DETERMINANTS OF THAILAND'S VEHICLE EXPORT VALUE

By

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Determinants of Thailand's vehicle export value

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I confirm that this independent study has been carried out under my supervision and it represents the original work of the candidate.

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ABSTRACT

The purpose of this report is to study the vehicle exports value in Thailand which is influenced by various key factors, such as inflation rate, interest rate, production number, real effective exchange rate, Terms of trade, world GDP growth, oil price, and patents granted for the period from 2000 to 2015. In identifying the various key determinants of Thailand's vehicle export value, effort was made to estimate regressions with value of exports being the explained variables in the respective regressions. The study found significant positive impacts of explanatory variables which production and patents granted. On the other hand, the researcher found an insignificant impact of inflation rate, interest rate, real effective exchange rate, Terms of trade, world GDP growth, and oil price on Thailand's vehicle export value.

The findings of this study would be helpful for export policy makers to obtain enhanced levels of economic development and growth of Thailand. It could also be used as a guideline for the private sector investors to identify the main factors and understand the risk factors that may impact the automotive trader, manufacturers of automotive parts, and dealers of automotive and component parts.

Keywords: Inflation Rate, Interest rate, Production, Real effective exchange rate, Terms of trade, World GDP growth, Oil price, Patents granted and Vehicle exports value

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CHAPTER I

GENERALITIES OF THE STUDY

1.1 Introductions and Research Problem

In the current situation of the world, international trade is an important factor in the development of the countries. Many countries around the world need to expand their market and invest in other countries by engaging in free trade between countries to open the opportunities to their country.

Thailand's economy is highly dependent on trade. Most revenues of Thailand come from export. Therefore, it is an extremely important key in determining Thai economic growth. In the past, Thailand was a major exporter of agricultural products in the world, especially rice and rubber, but as of 2015, Thailand's top three export products were automotive parts and accessories 863,828.36 million baht, computer equipment and components 595,418.55 million baht, jewelry 371,071.62 million baht. The export groups represent the highest baht value of overall exports from Thailand in industrial products (Statistics of Department of International Trade Promotion Ministry of Commerce, Thailand).

As of 2015, the main industries of Thailand's percentage growth for all industries combined were automotive including component parts, 11%; financial services, 9%; electric appliances and component parts, 8%; tourism, 6%; and others (Thailand central intelligence agency). Thailand's automotive industry was ranked 12th largest in the world, and it was the center of ASEAN, the largest in Southeast Asia and accounting for approximately 12% of Thailand's GDP.

Thailand's automotive industry is an important sector that drives the economy as it contributes extremely to export and trade inflows, creation of job, and development of automotive technology and other businesses involved in the supply chain of the industries with strong infrastructures including extensive network of small and large, local and foreign companies. Recently, Thailand's automotive industry is continuously growing.

However, even though Thailand’s automotive industry is continuously growing with a high trend of export value, but it is facing high competition after establishing free trade between and among countries, especially in competing with producers from Indonesia. Prior to 2014, Thailand was the strongest exporter of automotive products among the five countries of ASEAN. However, during 2014 to 2015, automotive export by Thailand to Indonesia suffered a major contraction of 20.5 % due to the development of its own manufacturing capabilities and the volatility of the various variables, such as macroeconomic factors, related industry factors and innovation factors as measured by patents granted that may impact on the exports value of Thailand’s automotive industry. This has led to much discussion in 2016 for the Thai automotive industry to find solutions to maintain its share in the export market.

Macroeconomic factors have been caused by both inside and outside the country factors (Masmoudi, 2013), so when Thailand’s exports do not consistently grow, it may enter a recession in the country. Many of the macroeconomic factors such as inflation rate (Dery, 2014 and Gylfason, 1997), interest rate (Furman and Stiglitz, 1998), real effective exchange rate (Berthou, 2008), terms of trade (Kalumbu, 2014), world GDP growth (Mashayekhi, 2013) have influenced on Thailand’s vehicle export value.

Related industry factors in this study are focused on oil prices and production which played an important role in Thailand’s vehicle export value (Kasornbua, 2014). The low price of oil negatively impacts on Thailand’s exportation of vehicle and component parts as it decreases the trading demand of vehicle and component parts with oil-exporting nations (Belenkiy, 2012) such as in middle east. The production of goods and services with cheap cost and the export of the production surplus will benefit Thailand, which means an increase in production surplus will lead to an increase in export (Kasornbua, 2014).

Innovation capability factor as measured by patents granted is for vehicle components and manufacturing processes, such as vehicle brake control systems, air-cushion vehicles, air-treating devices of vehicles, electric equipment for vehicles, motor-cycles, engine-assisted cycles, mounting of propulsion units or of transmissions in vehicles, servicing of vehicles, signalling or lighting devices, vehicle connections, vehicle parts, vehicle passenger accommodation, vehicle suspension arrangements, vehicle tyres, vehicle wheels, vehicles adapted for load transportation, windows, windscreens, non-fixed roofs, doors, protective coverings, and power supply lines.

The product innovation can keep customers interested and gain positive impact from new market export shares, while manufacturing innovation can reduce the costs of manufacturing. Innovation capability factor as measured by patents granted is a key to understanding the evolution of the automotive industry, specifically in terms of technology transfer from automotive manufacturers to their suppliers at all tiers.

The present study basically reflects in Thailand's economic growth because Thailand is the major automotive exporting country in Asia facing a strong competition in free trade between and among countries. This study is to find out the current situation of Thailand's automotive industry and various factors such as innovation capability factor as measured by patents granted, macroeconomic factors, and related industry factors which may impact on Thailand's vehicle export value.

1.2 Statement of the Problem

Thailand's automotive industry is one of the most important industrial sectors in the country. It has become more important in the automotive world market due to the high volume and value of vehicles and automotive parts exported. Even though Thailand's automotive industry is continuously growing with a high trend in export value, it still faces and face increasing competition after establishing free trade between and among countries. Due to the rapid growth of the automobile industry in Indonesia, it could become the major competitor of Thailand.

The establishment of the ASEAN Economic Community (AEC) in 2015, has made changes in the competitive environment. The competitors are becoming entrepreneurs with nine ASEAN member countries. Entrepreneurs expand or relocate production bases to other member countries. This will be an opportunity to make a profit and create growth for the entrepreneurs and increase Thailand's vehicle export value, but in reverse, it can be a threat to the business. So, when the environment changes entrepreneurs, it is also needed to know the current situation of Thailand's automotive industry and to understand the various factors that impact on exports of car parts and accessories to find a way to prevent the risk factors from innovation capability factor (product innovation), macroeconomic factors and related industry factors.

1.3 Research Objectives

This research study has the following objectives:

1. To study the current situation of Thailand's automotive industry;
2. To study the innovation capability as measured by patents granted that influence Thailand's vehicle export value;
3. To study the macroeconomics factors that influence Thailand's vehicle export value; and
4. To study the related industry factors that influence Thailand's vehicle export value.

1.4 Research Questions

1. Do the innovation capabilities as measured by patents granted influence Thailand's vehicle export value?
2. Do the macroeconomics factors influence Thailand's vehicle export value?
3. Do the related industry factors influence Thailand's vehicle export value?

1.5 Scope of the Research

This research study is related theories, such as International trade theory, Absolute advantage theory, Comparative advantage theory, Heckscher-Ohlin theory, Technology theory, the product life cycle theory, Loanable funds theory of interest, Neoclassic economic theory, and the theory changes in terms of trade.

This study used the data taken from Thailand covering the period from January 2000 to December 2015, a total of 192 months. These data include the following:

(1) Innovation capability factor as measured by patents granted for vehicle components and manufacturing processes, for which the monthly data were used.

(2) Macroeconomic factors refer to the interest rate MLR (Minimum Lending Rate), real effective exchange rate and terms of trade for which the monthly data were used. Also, inflation rate is which the core consumer price index excluding raw food and energy items (2011=100) and world GDP growth, which is the annual percentage, for which the data were used.

(3) Related industry factors are oil price and production numbers, for which the monthly average data were used.

1.6 Significance of the Study

This research is aimed to understand the factors that impact on Thailand's vehicle export value, such as innovation capability factor as measured by patents granted for vehicle in general, macroeconomic factors, and related industry factors.

To be used as a guideline for the private sector investors to identify the main factors and understand the risk factors that may impact the automotive trader, manufacturers of automotive parts, and dealers of automotive and component parts.

To be a guideline for the Government to determine the trade policy with foreign countries around the world to promote vehicle exports in the future, especially among the ASEAN group.

1.7 Definition of Terms

ASEAN Economic Community (AEC)	is a single market of Association of Southeast Asian Nations (ASEAN) and is characterized by free movement of services, goods, investment, and free flow of capital and skills (Chia, 2013). The AEC has 10 member states which are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Crude Oil Price	is the price of oil from the spot price of a barrel benchmark crude oil. This paper has used the oil price from West Texas Intermediate (WTI) because the delivery point is landlocked and the transportation is constrained. The price of WTI is cheaper than the other suppliers (Fattouh, 2011).
Exports Value	is the value of vehicles including component parts exported by monthly (Sear, 2015).
Inflation Rate	is the increase in the general level of prices of goods and services which are continually increasing. If inflation continues to rise, it will impact on the consumption and economic wealth. The high inflation will affect the interest rate after

	deducting the inflation out. The real interest rates will be reduce interms of value because inflation reduces the value of money, and the interest rate received can buy less of goods or services. When the product is more expensive, the sales will be reduced and the production costs are also high. As a result, some business owners may decide to slow down production and reduced investment and make more unemployment (Ariss, 2012 & ANTWI1, 2013).
Innovation capability factor	as measured by the number of patents granted for vehicle components and manufacturing processes. Patent is a right granted to the owner and an official document given to an inventor by a government. These documents are generally provided to inventors the right to stop other people from using, copying, selling or distributing the invention without their permission. Innovation is the development of new product, process, organizations, management practices, and strategies that solve a technical problem (Fu, 2008).
Interest Minimum Loan Rate (MLR)	is the minimum interest rate that banks lend as credit and the interest rate changes by time, depending on the economic conditions, inflation rate, or government policy, determinant by bank of Thailand (Bank of Thailand, 2005).

Production	is the number or production level of vehicle manufactured and calculated by the vehicle manufacturing in Thailand (Office of Industrial Economics, 2015).
Real effective exchange rate (REER)	is the nominal effective exchange rate (NEER) adjusted from domestic inflation and inflation of weighted average of trading partners. If the real effective exchange rate increases, the home (domestic) currency is in appreciation with the currencies of trading partners (average weighted rate baht from the bilateral exchange rate of one currency to another currency, so when the baht NEER is high it means value appreciation) (Bank of Thailand, 2015).
Terms of trade	is the ratio between the export price (PX) and the import price (PM). It measures the export country prices in relations to its import. If there is in a raise ratio in Terms of trade, it creates a benefit in terms of items that need to be exported to be purchased in a given amount of imports (Bank of Thailand, 2015).
World GDP	is global gross domestic product (Lanz & Maurer, 2015).

CHAPTER II

REVIEW OF RELATED LITERATURE AND STUDIES

Rys, Meyer, Sebranek's (2011) described that a literature review helps and guides readers and researcher through academic topics as it explains the key qualities as well as pointing out likeness and the differences between research methods, strategies, or perspectives and showing connections between the works. In this part of the study, the literature review explains the vehicle exports value in Thailand influenced by various key factors, such as patents granted, inflation rate, interest rate, real effective exchange rate, Terms of trade, world GDP growth, and Oil price and production.

A few empirical studies have been conducted to investigate the relationship between exports value in various macroeconomic variables. The researcher believes that some of the determinants of exports value include the macroeconomic factors, related industry factors and innovation capability factor as measured by patents granted for vehicle in general.

2.1 Previous Studies

Berthou (2008) made an investigation on the impact of real exchange rate movements on exports for OECD bilateral. This paper examined this issue by using a sample of OECD countries and developing and developed country importers from 1989 to 2004. The results showed that the strength of the domestic currency against the other major currencies has a significant negative impact on exports. The bilateral export has reduced by real exchange rate appreciation.

Belenkiy (2012) found negative significant impacts of oil price in all types of vehicle exports value, especially on SUVs which was $705 million. This also means that the less fuel efficient the vehicles are the more likely to suffer a competitive disadvantage when global crude price is high. The result of the research on oil price as the variable in this study is significantly correlated with exports value with a significance level of 10%.

Dery (2014) studied the relationship between the exchange rate movement in Ghana and the export growth. The result showed that the coefficient of inflation is positively significant with export goods and services; therefore, the researcher expected that as inflation goes up, export will decline.

Frietsch et al. (2014) examined the linkage between patents and efficacy of exports in selected countries in the field of technology. They analyzed the patents indicator for growth in macroeconomic, the value of patents by the volume of exports, and the result showed that patents and exports are strongly correlated.

Furman and Stiglitz (1998) found out that an increase in interest rate affects the future export performance, which reduces the future flow of foreign exchange reserves and thereby, leads to depreciation of currency.

Gylfason (1997) studied the determinant of exports and economic growth covering 160 countries from 1985 to 1994. The result found that the coefficient of inflation is a significantly negative at 5%, high inflation is associated with low exports and slow growth.

Kalumbu (2014) found out that there is a negative relationship between terms of trade and economic growth in Namibia. This has been revealed by the responses from proving that the shocks in GDP lead to a reduction in Terms of trade. This negative result may be the result of the import in larger quantities compared with the quantities of export by Namibian nation. There are many factors that determine the economic growth, and the Terms of trade is the one of them.

Kasornbua (2012) studied the market structure of automotive industry, determinants of Thailand vehicle export, and prediction on Automotive industry during 2010 to 2014. The researcher studied the five country markets, such as Indonesia, Australia, Malaysia, Japan and Saudi Arabia. The result found that the change in the increase of exchange rate, production, oil price, GDP is in the same direction with the increasing vehicle export value of Australia.

Mashayekhi (2013) studied the impact of the slowdown of world GDP growth on India's export growth. Apart from relative prices, the global GDP was also considered to be an important variable for estimating the export demand functions. The results showed that the factors found to be negatively significant at 1% decline in GDP global growth which will lead to 1.88% decline in India's exports growth to the world.

Yi, Wang, and Kafouros (2012) studied the effects of innovative capabilities on export performance, and patents to proxy R&D output used to measure innovation capabilities by number of patents. The result has shown a positive and significant moderating effect on the relationship between innovative capabilities and export performance.

Table 2.1: Summary of previous studies

Factor	**Data**	**Measurement**	**Impact on exporting**		
			Positive	**Negative**	**No effect**
Macroeconomic	**Inflation rate**	Core Consumer Price Index annual percentage data were used.	Dery (2014)	Gylfason (1997)	
	Interest rate (MLR)	Interest rates loan, monthly data were used.		Furman and Stiglitz (1998)	
	Production	Production units, monthly data were used.	Kasornbua (2014)		
	Real effective exchange rate	Adjusted nominal effective exchange rate (NEER) from domestic inflation and inflation of weighted average of trading partners), monthly data were used.		Berthou (2008)	
	Terms of trade	The value of the exports of a country, relative to the value of its imports, monthly data were used.	Kalumbu (2014)		

Source: Author

Table 2.1: Summary of previous studies

Factor	Data	Measurement	Impact on exporting		
			Positive	Negative	No effect
Macroeconomic	**World GDP**	Global gross domestic product, annual percentage data were used.	Mashayekhi (2013)		
Related industry factors	**Oil Price**	Oil price, monthly average data were used.	Kasornbua (2014)	Belenkiy (2012)	
Innovation capability	**Patents**	Counted number of patents granted, monthly data were used.	Yi, Wang, and Kafouros (2012)		
			Frietsch et al. (2014)		

Source: Author

2.2 Related theories

The theory of international trade is simply a different theory to explain international trade. The concept of the commercial exchange of goods and services between the two entities in the two countries is different, this type of trade gives growth to the world of economy in which supply, demand, and price are affected by global events; good and services sold to other countries are called exports; and if purchase from other countries is called import. Due to the increases in international trade with an increasing the level of openness in the economy, the price plays an important role in international trade. The difference in price is indicative of the ability to export or import goods and services of the country. International trade involves a variety of currencies (Samuelson, 2004).

The importance of international trade theories to a nation's economic welfare and development has been in the economics literature (Huan Chen, 2009), and the most famous theories are about the exports of surplus (Adam Smith, 1776). The reason underlying suggests that economies need to export goods and services in order to generate revenue and import goods and services, which cannot be produced (Coutts & Godley, 1992, McCombie & Thirlwall, 1992). The export growth is critical for country to bring income, generate foreign exchange and create employment, so many studies focus on the various factors that have an impact on export.

The classical trade theory contends that the basis for international trade can be sourced to differences in production characteristics and resource endowments which are founded on domestic exporting are the only mechanisms for transferring goods and services across national boundaries (Bradley, 1991). Theories of absolute advantage (Adam Smith, 1776) and of comparative advantage (David Ricardo, 1817), Heckscher-Ohlin theory, Eli Heckscher's (1919) and, Bertil Ohlin (1933) focus in national factor endowments, such as differences of labor, land, or capital, as opposed to Ricardo's theory which stresses productivity when Ricardo's theory of comparative advantage that different determinant of production, especially in different economic activities varies depending on the relative productivity. The theory point that the production of goods and service with cheap cost and export of the production surplus will benefits for both countries, it means increasing on production surplus will lead to increase on export.

The uses of technology theory to focus on export performance are mainly on the development of new products or processes (innovation capability in this study measure by patents granted for vehicle components and manufacturing processes is used) and push the firms to improve the quality of their products. Both of these mean the positive linkages between research and development or innovation on exporting. A Studies in the neo-endowment showed that the basic factor advantages would be important if the firm had a monopoly and natural factors. Technology theory (Davis 1995, Greenhalgh 1990, Vernon 1966, Krugman 1979, Dollar 1986, Posner 1961) is an extension of conventional technology-based models. In theoretical literature, some empirical studies point towards of Vernon (1966). The product life cycle theory is where product innovation should impact on the productivity level and thus will be indirectly linked to the later decision of a firm to start exporting.

Loanable Funds Theory of Interest. Due to the classical theory of interest rate that explains and determines the interest rate in long term, it is difficult to explain the level of change in short-term interest rate. An economist created a new theory called loanable funds theory which can be determined by two factors, First demand for loanable funds. It is loan needed from household, private sector, business sector, and government sector. The demands of loan from household, private sector, and business sector depend on interest rate. If the interest rate is high, the demand will decrease, but if the interest rate is low, the demand will increase. The government's demand of loan depends on the government policy. Second, Supply of loanable funds. The credit of loan supply coming from the first is saving of household, private sector, business sector, and government sector. Another is the money supplied by the central bank. An increase in money supply will lead to rise of bank reserve and able to lend more money. According to Furman and Stiglitz (1998), an increase in interest rate affects the future export performance, which reduces the future flow of foreign exchange reserves and thereby, leads to depreciation of currency.

The neoclassic economic theory emphasizes the role of the real effective exchange rate on export. The depreciation or appreciation of the country's currency is the gain or loss of export's competitiveness (Edwards, 1989). The theory predicts that a fall in a currency's domestic purchasing power will increase in the domestic price level of goods and the service will attack net exports, which means the goods are becoming more expensive relative to their competitors. Thapa (2002) referred that in the real exchange rate, the depreciation strengthens the international competitiveness of domestic goods and net exports.

Terms of trade is determined by dividing the export price of domestic by the imports price (Sherbourne, 2009). The theory changes in terms of trade impact of open economies that depend on the export, especially leads to a high ratio of terms of trade which in return will speed of economic growth (Kreinin, 2006 and Frourie, 2001).

