ERIA-DP-2014-05

ERIA Discussion Paper Series

Analysis on Price Elasticity of Energy Demand in East Asia: Empirical Evidence and Policy Implications for ASEAN and East Asia

Han PHOUMIN[1]
and
Shigeru KIMURA[2]

Economic Research Institute for ASEAN and East Asia (ERIA)

April 2014

Abstract: This study uses time series data of selected ASEAN and East Asia countries to investigate the patterns of price and income elasticity of energy demand. Applying a dynamic log-linear energy demand model, both short-run and long-run price and income elasticities were estimated by country. The study uses three types of dependent variable "energy demand" such as total primary energy consumption (TPES), total final energy consumption (TFEC) and total final oil consumption (TFOC) to regress on its determinants such as energy price and income. The finding shows that price elasticity is generally inelastic amongst all countries of studies. These findings support to the theory of price inelasticity of energy demand due to the assumption that energy remains a special commodity due to its nature of lack of substitution. Any shift from oil to other energy is difficult as it depends on equipment uses which are not easily to be replaced. As a result, a unit change in price may not induce equal change in quantity of demand. Although prices are inelastic, this study observed that price elasticity in developing counties is more sensitive than in developed countries. Among the countries studied, Thailand, Singapore and the Philippines have shown to be price sensitive compared to other developing countries and developed countries. For the income elasticity, this study also found that income has been very sensitive towards energy consumption, except for countries like India, China and Australia due to energy supply limitation in the cases of India and China and to less energy intensive industrial structure in the case of Australia. The price elasticity by energy type shows that TPES has a smaller impact than TFEC and TFOC, and TFEC is smaller than TFOC in terms of sensitivity of the price elasticity. Amongst other reasons, fuel subsidies may play roles in the insensitivity of energy prices. The findings have policy implications as inelastic price will impact on the uptake of energy efficiency in developing as well as developed countries. Therefore, removal of energy subsidies, albeit done in a gradual manner, will be critical to the promotion of energy efficiency. Its impact likewise goes further in that it will benefit the Renewable Energy uptake, the environment and social benefits.

***Keywords*:** Energy intensity, price and income elasticities, energy demand, energy subsidy, ASEAN and East Asia.
***JEL Classification*:** 04; L1 ; Q4

[1] Han, Phoumin, Energy Economist at the Economic Research Institute for ASEAN and East Asia (ERIA). He can be contacted at han.phoumin@eria.org.
[2] Shigeru Kimura, Special Energy Advisor to the Executive Director of ERIA. He can be contacted at shigeru.kimura@eria.org.

1. Introduction

Energy consumption is induced differently by countries due to differences in GDP level, industrial structure, life style, geographical location and energy price, especially relative energy price. This observation has been supported by an earlier work by Fan and Hyndman (2010) whose study focused on the electricity demand in South Australia and whose finding concluded that electricity demand had mainly been driven by the economy, demography and weather. In light of this, the present study aims to estimate price sensitivity in East Asian countries where prices are influenced by a different state of the economy and characteristics.

This paper is written to provide empirical evidences to energy price elasticity in some selected ASEAN and East Asian countries such as Australia, Japan, China, India, the Philippines, Singapore and Thailand. In theory, energy price elasticity measures the percentage change in energy consumption against a percentage change in energy price. In looking at studies on energy price elasticity, it is generally accepted that energy price is likely to be inelastic due to its basic nature of necessity and the lack of fuel substitutes. Inelasticity of energy price means that a percentage change in price induces less than a unity change in energy consumption.

Attempts in the past have been focused on the price elasticity of demand in various countries. For example, the Research and Economic Analysis Division (READ) of the Department of Business, Economic Development and Tourism of the State of Hawaii (2011) conducted the study on income and price elasticity of Hawaii's energy demand by using data from 1970 to 2008 and its result was that Hawaii consumers were not very sensitive to change in electricity prices and price of gasoline. Moreover, energy consumption has not been very sensitive to the change in income either.

However, in the ASEAN and East Asia context, one needs to investigate if the patterns of the energy price and income elasticity granger cause changes in the energy demand. Applying a dynamic log-linear energy demand model, both short-run and long-run price and income elasticities were estimated by country. The study uses three types of dependent variable "energy demand" such as total primary energy consumption (TPES), total final energy consumption (TFEC) and total final

oil consumption (TFOC) to regress on its determinants such as oil price representing overall energy price for TPES and TFEC and income.

