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The Role of Innovation on Thailand's Vehicle Export Value

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Abstract
The purpose of this report is to study the role of innovation on vehicle export value in Thailand during 2000-2015. The innovation is measured by the number of patents related to the automobile industry. The control variables include inflation rate, interest rate, production number, real effective exchange rate, terms of trade, world GDP growth, and oil price. The study found significant positive impacts of patents granted on Thailand's vehicle export value implying the impact of innovation to the export value. The findings of this study would be helpful for export policymakers to obtain enhanced levels of economic development and growth of the country. The governments should encourage the 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. Moreover, 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 the new technology.

Keywords: Innovation, Patents granted, Export Value, Vehicle Export, Thailand

1. Introduction

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. Therefore, it is a fundamental key in determining Thai economic growth. In the past, Thailand was a major exporter of agricultural products in the world, especially rice and rubber. However, as of 2015, Thailand's top three export products were automotive parts and accessories for 863,828.36 million baht, computer equipment and components for 595,418.55 million baht, and jewelry for 371,071.62 million baht (Statistics of Department of International Trade Promotion Ministry of Commerce, 2016).

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

This study aims to examine the impact of innovation capability on Thailand's vehicle export value. The innovation capability factor is measured by the number of patents granted in the vehicle industry. The control variables include the exchange rate, inflation rate, interest rate, the price of complementary goods for exported products, and world economic condition.

2. Previous Studies on Innovation and Export Determinants

The importance of international trade theories to a nation's economic welfare and development has been in the economics literature and the most famous theories are about the exports of surplus (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). The export growth is critical for the 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 explained by the 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). The Theory of Absolute Advantage (Smith, 1776), Theory of Comparative Advantage (Ricardo, 1817), and Heckscher-Ohlin Theory (Heckscher, 1919; Ohlin, 1933) focused on productivity, relative productivity and factor endowments, such as differences of labor, land, or capital respectively.

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 (Vernon, 1966; Krugman, 1979) is an extension of conventional technology-based models.

The innovation process can be affected by the role of government. Mahmood and Rufin (2005) proposed that the role of government on innovation process depends on the stage of technology development. In the early stage of development, the government should centralize its control. However, in the later stage of technology development, the government should promote economic freedom and promote the collaboration among business groups.

Yi, Wang, and Kafouros (2013) studied the effects of innovative capabilities on export performance, and patents to proxy R&D output used to measure innovation capabilities by the number of patents. The result has shown a positive and significant moderating effect on the relationship between innovative capabilities and export performance. Frietsch, Jung, Neuhaeusler, and Van Looy (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.

Ussahawanitchakit (2007) examined the role of innovation capability on Thailand's textile export and found that innovation capability has the positive impact on the export performance of the textile industry. Therefore, the major research hypothesis of this paper is "The innovation capability in vehicle industry can lead to the higher export value." The innovation capability in vehicle industry is proxied by the number of patents granted.

The control variables in this study include other factors generally affect the export value include exchange rate, inflation rate, interest rate, the price of complementary goods for exported products, and world economic condition. 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.

Nyeadi, Atiga, and Atogenzoya (2014) studied about the export growth in Ghana and the result showed that the coefficient of inflation is positively significant with export goods and services. 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.

Belenkiy and Osborne (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%. 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 the currency.

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 Namibia. There are many factors that determine the economic growth, and the terms of trade is one of them. 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.

3. Data and Methodology

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 the data was obtained from the Bank of Thailand.

The innovation capability is proxied by the number of patents granted for vehicle components and manufacturing processes obtained from The Department of Intellectual Property. The monthly macroeconomic factors included interest rate (MLR or Minimum Lending Rate), real effective exchange rate, and terms of trade. These variables were obtained from the Bank of Thailand. In addition, the annual growth rate of world GDP was from the World Bank. The related-industry factor in this paper was the oil price measured by monthly average Crude Oil Prices: West Texas Intermediate (WTI). The monthly production data were obtained from the Office of Industrial Economics Thailand. The summary of data collection is reported in Table 1.

For research methodology, this research used the OLS multiple regression analysis to identify the determinants of vehicle exports value. The multiple regression is used to examine the impact of various independent variables on the dependent variable. The simple regression analysis can be used to examine the impact of one independent variable on the dependent variable, but it is not appropriate because there are other factors affecting the export value. Ignoring those variables could result in the omitted variable problem. The more advanced statistical models like two-stage least square, seemingly unrelated regression, or simultaneous equations model can be used for the model with more than one regression equations examined simultaneously. However, this study focuses on only the impact of innovation capability and other control variables on the export value. The OLS multiple regression analysis is sufficient to examine such research hypotheses.