2.3 Background of Automotive Industry

In the history of Thailand's automotive industry, the year 1960 was the beginning of the Thai automotive industry which Field Marshal P. Pibulsongkram was the Prime Minister of Thailand. It was when the Thai government gave importance in promoting the import substitution policy to boost local industry by establishing automotive assembly plants in Thailand and exempting them from import tariffs for Completely Knocked Down (CKD) auto parts at lower cost than the complete Built Up (CBU).

For over past 50 years, Thai automotive sector has been continuously developing with strong support from the private and public sectors. Thailand's automotive industry has recovered quickly after the slow down during the global economic crisis. Thailand has been the center of ASEAN automotive industry, also dubbed as the Detroit of Southeast Asia with the largest automotive production within Southeast Asian countries.

The vehicle exports value of Thailand is a major drive to Thai economic growth when there is an increase on domestic sales and exports of car, motorcycles, accessories, and component parts, Moreover, it has helped create jobs over 550,000 people and improve inflows of money. It is important to understand the relationship of various factors that may affect the exports value, especially in the technology development and innovation capability as measured by patents granted for vehicle components and manufacturing processes in the automotive industries which can help succeed and sustain in Thai's automotive industry. Products innovation can attract customers' interest while innovation capability in manufacturing production can reduce the manufacturing costs. An analysis on granted patents indicates that from 2000 to 2015, Thailand research and development used innovation survey in Automotive Industry, and found that patents were granted to 1,025 items out of 3,307 items patent applications (during examination patent process (see table 2.2).

Table 2.2: Granted patents and Patent applications (during examination patent process)

Items	Granted patents (2000 - 2015)	Patent applications (2000 - 2015)	Total
Vehicle brake control systems	29	70	99
Air-cushion vehicles	3	16	19
Air-treating devices of vehicles	28	81	109
Electric equipment for vehicles	20	74	94
Motor-cycles, engine-assisted cycles	1	0	1
Mounting of propulsion units or of transmissions in vehicles	136	275	411
Servicing of vehicles	33	68	101
Signalling or lighting devices	31	77	108
Vehicle connections	20	20	40
Vehicle parts	402	647	1049
Vehicle passenger accommodation	27	96	123
Vehicle suspension arrangements	24	75	99
Vehicle tyres	85	419	504
Vehicle wheels	33	98	131
Vehicles adapted for load transportation or to transport	62	88	150
Windows, windscreens, non-fixed roofs, doors, protective coverings	91	177	268
Power supply lines	0	1	1
Total	**1025**	**2282**	**3307**

Source: Thailand Department of Intellectual Property 2016

Thailand's automotive domestic sales and exports have increasingly relied on the export market and continuously growing until year 2008. After year 2008 the exports value of vehicle and component parts has slowed down because of global financial crisis. However, after the dismal in 2009, Thailand has recovered on exports of vehicles and component parts, everything has come to new highs rebounded in 2012 to 2013.

Thai automotive industry experienced its golden years in 2012 and 2013. In the end of 2011, the first car project of the government led to an unusual rise in the demands of car. The total annual sales in 2012 was 1,436,144 units and in 2013, the total annual sales was 1,330,680 units. As a result, the major manufacturers were focusing on expanding the export market. Consequently, the number of transport vehicle exported increased from 702,672.29 to 750,200.84 units and motorcycles exported have increased from 856,935 to 935,747 units (see table 2.3 & 2.4, figure: 2.1 & 2.2).

However, in 2014 to 2015, the market for domestic and exported automotive was down badly due to the first car project of the government that led to rise in household debt. The total annual sales in year 2014 was 881,883 units and total sales in year 2015 was only 799,632 units as compared 1,436,144 to 1,330,680 units in 2012 and 2013 respectively. (see table 2.3 & 2.4, figure: 2.1 & 2.2).

Table 2.3: Thailand's Transport vehicle domestic sales and exports (1996 – 2015)

Year	Domestic Sales	Exports
1996	561,523	6,295.55
1997	349,033	20,722.84
1998	140,402	34,110.33
1999	218,330	60,105.53
2000	262,189	83,245.46
2001	297,052	107,110.16
2002	409,262	107,729.72
2003	533,176	138,161.39
2004	628,265	202,079.90
2005	703,261	294,243.90
2006	682,163	342,655.95
2007	631,251	469,303.35
2008	614,078	516,243.89
2009	548,871	379,486.62
2010	786,096	584,009.58
2011	796,123	527,064.27
2012	1,436,144	702,672.29
2013	1,330,680	750,200.84
2014	881,883	780,275.09
2015	799,632	840,236.07

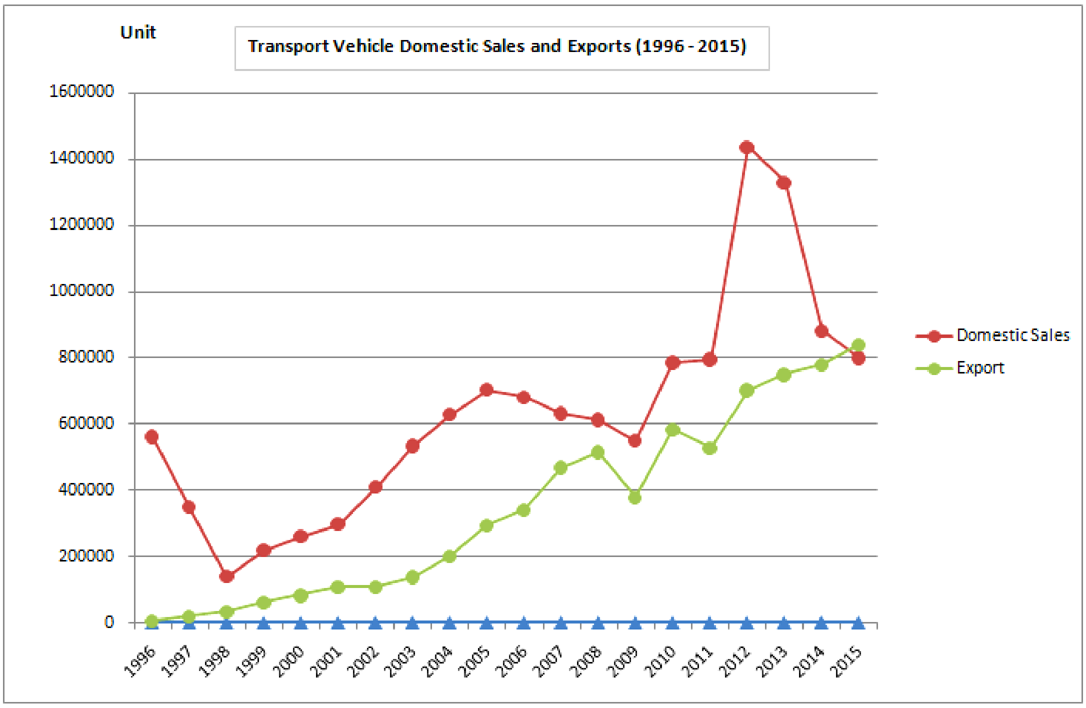
Source: Thailand Automotive Institute

Table 2.4: Thailand's Motorcycles domestic sales and exports (1996 – 2015)

Year	Domestic Sales	Export
1996	1,236,159	7,169.96
1997	910,664	7,448.89
1998	526,845	10,055.53
1999	604,010	8,506.48
2000	783,678	10,790.11
2001	907,100	12,756.38
2002	1,327,675	14,013.69
2003	1,766,860	17,587.89
2004	2,026,841	29,574.16
2005	2,112,426	1,337,586
2006	2,054,588	1,575,393
2007	1,598,613	1,790,739
2008	1,703,376	1,252,584
2009	1,535,461	588,398
2010	1,845,997	816,427
2011	2,007,080	1,133,002
2012	2,130,041	856,935
2013	2,004,498	935,747
2014	1,701,525	887,980
2015	1,639,085	934,994

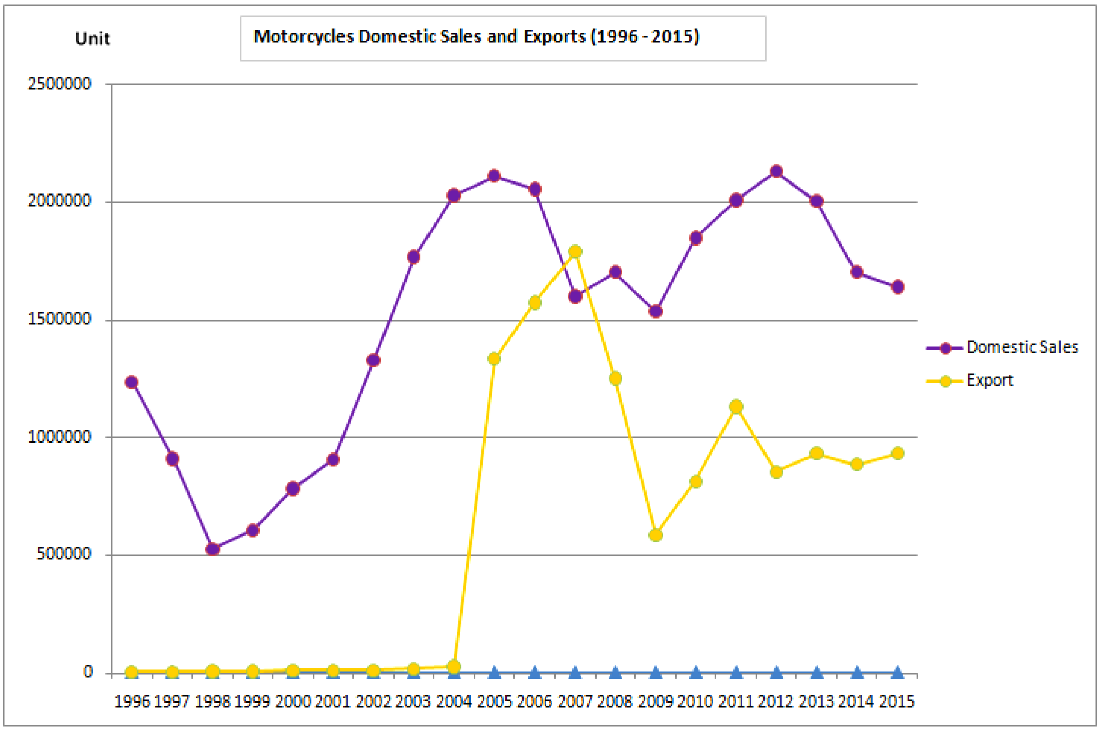
Source: Thailand Automotive Institute

Figure 2.1: Thailand's Transport vehicle domestic sales and exports (1996 – 2015)



Source: Thailand Automotive Institute

Figure 2.2: Thailand's Motorcycles domestic sales and exports (1996 – 2015)



Source: Thailand Automotive Institute

Thailand does not produce its own car brand; therefore, many foreign companies are producing or assembling cars, trucks, component parts and accessories, the mostly driven by Japanese companies in Thailand. The major multinational leaders in the automotive industry in Thailand are Honda, Chrysler, Honda (Honda Automobile Thailand Co. Ltd.), Toyota (Toyota Motor Thailand Co. Ltd.), Toyota Dyna (Hino Motors Thailand Ltd.), Isuzu modifications (Thai Rund Union Car Public Co. Ltd.), ,Isuzu (Isuzu Motors Company Thailand Ltd.), Mercedes-Benz (Thonburi Automotive Assembly Plant Co. Ltd.), VMC (Siam V.M.C. Automobile Co. Ltd.), BMW (BMW Manufacturing Thailand Co. Ltd.), Volvo (Thai Swedish Assembly Co. Ltd.), Land Rover, Volkswagen (Y.M.C. Assembly Co. Ltd.), Rover, Peugeot, Mitsubishi (MMC Sittipol Co. Ltd.), Ford (Auto Alliance Thailand Co. Ltd.), Hyundai (Bangchan General Assembly Co. Ltd.), Hino, Suzuki (Siam Nissan Automobile Co. Ltd.), Mazda, Nissan, Opel (General Motors Thailand Ltd.

Thailand has about 709 companies that can be divided into three categories: (1) Foreign Majority by 54 percent; (2) Thai Majority by 23 percent; and (3) Pure Thai by 23 percent of tier 1, the local suppliers in tier 2 and 3 has 1,700 companies of automotive parts manufacturer (figure 2.3 & 2.4). That is more than half of the tier 1 supplier of foreign companies, the most of the top 100 automotive parts manufacturers in the world and Thailand has 50 percent factory. Thai's manufacturing is strong enough to supply the entire necessary parts based in the country.

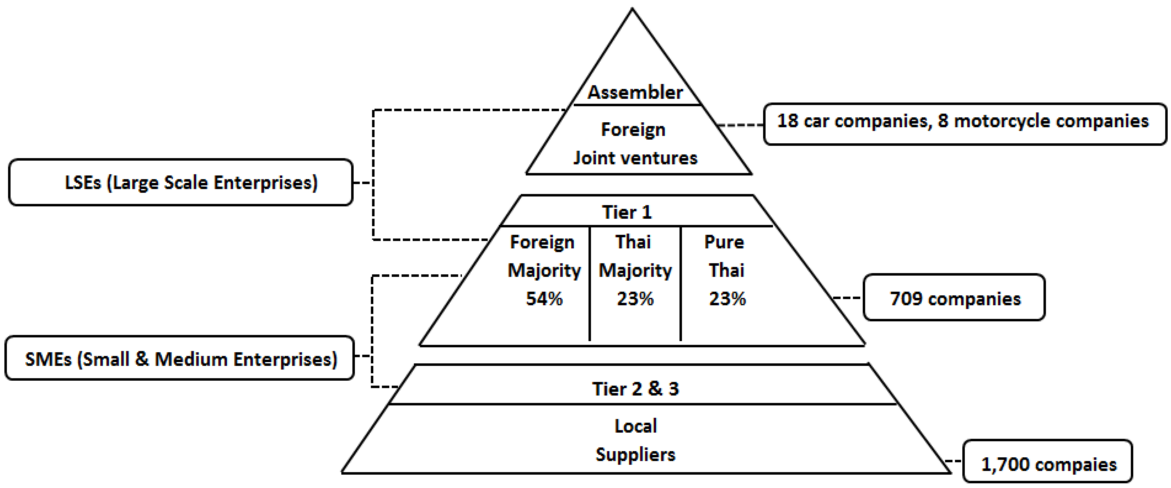
Production of automotive parts can be produced by the structure as follow:

Third Tier, the companies are the suppliers providing their products directly to the Second Tier suppliers.

Second Tier, the companies are the suppliers providing their products to the First Tier supplier (not directly to the OEMs).

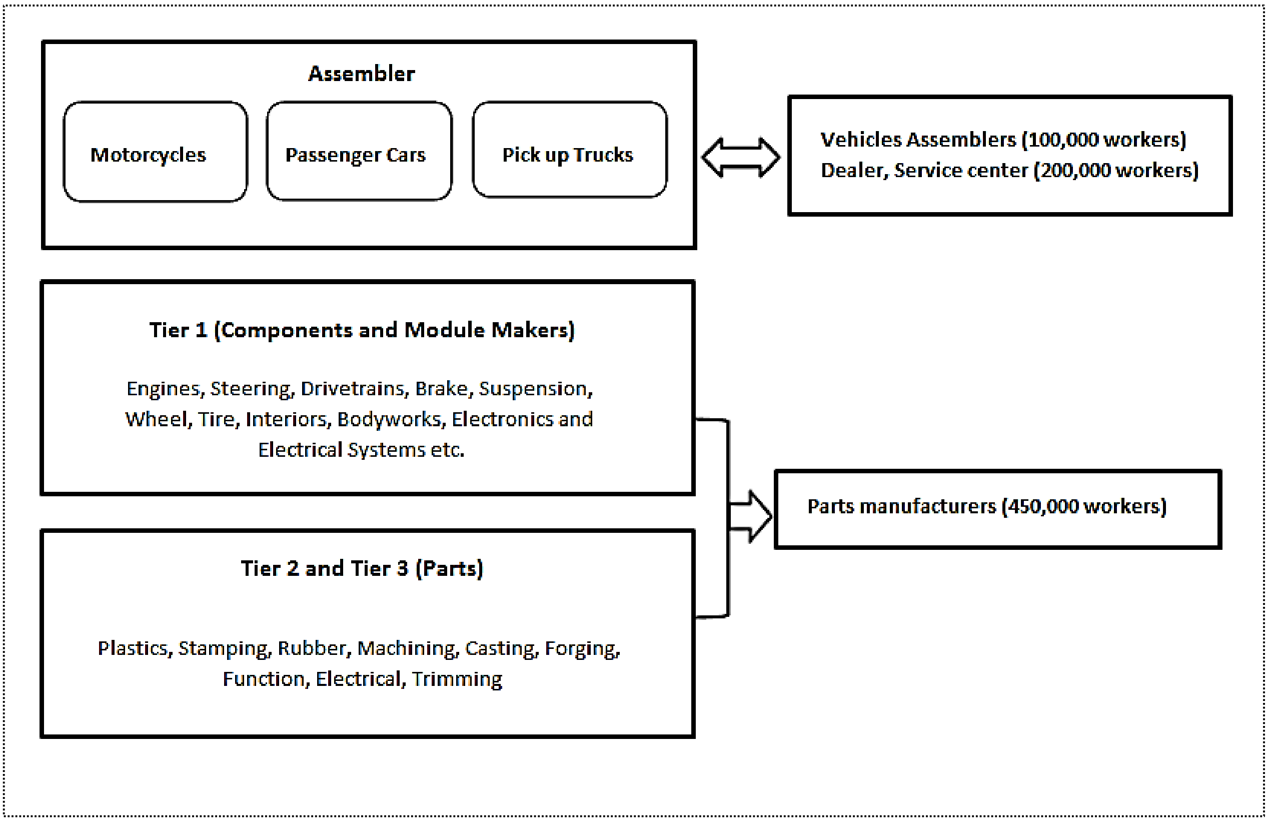
First Tier, the companies are the direct suppliers to Automobile and motorcycle assembly factories (Assemblers of motorcycles, passenger cars, pick-up trucks) direct (OEMs), which the companies must control the production standards, in accordance with the order as determined.

Figure 2.3: Structures of Thai Automotive Industry



Source: Thai Auto Parts Manufacturers Association, OIE and BOI as of 2014

Figure 2.4: Thailand Automotive Cluster



Source: Thai Auto Parts Manufacturers Association, OIE and BOI as of 2014

Automotive Organizations and Associations in Thailand. There are four main organizations and associations in Thailand as follows:

1. Thai Automotive Industry Association (TAIA)

Thai Automotive Industry Association was established in 1981 as the central organization of automobile members, which comprise of motorcycle assemblies, automobile assemblies, automobile engine, and auto parts industries. Thai Automotive Industry Association's objective is a compilation of information and news between automotive members; therefore, TAIA plays an important role in the exchange of information and facilitates meetings in group and related associations, both inside and outside the country. Moreover, TAIA coordinates with the government by providing advice related to automotive industry and others.

2. Thai Auto Parts Manufacturers Association (TAPMA)

Thai Auto Parts Manufacturers Association (TAPMA) was founded in 1987 and a union of automotive parts manufacturers from the private sector to function as a center agency for manufacturers of auto parts in the country, and it is the assigned to protect, support, and develop Thailand. The 578 strong Thai Auto Parts Manufacturers Association work with the government in implementing and important drafting important policies for the industry as the agent of the private sector of auto parts industry. It identifies problems and barrier of the industry to be taken to the government and acts as an agent of the automotive parts industry in relating with international negotiations of 238 stages. In addition, Thai Auto Parts Manufacturers Association is protecting the legal rights of its members and serves an avenue of information and news for members to exchange views among the members inside and outside of the country.