This paper is organized as follows. Section 2 presents the empirical model for the price and income elasticity of demand. Section 3 explains the data and variables used in the study. Section 4 discusses the results while Sections 5 and 6 present the findings and policy implications, respectively.

2. Empirical Model

2.1. Price and Income Elasticities in Log Dynamic Energy Demand Model

Price elasticity of demand measures the sensitivity or responsiveness of consumers to the change in price of the energy consumed. Likewise, income elasticity of demand measures the sensitivity or responsiveness of consumers to the change in their income. In theory, the energy demand is a function of price and income. Other exogenous variables can also explain the variable of energy demand, including energy efficiency, climate condition and other variables that may also impact on energy demand. Since covariates of time series data are not widely available, the authors assume that energy price and income are likely to be the major determinants of the energy demand, and other covariates will be captured in error terms.

A similar approach has been used by Cooper (2003) to investigate the price elasticity of demand for crude oil in 23 countries. This study will therefore use the standard energy demand model to derive both short and long run-elasticities of price and income.

$$E_t = f(Y_t, P_t);$$

where E_t is the energy demand and in this case, it is the aggregated form represented by total primary energy supply (TPES), Total Final Energy Consumption (TFEC), and Total Final Oil Consumption (TFOC).

Y_t is the income, and in this case, it takes the form of GDP at constant price 2000;

P_t is the energy price, and in this case, it has been adjusted to constant price by GDP deflator;

Thus the above function can be written into three types of equations because energy demand takes the form of TPES, TFEC and TFOC:

a. $LogTPES = \alpha_0 + \beta_1 LogGDP_t + \beta_2 LogP_t + \beta_3 LogTPES_{t-1} + \varepsilon_t$
a. $LogTFEC = \alpha_0 + \beta_1 LogGDP_t + \beta_2 LogP_t + \beta_3 LogTFEC_{t-1} + \varepsilon_t$
b. $LogTFOC = \alpha_0 + \beta_1 LogGDP_t + \beta_2 LogP_t + \beta_3 LogTFOC_{t-1} + \varepsilon_t$

With the following conditions:

$\beta_1 \succ 0$ *and* $\beta_2 \prec 0$

The multiple regressions in time series in logarithm form as shown in equation (a, b, c) capture the elasticity of energy price and income. The inclusion of lag variable is to capture the serial correlation in the equation as time series are likely to suffer from the serial correlation (Wooldridge, 2003) and at the same time one can derive the short and long run price elasticities.

From equation (a, b, c), the coefficients of β_1 *and* β_2 are the short-run elasticities for P_t *and* Y_t respectively. And the long-run elasticities are $\frac{\beta_2}{1-\beta_3}$ *and* $\frac{\beta_2}{1-\beta_3}$ for P_t *and* Y_t respectively.

It is important to check if the time series are in stationary or non-stationary process. A stationary process of time series is one whose probability distribution is stable over time. The aim of this study, however, is to assess the sensitivity of the price and income elasticity. Using an advanced Error Correction Model will have drawbacks on the interpretation of the elasticity. Hence, the study focuses on the serial correlation, and the Cochrane-Orcutt interactive process is employed to deal with the serial correlation, and with robust standard error correction (Wooldridge, 2003).

2.2. Construction of Price and Income Elasticities

For the purpose of visualizing graph of historical trend of price and income elasticities amongst countries studied, we construct the historical data of price and income elasticities based on the following concept:

Elasticity is a numerical measure of the response of supply and demand to price (Meier, 1986). The so-called elasticity of demand measure relative change in quantity demanded per unit of change in price or income. Mathematically, we define elasticity as:

For price elasticity: $e_{price} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta price}{price}} = \frac{\Delta Q}{\Delta price} \times \frac{price}{Q}$; and

For income elasticity: $e_{income} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta income}{income}} = \frac{\Delta Q}{\Delta income} \times \frac{income}{Q}$,

where $\Delta Q, \Delta price, \Delta income$ are the changes in quantity of demand, price and income respectively.

3. Data and Variables

This study uses two datasets in order to get the variables of interest in the model. The first dataset comes from the Institute of Energy Economics, Japan (IEEJ) in which variables such as Total Primary Energy Supply (TPES), Total Final Energy Consumption (TFEC), and Total Final Oil Consumption (TFOC) are obtained. The data from IEEJ are also obtained from the energy balance of the International Energy Agency (IEA).

Further, this study uses World Bank's dataset called World Development Indicators (WDI) in order to capture few more time series variables such as Gross

Domestic Products (GDP) at constant price 2000, GDP deflator at constant price 2000 and exchange rates. Combining variables of interest from these two datasets allows this study to formulate the time series of some selected ASEAN and East Asian countries. Table 1 provides descriptive statistics of the variables used in the multiple regressions.

