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Effect of International Trade and Labor Mobility on Income Distribution in Thailand: An Application of Non-Linear Distributed Lag Model

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Abstract

This research paper analyzes the impact of international trade and labor mobility on income distribution, using Thailand as a case study. In particular, the study tries to identify the econometric relationship between the Gini Index and lagged economic variables representing the degree of trade openness and labor mobility. The study used time series data and employed non-linear distributed lag multiple regression as a model to represent the relationship among variables. The significance of each factor was then tested using the Lagrange Multiplier Test (LM test). The results yielded from covariance analysis suggested that, in the long run, there exists a negative relationship between the Gini Index and exports, employment in the agricultural sector, and employment in the service sector. On the flip side, covariance analysis revealed a positive relationship between the Gini Index and imports and tariff rate.

Key words : International Trade; Labor Mobility; Gini Index; Income Distribution; Lagrange Multiplier Test; Distributed Lag Model

1. Introduction

The Association of Southeast Asian Nations (ASEAN) created the latest Framework Agreement, the ASEAN Concord II (also known as Bali Concord II), in 2003. The final goal of economic integration was to establish the ASEAN Economic Community (AEC) as outlined in ASEAN Vision 2015. With the population of 600 million in Southeast Asia, the AEC will soon become the largest economic integration in the developing world. Free mobility of goods, services, foreign direct investment, skilled labor, and capitals will likely take place within the region. The opportunity for the member countries to establish free trade agreements will occur both internally and externally. It is believed that every ASEAN member will mutually share the benefits. However, theoretically and empirically, there are many criticisms on free trade such as the infant industry argument (Sunderasan, 2011; Pugel, 2012; Sercovich & Teubal, 2013), the dying industry argument (Keenan *et al.*, 2004; Pugel, 2012), and the free-rider problem (Pugel

2012; Kleimann, 2014). A number of economic theories have been developed and used to explain the negative impact of international trade on income inequality.

Factor Endowments and the Heckcher-Ohlin Theorem (Heckscher, 1950; Milberg, 1996; Appleyard & Field, 2001) state that, in the short run, laborers, plots of land, and other inputs are tied to their current lines of production. The demands for these factors, and therefore the incomes or returns they earn, depend on the sector in which they are employed. Some people will enjoy higher demand for the factors they have to offer, because their factors are employed in the sector that is attempting to expand its production. However, in the long run, factors can move between sectors in response to differences in returns. Sellers of the same factor will eventually respond to the income gaps that have been opened up in the short run. Thus, the Stolper-Samuelson Theorem (1941) concludes that, in the long run, opening to trade splits a country into specific gainers and losers: it raises the real return to the factor used intensively in the rising-price industry but lowers the real return to the factor used intensively in the falling-price industry. The more a factor is specialized in the production of a product whose relative price is rising, the more this factor stands to gain from the change in the product price but vice versa for a falling price product (Stolper & Samuelson, 1941). After the countries engage in international trade and laborers are allowed to commute among different industries, regarding the theories, there are precisely specific gainers and losers in the long run.

A number of previous studies have been carried out to explain the negative impact of trade liberalization on income distribution. Xu (2003) developed a model with a continuum of goods, where the boundary between traded and non-traded goods is endogenous and determined by trade policy. The results demonstrated that trade liberalization by expanding a developing country's export set can increase wage inequality. Meschi and Vivarelli (2008) employed a dynamic specification to estimate the impact of trade on income equality within 65 developing countries. The results suggested that trade with high income countries worsen income distribution in developing countries, through both imports and exports. Additionally, Bergh and Nilsson (2010) concluded that freedom of trade internationally is robustly related to income inequality and reforms towards this economic freedom seem to increase inequality especially in rich countries.

