PIGEON PEA EXPORT INDUSTRY IN MYANMAR

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MASTER OF ECONOMICS

GRADUATE SCHOOL
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A THESIS SUBMITTED TO CHIANG MAI UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ECONOMICS

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THIS THESIS HAS BEEN APPROVED TO BE A PARTIAL FULFILLMENT OF
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ABSTRACT

This study analyzes pigeon pea export industry in Myanmar, and its composition in export sector of Myanmar during the period 1985-2013. Pigeon pea export and production in Myanmar gained attention in trade sector due to India and EU market demand. This paper analyzes the relative importance of five variables including pigeon pea production, export values, exchange rate, agricultural land and rural population. The data covers the annual data from 1985 to 2013. Autoregressive distributed lag (ARDL) models used for the analysis of long-run relations while Error Correction Model is applied for short run analysis. The results suggested that the exchange rate has relationships with economic growth. In this study, last year real economic growth rate and exchange rate of pigeon pea exports provide significant in both long run and short run estimations. It was also determined that both long run and short run estimations, although significant, results were capable of explain the presence of short run affecting the current year economic conditions.

หัวข้อวิทยานิพนธ์	อุตสาหกรรมการส่งออกถั่วแระในประเทศเมียนมาร์	
ผู้เขียน	นางสาวโม ฮนิน เอย์	
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บทคัดย่อ

งานวิจัยในครั้งนี้ เป็นการศึกษาวิเคราะห์ของอุตสาหกรรมการส่งออกถั่วแระในประเทศเมียนมาร์ และองค์ประกอบการส่งออกในประเทศเมียนมาร์โดยใช้ข้อมูลอนุกรมเวลา (time-series data) ในระหว่างปี ค.ศ. 1985 ถึง 2013 การปลูกและส่งออกถั่วแระของประเมียนมาร์ได้รับความสนใจในตลาดการค้า เนื่องมาจากความต้องการในตลาดของประเทศอินเดีย และ สหภาพยุโรป งานวิจัยนี้ได้ทำการวิเคราะห์ปัจจัยที่สำคัญได้แก่ ผลผลิตของการปลูกถั่วแระ มูลค่าการส่งออก อัตราแลกเปลี่ยนเงินตราต่างประเทศ พื้นที่ทางการเกษตร และจำนวนประชากรในพื้นที่ชนบท เพื่อใช้การวิเคราะห์ข้อมูลในระหว่างปี ค.ศ. 1985 ถึง 2013 แบบจำลองทางสถิติ Autoregressive distributed lag (ARDL) ใช้เพื่ออธิบายความสัมพันธ์ในระยะยาว แบบจำลองการปรับตัว และระยะสั้น ผลการศึกษาเสนอแนะว่าอัตราแลกเปลี่ยนเงินตราต่างประเทศ มีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติ กับการอัตราการเจริญเติบโตทางเศรษฐกิจ ทั้งในระยะยาวและระยะสั้น อีกทั้ง การวิเคราะห์ ในระยะยาวและระยะสั้นถึงแม้ว่าอย่างมีนัยสำคัญทางสถิติ ผลการศึกษาสามารถนำไปอธิบายการปรากฏผลกระทบในระยะสั้นของอัตราแลกเปลี่ยนเงินตราต่างประเทศ ต่อสถานะทางเศรษฐกิจ

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CHAPTER 1

Introduction

1.1 Background of the Study

Myanmar is an agricultural country and its rural population is about 65% of the whole population. Many people's lives rely on agricultural products.. Even though the country is rich in natural resources, abundant in labour and has low costs of production, the country is weak in producing skilled labour and applying modernized techniques and equipment. Nevertheless, Myanmar is situated at a strategic location between two of the world's largest populations, India and China. The surroundings of Myanmar are supportive to be a Trade Hub according to the strategic geographic location. However, after 1948 under military regime, Myanmar was not able to be involved in the movement of international trade and regional economic transactions due to the country's political situations. In 1988, the country set an open door policy and foreign trade become accelerated. In addition, the country was transformed from a military government to democratic government in 2011 and since then, the country regained the world's attention, and all the trade processes were accelerated and more open.

Myanmar is now known as the last frontier and stands out among the developing countries after transforming to civilian rule. Previously, when the country was trapped under the sanctions, most of the trade was done within the Asian region. However, now the country is being relieved of economic sanctions under civilian government. Therefore, in Myanmar, not only the agricultural sector but also the other sectors have a lot of potential to grow rapidly due to high interests of investors around the world. Myanmar is one of the ASEAN member countries. It has many chances and potential under AEC integration. With the free trade within ASEAN region, the country can have greater

chances to expand the trade sectors and investment sectors. Myanmar economic growth has regained to the current growth rate of 8.25% in 2015 after a sudden decline in 2008 as shown in Fig 1.1 due to the global financial crisis and Nargis Cyclone. During 1990 to 1991, the country experienced political instability and the whole economy was in a down turn. However, the country is now open for many investments around the world under the newly elected civilian government.

Source: World Bank

Figure 1.1 Real GDP Growth Rate in Myanmar

1.1.1 Myanmar's Trade Performance

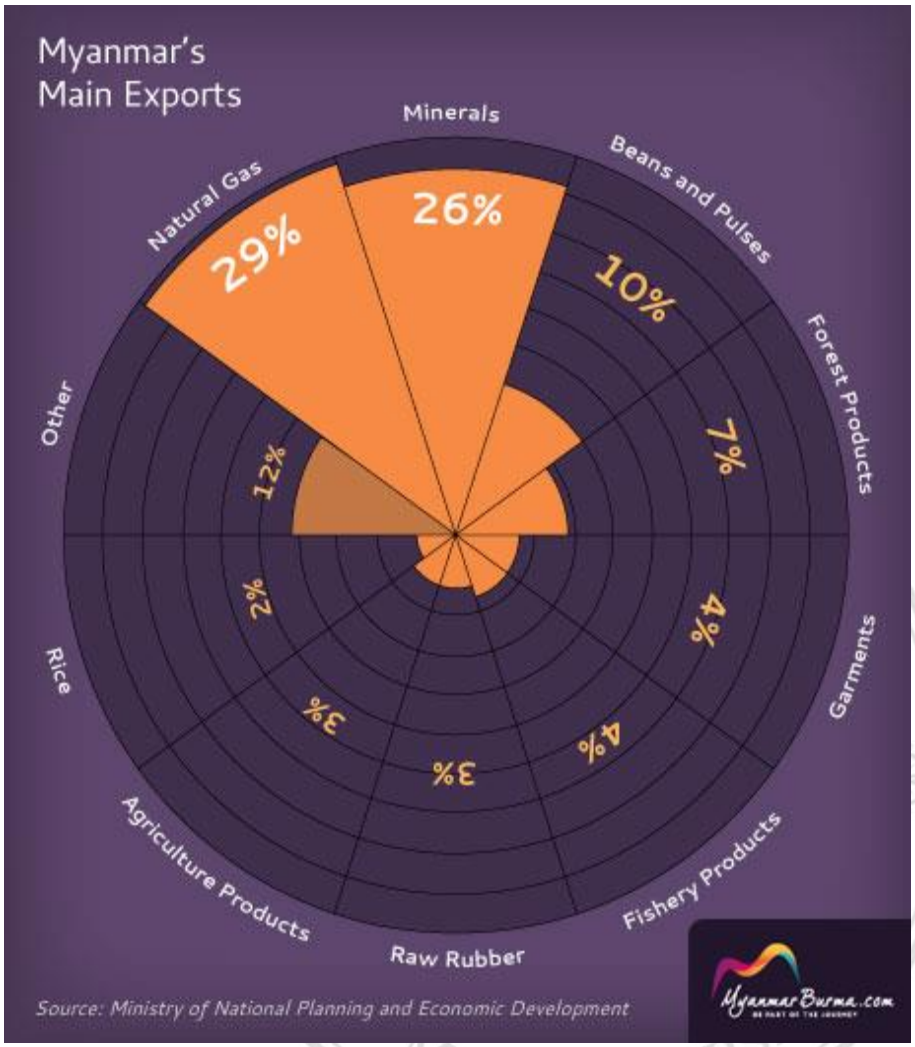
Myanmar's trade conditions have mainly relied on the exchange rates fluctuations. During the military regime in Myanmar, the currency exchange market was not liberalized and two markets had arisen; official and unofficial. The Central Bank in those years did not have the full autonomy and the exchange rate depended on the market demand and supply conditions. In 2012, the Central Bank gained autonomy and many currency exchange counters were allowed to operate under the Central Bank's supervision.

Increasing exports can enhance the economic growth of a country as well the lives of its people by earnings upon trading. This can increase income (per capita GDP)

in a country, which leads to an increase in economic growth. Through export promotion, the country can extend productivity, gain experiences and connections, and earn foreign currencies. On the other hand, import substitution has to be practiced. In Myanmar, the government practices both export promotion and import substitution.

By doing export promotion, the country is able to manage its resources efficiently and effectively. The policy of export promotion is set for the local firms to produce more for foreign countries and enter into the international markets by providing better quality of output and lower costs compared to the other competitors. As for the import substitution, it is for the purpose of allocating resources locally and producing substitute goods in the place of imports by imposing tariffs and barriers on import goods.

In the past, Myanmar was Asia's largest rice exporter and occupied nearly one third of total world's teak production. Myanmar's main exports in 2014 is as shown in Fig 1.2. The country relied mainly on natural gas export, which is 29% of the total export followed by minerals, which is 26%. These exports include natural resources such as natural gas, petroleum, petroleum products, precious stones, tin, tungsten, zinc, coal, copper, lead, and cement. The third main exports are beans and pulses, which are 10% of the total exports. This can be explained as the main agricultural exports for Myanmar are beans and pulses when compared with the rice exports of just 2%. The rest of the main exported goods are forest products which contributes 7% of the total exports, garments at 4%, fishery products at 4%, raw rubber at 3% , other agriculture products except beans, pulses and rice at 3%, and other commodities at 12% respectively.



Source: Ministry of National Planning and Economic Development 2015

Figure 1.2 Myanmar's Main Exports

Table 1.1 Export of Principal Commodities of Myanmar from 2010-11 to 2014-15

(US$ Million)

Commodities	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**
Agricultural Products	1228	1518	1245	1058	1240
Animal Products	13	9	20	11	8
Marine Products	287	452	373	206	160

Table 1.1 Export of Principal Commodities of Myanmar from 2010-11 to 2014-15 (continued)

(US$ Million)

Commodities	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**
Timber	594	605	574	898	42
Base Metal and Ores	42	71	71	107	426
Precious and Semi-precious	2028	41	12	604	280
Gas	2523	3503	3666	3299	3707
Garment	379	497	695	883	1022
Other Commodities	1767	2440	2321	4138	5639

Source: Statistical Yearbook CSO (2015)

In the above table, the statistics showed that the country's export sector is developing under the civilian government led by President U Thein Sein. Among the exports data during the five year period, gas sector is the highest earnings, followed by agricultural products and garments. Garment production accelerated and reached to USD 1022 millions in 2015. Many investors in garment industries came to Myanmar due to its youthful population and low labor costs.

This question aimed to answer an authorial target about how the pigeon pea production and current conditions and to test factors of pigeon pea export market influencing on the real GDP growth rate of Myanmar.

1.2 Purpose of the Study

The purposes of this study is to investigate the pigeon pea production and export market in Myanmar for the period of 1985- 2013 by using ARDL approach to co-integration method. The following are the main purposes of this study.

a. To study how export and pigeon pea production are contributing to the economic growth of Myanmar.

b. To analyze the effect of exchange rate, export, pigeon pea production, agricultural land, and rural population on the real GDP growth rate of Myanmar

1.3 Scope of the Study

The study focuses on pigeon pea production and exports and how those impact on economic growth in Myanmar. The study also focuses on empirical studies of cultivation and production of pigeon peas in Myanmar. The data is collected from reliable sources: World Bank, Food and Agriculture Organization of United Nations, and CSO Myanmar.

Table 1.2 Summary of the Scope of the Study

Scope	Myanmar
Time	1985-2013 (28 years)
Data Source	World Bank, Food and Agriculture Organization, CSO Myanmar
Method	ARDL approach to co integration

1.4 Advantage of the Study

This study contributes to the foundation of the literature in the pulses and beans exportation. At the theoretical view and practical insight, this thesis represents the first exploration of the competitiveness attributes of the pigeon pea in Myanmar's pulses and beans sector. This empirical study is beneficial to practitioners or academics interested in making further refinement of determinants of pulses and beans export performance. This study aims to provide the market conditions of beans and pulses, production and export conditions of pigeon pea, and to encourage the government to develop policy related to agricultural sector development so that it can enhance the lives of people living in the rural areas. The results of this study can help to promote the beans and pulses export performance and production.

CHAPTER 2

Theory and Literature Reviews

2.1 Theory

In the last decades, export plays an important role for stimulating economic growth. This has been become debates especially for the development economists. Exports of the Emerging Countries in East Asia also make acceleration for this debate. Based on their success stories, economies in Africa and Latin America are now facing with increasing growth rates. However, trade theory did not provide the casual relation between exports and output growth. Many researchers have to rely on empirical studies for doing research. Some scholars discussed that causality between exports and economic growth can be expressed as export-led growth hypothesis. On the other side, causality between growth and exports as growth-led exports.

