runs from RCOMP to REER, we use a Wald test of the null hypothesis based on Equation (4.13) as follows:

$$
\text{Null hypothesis } H_0: \beta_{111} = \beta_{112} = \ldots = \beta_{11k} = 0 \text{ against } \\
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{11j} \neq 0 \text{ for } j = 1, 2, \ldots, k
$$

To determine whether the causality runs from RIR to REER, we use a Wald test to test the null hypothesis based on Equation (4.13) as follows:

$$
\text{Null hypothesis } H_0: \beta_{131} = \beta_{132} = \ldots = \beta_{13k} = 0 \text{ against } \\
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{13j} \neq 0 \text{ for } j = 1, 2, \ldots, k
$$

Similarly, to determine whether causality runs from REER to RCOMP, we test the null hypothesis for Equation (4.14) as follows:

$$
\text{Null hypothesis } H_0: \beta_{211} = \beta_{212} = \ldots = \beta_{21k} = 0 \text{ against } \\
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{21j} \neq 0 \text{ for } j = 1, 2, \ldots, k
$$

To determine whether causality runs from RIR to RCOMP, we test the null hypothesis for Equation (4.14) as follows:
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Null hypothesis $H_0$: $\beta_{231} = \beta_{232} = \ldots = \beta_{23k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{23j} \neq 0$ $j = 1, 2, \ldots, k$

If the null hypothesis is rejected, it can be concluded that there is Granger causality in that direction and vice versa. In other words, the rejection of the null hypothesis proves the presence of Granger causality.

- **REER and RCOMP are cointegrated**

In the case where the cointegration between REER and RCOMP is found, Granger causality between REER and RCOMP is investigated based on a VEC model. Accordingly, Granger causality is sub-divided into long-run and short-run Granger causality.

**Short-run Granger causality**

For a VEC model, the short-run causality between variables can be done in the same manner as in a VAR model. We also use a Wald test to test for the joint hypothesis of the first difference of $k$ lagged explanatory variables. Based on Equation (4.15), we test the following null hypothesis to check if there is any Granger causality running from RCOMP to REER:

Null hypothesis $H_0$: $\beta_{111} = \beta_{112} = \ldots = \beta_{11k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{11j} \neq 0$ $j = 1, 2, \ldots, k$

And, the following null hypothesis is tested based on Equation (4.15) to see if there is any Granger causality running from RIR to REER:

Null hypothesis $H_0$: $\beta_{131} = \beta_{132} = \ldots = \beta_{13k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{13j} \neq 0$ $j = 1, 2, \ldots, k$

Identically, to detect whether causality run from REER to RCOMP we test the null hypothesis based on Equation (4.16):

Null hypothesis $H_0$: $\beta_{211} = \beta_{212} = \ldots = \beta_{21k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{21j} \neq 0$ $j = 1, 2, \ldots, k$
And, testing the following null hypothesis based on Equation (4.16) is to determine if there is any Granger causality running from RIR to RCOMP:

Null hypothesis $H_0$: $\beta_{231} = \beta_{232} = \ldots = \beta_{23k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{23j} \neq 0$, $j = 1, 2, \ldots, k$

If the null hypothesis is rejected, it can be concluded that there is Granger causality in that direction and vice versa. In other words, the rejection of the null hypothesis proves the presence of Granger causality.

**Long-run Granger causality**

Long-run causality is determined by the coefficients of $\text{ECT}_{t-1}$ in the VEC model. If $\text{ECT}_{t-1}$’s coefficients are significant and have proper sign, it can be concluded that there is evidence of long-run causality from the explanatory variable to the dependent variable. Particularly, if $\beta_{10}$ in Equation (4.15) is statistically significant and negative ($\beta_{10} < 0$), there will be a long-run causality running from RCOMP to REER.

And, if $\beta_{20}$ in Equation (4.16) is significant and has an appropriate sign, there will be a long-run causality running from REER to RCOMP. The expected sign of $\beta_{20}$ depends on the sign of $\beta$ in Equation (4.12). Specifically, it is expected that the sign of $\beta_{20}$ can satisfy the requirement of $- \beta_{20} \beta < 0$ (Johansen 1995).

**4.3.2 Panel-data technique**

Apart from the time-series technique applied for individual countries, we also employ panel-data technique to examine the relationship for each group: six OECD and six ASEAN countries. The panel data set is one that provides observations over time for a sample of individuals (Hsiao 2003). In order to facilitate the comparison of the relationship between commodity prices and exchange rate between developed and developing countries, two panel data sets are built: one for the group of six OECD commodity-exporting countries and one for the group of six ASEAN commodity-exporting countries.

There are some reasons explaining the employment of panel-data technique in our thesis. The most important reason is that panel-data technique can be used effectively in achieving common findings about the commodity prices – exchange rate nexus for a
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whole group of countries. These common findings will enable us to compare the real commodity prices – real exchange rate relationship between the two groups of countries without any difficulties. The panel-data technique will become especially useful for comparison when the result of the time series tests show the differences in relationship from country to country.

In addition, the panel-data technique is also superior to time-series technique in some aspects. First, panel data gives considerably more informative data, variability, degree of freedom, and less collinearity among variables compared to cross-sectional data and time-series data because panel data is the combination of both kinds of data (Gujarati 2009). Second, by using panel-data technique we can avoid problems of low power associated with the time-series tests, especially the traditional cointegration test and unit root test. With a great increase in the number of observations, the panel cointegration test has a higher power compared to the traditional one (Rapach & Wohar 2004). The traditional unit root tests are said to be notorious for their low power (see Cochrane (1991), DeJong et al. (1992), Maddala and Kim (1998)). Hatanaka (1996) also points out that with sample size 100, characteristic roots between 0.9 and 1.0 cannot be distinguished from a unit root.

On the whole, using panel data helps facilitate the comparison between developing countries and developed countries, which is the main aim of our thesis. Moreover, panel-data techniques can overcome the limitations of time-series technique. Therefore, a combination of time-series technique and the panel-data technique can help provide a reliable and comprehensive insight into the relationship between real commodity prices and real exchange rate in both developed and developing countries which forms a firm foundation for comparison.

When applying panel-data technique, the testing process is similar to that of time-series technique. First, we use a panel data unit root tests to check the stationarity of variables in each group of countries. If the REER and RCOMP are integrated of same order, we run the panel cointegration test to see if there is long-run relationship between the two variables in each group of countries and estimate the long-run commodity price elasticity of real exchange rate. Finally, we test for the Granger causality between REER and RCOMP based on panel Toda and Yamamoto (1995) augmented VAR or VEC model.
4.3.2.1 Panel unit root tests

Panel unit root tests are believed to be more powerful than traditional unit root tests on individual time series (Rapach & Wohar 2004). Since Levin and Lin (1992) unit root tests, there have been many various panel data unit root tests proposed. However, the most popular panel unit tests in practice are Levin, Lin and Chu (2002), Breitung (2000), Hadri (2000), Maddala and Wu (1999), Im, Pesaran and Shin (2003), and Choi (2001).

The general structure used by most (though not all) panel unit root testing procedures is:

\[ \Delta y_{it} = \alpha_i y_{i,t-1} + \sum_{j=1}^{P_i} \Delta y_{it-j} + X'_{it} \delta + \epsilon_{it} \] (4.19)

where

- \( P_i \) is the lag length for the difference terms, which varies across individuals
- \( X_{it} \) represent the exogenous variables in the model
- \( \epsilon_{it} \) refers to the error terms
- If \( \alpha_i < 0 \), \( y_i \) is weakly stationary. On the other hand, if \( \alpha_i = 0 \) then \( y_i \) contains a unit root.

Among the six panel unit root tests mentioned above, there are two natural assumptions about the \( \alpha \) used. While Levin, Lin and Chu (2002) (LLC), Breitung (2000), and Hadri (2000) panel unit root tests all assume that the parameters are the same across cross-sections so that \( \alpha_i = \alpha \) for all \( i \), Im, Pesaran and Shin (2003), Maddala and Wu (1999) and Choi (2001) allow \( \alpha_i \) to vary freely across cross-sections.

In our thesis, we only use heterogeneous panel unit root tests which allow for the slope heterogeneity as those of Im, Pesaran and Shin (2003), Maddala and Wu (1999) and Choi (2001). These heterogeneous panel unit root tests are the most suitable for our study because heterogeneity could stem from different economic conditions of individual countries.

**a. Im, Pesaran and Shin (2003) test**

The Im, Pesaran and Shin (2003) panel unit root test starts by estimating an augmented Dickey-Fuller (ADF) regression for each cross-section:
\[ \Delta y_{it} = \alpha_i y_{i,t-1} + \sum_{j=1}^{p_i} \Delta y_{it-j} + X'_{it}\delta + \epsilon_{it} \] (4.20)

Null hypothesis: \( H_0: \alpha_i = 0 \) for all \( i \)

Alternative hypothesis: \( H_1: \alpha_i = 0 \) for \( i = 1, 2, 3, \ldots, N \)

\[ \alpha_i < 0 \] for \( i = N_1, N_2, \ldots, N \)

After estimating the regression (4.18), the average of the t-statistics is calculated as follows:

\[ \bar{t}_{N,T} = \frac{1}{N} \sum_{i=1}^{N} t_{i,T} \]

\[ \sqrt{N} \frac{\bar{t}_{N,T} - \mu}{\sigma} \sim \mathcal{N}(0,1) \]

where \( E(t_{i,T}) = \mu \) and \( V(t_{i,T}) = \sigma^2 \)

The test assumes that \( T \) is the same for all cross-section units. Therefore, the Im, Pesaran and Shin (2003) test is only applied for balanced panel data.

**b. Maddala and Wu (1999) test**

Maddala and Wu (1999) panel unit root test uses the Fisher (\( p_\lambda \)) test which is based on gathering the p-values of the test-statistic for a unit root in each cross-section.

Similar to the Im, Pesaran and Shin (2003) test, the null and alternative hypotheses are as follows:

Null hypothesis: \( H_0: \alpha_i = 0 \) for all \( i \)

Alternative hypothesis: \( H_1: \alpha_i = 0 \) for \( i = 1, 2, 3, \ldots, N \)

\[ \alpha_i < 0 \] for \( i = N_1, N_2, \ldots, N \)

Under the null hypothesis of unit root for all cross-sections, we have the asymptotic result that:

\[ p_\lambda = -2 \sum_{i=1}^{N} \log e \pi_i \sim \chi^2_{2N}. \]

where \( \pi_i \) is the p-value from unit root test for each cross-section, which is derived from
the distribution of ADF t-statistics by Monte-Carlo simulation,

After the Fisher-test statistics are computed, we compare the Fisher-test statistics with the appropriate χ² critical value.

One advantage of the Maddala and Wu (1999) test is that it can be applied to an unbalanced panel. However, the shortcoming of the Maddala and Wu (1999) test is that the p-values for each cross-section have to be obtained by Monte-Carlo simulation. However, with the support of available computer software, the application of Maddala and Wu (1999) test is no longer a problem.

c. Choi (2001) test


$$Z = -\frac{1}{\sqrt{N}} \sum_{i=1}^{N} (\ln \pi_i + 1)$$

Assuming that the p-value of a unit root test for cross-section i is independent and identically distributed, and using the Lindeberg – Levy central limit theorem gives the null hypothesis $Z \sim N (0, 1)$ as $T_i \to \infty$ followed by $N \to \infty$.

The adoption of the three heterogeneous panel unit root tests mentioned in this section can overcome the deviation created by any single method. All three panel unit root tests are applied in both panel data sets – OECD and ASEAN commodity-exporting countries in order to test for the stationary of the three variables REER, RCOMP and RIR. Specifically, through the panel unit root test results, we can determine if these variables are stationary or integrated of order one (I(1)) or integrated of order two (I(2)).

4.3.2.2 Panel cointegration test

According to Granger (1981), it is believed that if the variables become stationary after being first-differenced (or integrated of order one I(1)), it is evidence that they are possibly cointegrated. Therefore, if the results from panel unit root tests imply that variables are I(1), what should be done next is to use panel cointegration tests to check if there exists a long-run relationship among the variables. A cointegration test can be considered as a “pre-test to avoid spurious regression” (Gujarati 2009).
Among existing panel cointegration tests, the most widely used ones are Kao (1999) and Pedroni (1999) tests. In our thesis, to determine whether a cointegrating relationship exists between REER and RCOMP, we employ the Pedroni (1999) test as it allows for heterogeneous intercepts and trend coefficients across cross-sections.

A Pedroni (1999) panel cointegration test is based on a unit root in the residuals of the cointegrating regression. If the residuals are I(0), it can be concluded that the variables are cointegrated. On the other hand, if the residuals are I(1), the variables are not cointegrated.

In a Pedroni (1999) panel unit root test, the cointegrating regression is first estimated independently for each cross-section. Then, the residuals obtained from the regression are pooled in order to conduct the panel tests.

First, the following cointegrating regression is estimated for each cross-section:

\[ Y_{it} = \alpha_i + \delta_i t + \beta_{1i}x_{1i,t} + \beta_{2i}x_{2i,t} + \cdots + \beta_{Mi}x_{Mi,t} + \epsilon_{it} \quad (4.21) \]

Assuming that \( y \) and \( x_{1i}, \ldots, x_{Mi} \) are I(1). The parameters \( \alpha_i \) are individual effects and \( \delta_i \) are trend effects.

The null hypothesis is no cointegration among variables or the residuals of the cointegrating regression is I(1). To test for the null hypothesis, we test whether the residuals obtained from (4.21) are I(1) by estimating the secondary regression for each cross-section.

\[ \epsilon_{it} = \gamma_i \epsilon_{it-1} + \sum_{j=1}^{p_i} \theta_{ij} \Delta \epsilon_{it-j} + \nu_{it} \quad (4.22) \]

Now, the null hypothesis of no cointegration becomes \( \gamma_i = 1 \). In the (Pedroni 1999) panel unit root test, there are two types of alternative hypotheses. They are homogenous alternative and heterogeneous alternative. Specifically, there are four within-dimension tests using homogenous alternative, \( (\gamma_i = \gamma < 1 \text{ for all } i) \) which are panel \( v \)-statistic, panel \( r \)-statistic, panel PP-statistic, and the panel ADF-statistic. In addition, there are three between-dimension tests using heterogeneous alternative, \( (\gamma_i < 1 \text{ for all } i) \) which are the group \( r \)-statistic, group PP-statistics, and the group ADF-statistic. For the seven test statistics, if the computed test statistics are smaller than the critical value, we reject the null hypothesis of absence of cointegration and vice versa. If the majority of the test
statistics cannot reject the null hypothesis of no cointegration, it can be concluded that there is no cointegration among variables.

4.3.2.3 Panel cointegrating equation

If there is evidence of cointegration between REER and RCOMP, we estimate the long-run equilibrium relationship between them. The panel cointegration equation is as follows:

\[ \text{REER}_{it} = \alpha + \beta \text{RCOMP}_{it} + \epsilon_{it} \] (4.23)

The coefficient \( \beta \) measures the long-run elasticity of REER with respect to RCOMP.

For panel framework, the most frequently used estimators of a long-run relationship are FMOLS and DOLS. It is commonly known that utilizing OLS to estimate cointegrated panels will lead to a biased and inconsistent estimator. Although bias-corrected OLS can be employed to reduce the bias, it cannot perform better than the OLS estimator in general.

In this thesis, we employ DOLS to estimate the long-run relationship between REER and RCOMP for each group of countries. This estimator enables us to correct bias created by endogeneity and serial correlation, which is the main problem of OLS estimators. Besides, it is worth noting that DOLS cannot perform sufficiently well if the number of time periods is smaller than 20 (Pedroni 2001). As in our case, each panel data set covers 113 time periods (quarters); DOLS is therefore suitable estimator.

For a DOLS estimator, Pedroni (2001) also claims that the group-mean estimator has smaller size distortions than the pooled panel estimator. Because of that, the group-mean DOLS estimator is used instead of the pooled panel one. For a detailed description of the group-mean DOLS, see Pedroni (2001).

4.3.2.4 Granger causality

a. Building models

- **REER and RCOMP are not cointegrated**

In the case that REER and RCOMP are not cointegrated, the panel Toda and Yamamoto (1995) augmented VAR model is estimated to test for Granger causality between REER
and RCOMP.

\[
\text{REER}_{it} = \alpha_{1i} + \sum_{k} \beta_{11k}\text{RCOMP}_{it-k} + \sum_{k} \beta_{11(k+m)}\text{REER}_{it-(k+m)} + \sum_{k} \beta_{12k}\text{REER}_{it-k} + \sum_{k} \beta_{13k}\text{RIR}_{it-k} + u_{1it}
\]

(4.24)

\[
\text{RCOMP}_{it} = \alpha_{2i} + \sum_{k} \beta_{21k}\text{REER}_{it-k} + \sum_{k} \beta_{21(k+m)}\text{REER}_{it-(k+m)} + \sum_{k} \beta_{22k}\text{RCOMP}_{it-k} + \sum_{k} \beta_{23k}\text{RIR}_{it-k} + u_{2it}
\]

(4.25)

where \(i = 1, 2, \ldots N; \ t = 1, 2, \ldots T; \) \(\alpha\) represents cross-section specific unit dummies; \(\beta\) is the parameters to be estimated; \(u\) denotes white-noise error terms; \(k\) is the lag length.