3. Thailand Automotive Institute (TAI)

Thailand Automotive Institute (TAI) was founded in 1998. It is responsible for researching and presenting the appropriate policy to the government. It also facilitates coordination with Thailand Automotive Industries and set the standard for automotive parts. In addition, the Institute has expanded testing services required for certification of automotive parts, collecting data about public automotive business among members of the strong of 652 institutes and for the future of the industry's global competitiveness through human resource development undertakings.

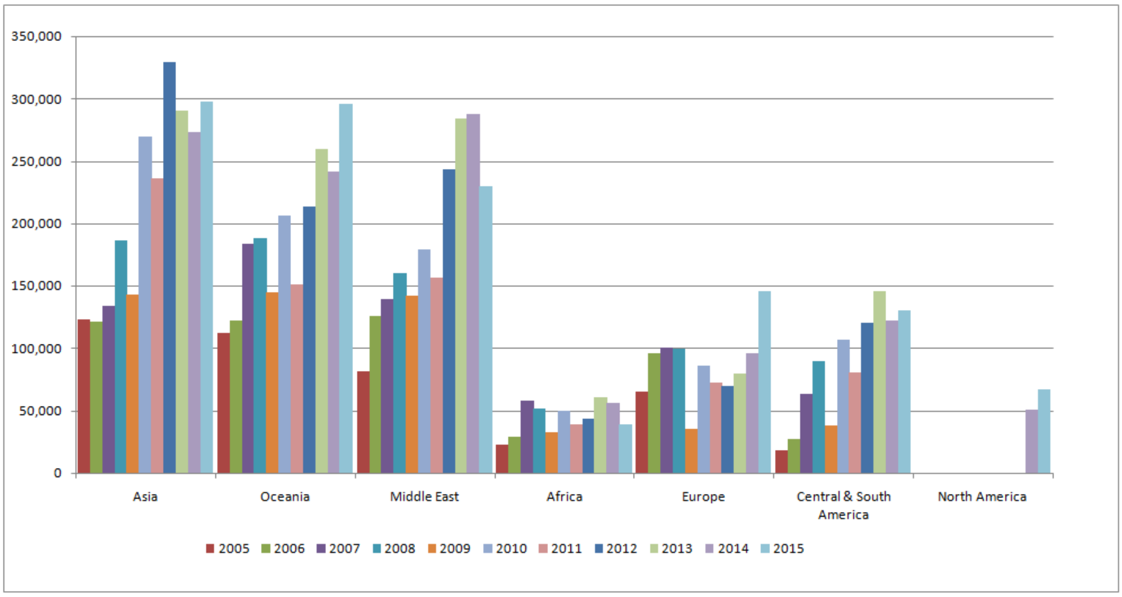
4. Automotive Industry Club (AIC)

Automotive Industry Club (AIC) was founded in 1976 under the Federation of Thai Industries, and it consists of manufacturers, dealer, exporters, and importers of vehicles. As the activities are purposely to support information sharing and facilitate link solutions between industry, thus, they enhance competitiveness and growth.

In many developing countries there have been studies conducted and efforts made in the development of the automotive sector. With their different methods of influence, directly and indirectly of government policies, such as trade liberalization program and innovation policy to encourage vehicle exports to be more powerful with the ASEAN

Economic community (AEC) approach in 2015, Association of Southeast Asian Nations (ASEAN) plays an important role as a major global production base. Thailand government and the private sector will continue to promote the investment location in Asia and a gateway to Association of Southeast Asian Nations (ASEAN) for automotive manufacturers. Figure 2.5 shows Thailand's vehicle export destinations to over 70 countries worldwide in Oceania, Europe, Middle East, Africa, Central &North and South America, especially in Asia.

Figure 2.5: Thailand's vehicle export destinations



Source: Automotive Intelligence Unit

The Association of Southeast Asian Nations (ASEAN) with the goal of establishing the ASEAN Economic Community (AEC) in the year 2015 has focused on economic integrations in the region. Automotive sector is one of the economic integrations which can benefit from people living in ID member countries of Association of Southeast Asian Nations (ASEAN) with more than 600 million people. However, the car ownership rates remain very low in the ASEAN Economic Community (AEC) member states. The Association of Southeast Asian Nations (ASEAN) is the sixth largest automotive market in the world after China, USA, Japan, Brazil, and Germany in 2014.

The growth opportunities in the automotive industry are driven by continued economic growth in the region. The income of member countries has continued to rise rapidly and expected to rise in the coming years as Association of Southeast Asian Nations (ASEAN) crosses the 3,000 to 10,000 dollar per capita income (IMF suggests). Vehicle ownership has grown twice as the fast as income. The fast growing needs of more than 600 million population benefit the market for vehicles because of the people's increasing purchasing power. The Association of Southeast Asian Nations (ASEAN) will be significantly important as the base of production for the world's largest automotive manufacturer. Also, EU, US, China, India, and Japan are growing rapidly in their market.

Table 2.5: Production of motor vehicles and motorcycles & scooters in five countries of ASEAN

Country	Passenger Vehicles	Commercial Vehicles	2015	2014	2013
Thailand	760,688	1,152,314	1,913,002	1,880,007	1,330,672
Indonesia	824,445	274,335	1,098,780	1,298,523	1,229,901
Malaysia	563,883	50,781	614,664	596,418	655,793
Vietnam	99,052	72,701	171,753	121,084	98,649
Philippines	36,395	62,373	98,768	88,845	181,738
Total	**2,284,463**	**1,612,504**	**3,896,967**	**3,984,877**	**3,496,753**

Source: ASEAN Automotive Federation

The automotive industry of the region was founded Indonesia which has become the fastest growing car market in ASEAN (see table 2.5). The Indonesian government has explicit policy in the development of the automotive industry by product campaign and low cost green car similar to Thailand. In the future, Indonesia will be the major competitor of Thailand and another is Malaysia's automotive industry which is the 3rd largest in ASEAN. Malaysian government has revised the National Automotive Policy and announced easing rules on trade and investment in the automotive industry to foreign companies that produce small car and Eco car. Its aim to become the hub of energy industry in the region and compete with Thailand and Indonesia.

In 2015, automotive industries car production during January to December 2015 was at 1,913,002 units and exports value was 892,623.48 million baht. There was an increase of 6.88 percent from 2014, especially exports to ASEAN member countries. The major automotive export market of Thailand is Indonesia. Thailand has a goal to produce three million units in 2017 and a vision to be center of excellence in the world in the development and production of the eco car, including to add value in the supply chain of the automotive industry in Thailand.

2.4 Dependent Variable

The importance of international trade theories to a nation's economic welfare and development has been in the economics literature of Adam Smith's (1776). The reason underlying suggests that economies need to export goods and services in order to generate revenue and import goods and services, which cannot be produced (Coutts & Godley, 1992, McCombie & Thirlwall, 1992).

Thailand's vehicle and components export growth is critical for the country. It is the main industry that brings income to the country to help generate foreign exchange and exports, create employment, growth of national product, technology development and linkage to other industry (Thichakorn Kasombua, 2014). This research studies the relationship and determines the main factors and finds direction of vehicle exports under change of economic variables that may impact on Thailand's vehicle and component part exports value.

2.5 Independent Variables

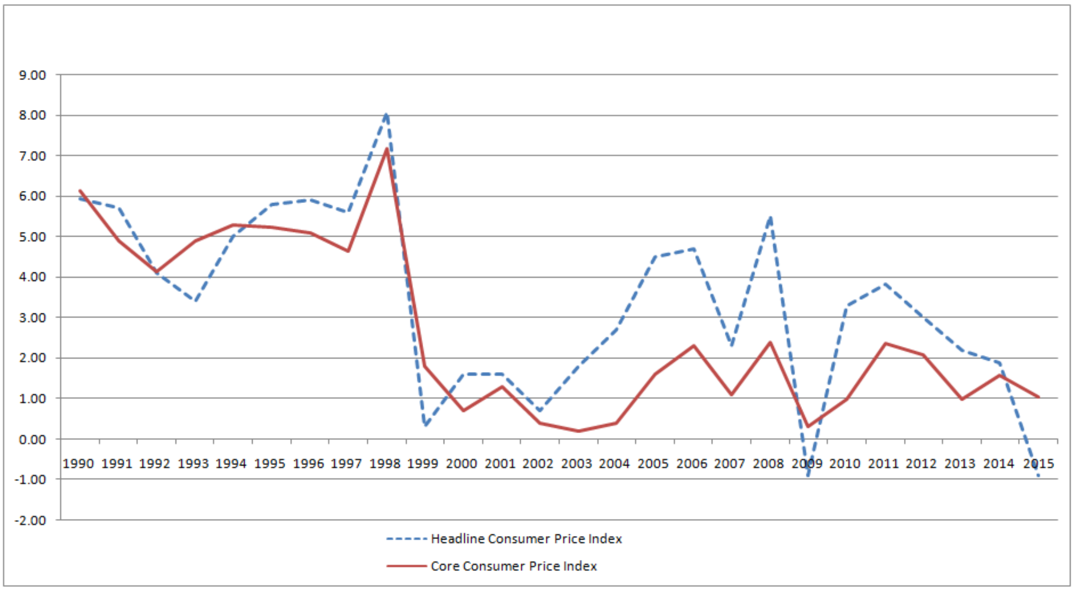
This study focuses on eight independent variables which are the macroeconomic factors, such as the inflation rate, interest rate, real effective exchange rate, terms of trade, world GDP growth. The related industry factors are crude oil price and production. An innovation capability measured by patents granted for vehicle components and manufacturing processes, an important determinants of vehicle exports value in Thailand.

2.5.1 Inflation rate is where the price level of goods and services rise continuously in an economy over a period of time (Anonymous, 2013) and the inflation is the decrease in purchasing power of currency (McConnel & Brue, 2008). The formula is as follows:

$$\text{Inflation rate} = \frac{\text{Consumer Price Index of year 2} - \text{Consumer Price Index of year 1}}{\text{Consumer Price Index of year 1}} \times 100$$

Based on the theory of economics, inflation is caused by two main factors which are (1) the increase of demand for goods and service, and (2) rise in product cost caused by increase of wages, natural crisis, change of import price, etc. The impact of inflation on output and sales has been one of the most common concerns in macroeconomics (Chifurira, 2014). The high inflation rate in the country compared with other trading partners will lead to decrease in exports and affect directly on production cost such as labor and raw materials. The high costs will have a significant impact on the competitiveness of exports in the international trading environment. The evidence in 2008 shows that change in inflation rate is 5.5 percent and negative decrease in exports value (see figure 2.6 & 2.7).

Figure 2.6: Headline and Core Inflation, Year on year change in percent.



Source: http://data.worldbank.org/indicator/

Figure 2.7: Headline and Core Inflation and Exports Value of Vehicle

Source: http://data.worldbank.org/indicator/

2.5.2 Interest Minimum Loan Rate (MLR) the minimum interest rate that banks lend for credit changes by time, depending on economic conditions, inflation rate, or government policy as determined by the bank of Thailand. The interest rate is the mechanism that links between the financial sector and the manufacturing sector. It is an important factor to various financial institutions to be taken into consideration in determining the source of loans for investors. Low interest rates will lead to lower borrowing costs, since the borrower is charged to pay less interest (Thobarry, 2009). Increase interest rate, which increases the cost of working capital for firms and, in turn, increases the cost of existing productive activities gives an impact to firm performance (Tuan-Minh Dinh, 2011), leading to a reduction in exports value.

2.5.3 The production is the number of vehicles manufactured calculated by the vehicle manufacturing in Thailand (Office of Industrial Economics, 2015). The recorded transport vehicle production of Thailand has decreased from 555,821 to 358,686 units in 1996 to 1997 and has decreased from 358,686 to 143,250 units in 1997 to 1998 and motorcycle production has decreased from 1,437,794 to 1,081,044 units in 1997 to 1997 and has decreased from 1,081,044 to 600,497 units in 1997 to 1998 (see table 2.6). This happened in 1997 during the Asian economic crisis, which caused by careless financial liberalization, loss in competitiveness, faster growth in imports than exports (see figure 2.8).

The consequences of the global financial crisis during 2008 to 2009 cased financial collapse in the U.S.A. and European countries have impacted Thailand. The recorded transport vehicle production of Thailand has dropped from 1,391,728 to 999,378 units and the motorcycle production side has dropped from 1,923,651 to 1,635,249 units (see table 2.6). After the dismal 2009, Thailand joined the major vehicle producers in the world in 2010, and it was when the local sales, production, and exports of vehicles all rebounded to new highs. The great promotion in Thai automotive industry is the way to be one of the top 12 largest vehicle producers in the world. Thailand accounted of 1,645,304 units of transport vehicle production and 2,026,401 units of motorcycle production.

In 2011, Thailand faced a problem of worse floods drowning many cars and component factories in central and southern parts. The problem of floods hit the vehicle production which dropped from 1,645,304 to 1,457,798 units (see table 2.6).

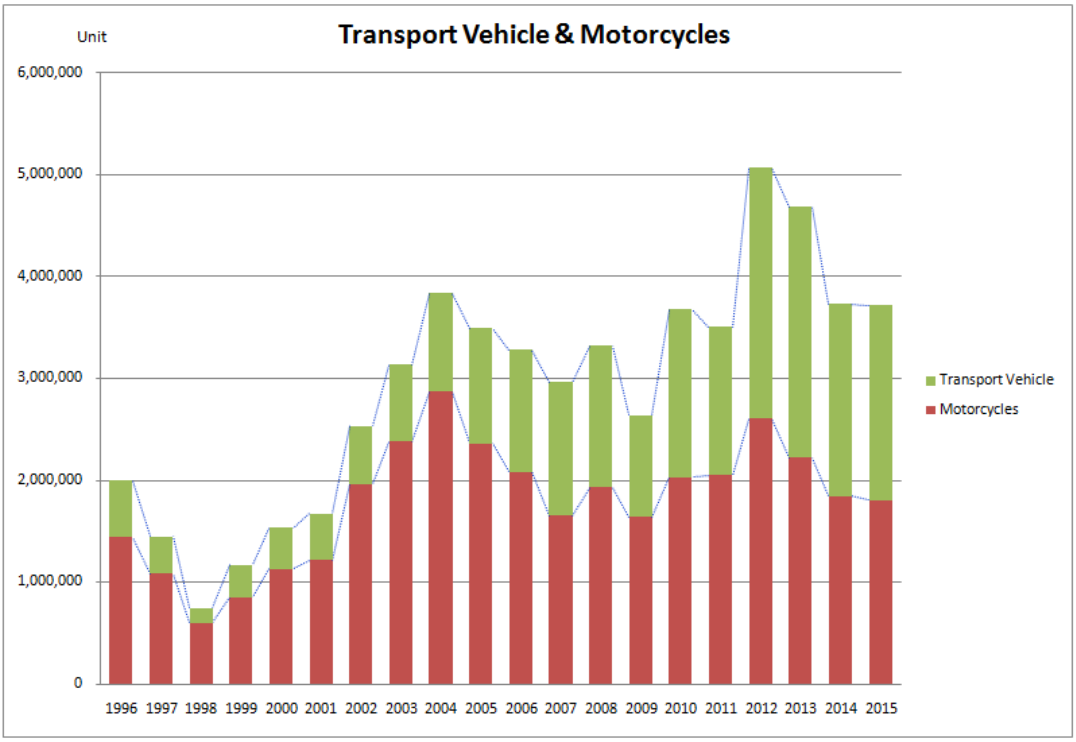
In 2012, Thailand was booming in the automotive industry. The government of Prime Minister Yingluck Shinawatra released policy initiatives when buying a car for the first time to get a tax discount of 100,000 baht. This project was available when buying eco cars, pickup, or trucks with the price under one million baht and the engine size is not over 1,500 cc. There was a huge increase from 1,457,798 to 2,453,717 units (see table 2.6), and an increase in production to tap the growing demand of both local and foreign markets (Krishnaveni* & Vidya, 2015).

In 2013 to 2014, there was a political crisis in Thailand, the anti-government protests, which occurred in November 2013 to May 2014. The political instability had a negative effect on growth because of the increasing uncertainty in the economic environment. The probability of a change in government in the future might affect the property rights, legal and clear policy which could affect the decisions on motorcycle, car and components production of Thailand. Car production dropped from 2,459,504 to 1,880,587 units and motorcycle production dropped from 2,218,625 to 1,842,708 units (see table 2.6).

In 2014-2015, the production has reduced by 23.54 percent from 2012 to 2013 because many buyers received an advantage of the tax benefits earlier, so they did not want to buy new cars. As shown in the graph in figure 2.8, domestic automotive production dropped tremendously in 2014 and 2015, from 2,453,717 units in 2012 to 1,911,751 units in 2015 at 28 percent.

The production of automotive has been growing continuously after the economic crisis. It was a result by the fact that many leading automotive companies have relocated their production lines to Thailand in order to establish their global production base for exports. Thailand takes advantage of free trade and reduced tax rates and cheap labor cost for its produce and able to sell in the home country and export to importer. The fact that an increased production is able to tap the growing demand of both home and foreign markets (Krishnaveni* & R. Vidya, 2015).

Figure 2.8: Productions of Automobiles in Thailand (1996 – 2015)



Source: Automotive Intelligence Unit

Table 2.6: Transport Vehicle Production (unit) in Thailand during year (1996 – 2015)

Year	Total	Passenger Cars								An optionally piloted vehicle	VAN & MICRO BUS	Buses		Trucks						
		<1200 cc	1201-1500 cc	1501-1800 cc	1801-2000 cc	2001-2500 cc	2501-3000 cc	> 3001 cc	Not specify how many cc			<10 Ton	>10 Ton	Pic Up < 1 Ton	PickUp 1 Ton	Duble cab	PPV	Pickup < 5 Ton	Pickup 5-10 Ton	Pickup >10 Ton
1996	**555,821**		55,217	54,640	10,995	15,875					1,095		609	17,993	350,857			3,775	14,137	28,776
1997	**358,686**		62,251	32,765	8,803	8,118					360		554	4,907	218,336			1,095	9,739	11,654
1998	**143,250**		8,533	6,865	2,154	1,526					60		577	1,977	119,986			324	500	748
1999	**321,411**		25,217	28,636	4,800	11,264	2,775	24					81	3,854	240,369			1,268	1,881	1,242
2000	**405,761**		28,811	44,700	6,651	14,753	2,214							4,601	294,834			3,278	4,165	1,754
2001	**454,797**		31,713	72,788	23,376	25,887	2,302					8	263	2,398	289,349			1,859	2,020	2,834
2002	**564,392**		36,407	77,203	25,661	27,700	2,348	2					388	2,375	229,000	145,407	7,890	3,388	2,054	4,569
2003	**750,512**		127,505	77,082	11,711	28,214	7,090	82		8,965	165		90		304,839	160,221	5,803	4,580	3,669	10,496
2004	**960,371**		154,308	86,005	22,745	30,426	5,916	39		4,910			213	2,397	399,006	220,127	11,071	7,029	3,965	12,214
2005	**1,125,316**		135,013	93,248	18,738	25,531	5,037	36					412	1,160	443,680	317,185	62,002	7,910	4,926	10,438
2006	**1,193,356**		157,600	89,428	22,799	25,030	3,416	546					272	964	451,552	367,473	52,920	7,016	4,407	9,933
2007	**1,301,149**		139,059	85,031	40,754	60,765	2,111	1,503				137	441		437,626	468,112	42,632	7,629	6,105	9,244
2008	**1,391,728**		170,347	125,625	44,750	49,089	720	8,904				1	375		423,433	504,905	46,164	4,337	5,787	7,291
2009	**999,378**		155,403	92,266	34,633	27,864	784	2,492				33	425		258,194	352,859	59,681	3,814	3,823	7,107
2010	**1,645,304**	59,441	261,129	133,234	51,784	41,657	4,033	2,989			120		472		392,996	558,424	115,339	7,510	5,206	10,970
2011	**1,457,798**	94,309	227,328	140,943	44,300	29,115	1,234	758					463		335,501	469,994	93,705	5,682	3,199	11,267
2012	**2,453,717**	242,129	419,010	184,204	61,667	37,730	161	666	10,934				428		495,138	796,503	160,611	9,055	22,760	11,445
2013	**2,459,504**	356,282	405,983	158,934	79,124	54,313	1,576	975	8,960				629		491,384	728,712	112,817	10,934	26,466	17,359
2014	**1,880,587**	247,644	275,368	127,629	55,520	23,880	1,068	825	10,180				525		371,663	628,070	115,045	4,461	2,719	14,808
2015	**1,911,751**	331,855	214,144	135,161	40,733	23,559	120	629	16,846		4,093		386		425,508	541,411	148,899	6,481	3,483	18,369

Year	Total	Family Type	Sport Type
1996	1,437,794	1,265,434	172,360
1997	1,081,044	982,012	99,032
1998	600,497	563,570	36,927
1999	846,426	810,920	35,506
2000	1,125,723	1,089,476	36,247
2001	1,209,995	1,145,001	64,994
2002	1,961,809	1,903,302	73,842
2003	2,378,491	2,368,272	56,406
2004	2,867,295	2,787,136	80,159
2005	2,358,510	2,265,888	92,622
2006	2,079,555	2,004,547	75,008
2007	1,652,773	1,563,434	89,339
2008	1,923,651	1,767,429	156,222
2009	1,635,249	1,511,238	124,011
2010	2,026,401	1,921,363	105,038
2011	2,045,017	1,871,014	174,003
2012	2,606,161	2,348,642	257,519
2013	2,218,625	1,872,174	346,451
2014	1,842,708	1,483,993	358,715
2015	1,800,623	1,425,734	374,889

Source: Automotive Intelligence

2.5.4 Real effective exchange rate is a weighted average of exchange rates of domestic versus foreign currencies (Wongpit, 2010). The real effective exchange rate (REER) is the adjusted nominal effective exchange rate (NEER) from domestic inflation and inflation of weighted average of trading partners. If the real effective exchange rates increase, it means home (domestic) currency appreciation with the currencies of trading partners (average weighted rate baht from the bilateral exchange rate of one currency to another currency, so when the baht NEER increases, it means value appreciation, see figure 2.9 & 2.10).