Classical economic theory was developed that trade can benefit a country through specialization over comparative advantage. This can be explained as if a country was fully focus on doing trade, then sell in international market. If the country is in this way, imports cannot produce domestically. Countries specialized on trade can gain a surplus of productive capacity if they can produce extra over local consumption. This can enhance the economic growth of the countries for purchase of imports and expand local market. Trade can improve the market performances and earn foreign currencies for a country so that it can upgrade the lives of its people. Moreover, a country can get lots of benefits through trade, entering international markets and exchanging technologies and experiences. Traders can earn profits and this can create wealth for them so that they can reinvest in their production facilities. Through export, it can have a spillover effects on

the other sectors development of a country. Export-led growth is vital based on the two reasons.

Firstly, export-led growth can generate profit that allows a country for the needs of finances. Secondly, increase in export can make higher productivity. Export promotion and import substitution policies are now practicing by many countries to enter and integrate into the world economy. Governments should encourage local industries to upgrade their technologies in their existing industries to have competitive advantage over competitors by producing diversified goods and large quantities. This is the best practices for the developing countries to apply to their economies.

2.1.1 Cobb-Douglas Production Function

Based on Cobb-Douglas production function for Pigeon Pea production, a farm's pea productivity can be assumed as the function of Pigeon Pea Production Labour input (L), materials like fertilizers (M), physical capital investment (K), human capital (H) and physical resource endowment (R). Each farm's pigeon pea productivity is the pea crop yield weighted by farm area and crop price. The Pigeon Pea production equation can be written as follows:

$$Y = f(L, M, K, H, R) \quad (1)$$

Generally, most production functions measure simply Labour (L) and Capital (K) as production inputs for Pea production. Mostly, production output can be regarded as the yields of pigeon peas produced by farms. Although the data on production output and production labour force can be available, the data on physical capital investment (K), human capital (H) and physical resource endowment (R) cannot. That is why it is hard to examine the diverse components of utilization inputs for Pigeon Pea production.

Thus the Cobb-Douglas production function used and estimated by Cobb and Douglas (1928) can be expressed as:

$$Q = AL^{\beta 1}\ K^{\beta 2} \quad (2)$$

Q denotes the output quantities of production function, L represents labour force and K capital respectively together with A, $\beta 1$ and $\beta 2$. The most important issue for this functional equation can be addressed as the omission of technological change, noted by Handsaker and Douglas (1937) and Williams (1945).

If $\beta 1 + \beta 2 = 1$ in Cobb-Douglas production function, it explains constant returns to scale. If $\beta 1 + \beta 2 > 1$, it is concluded that the production function has increasing returns to scale. If $\beta 1 + \beta 2 < 1$, diminishing returns to scale can be found.

Based on the previous research paper "Measuring Agricultural Productivity Using the Average Productivity Index (API)" written by Lal Mervin Dharmasiri (2009), several scholars have identified Agricultural Productivity with their own references, views and beliefs. As one scholar defined, agricultural productivity can be indicated by yield per unit while some explained factors of production such as labor force, farming experiences, fertilizers, seeds availability and variety, water management system, and other factors should be taken into account. As it is widely accepted that the average return per unit of production does not indicate the real agriculture production, using marginal return per agricultural unit instead of average return was more reliable.

Among various factors of production, productivity of land is important in the agriculture sector because it is one of three basic permanent and fixed categories of input namely land, labor, and capital. Productivity of land may be raised by applying various methods such as input packages including seeds, fertilizers, crop production chemicals and labour intensive methods, muti-cropping on the same land, raising ruminants, etc.

Moreover, productivity of labour which can be measured by the number of hours or days of work by the worker needed to produce a unit of production is also considerable determinant as a factor of the earnings of the population participation in agriculture sector. Labour productivity has a significant positive impact on national prosperity and it indicates the living standard of the agricultural population.

Besides, physical capital investment and human capital for various purposes in terms of purchase of land, reclamation of land, drainage, irrigation system

development, variety of seeds, agricultural implements, machineries, and crop production chemicals should be considered as determinants for the enhancement of agricultural productivity.

Cobb-Douglas function is advantageous by allowing hypothesis testing and calculating confidence intervals in order to test the reliability of the estimations for pigeon pea productivity. This production function clearly supports to measure the marginal contribution of each production input to aggregate pigeon pea output. Thus, as the functional form of the economic model is more flexible, fewer restrictive assumptions about technology are imposed as further advantage. One of the disadvantages of Cobb-Douglas production function is that it requires more data to determine pigeon pea productivity.

Cobb-Douglas production function is relatively simple, and it is convenient to specify and interpret for Pigeon Pea production. Some limitations for Cobb-Douglas production function can be found. It can be seen the unity between input substitution elasticities and these elasticities have to be weighed against some degree of freedom problems and multi-collinearity problem between explanatory variables.

2.1.2 Export Led Growth Model

It can be seen that Export Led Growth Model can contribute to the economic development of new industrialized countries. Looking back to the economic growth conditions of the less developed countries (LDCs), it is approved that the Export Led Growth Hypothesis is more effective and successful than other strategies. Jinjun Xie (1991) explained four types of trade led growth strategies that could be found in 1987 based on the economists in World Bank: (1) Strongly Inward Oriented Strategy, (2) Moderately Inward Oriented Strategy, (3) Strongly Outward Oriented Strategy, and (4) Moderately Outward Oriented Strategy. Based on the past experiences of the world economy such as South Korea, Taiwan, Thailand, Singapore, Malaysia, etc., countries that performed outward oriented strategy can give better results in economic performance than those that practiced inward oriented strategy.

Sami TABAN and İsmail AKTAR (2005) explained the export led growth hypothesis in detail. According to the comparative advantage from Ricardo's Theory, focusing on the production of most efficient and specialized commodities can contribute to trade with other nations through exports in order to achieve foreign exchange earnings. Then, the better country at producing its specialized commodities can raise more revenue from its exports. This trade theory started to introduce the export-led growth [ELG] hypothesis.

Additionally, the export-led growth [ELG] hypothesis believes that production of commodities for the purpose of export expansion can lead to economic growth of the country in the long term. For instance, export expansion encourages efficiency; efficiency leads to increase labour productivity; an increase in labour productivity can raise more earnings; an increase in income growth can contribute to economic growth. Moreover, apart from creating employment opportunities and labour productivity, export expansion capture increases total factor productivity and consequently the well-being of the country through the effective allocation of scarce resources and generating greater capacity utilization throughout the whole economy of the country.

According to Abdulnasser and Manuchehr (2000), the export-oriented policies contribute to economic growth from the different ways summarized as follows:

- *"Keynesian argument is that an increase in exports leads through the foreign trade multiplier to output expansion.*
- *Export relaxes the binding foreign exchange constraint to allow increases in imports of capital and intermediate goods which lead, in turn, to economic growth.*
- *Exports increase efficiency via competition.*

– *Competition gives rise to the economies of scale and diffusion of the technical knowledge in production, which is a potentially important source of growth."*

The paper "The Rise and Fall of Export-led Growth" explored by Thomas I. Palley (2011) concluded several structural problems affiliated by the export-led growth [ELG] hypothesis. The first one is the debt saturation of US consumers. As the model relied too much on consumer demand of developed nations, those markets are facing challenges like rising debt and asset price inflation. Secondly, the relative size of the Emerging Market economies is facing the structural Keynesian challenge of creating an income and demand generation process that supports productive capacity.

2.2 Literature Review

By looking at the previous research relating with the agriculture sector mainly in the beans and pluses sector, the author intended to find out two questions relying upon the literature: "what" (i.e., the contents and main focus of the previous research) and "how" (i.e., the methodologies used in those studies).

Nyein Zin Soe (2000) explained the role of Agriculture sector in the Myanmar Economy Development through descriptive analysis from 1985 to 1995. As the agriculture sector contributed to the Myanmar economy by providing not only food security for Myanmar citizens but also exports as primary products or raw materials for foreign earnings, the author suggested giving first priority on Agriculture sector development together with industrialization. Providing new technology, infrastructure development like dams, irrigation systems and scientific inputs to the agriculture sector in Myanmar, this sector can be moved forward from Labour-intensive into Technology-intensive sector. As Myanmar is a country endowed with natural resources, a growing population and favorable climate conditions for agriculture sector development, agriculture sector development can contribute to rural development which will lead to all around sector development of Myanmar's economy.

Nay Myo Aung (2009) explored an analysis of Myanmar's Exports Structure and its Implications for Myanmar Economic Development. This paper aimed to analyze the rate of agriculture exports in Myanmar together with the assessment of trade performance for the period from 1962 to 2006 through the use of different methodologies such as descriptive analysis and gravity econometric model. The author emphasized on GDP per capita income and employment in Myanmar to investigate the past and recent trends of Myanmar's economy. The major export commodities of Myanmar are peas and beans and shrimps and prawns for food and live animals which are included in main exports following crude materials and mineral fuels of the country. Through annual time series analysis from 1980 to 2006 by using Gravity model, it can be concluded that the Myanmar's agricultural export has relied mainly on a smaller number of exportable commodities for foreign exchange earnings. The research suggested that Myanmar Government should provide a clear conceptual which serves as a linkage among agricultural exports, domestic and international trade policies, and poverty reduction in the country.

Herieth Rogath (2010) investigated the value chain analysis process for Pigeon Pea in Tanzania in order to improve pigeon peas production and poverty reduction. The author focused on Babati District, regarded as the main district of pigeon peas production in Tanzania, through the collection of primary data on some crucial groups namely rural and urban assemblers or brokers, rural and urban wholesalers, urban open air retailers, and urban processors or retailers in both rural and urban market. The author addressed some issues and challenges concerning with pigeon pea production. Firstly, lack of market information for farmers in upstream can be found due to control of big buyers in downstream. That makes farmers to obtain low bargaining power due to all the amount of pigeon peas from the upstream of the value chain bought by the urban exporters. Second issue is gender of participation as women can't afford for the large capital amount in this pigeon pea business. Although the Tanzania Government removed trade barriers due to liberalization for smallholder farmers to access the market, they are still facing challenges due to uncertainties and high transaction costs in pigeon pea production.

Through the investigation of Socio-Economic Impact of pigeon peas in Mozambique done by **Mily Devij (2011)** through Logit and Tobit econometric model, the author aimed to describe and understand the role of pigeon peas in the farming system Gurue District. Primary data was collected on 200 farmer respondents in the four villages of Gurue District. The outcomes resulted that pigeon pea production affects significantly on natural, physical and financial aspects on Gurue District farmers and villagers, apart from human and social capital. The author revealed that the pigeon pea is performed as a multi-purpose crop in rural areas of Mozambique in order to deal with poverty related problems of those areas such as HIV/ AIDS impact and food insecurity. The government should support promoted strategies for agriculture development including pigeon pea as food security, poverty reduction and nutrition of rural people are main priorities for Mozambique.

Muhammad Zahir Faridi (2012) analyzed the Contribution of Agricultural Exports to Economic Growth in Pakistan. To quantify the relationship between agriculture expansion and economic growth of Pakistan, Johansen Co-integration was used for the period from 1972 to 2008. Gross domestic product (GDP) was regarded as the proxy for Pakistan's economic growth, and agricultural (AGX) and non-agricultural (NAX) exports were used as explanatory variables together with labour force (LAB), capital stock (CAP), and consumer price index (CPI). The outcomes showed that non-agricultural exports are crucial for Pakistan's economic growth in the long run rather than agricultural exports. Thus, agricultural exports in Pakistan did not support to economic growth as the results revealed that the declination of economic growth when the agricultural exports rise. Moreover, the author suggested that the government of Pakistan government should make efforts for structural changes in agricultural exports by transforming value added products on agricultural products. Apart from establishing agro-based industries, the government should endeavor on promotion of non-agriculture exports because of bidirectional causality between non-agricultural exports (NAX) and economic growth (GDP) in Pakistan.

Through examining the role of agriculture sector productivity in China's post-reform economic growth analyzed by **Kang Hua Cao and Javier A. Birchenall (2013)**,

the total factor productivity (TFP) growth of China's agricultural sector was found by using calibrated two-sector general equilibrium model for the period (1991-2009). The result revealed that the labor input in agriculture sector of China decreased by 5% annually and agricultural TFP grew by 6.5%. The rate of TFP growth in agriculture sector is much higher than in that of non-agriculture sector. In China, the author pointed out that productivity of agriculture sector plays a vital role in output reallocation and employment towards non-agricultural sector. That means the agriculture sector is one of the key factors for economic development in China.

Abdul Ghafoor Awan (2015) quantified the Impact of Agriculture Productivity on Economy in Pakistan by employing auto regressive distributed lags (ARDL) co-integration approach for the annual time series period from 1972 to 2012. Real gross domestic production per capita gross capital formation was used as a proxy for Pakistan economic growth while regarding labour force, inflation rate, trade, openness, and agriculture value added as explanatory variables for Pakistan agriculture sector. The research resulted that the inflation rate has a significant negative impact on RGDP while all other variables such as labour force, agriculture value added, trade and openness have positive effects to economic growth. The author concluded that in Pakistan, as the agriculture productivity mainly contributes to the economy, the government should undertake higher education policies and programs in enhancement of labour productivity that lead to both agriculture and industrial development.

The previous research during the past decades pointed out the significance of agriculture productivity in economic growth in developing countries by using various techniques. In Myanmar, about 90 % of total production of pigeon pea is exported to India, Singapore, Indonesia, Malaysia, and UAE by oversea or Border trade. As Pigeon Pea is one of the key commodities in the agriculture sector of Myanmar, the author believed this paper will provide information to researchers, farmers and policy makers in agricultural sector.