Based on the result of Im, Pesaran and Shin (2003), Maddala and Wu (1999) and Choi (2001) panel unit root tests, we can specify the order of integration of each variable – REER and RCOMP. Based on the order of integration, the maximum order of integration of the two variables \((m)\) is specified.

We also employ Akaike Information Criterion (AIC) to select the appropriate lag length \((k)\). And, the selected lag length must guarantee that there is no serial correlation in the residuals of panel VAR model. In case there is serial correlation, the lag length \(k\) should be increased until the serial correlation disappears.

One issue we have to concern is that whether time dummies should be included in our panel VAR model. For panel data set with large \(N\) and small \(T\), time dummies should be included because only a small number of dummies have to be added to the model. However, in our case, the time dimension \(T\) is large \((T=113)\), adding time dummies would involve a considerable loss in efficiency. Consequently, we only include cross-section specific unit dummies in our panel VAR model.

**- REER and RCOMP are cointegrated**

When REER and RCOMP are cointegrated, the following panel VEC model which is appropriate for heterogeneous panels, is considered:

\[
\Delta\text{REER}_{it} = \alpha_{1i} + \beta_{10}\text{ECT}_{it-1} + \sum_{k} \beta_{11k}\Delta\text{RCOMP}_{it-k} + \sum_{k} \beta_{12k}\Delta\text{REER}_{it-k} + \sum_{k} \beta_{13k}\Delta\text{RIR}_{it-k} + u_{1it}
\]

(4.26)

\[
\Delta\text{RCOMP}_{it} = \alpha_{2i} + \beta_{20}\text{ECT}_{it-1} + \sum_{k} \beta_{21k}\Delta\text{REER}_{it-k} + \sum_{k} \beta_{22k}\Delta\text{RCOMP}_{it-k} + \sum_{k} \beta_{23k}\Delta\text{RIR}_{it-k} + u_{2it}
\]

(4.27)

where \(\text{ECT}_{t-1}\) is “the measure of the extent by which the observed values in time t-1 deviate from the long-run equilibrium relationship”
(Costantini & Martini 2010). ECT_{1i,t-1} and ECT_{2i,t-1} are both stationary.

ECT_{1i,t-1} are the first lagged values of the residuals derived from the cointegration regression of the two variables REER and RCOMP for which REER is a dependent variable (see Equation (4.28)) and ECT_{2i,t-1} are the first lagged values of the residuals from the cointegration regression of the two variables RCOMP and REER for which RCOMP is a dependent variable (see Equation (4.29)).

\[
\text{REER}_{it} = \gamma_{1i} + \delta_1 \text{RCOMP}_{it} + \varepsilon_{1it} \quad (4.28)
\]

\[
\text{RCOMP}_{it} = \gamma_{2i} + \delta_2 \text{REER}_{it} + \varepsilon_{2it} \quad (4.29)
\]

As mentioned in Section 4.3.2.3, FMOLS and DOLS are the two common estimators used for cointegrating equations. In order to obtain ECT_{1i,t-1} and ECT_{2i,t-1}, we prefer using DOLS to estimate Equations (4.28) and (4.29). The DOLS estimator is chosen as it performs better than non-parametric FMOLS estimator. A DOLS estimator is believed to be superior to other estimators including both single equation estimators and system estimators (Wagner & Hlouskova 2009). Additionally, Harris and Sollis (2003) also claim that “non-parametric approaches such as FMOLS are less robust if the data have significant outliers and have problems in cases where the residuals have large negative moving average components.” These cases are quite common in macroeconomic series data. The coefficients \( \beta_{10} \), \( \beta_{20} \) of the ECTs represent the deviation of the dependent variables from the long-run equilibrium.

**b. Estimating models**

In order to estimate panel VAR or VEC models, there has been a wide range of estimation methods. One of the most popular methods is the generalized method of moments (GMM). Since the PVAR program, which supports effectively the estimation of panel VAR models by GMM, was written by Love and Zicchino (2006), GMM has been used more commonly. However, GMM is not chosen for estimating panel VAR or VEC models in our thesis because of the following reasons. The first reason is that the GMM technique have been designed for the case of a large cross-sectional dimension (N) relative to the time dimension (T) (Juessen & Linnemann 2010). Otherwise, the estimation result would be severely biased and imprecise (Bruno 2005a). Since in our thesis, each panel data set has a small N (six countries) relative to T (113 quarter periods from 1986Q1 to 2014Q1), a GMM estimator appears less suitable.
Secondly, although GMM performs reasonably well in terms of bias, it performs poorly in terms of root mean square error and tends to produce estimates with a large variance (Juessen & Linnemann 2010). Especially, “if the instruments used in the instrumental variables or GMM estimation are only weakly correlated with the instrumental variables, this would in turn give rise to biased coefficient estimates and hypothesis tests with large size distortions” (Stock & Yogo 2005).

For panels that are characterized by a relatively large $T$ but a small $N$ as typically encountered in macroeconomic applications, Juessen and Linnemann (2010) conclude that bias-corrected fixed effects or bias-corrected least square dummy variables (LSDVC) is the estimator of choice for estimating a panel VAR model. However, while LSDVC might produce superior results, it is not always practical to implement (Judson & Owen 1999). Most studies on LSDVC – such as Kiviet (1995), Kiviet (1999), Bun and Kiviet (2001), Bun and Kiviet (2003), and Bruno (2005a)–served the purpose of estimating a single dynamic panel data model. Especially, Bruno (2005b) has released a Stata program, xtlsdvc, that computes LSDVC estimators and their bootstrap variance covariance matrix for dynamic unbalanced panel data models based on the formulas stated by Bruno (2005a). However, an important limitation of these estimators is that they require all regressors to be strictly exogenous. A variable is called strictly exogenous in a particular equation if it is not related to past, current, and future errors in that equation. Therefore, these LSDVC versions should not be applied in our panel VAR or VEC model to test where both REER and RCOMP are treated as endogenous.

There is only one LSDVC estimator, developed by Hahn and Kuersteiner (2002) that can be used in estimating a panel VAR model when both $N$ and $T$ are large. However, because of the problems associated with the practical implementation of this approach, they are almost never used in empirical applications.

In this thesis, we decided to use the least square dummy variable (LSDV) estimator to estimate panel VAR or VEC. Although the LSDV is well known for yielding biased and inconsistent estimations in panel data models, it is finally chosen for several reasons. First, according to Nickell (1981) and Bun and Kiviet (2006), the size of the fixed-effects bias is dependent negatively on the time dimension ($N$) of the panel data sate. As in our thesis, we consider two panel data sets with a large number of observations per cross-section unit ($N=113$). Therefore, in our application, bias is not a problem.
addition, Judson and Owen (1999) compare the performance of the LSDV with the GMM regarding bias and root-mean-squared error of the coefficient estimates. According to the finding, even for a modest time dimension of 30 (N = 30), the LSDV also outperforms the GMM. Accordingly, with N = 113, the LSDV provides a more precise estimation in comparison with what is generated by the GMM. Moreover, the LSDV yields a relatively small variance compared to GMM (Bun & Kiviet 2001). Because of the above-mentioned strengths, the LSDV estimator is the most widely applied estimator in the macroeconomic panel VAR literature (Juessen & Linnemann 2010).

Following the LSDV estimator, we define a set of dummy variables $D_i$, where $D_i$ is equal to one in the case of an observation relating to individual $i$ and zero otherwise. With cross-sectional data, one would define a dummy variable for every observation, exhausting the degrees of freedom. After defining a set of dummy variables in each equation panel VAR or VEC model, we can use OLS to estimate the model effectively.

c. Checking for serial correlation

Serial correlation is not normally observed in time series data but is in panel data. Therefore, before testing hypotheses to specify the Granger causality between variables, we should test for serial correlation of panel Toda and Yamamoto (1995) augmented VAR or panel VEC model.

Similar to time series data, in order to test for serial correlation of our panel VAR or VEC model, we also apply the Breusch – Godfrey Lagrange Multiplier test (LM test). To guarantee the reliability of the Granger test result, there should be no serial correlation in these models. In case there is serial correlation in the model, lag length will be increased until the serial correlation disappears.

d. Testing Granger causality

We determine the direction of Granger causality by testing for the significance of the dependent variables’ coefficients in the equations of panel augmented VAR or VEC model.
- **REER and RCOMP are not cointegrated**

In the case where there is no cointegration between REER and RCOMP, short-run causality between REER and RCOMP is investigated based on the estimation result of the panel Toda and Yamamoto (1995) augmented VAR model.

Similar to a time-series technique, to determine whether the causality runs from RCOMP to REER, we use a Wald test to test the null hypothesis based on Equation (4.24) as follows:

\[
\text{Null hypothesis } H_0: \beta_{111} = \beta_{112} = \cdots = \beta_{11k} = 0 \text{ against }
\]

\[
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{11j} \neq 0 \text{ for } j = 1, 2, \ldots, k
\]

To determine whether the causality runs from RIR to REER, we use a Wald test to test the null hypothesis based on Equation (4.24) as follows:

\[
\text{Null hypothesis } H_0: \beta_{131} = \beta_{132} = \cdots = \beta_{13k} = 0 \text{ against }
\]

\[
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{13j} \neq 0 \text{ for } j = 1, 2, \ldots, k
\]

Similarly, to figure out whether causality runs from REER to RCOMP, we test the null hypothesis based on Equation (4.25) as follows:

\[
\text{Null hypothesis } H_0: \beta_{211} = \beta_{212} = \cdots = \beta_{21k} = 0 \text{ against }
\]

\[
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{21j} \neq 0 \text{ for } j = 1, 2, \ldots, k
\]

To determine whether causality runs from RIR to RCOMP, we test the null hypothesis based on Equation (4.25) as follows:

\[
\text{Null hypothesis } H_0: \beta_{231} = \beta_{232} = \cdots = \beta_{23k} = 0 \text{ against }
\]

\[
\text{Alternative hypothesis } H_1: \text{At least one } \beta_{23j} \neq 0 \text{ for } j = 1, 2, \ldots, k
\]

If the null hypothesis is rejected, it can be concluded that there is Granger causality in that direction and vice versa. In other words, the rejection of the null hypothesis proves the presence of Granger causality.
- **REER and RCOMP are cointegrated**

In the case where the cointegration between REER and RCOMP is found, short-run and long-run Granger causality between REER and RCOMP is investigated based on panel VEC model.

**Short-run Granger causality**

We also use a Wald test to test the joint hypothesis of the first difference of k lagged explanatory variables in the panel VEC model. Based on Equation (4.26), we test the following null hypothesis to check if there is any Granger causality running from RCOMP to REER:

Null hypothesis $H_0: \beta_{111} = \beta_{112} = \ldots = \beta_{11k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{11j} \neq 0$ \( j = 1, 2, \ldots, k \)

And, the following null hypothesis is tested based on Equation (4.26) to see if there is any Granger causality running from RIR to REER:

Null hypothesis $H_0: \beta_{131} = \beta_{132} = \ldots = \beta_{13k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{13j} \neq 0$ \( j = 1, 2, \ldots, k \)

Identically, to detect whether causality run from REER to RCOMP, we test the null hypothesis based on the Equation (4.27):

Null hypothesis $H_0: \beta_{211} = \beta_{212} = \ldots = \beta_{21k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{21j} \neq 0$ \( j = 1, 2, \ldots, k \)

And, testing the following null hypothesis based on Equation (4.27) to determine if there is any Granger causality run from RIR to RCOMP:

Null hypothesis $H_0: \beta_{231} = \beta_{232} = \ldots = \beta_{23k} = 0$ against

Alternative hypothesis $H_1$: At least one $\beta_{23j} \neq 0$ \( j = 1, 2, \ldots, k \)

If the null hypothesis is rejected, it can be concluded that there is Granger causality in that direction and vice versa.
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Long-run Granger causality

Long-run causality is determined by the coefficients of ECT_{t-1} in the VEC model. If ECT_{t-1}’s coefficients are significant and have proper sign, it can be concluded that there is evidence of long-run causality from the explanatory variable to the dependent variable.

Particularly, if $\beta_{10}$ in Equation (4.26) is statistically significant and negative ($\beta_{10} < 0$), there will be a long-run causality running from RCOMP to REER.

And, if $\beta_{20}$ in Equation (4.27) is significant and has an appropriate sign, there will be a long-run causality running from REER to RCOMP. The expected sign of $\beta_{20}$ depends on the sign of $\beta$ in Equation (4.23). Specifically, it is expected that the sign of $\beta_{20}$ can satisfy the requirement of $-\beta_{20} \cdot \beta < 0$ (Johansen 1995).

4.4 Summary

This chapter discusses the method of obtaining data for the three variables REER, RCOMP, and RIR. Based on the collected data from 1986Q1 to 2014Q1, the chapter also presents necessary steps to investigate the relationship between real effective exchange rate and real commodity prices in developed and developing countries. In our thesis, both time-series and panel-data techniques are employed. For each country, ADF and PP unit root tests are applied to test the stationarity of variables. A Johansen (1988) cointegration test is then used to test for long-run relationship as well as determine cointegrating equations between REER and RCOMP in individual countries. Finally, the Granger causality between exchange rate and commodity prices is examined based on Toda and Yamamoto (1995) augmented VAR or VEC model.

For each group of countries, panel data unit root tests consisting of Im, Pesaran and Shin (2003), Maddala and Wu (1999) and Choi (2001) techniques are used to test whether the variables are stationary or not. The Pedroni (1999) panel cointegration test is chosen in order to clarify the existence of long-run relationship between REER and RCOMP in each group of countries. If there is a long-run relationship between variables, the long-run commodity price elasticity of real exchange rate is estimated by DOLS. Granger causality is tested using a panel Toda and Yamamoto (1995)
Chapter 4 – Research Methodology

augmented VAR or VEC model. The result of these tests will be analysed in detail in the next chapter.
Chapter 5

Results and Discussion

This chapter presents results of tests listed in Chapter 4, including unit root tests, cointegration tests, and Granger causality. Furthermore, long-run elasticity of real exchange rate with respect to real commodity prices will be examined if real exchange rate and commodity prices are cointegrated. Based on tests results analysis, the two main research questions outlined in Section 1.2 will be clarified.

5.1 Test results

As mentioned in Section 4.3, the relationship between exchange rate and commodity prices in OECD and ASEAN are investigated by both time-series and panel-data techniques. The time-series technique is applied for individual countries and panel-data technique is used for each group of countries.

5.1.1 Individual countries

The results of unit root tests, Johansen (1988) cointegration test and Granger causality tests for individual countries are as follows.