In this study, the dependent variable is the export value. The independent variables are the number of patents granted which is the major variable in this study and other control variables including exchange rate, inflation rate, interest rate, the price of complementary goods for exported products, and world economic condition. This analysis is based on time series data from January 2000 to December 2015, which are totally 192 months. The multiple linear regression equation is as follows.

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

Where $ExportVal_t$ = Export value in month t
$PATENTS_t$ = 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_t = 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

Table 1: Summary of Data Collection

Data	Data source
Patents	The Department of Intellectual Property (DIP).
Real Effective Exchange Rate	Bank of Thailand.
Inflation Rate	Bank of Thailand
Interest Rate MLR	Bank of Thailand
Terms of trade	Bank of Thailand
World GDP	World Bank
Exports value of vehicles	Bank of Thailand
Oil Price	Crude Oil Prices: West Texas Intermediate (WTI)
Production	Office of Industrial Economics

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 the 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. Dickey and Fuller (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. The test equation is as follows.

$$\Delta Y_t = Y_t - Y_{t-1} = \alpha + \beta_t + \gamma\, Y_{t-1} + \sum_{i=1}^{p} \left(\overset{\delta}{i}\ \Delta Y_{t-i}\right) + \varepsilon_t, \qquad (2)$$

where α is an intercept or constant term (drift term). β is the coefficient on time and γ is the coefficient presenting process root. ρ is the lag order of the first-difference autoregressive process and ε_t is an error term. This test that tells whether the variable has unit root or not is represented by $\gamma = 0$ 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.

4. Analysis and Result

Figure 1 reports Thailand's transport vehicle domestic sales and export during 1996-2015. Thailand's automotive exports have increased continuously until the year 2008. After the 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.

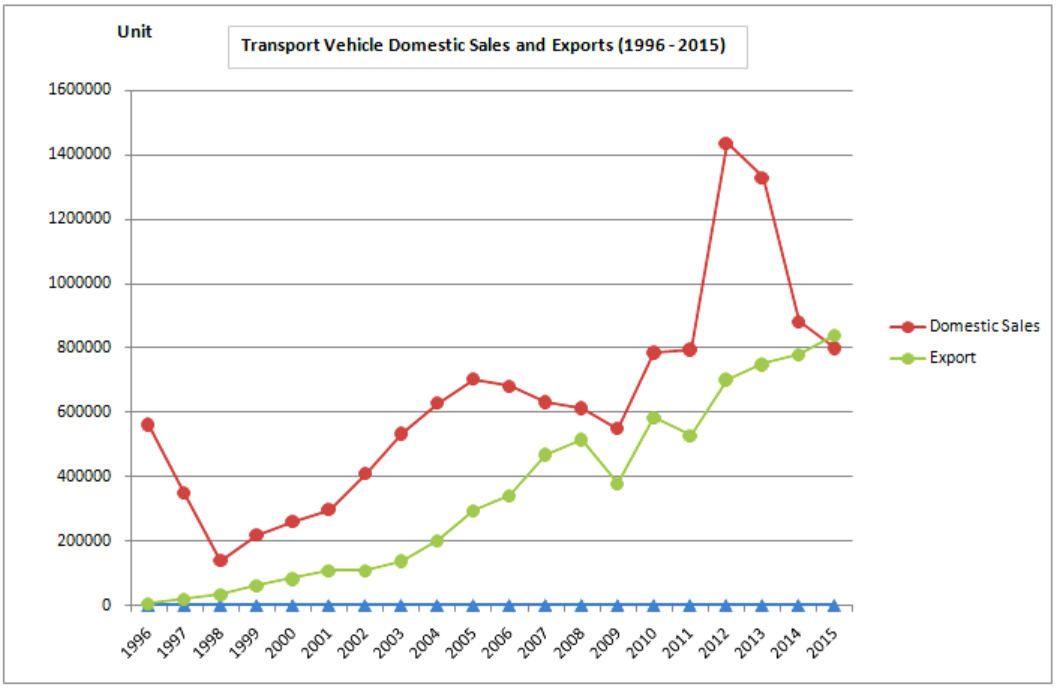

Figure 1: Thailand's Transport vehicle domestic sales and exports
Source: Thailand Automotive Institute

Table 2 reports the number of patents and patent application during 2000-2015. The total number of applied patents is 3,307 patents. Among these, there are 1,025 patents have been already granted and 2,282 patents are under the examination process. For all number of applied patents, the largest number of granted patents are the patents about vehicles parts which are 402 patents. The second largest number of granted patents are about mounting of propulsion units or of transmissions in vehicles which are 136 patents.