Table 0.1 Summary table of the Literature Review

Author	Title	Econometric method	Variables	Findings
Adam Mohammed Nsengo Swat (1999)	Effects of Space, Row Arrangement and Genoptype on Grain Yield of Pigeon Pea Intercropped with Sorghum	Descriptive	Land Equivalent Ratio, Crop Yields, Yields of Sole Crops	The Pigeon Pea yield declined with increased spacing sorghum suppressed Pigeon Pea growth subsequently.
Nyein Zin Soe (2000)	The role of agriculture in the development of Myanmar economy	Descriptive	Land, labor, capital, fertilizers, age, experience, education, off-farm	Agriculture provides both food and raw materials to the rest of the economy; a growing agricultural sector provides an enlarged market.
Donna C.Junk (2005)	Seed Coat Darkening Pinto Bean	Descriptive SAS system	L* Perfect Black, a* darkening/slow darkening genotype, b* yellow to blue	There was need for a quick, reliable in expensive, non-destructive protocol to accelerate seed coat darkening.

Table 2.1: Summary table of the Literature Review (continued)

Author	Title	Econometric method	Variables	Findings
Koichi Fujita, Ikuko Okamoto (2006)	The agricultural Policies and Development of Myanmar's agricultural sector	Description	Export, import, domestic market, state-owned enterprise	Production of crops for the domestic market has increased in response to the expansion of the domestic market.
Albert Gideon Changaya (2007)	Development of high yielding Pigeon Pea germplasm with resistance to Fusarium wilt in Malawi	Descriptive	Production, Marketing, Germplasm Collection	Pigeon Pea got many benefits to subsistence farmers. Pigeon Pea, as a legume, improves soil fertility. It was used as a green manure crop in some countries. It had many traditional medicinal uses. Fusaherium wilt was the most prevalent and destructive disease of Pigeon Pea in the area.

Table 2.1: Summary table of the Literature Review (continued)

Author	Title	Econometric method	Variables	Findings
Nay Myo Aung (2009)	An analysis of the Structure of Myanmar's Exports and its Implications for Economic Development	Gravity	Production, consumption on export	A change in import will change GDP more than a change in export but the change in import will decreased GDP in the third years.
Herieth Rogath (2010)	Analysis of Value Chain for Pigeon Pea in Tanzania	Descriptive	Harvested, yield, production, seed	The quality of Pigeon Pea was determined different by buyers in different market due to preference.
Mily Devij (2011)	Socio-Economic Impact of Pigeon Pea in Mozambique	Descriptive Statistics	Natural capital, human capital, physical capital, financial capital, social capital	Pigeon Pea is an important crop for two main components of farmers' livelihoods. These are farming system.

Table 2.1: Summary table of the Literature Review (continued)

Author	Title	Econometric method	Variables	Findings
Gezahegn Gebremedhim (2012)	Long-run effect of Export Volatility on GDP case of Ethiopia	Cobb-Douglas production growth model	GDP, export of goods/services, Stock of capital, Population growth	Long - run effect of export commodities where it had comparative advantage.
Kenneth Waluse Sibiko (2012)	Determinants of common bean productivity and efficiency	Stochastic Frontier model, Tobit model	Plot siege, seeds, fertilizer, manure, labor, chemical, inputs	Two limit Tobit was employed to evaluate the factors influencing farm technical, economic and allocation efficiency levels.

The present empirical studies are significant and takes an interest in a global scale as the outcomes of the implementation of export performance could assure private sector that the government revenues are spent justifiably. However, studies in literature dedicated to the adoption of pulse and beans' export performance in the public and private sector in several countries, particularly Myanmar. Therefore, in the present study, several factors are deemed to influence on pulse and beans industry export performance, which are export marketing strategy, management attitudes and perceptions, management characteristics, firm's characteristics and competencies, industry characteristics, foreign market characteristics, domestic market characteristics, and internal and external review. Added to the above factors are the pulse and beans production, other, and export performance environment. This study will be invaluable to both circles of academics and

researchers as it contributes to required information concerning the Myanmar pulse and beans export sector.

In conclusion, for a developing country starting to initiate industrialization through outward oriented strategy, export-led growth model offered a great contribution to economic growth of the country. Richness in natural resources and labour productivity of the developing country is significantly different from developed countries' economies. According to the previous studies on agricultural sector in Myanmar, they were only done in descriptive statistics. Thus, this paper aimed to fulfil the gap by applying quantitative analysis using ARDL approach in such a way that the findings will be even more effective than the former studies.

DilekTemiz & AytacGokmen (2010). In this study, the authors analyze the export economic growth of Turkey during 1950-2009. Their results suggested that there is a dynamic relationship between export and economic growth. The authors used annual time series data of Turkey. Granger causality, Johansen co-integration and vector error correction model (VECM) were applied to investigate the causal relationship between export and economic growth of Turkey. The authors found that economic growth of Turkey led to enhance productivity and create comparative advantages. The results of VECM and co-integration analysis show that Turkey needs to practice export expansion policy.

Nguyen (2011) investigated the effect of trade liberalization on economic growth in Malaysia and South Korea. In this research, the authors applied VAR model by using fours variables which are GDP, export, import and FDI. The study period of 1970-2004 for Malaysia and 1976-2007 for Korea were applied. Unit root test for four series were applied first, lag structure, then VAR diagnosis, Johansen co-integration test, Granger causality, and finally analysis of impulse response and variance decomposition. The results suggested that there has co-integration for all four variables in Malaysia and Korea. Export has long run relationship with growth in both Malaysia and Korea. The results provided the evidences to impose export promotion policies to implement in Malaysia.

Mustafa (2011) This study analysed the relationship between foreign trade and economic growth in Turkey. VAR and VEC models are applied for the two periods 1987: –2007:3 and 2000:1–2007:3 to estimate the dynamic relationship between GDP, exports, and imports. In the second part of the study, the authors analyse the composition change in foreign trade of Turkey between 1980-2009. The study analyzed the causality between the economic growth and foreign trade and their effects. The results confirmed that import is one of the most important determinant of economic growth in Turkey. Export effect was insignificant on economic growth.

Adesuyi et al. (2013) The study focus on trade and economic growth in Nigeria to investigate the relationship between foreign trade and economic growth and how trade can stimulate economic growth in Nigeria. The author used the annual data over the period of 1980-2010 (31 years). The methodology applied in this study is multiple regression model. The result shows that foreign trade and economic growth of Nigeria have a significance positive relationship. The study suggested that Nigeria's government should reduce the excise duties for the local industries to export their goods and services, and to improve the quality of their products.

Velnampy et al. (2013). This research explored the impact of export and import on economic growth in Sri Lanka and the authors analysed the annual data set of 1970-2010 to estimate the relationship between exports and economic growth, and imports and economic growth. Export, import and GDP are used as the variables in this study. The results proved that there is significance positive relationship between export and import; also have significance impact on the economic growth in Sri Lanka.

2.2.2 Literature Review Regarding Myanmar's Export

Toshihiro and Fumiharu (2007) The author studied the trade, foreign investment and Myanmar's economic development during the transition to an open economy during 1990-2005. Descriptive analysis was applied. In the 1990s, imports grew more rapidly than the exports. This led the economy to expand trade deficits. Myanmar faced foreign currency shortage and the government of Myanmar adopted import substitution policy for the expansion of the private sector. Through emerging garment

industries in 2002 in Myanmar, external sector has improved largely. FDI in Myanmar were aimed to invest for the exploration and development of new gas fields. Trade amount was increased and this encouraged government to focus on promoting trade performances and FDI flows in Myanmar.

Tin Maung Maung Than (2007) The author studied Myanmar's foreign trade under military rule: their patterns and recent trends.In this study, the author applied descriptive statistics for analysis of foreign trade conditions in Myanmar especially under military rule. Market oriented reforms were quickly adopted after the socialist system was abolished in 1988. At that time, the military government tried to promote trade in the country and changed policies. Government earned revenues from imports by collecting custom duties. The author suggested that the government's rule and regulations upon licensing, tax, and banking should be set out to encourage the role of foreign trade in order to contribute to the economic growth of Myanmar.

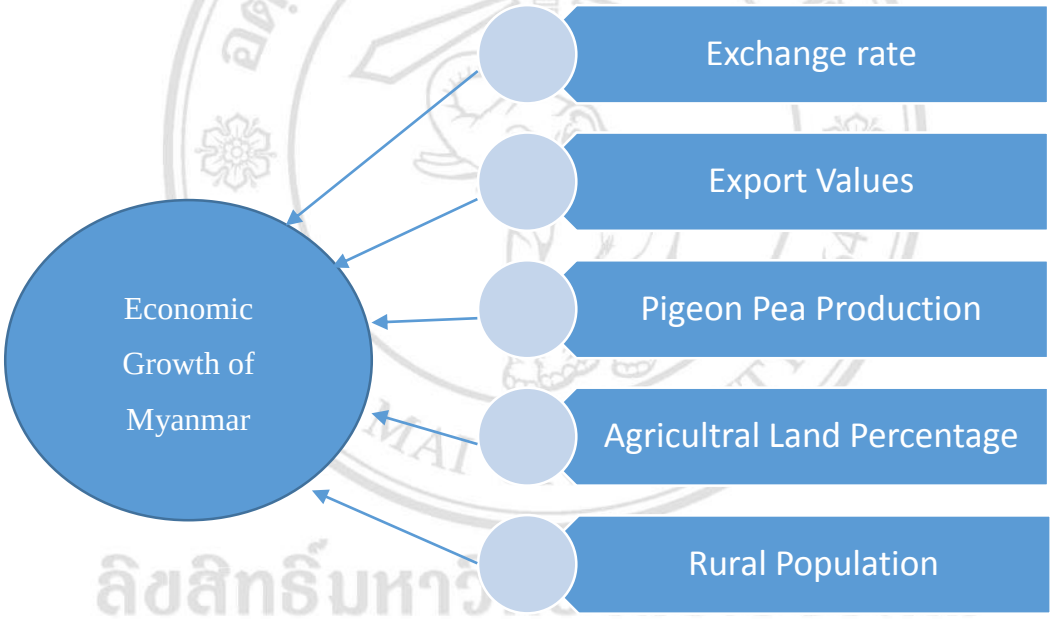
Tin Myo Hlaing (2014) studies trade reforms in Myanmar. This study was done in descriptive statistics to analyse the impacts of trade reforms on the external sector of Myanmar Economy. The author studied the trade reforms processes concerning with 4 eras – from 1848 to 1962, from 1962 to 1988, from 1988 to 2010 and from 2010 to 2014. Myanmar trade balance was in positive conditions after liberalization and trade surplus after FY 2002-2003. This research provided that Myanmar had great potential and should expand exports and practice import substitution policies.

According to the studies based on the evidence from Myanmar, most of the studies were only done in descriptive statistics. Thus, in this paper, quantitative analysis using ARDL approach to cointegration for time series data was conducted in such a way to fill the gap of the needs in this area.

CHAPTER 3

Methodology

3.1 Conceptual Framework



Source: Own Illustration

Figure 3.1 Conceptual Framework

Real GDP growth rate of Myanmar is used as dependent variable and Exchange rate, export values, Pigeon Pea Production, Agricultural land percentage, and rural population are used as independent variables. The methodology applied in this study is ARDL approach to cointegration for time series data. The data set is annual data set from 1985-2013.

3.2 Research Methodology

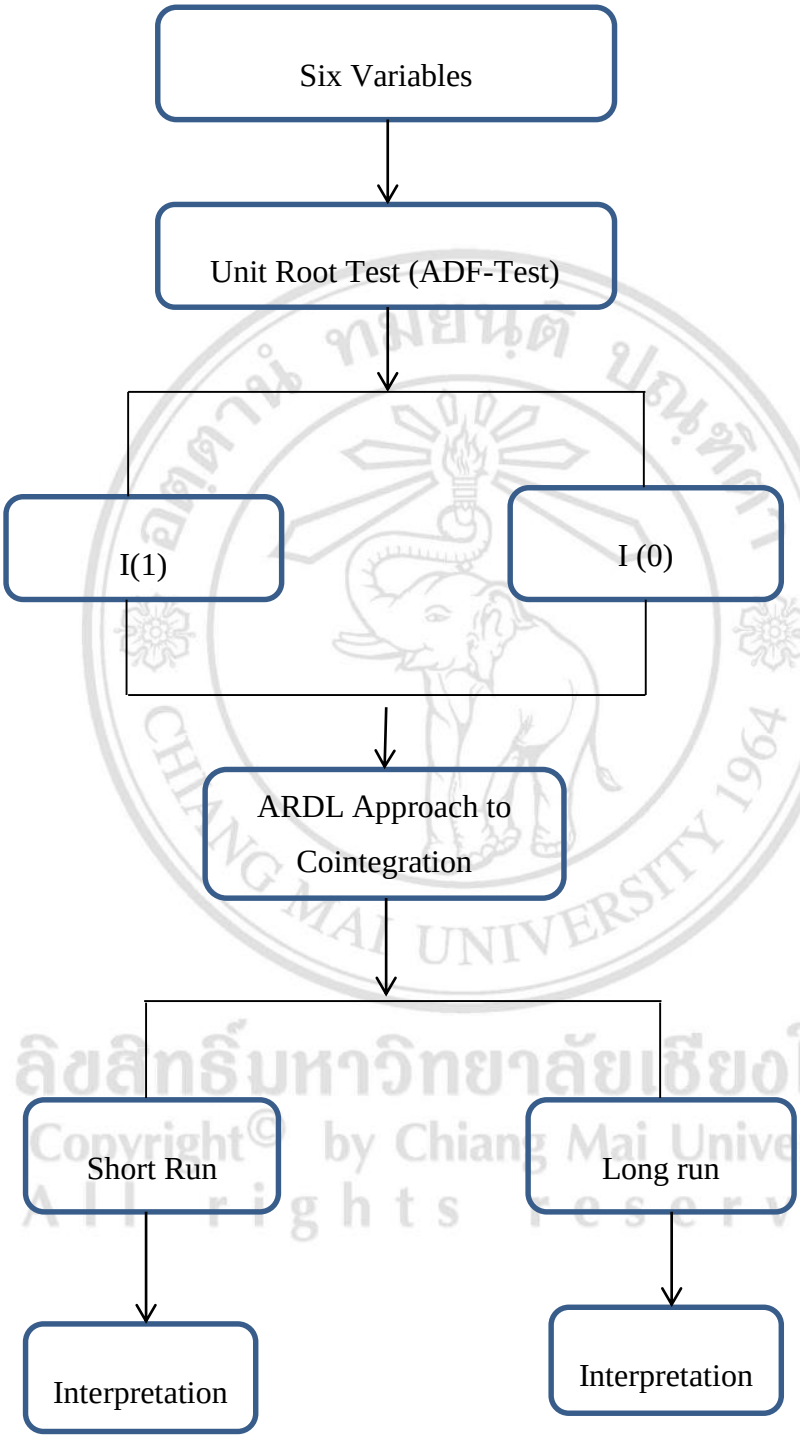


Figure 3.2 Research Methodology for analysis

The Research Method applied in this study can be laid down as follows:

Step (1) Test the variables by using ADF unit root test whether data is stationary or non-stationary

Step (2) If the data is stationary at mixed levels, ARDL approach to co-integration is applied

Step (3) Use ARDL bound test approach to test whether there is long run relationship

Step (4) Apply ECM model to check for short run relationship of the variables

Step (5) Diagnostics tests are applied to test stability, normality, heteroskedaticity, serial correlation and auto correlation

Step (6) Interpret the results and Conclusion

3.3 Model Specification

RGDP (real GDP growth) = f (ECR, EX_USD,PPP, AL_P, R_POP) (1)

RGDP represents real GDP growth rate of Myanmar.

ECR stands for exchange rate per USD to Myanmar Kyats.

EX_USD stands for the total export values in USD.

PPP stands for Pigeon Pea Production in Myanmar.

AL_P stands for Agricultural Land % of the total land available in Myanmar.

R_POP stands for the rural population of Myanmar.

Functional Form by taking log on independent variables can be written as:

$$RGDP_t = \beta_0 + \beta_1 lnECR_t + \beta_2 lnEX\_USD_t + \beta_3 lnPPP_t + \beta_4 lnAL\_P_t + \beta_5 lnR\_POP_{t+} + \mu_1 \quad (2)$$

3.4 Sources of Data

The variables are collected from the different sources. In this paper, data collection and data selection are very challenging tasks. Data was mostly collected from the reliable sources like World Bank, Food and Agriculture Organization of United Nations and CSO Myanmar.

Table 3.1 Sources of Data

Variables	Notation	Sources
Real GDP growth rate	RGDP	World Bank
Exchange rate	ECR	Collected from the previous studies
Export Values (USD)	EX_USD	CSO Myanmar
Pigeon Pea Production	PPP	FAO
Agricultural land %	AL_P	World Bank
Rural Population	R_POP	World Bank

This paper analyzed the importance of pigeon pea production and export in Myanmar by using the above selected variables and how these factors are impacting on the economic growth of Myanmar.

3.5 Hypotheses of the study

The main objective of this study was to find out the relationship between economic growth and pigeon pea production and export in Myanmar. According to this objective, five testable hypotheses can be stated as follows:

Hypothesis 1: Exchange rate has negative impact on economic growth in Myanmar during 1985-2013.

Hypothesis 2: Export has positive impact on economic growth of Myanmar during 1985-2013.

Hypothesis 3: Pigeon Pea Production has positive impact of economic growth of Myanmar during 1985-2013.

Hypothesis 4: Agricultural land % has positive impact on economic growth of Myanmar during 1985-2013.

Hypothesis 5: Rural population has negative impact on economic growth of Myanmar during 1985-2013.

3.6 ADF Unit Root Tests

ADF Unit root test was used to test whether the time series data of each variable is stationary or non-stationary at level, first difference, and second difference. As for intercept with trend test, the time series y_t can be written as follows.

$$\Delta Y_t = \beta_1 + \beta_2 t + \rho Y_{t-1} + \beta \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (3)$$

In the above equation,

β_1 denotes as constant term.

β_2 denotes as coefficient of time trend.

ε_t stands for the white noise error term.

ρ is coefficient of Y_{t-1}

m is denoted as lags order.

$Y_{t-1}$is lagged value of Y_t

ΔY_{t-1}stands for the changes in lagged values of Y_t.

The Dickey Fuller test statistics can be expressed as:

$$DF_\tau = \frac{\widehat{\beta} - 1}{Estimated\ Standard\ error} \quad (4)$$

ADF test statistics can be written as:

$$DF_\tau = \frac{\widehat{\beta}-1}{1-\widehat{\beta}-\ldots-\widehat{\beta_p}} \quad (5)$$

If the calculated critical value is above the DF test critical value, the null hypothesis of the ADF unit root test is rejected, which means there is no unit root problem and the time series data is stationary. If the calculated critical value is smaller than the DF test statistic, the null hypothesis is failed to reject, which means there is unit root in the time series data set.

3.7 ARDL Approach to Co-integration

ARDL approach is the most suitable for the mixed level stationary data set and co-integration equations. The method gives out better results and reliable estimated outcomes even though the sample size is small. Moreover, the method can be applied for the variables which are stationary at level and 1st difference, so called mixed levels. In addition, it gives out the better results with unbiased conditions and the estimations are conclusive even though there are endogenous conditions.

ARDL bound test of (p,q) model which is first developed by Pesaran and Shin (1997) can be expressed as below:

$$Y_t = c + \emptyset_t + \omega_0 Y_{t-1} + \cdots + \omega_p Y_{t-p} + \delta_0 X_{t-1} + \cdots \delta_q Y_{t-q} + \varepsilon_t \quad (6)$$

c = intercept term

t = time trend

ε = white noise error term

In logarithmic form, the ARDL regression with the consideration taking lags values in the equation can be expressed as:

$$\Delta lnY_t = \alpha_{0Y} + \sum_{i=1}^{n} \beta_{iY}\, \Delta lnY_{t-i} + \sum_{i=1}^{n} \gamma_{iY}\, \Delta lnX_{t-i} + \delta_{1Y} lnY_{t-1} + \delta_{2Y} lnX_{t-1} + \mu_t (7)$$

To determine the long-run relationships between dependent and independent variables, F-test would be the most suitable test for ARDL approach.

H_0: $\delta_{1Y} = \delta_{2Y} = 0$(there is no long-run co-integration)

H_1: $\delta_{1Y} \neq \delta_{2Y} \neq 0$(there is long-run co-integration)

ARDL bound test has two critical values sets; upper bound values and lower bound values.

If calculated critical values > upper bound test, H_0 is rejected and there is long-run co-integration.

If calculated critical values < lower bound test, H_0 is accepted and there is no long-run co-integration.

If the results were in between, then there will be no conclusive answer.

After testing long run, ECM (Error Correction Model) is applied which can be written as below:

$$\Delta lnY_t = \alpha_{0Y} + \sum_{i=1}^{n} \beta_{iY} \Delta lnY_{t-i} + \sum_{i=1}^{n} \gamma_{iY} \Delta lnX_{t-i} + \emptyset EC_{t-1} + \mu_t \quad (8)$$

β_{iY}, γ_{iY} = coefficient terms

EC_{t-1} = error correction term lagged one period

$\emptyset$ = adjustment coefficient

μ_t = error term

The variables used in this study are RGDP, ECR, EX_USD, PPP, AL_P and R_POP which are real GDP growth rate, exchange rate, export values, pigeon pea production, agricultural land percentage, and rural population. The ARDL equation with 2 lag length for this study can be expressed as:

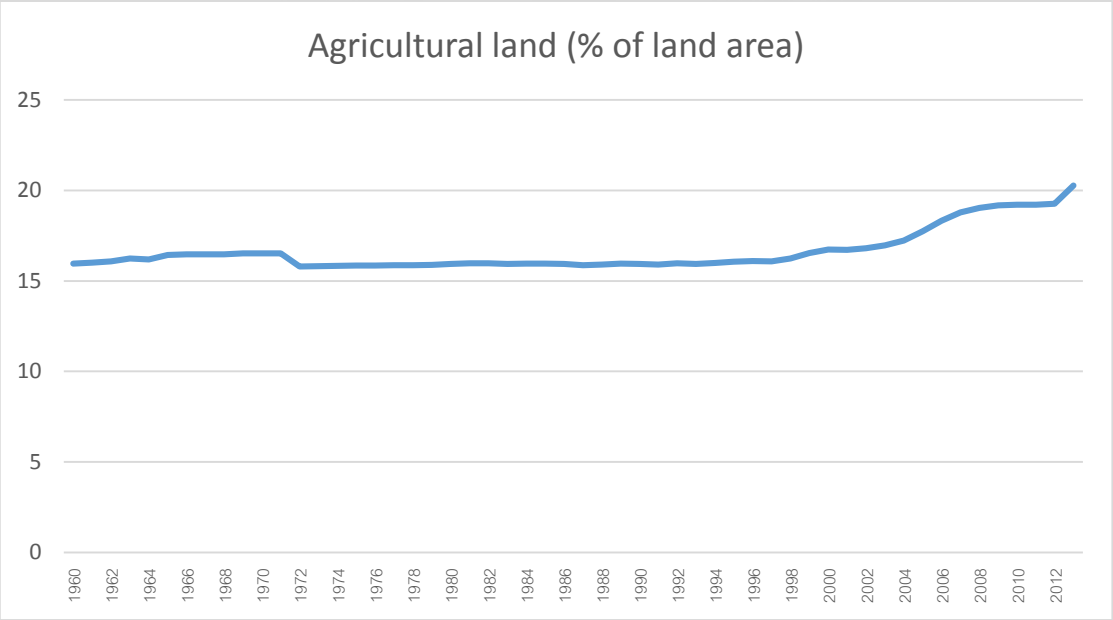
$$RGDP_t = \beta_0 + \alpha_1 LnRGDP_{t-1} + \alpha_2 lnRGDP_{t-2} + \rho_0 lnECR_t + \rho_1 lnECR_{t-1} + \rho_2 lnECR_{t-2} + \emptyset_1 lnEX\_USD_t + \emptyset_1 lnEX\_USD_{t-1} + \emptyset_2 lnEX\_USD_{t-2} + \delta_1 lnPPP_t + \delta_2 lnPPP_{t-1} + \delta_3 lnPPP_{t-2} + \theta_1 lnAL\_P_t + \theta_2 lnAL\_P_{t-1} + \theta_3 lnAL\_P_{t-2} + \mu_0 lnR\_POP_t + \mu_1 lnR\_POP_{t-1} + \rho_2 lnR\_POP_{t-2} + \varepsilon_t \quad (9)$$

CHAPTER 4

Empirical Results

The purposes of this chapter is to investigate the pigeon pea production and export market in Myanmar for the period of 1985- 2013. The followings are the main dedications of this study. Part one, to study how export and pigeon pea production are contributing to the economic growth of Myanmar.

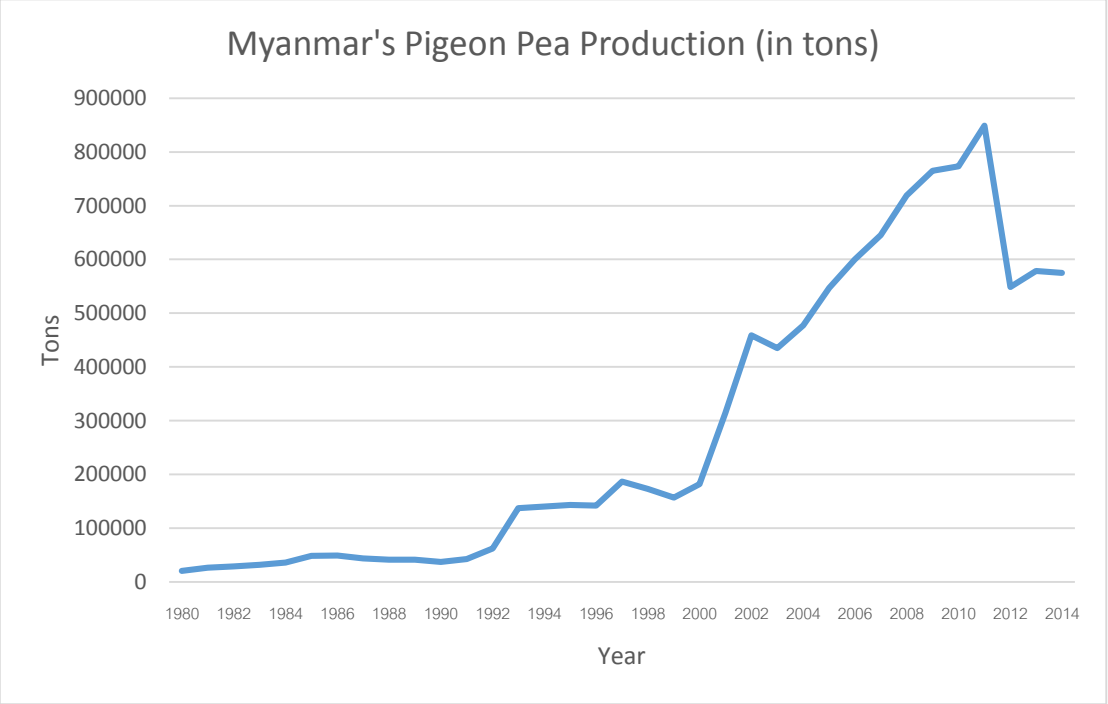
Myanmar has a total land area of 676,578 km^2 and is composed of seven states and seven divisions. The neighboring countries are Bangladesh and India in the west, China in the north, Thailand, Laos, and Cambodia in the east and Malaysia in the south. Myanmar has an abundance of land. Some of them are not cultivated fully yet and have many empty lots.