Where,

n : number of major trading currencies for home country

W_i: weight of a foreign currency (depends on the trading volume between the home country with that foreign country)

$S_{N,i,t}$: nominal exchange rates for the foreign currency at time t

($1/ S_{N,i,t}$) measures the home currency value in terms of foreign currencies

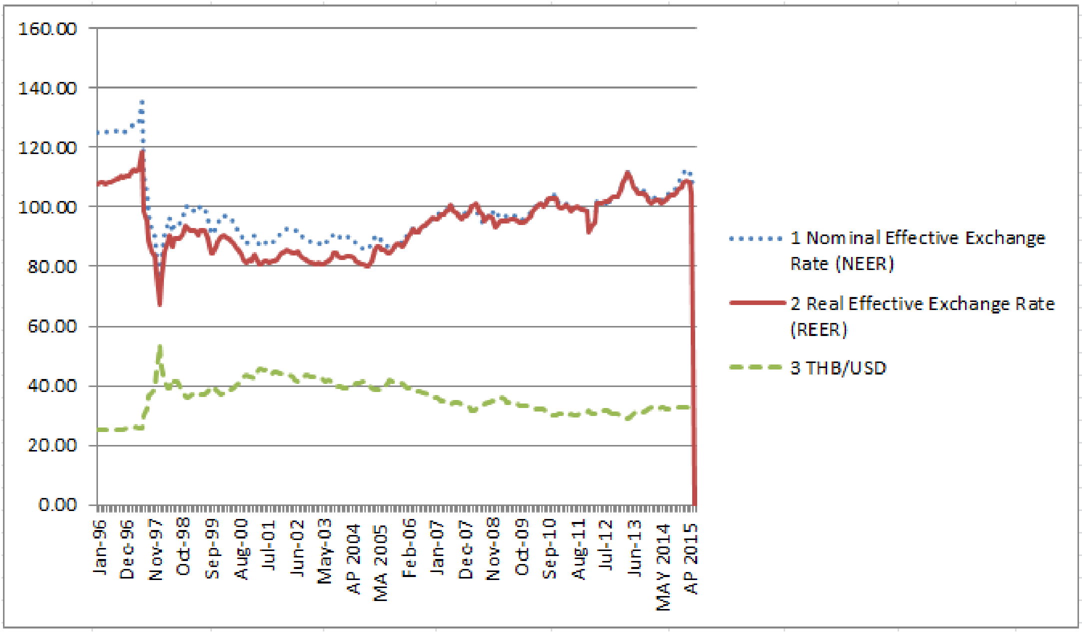
To be able to compete for more coverage, calculation is done for Real Effective Exchange Rate or index, the actual value of the baht using CPI as a domestic price index, $REER = \frac{NEER}{CPI_{others} / CPI_{Thailand}}$

Figure 2.9: Thai Baht

Source: www.tradingeconomics.com

The US dollar was worth 33.94 THB on Jul 10, 2015 in the interbank foreign exchange market. The average Thai Baht was 32.53 in 1981 to 2015, in January of 1998, it was high at 55.50 and low at 20.36 in July, 1981 (very high depreciation baht due to a lack of confidence in the economy of Thailand) (see figure 2.9).

Figure 2.10: Exchange Rates, NEER and REER



Source: Bank of Thailand

The export earnings assume vital importance to developing for developed countries. The main development of countries is from export of final goods and capital, Thailand as a country consists of automotive industry.

Many researches found that exchange rates have an impact in the profit of any sales in exports which can perform the export performance (Salomon 2005, Fabling & Sanderson 2015, Berman, 2008). Export performance is the relation between failure and success of the aim of a firm or countries to sell domestic services and produce goods in other countries for the engine growth of economy, because it will create profit, increase productivity and increase of employment, leading to an increase in the accumulation of reserves to help countries to balance their finances.

2.5.5 Terms of trade represents the country exports value and relative to their imports. If Terms of trade in the country has improved, it means that for every unit of exports sold, it can buy more units of imported goods and service and Terms of trade is determined by dividing the export price by the import price (Sherbourne, 2009). In other word, the ratio of a country's exports and imports (Sadeghi & Sadeghi, 2011) support that concept of the positive impact on Terms of trade volatility on economic growth of exporting countries. The formula is as follows:

$$TOT = \frac{\text{Index of export prices}}{\text{Index of import prices}} \times 100$$

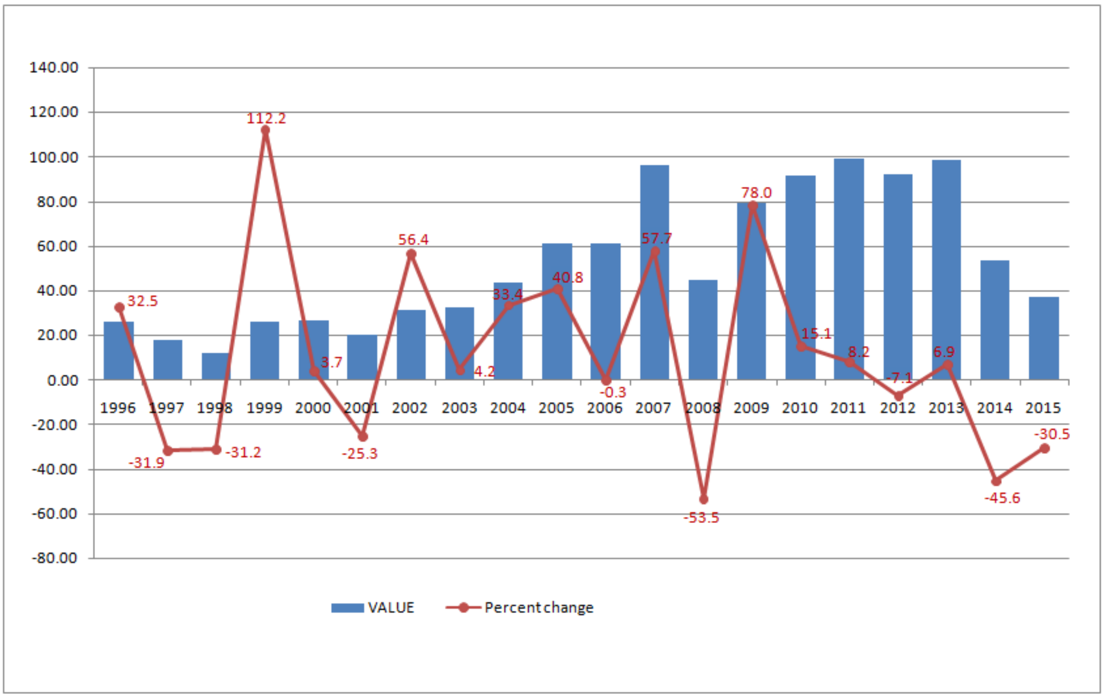
2.5.6 World GDP growth

Gross Domestic Product (GDP) is the value of final goods produced in the country in over a particular period of time (Brezina, 2012). Global demand plays an important role in determining the growth of exports. The impact of the slowdown in global demand and in the export of the country is largely determined by income (Ms. Mashayekhi, 2013). The exports goods and services to the world are very responsive by income changes. If the income is low, it leads to the decrease in demand that impacts on decline GDP growth of the world that will lead to the decline of the exports growth to the world.

2.5.7 Oil Price

This paper reviews how crude oil prices affect the vehicle exports value. Oil price fluctuation is an indicators of economic health. The rise in crude oil prices leads to alert the whole economies and the people are worried about increase in price of goods and service and their income decreases. The reliance on energy is the economic driver that makes consumers sensitive of change in crude oil price. The oil price is the important cost in vehicle use. An increase in oil price makes high cost of vehicle use that will be impact on the decrease in demand of vehicle (Belenkiy, 2012). Thailand is an importer nation with net oil imports amounting to $32 billion in 2014. Low and high prices both have an impact on Thai economy. Low oil prices will have a positive impact on the overall economy. The industry, such as wholesale / retail, food and drink, and electronic equipment will benefit from the increasing consumption, while the logistics sector will benefit from the price drop. On the other hand, there will be some sectors adversely impacted, low in crude price impacts to see the falling demand in automotive industry from the oil producer (Economic Intelligence Center). In 2008, the financial crisis year, the oil price dropped by 53.5% (see figure 2.11).

Figure 2.11: Crude Oil Price



Source: Crude Oil Prices West Texas Intermediate (WTI)

2.5.8 An innovation capability as measured by patents granted for vehicle components and manufacturing processes evaluates how strong the patent rights (PRs) are Thailand has increased on its vehicle exports value, and patent is one of the most important innovation capability indicators in assessing competitiveness in national, regional or sector of technology system as it is one possible output of research and development among others. Studies of Freeman (1982), Schmoch (2006), Grupp (1997), Grupp (1998) showed that on one hand technological profile is an output indicator of the research and development (R&D) process, but on the other hand, the authors also pointed at the future that an established patent is an indicator of future economic activities reflected on production, employment, exports, and to gain new market shares with new product.

The patents can help to measure the competitiveness of companies, sectors, or economies now and in the future (Frietsch & Schmoch, 2006, Schmoch 2004). Thailand has a very strong automotive sector, the strong patent rights (PR) are the key factors in the create on of new jobs and growth of Thailand economy. Product innovation can keep customers interested while manufacturing innovation can reduce the costs of manufacturing. Innovation is a key to understanding the evolution of the automotive industry, specifically in terms of technology transfer from automotive manufacturers to their suppliers at all tiers.

The history of Intellectual Property in Thailand based on the historical records was introduced more than 100 years ago to provide copyright protection. The patent system in Thailand has been used as part of the Thai government's economic policies as a result of Thailand seeking to accelerate industrial trade expansion and productivity. The first patent of Thailand was founded in 1979 and amended in 1992 and 1999. Therefore, the current law is the patents number 3 in year 1999. Patent means a right granted to the owner and an official document are given to an inventor by a government. These documents generally provided to inventors the right to stop other people from using, copying, selling or distributing the invention without their permission. There are three different types of patent: (1) an invention patent, (2) a petty patent or utility model, and (3) a design patent (Subsompon, 2007).

CHAPTER III

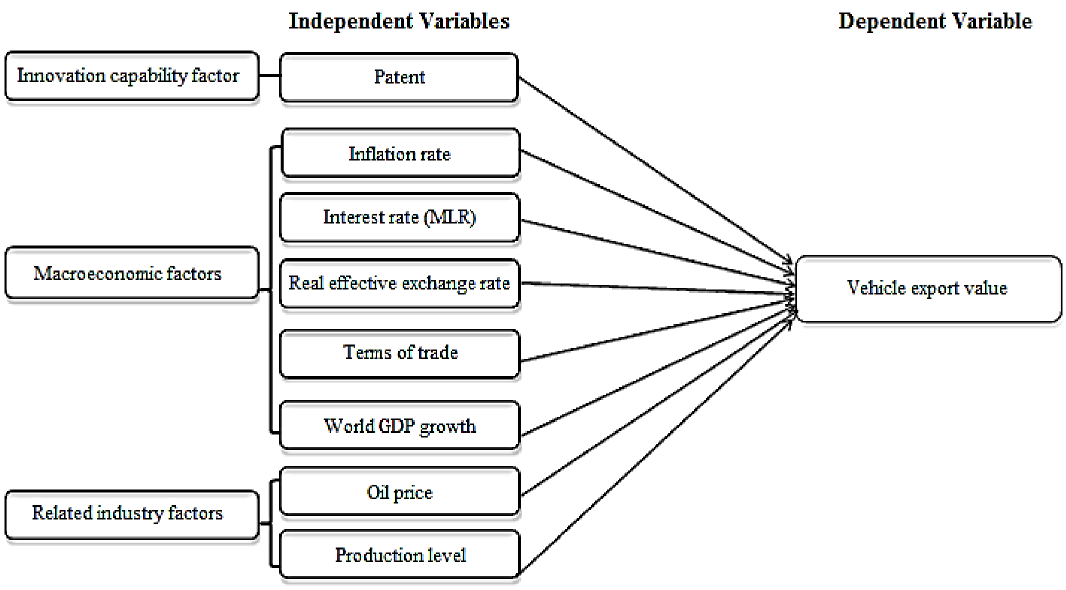
RESEARCH FRAMEWORK AND HYPOTHESES DEVELOPMENT

The literature review gives an understanding that there are various factors that influence the Thai automotive export value. This study uses time series data to estimate the relationship between dependent and independents variables. The analysis consists of the following steps:

3.1 Theoretical Framework

Figure 3.1 represents the relationship between the dependent and independent variables. The dependent variable in this study is vehicle exports value that indicates the automotive industry export growth. However, the independent variables are influenced by the dependent variable. Therefore, there are eight independent variables that have relationship with the dependent variable where the value results directly from the independent variables. It dependent variables include patents, inflation rate, interest rate, real effective exchange rate, Terms of trade, world GDP growth, oil price, and production.

Figure 3.1: Theoretical Framework



Source: Author

3.2 Data

The sources of this study were based on secondary data covering the period from 2000 to 2015, the main sources to get the quantitative data were from the published information service. The purpose of this paper is to study the vehicle exports value in Thailand which is influenced by various key factors, such as macroeconomic factors, related industry factors, and innovation capability factor as measured by patents granted for vehicle in general. In this study, vehicle exports value is considered as the dependent variable, and were the data (monthly) obtained from the Bank of Thailand.

3.2.1 Innovation capability factor as measured by patents granted for vehicle components and manufacturing processes, monthly data were used.

3.2.2 In macroeconomic factors, monthly data used were on interest rate MLR (Minimum Lending Rate), real effective exchange rate, and Terms of trade. Inflation rate was used for annual percentage. The above variables were obtained from the Bank of Thailand. In addition, the world GDP growth for annual percentage was from the World Bank.

3.2.3 Related industry factors in this paper focused on oil price, which the data were monthly average obtained from Crude Oil Prices: West Texas Intermediate (WTI), and the production monthly data were obtained from the Office of Industrial Economics Thailand.

Table 3.1: Summary of Data Collection

Factor	Data	Data source	Website Source
Innovation capability	Patents	The Department of Intellectual Property (DIP).	http://patentsearch.ipthailand.go.th
Macroeconomic	Real Effective Exchange Rate	Bank of Thailand.	http://www2.bot.or.th/statistics/ReportPage.aspx?reportID=407&language=eng
	Inflation Rate	Bank of Thailand	http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=409&language=ENG
	Interest Rate MLR	Bank of Thailand	http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=222&language=ENG
	Terms of trade	Bank of Thailand	http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=113&language=ENG
	World GDP	World Bank	http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2015&start=1961&view=chart
Related industry factors	Exports value of vehicle	Bank of Thailand	http://www2.bot.or.th/statistics/BOTWEBSTAT.aspx?reportID=748&language=ENG
	Oil Price	Crude Oil Prices: West Texas Intermediate (WTI)	https://research.stlouisfed.org/fred2/series/DCOILWTICO/downloaddata
	Production	Office of Industrial Economics	http://www.oie.go.th/academic/statistics

Source: Author

3.3 Methodology

This research used the ordinary least squared (OLS) to identify the determinants of vehicle exports value between independent variables and dependent variable. Dependent variable is the value that results directly from the independent variables. Finally, it depends on the independent variable. This analysis was based on time series data from January 2000 to December 2015, total of 192 months.

However, it is important to keep in mind that time series data analysis is subject to the problem of spurious regression if the data is non-stationary, resulting in inability to be the trusted results of the models constructed. So, avoid spurious regression by the unit root test (Augmented Dickey–Fuller test) in checking if the data is stationary. If the result shows that the data is non-stationary, the first difference of the variables will be employed before conducting the OLS method.

3.3.1 Multiple Linear Regression Model

Multiple linear is used to explain the relationship between more than one independent (explanatory) with one dependent variable. Consequently, a Multiple Linear Regression analysis is performed to predict the value of vehicle exports value. The Multiple Linear Regressions is developed in the following equation:

Multiple Linear Regression Model

$$ExportVal_t = \alpha + \beta_1 PATENTS_t - \beta_2 IFR_t - \beta_3 IMLR_t - \beta_4 REER_t + \beta_5 TOT_t + \beta_6 GDP_t - \beta_7 OIL_t + \beta_8 PRODUCTION_t + \varepsilon \qquad (1)$$

Where,

$PATENTS_t$ = *Patent in month t*
IFR_t = *Inflation Rate annual % in month t*
$IMLR_t$ = *Interest Rate in month t*
$REER_t$ = *Real effective exchange rate in month t*
TOT = Terms of trade (measure of trade openness) in month t
GDP_t = *World GDP growth annual % in month t*
OIL_t = *Oil Price dollars per Barrel in month t*
$PRODUCTION_t$ = *Production numbers in month t*
$ExportVal_t$ = *Export value in month t*

Firstly, some variables under this study were transformed into logarithmic form, but due to the existence of a unit root in variables data series (see table 8), the first difference of logarithm of the variables was used.

Expected sign of variables,

$$\begin{array}{lcccccccc} Expected\ sign & + & - & - & - & + & + & - & + \\ ExportVal_t = f(& PATENTS_t, & IFR_t, & IMLR_t, & REER_t, & TOT_t, & GDP_t, & OIL_t, & PRODUCTION_t, + \varepsilon \end{array}$$

Patents

The patents granted is an indicator of innovation capability which are always beneficial for export by developing and testing the product before production, increase of patents leads to significant growth in the exports of high-tech products (Yi, 2013). Therefore, the expected sign of the coefficient of β_1 is positive.

H_1= There is an impact of patent and exports value.