Although the negative impact of international trade on income distribution is quite clear on theoretical side, a number of empirical evidences are surprisingly paradoxical. In the ASEAN arena, Nguyen (2002) indicated that, as Viet Nam followed a number of unilateral as well as multilateral moves to free the trading sector, the most fruitful impacts of trade liberalization was on the agricultural and labor-intensive sectors. In other words, trade liberalization directly contributes to the poverty reduction of Viet Nam. In addition, Carter (2007) represented estimates for a fixed-effects model of country-level Gini coefficients as a function of economic freedom along with relevant control variables: per capita income, political structure, education, demographics, and industrial composition. The results showed that economic freedom positively correlated with income inequality. In the Philippines, Cororaton (2005) analyzed the effects of trade liberalization (using tariff as a control variable) on poverty and income inequality using a CGE micro-simulation approach. The findings indicated that

tariff reduction results in poverty reduction in all areas not because of the improvement in household income, but because of the drop in consumer prices.

At this point, it is interesting to note that, to the best of the author's knowledge, there is no international economic literature explaining the effect of international trade and labor mobility on income distribution undertaken in Thailand especially. Therefore, this research paper aims to examine the relationship between the level of income gap (Gini Index) and independent lagged economic variables, which represent the degree of trade openness (such as exports, imports, and tariff rates) (Akapaiboon, 2010) and labor mobility (the amount of Thai labor in 3 main sectors: agriculture, industry, and service) (Xie & Shi, 1986; Kuijs & Wang, 2006). This paper hypothesizes that the greater degree of openness to trade and labor mobility will increase the country's level of income distribution. Using Thailand as a sample, this study employed non-linear (logistic) distributed lag model to examine this relationship. The model was tested using the Lagrange Multiplier Testing (LM testing) (Engle, 1983; Bera, 2001) and lastly interpreted the marginal effects of each determinant by Covariance Analysis. Taking the income distribution into account, economic gains and losses can be expressed more meaningfully, therefore, benefiting governments and private sectors in their future policy development.

2. Methodology

2.1 Model Specification and Data

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \ldots + \beta_i X_{t-i} + u_t \quad (1)$$

Ramanathan (2002) indicated that, in the above model (distributed lag model), only current (X_t) and lagged values of X ($X_{t-1}, \ldots, X_{t-i}$) are used to predict Y_t, where α is a constant and u_t is a residual. β_0 is known as the impact multiplier, which is the marginal effect of X on Y in the same time period. Using the same principle, β_i is the average increase in Y_t for a unit increase in X_{t-i}. β_i is known as the interim multiplier of order *i*.

Suppose the economy was in a steady state (long-run equilibrium) in which all the variables were constant over time. Denoting the long-run value with an asterisk, the steady-state relation becomes:

$$Y^* = \alpha + \beta_0 X^* + \beta_i X^* + \ldots + \beta_i X^* = \alpha + X^*(\beta_0 + \beta_1 + \ldots + \beta_i) \quad (2)$$

Noted that $u_t = 0$ in the steady state. This gives the cumulative effect over time as $\Delta Y^*/\Delta X^* = \beta_0 + \beta_1 + \ldots + \beta_i$, which is known as the long-run multiplier (Ramanathan, 2002; Verbeek, 2004)

In this study, the following general specification has been used to empirically examine the long run relationship between international trade and labor mobility and income inequality:

$$Gini^* = \alpha + \beta_0 Export^* + \beta_1 Import^* + \beta_2 Tariff^* + \beta_3 Agrigulture^* + \beta_4 Service^* + \beta_5 Industrial^* + u_t \quad (3)$$

where Gini represents the gini coefficient which measures inequality in the distribution of income in Economy. Ang (2010) used it for India and Shahbaz & Islam (2011) used it for Pakistan in the context of financial development and income inequality relationship. Export and Import value index captures the impact of trade openness on income inequality (Sehrawat & Giri, 2015). It is hypothesized that higher degree of trade openness positively correlates with income inequality. Although tariff rate also captures degree of trade openness (Appleyard & Field, 2001),

according to Cororaton (2005), tariff reduction is hypothesized to reduce income inequality. Different percentages of employment in Agricultural, Service, and Industrial sectors in Thailand signify labor mobility (Xie & Shi, 1986; Kuijs & Wang, 2006). Percentages of employment in different sectors are hypothesized to correlate differently with income distribution.[1]

2.2 The Lagrange multiplier Test

The Lagrange Multiplier Test was used to determine whether some or all stated economic independent variables are significant. The following list includes a number of quantitative dependent and independent variables required for the model (both current and lagged). Note that *t* refers to current and *n* refers to the number of lag. Only 2-period-lag was used. Due to the availability of the data set, the optimal lag length was estimated by Gretl software (Adkins, 2010). To increase the number of time periods in the model, the quarterly data was collected. Some missing data was added using the imputation from conditional distribution method (Kyureghian *et al.*, 2011) because it has the best rate of coverage.