5.1.1.1 Unit root tests

We apply both augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests with trend and without trend to check the stationarity of the three variables REER,
### Table 5.1 – Unit root tests for REER, RCOMP and RIR – individual OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Variables</th>
<th>Level/First difference</th>
<th>ADF Test Statistic</th>
<th>PP Test Statistic</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without trend</td>
<td>With trend</td>
<td>Without trend</td>
</tr>
<tr>
<td>Australia</td>
<td>REER</td>
<td>Level</td>
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<td>-1.67 (1)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>First difference</td>
<td>-7.33 (0)*</td>
<td>-7.35 (0)*</td>
<td>-7.12 (5)*</td>
</tr>
<tr>
<td>Canada</td>
<td>REER</td>
<td>Level</td>
<td>-1.31 (2)</td>
<td>-1.32 (2)</td>
<td>-1.49 (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First difference</td>
<td>-7.97 (1)*</td>
<td>-7.94 (1)*</td>
<td>-8.34 (3)*</td>
</tr>
<tr>
<td>Iceland</td>
<td>REER</td>
<td>Level</td>
<td>-1.72 (0)</td>
<td>-1.72 (0)*</td>
<td>-2.00 (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First difference</td>
<td>-10.72 (0)*</td>
<td>-10.67 (0)*</td>
<td>-10.79 (3)*</td>
</tr>
<tr>
<td></td>
<td>RCOMP</td>
<td>Level</td>
<td>-1.99 (2)</td>
<td>-1.21 (2)</td>
<td>-2.10 (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First difference</td>
<td>-10.30 (1)*</td>
<td>-10.50 (1)*</td>
<td>-12.04 (0)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level</td>
<td>-4.02 (8)*</td>
<td>-4.04 (8)*</td>
<td>-2.08 (18)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First difference</td>
<td>-8.64 (2)*</td>
<td>-8.76 (2)*</td>
<td>-11.22 (27)*</td>
</tr>
</tbody>
</table>
### Chapter 5 – Results and discussion

<table>
<thead>
<tr>
<th>Country</th>
<th>Variables</th>
<th>Level/ First difference</th>
<th>ADF Test Statistic</th>
<th>PP Test Statistic</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td>Without trend</td>
<td>With trend</td>
<td>Without trend</td>
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<td>Without trend</td>
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<td>New Zealand</td>
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<td>-2.04 (4)</td>
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<td>Level</td>
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<td></td>
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<td>-6.92 (9)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level</td>
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<td>-5.50 (0)*</td>
<td>-3.23 (6)*</td>
</tr>
<tr>
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<td>First difference</td>
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<td>-15.73 (0)*</td>
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<td>Norway</td>
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<td>Level</td>
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<td>-3.23 (0)</td>
<td>-3.18 (4)*</td>
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<td></td>
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<td>-13.19 (13)*</td>
</tr>
<tr>
<td></td>
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<td>-1.42 (0)</td>
<td>-2.73 (0)</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>-9.95 (1)*</td>
<td>-10.97 (3)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level</td>
<td>-1.32 (3)</td>
<td>-4.80 (0)*</td>
<td>-1.57 (6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>First difference</td>
<td>-9.81 (2)*</td>
<td>-9.79 (2)*</td>
<td>-16.78 (3)*</td>
</tr>
<tr>
<td>Greece</td>
<td>REER</td>
<td>Level</td>
<td>-2.29 (0)</td>
<td>-2.19 (0)</td>
<td>-2.29 (0)</td>
</tr>
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<td></td>
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<td>-11.11 (0)*</td>
<td>-11.00 (1)*</td>
</tr>
<tr>
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<td>RCOMP</td>
<td>Level</td>
<td>-2.36 (1)</td>
<td>-2.60 (1)</td>
<td>-2.20 (3)</td>
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<tr>
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<td></td>
<td>First difference</td>
<td>-8.50 (0)*</td>
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<td>-8.34 (6)*</td>
</tr>
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<td>Level</td>
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<td>-1.63 (7)</td>
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<tr>
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<td></td>
<td>First difference</td>
<td>-4.45 (6)*</td>
<td>-4.42 (6)*</td>
<td>-32.80 (7)*</td>
</tr>
</tbody>
</table>

Note: - Lag length is in parenthesis, which is chosen following Akaike Info Criterion.
- * denotes that the null hypothesis of unit root is rejected at 5% significance level or series is stationary.
Table 5.2 – Unit root tests for REER, RCOMP and RIR – individual ASEAN countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Variables</th>
<th>Level/First difference</th>
<th>ADF Test Statistic</th>
<th>PP Test Statistic</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without trend</td>
<td>With trend</td>
<td>Without trend</td>
</tr>
<tr>
<td>Brunei</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-0.38 (0)</td>
<td>-2.64 (4)</td>
<td>-0.71 (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-3.47 (2)*</td>
<td>-3.46 (2)*</td>
<td>-9.53 (5)*</td>
</tr>
<tr>
<td></td>
<td>RCOMP</td>
<td>Level 1st difference</td>
<td>-1.40 (0)</td>
<td>-2.81 (0)</td>
<td>-1.40 (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-9.89 (1)*</td>
<td>-9.88 (1)*</td>
<td>-10.99 (3)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level 1st difference</td>
<td>-4.30 (4)*</td>
<td>-4.36 (4)*</td>
<td>-6.27 (1)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-4.11 (3)*</td>
<td>-4.07 (3)*</td>
<td>-29.09 (58)*</td>
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<tr>
<td>Laos</td>
<td>REER</td>
<td>Level 1st difference</td>
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<td>-1.13 (2)</td>
</tr>
<tr>
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<td>-11.44 (0)*</td>
<td>-8.93 (1)*</td>
<td>-12.25 (4)*</td>
</tr>
<tr>
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<td>-2.27 (2)</td>
</tr>
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<td></td>
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<td>-9.65 (0)*</td>
<td>9.62 (0)*</td>
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</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level 1st difference</td>
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<td>-4.17 (4)*</td>
<td>-5.32 (7)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-5.7 (3)*</td>
<td>-5.67 (3)*</td>
<td>-14.15 (6)*</td>
</tr>
<tr>
<td>Malaysia</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-2.57 (0)</td>
<td>-2.55 (0)</td>
<td>-2.47 (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-9.30 (0)*</td>
<td>-9.32 (0)*</td>
<td>-9.26 (4)*</td>
</tr>
<tr>
<td></td>
<td>RCOMP</td>
<td>Level 1st difference</td>
<td>-1.55 (0)</td>
<td>-2.25 (0)</td>
<td>-1.45 (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-8.32 (1)*</td>
<td>-8.28 (1)*</td>
<td>-9.71 (8)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level 1st difference</td>
<td>-3.43 (0)*</td>
<td>-4.36 (0)</td>
<td>-3.21 (5)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-10.34 (1)*</td>
<td>-10.30 (1)*</td>
<td>-15.11 (6)*</td>
</tr>
</tbody>
</table>
### Chapter 5 – Results and discussion

<table>
<thead>
<tr>
<th>Country</th>
<th>Variables</th>
<th>Level/ First difference</th>
<th>ADF Test Statistic</th>
<th>PP Test Statistic</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without trend</td>
<td>With trend</td>
<td></td>
</tr>
<tr>
<td>Myanmar</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-1.72 (3)</td>
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<td>-2.02 (7)</td>
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<tr>
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<td>RCOMP</td>
<td>Level 1st difference</td>
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<td>-1.70 (0)</td>
<td>-1.77 (2)</td>
</tr>
<tr>
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<td>RIR</td>
<td>Level 1st difference</td>
<td>-4.55 (0)*</td>
<td>-5.98 (0)*</td>
<td>-4.62 (6)*</td>
</tr>
<tr>
<td>Thailand</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-2.11 (2)</td>
<td>-1.91 (2)</td>
<td>-2.29 (6)</td>
</tr>
<tr>
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<td>Level 1st difference</td>
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<td>-2.01 (1)</td>
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<td>RIR</td>
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<td>-2.27 (7)</td>
</tr>
<tr>
<td>Vietnam</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-9.64 (1)</td>
<td>-9.29 (1)</td>
<td>-5.60 (17)*</td>
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<td>RCOMP</td>
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<td>-1.16 (4)</td>
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<td>RIR</td>
<td>Level 1st difference</td>
<td>-3.92 (2)</td>
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<td></td>
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Note: - Lag length is in parenthesis, which is chosen following Akaike Info Criterion.
- * denotes that the null hypothesis of unit root is rejected at 5% significance level or series is stationary.
### Table 5.3 – Lag length for Johansen (1988) cointegration test between REER and RCOMP

<table>
<thead>
<tr>
<th>Country</th>
<th>Lag length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
</tr>
<tr>
<td>Iceland</td>
<td>3</td>
</tr>
<tr>
<td>New Zealand</td>
<td>2</td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
</tr>
<tr>
<td>Greece</td>
<td>1</td>
</tr>
<tr>
<td>Brunei</td>
<td>1</td>
</tr>
<tr>
<td>Laos</td>
<td>6</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0</td>
</tr>
<tr>
<td>Myanmar</td>
<td>3</td>
</tr>
<tr>
<td>Thailand</td>
<td>2</td>
</tr>
<tr>
<td>Vietnam</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Lag length for Johansen (1999) cointegration test is one fewer than lag length for VAR model.
### Table 5.4 – Johansen (1988) cointegration tests for REER and RCOMP – OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Hypothesized No. of CE(s)</th>
<th>Trace test</th>
<th>Maxi Eigenvalue test</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trace statistic</td>
<td>Critical value (10%)</td>
<td>No. of CE(s)</td>
</tr>
<tr>
<td>Australia¹</td>
<td>H₀: r = 0</td>
<td>15.18*</td>
<td>13.43</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>H₀: r ≤ 1</td>
<td>0.51</td>
<td>2.71</td>
<td>0</td>
</tr>
<tr>
<td>Canada²</td>
<td>H₀: r = 0</td>
<td>20.81</td>
<td>23.34</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>H₀: r ≤ 1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Iceland²</td>
<td>H₀: r = 0</td>
<td>19.06</td>
<td>23.34</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>H₀: r ≤ 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>New Zealand¹</td>
<td>H₀: r = 0</td>
<td>17.66*</td>
<td>13.43</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>H₀: r ≤ 1</td>
<td>4.06*</td>
<td>2.71</td>
<td>-</td>
</tr>
<tr>
<td>Norway²</td>
<td>H₀: r = 0</td>
<td>25.12*</td>
<td>23.34</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>H₀: r ≤ 1</td>
<td>4.84</td>
<td>10.67</td>
<td>-</td>
</tr>
<tr>
<td>Greece²</td>
<td>H₀: r = 0</td>
<td>12.46</td>
<td>23.34</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>H₀: r ≤ 1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note:
- CE: cointegrating equation
- * indicates the null hypothesis H₀ is rejected at the 10% significance level (when the statistic value is less than 0.1 critical value)
- ¹ implies the use of Model 1 - intercept without deterministic trend & ² implies the use of Model 2 – intercept and deterministic trend
- Model (1 or 2) is selected based on the trend of REER and RCOMP (see Figure 4.1 to 4.6)
### Table 5.5 – Johansen (1988) cointegration tests for REER and RCOMP – ASEAN countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Hypothesized No. of CE(s)</th>
<th>Trace test</th>
<th>Maxi Eigenvalue test</th>
<th>Conclusion</th>
<th>No. of CE(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Trace statistic</td>
<td>Critical value (10%)</td>
<td>No. of CE(s)</td>
<td>Max-Eigen statistic</td>
</tr>
<tr>
<td>Brunei</td>
<td>$H_0$: $r = 0$</td>
<td>37.62*</td>
<td>23.34</td>
<td>1</td>
<td>33.35*</td>
</tr>
<tr>
<td></td>
<td>$H_0$: $r \leq 1$</td>
<td>0.05</td>
<td>4.26</td>
<td>0</td>
<td>4.26</td>
</tr>
<tr>
<td>Laos</td>
<td>$H_0$: $r = 0$</td>
<td>7.67</td>
<td>13.43</td>
<td>0</td>
<td>7.64</td>
</tr>
<tr>
<td></td>
<td>$H_0$: $r \leq 1$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Malaysia</td>
<td>$H_0$: $r = 0$</td>
<td>8.80</td>
<td>13.43</td>
<td>0</td>
<td>6.03</td>
</tr>
<tr>
<td></td>
<td>$H_0$: $r \leq 1$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Myanmar</td>
<td>$H_0$: $r = 0$</td>
<td>11.29</td>
<td>23.34</td>
<td>0</td>
<td>9.20</td>
</tr>
<tr>
<td></td>
<td>$H_0$: $r \leq 1$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thailand</td>
<td>$H_0$: $r = 0$</td>
<td>13.29</td>
<td>13.43</td>
<td>0</td>
<td>10.96</td>
</tr>
<tr>
<td></td>
<td>$H_0$: $r \leq 1$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note:  
- CE: cointegrating equation  
- * indicates the null hypothesis $H_0$ is rejected at the 10% significance level (when the statistic value is less than 0.1 critical value)  
- $^1$ implies the use of Model 1 - intercept without deterministic trend & $^2$ implies the use of Model 2 – intercept and deterministic trend  
- Model (1 or 2) is selected based on the trend of REER and RCOMP (see Figure 4.7 to 4.11)  
- No Johansen (1988) cointegration test applied for Vietnam because in this country REER and RCOMP are not integrated of same order.
Table 5.6 – Cointegration equations – OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>$\alpha$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>2.8343</td>
<td>0.3814**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.047)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[-8.092]</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1.1059</td>
<td>0.7546**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.163)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[-4.641]</td>
</tr>
<tr>
<td>Canada</td>
<td>3.7338</td>
<td>0.2127*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.126)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[-1.688]</td>
</tr>
<tr>
<td>Norway</td>
<td>4.5070</td>
<td>0.0377*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.022)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[-1.717]</td>
</tr>
</tbody>
</table>

Note:
- Cointegration model: $\text{REER} = \alpha + \beta \ \text{RCOMP}$
- Standard errors are in parenthesis and t-statistics are in square brackets.
- Critical values at the 10% and 5% significance level with $df = 111 (= N-2)$ are nearly 1.658 and 1.980 respectively
- *, **: The estimated coefficients are statistically significant at 10% and 5% level.

Table 5.7 – Cointegration equations – ASEAN countries

<table>
<thead>
<tr>
<th>Country</th>
<th>$\alpha$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>5.7203</td>
<td>0.2361**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.058)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[4.062]</td>
</tr>
</tbody>
</table>
### Table 5.8 – Granger causality test (VEC model) – OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Lag length (k)</th>
<th>Serial correlation (∎)</th>
<th>Long-run (ECT)</th>
<th>Short-run RCOMP → REER (ΔRCOMPₜ₋ₖ)</th>
<th>Short-run RIR → REER (ΔRIRₜ₋ₖ)</th>
<th>Long-run (ECT)</th>
<th>Short-run REER → RCOMP (ΔREERₜ₋ₖ)</th>
<th>Short-run RIR → RCOMP (ΔRIRₜ₋ₖ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>2</td>
<td>No</td>
<td>-0.1842</td>
<td>-2.58** (0.011)</td>
<td>2.12 (0.347)</td>
<td>0.1341</td>
<td>1.46 (0.15)</td>
<td>5.14* (0.076)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>1</td>
<td>No</td>
<td>-0.0510</td>
<td>-1.71* (0.095)</td>
<td>0.56 (0.578)</td>
<td>0.0483</td>
<td>0.43 (0.670)</td>
<td>0.82 (0.414)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>2</td>
<td>No</td>
<td>-0.1051</td>
<td>-2.56** (0.01)</td>
<td>4.89* (0.092)</td>
<td>0.1061</td>
<td>2.11** (0.037)</td>
<td>3.67 (0.160)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
<td>No</td>
<td>-0.2050</td>
<td>-3.02** (0.003)</td>
<td>5.83* (0.059)</td>
<td>0.2150</td>
<td>-0.46 (0.648)</td>
<td>1.62 (0.448)</td>
</tr>
</tbody>
</table>

Note:
- *, **, ***: The estimated coefficients are statistically different from zero at the 10%, 5% and 1% level respectively.
- (∎): See more information in Table 5.12
- To test the significance of β₁₀ and β₂₀, the T-test is used.
- To test the joint significance of several coefficients, the Wald test is used.
- P-values are in parenthesis. If p-value is less than the level of significance, the null hypothesis that coefficients are (jointly) zero is rejected.
- β is the long-run elasticity in cointegration model between REER and RCOMP (Table 5.6)
Table 5.9 – Granger causality test proposed by Toda and Yamamoto (VAR model) – OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Lag length (k)</th>
<th>Maximum order of integration (m)</th>
<th>Serial correlation (∎)</th>
<th>Does RCOMP and RIR cause REER?</th>
<th>Does REER and RIR cause RCOMP?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RCOMP→ REER. (RCOMP(_{t-k}))</td>
<td>RIR→ REER. (RIR(_{t-k}))</td>
</tr>
<tr>
<td>Iceland</td>
<td>1</td>
<td>1</td>
<td>No</td>
<td>0.17 (0.68)</td>
<td>0.45 (0.50)</td>
</tr>
<tr>
<td>Greece</td>
<td>4</td>
<td>1</td>
<td>No</td>
<td>0.17 (0.68)</td>
<td>0.45 (0.50)</td>
</tr>
</tbody>
</table>

Note:
- *, **, ***: The estimated coefficients are statistically different from zero at the 10%, 5% and 1% level respectively.
- (∎): See more information in Table 5.13
- To test the joint significance of several coefficients, the Wald test is used.
- P-values are in parenthesis. If p-value is less than the level of significance, the null hypothesis that coefficients are (jointly) zero is rejected.
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Table 5.10 – Granger causality test (VEC model) – ASEAN countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Lag length (k)</th>
<th>Serial correlation (∎)</th>
<th>Does RCOMP and RIR cause REER?</th>
<th>Does REER and RIR cause RCOMP?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Long-run (ECT)</td>
<td>Short-run (ΔRCOMP&lt;sup&gt;→&lt;/sup&gt; REER)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coefficient (β&lt;sub&gt;20&lt;/sub&gt;)</td>
<td>t-statistics</td>
</tr>
<tr>
<td>Brunei</td>
<td>1</td>
<td>No</td>
<td>0.0186 (0.15)</td>
<td>-0.44 (0.66)</td>
</tr>
</tbody>
</table>