Inflation Rate

Inflation Rate is the increase in general level of prices of goods and services and is continuously increasing. If inflation continues to rise, it will impact on the home currency depreciation leading to the increase in the price of raw material for production from importing. Also, it has an impact on the export product of the country which tends to decrease because the export product is more expensive from the perspective of the trading partners. Therefore, the expected sign of the coefficient of $\beta_2$is negative. Muktadir-Al- Mukit, J (2015) reported an analysis revealing that export has a negative impact on inflation where the coefficients of all the explanatory variables are found statistically significant.

H_2 = There is an impact of inflation rate and exports value.

Interest Minimum Loan Rate (MLR)

The minimum interest rate that banks lend for credit. Interest rate reflects costs of capital investment for expanding businesses (Dinh, Malesky, Trung-Thanh & Nguyen, 2012). Interest rate is in opposite direction with investment for expanding businesses. When the interest rate is high, the expansion of export fail. Therefore, the expected sign of the coefficient of $\beta_3$is negative.

H_3 = There is an impact of interest minimum loan rate (MLR) and exports value.

Real effective exchange rate

Real effective exchange rate is the nominal effective exchange rate (NEER) adjusted between domestic inflation and inflation of weighted average of trading partners. If the real effective exchange rate is high, export product of the country tends to decrease because the export product is more expensive from the perspective of the trading partners. Therefore, the expected sign of the coefficient of β_4 is negative. Berthou (2008) reported that the real appreciation of the domestic currency against the other major currencies has a strong negative effect on export.

H_4 = There is an impact of real effective exchange rate and exports value.

Terms of trade

Terms of trade is the ratio between export price (PX) and the import price (PM). It measures the country's export prices in relations to its import, that means, if Terms of trade ratio is increasing, there will be a positive change in export. Changes in terms of trade have an impact on open economies that depend on the export, a high ratio of Terms of trade which in return will accelerate economic growth (Kalumbu, 2014). The Terms of trade fluctuate in line direction with the changes in export; therefore, the expected sign of the coefficient of β_5 is positive.

H_5 = There is an impact of terms of trade and exports value.

World GDP growth

The increase in gross domestic product of any countries indicates that the income per capita increases in the trading partner. When the income of trading partners increases, they tend to consume more, and then the exporting country can improve its export for exporting more. The global demand plays an important role in determining the growth of exports. The impact of the slowdown in global demand and in the export of the country is largely determined by income (Mashayekhi, 2013). Therefore, the expected sign of the coefficient of β_6 is positive.

H_6 = There is an impact of world GDP growth and exports value.

Oil price

The change in oil price negatively impacts on Thailand's vehicle and components part exports that decreases the demand of trading vehicle and component parts with oil-exporting countries such as middle-east. Thus, oil importing country's demand for vehicles decreases as crude oil prices increase (Belenkiy, 2012).

Therefore, the expected sign of the coefficient of β_7 is negative.

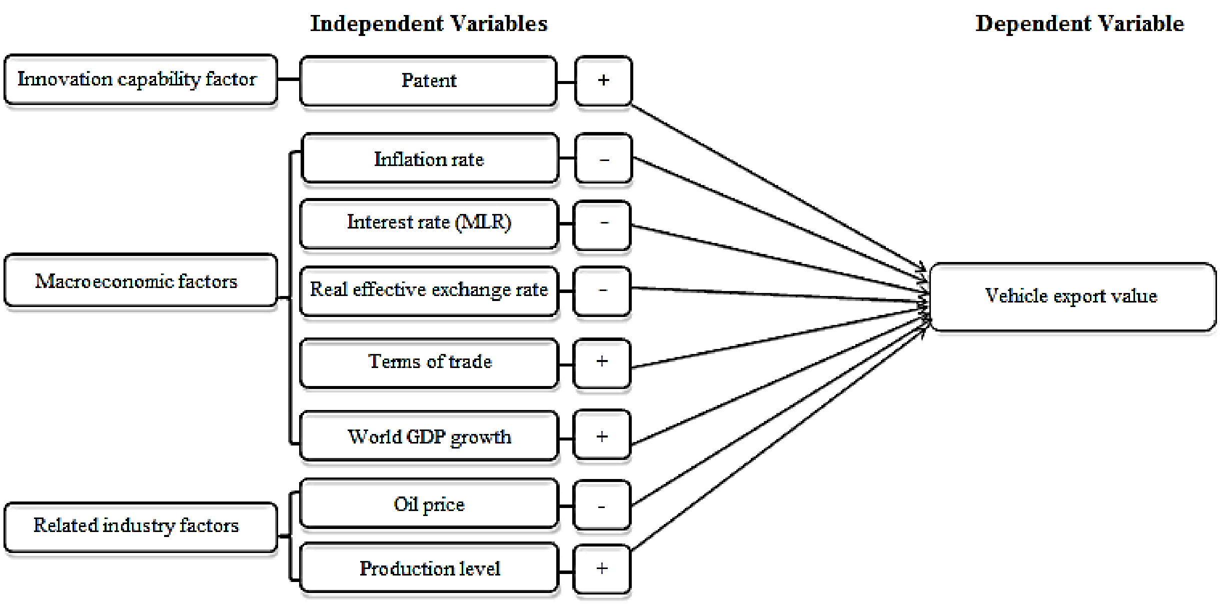
H_7 = There is an impact of oil price and exports value.

Production

Many importing countries are unable to assemble cars by themselves because of the barriers of cost of raw material, labor, environment. Hence, Thailand is taking advantage of free trade and reduced tax rates, cheap labor cost for its produce and able to sell with in its country and export to importer. The relationship of Thai production is the same direction with export (Kasornbua, 2014) case of demand of vehicle and component parts from the importer higher than the produce. When Thai increases its production level, then the importers will import more to cover their demand (an increased production level to tap the growing demand both at home and in the foreign markets (Krishnaveni* & Vidya, 2015). Therefore, the expected sign of the coefficient of β_8 is positive.

H_8 = There is an impact of production and exports value.

Figure 3.2: Summary of expected sign



Source: Author

3.3.2 Unit Root Test (Dickey-Fuller)

The traditional regression models supposedly of dependent and independent variables have a mean of zero and the variance is constant, while in the standard regression models, the data of both independent and dependent variables have to be stationary, meaning that they must be first differences ($\Delta Y_t = Y_t - Y_{t-1}$) or what is called as log to make the data stationary. A time series is stationary when its values have constant variability. However, the data of non-stationary variables may show spurious regressions. Therefore, the unit root tests for the correlation of unit roots are the first differences in the time series. These tests allow the presence of a nonzero mean and a deterministic linear time trend. The unit root tests b applied in this study is Augmented Dickey-Fuller (ADF).

Dickey and Fuller—DF (1979) developed three differential-form autoregressive equations in differences useful to detect the presence of a unit root. Three differential equations are (1) Pure random walk, (2) Random walk around a drift, it has an intercept (drift) term, and (3) Random walk around trend has a drift and a linear deterministic trend.

The features test in this study is stationary or not; therefore, to analyze the stability of the data collected in this study the unit root test by Augmented Dickey-Fuller (ADF) was used. Below is a capture in third of equation developed:

$$\Delta Y_t = Y_t - Y_{t-1} = \alpha + \beta_t + \gamma\, Y_{t-1} + \sum_{i=1}^{p} (\delta_i\, \Delta Y_{t-i}) + \varepsilon_t$$

Where,

t is time

α is an intercept constant (drift)

β is the coefficient on time

.$\gamma$is the coefficient presenting process root

$\rho$is the lag order of the first – differences autoregressive process

$\varepsilon_t$is an error term

Unit Root Hypothesis testing using the method of Augment Dickey-Fuller Test is as follow:

H_0 : γ = 0, $\beta \neq 0$ (variableY_t is Non-Stationary)

H_1 : γ ≠ 0, $\beta \neq 0$ (variable$Y_t$is Stationary)

This test that tells whether the variable has unit root or not is represented by γ = 0 that means the variable is not stable, the data is non-stationary. If the result of the data is non-stationary, it must be first differences ($\Delta Y_t = Y_t - Y_{t-1}$) or what is called as use log or added lag of Y to make the data stationary.

3.3.3 Heteroskedasticity

Heteroskedasticity is presently used as the White Heteroskedasticity test with the null hypothesis that the error variance is constant or call Homoskedasticity. If the error variance is non-constant, it is called heteroskedastic.

The hypotheses are:

H_0 : Homoskedasticity

H_1 : Heteroscedasticity

3.3.4 Autocorrelation

Autocorrelation is correlation of a time series with its own past and future values of the same variables are based on related objects (TagneTalla, 2013). The residuals for OLS output is tested for serial correlation using the Durbin-Watson (DW) statistic.

The hypotheses are:

H_0 : No autocorrelation

H_1 : Autocorrelation

3.3.5 Multicollinearity

Multicollinearity exists when two or more of the predictors variables that are correlated with other predictors variables in a regression model are highly correlated. The state of that correlation is high when the correlation exceeds 0.80 (Cramer, 2001).

CHAPTER IV

PRESENTATION AND RESULTS

This chapter is the analysis on the impact of macroeconomic factors, related industry factors, and innovation capability factor as measured by patents granted for vehicle components and manufacturing processes on Thailand's vehicle export value. The statistical tests used in the data to get reliable results require testing for the different assumptions, the Ordinary Least Square assumes for the method to be valid. This study has used time series data, which the concern is on the problem of non-stationary data because its process generates the spurious regression problem of unrelated variables. Therefore, before running the linear regression, it is needed to test the unit root to make sure that it deals with stationary data. Thus, in the order to verify the stationary of the variables, Augmented Dickey Fuller (ADF) test was applied. The OLS results are presented in table 4.7.

4.1 Descriptive statistics

After the data are collected, the arithmetic mean is calculated. In case of having or involving distribution mode, the averages of the data are described. For the description of the variability of the data, variance and standard deviation are used.

In statistics, to summarize the dispersion (or called spread, variability, scatter) of the distribution, variability in a sample data is used. It is used to measure the central tendency with mean or median to provide an overall description of a set of data. A measure of dispersion (spread) gives an idea of how well is the mean that represents the data. If the value in the data set is large dispersion (high variability), it indicates that there is probably a large difference between individual scores, but if the data set is small dispersion (low variability), indicates that there is probably aa similarity between individual scores.

Range is the difference between the highest and lowest value in data set. It is the simplest measure of dispersion. Range is the maximum value minus the minimum value. While it is limited to use the range in measuring dispersion, it sets the scope of the scores, and it can be used to detect any errors when entering data. For example, if there is too much difference between individual scores, that means the data are wrong.

The standard deviation is a measure of dispersion of value within data set. It is used in conjunction with the mean to summarize continuous data. It is normally appropriate only when the continuous data has no outliers or not significantly skewed. The zero value of Skewness means that the tails on both sides of the mean are balance in the case of a symmetric distribution.

The summary of descriptive statistics of the time series data for the selected dependent and independent variables under study of 192 monthly observations of all the variables have been examined to estimate as presented in table 4.1.

Table 4.1: Descriptive statistics for 2000 to 2015

	IFR (%)	IMLR (%)	REER (baht)	TOT (US dollar)	WORLDGDP (%)	OIL (US dollar)	PRODUCTION (Unit)	PATENT (Unit)	EPORTV (US dollar)
Observations	192	192	192	192	192	192	192	192	192
Minimum	0.20	5.75	80.09	96.73	1.72	19.39	26919.00	0.005	190.25
Maximum	2.40	8.50	111.70	117.06	4.46	133.88	510437.00	20.00	3151.34
Mean	1.24	7.05	93.79	103.10	3.08	63.70	321048.50	4.47	1375.31
Std. Dev.	0.73	0.73	8.66	3.62	0.99	28.52	109521.50	5.06	905.17
Skewness	0.26	-0.22	-0.09	1.22	0.23	0.19	-0.68	0.82	0.28

Results show that the variable inflation, interest rate (MLR), real effective exchange rate, Terms of trade, world GDP rate, oil price and patents have small value, with the mean of 1.24, 7.05, 93.79, 103.10, 3.08, 63.70, 4.47 and dispersion of 0.73, 0.73, 8.66, 3.62, 0.99, 28.52, 5.06, respectively. Therefore, the low variability indicates that there are probably similarities between individual scores.

The high value data dispersion is the production and export value, with the mean of 321048.50 and 1375.31and dispersion of 109521.50 and 905.17 respectively. Therefore, they have high variability which indicate that there are probably large differences between individual scores.

The skewness shows that interest rate (MLR), real effective exchange rate, and production have negative skew which indicates that the tail on the left side of the probability density function is fatter than the right side; therefore, the variables are lefty asymmetric. The other side are inflation rate, Terms of trade, world GDP, oil price, patents and export value, showing positive skewness, which indicates that the tail on the right side is fatter than the left side. Thus, the variables are rightly asymmetric.

4.2 Unit Root Test

In order to know the stationary or non-stationary data is to evaluate the time series data to avoid the spurious regression by using unit root test. For this study, the procedure, Augmented Dickey Fuller Test (ADF), was used to test the unit root by level and 1st difference including in test equation which are without intercept and trend, with intercept and trend, and with intercept but without trend. The procedure was to choose lag length by Automatic based on SIC, MAXLAG=12 base on time series, using the monthly data.

The analysis was comparing between the result of Augmented Dickey-Fuller test statistic and MacKinnon critical at 1%, 5% and 10%. If Augmented Dickey-Fuller test statistic is greater than MacKinnon critical, (H_0) is accepted and (H_1) is rejected. It means time series is non-stationary, and to solve the problem 1st difference is used. If the variable is non-stationary, high R^2 is obtained, therefore is no meaningful relation between variables (Talla, 2014).

Table 4.2: Augmented Dickey-Fuller test

Test for unit root in	Include in test equestion	Variable									Test Critical Value		
		EPORTV	IFR	IMLR	PRODUCTION	REER	TOT	GDP	OIL	PATENT			
		ADF test	ADF test	ADF test	ADF test	ADF test	ADF test	ADF test	ADF test	ADF test	1%	5%	10%
Level	None	0.61563	-1.29295	-0.95641	-0.24211	0.78499	0.37379	-1.15955	-0.84490	-1.54766	-2.57726	-1.94252	-1.61558
	Trend and intercept	-5.57760*	-2.83977	-2.12454	-3.623946*	-2.69272	-1.95847	-2.70477	-2.20116	-6.41420*	-4.00708	-3.43365	-3.14070
	intercept	-0.91526	-2.76306*	-2.19795	-3.288063*	-1.17200	-0.92393	-2.678732*	-2.16050	-2.577187*	-3.46501	-2.87668	-2.57492
1st difference	None	-14.81314**	-13.74773**	-10.89899**	-13.34245**	-8.833781**	-8.090619**	-13.74773**	-8.992507**	-15.72163**	-2.57726	-1.94252	-1.61558
	Trend and intercept	-14.8629**	-13.68294**	-10.95488**	-13.40344**	-8.80931**	-6.57735**	-13.68893**	-9.010768**	-15.64781**	-4.00735	-3.43378	-3.14077
	intercept	-14.90309**	-13.71187**	-10.91067**	-13.34234**	-8.829602**	-8.080306**	-13.72168**	-8.968161**	-15.69022**	-3.46501	-2.87668	-2.57492

Source: Author

Note 1) * It means the data is stationary at level.

2) ** It means the data is stationary at 1st difference.

3) Lag Length means the reasonable lag lengths for lag order based on monthly data used Automatic based on SIC, MAXLAG = 12.

Table 4.2 shows that the unit root test in levels without trend and intercept of export with ADF test of exports value, inflation rate, interest rate, production, real effective exchange rate, Terms of trade, world GDP, patents, and oil price are 0.615629, -1.292951, -0.956406, -0.242107, 0.784987, 0.373786, -1.159553, -0.844895, -1.547662, respectively, which are less than MacKinnon critical value at 1% level (-2.577255), 5% (-1.942517), and at 10% (-1.615583) respectively. Hence, the null hypothesis (H_0) is accepted and alternative hypothesis (H_1) is rejected. It is to conclude that those variables are non-stationary at levels without trend and intercept.

Augmented Dickey Fuller Test (ADF) with intercept and trend of inflation rate, interest rate (MLR), real effective exchange rate, Terms of trade, world GDP, and oil price are -2.839765, -2.124537, -2.692717, -1.958471, -2.704766, -2.201164, respectively which are less than MacKinnon critical value at 1% level (-4.007084), 5% (-3.433651), and at 10% (-3.140697) respectively. Hence, the null hypothesis (H_0) is accepted, and alternative hypothesis (H_1) is rejected. It is to conclude that those variables are non-stationary with intercept and trend. The result of exports value, production, and patent represent that ADF value are -5.577601, -3.623946 and -6.414202, respectively which are greater than MacKinnon critical value at 1% level (-4.007084), 5% (-3.433651) and at 10% (-3.140697) respectively. Hence, the null hypothesis (H_0) is rejected, and alternative hypothesis (H_1) is accepted. These three variables are stationary with intercept and trend.

Augmented Dickey Fuller Test (ADF) with intercept but without trend of exports value, inflation rate, interest rate, production, real effective exchange rate, Terms of trade, and oil price are -0.915256, -2.76306, -2.197947, -1.172001, -0.923933, -2.1605, respectively which are less than MacKinnon critical value at 1% level (-3.465014), 5% (-2.876677), and at 10% (-2.574917) respectively. Hence, the null hypothesis (H_0) is accepted, and alternative hypothesis (H_1) is rejected. It is to conclude that those variables are non-stationary with intercept but without trend. The result of production, world GDP, and patent represent that ADF value are -3.288063, -2.678732 and -2.577187, respectively which are greater than MacKinnon critical value at 1% level (-3.465014), 5% (-2.876677), and at 10% (-2.574917) respectively. Hence, the null hypothesis (H_0) is rejected, and alternative hypothesis (H_1) is accepted. These three variables are stationary with intercept and trend.

However, for the results shows in table 4.2, the problem is solved by taking the first difference of the variables which are interest rate (MLR), real effective exchange rate, Terms of trade, and oil price, before using them in the regression model.

Table 4.3: ADF test result at level, trend and intercept

Variables	P-Value	Null hypothesis	Result
EPORTV	0.00000**	Reject	Stationary
PATENT	0.00000**	Reject	Stationary
IFR	0.18500	Do not reject	Non-stationary
IMLR	0.52840	Do not reject	Non-stationary
REER	0.24100	Do not reject	Non-stationary
TOT	0.61960	Do not reject	Non-stationary
GDP	0.23600	Do not reject	Non-stationary
OIL	0.48580	Do not reject	Non-stationary
PRODUCTION	0.03040**	Reject	Stationary

(**) $p<0.05$

The ADF test result shows that the p-value is less than the critical level at 5%, therefore, the null hypothesis is rejected and conclude that these variables are stationary.

4.3 Regression Output (OLS)

OLS equation is as follows:

$$Log(ExportVal_t) = \alpha + \beta_1 PATENTS_t - \beta_2 D(IFR_t) - \beta_3 D(IMLR_t) - \beta_4 Dlog(REER_t) + \beta_5 Dlog(TOT_t) + \beta_6 D(GDP_t) - \beta_7 Dlog(OIL_t) + \beta_8 Log(PRODUCTION_t) + \varepsilon \quad (2)$$

After the regression analysis using eviews 7, the researcher found a satisfying result that real effective exchange rate, Terms of trade, and oil price are non-stationary. They were fixed by taking the first difference (dlog), except for export value and production where only log is taken to reduce variation. For interest rate (MLR), inflation rate, and world GDP, only difference (D) is taken because they show percentage value. The result is shown in table 4.4.