Following Clarke *et al.* (2007) for non-linear specification in testing income inequality, $Gini_t$ was regressed against *a constant*, $Gini_{t-1}$, $Gini_{t-2}$, $Export_t$, $Export_{t-1}$, $Export_{t-2}$, $Import_t$, $Import_{t-1}$, $Import_{t-2}$, $Tariff_t$, $Tariff_{t-1}$, $Tariff_{t-2}$, $Agriculture_t$, $Agriculture_{t-1}$, $Agriculture_{t-2}$, $Service_t$, $Service_{t-1}$, $Service_{t-2}$, $Industrial_t$, $Industrial_{t-1}$, and $Industrial_{t-2}$ (Ramanathan, 2002). The auxiliary regression equation is shown in Appendix B. The next step was to select variables to be added to the basic model using simple but arbitrary rule of thumb of including newly added variables that have p-value less than 0.10 (Ramanathan, 2002). Then we regressed selected variables with $Gini_t$ and omitted variables with insignificant coefficients, a few at a time, until all coefficients were significant at 10 percent or below. The results are shown in section 3.

3. Empirical Results and Discussion

Table 1: Regression Results

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*	
Export	-0.0013224	0.000123915	-10.6718	<0.00001	***
Import	0.00110959	9.82E-05	11.2996	<0.00001	***
Tariff	0.00117349	0.000666268	1.7613	0.09728	*
Agriculture	-0.0444727	0.00273538	-16.2583	<0.00001	***
Service	-0.0636481	0.00351674	-18.0986	<0.00001	***
$Export_{t-1}$	0.000966701	0.000115932	8.3385	<0.00001	***
$Import_{t-1}$	-0.000776967	9.42E-05	-8.2494	<0.00001	***
$Agriculture_{t-1}$	0.0289784	0.00264335	10.9628	<0.00001	***
$Service_{t-1}$	0.0413718	0.00346715	11.9325	<0.00001	***
$Gini_{t-1}$	0.0271792	0.000846585	32.1045	<0.00001	***

Variable	*Coefficient*	*Std. Error*	*t-ratio*	*p-value*
Statistics based on the transformed data:				
Sum squared residual	0.000103		S.E. of regression	0.00254
R-squared	0.999966		Adjusted R-squared	0.999947
F(10, 16)	47049.38		P-value(F)	8.85E-34
Log-likelihood	124.7886		Akaike criterion	-229.5772
Schwarz criterion	-216.9963		Hannan-Quinn	-225.9544
rho	-0.011063		Durbin-Watson	2.007739

Logistic, using observations 2003-2011 quarterly (T = 26), Dependent variable: GINI
yhat = 100 / (1 + exp(-X*b))
***Denotes significant at 1% level, **significant at 5% level, *significant at 1% level

Table 1 indicates the results of Lagrange Multiplier Test on all the suspected economic variables representing openness to trade and labor mobility. The adjusted R-squared statistic of 0.9999 with the corresponding p-value (F) of 8.85e-34 is quite acceptable for time series data. Additionally, p-values of all the selected variables (*Export, Import, Tariff, Agriculture, Service,* $Export_{t-1}$, $Import_{t-1}$, $Agriculture_{t-1}$, $Service_{t-1}$, $Gini_{t-1}$) demonstrate that all coefficients in the model are significant at 10 percent or lower level. As a result, $Gini_t$ is well explained by the constructed model, and hence, clearly signifying the superiority of this model. Moreover, the results neglect some variables namely, *Industrial,* $Industrial_{t-1}$, $Indystrial_{t-2}$, $Tariff_{t-1}$, $Gini_{t-2}$, $Export_{t-2}$, $Import_{t-2}$, $Tariff_{t-2}$, $Agriculture_{t-2}$, *and* $Service_{t-2}$, suggesting that they are insignificant.