Note:
- *, **, ***: The estimated coefficients are statistically different from zero at the 10%, 5% and 1% level respectively.
- (∎): See more information in Table 5.12
- To test the significance of β<sub>10</sub> and β<sub>20</sub>, the T-test is used.
- To test the joint significance of several coefficients, the Wald test is used.
- P-values are in parenthesis. If p-value is less than the level of significance, the null hypothesis that coefficients are (jointly) zero is rejected.
- β is the long-run elasticity in cointegration model between REER and RCOMP (Table 5.7)
Table 5.11 – Granger causality test proposed by Toda and Yamamoto (VAR model) – ASEAN countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Lag length (k)</th>
<th>Maximum order of integration (m)</th>
<th>Serial correlation (∎)</th>
<th>Does RCOMP and RIR cause REER?</th>
<th>Does REER and RIR cause RCOMP?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RCOMP→ REER (RCOMP_{t-k})</td>
<td>REER→ RCOMP (REER_{t-k})</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RIR→ REER (RIR_{t-k})</td>
<td>RIR→ RCOMP (RIR_{t-k})</td>
</tr>
<tr>
<td>Laos</td>
<td>7</td>
<td>1</td>
<td>No</td>
<td>39.92*** (0.00)</td>
<td>10.60 (0.16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>47.40*** (0.00)</td>
<td>20.85*** (0.00)</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1</td>
<td>1</td>
<td>No</td>
<td>0.04 (0.84)</td>
<td>0.05 (0.82)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.28 (0.60)</td>
<td>0.21 (0.65)</td>
</tr>
<tr>
<td>Myanmar</td>
<td>7</td>
<td>1</td>
<td>No</td>
<td>7.51 (0.38)</td>
<td>3.34 (0.85)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.53** (0.01)</td>
<td>5.48 (0.60)</td>
</tr>
<tr>
<td>Thailand</td>
<td>3</td>
<td>1</td>
<td>No</td>
<td>3.09 (0.37)</td>
<td>1.80 (0.62)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.51 (0.47)</td>
<td>9.69** (0.02)</td>
</tr>
<tr>
<td>Vietnam</td>
<td>3</td>
<td>1</td>
<td>No</td>
<td>7.42* (0.06)</td>
<td>4.82 (0.19)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.98 (0.80)</td>
<td>6.17* (0.10)</td>
</tr>
</tbody>
</table>

Note:
- *, **, ***: The estimated coefficients are statistically different from zero at the 10%, 5% and 1% level respectively.
- (∎): See more information in Table 5.13
- To test the joint significance of several coefficients, the Wald test is used.
- P-values are in parenthesis. If p-value is less than the level of significance, the null hypothesis that coefficients are (jointly) zero is rejected.
## Table 5.12 – Residual serial correlation Lagrange multiplier test for VEC models

<table>
<thead>
<tr>
<th>Country</th>
<th>LM statistics</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>4.48 (0.35)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>New Zealand</td>
<td>3.70 (0.45)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Norway</td>
<td>4.51 (0.34)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Brunei</td>
<td>1.47 (0.83)</td>
<td>No serial correlation</td>
</tr>
</tbody>
</table>

Note: P-value is in parenthesis

## Table 5.13 – Residual serial correlation Lagrange multiplier test for VAR models

<table>
<thead>
<tr>
<th>Country</th>
<th>LM statistics</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>6.54 (0.69)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Iceland</td>
<td>13.29 (0.15)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Greece</td>
<td>8.63 (0.47)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Laos</td>
<td>5.91 (0.75)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Malaysia</td>
<td>11.36 (0.25)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Myanmar</td>
<td>9.36 (0.40)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Thailand</td>
<td>7.19 (0.62)</td>
<td>No serial correlation</td>
</tr>
<tr>
<td>Vietnam</td>
<td>5.78 (0.76)</td>
<td>No serial correlation</td>
</tr>
</tbody>
</table>

Note: P-value is in parenthesis
Chapter 5 – Results and discussion

RCOMP and RIR in level and first difference.

a. OECD

For individual OECD countries, the unit root test results on level and first difference of the three variables REER, RCOMP and RIR are shown in Table 5.1.

The test results reveal that for six OECD countries, all variables REER, RCOMP and RIR are integrated of order one (I(1)), except RIR for New Zealand. It can be said that in each country the three variables are not stationary in level but stationary in first difference. Only in New Zealand, RIR is stationary in level.

b. ASEAN

Table 5.2 summarizes the unit root test results on level and first difference of the variables for individual ASEAN commodity-exporting countries.

For five ASEAN countries—Brunei, Laos, Malaysia, Myanmar and Thailand—the unit root test results show that REER and RCOMP are found to be integrated of order one (I(1)) while RIR is stationary I(0). The unit test results of Vietnam are quite different. Only RCOMP is integrated of order one (I(1)) while REER and RIR are stationary in level I(0).

5.1.1.2 Johansen (1988) cointegration test

Based on the unit root tests results, we cannot apply a Johansen (1988) cointegration test for Vietnam, as this test requires the same order of integration of the two variables REER and RCOMP.

For the eleven remaining countries where REER and RCOMP are both I(1), we use a Johansen (1988) cointegration test to examine whether REER and RCOMP are cointegrated. Table 5.4 and 5.5 provide the results of the Johansen (1988) cointegration test for individual OECD and ASEAN commodity-exporting countries.

a. OECD

As mentioned in section 4.3.1.2, the lag length for a Johansen (1988) cointegration test is one fewer than the lag length for a VAR model. The lag length for the Johansen (1988) cointegration test of each country is shown in Table 5.3.
Table 5.4 shows the results of Johansen (1988) cointegration tests between REER and RCOMP in OECD countries. The results indicate that REER and RCOMP are cointegrated in four out of six countries, including Australia, Canada, New Zealand, and Norway.

Specifically, for Australia and Norway, the null hypothesis of no cointegration \( (r = 0) \), is clearly rejected since both trace statistics and maximum eigenvalue statistics exceed the critical values at the 10% significance level. However, the null hypothesis of no more than one cointegrating equation \( (r \leq 1) \) cannot be rejected at the 10% level. This suggests that in Australia and Norway there is one cointegrating equation between REER and RCOMP. For New Zealand, both the trace test and the maximum eigenvalue test indicate two cointegrating relations between REER and RCOMP at 10% significance level.

For Canada, the results of Johansen’s trace test and maximum eigenvalue test are inconsistent. According to the trace test, the null hypothesis of no cointegration \( (r = 0) \) cannot be rejected. Thus, there is no cointegrating equation between REER and RCOMP. Meanwhile, the result of the maximum eigenvalue test implies one cointegrating equation between the two variables. Because the maximum eigenvalue test normally pins down the number of cointegrating vectors (Enders 2004), it can be concluded that for Canada, there is one cointegrating equation between REER and RCOMP.

The Johansen (1988) cointegration test fails to indicate long-run relationships between REER and RCOMP in Iceland and Greece. Based on the acceptance of the null hypothesis of no cointegrating equation \( (r = 0) \), both the trace test and maximum eigenvalue test indicate no cointegration between the two variables. This implies that in Iceland and Greece, REER and RCOMP appear to move independently and are not bound together in the long run.

b. ASEAN

Brunei is the only country among ASEAN countries where REER and RCOMP are cointegrated. As shown in Table 5.5, in both the trace test and maximum eigenvalue test, the null hypothesis of no cointegration \( (r = 0) \) is rejected while the null hypothesis of no more than one cointegrating equation \( (r = 1) \) cannot be rejected. It can be
concluded that there is one cointegrating equation between REER and RCOMP. In Laos, Malaysia, Myanmar and Thailand, both the trace test and maximum eigenvalue test indicate that there is no cointegration between REER and RCOMP. Generally, in most ASEAN commodity-exporting countries, there is no evidence of a long-run relationship between REER and RCOMP, except for Brunei.

5.1.1.3 Cointegrating equations

For Australia, Canada, New Zealand, Norway and Brunei where REER and RCOMP are cointegrated, cointegrating equations are estimated.

a. OECD

The cointegrating equations, when normalized for a unit coefficient on REER, of Australia, Canada, New Zealand and Norway are illustrated in Table 5.6. The slope coefficient $\beta$ measures the long-run elasticity of REER with respect to RCOMP. $\beta$ can be translated as the percentage change in REER for a percentage change in RCOMP.

In Australia, the coefficient of RCOMP is statistically significant at 5% significance level because the absolute t-statistic value (8.092) is larger than the critical value (1.960). Moreover, the coefficient is positive, which suggests that REER and RCOMP are positively related. When RCOMP increases by 1%, on average, REER increases by about 0.38%.

In Canada and Norway, the coefficient of RCOMP is lower: 0.2127 and 0.0377, respectively. The largest coefficient belongs to New Zealand, which is 0.7546. In New Zealand, when RCOMP increases by 1%, REER goes up by approximately 0.75%.

In summary, the long-run coefficients of RCOMP are all statistically significant and positive in OECD countries. This implies that RCOMP and REER move together in long-run with the same direction (up or down together).

b. ASEAN

Among ASEAN commodity-exporting countries, Brunei is the only country where exchange rate and commodity prices have a long-run relationship. As shown in Table 5.7, the coefficient of RCOMP ($\beta$) is statistically different from zero at the 5% significance level. This can be concluded because t-statistic value (4.062) is larger than
the critical value.

However, this coefficient is positive (0.2361). This suggests that in the long run, RCOMP and REER move together in same direction. Specifically, if RCOMP increases 1%, REER increases 0.24% on average, and vice versa.

5.1.1.4 Granger causality tests

As mentioned in Section 4.3 – Research methodology, in case REER and RCOMP are cointegrated, a VEC model will be used to test for Granger causality between the two variables. Otherwise, Toda and Yamamoto (1995) augmented VAR model will be used to test for Granger causality.

a. OECD

- Australia, Canada, New Zealand and Norway:

According to the Johansen (1988) cointegration test, REER and RCOMP are found to be cointegrated in Australia, Canada, New Zealand and Norway. Therefore, Granger causality between REER and RCOMP will be investigated based on a VEC model (Equations (4.15) and (4.16)). The test results for each country are reported in Table 5.8.

For Australia, the coefficient of ECT ($\beta_{10}$) in Equation (4.15) is statistical significant at the 5% significance level. Moreover, it is negative ($-0.1842$) and its absolute value is less than one. It can be concluded that there is long-run Granger causality running from RCOMP to REER. However, there is no evidence of Granger causality from REER to RCOMP since the coefficient of ECT ($\beta_{20}$) in Equation (4.16) is not significant.

Regarding short-run Granger causality, the significance of the first differences of lagged REERs in Equation (4.16) indicates that there is a unidirectional short-run Granger causality running from REER to RCOMP.

For Canada, RCOMP Granger-causes REER in the long run, but not vice versa. This can be explained by noting that the coefficient of ECT ($\beta_{10}$) in Equation (4.15) is negative ($-0.0510$), statistically different from zero at the 10% significance level and

---

37 The term “Granger causality” always implies a short-term relationship (Gujarati 2009). The term “short-run Granger causality” is only used to easily distinguish “Granger causality” from “long-run Granger causality.”
less than one in absolute value. There is no evidence of short-run Granger causality in either direction.

For New Zealand, there is two-way long-run Granger causality between REER and RCOMP since both coefficients of ECT in both equations (\(\beta_{10}\) and \(\beta_{20}\)) are significant at the 5% level and have appropriate sign and magnitude. Specifically, \(\beta_{10} (-0.1051)\) is negative and its absolute value is less than one, and the sign of \(\beta_{20} (0.1061)\) satisfies the requirement \(-\beta_{20} \beta < 0\) (as \(\beta > 0\)). Based on the Wald test result, all the coefficients of first-differenced lagged RCOMPs in Equation (4.15) are found to be jointly significant while that of first-differenced lagged REERs in Equation (4.16) are not jointly significant. This implies unidirectional short-run Granger causality running from REER to RCOMP.

For Norway, the significance of ECT (\(\beta_{10}\)) in Equation (4.15) at the 5% level of significance suggests a long-run Granger causality from RCOMP to REER. In addition, there is also Granger causality running from RCOMP to REER in the short-run since the coefficients of lagged RCOMPs in Equation (4.15) are jointly statistically different from zero at the 10% level of significance. There is no short-run or long-run Granger causality in the opposite direction.

- **Iceland, Greece:**

The Johansen (1988) cointegration test results for Iceland and Greece indicate that REER and RCOMP are not cointegrated. Therefore, for Iceland and Greece, the direction of the Granger causality will be detected through the Toda and Yamamoto (1995) augmented VAR model (Equations (4.13) and (4.14)). Table 5.9 shows the Granger causality test results for these two countries based on the augmented VAR model.

For Iceland and Greece, the Wald test result reveals that both the coefficients related to the lagged RCOMPs and the coefficients related to REERs are not jointly significant. This indicates no Granger causality between REER and RCOMP.

In short, there is long-run Granger causality running from RCOMP to REER in four out of six OECD commodity-exporting countries: Australia, Canada, New Zealand, and Iceland. Regarding short-run Granger causality, while in New Zealand and Norway
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RCOMP Granger-causes REER, in Australia, REER leads RCOMP in the short-run and there is no short-run Granger causality in Canada. Moreover, there is no evidence of Granger causality from RIR to either RCOMP or REER. It is also worth noting that there is no serial correlation in both VEC and VAR models (see Table 5.12 and 5.13).

b. **ASEAN**

- **Brunei**

Because REER and RCOMP are found to be cointegrated in Brunei, Granger causality between REER and RCOMP is therefore investigated based on a VEC model. It can be seen from Table 5.10 that the estimated coefficient of ECT (β₀) in Equation (4.16) is statistically significant at the 5% level of significance with appropriate sign (−β₀ < 0). In particular, both β₂₀ (−0.5620) and β (−0.2361) are negative so −β₂₀ .β is negative as expected. Meanwhile, β₁₀ is not statistically significant. This suggests that there is a long-run Granger causality running from REER to RCOMP. In addition, there is no evidence of short-run Granger causality between REER and RCOMP. It is interesting to note that RIR Granger causes both RCOMP and REER in the short-run.

- **Laos, Malaysia, Myanmar, Thailand and Vietnam:**

For the five remaining developing countries—Laos, Malaysia, Myanmar, Thailand and Vietnam—where REER and RCOMP are not cointegrated, we utilize Toda and Yamamoto (1995) augmented VAR model to explore the Granger causality between the variables. Table 5.11 shows the Wald test results for the joint significance of lagged independent variables.

For Laos, based on the joint significance of lagged RCOMPs, it can be concluded that, in these two countries, there is Granger causality running from RCOMP to REER. There is no evidence of Granger causality in the opposite direction.

Similar to Laos, Vietnam has a short-run unidirectional Granger causality with the direction from RCOMP to REER. For Malaysia, Myanmar and Thailand, no Granger of causality between REER and RCOMP can be found.

In short, among six ASEAN commodity-exporting countries, long-run Granger causality between REER and RCOMP can only be found in Brunei with the direction
from RCOMP to REER. Three out of the five remaining countries, namely Malaysia, Myanmar, and Thailand, show no Granger causality relationship between RCOMP and REER. In Vietnam and Laos, there is short-run Granger causality from RCOMP to REER.

It is worth mentioning that short-run Granger causality implies only the short-term relationship between variables while theory as well as policy implications typically have not much to say about short-term relationships (Thomas 1993). Because one of our main purposes is providing policy implications for ASEAN commodity-exporting countries in their transition period to become developed countries, the long-run Granger causality is our main concern.

While in OECD countries, there is no evidence of Granger causality from RIR to either RCOMP or REER; RIR seems to have more influence on REER and RCOMP in ASEAN. Specifically, in Brunei and Laos, RIR Granger-causes both RCOMP and REER. In Vietnam and Thailand, Granger causality is running from RIR to RCOMP, while in Myanmar, Granger causality runs from RIR to REER. The only country where there is no Granger causality from RIR to either RCOMP or REER is Malaysia.

5.1.2 Groups of countries

The panel-data technique is applied for each group – OECD commodity-exporting countries group and ASEAN commodity-exporting countries – to investigate the most common characteristics of the relationship between REER and RCOMP in each group.

5.1.2.1 Panel unit root tests

The panel unit root tests are applied both in level and first difference for all variables REER, RCOMP, and RIR. Table 5.14 shows the panel unit root test results for each group, OECD and ASEAN.

a. OECD

According to the three panel unit root tests including – Im, Pesaran and Shin (2003), Maddala and Wu (1999) and Choi (2001) – we cannot reject the null hypothesis of unit root when the three variables are taken in level. Nevertheless, when the first-difference is used, the null hypothesis can be rejected at the 1% level of significance. Therefore,
we can conclude that in OECD commodity-exporting countries, all variables – REER, RCOMP and RIR – are integrated of order one (I(1)).