Table 4.4: Regression Output (OLS)

Dependent Variable: LOG(EPORTV)
Method: Least Squares
Sample (adjusted): 2000M02 2015M12
Included observations: 191 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.209031	0.807302	-5.213698	0.0000
PATENT	0.089723**	0.006180	14.51737	0.0000
D(IFR)	0.000811	0.104961	0.007722	0.9938
D(IMLR)	0.375759	0.227249	1.653511	0.1000
DLOG(REER)	1.659199	2.106256	0.787748	0.4319
DLOG(TOT)	4.709186	3.426508	1.374340	0.1710
D(WORLDGDP)	0.025085	0.081190	0.308963	0.7577
DLOG(OIL)	-0.062436	0.346762	-0.180054	0.8573
LOG(PRODUCTION)	0.853257**	0.064904	13.14649	0.0000
R-squared	0.791676			
Adjusted R-squared	0.782519			

(**) p<0.05

Table 4.4 shows the result of Ordinary Least Square (OLS) method shows the impact of Macroeconomic factors, Related industry factors and Innovation capability factor variables. It can be noticed that both the dependent and independent variables in which some of the predictor variables are log transformed. It is associated with the meaning that the percentage change in dependent variable is caused by one percentage change in independent variables.

4.4 Heteroskedasticity and Autocorrelation

After conducting the Heteroskedasticity and Autocorrelation analysis, the researcher found that both have problem. The Durbin-Watson statistic (D.W.) result should be equal to 2, but the Durbin-Watson statistic result is 1.079 as show in table 4.5. Also, there is a problem in White heteroskedasticity (see table 4.6) in which the result shows that coefficient estimates have not changed, but standard errors have become lower and t value higher. The chance of rejecting the null hypothesis is reduced when small p-value is given that the null hypothesis is true. The standard errors are biased when heteroskedasticity is present.

Table 4.5: Durbin-Watson statistic

Dependent Variable: LOG(EPORTV)
Included observations: 191 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.209031	0.807302	-5.213698	0.0000
PATENT	0.089723	0.006180	14.51737	0.0000
D(IFR)	0.000811	0.104961	0.007722	0.9938
D(IMLR)	0.375759	0.227249	1.653511	0.1000
DLOG(REER)	1.659199	2.106256	0.787748	0.4319
DLOG(TOT)	4.709186	3.426508	1.374340	0.1710
D(WORLDGDP)	0.025085	0.081190	0.308963	0.7577
DLOG(OIL)	-0.062436	0.346762	-0.180054	0.8573
LOG(PRODUCTION)	0.853257	0.064904	13.14649	0.0000

R-squared	0.791676	Mean dependent var	6.941352
Adjusted R-squared	0.782519	S.D. dependent var	0.833937
S.E. of regression	0.388906	Akaike info criterion	0.995014
Sum squared resid	27.52706	Schwarz criterion	1.148262
Log likelihood	-86.02383	Hannan-Quinn criter.	1.057087
F-statistic	86.45490	Durbin-Watson stat	1.079746
Prob(F-statistic)	0.000000		

Table 4.6: Heteroskedasticity Test: White

F-statistic	2.099270	Prob. F(8,182)	0.0380
Obs*R-squared	16.13571	Prob. Chi-Square(8)	0.0405
Scaled explained SS	10.67406	Prob. Chi-Square(8)	0.2209

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Included observations: 191

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.781582	0.176309	4.433032	0.0000
PATENT^2	0.000135	0.000188	0.714921	0.4756
(D(IFR))^2	0.007904	0.031875	0.247960	0.8044
(D(IMLR))^2	-0.240708	0.220946	-1.089444	0.2774
(DLOG(REER))^2	-9.539902	21.40263	-0.445735	0.6563
(DLOG(TOT))^2	-12.33458	87.25086	-0.141369	0.8877
(D(WORLDGDP))^2	0.005032	0.016191	0.310794	0.7563
(DLOG(OIL))^2	0.790730	0.896129	0.882384	0.3787
(LOG(PRODUCTION))^2	-0.004054	0.001114	-3.638446	0.0004

R-squared	0.084480	Mean dependent var	0.144121
Adjusted R-squared	0.044238	S.D. dependent var	0.174427
S.E. of regression	0.170525	Akaike info criterion	-0.653891
Sum squared resid	5.292361	Schwarz criterion	-0.500643
Log likelihood	71.44660	Hannan-Quinn criter.	-0.591818
F-statistic	2.099270	Durbin-Watson stat	1.368167
Prob(F-statistic)	0.037950		

Therefore, it is appropriate to use a Newey–West estimator to solve both problems in Autocorrelation and Heteroscedastic. Newey-West estimator is an estimate provided to be used in statistics. It is the estimation of the covariance matrix of the parameters in linear regression model with heteroscedastic, temporary dependent errors of unknown form. The Newey-West standard errors are heteroskedasticity and autocorrelation consistent estimates of the standard error (Wooldridge, 2012).

Newey-West correction standard error can solve both problems in Heteroskedasticity and Autocorrelation from the same equation, by comparing the value of standard error (Std. Error) with the equation before and after solving the problem. The standard error value before the adjustment is low which makes the t value high, but after adjustment using Newey –West method in correcting standard error, the value of standard error will increase and reduce t value.

4.5 Multicollinearity

The result clearly shows that none of the explanatory (independent) variables' coefficients are higher than 0.8, if a coefficient is higher than 0.8, it indicates near multicollinearity problem, while those equal to 1 indicate perfect multicollinearity problem (Taoulaou & Burchuladze, 2014). It has been concluded that there is no multicollinearity problem between the explanatory variables (see table 4.7).

Table 4.7: Multicollinearity

	IFR	IMLR	PRODUCTION	REER	TOT	WORLDGDP	OIL	PATENT
IFR	1	0.442155	0.331304	0.485407	-0.064048	0.066419	0.58889	0.300717
IMLR	0.442155	1	-0.337051	0.192438	-0.113812	-0.120922	0.012734	0.037141
PRODUCTION	0.331304	-0.337051	1	0.484362	-0.141346	-0.002869	0.681508	0.464283
REER	0.485407	0.192438	0.484362	1	0.26063	-0.15472	0.774893	0.609168
TOT	-0.064048	-0.113812	-0.141346	0.26063	1	0.280669	-0.068231	0.021767
WORLDGDP	0.066419	-0.120922	-0.002869	-0.15472	0.280669	1	-0.005246	-0.209067
OIL	0.58889	0.012734	0.681508	0.774893	-0.068231	-0.005246	1	0.530368
PATENT	0.300717	0.037141	0.464283	0.609168	0.021767	-0.209067	0.530368	1

4.6 Final Regression Output

The output of the Ordinary Least Square method shows the impact of the innovation capability factor, macroeconomic factors, and related industry factors on vehicle exports value as represented in table 4.8.

Table 4.8: The impact of various key factor variables on Thailand's vehicle export value

Dependent Variable: LOG(EPORTV)
Method: Least Squares
Sample (adjusted): 2000M02 2015M12
Included observations: 191 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.209031	2.045991	-2.057208	0.0411
PATENT	0.089723**	0.009234	9.716313	0.0000
D(IFR)	0.000811	0.108037	0.007502	0.9940
D(IMLR)	0.375759	0.217063	1.731103	0.0851
DLOG(REER)	1.659199	2.099249	0.790377	0.4303
DLOG(TOT)	4.709186	3.724697	1.264314	0.2077
D(WORLDGDP)	0.025085	0.090983	0.275709	0.7831
DLOG(OIL)	-0.062436	0.426762	-0.146301	0.8838
LOG(PRODUCTION)	0.853257**	0.162949	5.236343	0.0000

R-squared	0.791676	Mean dependent var	6.941352
Adjusted R-squared	0.782519	S.D. dependent var	0.833937
S.E. of regression	0.388906	Akaike info criterion	0.995014
Sum squared resid	27.52706	Schwarz criterion	1.148262
Log likelihood	-86.02383	Hannan-Quinn criter.	1.057087
F-statistic	86.45490	Durbin-Watson stat	1.079746
Prob(F-statistic)	0.000000		

** $p<0.05$

The coefficient of patent is significantly positive at 5% level. This means that a one percentage increase of patents granted for vehicle components and manufacturing processes will increase the vehicle exports value of Thailand about 0.089723%. This result is consistent with the finding of Yi (2013). The patent granted is an indicator of innovation capability which is always beneficial for exports by developing and testing the product before production, increase of patents leading to significant growth in the exports of high tech products.

The coefficient of inflation rate is insignificant. This result contradicts the finding of Muktadir-Al- Mukit, (2015) who reported an analysis revealing that export has a negative impact on inflation where the coefficients of all the explanatory variables are found statistically significant.

The coefficient of interest minimum loan rate (MLR) is insignificant. This result contradicts with the finding of Furman and Stiglitz (1998) that an increase in the interest rate affects the future export performance, which reduces the future flow of foreign exchange reserves and thereby, leads to depreciation of currency.

The coefficient of production level is significantly positive at 5% level; therefore, a one percentage increase in production will increase the vehicle exports value of Thailand about 0.853257%. This result is consistent with the finding of Kasornbua (2014) because the demand of vehicle and component parts from importer is higher than the production. Therefore, Thai increases its production, the importers will import more to cover their demand. An increased production is to tap the growing demand both at home and in the foreign markets (Krishnaveni* & R. Vidya, 2015).

The coefficient of real effective exchange rate (REER) is insignificant. This result contradicts with the finding of Berthou (2008) who reported that the real appreciation of the domestic currency against other major currencies has a strong negative effect on export.

The coefficient of terms of trade is insignificant. This result contradicts with the finding of Kalumbu (2014), if Terms of trade ratio is increasing, it will have a positive change in export, changes in terms of trade impact in open economies that depend on the export, and a high ratio of Terms of trade which in return will accelerate economic growth.

The coefficient of world GDP growth rate is insignificant. This result contradicts with the finding of Ms. Mina Mashayekhi (2013), the increase in gross domestic product of any countries indicate that the income per capita increases in the trading partner. When the income of trading partners increases, they tend to consume more, and then the exporting country can improve its export for exporting more. The global demand plays an important role in determining the growth of exports. The impact of the slowdown in global demand and in the export of the country is largely determined by income.

The coefficient of oil price is insignificant. This result contradicts with the finding of Belenkiy (2012), for oil importing country, its demand for vehicles decreases as crude oil prices increase.

4.7 Additional analysis

The summaries of above coefficients explain the importance of promoting innovation through patent which is always beneficial for exports by developing and testing the product before production, increase of patent leading to significant growth in the exports of high tech products. However, the time between the filing date of a patent and the filing date of the most recent patent cited as reference is an indicator of Innovation lag; therefore, an examination the 1-year lag of patent is done to predict the future, and the result from table 4.9 shows that patent is significantly positive at 5% level.

It has been concluded that the outputs in industries and exports growth that rely on innovation through patent granted are important in preserving the export markets share. Also, product innovation has appeared as more rewarding in terms of export performance as if displays a positive significant impact on Thailand's vehicle export and plays an important role in promoting the export growth in the future.

Table 4.9: Lag patent

Dependent Variable: LOG(EPORTV)
Method: Least Squares
Included observations: 191 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 5.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.788348	2.131626	-2.246336	0.0259
PATENT(-1)	0.089551	0.008980	9.972648	0.0000
D(IFR)	0.087673	0.082196	1.066636	0.2875
D(IMLR)	0.399275	0.200392	1.992471	0.0478
DLOG(REER)	-1.296960	2.057073	-0.630488	0.5292
DLOG(TOT)	1.766530	3.316079	0.532716	0.5949
D(WORLDGDP)	0.106495	0.068535	1.553888	0.1219
DLOG(OIL)	-0.146693	0.378191	-0.387880	0.6986
LOG(PRODUCTION)	0.899935	0.169709	5.302814	0.0000

R-squared	0.795172	Mean dependent var	6.941352
Adjusted R-squared	0.786168	S.D. dependent var	0.833937
S.E. of regression	0.385629	Akaike info criterion	0.978091
Sum squared resid	27.06514	Schwarz criterion	1.131340
Log likelihood	-84.40769	Hannan-Quinn criter.	1.040164
F-statistic	88.31869	Durbin-Watson stat	1.022496
Prob(F-statistic)	0.000000		

CHAPTER V

SUMMARY, IMPLICATIONS AND RECOMMENDATIONS

5.1 Summary of findings and discussion of result

Generally, it is believed that for a developing country like Thailand, better export performance plays an important role in the economic growth. The purpose of this study was to evaluate the current situation and find out the main factors that are important in the determination of vehicle export value of Thailand. In order to attain this objective, the study used secondary data covering the period from January 2000 to December 2015, a total of 192 months. For this purpose, the study has included innovation capabilities, macroeconomic factors, and related industry factors. This study has included eight variables; namely, inflation rate, interest rate, production numbers, real effective exchange rate, Terms of trade, world GDP growth, oil price, and patents granted.

The Ordinary Least Square result showed (see table 4.7) that innovation capability factor, as measured by the number of patents granted for vehicle components and manufacturing processes, had a significant positive impact on Thailand's vehicle export value.

Macroeconomic factors which are inflation rate, interest rate (MLR), real effective exchange rate, Terms of trade, and world GDP had an insignificant impact on Thailand's vehicle export value (see table 4.7). This study also showed a positive correlation, but the correlation was very insignificant. Clearly, there were some reasons behind this insignificance. It should be considered that inflation rate, interest minimum loan rate (MLR), real effective exchange rate, Terms of trade, and world GDP were not the only causes that can affect the export trade. There were other factors that can influenced Thailand's vehicle export value, and the reasons were the massive pressure on the huge population, demand of vehicle and component parts available, exchange rate fluctuation, frequent natural disasters of Thailand, different government policies, inflation rate of the importing country, difference of National Income (NI), Personal

Income (PI), etc. As so many factors had influenced Thailand's vehicle export value,the inflation rate, interest rate (MLR), real effective exchange rate, Terms of trade, and world GDP were not able to create a huge pressure on Thailand's vehicle export value.

Related industry factors are oil price and production numbers. The Ordinary Least Square result (see table 4.7) for the oil price had an insignificant impact on Thailand's vehicle export value, but production had a significant positive impact on Thailand's vehicle export value.

The findings of this study would be helpful for export policy makers to obtain enhanced levels of economic development and growth of Thailand. It could also be used as a guideline for the private sector investors to identify the main factors, and understand the risk factors that may impact the automotive trader, manufacturers of automotive parts, and dealers of automotive and component parts.

The results from this study showed that innovation capability and high production levels had an important impact on vehicle export value. Most important is high technical standards to produce superior products at competitive prices to succeed in the markets. Technical improvements can be made through internal research and development or external acquiring through purchase.

Since increasing exports is a high priority of any government wishing to boost economic growth, the government could implement programs to help the industry achieve a higher level of technical capability through training at the industry and university level.

5.2 Implications and Recommendations

The governments should encourage development of research and development either at the company level or create and automotive technology institute that all companies could join to develop, share, and increase their technical capability.

The governments should allow or grant firms a deduction on expenditure (tax deduction) and financial support for internal research and development, innovation, and patents registration. They could give awards for the firms that are successful in developing new products and patents on new technology.

Thailand's manufacturers of motorcycle, car and component parts should develop strategies to increase their productivity by developing technologies efficient of production, technology with improved efficiency and production rates while reducing human error in countless industries. Therefore, the technologies efficient of production can promote efficient product and lead to export growth.

Firm’s vehicle exporter, and private sector investors could use the result from this study for future planning to protect and reduce the impact of a risk factor on Thailand's vehicle export value.

5.3 Future Study

For future research, other researchers can add other interesting variables for study, such as research and development expenditures, and labor cost influencing Thailand’s vehicle export value.

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APPENDICES

APPENDIX
A

Table 1.1: The statistical data showing export product groups of export during year 2013 to 2015.

Industrial goods exports	Ranking	Value: Million Baht		
		2013	2014	2015
Automotive parts and accessories	1	738,113.38	789,234.78	863,828.36
Computer Equipment and components	2	537,049.34	588,613.82	595,418.55
Jewelry	3	305,838.44	324,155.80	371,071.62
Plastic beads	4	270,792.03	311,139.90	278,334.85
electronic board	5	218,087.98	240,854.58	261,316.83
Machinery and components	6	205,043.42	231,942.13	238,564.91
Rubber products	7	257,204.49	257,337.61	230,427.74
chemical	8	274,939.09	276,481.19	215,346.57
steel products	9	191,396.29	169,414.45	179,253.82
Air conditioning and components	10	135,783.89	148,274.61	154,010.42
Electronics and other components	11	132,825.24	127,426.11	131,261.93
Radio receiver and components	12	117,598.98	129,009.40	123,611.11
Plastic product	13	107,139.35	120,806.10	121,431.56
Reciprocating engine	14	101,252.36	108,898.08	107,005.81
Clothes	15	86,910.89	91,860.11	89,263.18

Source: http://www.ops3.moc.go.th/infor/Export/recode_export_rank/report.asp

APPENDIX

B

Unit root test

Null Hypothesis: EPORTV has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.915256	0.7818
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EPORTV)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EPORTV(-1)	-0.016355	0.017870	-0.915256	0.3612
D(EPORTV(-1))	-0.372255	0.071192	-5.228883	0.0000
D(EPORTV(-2))	-0.293941	0.070652	-4.160431	0.0000
C	43.49821	29.13461	1.493008	0.1371

R-squared	0.171927	Mean dependent var	11.92206
Adjusted R-squared	0.158499	S.D. dependent var	236.8361
S.E. of regression	217.2577	Akaike info criterion	13.62098
Sum squared resid	8732170.	Schwarz criterion	13.68959
Log likelihood	-1283.183	Hannan-Quinn criter.	13.64878
F-statistic	12.80344	Durbin-Watson stat	2.045586
Prob(F-statistic)	0.000000		

Null Hypothesis: EPORTV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.577601	0.0000
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EPORTV)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EPORTV(-1)	-0.369603	0.066266	-5.577601	0.0000
D(EPORTV(-1))	-0.110733	0.072898	-1.519019	0.1305
C	-38.56389	32.41568	-1.189668	0.2357
@TREND(2000M01)	5.807833	1.076814	5.393534	0.0000

R-squared	0.216934	Mean dependent var	11.99705
Adjusted R-squared	0.204304	S.D. dependent var	236.2110
S.E. of regression	210.7044	Akaike info criterion	13.55962
Sum squared resid	8257720.	Schwarz criterion	13.62798
Log likelihood	-1284.164	Hannan-Quinn criter.	13.58731
F-statistic	17.17600	Durbin-Watson stat	2.033342
Prob(F-statistic)	0.000000		

Null Hypothesis: EPORTV has a unit root
Exogenous: None
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.615629	0.8485
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EPORTV)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EPORTV(-1)	0.006015	0.009770	0.615629	0.5389
D(EPORTV(-1))	-0.382498	0.071094	-5.380142	0.0000
D(EPORTV(-2))	-0.299081	0.070800	-4.224288	0.0000
R-squared	0.161950	Mean dependent var		11.92206
Adjusted R-squared	0.152939	S.D. dependent var		236.8361
S.E. of regression	217.9744	Akaike info criterion		13.62238
Sum squared resid	8837385.	Schwarz criterion		13.67383
Log likelihood	-1284.315	Hannan-Quinn criter.		13.64322
Durbin-Watson stat	2.046030			

Null Hypothesis: D(EPORTV) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.90309	0.0000
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EPORTV,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EPORTV(-1))	-1.683908	0.112991	-14.90309	0.0000
D(EPORTV(-1),2)	0.300960	0.070204	4.286959	0.0000
C	21.13982	15.86981	1.332078	0.1845

R-squared	0.677479	Mean dependent var	-1.368413
Adjusted R-squared	0.674012	S.D. dependent var	380.3510
S.E. of regression	217.1629	Akaike info criterion	13.61492
Sum squared resid	8771710.	Schwarz criterion	13.66637
Log likelihood	-1283.610	Hannan-Quinn criter.	13.63576
F-statistic	195.3537	Durbin-Watson stat	2.048844
Prob(F-statistic)	0.000000		