From Figure 2, the Logistic Model results in the following equation:

$$Gini_t = 0.02718Gini_{t-1} - 0.00132Export_t + 0.00097Export_{t-1} + 0.00111Import_t - 0.00078Import_{t-1} + 0.00117Tariff_t - 0.04447Agriculture_t + 0.02898Agriculture_{t-1} - 0.06365Service_t + 0.04137Service_{t-1} + u_t \quad (4)$$

Suppose the economy was in a steady state (long-run equilibrium) in which all the variables were constant over time (Ramanathan, 2002; Verbeek, 2004). Therefore, to analyze the impact of each variable on $Gini_t$ in-depth, the marginal effects (Covariance Analysis) of each independent variable in long-run was examined separately.[2]

In the long-run, the increase in exports by 1% tends to decrease Gini Index by 0.04%, ceteris paribus. The result agrees with Nguyen (2002)'s findings and imply that exports decrease income gap between the rich and the poor in Thailand, which contradicts the original hypothesis pertaining export variable. However, the effect of exports on income inequality is minimal in this model. On the other hand, the increase in imports by 1% widens income inequality in Thailand by 0.03%, ceteris paribus. This result is consistent with the findings of Xu (2003), Meschi & Vavarelli (2008), and Bergh & Nilsson (2010). Though, the effect is still minimal. In conflict with Cororaton (2005)'s study in the Philippines, in this model, as the tariff rate increases by 1%, Thailand's income inequality grows by 0.12%, ceteris paribus, opposing the original hypothesis. As for labor mobility,

in the long-run, as employment in the agricultural sector of Thailand increases by 1%, the country's income gap falls by 1.55%, ceteris paribus. Additionally, as employment in the service sector of Thailand increases by 1%, the country's income gap falls by 2.23%, ceteris paribus.

4. Conclusions and Policy Recommendations

In recent decades, numerous researchers have documented a relationship between trade openness and labor mobility and income inequality. Yet, no previous study has examined this relationship especially in Thailand, using Gini Index as dependent variable. This study employed non-linear (logistic) distributed lag model to examine the relationship between trade openness and labor mobility and income inequality. The model was tested using the Lagrange Multiplier Testing (LM testing) (Engle, 1983; Bera, 2001). The results yielded from covariance analysis suggested that, in the long run, there exists a negative relationship between the Gini Index and exports, employment in the agricultural sector, and employment in the service sector. Conversely, covariance analysis indicated a positive relationship between the Gini Index and imports and tariff rate. The policy recommendations can be proposed as follows.

As for policies relating to labor mobility in Thailand, the empirical results recommend that the number of workers in both agricultural and service sectors be increased. Additionally, increasing the number of workers in the service sector would yield a better result in reducing income inequality in Thailand. However, the results indicate insignificant relationship between industrial sector and the Gini Index. To increase the number of workers in agricultural sector and prevent them from migrating to work in the industrial sector, the policies which aim at improving farmers' wellbeing and their work conditions should be encouraged. Access to advanced agricultural technologies and proper training should be provided to the farmers. Due to the fact that increasing the number of workers in service sector yields a better result in reducing the income gap, a smooth transition of the poor and unskilled workers to the service sector should be encouraged. Educating service workers to have essential knowledge and skills required for their specific tasks is also very essential.

As for international trade policies of Thailand, although exports and imports have minimal effects on income inequality in Thailand, the policies concerning international trade should not be neglected. In order to reduce the level of income disparity, it is recommended that exports be improved but imports be reduced. As the tariff rates have the direct impact on the value of Gini Index, reducing tariff rates will result in lowering the income gap in Thailand. In other words, trade liberalization may help in reducing the country's income disparity. In addition, exports of agricultural products and services should be promoted so as to increase the number of workers in both agricultural and service sectors, resulting in lower income inequality. Moreover, as the tourism industry symbolizes exports of services, promoting tourism and proper training for workers within the industry may bring in foreign money and help in reducing the inequality.