Source: World Bank

Figure 4.1 Agricultural land in Myanmar

As per Fig 1.3, agricultural land in Myanmar is increasing and the cultivated area has been expanding according to increasing market demand and high exports. Among the agricultural products, Pigeon peas and beans have become the leading agricultural export in Myanmar. Rice is produced mainly for local consumption and exports of rice is still far from the neighboring country, Thailand. This is because of a lack of government planning and control in its agricultural sector. Most of the agricultural products are traded through market mechanisms.



Source: FAO database

Figure 4.2 Myanmar's Pigeon Pea Production (in Tons)

There are 17 kinds of beans and pulses produced in Myanmar. Industrial crops are also grown and mainly produced for the use of state owned enterprises. Among them, Myanmar's Pigeon Pea occupies the biggest market share like India. In Myanmar, Pigeon Pea is grown during May to June and takes about 5 to 7 months duration for harvesting. Production of Pigeon Pea is mainly in the dry zone, the upper Myanmar, and Bago and Mon divisions in lower Myanmar. The red Pigeon Pea produced from Magway division is very famous among buyers. As per Fig 1.4, Pigeon Pea production in Myanmar has been growing steadily. The production reached to the total production of around 800,000 tons in 2010. After that, there was a sharp decline in the later years. Myanmar's trade

sanctions have been less restricted since the beginning of 2012. But, the decline was probably due to international demand decrease.

Under the newly elected government, economic reforms were made and promoting trade was one of the priority tasks done in the reforms by reducing export taxes and giving tax exemptions. In Myanmar, nearly 90% of Pigeon Pea's total production is exported to India, Singapore, Indonesia, Malaysia, and UAE through border trades and shipping. Among the export countries, India is the biggest market for Myanmar's beans and pulses as 85%-90% of beans exports to India. For pigeon pea, Myanmar is a major exporter followed by Malawi, Kenya, Uganda and the Dominican Republic. International prices of both chickpea and pigeon pea declined in real terms until 2006. Since then, prices for both crops have increased in line with the general rise in prices of all agricultural commodities.[1]

As for the production of beans and pulses, the main purpose is to export due to there is low local consumptions. The trading process of beans and pulses in Myanmar was complex and involved many parties such as farmers, traders, wholesalers, exporters and local or foreign agents. Sometimes, the farmers cannot get the full benefits from producing and exporting those agricultural products due to its complicated and hierarchial transactions. Nevertheless, the local consumptions and productions of products by using latest techniques are far beyond satisfactory.

Producing diversified products are one of the main purpose of pigeon pea export promotion policy in Myanmar. In addition, on the other hand, it is important to produce more exportable goods and needs to sustain the production process to have Myanmar sustainable economic growth. Trading beans and pulses can have more profitable and potentials. After infrastructural needs are done, the country will be well connected with the neighboring countries and as well can enter into the global market. The commodity

[1] Parthasarathy Rao P, Birthal PS, Bhagavatula S and Bantilan MCS . 2010. Chickpea and Pigeonpea Economies in Asia: Facts, Trends and Outlook. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 76 pp. ISBN: 978-92-9066-530-4. Order code: BOE 049

markets will then be established and support to the economic growth of the country through agricultural sector developments.

Chickpea and pigeon pea prices were declined due to the entry of non-traditional growing countries. As for Canada and Australia, it was entering the market by exporting chickpea and Myanmar for pigeon pea. Prices of all agricultural products increased globally during 2006-2008. This caused prices of chickpea and pigeon pea to increase. During that period, there were short-term supply shocks which caused major exporting countries to drought and sharp increased demand from importing countries. India was a net importer since then, accounting for 2.5 million tons or 25% of global pulse imports in 2005-07, ICRISAT (2010). Therefore, Asia became net exporter of beans and pulses to the rest of the world.

Annexure 3. Regional exports and imports of pulses ('000 t).

	Exports		Imports	
Regions	1981-83	2003-05	1981-83	2003-05
World	**3,107**	**9,046**	**3,228**	**9,261**
Developed countries	**1,580**	**5,445**	**1,231**	**3,090**
Developing countries	**1,527**	**3,600**	**1,997**	**6,171**
Africa	171	335	336	1,244
Asia	1,048	2,784	935	3,971
South Asia	25	519	288	2,673
Southeast Asia	334	844	87	234
Europe	608	1,740	1,159	2,712
Latin America	307	481	726	956
North America	891	3,105	52	349
Oceania	80	600	20	29

Figure 4.3 Regional exports and imports of pulses ('000 in Tons).[2]

Part Two. By using ARDL approach to co-integration method the study aim to investigate the effect of exchange rate, export, pigeon pea production, agricultural land and rural population on the real GDP growth rate of Myanmar. Real GDP growth rate of Myanmar is used as dependent variable and exchange rate, export values, pigeon pea production, agricultural land percentage and rural population are used as independent variables. The methodology applied in this study is ARDL approach to cointegration for time series data. The data set is annual data set from 1985-2013.

[2] Chickpea and Pigeonpea Economies in Asia: Facts, Trends and Outlook. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), 2010 p 65

As for the production of beans and pulses, the main purpose is to export due to there is low local consumption. The trading process of beans and pulses in Myanmar is complex and involves many parties such as farmers, traders, wholesalers, exporters, and local or foreign agents. Sometimes, the farmers cannot get the full benefits from producing and exporting those agricultural products due to its complicated and hierarchical transactions. Nevertheless, the local consumptions and production of products by using the latest techniques are far beyond satisfactory.

Producing diversified products and exporting them are one of the main purposes of export promotion policy in Myanmar. On the other hand, it is important to produce more exportable goods and to sustain the production process to have sustainable economic growth in Myanmar.

Trading beans and pulses can have more profitable potential in Myanmar. After infrastructural needs are done, the country will be well connected with the neighbouring countries and as well can enter into the global market. Commodity markets will then be established and support the economic growth of the country through agricultural sector developments. This paper aims to analyse the pigeon pea production and current conditions and future prospects of pigeon pea export market in Myanmar.

4.1 Unit Root Tests Results

In this paper, the author used real GDP growth rate as dependent variable and exchange rate, total export, pigeon pea production, agricultural land percentage, and rural population as independent variables. Firstly, the author applied unit root tests to check stationary levels of the variables, Autoregressive distributed lag (ARDL) Bound Test to check co-integrating equation for the long run and ECM, and error correction model to check the relationships of the variables in the short run. After testing the above tests, the author applied long-run diagnostic tests (Q-statistic test & LM test) in order to check serial correlation. Then, the author used heteroscedasticity test, and normality test. At the end, the author checked the stability of the model by using CUSUM and CUSUMSQ tests.

4.1.1 ADF (Augmented Dickey-Fuller) Test

Firstly, the author applied ADF test to test the stationary level of both dependent and independent variables. In order to confirm the stationary levels of the data, the author checked the p-value of the test results of the data, test statistics and critical values of the data. If the 10% critical value is larger than test statistics, the null hypothesis is failed to reject. This means that the time series of the data is not stationary (has unit root). If the 10% critical value is smaller than test statistics, the null hypothesis is rejected. This means that the time series of the data is stationary (has no unit root).

Table 4.1 Summary of ADF Unit Root Test Results

Variables	Level	Test	P-value	Result
RGDP	Level	Intercept and Trend	-2.297520 (0.4216)	Non-Stationary
	1st Difference		-6.507963*** (0.0001)	Stationary
LNECR	Level	Intercept and Trend	-0.740857 (0.9591)	Non-Stationary
	1st Difference		-3.740540** (0.0366)	Stationary
LNEX_USD	Level	Intercept and Trend	-3.736651 (0.0369)**	Stationary
LNPPP	Level	Intercept and Trend	-2.565702 (0.2972)	Non-Stationary
	1st Difference		-4.112775** (0.0195)	Stationary
LNAL_P	Level	Intercept and Trend	0.671370 (0.9992)	Non-Stationary
	1st Difference		-4.806994*** (0.0044)	Stationary
LNR_POP	Level	Intercept and Trend	-3.615234* (0.0517)	Stationary

Source: Own Illustration

Note: ***,**, * represents 1%, 5% and 10% significant levels

In the above table, the ADF unit root tests results show that the variables are stationary at mixed levels which are I(0) and I(1). RGDP, LNECR, LNPPP, and LNAL_P are non-stationary at I (0). Therefore, the author checked them at level I(1) and found that they are stationary at I (1). As for LNEX_USD and LNR_POP, they are stationary at level I(0). Therefore, as a conclusion, time series data of the variables are

stationary at mixed levels. That is why the author chose the methodology of ARDL approach to co-integration which is the most suitable method for this type of data set.

4.2 Auto Regressive Distributed Lag Bound Testing Approach to co-integration

ARDL bound test is applied to test for long-run co-integration after checking the stationary levels of the variables. Unit root tests suggested that the time series data of the variables are stationary at mixed levels. By using Akaike Information Criterion (AIC) method, the author chose the optimal lag length of the model and found that the best optimal lag length for the model is two lag. When the author first applied ARDL method to estimate the relationships between dependent variables and independent variables, the method is based on OLS (Ordinary Least Square method) regression. The method suggested that the parameters of $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ are short run multipliers, $\delta_1, \delta_2, \delta_3, \delta_4, \delta_5, \delta_6, \delta_7$ are long run multipliers, α_0 is constant term and μ_0 is error term. The null hypothesis H_0 of the ARDL regression analysis is that the parameters, long run multipliers have the same value of zero, $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = 0$. This indicates that there is no long-run relationship between dependent and independent variables and the alternative H_a is that the multipliers have different values, $\delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq \delta_7 \neq 0$. This means that there is long-run relation between dependent and independent variables.

The author tested the long run and short run relationships of dependent variables and independent variables in this study by applying ARDL bound testing approach and ARDL approach to co-integration. As for the bound test criteria, the decision is based mainly on the values of F statistics whether it is larger or smaller than the critical values of upper bond. If H_0 is failed to accept, there is long run co-integration, which means that F statistic is larger than the critical values of the upper bound. If F statistic is smaller than the critical values of the upper bound, there is no long-run co-integration and thus accepts the null hypothesis.

Table 4.2 ARDL Bound Test Results

Model	F-Statistics	Upper Bound	Lower Bound	Result
F(RGDP, LNECR, LNEX_USD, LNPPP, LNAL_P, LNR_POP)	7.885483	3.38*	2.39*	H_0: Rejects (Co-integration exits)
		3.73**	2.7**	
		4.15***	3.06***	

Source: Author's Illustration

Note: ***, **, * means that the 1%, 5% and 10% significant level.

In the above Table 4.2, F statistics is 7.885483 and higher than the upper bound and lower bound critical values. The result suggested that it is significant at 1% significance level. H_0 is rejected, and thus, co-integration exists. Therefore, there is long run co-integrated relationship between dependent variable (RGDP) and independent variables (LNECR, LNEX_USD, LNPPP, LNAL_P, LNR_POP).

4.2.1 ARDL Long-run Coefficients Estimations

ARDL bound test confirmed that there is long run co-integration between real GDP growth rate of Myanmar and its independent variables. AIC method for lag length selection confirmed that the model has optimal lag length at lag 2. The lag structure of the variables are (2,1,2,0,2,2) for the long run ARDL model. Short run estimations results are given out by Error correction model. Table 4.3 shows the results of long run estimations and Table 4.4 shows the results of short run estimations.

The results of long run estimation indicates that total export values of Myanmar has a negative significant relationship with real GDP growth rate at 10% significance level in the long run.

Additionally, exchange rate has a positive significant relationship with real GDP growth rate in Myanmar at 1% significance level. This means that exchange rate of pigeon pea exports in Myanmar can contribute to the country's economic growth in the long run.

Moreover, pigeon pea production has a positive significant relationship with real GDP growth rate in Myanmar at 10% significance level. This means that higher productivity of pigeon pea in Myanmar can contribute to the country's economic growth in the long run.

The results found no significant relationship between agricultural land percentage of total land area and GDP growth rate in Myanmar that there is no statistically significant at the level in the long run. The results found no significant relationship between rural population and GDP growth rate in Myanmar that there is no statistically significant at the level in the long run. The instability long run models presented for agricultural land percentage of total land area and rural population cannot be used. The situation is, therefore, not conclusive to real GDP growth rate in Myanmar.