Table 2: Granted patents and Patent applications (during examination patent process)

Items	Granted	In Process	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
Signaling 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 tires	85	419	504
Vehicle wheels	33	98	131
Vehicles adapted for load transportation	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

Table 3 reports the descriptive statistics of all variables including mean, standard deviation (S.D.), minimum, maximum, and skewness. The production and export value have high dispersion with the mean of 321,048.50 unit and 1,375.31 million USD and the standard deviation of 109,521.50 unit and 905.17 million USD respectively. Therefore, they have high variability which indicates that there are probably enormous differences among individual observations. 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. In the other hand, the inflation rate, terms of trade, world GDP, oil price, patents, and export value show positive skewness, which indicates that the tail on the right side is fatter than the left side. Thus, the variables are rightly asymmetric.

Table 3: Descriptive statistics

Variables	Mean	S.D.	Minimum	Maximum	Skewness
EXPORTVAL (million USD)	1,375.31	905.17	190.25	3,151.34	0.28
PATENT (Unit)	4.47	5.06	0.005	20.00	0.82
IFR (%)	1.24	0.73	0.20	2.40	0.26
IMLR (%)	7.05	0.73	5.75	8.50	-0.22
REER	93.79	8.66	80.09	111.70	-0.09
TOT (USD)	103.10	3.62	96.73	117.06	1.22
GDP (%)	3.08	0.99	1.72	4.46	0.23
OIL (USD)	63.70	28.52	19.39	133.88	0.19
PRODUCTION (Units)	321,048.50	109,521.50	26,919.00	510,437.00	-0.68

Table 4 reports the correlation coefficient among explanatory variables. The result clearly shows that none of the explanatory (independent) variables' coefficients are higher than 0.8. The coefficient higher than 0.8 indicates near multicollinearity problem whereas those equal to 1 indicates perfect multicollinearity problem (Taoulaou & Burchuladze, 2014). This can be concluded that there is no multicollinearity problem among explanatory variables

Table 4: Correlation Coefficients

	IFR	IMLR	PROD	REER	TOT	GDP	OIL	PATENT
IFR	1	0.4421	0.3313	0.4854	-0.0640	0.0664	0.5888	0.3007
IMLR	0.4421	1	-0.3370	0.1924	-0.1138	-0.1209	0.0127	0.0371
PROD	0.3313	-0.3370	1	0.4843	-0.1413	-0.0028	0.6815	0.4642
REER	0.4854	0.1924	0.4843	1	0.2606	-0.1547	0.7748	0.6091
TOT	-0.0640	-0.1138	-0.1413	0.2606	1	0.2806	-0.0682	0.0217
GDP	0.0664	-0.1209	-0.0028	-0.1547	0.2806	1	-0.0052	-0.2090
OIL	0.5888	0.0127	0.6815	0.7748	-0.0682	-0.0052	1	0.5303
PATENT	0.3007	0.0371	0.4642	0.6091	0.0217	-0.2090	0.5303	1

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 is without the intercept term and trend term, with the intercept term and trend term, and with the intercept term but without the trend term. The procedure was to choose lag length by Automatic based on SIC, MAXLAG=12 base on time series, using the monthly data. There are two non-stationary variables which are export value and production. Therefore, the log transformation has been used for export value and production before further analysis.

Table 5 reports the result of multiple regression analysis for various factors including the number of patents as the proxy of innovation on the export value. The standard errors have been adjusted using heteroskedastic and autocorrelation consistent (HAC) standard error proposed by Newey and West (1987).

Table 5: Regression Analysis of Number of Patents on Export Value

Variables	Coefficient	t-Statistic	p-value
Constant	-4.2090	-2.0572	0.0411
PATENT	0.0897	9.7163	0.0000
IFR	0.0008	0.0075	0.9940
IMLR	0.3757	1.7311	0.0851
REER	1.6591	0.7903	0.4303
TOT	4.7091	1.2643	0.2077
GDP	0.0250	0.2757	0.7831
OIL	-0.0624	-0.1463	0.8838
PRODUCTION	0.8532	5.2363	0.0000

From Table 5, the patent has the significant impact on export value, $\beta = 0.0897$, $t(182) = 9.71$, $p < 0.001$. This means there is a positive relationship between the number of patents and the export value of vehicles and implies the role of innovation on the export of vehicles. The higher level of innovation related to vehicle production measured by more number of patents has resulted in the higher export value of vehicles. This result is consistent with the finding of Yi et al. (2013). The patent granted is an indicator of innovation capability which is always beneficial for exports by developing and testing the product before production, the increase of patents leading to significant growth in the exports of high tech products.