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6. References

Adkins, L. C. 2010. ***Using gretl for Principles of Econometrics****, 3rd Edition.* Oklahoma: Free Software Foundation.

Akapaiboon, N. 2010. ***Trade Liberalization, Poverty and Income Distribution in Thailand: A Computable General Equilibrium-Microsimulation Analysis.*** North Carolina: The University of North Carolina at Chapel - the Department of Economics.

Ang, J. B. 2010, Finance and inequality: the case of India, **Southern Economic Journal**, Vol. 76 No. 3, 738-761.

Appleyard, D. R., & Field, J. A. 2001. **International Economics**. New York: McGraw-Hill.

Bera, A. K. 2001. Rao's score, Neyman's C(α) and Silvey's LM tests: an essay on historical developments and some new results. ***Journal of Statistical Planning and Inference*** , 9-44.

Bergh, A., & Nilsson, T. 2010. Do liberalization and globalization increase inequality? ***European Journal of Political Economy*** , 488-505.

Carter, J. R. 2007. **An empirical note on economic freedom and income inequality**. *Public Choice* , 163-177.

Clarke, G., Xu, L.C. and Zou, H. 2007, Finance and income inequality: what do the data tell us?. **Southern Economic Journal**, Vol. 72 No. 3, 578-596.

Cororaton, C. B. 2005. ***Doha scenarios, trade reforms, and poverty in the Philippines: A CGE analysis.*** Retrieved Feb 10, 2013, from MPIA Working Papers 2005-03: www.pep-net.org.

Engle, R. F. 1983. Wald, Likelihood Ratio, and Lagrange Multiplier Tests in Econometrics. ***Handbook of Econometrics****, Volume II* , 796-801.

Heckscher, Eli F. 1950. The Effect of Foreign Trade on the Distribution of Income. *Readings in the* ***Theory of International Trade****.* Philadelphia: Blakiston, Chapter 13.

Keenan, M., Saritas, O., Kroener, I. 2004. **A dying industry - Or not? The future of the European textiles and clothing industry**. *Foresight*, 313-322.

Kuijs, L., & Wang, T. 2006. China's pattern of growth: Moving to sustainability and reducing inequality. ***China and World Economy***, 1-14.

Kleimann, D. 2014. Beyond market access?: The anatomy of ASEAN's preferential trade agreements. ***Journal of World Trade***, 629-682.

Kyureghian, G., Capps Jr., O., & Nayga Jr., R. 2011. A missing variable imputation methodology with an empirical application. ***Advances in Econometrics***, 313-377.

Meschi, E., & Vivarelli, M. 2008. Trade and Income Inequality in Developing Countries. ***World Development***, 287-302.

Milberg, W. 1996. The rhetoric of policy relevance in international economics. ***Journal of Economic Methodology***, 237-259.

Nguyen, T. T. 2002. **Vietnam's trade liberalization in the context of ASEAN and AFTA CAS.** Discussion *Paper No 36. Centre for ASEAN Studies, Centre for International Management and Development Antwerp.*

Pugel, T. A. 2012. ***International Economics***. Illinois: McGraw-Hill.

Ramanathan, R. 2002. ***Introductory Econometrics with Applications* (5th ed.).** Orlando, FL, USA: Harcourt College Publishers.

Sehrawat, M., & Giri, A. 2015. Financial development and income inequality in India; an application of ARDL approach. ***International Journal of Social Economics***, 64-81.

Sercovich, F.C., and Teubal, M. 2013. **An evolutionary view of the infant-industry argument**. *Technology Analysis & Strategic Management*, 799-815.

Shahbaz, M. and Islam, F. 2011. Financial development and income inequality in Pakistan: an application of ARDL approach, ***Journal of Economic Development***, Vol. 36, 35-58.

Stolper, Wolfgang F., and Samuelson, Paul A. Protection and Real Wages. 1941 ***Review of Economic Studies*** *9,* 58-73.

Sunderasan, S. 2011. **Infant industry and incentive structures**. *Green Energy and Technology* , 1-5.

Verbeek, M. (2004). *A Guide to Modern Econometrics.* West Sussex, England: John Wiley & Sons Ltd.