Table 4.3 ARDL Long Run Coefficients Estimation with lag (2,1,2,0,2,2) by AIC

Dependent Variable	RGDP			
Independent Variables	Coefficient	Standard Error	t-statistics	Probability
LNECR	-5.634566	3.245287	-1.736230	0.1081
LNEX_USD	13.800105***	2.417330	5.708823	0.0001
LNPPP	1.401282*	1.493057	0.938532	0.0665
LNAL_P	-148.485518	27.299039	-5.439221	0.2002
LNR_POP	17.472264	66.672022	0.262063	0.7977
Constant	36.218212	1201.042731	0.030156	0.9764

Note: R^2 = 0.753437

Adjusted R^2 =0.506874

F-statistic =3.055755

Pro (F-stat) =0.026906

Durbin-Watson=2.323529

*, **, *** indicates 10%, 5%, 1% significance levels

Source: Author's Illustration

Based on the long run results, the estimation confirmed that greater total export exchange rate of pigeon pea exports and higher pigeon pea production are

important for the real economic growth of the country. Therefore, government should enhence agricultural policies and trade policies in order to upgrade the economic conditions of greater total export, exchange rate of pigeon pea exports and higher pigeon pea production in Myanmar. It was also determined that long run results, although significant, results were capable of explaining the presence of long run results. The long run results of greater total export, exchange rate of pigeon pea exports and higher pigeon pea production were to exist. However, the support is strong and the data is conclusive.

4.2.2 ARDL Short Run Coefficients Estimations by using Error Correction Model

In the short run estimation, in order to confirm the short run relationship, ECM term has to be negative and significant. ECM shows the speed of adjustment towards the long run equilibrium and having negative sign means that converge to the equilibrium. As per Table 4.4, the results indicate that ECM term is negative 2.11 and significant at 0 significant level. Therefore, the study can conclude that there has both long run and short run relationship in the estimated model for this study.

Table 4.4 ARDL Short Run Results Estimation by using ECM

Dependent Variable	RGDP			
Independent Variable	Coefficient	Standard Error	t-Statistics	P-value
D(RGDP(-1))	0.441817**	0.120769	3.658356	0.0033
D(LNECR)	-2.740023	2.266350	-1.209003	0.2499
D(LNEX_USD)	12.909165***	2.379200	5.425842	0.0002
D(LNEX_USD(-1))	-10.971772***	2.308203	-4.753384	0.0005
D(LNPPP)	2.131598	1.641010	1.298955	0.2184
D(LNAL_P)	-9.248137	27.920757	-0.331228	0.7462
D(LNAL_P(-1))	352.361337***	68.718198	5.127628	0.0003

Table 4.4 ARDL Short Run Results Estimation by using ECM (continued)

Dependent Variable	RGDP			
Independent Variable	Coefficient	Standard Error	t-Statistics	P-value
D(LNR_POP)	-7312.2163***	948.571370	-7.708662	0.0000
D(LNR_POP(-1))	7121.9901***	905.143289	7.868357	0.0000
CointEq(-1)	-2.118016***	0.232444	-9.111955	0.0000
Cointeq=LNRGDP-(-5.6346*LNECR+13.8001*LNEX_USD+1.4013*LNPPP-148.4855*LNAL_P+17.4723*LNR_POP+36.2182)				

Note: *, **, *** indicates that 10%,5% and 1% significant level of the short run parameters.

Source: Author's Calculation

The short run results provide that real economic growth in the last year have positive short run significant relationship with the current year real GDP growth rate in Myanmar at 1% significance level. If the last year real economic growth rate increase, this year real economic growth rate can be increased. The results suggested that growth has interest and the last year growth can bring positive influence on the current year economic conditions in the short run. Exchange rate has significant relationship with the current year real GDP growth rate in Myanmar at 1% significance level.

In this study, the last year real economic growth rate and exchange rate of pigeon pea exports provide insignificant in both long run and short run estimations. The results suggested that explaining the presence of short run affecting the current year economic conditions are not indicative. (Martin Rapetti, March 5, 2011) The short run results of real economic growth in the last year and exchange rate of pigeon pea exports were to exist. However, the support is strong and the data is conclusive. This may be due to the exchange rate fluctuations and many farmers can get full benefits from transaction agricultural products. The relationship between Exchange Rate (ER) and Economic Growth (EG) proxied by Real Gross Domestic Product Growth Rate (RGDP) confirmed by (Kazi Mohammed Kamal Uddin, 2014 edition vol.10, No.31 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431).

In the short run current year total export values in USD has significant positive significant relationship with real GDP growth rate. The long run results of current year total export values in USD with the current year economic growth were to exist. However, the support of short run results was not strong that means it did not lead to a conclusion.

In the short run, production of pigeon pea has insignificant relationship with the current year economic growth. The long run results of production of pigeon pea with the current year economic growth were to exist. However, the support of short run results was not strong that means it did not lead to a conclusion.

In the short run, the agricultural land percentage of total land area has insignificant relationship with the current year economic growth.

Current year rural population increase has significant relationship with the economic growth of Myanmar. The short run results of current year rural population with the current year economic growth were to exist. However, the support of long run results was not strong that means it did not lead to a conclusion.

4.3 Diagnostics Tests

Breusch- Pagan- Godfrey test was applied to test heteroskedasticity problem of the variables to check whether the error terms are dispersing differently. Breusch- Godfrey LM test is applied to test the serial correlation of the variables whether the error terms are serially correlated or not. CUSUM and CUMUM squared tests were used to test model's stability.

Table 4.5 Diagnostics Tests Results

Diagnostic tests	F-Statistics	Prob
Breusch-Godfrey LM test	2.699711	0.0888***
Heteroskedasticity test	3.055755	0.9710***

Note: *** provides that the 5% significant level

Source: Author's illustration

LM test is applied to test the serial correlation of the residuals. H_0 of LM test is that there is no serial correlation among variables' error terms. LM test gives out p value of 0.0888, which means that H_0 is accepted due to p-value is insignificant and thus, there is no serial correlation. Heteroskedasticity test is to test for heteroskedasticity problems. H_0 is that the there is no heteroskedasticity problem. In order to determine that, the author tests p value and found that 0.9710 is not significant. Therefore, H_0 is accepted and there is no heteroskedastic problems.

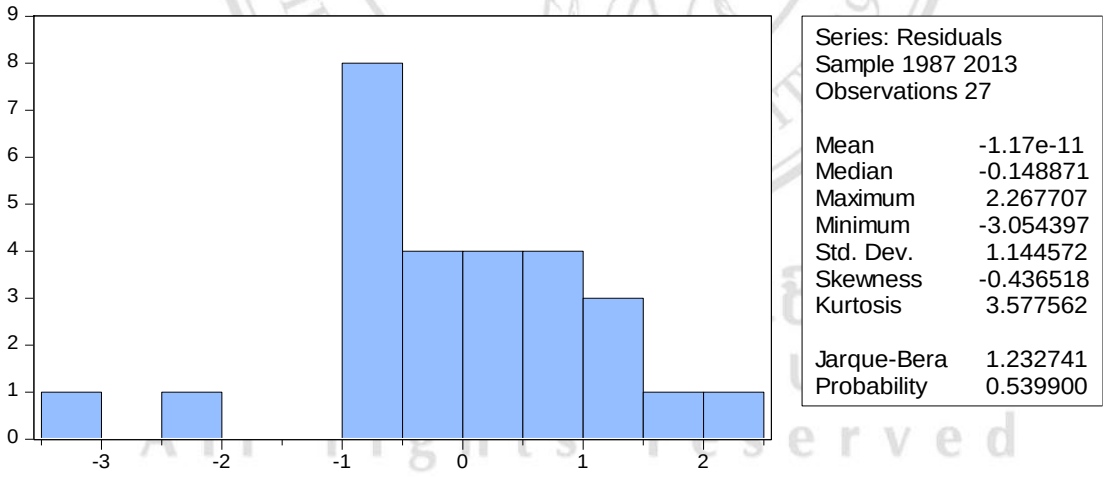


Figure 4.4 Histogram (Normality test)

Figure 4.1 indicated that the histogram is distributed normally and Jarque-Bera is insignificant with the probability values of 0.539900. Therefore, the null hypothesis is failed to reject and accepted, so it is normally distributed.

Figure 4.2 and 4.3 show that CUSUM, cumulative sum of recursive residuals and CUSUMSQ, cumulative sum of squares of recursive residuals tests are applied to test the

stability of the parameters in both long run and short run. The stability of the parameters is determined by checking with the critical bounds which are represented as red lines in the figures with 5% significance levels. If the residuals are within the red lines, it means that the residuals are stable.

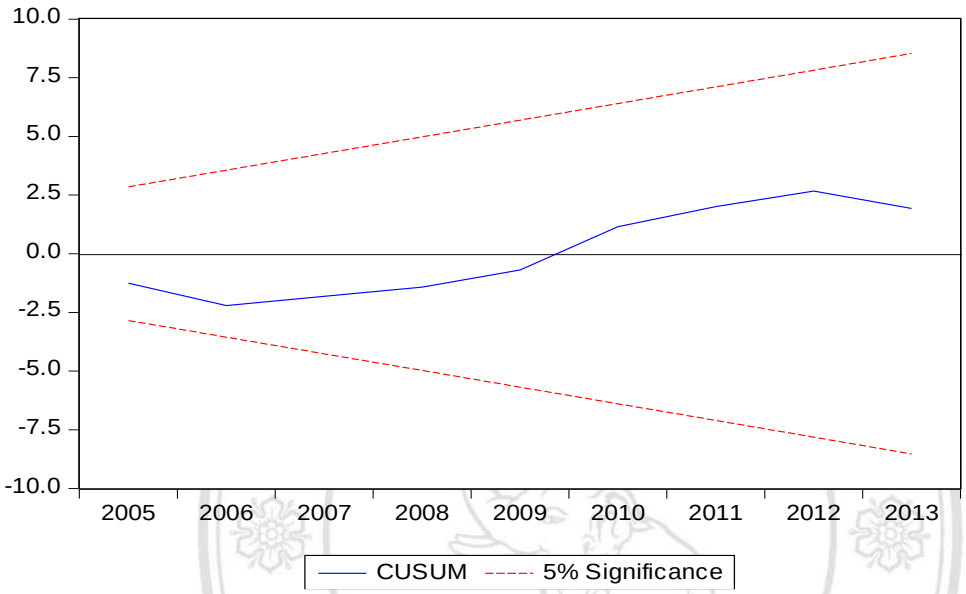


Figure 4.5 CUSUM

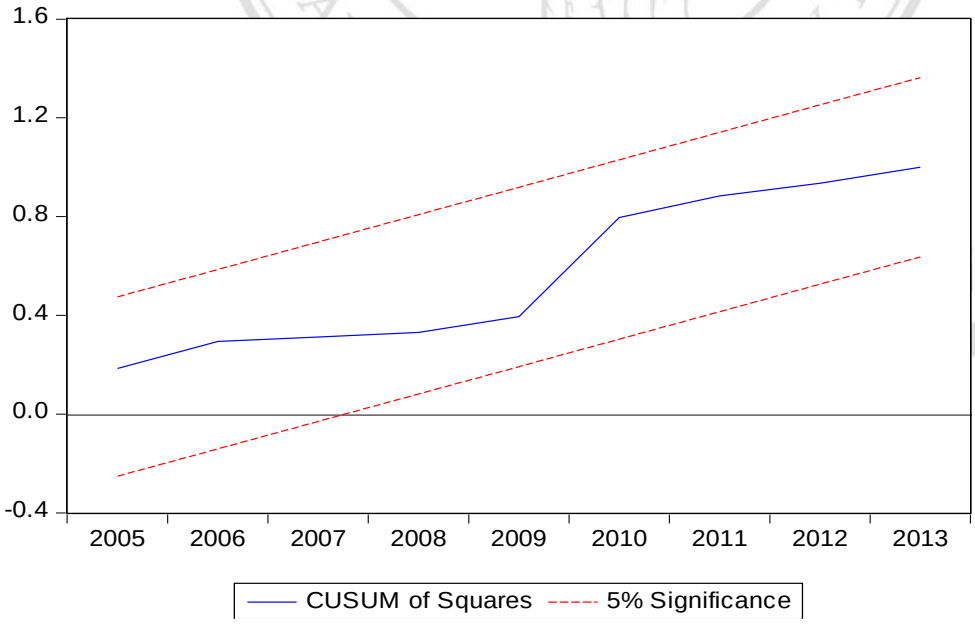


Figure 4.6 CUSUM Squares

CHAPTER 5

Conclusions

5.1 Conclusion

In this research, Myanmar pigeon pea export and production affect to the economic growth of Myanmar by using real GDP per capital as dependent variable and exchange rate, export values, pigeon pea production, agricultural land percentage and rural population were analysed. The results suggested that pigeon pea production and export have positive long run impact on economic growth of Myanmar. As for the short run, previous year growth has positive relation on current year growth which mean that if the economic situations were good in the previous year, it can positive effect on the current economic growth.

As for pigeon pea exports, the exchange rate has relationships with economic growth, In this study, last year real economic growth rate and exchange rate of pigeon pea exports provide significant in both long run and short run estimations. It was also determined that both long run and short run estimations, although significant, results were capable of explain the presence of short run affecting the current year economic conditions. The short run results of real economic growth in the last year, and exchange rate of pigeon pea exports were to exist. However, the support is strong and the data is conclusive. This result suggests that government should set out rules and regulations for exploring effective utilization of exchange rate of pigeon pea exports. This indicates that increase in productivity of agricultural products agricultural sector needs a better exchange rate control and liberalization with respect to pricing. Therefore, the government should give financial supports utilizing of exchange rate of pigeon pea exports for the farmers to be able to buy machinery and equipment for the productivity of the agricultural products. Moreover, the other agricultural related industries should

improve in order to accelerate the whole supply chain for agricultural products. Exploring effective utilization of exchange rate of pigeon pea exports is one of the main sectors that can contribute to accelerate economic growth of Myanmar. Therefore, increase in productivity can help to use the resources more efficiently and effectively. Moreover, it can help increase in production of specialized export products and together with increasing human capacity and skills. In addition, export earnings getting from trade can intensification through exporting to foreign markets.