Null Hypothesis: D(EPORTV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.86290	0.0000
Test critical values:	1% level	-4.007347	
	5% level	-3.433778	
	10% level	-3.140772	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EPORTV,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EPORTV(-1))	-1.684070	0.113307	-14.86290	0.0000
D(EPORTV(-1),2)	0.301044	0.070397	4.276343	0.0000
C	18.57260	32.32629	0.574535	0.5663
@TREND(2000M01)	0.026489	0.290338	0.091235	0.9274

R-squared	0.677494	Mean dependent var	-1.368413
Adjusted R-squared	0.672264	S.D. dependent var	380.3510
S.E. of regression	217.7442	Akaike info criterion	13.62546
Sum squared resid	8771316.	Schwarz criterion	13.69406
Log likelihood	-1283.606	Hannan-Quinn criter.	13.65325
F-statistic	129.5442	Durbin-Watson stat	2.048798
Prob(F-statistic)	0.000000		

Null Hypothesis: D(EPORTV) has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.81314	0.0000
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EPORTV,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EPORTV(-1))	-1.669437	0.112700	-14.81314	0.0000
D(EPORTV(-1),2)	0.293662	0.070134	4.187138	0.0000

R-squared	0.674403	Mean dependent var	-1.368413
Adjusted R-squared	0.672661	S.D. dependent var	380.3510
S.E. of regression	217.6121	Akaike info criterion	13.61383
Sum squared resid	8855392.	Schwarz criterion	13.64814
Log likelihood	-1284.507	Hannan-Quinn criter.	13.62773
Durbin-Watson stat	2.042332		

Null Hypothesis: IFR has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.763060	0.0656
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IFR)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IFR(-1)	-0.077181	0.027933	-2.763060	0.0063
D(IFR(-1))	0.037917	0.072983	0.519533	0.6040
C	0.097524	0.040059	2.434521	0.0159

R-squared	0.039225	Mean dependent var	0.001789
Adjusted R-squared	0.028949	S.D. dependent var	0.281227
S.E. of regression	0.277127	Akaike info criterion	0.286981
Sum squared resid	14.36147	Schwarz criterion	0.338249
Log likelihood	-24.26316	Hannan-Quinn criter.	0.307749
F-statistic	3.817252	Durbin-Watson stat	2.003101
Prob(F-statistic)	0.023721		

Null Hypothesis: IFR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.839765	0.1850
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IFR)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IFR(-1)	-0.085479	0.030101	-2.839765	0.0050
D(IFR(-1))	0.043347	0.073432	0.590300	0.5557
C	0.079394	0.046906	1.692631	0.0922
@TREND(2000M01)	0.000295	0.000395	0.745374	0.4570

R-squared	0.042086	Mean dependent var	0.001789
Adjusted R-squared	0.026636	S.D. dependent var	0.281227
S.E. of regression	0.277457	Akaike info criterion	0.294524
Sum squared resid	14.31870	Schwarz criterion	0.362883
Log likelihood	-23.97982	Hannan-Quinn criter.	0.322215
F-statistic	2.723981	Durbin-Watson stat	2.003801
Prob(F-statistic)	0.045623		

Null Hypothesis: IFR has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.292951	0.1806
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IFR)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IFR(-1)	-0.018363	0.014202	-1.292951	0.1976
D(IFR(-1))	0.009549	0.072985	0.130833	0.8960

R-squared	0.008773	Mean dependent var	0.001789
Adjusted R-squared	0.003501	S.D. dependent var	0.281227
S.E. of regression	0.280735	Akaike info criterion	0.307657
Sum squared resid	14.81665	Schwarz criterion	0.341836
Log likelihood	-27.22742	Hannan-Quinn criter.	0.321503
Durbin-Watson stat	2.000170		

Null Hypothesis: D(IFR) has a unit root
Exogenous: Constant
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.71187	0.0000
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IFR,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IFR(-1))	-1.000041	0.072932	-13.71187	0.0000
C	0.001790	0.020457	0.087479	0.9304

R-squared	0.500020	Mean dependent var	6.15E-20
Adjusted R-squared	0.497361	S.D. dependent var	0.397724
S.E. of regression	0.281974	Akaike info criterion	0.316469
Sum squared resid	14.94779	Schwarz criterion	0.350648
Log likelihood	-28.06457	Hannan-Quinn criter.	0.330315
F-statistic	188.0153	Durbin-Watson stat	2.000000
Prob(F-statistic)	0.000000		

Null Hypothesis: D(IFR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.68294	0.0000
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IFR,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IFR(-1))	-1.000592	0.073127	-13.68294	0.0000
C	0.013415	0.041510	0.323175	0.7469
@TREND(2000M0 1)	-0.000120	0.000374	-0.322112	0.7477

R-squared	0.500298	Mean dependent var	6.15E-20
Adjusted R-squared	0.494953	S.D. dependent var	0.397724
S.E. of regression	0.282649	Akaike info criterion	0.326441
Sum squared resid	14.93950	Schwarz criterion	0.377710
Log likelihood	-28.01188	Hannan-Quinn criter.	0.347209
F-statistic	93.61137	Durbin-Watson stat	2.000006
Prob(F-statistic)	0.000000		

Null Hypothesis: D(IFR) has a unit root
Exogenous: None
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.74773	0.0000
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IFR,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IFR(-1))	-1.000000	0.072739	-13.74773	0.0000

R-squared	0.500000	Mean dependent var	6.15E-20
Adjusted R-squared	0.500000	S.D. dependent var	0.397724
S.E. of regression	0.281233	Akaike info criterion	0.305984
Sum squared resid	14.94840	Schwarz criterion	0.323073
Log likelihood	-28.06844	Hannan-Quinn criter.	0.312906
Durbin-Watson stat	2.000000		

Null Hypothesis: IMLR has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.197947	0.2078
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMLR)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMLR(-1)	-0.027414	0.012473	-2.197947	0.0292
D(IMLR(-1))	0.229262	0.070388	3.257104	0.0013
C	0.186454	0.088360	2.110172	0.0362

R-squared	0.074352	Mean dependent var	-0.008684
Adjusted R-squared	0.064452	S.D. dependent var	0.128709
S.E. of regression	0.124492	Akaike info criterion	-1.313486
Sum squared resid	2.898177	Schwarz criterion	-1.262217
Log likelihood	127.7812	Hannan-Quinn criter.	-1.292718
F-statistic	7.510313	Durbin-Watson stat	2.079754
Prob(F-statistic)	0.000729		

Null Hypothesis: IMLR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.124537	0.5284
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMLR)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMLR(-1)	-0.026602	0.012521	-2.124537	0.0349
D(IMLR(-1))	0.223898	0.070743	3.164963	0.0018
C	0.167392	0.091367	1.832087	0.0685
@TREND(2000M01)	0.000138	0.000166	0.830036	0.4076

R-squared	0.077768	Mean dependent var	-0.008684
Adjusted R-squared	0.062893	S.D. dependent var	0.128709
S.E. of regression	0.124596	Akaike info criterion	-1.306657
Sum squared resid	2.887482	Schwarz criterion	-1.238299
Log likelihood	128.1324	Hannan-Quinn criter.	-1.278966
F-statistic	5.228200	Durbin-Watson stat	2.076512
Prob(F-statistic)	0.001734		

Null Hypothesis: IMLR has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.956406	0.3016
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMLR)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IMLR(-1)	-0.001233	0.001289	-0.956406	0.3401
D(IMLR(-1))	0.223769	0.070983	3.152428	0.0019

R-squared	0.052310	Mean dependent var	-0.008684
Adjusted R-squared	0.047270	S.D. dependent var	0.128709
S.E. of regression	0.125630	Akaike info criterion	-1.300480
Sum squared resid	2.967188	Schwarz criterion	-1.266300
Log likelihood	125.5456	Hannan-Quinn criter.	-1.286634
Durbin-Watson stat	2.070488		

Null Hypothesis: D(IMLR) has a unit root
Exogenous: Constant
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.91067	0.0000
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMLR,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IMLR(-1))	-0.775414	0.071069	-10.91067	0.0000
C	-0.006734	0.009144	-0.736423	0.4624

R-squared	0.387707	Mean dependent var	0.000000
Adjusted R-squared	0.384450	S.D. dependent var	0.160284
S.E. of regression	0.125754	Akaike info criterion	-1.298506
Sum squared resid	2.973049	Schwarz criterion	-1.264327
Log likelihood	125.3581	Hannan-Quinn criter.	-1.284661
F-statistic	119.0426	Durbin-Watson stat	2.070759
Prob(F-statistic)	0.000000		

Null Hypothesis: D(IMLR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.95488	0.0000
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMLR,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IMLR(-1))	-0.781685	0.071355	-10.95488	0.0000
C	-0.022741	0.018578	-1.224110	0.2225
@TREND(2000M01)	0.000165	0.000167	0.989860	0.3235

R-squared	0.390899	Mean dependent var	0.000000
Adjusted R-squared	0.384384	S.D. dependent var	0.160284
S.E. of regression	0.125761	Akaike info criterion	-1.293206
Sum squared resid	2.957552	Schwarz criterion	-1.241937
Log likelihood	125.8546	Hannan-Quinn criter.	-1.272438
F-statistic	60.00484	Durbin-Watson stat	2.067082
Prob(F-statistic)	0.000000		

Null Hypothesis: D(IMLR) has a unit root
Exogenous: None
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.89899	0.0000
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(IMLR,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IMLR(-1))	-0.771882	0.070821	-10.89899	0.0000

R-squared	0.385941	Mean dependent var	0.000000
Adjusted R-squared	0.385941	S.D. dependent var	0.160284
S.E. of regression	0.125602	Akaike info criterion	-1.306152
Sum squared resid	2.981625	Schwarz criterion	-1.289063
Log likelihood	125.0845	Hannan-Quinn criter.	-1.299229
Durbin-Watson stat	2.072977		

Null Hypothesis: OIL has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.160500	0.2216
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL(-1)	-0.028907	0.013380	-2.160500	0.0320
D(OIL(-1))	0.411199	0.066638	6.170617	0.0000
C	1.859304	0.936307	1.985785	0.0485

R-squared	0.178932	Mean dependent var	0.041158
Adjusted R-squared	0.170151	S.D. dependent var	5.730249
S.E. of regression	5.220032	Akaike info criterion	6.158548
Sum squared resid	5095.513	Schwarz criterion	6.209816
Log likelihood	-582.0620	Hannan-Quinn criter.	6.179316
F-statistic	20.37607	Durbin-Watson stat	2.067766
Prob(F-statistic)	0.000000		

Null Hypothesis: OIL has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.201164	0.4858
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL(-1)	-0.044029	0.020003	-2.201164	0.0290
D(OIL(-1))	0.427120	0.068447	6.240180	0.0000
C	1.808924	0.937531	1.929455	0.0552
@TREND(2000M01)	0.010543	0.010367	1.016930	0.3105

R-squared	0.183472	Mean dependent var	0.041158
Adjusted R-squared	0.170302	S.D. dependent var	5.730249
S.E. of regression	5.219555	Akaike info criterion	6.163529
Sum squared resid	5067.339	Schwarz criterion	6.231888
Log likelihood	-581.5353	Hannan-Quinn criter.	6.191220
F-statistic	13.93125	Durbin-Watson stat	2.084097
Prob(F-statistic)	0.000000		

Null Hypothesis: OIL has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.844895	0.3488
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL(-1)	-0.004608	0.005454	-0.844895	0.3992
D(OIL(-1))	0.401535	0.066978	5.994983	0.0000

R-squared	0.161618	Mean dependent var	0.041158
Adjusted R-squared	0.157158	S.D. dependent var	5.730249
S.E. of regression	5.260736	Akaike info criterion	6.168889
Sum squared resid	5202.964	Schwarz criterion	6.203069
Log likelihood	-584.0445	Hannan-Quinn criter.	6.182735
Durbin-Watson stat	2.052354		

Null Hypothesis: D(OIL) has a unit root
Exogenous: Constant
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.968161	0.0000
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OIL(-1))	-0.601186	0.067036	-8.968161	0.0000
C	0.009295	0.382415	0.024306	0.9806

R-squared	0.299626	Mean dependent var	-0.038737
Adjusted R-squared	0.295900	S.D. dependent var	6.281331
S.E. of regression	5.270706	Akaike info criterion	6.172676
Sum squared resid	5222.703	Schwarz criterion	6.206855
Log likelihood	-584.4042	Hannan-Quinn criter.	6.186522
F-statistic	80.42791	Durbin-Watson stat	2.047976
Prob(F-statistic)	0.000000		

Null Hypothesis: D(OIL) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.010768	0.0000
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OIL(-1))	-0.606938	0.067357	-9.010768	0.0000
C	0.629440	0.777176	0.809906	0.4190
@TREND(2000M01)	-0.006422	0.007005	-0.916711	0.3605

R-squared	0.302759	Mean dependent var	-0.038737
Adjusted R-squared	0.295302	S.D. dependent var	6.281331
S.E. of regression	5.272945	Akaike info criterion	6.178719
Sum squared resid	5199.338	Schwarz criterion	6.229987
Log likelihood	-583.9783	Hannan-Quinn criter.	6.199487
F-statistic	40.59999	Durbin-Watson stat	2.044940
Prob(F-statistic)	0.000000		

Null Hypothesis: D(OIL) has a unit root
Exogenous: None
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.992507	0.0000
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(OIL,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OIL(-1))	-0.601164	0.066852	-8.992507	0.0000

R-squared	0.299624	Mean dependent var	-0.038737
Adjusted R-squared	0.299624	S.D. dependent var	6.281331
S.E. of regression	5.256752	Akaike info criterion	6.162153
Sum squared resid	5222.720	Schwarz criterion	6.179242
Log likelihood	-584.4045	Hannan-Quinn criter.	6.169076
Durbin-Watson stat	2.048018		

Null Hypothesis: PATENT has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.577187	0.0995
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PATENT)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PATENT(-1)	-0.136529	0.052976	-2.577187	0.0107
D(PATENT(-1))	-0.609976	0.078463	-7.774106	0.0000
D(PATENT(-2))	-0.217521	0.072422	-3.003508	0.0030
C	0.698924	0.335027	2.086171	0.0383

R-squared	0.379357	Mean dependent var	0.052884
Adjusted R-squared	0.369292	S.D. dependent var	4.122745
S.E. of regression	3.274165	Akaike info criterion	5.230939
Sum squared resid	1983.229	Schwarz criterion	5.299548
Log likelihood	-490.3238	Hannan-Quinn criter.	5.258734
F-statistic	37.69264	Durbin-Watson stat	2.020892
Prob(F-statistic)	0.000000		

Null Hypothesis: PATENT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.414202	0.0000
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PATENT)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PATENT(-1)	-0.564528	0.088012	-6.414202	0.0000
D(PATENT(-1))	-0.274450	0.070763	-3.878464	0.0001
C	-1.245176	0.501136	-2.484708	0.0138
@TREND(2000M01)	0.039646	0.007430	5.336224	0.0000

R-squared	0.435043	Mean dependent var	0.052605
Adjusted R-squared	0.425931	S.D. dependent var	4.111826
S.E. of regression	3.115422	Akaike info criterion	5.131434
Sum squared resid	1805.289	Schwarz criterion	5.199793
Log likelihood	-483.4862	Hannan-Quinn criter.	5.159125
F-statistic	47.74285	Durbin-Watson stat	2.054260
Prob(F-statistic)	0.000000		

Null Hypothesis: PATENT has a unit root
Exogenous: None
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.547662	0.1141
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PATENT)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PATENT(-1)	-0.058825	0.038009	-1.547662	0.1234
D(PATENT(-1))	-0.660701	0.075269	-8.777844	0.0000
D(PATENT(-2))	-0.240730	0.072205	-3.333995	0.0010

R-squared	0.364756	Mean dependent var	0.052884
Adjusted R-squared	0.357926	S.D. dependent var	4.122745
S.E. of regression	3.303537	Akaike info criterion	5.243610
Sum squared resid	2029.884	Schwarz criterion	5.295066
Log likelihood	-492.5211	Hannan-Quinn criter.	5.264456
Durbin-Watson stat	2.030261		

Null Hypothesis: D(PATENT) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.69022	0.0000
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PATENT,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PATENT(-1))	-1.965346	0.125259	-15.69022	0.0000
D(PATENT(-1),2)	0.262672	0.071329	3.682536	0.0003
C	0.091850	0.241822	0.379824	0.7045

R-squared	0.793024	Mean dependent var	0.021164
Adjusted R-squared	0.790798	S.D. dependent var	7.266187
S.E. of regression	3.323451	Akaike info criterion	5.255630
Sum squared resid	2054.431	Schwarz criterion	5.307086
Log likelihood	-493.6570	Hannan-Quinn criter.	5.276476
F-statistic	356.3269	Durbin-Watson stat	2.042594
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PATENT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.64781	0.0000
Test critical values:	1% level	-4.007347	
	5% level	-3.433778	
	10% level	-3.140772	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PATENT,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PATENT(-1))	-1.965353	0.125599	-15.64781	0.0000
D(PATENT(-1),2)	0.262679	0.071525	3.672551	0.0003
C	0.087617	0.494476	0.177192	0.8596
@TREND(2000M01)	4.36E-05	0.004443	0.009821	0.9922

R-squared	0.793024	Mean dependent var	0.021164
Adjusted R-squared	0.789667	S.D. dependent var	7.266187
S.E. of regression	3.332420	Akaike info criterion	5.266212
Sum squared resid	2054.430	Schwarz criterion	5.334820
Log likelihood	-493.6570	Hannan-Quinn criter.	5.294007
F-statistic	236.2743	Durbin-Watson stat	2.042597
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PATENT) has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.72163	0.0000
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PATENT,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PATENT(-1))	-1.964171	0.124934	-15.72163	0.0000
D(PATENT(-1),2)	0.262025	0.071145	3.682954	0.0003

R-squared	0.792863	Mean dependent var	0.021164
Adjusted R-squared	0.791756	S.D. dependent var	7.266187
S.E. of regression	3.315838	Akaike info criterion	5.245823
Sum squared resid	2056.024	Schwarz criterion	5.280128
Log likelihood	-493.7303	Hannan-Quinn criter.	5.259721
Durbin-Watson stat	2.041964		

Null Hypothesis: PRODUCTION has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.288063	0.0168
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRODUCTION)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PRODUCTION(-1)	-0.104703	0.031843	-3.288063	0.0012
D(PRODUCTION(-1))	-0.215603	0.069907	-3.084153	0.0024
C	35677.26	10790.76	3.306280	0.0011

R-squared	0.117680	Mean dependent var	1559.258
Adjusted R-squared	0.108243	S.D. dependent var	49212.02
S.E. of regression	46472.33	Akaike info criterion	24.34677
Sum squared resid	4.04E+11	Schwarz criterion	24.39803
Log likelihood	-2309.943	Hannan-Quinn criter.	24.36753
F-statistic	12.47059	Durbin-Watson stat	2.083292
Prob(F-statistic)	0.000008		

Null Hypothesis: PRODUCTION has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.623946	0.0304
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRODUCTION)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PRODUCTION(-1)	-0.157440	0.043444	-3.623946	0.0004
D(PRODUCTION(-1))	-0.185536	0.071549	-2.593146	0.0103
C	38272.23	10828.84	3.534288	0.0005
@TREND(2000M01)	148.8759	83.97619	1.772835	0.0779

R-squared	0.132341	Mean dependent var	1559.258
Adjusted R-squared	0.118347	S.D. dependent var	49212.02
S.E. of regression	46208.32	Akaike info criterion	24.34054
Sum squared resid	3.97E+11	Schwarz criterion	24.40889
Log likelihood	-2308.351	Hannan-Quinn criter.	24.36823
F-statistic	9.456648	Durbin-Watson stat	2.062096
Prob(F-statistic)	0.000008		