Xie, C., & Shi, X. 1986. **The movement of rural labor and the establishment of small towns as suggested by factors of production**. *Ren kou yan jiu = Renkou yanjiu* , 21-25.

Xu, B. 2003. Trade liberalization, wage inequality, and endogenously determined non-traded goods. ***Journal of International Economics***, *60,* 417-431

Appendices

Appendix A: Data Source

Time secures data was collected from the World Bank's website - *http://data.worldbank.org/data-catalog/world-development-indicators.* The data ranges from 2003 to 2011

Appendix B: Lagrange Multiplier Test

	Coefficient	Std. Error	t-ratio	p-value	
Export$_{t}$	-0.00126985	0.000169646	-7.4853	0.00007	***
Import$_{t}$	0.00107967	0.000131188	8.2300	0.00004	***
Tariff$_{t}$	0.00195128	0.00113076	1.7256	0.12269	
Agriculture$_{t}$	-0.0391529	0.0169464	-2.3104	0.04966	**
Service$_{t}$	-0.0583632	0.0174623	-3.3422	0.01020	**
Export$_{t-1}$	0.00083188	0.00045976	1.8094	0.10799	
Import$_{t-1}$	-0.000707098	0.000384635	-1.8384	0.10330	
Agriculture$_{t-1}$	0.028626	0.0149158	1.9192	0.09123	*
Service$_{t-1}$	0.0411716	0.0212637	1.9362	0.08886	*
Gini$_{t-1}$	0.0270005	0.0135003	2.0000	0.08052	*
Industrial$_{t}$	0.00458997	0.0165344	0.2776	0.78836	
Tariff$_{t-1}$	-0.00129239	0.00145684	-0.8871	0.40090	
Gini$_{t-2}$	-0.00320127	0.0142744	-0.2243	0.82817	
Export$_{t-2}$	2.83774e-06	0.000472664	0.0060	0.99536	
Import$_{t-2}$	1.02537e-05	0.000397264	0.0258	0.98004	
Tariff$_{t-2}$	0.000165198	0.00132097	0.1251	0.90356	
Agriculture$_{t-2}$	-0.0034996	0.0155613	-0.2249	0.82770	
Service$_{t-2}$	-0.00526237	0.0222388	-0.2366	0.81889	

Statistics based on the transformed data:

Sum squared residual	0.000080	S.E. of regression	0.003154
R-squared	0.996622	Adjusted R-squared	0.989443
F(17, 8)	138.8348	P-value(F)	5.18e-08
Log-likelihood	128.1649	Akaike criterion	-220.3297
Schwarz criterion	-197.6840	Hannan-Quinn	-213.8086
Rho	-0.169236	Durbin-Watson	2.318153

Statistics based on the original data:

Mean dependent variable	41.57538	S.D. dependent variable	0.743716
Sum squared residual	0.047113	S.E. of regression	0.076741

Logistic, using observations 2003-2011 quarterly (T = 26)

Dependent variable: GINI; yhat = 100 / (1 + exp(-X*b))

***Denotes significant at 1% level, **significant at 5% level, *significant at 1% level

Appendix C: Calculation of Partial Effects

Given that,

$Gini_t = 0.02718Gini_{t-1} - 0.00132Export_t + 0.00097Export_{t-1} + 0.00111Import_t - 0.00078Import_{t-1} + 0.00117Tariff_t - 0.04447Agriculture_t + 0.02898Agriculture_{t-1} - 0.06365Service_t + 0.04137Service_{t-1} + u_t$, the partial effects in the long run equilibrium determined by different independent variables are (Ramanathan, 2002; Verbeek, 2004):

Export: $\frac{\Delta Gini*}{\Delta Export*}$ = -0.0004

Import: $\frac{\Delta Gini*}{\Delta Import*}$ = 0.0003

Tariff Rate: $\frac{\Delta Gini*}{\Delta Tariff*}$ = 0.0012

Employment in Agricultural Sector: $\frac{\Delta Gini*}{\Delta Agriculture*}$ = -0.0155

Employment in Service Sector: $\frac{\Delta Gini*}{\Delta Service*}$ = -0.0223