Current year export values, higher pigeon pea production, agricultural land percentage of total land area, and rural population did not hold consistently to provide significant in both long run and short run estimations of Myanmar. Current year greater total export or export values has no relationship with current year economic growth but last year export values has no impact on economic growth. Pigeon pea production has no impact on economic growth. Agricultural land percentage of total land area in last year has no impact on economic growth. Rural population has no negative impact on the economic growth of the country.

5.2 Further Studies

The future research suggest exploring more about the market analysis of Myanmar export sectors, not just beans and pulses.

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APPENDIX

Unit Root Tests Results

RGDP

Null Hypothesis: RGDP has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.297520	0.4216
Test critical values:	1% level	-4.323979	
	5% level	-3.580623	
	10% level	-3.225334	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RGDP)

Method: Least Squares

Date: 09/09/16 Time: 14:21

Sample (adjusted): 1986 2013

Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP(-1)	-0.356395	0.155122	-2.297520	0.0302
C	1.955473	1.293899	1.511303	0.1432
@TREND("1985")	0.060253	0.077504	0.777422	0.4442

R-squared	0.177795	Mean dependent var	0.162500
Adjusted R-squared	0.112018	S.D. dependent var	3.093445
S.E. of regression	2.915040	Akaike info criterion	5.078601
Sum squared resid	212.4364	Schwarz criterion	5.221337

Log likelihood	-68.10041	Hannan-Quinn criter.	5.122237
F-statistic	2.703016	Durbin-Watson stat	2.141445
Prob(F-statistic)	0.086547		

Null Hypothesis: D(RGDP) has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.507963	0.0001
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RGDP,2)

Method: Least Squares

Date: 09/09/16 Time: 14:22

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RGDP(-1))	-1.278870	0.196508	-6.507963	0.0000
C	0.775595	1.318685	0.588158	0.5619
@TREND("1985")	-0.037993	0.077948	-0.487411	0.6304

R-squared	0.638327	Mean dependent var	0.035185

Adjusted R-squared	0.608188	S.D. dependent var	5.021517
S.E. of regression	3.143214	Akaike info criterion	5.232808
Sum squared resid	237.1150	Schwarz criterion	5.376790
Log likelihood	-67.64291	Hannan-Quinn criter.	5.275621
F-statistic	21.17915	Durbin-Watson stat	2.056635
Prob(F-statistic)	0.000005		

LNECR

Null Hypothesis: LNECR has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 1 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.740857	0.9591
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNECR)

Method: Least Squares

Date: 09/09/16 Time: 14:23

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNECR(-1)	-0.059807	0.080727	-0.740857	0.4663

D(LNECR(-1))	0.395919	0.211789	1.869402	0.0744
C	0.378450	0.258032	1.466677	0.1560
@TREND("1985")	0.002544	0.013585	0.187296	0.8531

R-squared	0.347161	Mean dependent var	0.127502
Adjusted R-squared	0.262008	S.D. dependent var	0.157413
S.E. of regression	0.135228	Akaike info criterion	-1.027750
Sum squared resid	0.420594	Schwarz criterion	-0.835774
Log likelihood	17.87462	Hannan-Quinn criter.	-0.970665
F-statistic	4.076909	Durbin-Watson stat	2.108402
Prob(F-statistic)	0.018484		

Null Hypothesis: D(LNECR) has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.740540	0.0366
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNECR,2)

Method: Least Squares

Date: 09/09/16 Time: 14:28

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNECR(-1))	-0.681773	0.182266	-3.740540	0.0010
C	0.195106	0.072364	2.696195	0.0126
@TREND("1985")	-0.007142	0.003655	-1.953915	0.0625

R-squared	0.370995	Mean dependent var	0.003302
Adjusted R-squared	0.318578	S.D. dependent var	0.162270
S.E. of regression	0.133951	Akaike info criterion	-1.078240
Sum squared resid	0.430631	Schwarz criterion	-0.934258
Log likelihood	17.55624	Hannan-Quinn criter.	-1.035427
F-statistic	7.077747	Durbin-Watson stat	2.035041
Prob(F-statistic)	0.003836		

LNEX_USD

Null Hypothesis: LNEX_USD has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 1 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.736651	0.0369
Test critical values:	1% level	-4.339330	
	5% level	-3.587527	
	10% level	-3.229230	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNEX_USD)

Method: Least Squares

Date: 09/09/16 Time: 14:29

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEX_USD(-1)	-0.584699	0.156477	-3.736651	0.0011
D(LNEX_USD(-1))	0.277006	0.172039	1.610131	0.1210
C	3.052364	0.797189	3.828909	0.0009
@TREND("1985")	0.088092	0.023125	3.809325	0.0009

R-squared	0.393256	Mean dependent var	0.131224
Adjusted R-squared	0.314115	S.D. dependent var	0.167364
S.E. of regression	0.138608	Akaike info criterion	-0.978383
Sum squared resid	0.441879	Schwarz criterion	-0.786407
Log likelihood	17.20817	Hannan-Quinn criter.	-0.921298
F-statistic	4.969077	Durbin-Watson stat	1.984886
Prob(F-statistic)	0.008380		

LNPPP

Null Hypothesis: LNPPP has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 1 (Automatic - based on AIC, maxlag=6)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.565702	0.2972

Test critical values:	1% level	-4.339330
	5% level	-3.587527
	10% level	-3.229230

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNPPP)

Method: Least Squares

Date: 09/09/16 Time: 15:01

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPPP(-1)	-0.430380	0.167744	-2.565702	0.0173
D(LNPPP(-1))	0.516363	0.207097	2.493332	0.0203
C	4.484574	1.705161	2.630000	0.0150
@TREND("1985")	0.054464	0.023021	2.365820	0.0268

R-squared	0.280295	Mean dependent var	0.091525
Adjusted R-squared	0.186420	S.D. dependent var	0.232860
S.E. of regression	0.210037	Akaike info criterion	-0.147114
Sum squared resid	1.014656	Schwarz criterion	0.044862
Log likelihood	5.986034	Hannan-Quinn criter.	-0.090029
F-statistic	2.985839	Durbin-Watson stat	2.002418
Prob(F-statistic)	0.052119		

Null Hypothesis: D(LNPPP) has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 5 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.112775	0.0195
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNPPP,2)

Method: Least Squares

Date: 09/09/16 Time: 15:02

Sample (adjusted): 1992 2013

Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNPPP(-1))	-2.408211	0.585544	-4.112775	0.0011
D(LNPPP(-1),2)	1.314480	0.476096	2.760959	0.0153
D(LNPPP(-2),2)	1.105371	0.442208	2.499664	0.0255
D(LNPPP(-3),2)	0.507478	0.340146	1.491942	0.1579
D(LNPPP(-4),2)	0.615822	0.256324	2.402520	0.0307
D(LNPPP(-5),2)	0.382680	0.238453	1.604847	0.1308
C	0.620225	0.176907	3.505946	0.0035
@TREND("1985")	-0.018418	0.007709	-2.389247	0.0315

R-squared	0.726815	Mean dependent var	-0.003584

Adjusted R-squared	0.590223	S.D. dependent var	0.310397
S.E. of regression	0.198697	Akaike info criterion	-0.118782
Sum squared resid	0.552728	Schwarz criterion	0.277961
Log likelihood	9.306597	Hannan-Quinn criter.	-0.025321
F-statistic	5.321056	Durbin-Watson stat	2.124521
Prob(F-statistic)	0.003892		

LNAL_P

Null Hypothesis: LNAL_P has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 5 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.671370	0.9992
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNAL_P)

Method: Least Squares

Date: 09/09/16 Time: 15:02

Sample (adjusted): 1991 2013

Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

LNAL_P(-1)	0.058950	0.087806	0.671370	0.5122
D(LNAL_P(-1))	0.698930	0.330246	2.116392	0.0514
D(LNAL_P(-2))	-0.861073	0.468606	-1.837518	0.0860
D(LNAL_P(-3))	-0.075573	0.524665	-0.144040	0.8874
D(LNAL_P(-4))	-0.347867	0.446651	-0.778833	0.4482
D(LNAL_P(-5))	-0.833957	0.397797	-2.096440	0.0534
C	-0.178501	0.236103	-0.756033	0.4613
@TREND("1985")	0.001911	0.000870	2.196055	0.0442

R-squared	0.756351	Mean dependent var	0.010461
Adjusted R-squared	0.642649	S.D. dependent var	0.013181
S.E. of regression	0.007879	Akaike info criterion	-6.580958
Sum squared resid	0.000931	Schwarz criterion	-6.186003
Log likelihood	83.68102	Hannan-Quinn criter.	-6.481628
F-statistic	6.652010	Durbin-Watson stat	2.068300
Prob(F-statistic)	0.001071		

Null Hypothesis: D(LNAL_P) has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 4 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.806994	0.0044
Test critical values:	1% level	-4.416345	
	5% level	-3.622033	
	10% level	-3.248592	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNAL_P,2)

Method: Least Squares

Date: 09/09/16 Time: 15:03

Sample (adjusted): 1991 2013

Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNAL_P(-1))	-2.273547	0.472967	-4.806994	0.0002
D(LNAL_P(-1),2)	1.956775	0.386158	5.067298	0.0001
D(LNAL_P(-2),2)	1.136639	0.477303	2.381378	0.0300
D(LNAL_P(-3),2)	1.114509	0.337962	3.297736	0.0045
D(LNAL_P(-4),2)	0.760854	0.375980	2.023657	0.0600
C	-0.020041	0.005927	-3.381512	0.0038
@TREND("1985")	0.002381	0.000507	4.692147	0.0002

R-squared	0.704621	Mean dependent var	0.002249
Adjusted R-squared	0.593853	S.D. dependent var	0.012150
S.E. of regression	0.007743	Akaike info criterion	-6.638308
Sum squared resid	0.000959	Schwarz criterion	-6.292723
Log likelihood	83.34054	Hannan-Quinn criter.	-6.551394
F-statistic	6.361274	Durbin-Watson stat	1.954964
Prob(F-statistic)	0.001420		

LNR_POP

Null Hypothesis: LNR_POP has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 6 (Automatic - based on AIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.615234	0.0517
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNR_POP)

Method: Least Squares

Date: 09/09/16 Time: 15:04

Sample (adjusted): 1992 2013

Included observations: 22 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNR_POP(-1)	-0.008248	0.002282	-3.615234	0.0031
D(LNR_POP(-1))	2.207340	0.242738	9.093508	0.0000
D(LNR_POP(-2))	-1.919482	0.577465	-3.323977	0.0055
D(LNR_POP(-3))	0.625736	0.725758	0.862184	0.4042
D(LNR_POP(-4))	-0.213053	0.803052	-0.265305	0.7949
D(LNR_POP(-5))	0.420866	0.672752	0.625589	0.5424
D(LNR_POP(-6))	-0.323108	0.273942	-1.179474	0.2593
C	0.146198	0.039942	3.660230	0.0029

@TREND("1985")	-9.85E-05	5.75E-05	-1.713701	0.1103

R-squared	0.999588	Mean dependent var	0.004629
Adjusted R-squared	0.999334	S.D. dependent var	0.004278
S.E. of regression	0.000110	Akaike info criterion	-15.09281
Sum squared resid	1.58E-07	Schwarz criterion	-14.64648
Log likelihood	175.0209	Hannan-Quinn criter.	-14.98767
F-statistic	3940.587	Durbin-Watson stat	2.604570
Prob(F-statistic)	0.000000		

Dependent Variable: RGDP

Method: ARDL

Date: 09/09/16 Time: 12:42

Sample (adjusted): 1987 2013

Included observations: 27 after adjustments

Maximum dependent lags: 2 (Automatic selection)

Model selection method: Akaike info criterion (AIC)

Dynamic regressors (2 lags, automatic): LNECR LNEX_USD LNPPP LNAL_P LNR_POP

Fixed regressors: C

Number of models evalulated: 486

Selected Model: ARDL(2, 1, 2, 0, 2, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDP(-1)	-0.699495	0.232809	-3.004585	0.0110
RGDP(-2)	-0.421840	0.169253	-2.492365	0.0283
LNECR	-2.825047	5.037904	-0.560758	0.5853
LNECR(-1)	-9.127753	4.863486	-1.876792	0.0851
LNEX_USD	12.46459	4.208988	2.961423	0.0119
LNEX_USD(-1)	5.496761	3.257887	1.687217	0.1174
LNEX_USD(-2)	11.31329	3.290604	3.438059	0.0049
LNPPP	2.972589	3.242285	0.916819	0.3773
LNAL_P	-5.856207	46.05295	-0.127162	0.9009
LNAL_P(-1)	46.10016	82.46713	0.559013	0.5864
LNAL_P(-2)	-355.2315	99.22469	-3.580071	0.0038
LNR_POP	-7243.729	2285.939	-3.168820	0.0081
LNR_POP(-1)	14340.71	4891.719	2.931629	0.0126
LNR_POP(-2)	-7059.914	2522.950	-2.798277	0.0161
C	76.83095	2550.199	0.030127	0.9765

R-squared	0.919948	Mean dependent var	7.790889
Adjusted R-squared	0.826555	S.D. dependent var	4.045366
S.E. of regression	1.684764	Akaike info criterion	4.181309
Sum squared resid	34.06117	Schwarz criterion	4.901219
Log likelihood	-41.44767	Hannan-Quinn criter.	4.395376
F-statistic	9.850224	Durbin-Watson stat	2.684049
Prob(F-statistic)	0.000159		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Cointegrating And Long Run Form