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, the 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 the reference is an indicator of Innovation lag; therefore, an examination the one-year lag of patent is used, and the result is reported in table 6.

The result in table 6 is qualitatively similar to the result in table 5. The lag number of patents has the positive relationship with the export value of vehicles.

Table 6: Regression Analysis of Lag Number of Patents on Export Value

Variables	Coefficient	t-Statistic	t-Statistic
Constant	-4.7883	-2.2463	0.0259
LAGPATENT	0.0895	9.9726	0.0000
IFR	0.0876	1.0666	0.2875
IMLR	0.3992	1.9924	0.0478
REER	-1.2969	-0.6304	0.5292
TOT	1.7665	0.5327	0.5949
GDP	0.1064	1.5538	0.1219
OIL	-0.1466	-0.3878	0.6986
PRODUCTION	0.8999	5.3028	0.0000

From Table 6, the lagged patent has the significant impact on export value, $\beta = 0.0895$, $t(182) = 9.97$, $p < 0.001$. Therefore, this 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, the product innovation has appeared to affect the export performance as it displays a positive significant impact on Thailand's vehicle export. Therefore, the innovation can play a significant role in promoting the export growth in the future.

5. Conclusion

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 multiple regression analysis shows 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. 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. The governments should encourage the 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 also 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 the 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 technology improvement in production can promote efficiency and leads to the export growth.

Reference

Belenkiy, M. & Osborne, S. (2012). The effect of changes in world crude oil prices on U.S. automobile exports. *International Journal of Energy Economics and Policy, 2* (3), 147-159.

Berthou, A. (2008). An investigation on the effect of real exchange rate movements on OECD bilateral exports. *Working Paper Series No. 920*.

Bradley, F. (1991). *International Marketing Strategy*, Prentice-Hall International, London.

Coutts K. & Godley W. (1992). Does Britain's balance of payments matter any more? In Michie J. (ed.), The Economic Legacy 1979–1992 (London: Academic Press), 60–67.

Dickey, D. A. & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74* (366), 427–431.

Frietsch, R., Jung, T., Neuhaeusler, P., & Van Looy, B. (2014). Patent indicators for macroeconomic growth the value of patents estimated by export volume. *Journal Technovation, 34*, 546-558.

Furman, J. and Stiglitz J. E. (1998). Economic crises: Evidence and insights from East Asia, *Brooking Papers on Economic Activity No. 2*, Brooking Institution,Washington D.C.

Gylfason, T., Herbertsson, T., & Zoega, G. (1997). A mixed blessing: Natural resources and economic growth. *CEPR Discussion Papers No. 1668*.

Heckscher, E. (1919). The effect of foreign trade on the distribution of income. *Ekonomisk Tidskriff*, 497–512. Translated as chapter 13 in American Economic Association, *Readings in the Theory of International Trade*, Philadelphia: Blakiston, 1949, 272–300.

Kalumbu. S. A. (2014). Terms of trade and economic growth in Namibia. *International Review of Research in Emerging Markets and the Global Economy, 1* (3), 90-101.

Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics, 9* (4), 469-479.

Mahmood, I. P. & Rufin, C. (2005). Government's dilemma: the role of government in imitation and innovation. *Academy of Management Review, 30* (2), 338-360.

Mashayekhi, M. (2013). Impact of the global slowdown on India’s exports and employment. *United Nations Conference on Trade and Development*.

Newey, W. K. & West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica, 55* (3), 703-708.

Ohlin, B. (1933). *Interregional and International Trade*. Cambridge, Mass.: Harvard University Press, 1966.

Ricardo, D. (1817). Principles of political economy in Saffra, P. (Ed.) (1951), Th*e Works and Correspondence of David Ricardo*, Vol. 1, Cambridge University Press, London.

Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*, W. Strahan and T. Cadell, London.

Taoulaou, A. & Burchuladze, G. (2014). How do macroeconomic factors affect capital structure? The case of Swedish firms. *LUP Student Papers*.

Vernon, R. (1966). International investment and international trade in the product cycle. *Quarterly Journal of Economics, 80* (2), 190-207.

Ussahawanitchakit, P. (2007) Innovation capability and export performance: an empirical study of textile businesses in Thailand. *Journal of International Business Strategy, 7* (1), 1-9.

Yi, J., Wang, C., & Kafouros, M. (2013). The effects of innovative capabilities on exporting: Do institutional forces matter? *International Business Review, 22* (2), 392-406.