**b. ASEAN**

For the ASEAN group, the panel unit test results indicate that REER and RCOMP are both integrated of order one (I(1)). As shown in Table 5.14, all the three panel unit root tests (both with and without trend) reveal that REER and RCOMP are not stationary in level but stationary in first difference.

Meanwhile, all of the panel unit root test results show that RIR is stationary in level (I(0)).
### Table 5.14 – Panel unit root tests for REER, RCOMP and RIR

<table>
<thead>
<tr>
<th>Group</th>
<th>Variables</th>
<th>Level/ First difference</th>
<th>Im Pesaran and Shin Test Statistic</th>
<th>Maddala and Wu Test Statistic</th>
<th>Choi Test statistic</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Without trend</td>
<td>With trend</td>
<td>Without trend</td>
<td>With trend</td>
</tr>
<tr>
<td>6 OECD countries</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-1.21 (0-2)</td>
<td>-0.74 (0-3)</td>
<td>16.55 (0-2)</td>
<td>15.07 (0-3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-24.96 (0-1)*</td>
<td>-25.61 (0-1)*</td>
<td>379.75 (0-1)*</td>
<td>348.67 (0-1)*</td>
</tr>
<tr>
<td></td>
<td>RCOMP</td>
<td>Level 1st difference</td>
<td>-0.70 (0-1)</td>
<td>-0.23 (0-1)</td>
<td>14.00 (0-1)</td>
<td>10.53 (0-1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-20.99 (0-1)*</td>
<td>-20.66 (0-1)*</td>
<td>316.11 (0-1)*</td>
<td>277.92 (0-1)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level 1st difference</td>
<td>-1.20 (0-8)</td>
<td>-3.86 (0-8)</td>
<td>20.81 (0-8)</td>
<td>51.31 (0-8)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-25.48 (0-6)*</td>
<td>-26.22 (0-6)*</td>
<td>348.50 (0-6)*</td>
<td>318.06 (0-6)*</td>
</tr>
<tr>
<td>6 ASEAN countries</td>
<td>REER</td>
<td>Level 1st difference</td>
<td>-1.04 (0-10)</td>
<td>2.15 (0-10)</td>
<td>16.35 (0-10)</td>
<td>8.98 (0-10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-17.36 (0-5)*</td>
<td>-17.88 (0-9)*</td>
<td>191.38 (0-5)*</td>
<td>220.73 (0-9)*</td>
</tr>
<tr>
<td></td>
<td>RCOMP</td>
<td>Level 1st difference</td>
<td>-0.22 (0-2)</td>
<td>-0.64 (0-2)</td>
<td>9.43 (0-2)</td>
<td>14.33 (0-2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-17.80 (0-1)*</td>
<td>-17.63 (0-1)*</td>
<td>245.84 (0-1)*</td>
<td>225.50 (0-1)*</td>
</tr>
<tr>
<td></td>
<td>RIR</td>
<td>Level 1st difference</td>
<td>-3.78 (2-11)*</td>
<td>-5.55 (0-12)*</td>
<td>42.99 (2-11)*</td>
<td>51.61 (0-12)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-10.65 (2-11)*</td>
<td>-9.68 (2-11)*</td>
<td>143.54 (2-11)*</td>
<td>120.16 (2-11)*</td>
</tr>
</tbody>
</table>

**Note:**
- Lag length is in parenthesis, which is chosen following Akaike Info Criterion.
- For Choi (2001) unit root test, Newey-West automatic bandwidth selection and Bartlett kernel is selected.
- * denotes that the null hypothesis of unit root is rejected at 5% significance level or series is stationary.
Table 5.15 – Pedroni (1999) Panel Cointegration Test for REER and RCOMP – 6 OECD countries

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Individual intercept</th>
<th>Individual intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel statistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance ratio statistic</td>
<td>2.29*</td>
<td>2.26*</td>
</tr>
<tr>
<td>Rho statistic</td>
<td>-2.13*</td>
<td>-3.71*</td>
</tr>
<tr>
<td>PP statistic</td>
<td>-1.82*</td>
<td>-3.06*</td>
</tr>
<tr>
<td>ADF statistic</td>
<td>-1.66*</td>
<td>-3.54*</td>
</tr>
<tr>
<td><strong>Group statistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rho statistic</td>
<td>-2.02*</td>
<td>-3.16*</td>
</tr>
<tr>
<td>PP statistic</td>
<td>-2.03*</td>
<td>-3.06*</td>
</tr>
<tr>
<td>ADF statistic</td>
<td>-1.66*</td>
<td>-3.21*</td>
</tr>
<tr>
<td><strong>Cointegration</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>CONCLUSION</strong></td>
<td>REER and RCOMP are cointegrated</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * implies that the null of no cointegration is rejected at the 5% level of significance.
Table 5.16 – Pedroni (1999) Panel Cointegration Test for REER and RCOMP – 6 ASEAN countries

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Individual intercept</th>
<th>Individual intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel statistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance ratio statistic</td>
<td>-2.22</td>
<td>4.72*</td>
</tr>
<tr>
<td>Rho statistic</td>
<td>1.54</td>
<td>-0.46</td>
</tr>
<tr>
<td>PP statistic</td>
<td>0.47</td>
<td>0.18</td>
</tr>
<tr>
<td>ADF statistic</td>
<td>0.74</td>
<td>-0.32</td>
</tr>
<tr>
<td>Group statistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rho statistic</td>
<td>-0.68</td>
<td>-2.60*</td>
</tr>
<tr>
<td>PP statistic</td>
<td>-1.48</td>
<td>-2.64*</td>
</tr>
<tr>
<td>ADF statistic</td>
<td>-0.02</td>
<td>-1.05</td>
</tr>
<tr>
<td>Cointegration</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td></td>
<td>REER and RCOMP are not cointegrated</td>
</tr>
</tbody>
</table>

Notes: * implies that the null of no cointegration is rejected at the 5% level of significance.
Chapter 5 – Results and discussion

Table 5.17 – Granger causality test (panel VEC model) – 6 OECD countries

<table>
<thead>
<tr>
<th>Group</th>
<th>Lag length (k)</th>
<th>Serial correlation (■)</th>
<th>Does RCOMP and RIR cause REER?</th>
<th></th>
<th>Does REER and RIR cause RCOMP?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Long-run (ECT)</td>
<td></td>
<td>Short-run</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coefficient (\beta_{10}) t-statistics</td>
<td></td>
<td>Coefficient (\beta_{20}) t-statistics</td>
</tr>
<tr>
<td>6 OECD countries</td>
<td>5</td>
<td>No</td>
<td>-0.05 (-3.56*** (0.00))</td>
<td></td>
<td>8.47 (0.13)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.55 (0.18)</td>
<td></td>
<td>&gt; 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.05 (0.21)</td>
<td></td>
<td>1.26 (0.00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18.30*** (0.00)</td>
<td></td>
<td>7.90 (0.16)</td>
</tr>
</tbody>
</table>

Note:
- *, **, ***: The coefficients are statistically significant at the 10%, 5% and 1% level respectively.
- (■): See more information in Table 5.18
- To test the significance of \(\beta_{10}\) and \(\beta_{20}\), the T-test is used.
- To test the joint significance of several coefficients, the Wald test is used.
- P-values are in parenthesis. If p-value is less than the level of significance, the null hypothesis that coefficients are (jointly) zero is rejected.
- \(\beta\) is the long-run elasticity in cointegration model between REER and RCOMP (Equation (5.1))

Table 5.18 – Residual serial correlation Lagrange multiplier (LM) test for panel VEC model

<table>
<thead>
<tr>
<th>Lag length</th>
<th>LM statistics</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6.90 (0.14)</td>
<td>No serial correlation</td>
</tr>
</tbody>
</table>

Note: P-value is in parenthesis
### Table 5.19 – Granger causality test proposed by Toda and Yamamoto (VAR model) – 6 ASEAN countries

<table>
<thead>
<tr>
<th>Group</th>
<th>Lag length (k)</th>
<th>Maximum order of integration (m)</th>
<th>Serial correlation (■)</th>
<th>Does RCOMP and RIR cause REER?</th>
<th>Does REER and RIR cause RCOMP?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Short-run RCOMP→ REER (RCOMP&lt;sub&gt;t-k&lt;/sub&gt;)</td>
<td>Short-run RIR→ REER (RIR&lt;sub&gt;t-k&lt;/sub&gt;)</td>
</tr>
<tr>
<td>6 ASEAN countries</td>
<td>5</td>
<td>1</td>
<td>No</td>
<td>3.93 (0.69)</td>
<td>8.66 (0.19)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.05 (0.54)</td>
<td>2.55 (0.86)</td>
</tr>
</tbody>
</table>

Note:
- *, **, ***: The coefficients are statistically significant at the 10%, 5% and 1% level respectively.
- (■): See more information in Table 5.20
- To test the joint significance of several coefficients, the Wald test is used.
- P-values are in parenthesis. If p-value is less than the level of significance, the null hypothesis that coefficients are (jointly) zero is rejected.

### Table 5.20 – Residual serial correlation Lagrange multiplier test for VAR model

<table>
<thead>
<tr>
<th>Lag length</th>
<th>LM statistics</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>28.07 (0.00)</td>
<td>Serial correlation</td>
</tr>
<tr>
<td>5</td>
<td>4.53 (0.87)</td>
<td>No serial correlation</td>
</tr>
</tbody>
</table>

Note: P-value is in parenthesis
5.1.2.2 Pedroni (1999) panel cointegration tests

The results of the panel unit root tests show that in OECD and ASEAN, REER and RCOMP are cointegrated of same order (both of them are I(1)). This enables us to test for the cointegration between REER and RCOMP for the two groups. As mentioned in Section 4.3.2.2, to examine whether a cointegrating relationship exists between REER and RCOMP, we employ the Pedroni (1999) panel cointegration test.

a. OECD

The Pedroni (1999) panel cointegration test results for OECD are shown in Table 5.15. A Pedroni (1999) panel cointegration test is applied with individual intercept only or with both individual intercept and trend. In both cases, all seven tests can reject the null hypothesis of no cointegration at the significance level of 5%. It can be concluded that REER and RCOMP are cointegrated.

The cointegrating equation (following Equation (4.23)) between REER and RCOMP is estimated by group-mean DOLS as follows:

\[
\text{REER} = 3.3488 + 0.2782 \times \text{RCOMP} \tag{5.1}
\]

Note: Standard errors in ( ) and t-statistics in [ ]

The long-run elasticity of REER in response to RCOMP is 0.2782. This implies that REER and RCOMP move together in the long run with the same direction. For example, if RCOMP increases 1%, REER increases nearly 0.28% on average.

b. ASEAN

As presented in Table 5.16, in both cases – with and without trend – the Pedroni (1999) panel cointegration results show that there is no cointegration between REER and RCOMP for ASEAN.

Specifically, in the case of intercept only, all of the seven tests cannot reject the null hypothesis of no cointegration at the 5% significance level. For this case, it is quite clear that REER and RCOMP are not cointegrated.

In the case of both intercept and trend, the majority of tests (four out of seven tests namely panel Rho statistic, panel PP statistic, panel ADF statistic, group ADF statistic) cannot reject the null hypothesis of no cointegration at the 5% significance level. As the
majority of tests show no cointegration between REER and RCOMP, it can be concluded that REER and RCOMP are not cointegrated.

5.1.2.3 Panel Granger causality tests

It can be inferred from the Pedroni (1999) panel cointegration results that in OECD, REER and RCOMP are cointegrated. Therefore, we use the VEC model to examine the Granger causality between REER and RCOMP. For ASEAN, Toda and Yamamoto (1995) augmented VAR model will be employed when testing for Granger causality.

a. OECD

As depicted in Table 5.17, the coefficient of ECT ($\beta_{10}$) in Equation (4.26) is statistically significant at the 1% level of significance. Moreover, $\beta_{10} (-0.05)$ has a proper sign (negative) and is less than one in absolute value. Thus, it can be stated that in the long run, RCOMP Granger-causes REER. Since the coefficient of ECT ($\beta_{20}$) in Equation (4.27) is not statistically significant, there is no long-run Granger causality running from REER to RCOMP.

Short-run Granger causality is detected based on Wald statistics test results. The Wald statistics test proves that there is joint significance of first-differenced lagged REERs in Equation (4.27) and no joint significance for other first-differenced lagged explanatory variables. This implies that there is a unidirectional short-run causality running from REER to RCOMP. In addition, RIR does not Granger-cause either REER or RCOMP.

b. ASEAN

Based on lag length selection criteria, the optimal lag length is 6. However, this lag length leads to serial correlation in the VAR model (see Table 5.20). To avoid the serial correlation, the lag length has been reduced to 5.

According to the results reported in Table 5.19, the Wald statistics test result based on Equation (4.24) shows that the coefficients of first-differenced lagged RCOMPs are jointly insignificant. In addition, the coefficients of first-differenced lagged REERs in Equation (4.25) are also jointly insignificant at the 10% level of significance. We can conclude that there are no Granger causality between REER and RCOMP in ASEAN. Moreover, the Wald statistics test results also show that there is no Granger causality running from RIR to either REER or RCOMP.
5.2 Analysis of test results

In this part, the test results from both time-series and panel-data methods will be analysed to provide insight into the relationship between exchange rate and commodity prices in OECD and ASEAN.

5.2.1 OECD

For both OECD and ASEAN, the findings obtained from time-series and panel-data techniques are relatively consistent.

Regarding cointegration, when applying the Johansen (1988) cointegration test for each OECD commodity-exporting country, the test results indicate that in most OECD countries (four out of six countries including Australia, Canada, New Zealand and Norway), there is cointegration between real exchange rate and real commodity prices. These findings are consistent with what is being implied by the panel cointegration test result. The Pedroni (1999) panel cointegration test on the group of six OECD countries also finds out that real exchange rate and real commodity prices move together in the long-run.

While estimating cointegrating equations for individual countries (Australia, Canada, New Zealand and Norway), all the coefficients of real commodity prices in cointegrating equations are positive. The estimation result by the DOLS method for the OECD panel data set shows the same result. This implies that in OECD commodity-exporting countries, real exchange rate and real commodity prices move together in the long-term with the same direction.

About Granger causality, both time-series and panel-data methods indicate that there is long-run Granger causality running from commodity prices to exchange rate in OECD commodity-exporting countries. Specifically, the result of the Granger causality test applied for OECD panel data set implies that there is evidence of unidirectional Granger causality from commodity prices to exchangerate in OECD countries. In line with this finding, following the Granger test results for individual countries, in four out of six OECD countries, which are Australia, Canada, New Zealand and Norway, commodity prices Granger-causes exchange rate in the long-run. It can be concluded that in OECD commodity-exporting countries, real commodity prices are initial receptors of
Chapter 5 – Results and discussion

Exogenous shocks to the long-run equilibrium and real exchange rate always respond to changes in real commodity prices in order to maintain the long-run relationship between the two variables. This finding is in line with some existing works Simpson and Evans (2004), Trezzi (2014), Harri, Nalley and Hudson (2009) and Chaudhuri and Daniel (1998).

Whereas the two empirical methods provide consistent findings about long-run Granger causality, the findings about short-run Granger causality are somewhat contradictory. According to Granger causality test results for individual countries: in Australia, real exchange rate Granger-causes real commodity prices in the short run; in New Zealand and Norway, Granger causality runs in the opposite direction, from real commodity prices to real exchange rate; and in the three remaining countries of Canada, Iceland and Greece, there is no short-run Granger causality in either direction. On the other hand, the results of Granger causality tests performed on OECD panel data set indicate an existence of short-run Granger causality running from real exchange rate to real commodity prices in OECD commodity-exporting countries.

5.2.2 ASEAN

The test results from both time-series and panel-data techniques show that the relationship between exchange rate and commodity prices in ASEAN commodity-exporting countries is considerably different from that in OECD commodity-exporting countries.

In regard to cointegration, in most of the ASEAN commodity-exporting countries (five out of six) there is no evidence of cointegration between real exchange rate and real commodity prices. Only in Brunei – the largest oil exporter in ASEAN – real exchange rate and real commodity prices are cointegrated. Moreover, the result of panel cointegration tests on the group of six ASEAN countries also indicates that there is cointegration between these two variables. Therefore, it can be concluded that in ASEAN commodity-exporting countries, real exchange rate and real commodity prices move independently in the long run.

Because of the lack of cointegration between real exchange rate and real commodity prices, there is obviously no long-run Granger causality between these two variables in...
ASEAN countries. Based on panel Granger causality test results, there is also no evidence of short-run Granger causality between real exchange rate and real commodity prices. This finding is consistent with the finding from time-series techniques that only two out of six ASEAN countries (Vietnam and Laos) have short-run Granger causality running from real commodity prices to real exchange rate.