Null Hypothesis: PRODUCTION has a unit root
Exogenous: None
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.242107	0.5979
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRODUCTION)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PRODUCTION(-1)	-0.002442	0.010087	-0.242107	0.8090
D(PRODUCTION(-1))	-0.307691	0.072178	-4.262965	0.0000
D(PRODUCTION(-2))	-0.203389	0.071991	-2.825193	0.0052

R-squared	0.104577	Mean dependent var	1541.466
Adjusted R-squared	0.094949	S.D. dependent var	49342.12
S.E. of regression	46941.21	Akaike info criterion	24.36693
Sum squared resid	4.10E+11	Schwarz criterion	24.41838
Log likelihood	-2299.674	Hannan-Quinn criter.	24.38777
Durbin-Watson stat	2.074216		

Null Hypothesis: D(PRODUCTION) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.34234	0.0000
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRODUCTION,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PRODUCTION(-1))	-1.518641	0.113821	-13.34234	0.0000
D(PRODUCTION(-1),2)	0.206944	0.071749	2.884266	0.0044
C	2382.493	3415.572	0.697539	0.4863

R-squared	0.644965	Mean dependent var	-60.86772
Adjusted R-squared	0.641147	S.D. dependent var	78270.34
S.E. of regression	46887.32	Akaike info criterion	24.36463
Sum squared resid	4.09E+11	Schwarz criterion	24.41608
Log likelihood	-2299.457	Hannan-Quinn criter.	24.38547
F-statistic	168.9458	Durbin-Watson stat	2.077180
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PRODUCTION) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.40344	0.0000
Test critical values:	1% level	-4.007347	
	5% level	-3.433778	
	10% level	-3.140772	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRODUCTION,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PRODUCTION(-1))	-1.529696	0.114127	-13.40344	0.0000
D(PRODUCTION(-1),2)	0.212432	0.071845	2.956806	0.0035
C	9397.139	6985.793	1.345179	0.1802
@TREND(2000M01)	-72.13060	62.67945	-1.150786	0.2513

R-squared	0.647488	Mean dependent var	-60.86772
Adjusted R-squared	0.641772	S.D. dependent var	78270.34
S.E. of regression	46846.50	Akaike info criterion	24.36808
Sum squared resid	4.06E+11	Schwarz criterion	24.43669
Log likelihood	-2298.783	Hannan-Quinn criter.	24.39587
F-statistic	113.2684	Durbin-Watson stat	2.083002
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PRODUCTION) has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.34245	0.0000
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PRODUCTION,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PRODUCTION(-1))	-1.514338	0.113498	-13.34245	0.0000
D(PRODUCTION(-1),2)	0.204773	0.071583	2.860631	0.0047

R-squared	0.644036	Mean dependent var	-60.86772
Adjusted R-squared	0.642132	S.D. dependent var	78270.34
S.E. of regression	46822.91	Akaike info criterion	24.35666
Sum squared resid	4.10E+11	Schwarz criterion	24.39096
Log likelihood	-2299.704	Hannan-Quinn criter.	24.37056
Durbin-Watson stat	2.075209		

Null Hypothesis: REER has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.172001	0.6864
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REER(-1)	-0.012731	0.010863	-1.172001	0.2427
D(REER(-1))	0.235926	0.073390	3.214676	0.0015
D(REER(-2))	-0.029084	0.073594	-0.395190	0.6932
C	1.239427	1.022412	1.212257	0.2270

R-squared	0.057614	Mean dependent var	0.057513
Adjusted R-squared	0.042333	S.D. dependent var	1.314003
S.E. of regression	1.285890	Akaike info criterion	3.361716
Sum squared resid	305.8998	Schwarz criterion	3.430324
Log likelihood	-313.6821	Hannan-Quinn criter.	3.389511
F-statistic	3.770107	Durbin-Watson stat	2.007590
Prob(F-statistic)	0.011685		

Null Hypothesis: REER has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 11 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.692717	0.2410
Test critical values:	1% level	-4.009849	
	5% level	-3.434984	
	10% level	-3.141481	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER)
Method: Least Squares
Sample (adjusted): 2001M01 2015M12
Included observations: 180 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REER(-1)	-0.095288	0.035387	-2.692717	0.0078
D(REER(-1))	0.266806	0.078634	3.392990	0.0009
D(REER(-2))	0.050795	0.080961	0.627406	0.5313
D(REER(-3))	-0.131789	0.080008	-1.647198	0.1014
D(REER(-4))	0.111508	0.079983	1.394151	0.1651
D(REER(-5))	0.031498	0.080784	0.389908	0.6971
D(REER(-6))	-0.021724	0.079965	-0.271668	0.7862
D(REER(-7))	0.099955	0.079967	1.249947	0.2131
D(REER(-8))	-0.008491	0.082178	-0.103323	0.9178
D(REER(-9))	-0.006044	0.080240	-0.075327	0.9400
D(REER(-10))	0.009451	0.080268	0.117746	0.9064
D(REER(-11))	0.067290	0.078697	0.855060	0.3938
C	7.632458	2.777590	2.747870	0.0067
@TREND(2000M01)	0.013743	0.005696	2.412974	0.0169

R-squared	0.121177	Mean dependent var	0.102833
Adjusted R-squared	0.052354	S.D. dependent var	1.318892
S.E. of regression	1.283904	Akaike info criterion	3.412274
Sum squared resid	273.6359	Schwarz criterion	3.660615
Log likelihood	-293.1047	Hannan-Quinn criter.	3.512966
F-statistic	1.760697	Durbin-Watson stat	2.005671
Prob(F-statistic)	0.053227		

Null Hypothesis: REER has a unit root
Exogenous: None
Lag Length: 8 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.784987	0.8817
Test critical values:	1% level	-2.577660	
	5% level	-1.942574	
	10% level	-1.615547	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER)
Method: Least Squares
Sample (adjusted): 2000M10 2015M12
Included observations: 183 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REER(-1)	0.000809	0.001031	0.784987	0.4335
D(REER(-1))	0.229006	0.075445	3.035408	0.0028
D(REER(-2))	-0.015768	0.077310	-0.203955	0.8386
D(REER(-3))	-0.182729	0.076996	-2.373233	0.0187
D(REER(-4))	0.081003	0.078090	1.037308	0.3010
D(REER(-5))	-0.020682	0.078749	-0.262629	0.7931
D(REER(-6))	-0.053555	0.077311	-0.692727	0.4894
D(REER(-7))	0.073199	0.077516	0.944302	0.3463
D(REER(-8))	-0.066970	0.077793	-0.860876	0.3905

R-squared	0.082056	Mean dependent var	0.090656
Adjusted R-squared	0.039851	S.D. dependent var	1.319708
S.E. of regression	1.293145	Akaike info criterion	3.399961
Sum squared resid	290.9668	Schwarz criterion	3.557804
Log likelihood	-302.0964	Hannan-Quinn criter.	3.463943
Durbin-Watson stat	2.011947		

Null Hypothesis: D(REER) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.829602	0.0000
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REER(-1))	-0.807390	0.091441	-8.829602	0.0000
D(REER(-1),2)	0.037869	0.073285	0.516742	0.6059
C	0.046200	0.093787	0.492607	0.6229

R-squared	0.389526	Mean dependent var	-0.001481
Adjusted R-squared	0.382961	S.D. dependent var	1.638639
S.E. of regression	1.287180	Akaike info criterion	3.358531
Sum squared resid	308.1710	Schwarz criterion	3.409987
Log likelihood	-314.3812	Hannan-Quinn criter.	3.379377
F-statistic	59.34053	Durbin-Watson stat	2.009826
Prob(F-statistic)	0.000000		

Null Hypothesis: D(REER) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.809310	0.0000
Test critical values:	1% level	-4.007347	
	5% level	-3.433778	
	10% level	-3.140772	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REER(-1))	-0.808156	0.091739	-8.809310	0.0000
D(REER(-1),2)	0.038172	0.073485	0.519452	0.6041
C	0.008695	0.191481	0.045412	0.9638
@TREND(2000M01)	0.000387	0.001722	0.224844	0.8223

R-squared	0.389692	Mean dependent var	-0.001481
Adjusted R-squared	0.379795	S.D. dependent var	1.638639
S.E. of regression	1.290478	Akaike info criterion	3.368840
Sum squared resid	308.0868	Schwarz criterion	3.437448
Log likelihood	-314.3554	Hannan-Quinn criter.	3.396635
F-statistic	39.37527	Durbin-Watson stat	2.009541
Prob(F-statistic)	0.000000		

Null Hypothesis: D(REER) has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.833781	0.0000
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(REER,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(REER(-1))	-0.804770	0.091101	-8.833781	0.0000
D(REER(-1),2)	0.036537	0.073087	0.499919	0.6177

R-squared	0.388729	Mean dependent var	-0.001481
Adjusted R-squared	0.385460	S.D. dependent var	1.638639
S.E. of regression	1.284571	Akaike info criterion	3.349253
Sum squared resid	308.5731	Schwarz criterion	3.383557
Log likelihood	-314.5044	Hannan-Quinn criter.	3.363150
Durbin-Watson stat	2.009384		

Null Hypothesis: TOT has a unit root
Exogenous: Constant
Lag Length: 7 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.923933	0.7789
Test critical values:	1% level	-3.465977	
	5% level	-2.877099	
	10% level	-2.575143	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT)
Method: Least Squares
Sample (adjusted): 2000M09 2015M12
Included observations: 184 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TOT(-1)	-0.022883	0.024767	-0.923933	0.3568
D(TOT(-1))	0.232435	0.077635	2.993948	0.0032
D(TOT(-2))	0.005831	0.077763	0.074989	0.9403
D(TOT(-3))	0.124371	0.077066	1.613820	0.1084
D(TOT(-4))	0.026881	0.077450	0.347078	0.7289
D(TOT(-5))	0.106868	0.077411	1.380534	0.1692
D(TOT(-6))	-0.152060	0.077432	-1.963778	0.0511
D(TOT(-7))	0.060588	0.077153	0.785294	0.4333
C	2.393179	2.544497	0.940531	0.3482

R-squared	0.087899	Mean dependent var	0.055217
Adjusted R-squared	0.046203	S.D. dependent var	0.926991
S.E. of regression	0.905323	Akaike info criterion	2.686627
Sum squared resid	143.4317	Schwarz criterion	2.843879
Log likelihood	-238.1697	Hannan-Quinn criter.	2.750363
F-statistic	2.108083	Durbin-Watson stat	2.003007
Prob(F-statistic)	0.037338		

Null Hypothesis: TOT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.958471	0.6196
Test critical values:	1% level	-4.007613	
	5% level	-3.433906	
	10% level	-3.140847	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT)
Method: Least Squares
Sample (adjusted): 2000M05 2015M12
Included observations: 188 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TOT(-1)	-0.041773	0.021329	-1.958471	0.0517
D(TOT(-1))	0.203215	0.074110	2.742052	0.0067
D(TOT(-2))	0.012444	0.075177	0.165530	0.8687
D(TOT(-3))	0.112130	0.074113	1.512966	0.1320
C	3.999747	2.172348	1.841209	0.0672
@TREND(2000M01)	0.003347	0.001285	2.604862	0.0100

R-squared	0.104712	Mean dependent var	0.034415
Adjusted R-squared	0.080117	S.D. dependent var	0.930177
S.E. of regression	0.892138	Akaike info criterion	2.641003
Sum squared resid	144.8558	Schwarz criterion	2.744294
Log likelihood	-242.2543	Hannan-Quinn criter.	2.682853
F-statistic	4.257327	Durbin-Watson stat	1.992027
Prob(F-statistic)	0.001100		

Null Hypothesis: TOT has a unit root
Exogenous: None
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.373786	0.7913
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TOT(-1)	0.000240	0.000643	0.373786	0.7090
D(TOT(-1))	0.217959	0.073310	2.973131	0.0033
D(TOT(-2))	0.033240	0.073190	0.454155	0.6502

R-squared	0.050885	Mean dependent var	0.031481
Adjusted R-squared	0.040679	S.D. dependent var	0.928576
S.E. of regression	0.909493	Akaike info criterion	2.663888
Sum squared resid	153.8551	Schwarz criterion	2.715344
Log likelihood	-248.7374	Hannan-Quinn criter.	2.684734
Durbin-Watson stat	2.001450		

Null Hypothesis: D(TOT) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.080306	0.0000
Test critical values:	1% level	-3.465014	
	5% level	-2.876677	
	10% level	-2.574917	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TOT(-1))	-0.748559	0.092640	-8.080306	0.0000
D(TOT(-1),2)	-0.033386	0.073174	-0.456256	0.6487
C	0.027059	0.066172	0.408926	0.6831

R-squared	0.385605	Mean dependent var	0.014021
Adjusted R-squared	0.378998	S.D. dependent var	1.154040
S.E. of regression	0.909426	Akaike info criterion	2.663740
Sum squared resid	153.8324	Schwarz criterion	2.715196
Log likelihood	-248.7234	Hannan-Quinn criter.	2.684586
F-statistic	58.36832	Durbin-Watson stat	2.001491
Prob(F-statistic)	0.000000		

Null Hypothesis: D(TOT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.577350	0.0000
Test critical values:	1% level	-4.007613	
	5% level	-3.433906	
	10% level	-3.140847	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT,2)
Method: Least Squares
Sample (adjusted): 2000M05 2015M12
Included observations: 188 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TOT(-1))	-0.739705	0.112463	-6.577350	0.0000
D(TOT(-1),2)	-0.077060	0.095914	-0.803436	0.4228
D(TOT(-2),2)	-0.082951	0.073160	-1.133827	0.2584
C	-0.246113	0.139291	-1.766901	0.0789
@TREND(2000M01)	0.002821	0.001266	2.227706	0.0271

R-squared	0.408813	Mean dependent var	0.011702
Adjusted R-squared	0.395891	S.D. dependent var	1.156680
S.E. of regression	0.899024	Akaike info criterion	2.651221
Sum squared resid	147.9086	Schwarz criterion	2.737297
Log likelihood	-244.2148	Hannan-Quinn criter.	2.686096
F-statistic	31.63665	Durbin-Watson stat	1.992244
Prob(F-statistic)	0.000000		

Null Hypothesis: D(TOT) has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.090619	0.0000
Test critical values:	1% level	-2.577255	
	5% level	-1.942517	
	10% level	-1.615583	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TOT,2)
Method: Least Squares
Sample (adjusted): 2000M04 2015M12
Included observations: 189 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TOT(-1))	-0.747608	0.092404	-8.090619	0.0000
D(TOT(-1),2)	-0.033880	0.073001	-0.464098	0.6431

R-squared	0.385052	Mean dependent var	0.014021
Adjusted R-squared	0.381764	S.D. dependent var	1.154040
S.E. of regression	0.907399	Akaike info criterion	2.654056
Sum squared resid	153.9707	Schwarz criterion	2.688361
Log likelihood	-248.8083	Hannan-Quinn criter.	2.667954
Durbin-Watson stat	2.000705		

Null Hypothesis: WORLDGDP has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.678732	0.0796
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLDGDP)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORLDGDP(-1)	-0.070425	0.026290	-2.678732	0.0080
D(WORLDGDP(-1))	0.032742	0.072845	0.449480	0.6536
C	0.207337	0.085053	2.437748	0.0157

R-squared	0.036955	Mean dependent var	-0.009842
Adjusted R-squared	0.026655	S.D. dependent var	0.358879
S.E. of regression	0.354064	Akaike info criterion	0.776984
Sum squared resid	23.44252	Schwarz criterion	0.828252
Log likelihood	-70.81344	Hannan-Quinn criter.	0.797752
F-statistic	3.587858	Durbin-Watson stat	2.002590
Prob(F-statistic)	0.029578		

Null Hypothesis: WORLDGDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.704766	0.2360
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLDGDP)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORLDGDP(-1)	-0.073745	0.027265	-2.704766	0.0075
D(WORLDGDP(-1))	0.034890	0.073138	0.477040	0.6339
C	0.239746	0.109371	2.192037	0.0296
@TREND(2000M01)	-0.000230	0.000486	-0.472837	0.6369

R-squared	0.038111	Mean dependent var	-0.009842
Adjusted R-squared	0.022597	S.D. dependent var	0.358879
S.E. of regression	0.354801	Akaike info criterion	0.786309
Sum squared resid	23.41438	Schwarz criterion	0.854667
Log likelihood	-70.69932	Hannan-Quinn criter.	0.814000
F-statistic	2.456499	Durbin-Watson stat	2.002798
Prob(F-statistic)	0.064440		

Null Hypothesis: WORLDGDP has a unit root
Exogenous: None
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.159553	0.2242
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLDGDP)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORLDGDP(-1)	-0.009330	0.008047	-1.159553	0.2477
D(WORLDGDP(-1))	0.002229	0.072699	0.030665	0.9756

R-squared	0.006350	Mean dependent var	-0.009842
Adjusted R-squared	0.001065	S.D. dependent var	0.358879
S.E. of regression	0.358688	Akaike info criterion	0.797741
Sum squared resid	24.18750	Schwarz criterion	0.831921
Log likelihood	-73.78544	Hannan-Quinn criter.	0.811587
Durbin-Watson stat	2.000056		

Null Hypothesis: D(WORLDGDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.72168	0.0000
Test critical values:	1% level	-3.464827	
	5% level	-2.876595	
	10% level	-2.574874	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLDGDP,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WORLDGDP(-1))	-1.000756	0.072932	-13.72168	0.0000
C	-0.009850	0.026115	-0.377163	0.7065

R-squared	0.500378	Mean dependent var	-6.04E-18
Adjusted R-squared	0.497720	S.D. dependent var	0.507723
S.E. of regression	0.359832	Akaike info criterion	0.804112
Sum squared resid	24.34207	Schwarz criterion	0.838291
Log likelihood	-74.39060	Hannan-Quinn criter.	0.817957
F-statistic	188.2845	Durbin-Watson stat	2.000001
Prob(F-statistic)	0.000000		

Null Hypothesis: D(WORLDGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.68893	0.0000
Test critical values:	1% level	-4.007084	
	5% level	-3.433651	
	10% level	-3.140697	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLDGDP,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WORLDGDP(-1))	-1.001025	0.073127	-13.68893	0.0000
C	-0.020341	0.052984	-0.383908	0.7015
@TREND(2000M01)	0.000109	0.000477	0.227759	0.8201

R-squared	0.500517	Mean dependent var	-6.04E-18
Adjusted R-squared	0.495175	S.D. dependent var	0.507723
S.E. of regression	0.360743	Akaike info criterion	0.814361
Sum squared resid	24.33531	Schwarz criterion	0.865629
Log likelihood	-74.36425	Hannan-Quinn criter.	0.835129
F-statistic	93.69341	Durbin-Watson stat	2.000019
Prob(F-statistic)	0.000000		

Null Hypothesis: D(WORLDGDP) has a unit root
Exogenous: None
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.74773	0.0000
Test critical values:	1% level	-2.577190	
	5% level	-1.942508	
	10% level	-1.615589	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLDGDP,2)
Method: Least Squares
Sample (adjusted): 2000M03 2015M12
Included observations: 190 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WORLDGDP(-1))	-1.000000	0.072739	-13.74773	0.0000

R-squared	0.500000	Mean dependent var	-6.04E-18
Adjusted R-squared	0.500000	S.D. dependent var	0.507723
S.E. of regression	0.359015	Akaike info criterion	0.794342
Sum squared resid	24.36048	Schwarz criterion	0.811431
Log likelihood	-74.46245	Hannan-Quinn criter.	0.801264
Durbin-Watson stat	2.000000		