Dependent Variable: RGDP

Selected Model: ARDL(2, 1, 2, 0, 2, 2)

Date: 09/09/16 Time: 12:42

Sample: 1985 2013

Included observations: 27

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RGDP(-1))	0.441817	0.120769	3.658356	0.0033
D(LNECR)	-2.740023	2.266350	-1.209003	0.2499
D(LNEX_USD)	12.909165	2.379200	5.425842	0.0002
D(LNEX_USD(-1))	-10.971772	2.308203	-4.753384	0.0005
D(LNPPP)	2.131598	1.641010	1.298955	0.2184
D(LNAL_P)	-9.248137	27.920757	-0.331228	0.7462
D(LNAL_P(-1))	352.361337	68.718198	5.127628	0.0003
D(LNR_POP)	-7312.216337	948.571370	-7.708662	0.0000
D(LNR_POP(-1))	7121.990190	905.143289	7.868357	0.0000
CointEq(-1)	-2.118016	0.232444	-9.111955	0.0000

Cointeq = RGDP - (-5.6346*LNECR + 13.8001*LNEX_USD + 1.4013 *LNPPP -148.4855*LNAL_P + 17.4723*LNR_POP + 36.2182)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNECR	-5.634566	3.245287	-1.736230	0.1081
LNEX_USD	13.800105	2.417330	5.708823	0.0001
LNPPP	1.401282	1.493057	0.938532	0.0665

LNAL_P	-148.485518	27.299039	-5.439221	0.2002
LNR_POP	17.472264	66.672022	0.262063	0.7977
C	36.218212	1201.042731	0.030156	0.9764

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	3.055755	Prob. F(13,13)	0.0269
Obs*R-squared	20.34279	Prob. Chi-Square(13)	0.0870
Scaled explained SS	5.178747	Prob. Chi-Square(13)	0.9710

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 09/09/16 Time: 12:43

Sample: 1987 2013

Included observations: 27

Collinear test regressors dropped from specification

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2029.011	1269.144	-1.598724	0.1339
RGDP(-1)	0.494837	0.180763	2.737484	0.0169
RGDP(-2)	0.327789	0.144031	2.275827	0.0404
LNECR	-1.810675	3.403715	-0.531970	0.6037
LNECR(-1)	1.846568	3.092610	0.597090	0.5607
LNEX_USD	-4.150746	3.493165	-1.188248	0.2560
LNEX_USD(-1)	-0.124443	2.759314	-0.045099	0.9647
LNEX_USD(-2)	-5.524262	2.759415	-2.001969	0.0666
LNPPP	-6.421977	1.961205	-3.274505	0.0060
LNAL_P	-18.39708	38.74403	-0.474837	0.6428
LNAL_P(-1)	-56.60889	70.61401	-0.801666	0.4372
LNAL_P(-2)	202.7359	85.35024	2.375341	0.0336
LNR_POP	-492.2185	428.9795	-1.147417	0.2719
LNR_POP(-1)	597.0692	387.4876	1.540873	0.1473

R-squared	0.753437	Mean dependent var	1.261525
Adjusted R-squared	0.506874	S.D. dependent var	2.063933
S.E. of regression	1.449355	Akaike info criterion	3.886263
Sum squared resid	27.30818	Schwarz criterion	4.558179
Log likelihood	-38.46456	Hannan-Quinn criter.	4.086059
F-statistic	3.055755	Durbin-Watson stat	2.323529
Prob(F-statistic)	0.026906		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.699711	Prob. F(2,10)	0.1155
Obs*R-squared	9.466875	Prob. Chi-Square(2)	0.0888

Test Equation:

Dependent Variable: RESID

Method: ARDL

Date: 09/09/16 Time: 12:46

Sample: 1987 2013

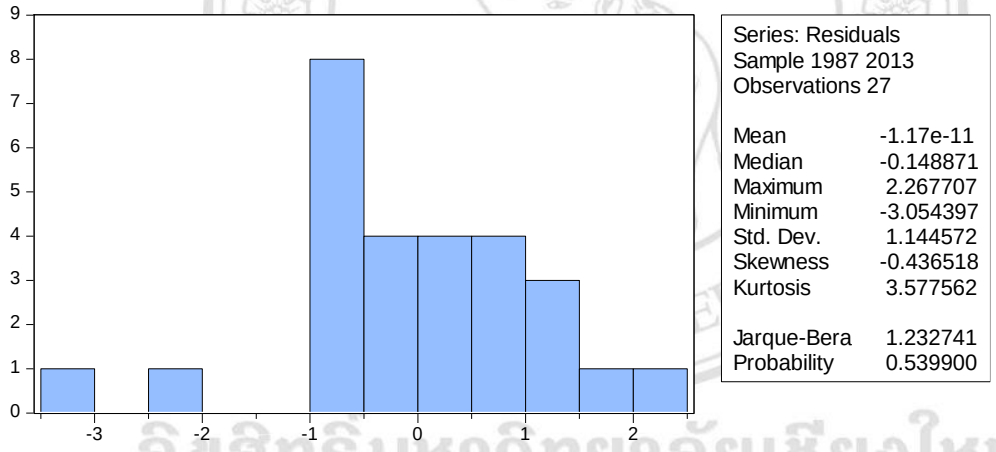
Included observations: 27

Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RGDP(-1)	0.273392	0.250057	1.093316	0.2999
RGDP(-2)	0.117224	0.178455	0.656882	0.5261
LNECR	2.255773	4.553921	0.495347	0.6311
LNECR(-1)	1.444803	4.350220	0.332122	0.7467
LNEX_USD	3.357772	4.072983	0.824401	0.4289
LNEX_USD(-1)	1.433766	3.401631	0.421494	0.6823
LNEX_USD(-2)	-2.015502	3.035109	-0.664062	0.5217
LNPPP	-5.236038	3.892316	-1.345224	0.2083
LNAL_P	12.25729	40.99458	0.298998	0.7711
LNAL_P(-1)	-59.56635	77.19446	-0.771640	0.4582
LNAL_P(-2)	24.60278	91.24918	0.269622	0.7929
LNR_POP	1781.544	2159.521	0.824972	0.4286
LNR_POP(-1)	-4082.187	4662.044	-0.875622	0.4018
LNR_POP(-2)	2213.403	2423.234	0.913409	0.3825
C	1600.301	2366.347	0.676275	0.5142

RESID(-1)	-0.962900	0.415266	-2.318755	0.0429
RESID(-2)	-0.751988	0.529305	-1.420708	0.1858

R-squared	0.350625	Mean dependent var	-1.17E-11
Adjusted R-squared	-0.688375	S.D. dependent var	1.144572
S.E. of regression	1.487228	Akaike info criterion	3.897712
Sum squared resid	22.11847	Schwarz criterion	4.713610
Log likelihood	-35.61912	Hannan-Quinn criter.	4.140321
F-statistic	0.337464	Durbin-Watson stat	2.207985
Prob(F-statistic)	0.974207		



Date: 09/09/16 Time: 12:50

Sample: 1985 2013

Included observations: 27

Q-statistic probabilities adjusted for 2 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
***| . |	***| . |	1	-0.347	-0.347	3.6198	0.057
. | . |	. *| . |	2	-0.022	-0.162	3.6355	0.162
.**| . |	.**| . |	3	-0.213	-0.325	5.1186	0.163
. | . |	***| . |	4	-0.051	-0.349	5.2085	0.267
. |* . |	. *| . |	5	0.119	-0.189	5.7086	0.336
. | . |	. *| . |	6	0.069	-0.116	5.8881	0.436
. | . |	. *| . |	7	-0.016	-0.146	5.8979	0.552
. | . |	. *| . |	8	-0.046	-0.149	5.9852	0.649
. | . |	. | . |	9	0.030	-0.033	6.0252	0.737
. *| . |	.**| . |	10	-0.149	-0.250	7.0543	0.720
. |* . |	. *| . |	11	0.173	-0.083	8.5225	0.666
. | . |	. |* . |	12	0.058	0.085	8.6977	0.729

*Probabilities may not be valid for this equation specification.

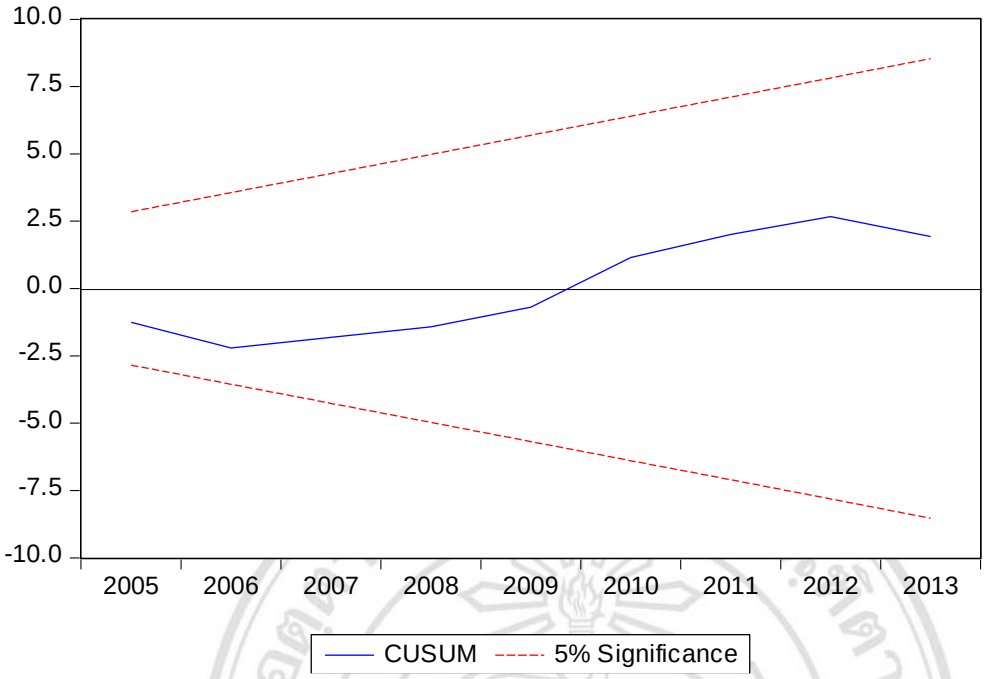
Date: 09/09/16 Time: 12:50

Sample: 1985 2013

Included observations: 27

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. |**. |	. |**. |	1	0.283	0.283	2.4150	0.120
. *| . |	. *| . |	2	-0.099	-0.194	2.7197	0.257
. *| . |	. *| . |	3	-0.189	-0.113	3.8801	0.275
. *| . |	. | . |	4	-0.110	-0.039	4.2948	0.368
. *| . |	. *| . |	5	-0.076	-0.082	4.5028	0.480
. *| . |	. *| . |	6	-0.076	-0.081	4.7154	0.581
. | . |	. | . |	7	-0.062	-0.062	4.8648	0.676
. *| . |	. *| . |	8	-0.122	-0.153	5.4760	0.706
. *| . |	. | . |	9	-0.077	-0.061	5.7315	0.766
. | . |	. | . |	10	0.069	0.044	5.9512	0.819
. | . |	. *| . |	11	0.051	-0.074	6.0773	0.868
. | . |	. *| . |	12	-0.042	-0.097	6.1715	0.907

*Probabilities may not be valid for this equation specification.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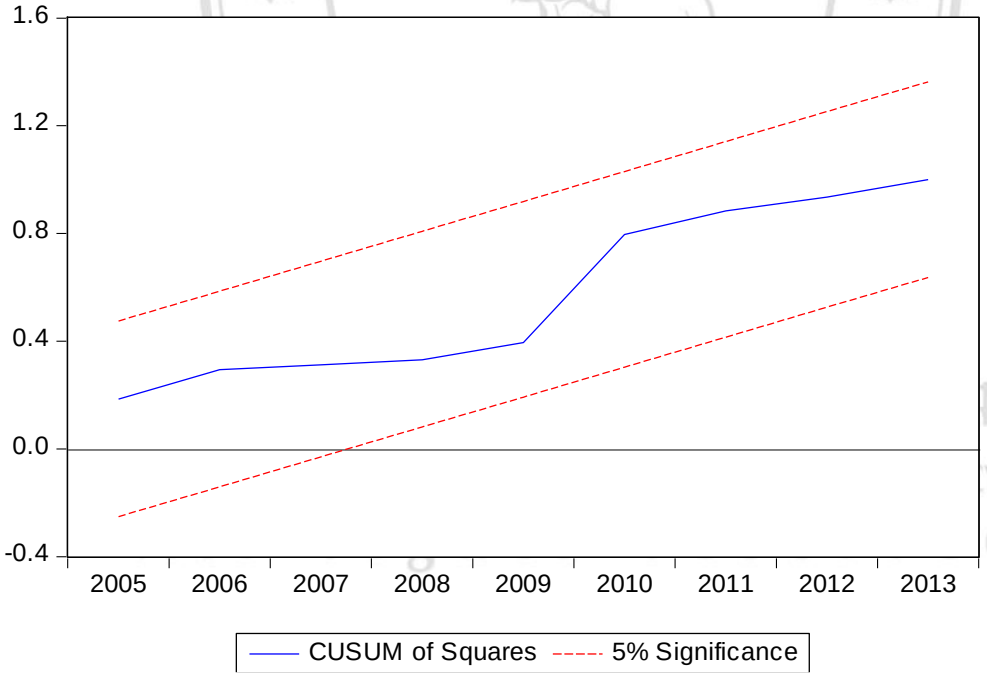
1.6
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0.8
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2005
2006
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2010
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2012
2013
CUSUM of Squares
5% Significance

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