On the whole, there is a significant difference in the relationship between exchange rate and commodity prices in ASEAN and OECD commodity-exporting countries. While exchange rate and commodity prices have a long-term relationship in OECD, there is no long-run or short-run relationship between the two variables in ASEAN countries. In other words, the commodity prices – exchange rate nexus in ASEAN countries is not obvious.

5.3 Discussion

It can be derived from the test results that most OECD commodity-exporting countries have a strong relationship between real exchange rate and real commodity prices. Specifically, changes in real commodity prices will lead to responses of real exchange rate to re-establish the equilibrium in the long run. This finding is in line with Cashin, Céspedes and Sahay (2004) theory (mentioned in Section 1.4).

However, in ASEAN commodity exporting countries, the relationship between real commodity prices and real exchange rate is not obvious. The difference in the commodity prices – exchange rate nexus between OECD and ASEAN can be explained as follows.

Different exchange rate regimes

OECD countries adopt a free-floating exchange rate while ASEAN countries manage their exchange rate or peg their currencies to a major currency or to a basket of currencies. In fact, Australia, Canada, New Zealand, and Norway adopted a free-floating exchange rate regime quite early. Canada was the first Western country to move to a floating exchange rate (in 1970) after the Second World War. Australia and New Zealand in turn decided to float the exchange rate in 1983 and 1985, respectively. For Norway, after fixing the exchange rate from 1986 to the end of the decade, in 1992, the country decided to float the Norwegian krone after the demand shock caused by the
reunification of the Germany. Iceland and Greece are two countries that adopted a free-floating exchange rate so late. Iceland had pegged the value of the Króna to a basket of nine currencies until 2000 and decided to float the Króna in 2001. Greece also began floating its exchange rate in 2001. Before that, the exchange rate for the drachma is determined in the domestic and foreign interbank markets, as well as in daily fixing sessions in which the Bank of Greece (BOG) and authorized commercial banks participate.

Meanwhile, ASEAN commodity-exporting countries have been in favour of a managed floating and pegged exchange rate regime through the period from 1986 to 2014. As can be seen from Table 5.21, there is a trend to move from pegged exchange rate regime to managed floating regime in ASEAN countries, except for Brunei. From 1984 to now, Brunei has maintained a currency board arrangement and tied its currency to the Singapore dollar. This regime eliminates traditional central bank functions of the Brunei Currency Board such as lender of last resort and monetary control. In Laos, Malaysia, and Thailand, before adopting a managed floating exchange rate, the currencies of these countries had been pegged against the USD for a long time. Specifically, from 1953 to 1988, the Lao kip was fixed to the USD. After that, Laos adopted a managed floating system. Malaysia adopted a pegged arrangement system exchange rate from 1975, pegging against the USD at MYR 3.80 per 1 USD. Since July 2005, this country has adopted a managed floating system. Thailand is the only country in ASEAN that announced the allowance of a free-floating exchange rate regime in July 1997, after 13 years of pegging to the USD at an exchange rate of around Baht 25 per 1 USD. However, according to the IMF, Thailand fails to adapt requirements for a free-floating exchange rate regime as the authorities of this country have indirectly intervened in the foreign exchange market. This explains why the IMF reclassified the exchange rate regime of Thailand as managed floating. Similarly, in Myanmar, the Myanmar kyat is officially pegged to the SDR (Special Drawing Right) at Kyat 8.50847 per 1 SDR 30 years before becoming managed floating currency in June 2001 (as the result of the liberalization of the secondary market for foreign exchange). In Vietnam, The State Bank of Vietnam has managed its floating exchange rate most of the time by quoting an interbank market rate as the daily average exchange rate in the interbank market during the previous business day and setting up the range by which the participating banks can quote rates.
### Table 5.21 – Exchange rate regimes

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Note: Source: Annual report on exchange arrangements and exchange restrictions  
S: Stabilized arrangement  
M: Managed floating  
Cr: Crawling peg  
C: Currency board  
F: Free-floating  
O: Other managed arrangement  
P:B: Pegged to a basket of currencies  
P: Pegged to SDR  
P: Pegged to USD
For a free-floating exchange rate regime, the exchange rate is determined by the market forces and the monetary authority usually does not intervene in the foreign exchange market. The intervention is only aimed at preventing excessive fluctuations in the exchange rate (IMF 2007). Thus, it might enable the translation from real commodity prices fluctuation to real exchange rate (according to Cashin, Céspedes and Sahay (2004) theory). It can be said that the relationship between real exchange rate and real commodity prices in OECD commodity-exporting countries is strong because most of them freely float their exchange rate.

Meanwhile, ASEAN countries either manage their exchange rate or peg their currencies to a major currency or to a basket of currencies. In a managed floating exchange rate regime, the monetary authorities effect the movements of the exchange rate by intervening actively in the foreign exchange market in order to maintain stability and competitiveness of exchange rate. This intervention might lead the exchange rate to deviate from its own way, preventing commodity prices and exchange from moving together. Besides, in a pegged exchange rate regime, a currency will be pegged at a fixed rate to another prevalent currency or a basket of currencies, by which a currency will become more stable (IMF 2007). However in doing so, the pegged currency is then controlled by its reference value (or the value of anchor currency). As such, the movements of the exchange rate will be mainly dependent on the movement of reference value, and not influenced by commodity prices. As a result, a pegged exchange rate regime also contributes to weaken the relation between real exchange rate and real commodity prices. It can be concluded that the use of both pegged and managed floating exchange rate makes the relationship between real exchange rate and real commodity prices in ASEAN countries rather obscured.

Based on the discussion above, we can conclude that late adoption of a free-floating exchange rate is one of the reasons explaining why in Iceland and Greece real exchange rate and real commodity prices do not have a long-run relationship.

**Difference in ability to expand natural-resource sector**

According to the “Dutch Disease” theory, in resource-rich countries, an increase in natural resources commodity prices will make a given nation’s real exchange rate appreciate (Brahmbhatt, Canuto & Vostroknutova 2010). To explain the “Dutch
Disease” theory, researchers divide the economy into three sectors: the natural-resource sector, the non-resource tradables sector (as agriculture and manufacturing), and the nontradables sector. Natural resource commodity prices might affect real exchange rate through two channels (Brahmbhatt, Canuto & Vostroknutova 2010). The first one is spending effect. When commodity prices increase, export income will increase. This normally leads to higher spending by public as well as private sectors. Consequently, the demand for nontradables will increase. As the result, prices of nontradables will be higher. On the other hand, wages in the economy will tend to rise. The increase in wages will contribute to a rise in the relative prices of nontradables. As real exchange rate is defined as the price of nontradables relative to the price of tradables, an increase in commodity prices will lead to appreciation of real exchange rate. The second channel is movement effect. A boom in the natural-resource sector will attract capital and labor from the nontradables sector. It tends to reduce the output in the nontradables sector of the economy. In particular, the output of the nontradables sector declines. This decline makes the price of nontradables rise relative to the price of tradables (being set in the world market), or real exchange rate appreciate. Through these two above channels, an increase in commodity prices will lead to appreciation in real exchange rate.

However, the movement effect is less likely in ASEAN countries. This might be the reason why the relationship between exchange rate and commodity prices is not obvious in ASEAN. A lesser movement effect in ASEAN compared to OECD is clarified as follows.

Natural resources such as crude oil, natural gas, minerals and woods dominate the export of both ASEAN and OECD commodity-exporting countries. In fact, the extraction of natural resources is very capital- and technology-intensive, especially crude oil, natural gas, coal, and minerals. While OECD countries can run their own natural resources extraction industry, ASEAN developing countries are strongly dependent on FDI to develop their extractive industry because of the shortage of capital, advanced technology and high-skilled labors (IESR 2014), (Sovacool 2010), and (Diana & Maia 2000).
Chapter 5 – Results and discussion

In developing countries, the government tightly controls the extraction of natural resources. State-owned national companies are major players in the natural-resource sector, especially in oil extraction (Ross 2013; Pirog 2007). A limited source of finance and lack of high technology prevent these state-owned national companies to expand their operations. Thus, the most efficient way to develop the extractive industries in ASEAN countries is to seek inflows of FDI (IESR 2014).

Nevertheless, the ability to attract FDI in the extractive industries in ASEAN is limited. This can be explained by the fact that investing in extractive industries is normally more risky than other sectors (Ruta & Venables 2012). Apart from the capital-intensive and long-term nature of the mining industry, in the event of the project failing, a mine or oil well cannot be dismantled and moved to another location (Ruta & Venables 2012). Moreover, much of the crude oil and natural gas of Southeast Asia region is located in deep-water offshore areas and a long way from the centre of demand; and much of the mineral reserves is located in isolated areas which often lack basic services and infrastructure, such as power. These things make investors ask for higher returns (ASEAN 2014b).

Another main impediment to FDI across ASEAN countries is weak governance at many levels, including an absence of rule of law, a lack of robust mechanisms to ensure transparency and accountability to facilitate partnership between government and nongovernment organizations, and lack of coordination among government agencies (IESR 2014; Ponciano, Narjoko & Simorangkir 2011). Moreover, the process for obtaining exploration and mining licenses, or the resolution of land access issues, represents a major impediment to investment in many ASEAN countries (IESR 2014). Apart from Malaysia, the speed of processing in other developing ASEAN countries is classified as slow and mainly slow (Ponciano, Narjoko & Simorangkir 2011). It is also worth mentioning that some countries have their own problems that delay investment decision-making of foreigners, such as political instability in Thailand, low investment incentives and unstable macro economy in Vietnam, and high labor cost in Myanmar (Ponciano, Narjoko & Simorangkir 2011). These factors, combined with the volatile nature of commodity prices and high risks associated with extractive industry activities prevent FDI in natural-resource sector in ASEAN countries.
Chapter 5 – Results and discussion

In summary, the expansion of the natural-resource sector in ASEAN countries mostly relies on FDI. Meanwhile, investment attraction is not effective in these countries. Thus, it can be said that the expansion or increasing productivity of the natural-resource sector in the short term seems to be impossible. As mentioned above, the natural-resource sector dominates the tradables sectors in commodity-exporting countries. Because of the difficulty in expanding the operations of the natural-resource sector in ASEAN, the movement of capital and labor from the nontradables sector to the natural-resource sector (main tradables sector) in commodity booms is less likely to occur. For this reason, the fluctuations in commodity prices are less likely to translate into volatility in the real exchange rate in ASEAN countries than in OECD countries.

**Difference in degree of financial openness**

It is easily recognized that OECD countries have maintained much higher levels of financial openness than ASEAN countries through the period from 1986 to 2014 (see Table 5.22).

The degree of financial openness is measured using the KAOPEN index (Chinn & Ito 2006). As can be seen from Table 5.22, the level of financial openness is high in OECD commodity-exporting countries (except for Iceland). Especially, Canada, New Zealand, Norway and Greece are the most financially open in the world, with KAOPEN values of 2.42 for a long period (Chinn & Ito 2014). For Iceland, before 2008, this country maintained a relatively high level of financial openness, with KAOPEN index of 1.11. In 2008, there was a financial crisis in Iceland. Almost 90% of Iceland’s banking sector failed in October (Iceland 2013a). This systemic banking collapse was the largest experienced by any country in economic history. The crisis led to a low level of financial openness afterwards (KAOPEN was negative, \(-1.18\), from 2008 to 2012).

On the contrary, ASEAN commodity-exporting countries are not very financially open. Specifically, KAOPEN indices of these countries are negative. Myanmar is the least financially open with KAOPEN index of \(-1.88\) most of the time.

According to Bodart, Candelon and Carpentier (2011), the response of the real exchange rate to a commodity price shock will be more pronounced in more financially open economies. They show that if capital is not mobile internationally, interest rate is no longer exogenously given by the world interest rate but is determined endogenously
Chapter 5 – Results and discussion

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Note: KAOPEN index is a measure of degree of financial openness. The data for Brunei is not available.
Source: (Chinn & Ito 2008)
from domestic conditions. It therefore appears that in response to a change in commodity prices, exchange rate will remain unchanged because the marginal productivity of capital and labor in the tradable sector is therefore fixed. This implies that any increase in the export prices will lead to a proportional increase in the domestic interest rate and the wage rate. In turn, the price of nontradables increases in the same proportion, so leaving the real exchange rate unchanged. Thus, the relationship between real exchange rate and commodity prices in ASEAN countries is not as strong as the relationship in OECD countries since ASEAN countries maintain relatively closed financial markets.

Exceptional case

While most OECD commodity-exporting countries are found to have a strong relationship between real exchange rate and real commodity prices, Iceland and Greece are exceptions. According to the preceding discussion, the lack of a long-run relationship between real exchange rate and real commodity prices in Greece can be explained by the late adoption of a free-floating exchange rate. For Iceland, apart from the late adoption of a free-floating exchange rate, the low level of financial openness is also a reason for this.

Among ASEAN commodity-exporting countries, Brunei is the only country where real exchange rate and real commodity prices move together in the long term. This is because of the fact that Brunei is the only country in ASEAN heavily reliant on commodity exports. Oil and natural gas account for more than 90% of this country’s exports. Because of the over dependence of the economy on oil and gas export, the long-run relationship between oil and natural gas prices and real exchange rate is inevitable. This finding is in line with most existing studies on the link between oil prices and real exchange rate such as Doğan, Ustaoğlu and Demez (2012), Koranchelian (2005), Oriavwote and Erriemo (2012), Yinusa and Adedokun (2014) and Bhattacharya and Ghura (2006).

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38 Source: Tradingeconomics
5.4 Summary

This chapter presents the results of unit root tests, cointegration tests and Granger causality tests implemented by both time-series and panel-data techniques. The test results indicate that in OECD commodity-exporting countries, real commodity prices and real exchange rate move together in the same direction in the long run, and changes in real commodity prices will lead to responses of real exchange rate to re-establish the equilibrium. In ASEAN commodity-exporting countries, real commodity prices and real exchange rate do not seem to have a long-term relationship. This chapter gives explanations for the difference in this relationship between OECD and ASEAN commodity-exporting countries, which are differences in exchange rate regimes, ability to expand the natural-resource sector, and level of financial openness between the two groups of countries. In the next chapter, some policy implications will be given for ASEAN commodity-exporting countries in their transition period.
In this chapter, we first discuss development plans of ASEAN commodity-exporting countries and then we explore the future of the real exchange rate – real commodity prices nexus for the time when these countries achieve “developed country” status. And, some policy implications will be provided for ASEAN commodity-exporting countries during the transition period.

6.1 Development plans of ASEAN commodity-exporting countries

6.1.1 Development plans of ASEAN

ASEAN has a long-term plan to become the ASEAN borderless economic community, which has following key characteristics (Institute 2014):

(1) A single market and production base;\(^{39}\)

(2) A stable, prosperous, and highly competitive economic region;

(3) A region of equitable economic development;

(4) A region fully integrated into the global economy.

\(^{39}\) “An ASEAN single market and production base shall comprise five elements: free flow of goods; free flow of services; free flow of investment; free flow of capital; and free flow of skilled labor” (Secretariat 2008).
As being members of the ASEAN regional integration, these countries will gain benefits from expanding markets, growing economic welfare and increasing cooperation opportunities with countries outside the region (Guerrero 2008). To achieve this end goal, ASEAN plans to implement the following key elements of integration:

**Macroeconomic and financial cooperation**

ASEAN encourages macroeconomic and financial cooperation among its members because of its significance in the reform process of member countries as well as the whole region, especially in the recovery of member countries in economic crisis (Institute 2014). This can be implemented by sharing information on the measures to stop crisis situations, cooperation, or through a regional financing arrangement that enables members to meet temporary shortfalls in their foreign exchange reserves in difficult times (Habito, Aldaba & Templo 2004).

Moreover, ASEAN drives toward the financial liberalization in the region, which is consistent with the vision of integrating ASEAN. The financial liberalization requires some prerequisites which cannot be set up in countries with undeveloped financial systems (Habito, Aldaba & Templo 2004). With the development of the financial system of ASEAN members in the future, the financial liberalization in the region is expected in the future.

**Trade development**

ASEAN plans to remove all tariffs as well as non-tariff barriers on all intra-ASEAN goods (Habito, Aldaba & Templo 2004). Moreover, ASEAN is looking forward to a “simple, harmonized and standardized trade and customs, processes, procedures and related information flows” (Secretariat 2008). This will help reduce transaction costs, which will make exports from this region become more competitive, and facilitate the transformation into “a single market for goods, services and investments and a single production base” (Habito, Aldaba & Templo 2004). In particular, liberation of trade in services is one of the significant objectives in the future. A free flow of trade in services will remove limitations in access to ASEAN services suppliers and restrictions in starting businesses across national borders within the ASEAN region (Habito, Aldaba & Templo 2004).
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**Infrastructure development**

To achieve ASEAN regional integration, another important challenge for ASEAN is binding ASEAN countries closer through efficient infrastructure in transportation, telecommunications, and energy (Bhattacharyay 2009). Infrastructure has important roles in promoting growth, facilitating trade within and outside ASEAN, reducing income disparities within a country and inequalities across the region by providing them with access to the larger regional market, linking them to the regional production network and supply chain, or improving resource sharing in the region to provide basic needs, such as water and electricity (Bhattacharyay 2009).

**Science and technology development**

Recognizing the importance of science and technology in facilitating integration and enhancing the dynamism of the region’s economy, ASEAN is making efforts to develop in these fields in the future. It is believed that long-term development of ASEAN can only be achieved with enhanced technologies and knowledge, especially when financial capital has moved faster to other regions of China and India (Habito, Aldaba & Templo 2004). Apart from the purpose of supporting sustained economic growth, development of science and technology also helps address the social needs of the region (Habito, Aldaba & Templo 2004).

**Human resource development**

There has been a large mismatch between the skills required by industry and those provided by universities and by technical and vocational education facilities in ASEAN countries (OECD 2014a). This problem is a significant obstacle to the development of industries, especially technology-intensive ones. Identifying the crucial importance of human capital to their overall development, ASEAN members make efforts to improve their capacity to provide the education and job skills. Furthermore, strengthening human resource development is a must for implementation of custom integration and an ASEAN single window in the future (Habito, Aldaba & Templo 2004).

**Efficient and dynamic small and medium-sized enterprises (SMEs)**

According to (ASEAN 2010), SMEs are the backbone of the ASEAN economies,
accounting for about 96% of enterprises in the region and making a significant contribution to GDP (about 30 – 53%). Dynamic and efficient SMEs will ensure sustainable, inclusive, and broad-based economic and social development. In addition, SMEs will help increase employment and enable more integration of women and youth into the ASEAN economy (ASEAN Secretariat 2015). Therefore, ASEAN makes continuous effort to improve the effectiveness of SMEs by facilitating SMEs’ access to information, market, developing human resource, finance and technology. The improvement is necessary for SMEs to face challenges from a more free-trading environment (Secretariat 2008).

**Narrowing the gap between member countries**

The social disparities and economic development gaps between member countries is a key barrier to ASEAN regional integration (Yong 2012). Hence, ASEAN’s policy challenge is to narrow the social and economic development gaps between its member countries, especially between CLMV countries and the ASEAN six. In fact, the process requires member countries to not only stay on the same track but to keep pace. It is believed that greater efforts are required in poverty alleviation and human capital development to narrow development gaps in the region (OECD 2014a).

**Free and open investment regime**

ASEAN is moving toward a free and open investment regime (Secretariat 2008). Boosting ASEAN’s competitiveness in attracting intra-ASEAN investment as well as FDI is critical for dynamic development of most ASEAN countries. The power to attract FDI will increase if ASEAN provides more protection to all investors and their investments as well as a more clear, coherent investment rules, policies, and procedures and easier access to factors of production (Secretariat 2008).

As planned, both the Framework Agreement on the ASEAN Investment Area (AIA) and the ASEAN Investment Guarantee Agreement (IGA) will be reviewed with improvements to put these investment agreements into reality. It is expected that ability to attract investment to ASEAN countries will be improved.

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40 ASEAN six comprises “Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore and Thailand” (ASEAN Secretariat 2014).
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Environmental cooperation

ASEAN is endowed with rich natural resources that play an important role in supporting economic activities and livelihoods. Increased population and rapid economic growth in this area have created increasing pressures on the natural resources of the region and brought along various environmental issues. It has also led to increased consumption of resources and generation of waste, resulting in unsustainable development. Therefore, ASEAN is facing an enormous challenge in maintaining the subtle balance of environmental sustainability and economic development (Secretariat 2009a).

Taking cognizance of the importance of environmental cooperation for sustainable development and regional integration, ASEAN member countries are committed to integrating global environmental priorities into their own national sustainable development plans (Habito, Aldaba & Templo 2004). At the regional level, ASEAN will work toward achieving sustainable development and a green environment in many ways, such as addressing global environmental issues, managing and preventing transboundary environmental pollution, promoting sustainable management of natural resources, biodiversity, and freshwater, and responding to climate change (Secretariat 2009a).

Regional peace and security

Maintaining regional peace and security is a prerequisite for the development of the economies of ASEAN member countries. It is also a significant factor that influences FDI flows into the region.

6.1.2 Development plans of individual ASEAN commodity-exporting countries

The development plans of each ASEAN member country will be generally in line with the region’s development plans. However, they will depend largely on the country’s particular situation and level of development. In this part, the developmentally key priorities of individual ASEAN commodity-exporting countries will be presented.
6.1.2.1 Brunei

The oil and gas industry has led the Brunei economy for nearly a century. Because of the high dependence on oil and gas, the government plays a large role in the Brunei economy.

Brunei’s key goal in 2030 is to become less dependent on the oil and gas sectors and to create a more diversified economy beyond the hydrocarbon economy (Institute 2014). Moving from an energy-dependent to a more diversified economy is also the key condition for Brunei to be classified as a developed country (Bank 2013).

Another important goal of Brunei is strengthening the private sector and rebalancing the public and private sectors (Institute 2014). This goal would be achieved by providing assistance for the private sector and reducing the cost of doing business. Increased competition would be a crucial condition for developing the private sector. To enhance the competition, a comprehensive competition policy and law is needed (OECD 2013).

The long-term development vision for Brunei also puts priorities on education and human capital development (Rahman 2008). Brunei will make efforts to improve tertiary education, as the tertiary education attainment level is very low (OECD 2013).

6.1.2.2 Laos

Laos is a resource-based economy, which is motivated by agriculture, forestry, hydropower, and minerals. Laos is making efforts to become an industrialized and modernized economy by 2020 and enter the upper-middle income group by 2030 (Chheang & Wong 2012), (Institute 2014).

While the mining sector dominates the economy, its development has threatened environmental and human health (OECD 2013). Therefore, the government is working to improve its management, optimizing the mining of mineral resources, both quantitatively and qualitatively, to ensure environmental sustainability (OECD 2013).

Substandard infrastructure has weakened Laos’ growth of manufacturing and industry and become an obstacle for Laos’ strong economic growth (OECD 2013). The infrastructure development will be beneficial for economic development. Apart from developing infrastructure, building the capacity to manage and operate the infrastructure
is critically important (OECD 2013). Moreover, government will make some reforms to attract more FDI in the mining sector such as introducing a clear investment regime and a greater security of tenure associated with a mining title (OECD 2013).

6.1.2.3 Malaysia

The Malaysian government aims to drive the country into a knowledge- and innovation based economy and become an advanced nation by 2020 (OECD 2013), or possibly earlier (Institute 2014).

Currently, the Malaysian economy suffers from skills shortages, skills mismatches, and weak productivity growth stemming from a lack of innovation in the workforce (OECD 2013). To address these weaknesses in labor market functioning, Malaysia has a plan to strengthen technical and vocational education and training and the education system to address the skills shortage (OECD 2013). The education system needs to be improved with an emphasis on developing analytical and problem-solving capabilities, English, and social networking skills (OECD 2013).

In addition, the services sector of Malaysia is behind that of developed countries and its contribution to GDP as well as productivity has remained largely unchanged in the past ten years (OECD 2013). Further development of the services sector will be critical for Malaysia to become an advanced economy (OECD 2013).

SMEs play an important role in the Malaysian economy (OECD 2013). Therefore, enhancing the productivity of SMEs is a critical part in Malaysia’s development plans. This would be done by encouraging technology and greater innovation adoption by SMEs, enhancing human capital and entrepreneurship development among SMEs, ensuring that creditworthy SMEs have access to financing, expanding market access for goods and services produced by SMEs, improving the infrastructure required for SMEs to operate effectively, and ensuring that the legal and regulatory environment is convenient for the formation and growth of SMEs (OECD 2013).

6.1.2.4 Myanmar

Myanmar aspires to become a knowledge-based economy by 2020 (Htut 2011) and achieve upper-middle income status by 2030 (Institute 2014). In Myanmar, there are significant barriers to business such as “limited access to capital and credit, poor trade
facilitation and high customs related fees, cumbersome business and trade licensing and permits, shortages of electricity, and weak telecommunications and inefficient transportation systems” (OECD 2013). Building a more attractive business-enabling environment and satisfying investors’ requirements will be a policy challenges for Myanmar in the future.

Human capital is another problem for sustainable economic development in Myanmar. Although there has been some improvement in the educational system, more needs to be done to address the skills shortage.

The current banking system is segmented, underdeveloped and poorly connected (OECD 2013). It is regarded as by far the least developed in ASEAN. A top priority of Myanmar is building a strong financial system. It is expected that a stable and efficient financial system is a crucial condition for effective resources allocation, an increase of capital, and faster technological development. In turn, these factors will contribute to the economic growth of Myanmar (OECD 2013). Besides, the Myanmar government plans to develop the private sector to turn it into a driver of development (OECD 2013).

6.1.2.5 Thailand

Thailand aims to develop in a sustainable manner with the principle: People have occupation and incomes, economy and financial system has stability, and its production and consumption do not destroy its environment (Board 2008). Based on sustainable growth in past decades, Thailand targets to become a developed nation with per capita GDP of USD 15,000 by 2030 (Institute 2014).

Thailand has set four main goals to be achieved in the future. They are eliminating poverty through sustained economic growth, enhancing environmental security and sustainability, building a knowledge-based society, and improving government management at all levels of society.

To create a knowledge-based society, one of the major challenges is raising the quality of education and reducing disparities (OECD 2013). In Thailand, the education system has been subject to many weaknesses. For example, the teaching quality is low; poor students cannot attend schools because of financial difficulties; and there are performance differentials between students in urban and rural areas (OECD 2013).
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Although some improvements have been established, more needs to be done to enhance the quality of education and reducing gaps. As Thailand’s economy and society mature, in the next two decades, Thailand will focus on improving access to public services and creating a comprehensive universal welfare system to foster greater social cohesion (Institute 2014).

6.1.2.6 Vietnam

By 2030, Vietnam intends to increase its per capita GDP level four times (reaching $4,700), making the country enter the upper-middle income group. Vietnam has diversified its economy away from agriculture and is currently fostering eco-tourism and new green industries (OECD 2013).

Similar to other countries in the region, the lack of a skilled workforce needs to be solved to adapt to the needs of industry. Thus, reforms to the vocational training and education systems, including further encouragement of workplace training are required (OECD 2013).

The financial system of Vietnam is subject to many weaknesses. Extensive bad debt has prevented banks from functioning as the key lender to the economy (OECD 2013). In the medium-term, the bad debts should be addressed and in the long-term the banking sector needs to improve its governance and strengthen regulatory oversight (OECD 2013).

Macroeconomic instability, with continued high inflation, high interest rates, a large trade deficit and rising public debt is also a primary problem of Vietnam. In the medium and long term, Vietnam plans on driving its monetary policy towards monitoring inflation and diminishing fluctuations in macroeconomics (OECD 2013).

Besides, state-owned enterprises (SOEs) control key industries of the economy. Reforms to ownership diversification of SOEs should be broadened in the future. Moreover, Vietnam will focus on strengthening the governance of SOEs and oversee the SOEs performance to enhance its effectiveness.
6.2 Predictions for the relationship between exchange rate and real commodity prices in ASEAN commodity-exporting countries

As discussed in Section 5.3, the differences in the relationship between exchange rate and commodity prices in OECD and ASEAN commodity-exporting countries is explained by the difference in exchange rate regimes, ability to expand the natural-resource sector, and level of financial openness between the two groups of countries.

According to development plans mentioned in Section 6.1, Thailand, Malaysia and Brunei could become developed nations by 2030 by further developing their service sectors. Meanwhile, Laos, Myanmar and Vietnam need more time and effort to reach the “developed country” status. In the medium-term, these three less-developed countries will concentrate on industrialization and overall socioeconomic development.

In fact, the journey to become developed would not be the same for all ASEAN developing commodity-exporting countries. However, it is expected that on the way to achieving the “developed country” status, the three factors including exchange rate regimes, ability to expand the natural-resource sector, and degree of financial openness in ASEAN developing countries would be likely to evolve toward the trend currently seen in OECD developed countries. The three factors will be clarified as follows:

**Exchange rate regime**

Currently, most ASEAN commodity-exporting countries run managed floating exchange rate regime. This regime is popular among developing countries as it can help these countries obtain the benefits of a free-floating exchange regime while still enabling them to intervene and minimize the risks associated with a free-floating currency (Boundless 2015).

According to the development plans, all ASEAN member countries aim at realizing the promise of ASEAN financial integration. At the time when ASEAN commodity-exporting countries reach “developed country” status or at least become more financially integrated in the global capital markets, these countries would adopt a freely floating exchange rate. This prediction is made based on the findings of existing studies.
Ghosh and Ostry (2009) claim that emerging market countries and developing countries should adopt a freely floating exchange rate when they become more financially integrated. Yagci (2001) also confirms that in developed countries and some emerging market economies which are fully integrated in the global capital markets, and have a strong financial sector, a freely floating exchange rate is the most suitable regime. This trend is supported by Bordo and Marc (2001) and Sullivan (2001). Bordo and Marc (2001) provide evidence that countries with more developed financial systems tend to have floating exchange rate regimes. In line with this finding, Sullivan (2001) inspects the evolution of exchange rate regimes in a large sample of countries in 1990s and detects that there was a trend away from intermediate regimes (including stabilized arrangement, crawling peg, crawl-like arrangement, and pegged exchange rate) toward floating regimes. In emerging-market countries, there was a decline in intermediate regimes from 64% to 42%, while floating regimes increased from 30% to 48%.

According to the discussion about factors causing the differences in Section 5.3, a more floating exchange rate might lead to a tighter relationship between commodity prices and exchange rate in ASEAN commodity-exporting countries.

**Ability to expand natural-resource sector**

As mentioned in Section 5.3, during the last three decades, ASEAN commodity-exporting countries have depended on FDI to develop the extractive industries. However, the ability to attract FDI in the extractive industries in ASEAN is limited. It is one of the main reasons leading to the lack of relationship between real exchange rate and real commodity prices in ASEAN commodity-exporting countries. It is expected that the ability to allure FDI in extractive industries in these countries will be improved considerably on their way to achieving “developed country” status.

Following the development plans of ASEAN developing commodity-exporting countries, the current obstacles for foreign investors in extractive industries will be gradually removed and FDI will be growing. To clarify, first, ASEAN is moving toward a free and open investment regime. This regime will help create an investment-friendly environment to attract more investment from both intra-ASEAN and outside ASEAN. Second, the improvement of the ASEAN countries’ government systems will be another factor appealing FDI into the natural resources extraction industry. When being
implemented, reforms in governance such as clearer, consistent investment rules and regulations, simpler and fast procedures, easier access to factors of production, and more protection to all investors will definitely encourage foreign investment. Third, the development of physical infrastructure including roads, railways, ports, airports, electricity, water, sanitation, and telecommunications in remote areas of ASEAN countries will encourage investors to implement the extraction of natural resources since most mineral resources are located in remote areas (ASEAN 2014b).

Additionally, with the goal of becoming a highly competitive economic region, the participation of private sectors in natural resource extraction is encouraged (Secretariat 2008). Greater competition implies that the extractive industries will be not tightly controlled by the government any longer and will become more efficient. Together with the development of technology and human resource as well as freer access to the ASEAN integrated region’s capital market, ASEAN commodity-exporting countries would be able to run the natural resources industries on their own.

To sum up, on the way to ASEAN commodity-exporting countries becoming developed ones, domestic enterprises would have the ability to run the natural-resource sector and foreign investors would penetrate into this sector or expand their current operations easily as barriers to FDI would be removed. Because of that, in the future, ASEAN commodity-exporting countries could expand their natural-resource sector at any particular time without difficulties as OECD commodity-exporting countries do. It can be predicted that there would be a movement of capital and labor from the nontradables sector to the natural-resource sector (main tradables sector) in commodity booms. As a result, the fluctuations in commodity prices would be translated into volatility in the real exchange rate in ASEAN commodity-exporting countries.

**Degree of financial openness**

As a part of the ASEAN Economic Community, financial integration in ASEAN should accelerate in the years ahead (Almekinders et al. 2015). A modern, ASEAN integrated financial services system together with greater integration with capital-abundant regions comprising China, Japan, and Korea could end up drawing a huge amount of capital into ASEAN (Almekinders et al. 2015). To gain benefits from ASEAN financial integration, individual ASEAN commodity-exporting countries will take steps toward
further financial liberalization. The financial liberalization will help ASEAN less-financially developed economies catch up with the more developed ones (Almekinders et al. 2015). Bekaert, Harvey and Lundblad (2011) also show that financial openness is often associated with higher rates of economic growth.

In short, in the process of development, ASEAN commodity-exporting countries will become more financially open. This implies that the real exchange rate will respond more strongly to a commodity price shock in ASEAN in the future.

To sum up, on the way to achieving the “developed country” status, the changes in exchange rate regimes, ability to expand the natural-resource sector and degree of financial openness will make the relationship between real exchange rate and commodity prices in ASEAN commodity-exporting countries stronger. With the similarity to OECD countries in respect of demographics, commodities export, financial markets, economic performance and development prospects (as discussed in Section 2.3), when reaching “developed country” status, the relationship between commodity prices and real exchange rate of ASEAN should be similar to that of OECD. In particular, real exchange rate and real commodity prices will move together in the long run and real exchange rate will respond to changes in commodity prices to maintain that equilibrium. These characteristics are totally consistent with the Cashin, Céspedes and Sahay (2004) theory about exchange rate and commodity relationship.

6.3 Policy implications for ASEAN commodity-exporting countries in their transition period

Commodity prices are well known for being excessively volatile. Commodity prices are subject to cyclical variation and the amplitude and frequency of these cycles is also highly variable, with booms and busts that last many years (Kirchner 2008). It is believed that commodity prices are “even more volatile than other prices that adjust on a daily basis such as financial prices” (Dwyer, Gardner & Williams 2011).

There is a trend that the relationship between real exchange rate and real commodity prices will become stronger on the way to ASEAN commodity-exporting developing countries turning into developed nations. From the time in the transition period when the relationship between real exchange rate and real commodity prices becomes strong
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enough ("Strong relationship point" in Figure 6.1), or commodity prices begin to lead exchange rate in the long run, the volatility from commodity prices will be transferred to real exchange rate. In other words, from time “t” (see Figure 6.1) upwards, the volatility from commodity prices will be transferred to real exchange rate.

However, the effect of real exchange rate’s volatility on the economy is highly reliant on a country’s level of financial development (Eichengreen 2007), (Aghion et al. 2009), (Clark et al. 2004). For countries with less developed financial systems, the real exchange rate’s volatility has clear adverse effects on economic performance (Eichengreen 2007). Aghion et al. (2009) find that in financially underdeveloped economies, a more volatile exchange rate is negatively related with productivity growth. Clark et al. (2004) also shows that the variability of exchange rates will lead to smaller trade with developing countries with less developed and less liquid foreign exchange markets. In addition, Serven (2002) states that the undesirable impact of real exchange rate volatility on investment is significantly larger in economies with less developed financial systems.

As countries become more financially developed, these adverse effects will shrink in magnitude. For countries with well-developed financial sector, exchange rate volatility is not a serious problem. According to Bailliu and John (2002), Aghion et al. (2009), and Clark et al. (2004), exchange rate uncertainty is less likely to affect productivity growth, investment and trade flows in countries with developed financial sectors. This is explained by the fact that a well-developed financial sector can help reduce negative effects on the economy as it is able to absorb exchange rate shocks and provide agents with appropriate hedging instruments to guard against the risk associated with high exchange rate volatility (Bailliu & John 2002).

We assume that the "Developed financial sector point" (see Figure 6.1) is the point when the financial system of an ASEAN commodity-exporting country is developed enough. From that time on, the volatility will not have much negative impact on the country’s overall economy. In other words, from point “k” (see Figure 6.1) upwards, the long-run relationship between real exchange rate and commodity prices will not adversely affect the ASEAN country’s economy.
In the transition period to becoming developed countries of ASEAN commodity-exporting countries, the relationship between real exchange rate and commodity prices has a tendency to be stronger, and the financial sector will become more developed. This trend can be easily seen in Figure 6.1, through lines (1) and (3).

In this transition period, there are two situations that might happen. The first situation is that “Developed financial sector point” occurs before or at the same time with “Strong relationship point.” In this situation, it can be assured that on the journey to become a developed country, the long-run relationship between real exchange rate and real commodity prices will not have a negative impact on the economy. Another one is that the “Developed financial sector point” occurs after “Strong relationship point.” This situation is illustrated in Figure 6.1. In the period between “Strong relationship point” and “Developed financial sector point” (the period from “t” to “k”), the long-run relationship between real exchange rate and real commodity prices will bring harmful effects to productivity growth, trading, and investment.

**Figure 6.1 – Policy implication target for ASEAN commodity-exporting countries**
So, there is a possibility that the economy of an ASEAN commodity-exporting country will be negatively influenced by the relationship between real exchange rate and real commodity prices on that country’s development process. Indeed, these negative impacts stem from the excessive fluctuation of commodity prices. Because of the long-run relationship between real exchange rate and real commodity prices in the future (real commodity prices lead real exchange rate), the volatility of real commodity prices will be transferred to real exchange rate. Then, it is the real exchange rate volatility that negatively affects the economy. It can be said that in the transition period, there is a possibility that commodity prices volatility adversely affects the economy through the real exchange rate channel.

In this chapter, we made some suggestions for ASEAN commodity-exporting countries to reduce negative effects of commodity volatilities on the economy on their way to becoming developed. This goal can be achieved through three approaches. The first approach is weakening the transfer of volatility from real commodity prices to real exchange rate. The second approach is minimizing the effects of commodity prices volatility and the last one is reducing the dependence on commodity exports. Following these three approaches, some suggestions are made for policy makers as follows:

### 6.3.1 Smooth spending

As discussion in Section 5.2.3, real commodity prices affect real exchange rate through two channels: spending effect and movement effect. If we can reduce the spending effects, the transfer of volatility from real commodity prices to real exchange rate will be diminished. Maintaining smooth government spending over time would help lessen volatility and its harmful impact on the economy. It can be achieved through a proper and stable spending plan. The introduction of rules for how much of the commodity export revenues can be spent and how much can be saved is significant. To lessen the economy’s vulnerability to commodity shocks, we suggest avoiding overspending in boom times.

ASEAN commodity-exporting countries could learn from the experiences of Chile. The copper resources management of Chile are often mentioned as a success. The surplus from export (in foreign currency), which is earned in excess based on the pre-established reference price, is deposited on a quarterly basis in Chile’s Copper
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Stabilization Fund’s Central Bank account. In case of a drop in copper prices, the fund would be used to cover budget spending (Ruiz-Dana 2007). Moreover, the fund could be withdrawn to fulfill debt obligations (Ruiz-Dana 2007). In short, Chile’s Copper Stabilization Fund performed as a savings account, protecting the economy and the fiscal budget from the effects of price volatility.

ASEAN commodity-exporting countries should run a stabilization fund, which is similar to Chile’s Copper Stabilization Fund. The fund will help foster export growth by controlling the boom’s effect on the exchange rate implications. When commodity prices drop below its long-term forecasted price, the government would withdraw funds to strengthen the economy. In the reverse situation, increasing saving is necessary to cope with increased foreign currency inflows. As high domestic spending can put pressure on the type of exchange rate, the fund can be invested abroad to avoid such pressure.

6.3.2 Diversifying export commodities

Although prices of different commodity prices are volatile, they do not always move together. At a particular period, some commodities’ prices are upward, while other commodities’ prices show downtrend. Being reliant on many export commodities tends to reduce the volatility of commodity prices on the whole. This will be followed by a decrease in real exchange rate’s volatility because there is a long-run Granger causality from commodity prices to real exchange rate.

This solution is in line with Bodart, Candelon and Carpentier (2011) which shows that a high degree of export diversification will decrease the effect of commodity prices on real effective exchange rate. In conclusion, commodity diversification will be useful for ASEAN countries in attempting to diminish the effect of commodity volatility on real exchange rate in the future.

6.3.3 Diversifying economies

Another way to diminish the negative effects of commodity prices volatility on the overall economy is diversifying the economy to make it less dependent on commodity exports. When the contribution of commodity exports to the total revenue is decreased, commodity prices movement will definitely have less impact on the economy.
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This solution is based on Australia’s historical experience. Although being a major exporter of commodities, frequent and large commodity price shocks have had a much more modest impact on Australia’s economic performance than other commodity-exporting countries (Bhattacharyya & Williamson 2011). This can be explained by the diversification of Australia’s economy (Bhattacharyya & Williamson 2011). Australia expanded the industrial sector before 1970 and the service sector since 1970. During recent decades, the service sector has become the backbone of Australia’s economy with GDP composition of more than 70% while the mining and agricultural sectors has made only an insignificant contribution to GDP growth (Bhattacharyya and Williamson 2011; Kirchner 2008). A minor contribution of commodity production and exports to the overall economy is the reason for small impact of commodity prices fluctuation on Australia’s economy.

This solution is particularly suitable for Laos and Brunei where the revenue from commodity exports account for large share of their GDP. To reduce over-reliance on commodity exports, apart from developing manufacturing and service industry, ASEAN commodity-exporting countries should step up the export of manufacturers with high skill and technology intensity and reduce the export of primary commodities. In addition to reducing adverse effects caused by commodity prices volatility, increased manufacturing exports can create higher incomes for ASEAN commodity-exporting countries.

6.4 Summary

This chapter presents the development plans of ASEAN commodity-exporting countries. Based on the development plans, it is expected that on the way to achieving the “developed country” status, three factors causing the differences in the real exchange rate – real commodity prices relationship between the two groups of countries (mentioned in Section 5.3) would be likely to evolve toward the trend currently seen in OECD commodity-exporting countries and make the relationship become stronger. This chapter provides some policy implications for ASEAN for those countries in the transition period in order to reduce the negative effects of the relationship on the overall economy. We suggest that ASEAN countries should smooth their government spending, diversify export commodities and diversify their economies.
In this chapter, we conclude our work with the summary of the thesis. In addition, we also present the limitations of the study as well as provide directions for future research.

### 7.1 Summary of the thesis

This thesis aims to investigate if the relationship between real exchange rate and real commodity prices differs between developed and developing countries. However, our focus is OECD and ASEAN regions. The comparison is based on the results of the empirical study on the relationship between real exchange rate and real commodity prices for the period from 1986 to 2014. This relationship is examined in terms of cointegration, elasticity of real exchange rate to real commodity prices, and Granger causality. To gain a comprehensive understanding about this relationship in developed and developing countries, this thesis employs both time-series technique (for individual countries) and panel-data technique (for each group of countries).

According to the test results, the two research questions of the thesis are addressed. Regarding the first question, in most OECD commodity-exporting countries (except for Iceland and Greece), real exchange rate and real commodity prices are found to be cointegrated; the long-run elasticity of real exchange rate to real commodity prices is positive and there is long-run Granger causality running from real commodity prices to real exchange rate. Meanwhile, in most ASEAN commodity-exporting countries (except for Brunei), real exchange rate and real commodity prices are not cointegrated and there is no Granger causality between real commodity prices and real exchange rate.
Accordingly, there is considerable difference in this relationship between OECD and ASEAN commodity-exporting countries.

The differences in the relationship between OECD and ASEAN commodity-exporting countries can be explained by differences in exchange rate regimes, ability to expand the natural-resource sector, and level of financial openness between the two groups of countries. Besides, some explanations are also given for the exceptional cases of Iceland, Greece, and Brunei. It is predicted that on the way to achieving the “developed country” status, the three factors including exchange rate regime, ability to expand the natural-resource sector and the level of financial openness of ASEAN commodity-exporting countries would be likely to evolve toward the trend currently seen in OECD commodity-exporting countries and the relationship between real commodity prices and real exchange rate in these countries would become stronger. This assumption is made on the basis of similarity between OECD and ASEAN in terms of demographics, commodities export, financial markets, economic performance, and development prospects.

However, a stronger relationship between real exchange rate and real commodity prices can be detrimental to the economy, especially when a country’s financial system is not developed enough. In order to reduce negative effects of the relationship on the overall economy, this thesis suggests that ASEAN commodity-exporting countries smooth their government spending, diversify export commodities, and diversify their economies.

### 7.2 Limitations of the thesis

This thesis has some limitations that need to be acknowledged. They are limitations identified in research methodology, research scope, and analysis.

**Limitations regarding the research methodology**

There are three limitations regarding the methodology. The first limitation is the low power of traditional unit root tests and the Johansen (1998) cointegration test. Specifically, unit root tests including the ADP test and PP test are notorious for low power, according to Cochrane (1991), DeJong et al. (1992) and Maddala and Kim (1998). Hatanaka (1996) also points out that with a sample size of 100, characteristic roots between 0.9 and 1.0 cannot be distinguished from a unit root. Regarding the
Johansen (1998) cointegration test, Reimers (1992) and Toda (1995) state that this test is quite sensitive to the values of the nuisance parameters in finite samples and therefore not very reliable for sample sizes that are typical for economic time series.

Second, although LSDV is chosen as the estimator for panel VAR and VEC models in our thesis, this estimator can yield biased and inconsistent results (see Section 4.3.2.4 for more details). Owing to a large number of time-series observations (N), bias is likely to be of limited significance since it is negatively related to N. However, to some extent, LSDV also affects quality of estimation results.

Third, while three-month risk-free Treasury Bill Rate is regarded as the most suitable interest rate for our study, the three-month Deposit Rate is chosen in our analysis because data for three-month risk-free Treasury Bill Rate are not available for all countries. This replacement might affect the accuracy of test results to some extent.

**Limitations regarding research scope**

This thesis limits the scope to the comparison of the relationship between real exchange rate and real commodity prices in OECD and ASEAN countries. Thus it might not be sufficient to provide a complete picture of such comparison between developed and developing countries.

**Limitations regarding analysis**

There are four limitations identified in the analysis.

The first one is related to test results analysis. This thesis provides three factors explaining the differences between the relationship between real exchange rate and real commodity prices in developed and developing countries. They are exchange rate regimes, ability to expand the natural-resource sector, and level of financial openness. Nevertheless, it cannot be confirmed that the differences are only caused by these three factors. There might be other reasons leading to the differences that have not been discussed in this study. Moreover, the explanations are only based on “Dutch Disease” theory and findings of existing studies, without being proved again by qualitative analysis.

The second limitation is regarding policy implications. It is worth noting that policy implications for ASEAN commodity-exporting countries are not necessary for the
whole transition period but only for the period when the relationship between real exchange rate and real commodity prices is strong enough and the financial development is not developed enough. The limitation is that this policy implications targeted period is still vague because how much is “enough” has not been defined yet.

The third one is that the use of international prices for all commodities might lead to the bias of the nominal country-specific commodity prices index to some extent.

Last, this thesis relies on the development plans of ASEAN commodity-exporting countries and the similarity between OECD and ASEAN to make assumptions about the future of the relationship between real exchange rate and real commodity prices in those ASEAN countries when they reach “developed country” status. And, the policy implications for ASEAN commodity-exporting countries in the transition period are also made based on these assumptions. However, it should be acknowledged that these assumptions are only what are likely to occur in the future.

7.3 Future research

Based on the significant limitations of this thesis, we provide some suggestions for further research.

Larger scope

Further studies should consider a larger set of developed and developing commodity-exporting countries. While OECD includes most developed countries in the world, ASEAN is only a minor group of developing countries over the world. Developing countries of SARRC, Latin America, or Sub-Sahara Africa could be added to a set of developing countries in order to obtain a more comprehensive comparison between the real exchange rate—real commodity prices relationship in developed and developing countries.

Determine factors causing differences in relationship by qualitative study

In this thesis, the three factors explaining differences in the real exchange rate – real commodity prices relationship between OECD and ASEAN are given only based on theory and findings of existing studies. These factors have not been re-checked by
qualitative studies. A qualitative study that determines factors causing the differences between the relationship in OECD and ASEAN, would be of great significance. By considering potential variables that might affect the relationship, a qualitative study would help confirm what factors bring about the differences as well as the impact magnitude of each factor. Such work would make a good contribution to the literature.

**Figure out the “enough” points**

As mentioned in Section 7.2, one limitation of this thesis is the vagueness of the “enough” points. Future research is recommended to figure out the point when the relationship between real exchange rate and real commodity prices is strong enough to adversely affect the overall economy and the point when the financial system is strong enough to resist the negative impact of the relationship between real exchange rate and real commodity prices. In other words, future research should determine what is the indicator, or what specific conditions are to be met, for understanding that the relationship and also the financial system is strong enough. This concern is obviously not easy to be addressed. Once this concern is solved, it would help each ASEAN commodity-exporting country to know when the relationship between real exchange rate and real commodity prices will have negative impacts on its economy. Based on this information, necessary measures can be taken in proper time to minimize negative effects.

**7.4 Summary**

Apart from summarizing the key points of the thesis, this chapter points out significant limitations of our study in terms of research methodology, research scope and analysis, as well as opportunities for future research. This information might be useful for researchers interested in conducting studies in the same field.
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