The study uses Japan's CIF of crude oil as representative of world crude oil price as well as overall energy price because crude oil price should be fundamental for any energy price if a country applies market economy in the cases of TPES and TFEC. Therefore, crude oil price is normalized by the GDP deflator 2000 after converting from US$/barrel to NC (National Currency) using exchange rates.

All variables have been transformed into logarithm so as to capture the price and income elasticity.

Table 1: Descriptive Statistics

Country	Variable	Obs	Mean	Std. Dev.	Min	Max
Australia	Log TPES	21	11.50846	.1214961	11.30493	11.68131
	Log TFEC	21	11.05635	.1082868	10.87576	11.19664
	Log TFOC	21	10.42524	.1018755	10.24811	10.5641
	Log GDP	21	27.08255	.2163957	26.772	27.40452
	Log EP	21	-.8178307	.4625645	-1.602393	.0410695
Japan	Log TPES	21	13.09927	.0543091	12.98156	13.15459
	Log TFEC	21	12.69513	.0477954	12.60084	12.74537
	Log TFOC	21	12.18429	.068679	12.05234	12.26112
	Log GDP	21	29.09217	.0597573	28.97942	29.18942
	Log EP	21	-1.233659	.668306	-2.155407	-.0422246
China	Log TPES	21	13.90416	.4076589	13.37793	14.64977
	Log TFEC	21	13.47244	.3375681	13.04721	14.09832
	Log TFOC	21	12.10464	.4579458	11.34567	12.85248
	Log GDP	21	27.99489	.5991104	26.98796	28.97597
	Log EP	21	-1.158321	.4469094	-2.05107	-.4184135
India	Log TPES	21	12.63342	.3193194	12.1188	13.20607
	Log TFEC	21	12.07476	.271638	11.68044	12.62726
	Log TFOC	21	11.37512	.2925261	10.86998	11.81765
	Log GDP	21	27.1462	.3968737	26.58189	27.85169
	Log EP	21	-.9806735	.386153	-1.831074	-.3183931
Philippines	Log TPES	21	10.21154	.2112802	9.769671	10.42258
	Log TFEC	21	9.645578	.1931893	9.21411	9.813705
	Log TFOC	21	9.332679	.1867411	8.898133	9.548647
	Log GDP	21	25.16487	.2453564	24.8462	25.59946
	Log EP	21	-1.078136	.3791594	-1.939554	-.4637494
Singapore	Log TPES	21	9.930412	.2570615	9.346298	10.41745
	Log TFEC	21	9.236406	.5200884	8.487645	10.09175
	Log TFOC	21	8.976227	.5548539	8.17186	9.875498
	Log GDP	21	25.2619	.3624895	24.61634	25.85591
	Log EP	21	-1.169026	.5681294	-2.055215	-.1451432
Thailand	Log TPES	21	10.96982	.3765344	10.21311	11.45978
	Log TFEC	21	10.64273	.3806036	9.887175	11.16411
	Log TFOC	21	10.27639	.3354904	9.611247	10.69003

	Log GDP	21	25.6948	.2435054	25.21105	26.0708
	Log EP	21	-1.668238	.4728295	-2.579158	-.8081316

4. Coefficients Estimate of the Case Study

The study selected some countries in ASEAN and East Asia for the analysis of the price elasticity. These countries are Australia, Japan, China, the Philippines, India, Singapore and Thailand. The study chose three time periods for the analysis to assess the price elasticity. These periods are from 1990-2010, 1990-2000, and 2000-2010. The formula in heading (3) above for the selected countries was employed.

The results of the regressions by country and by period are shown below (Tables 2a to 2g):

Table 2a: Regression Coefficients for the Case of Australia

Period	**Dependent Variable**	**Intercept (a0)**	**Lag(1) Dependent Variable**	**Income Elasticity**		**Price Elasticity**	
				Short-run	***Long-run***	***Short-run***	***Long-run***
1990-2010	Log TPES	-4.880501**	.0842896	.568331**	.62064491	-.0350073**	-.03822966
		(1.885187)	(.3281561)	(.2057816)		(.015029)	
	Log TFEC	-2.447808*	.3494695*	.3554824**	.54645001	-.0228004**	-.03504893
		(1.211503)	(.1986724)	(.1222084)		(.0102512)	
	Log TFOC	-1.814148	.3244738	.3269297**	.48396302	-.0089681	-.01327572
		(1.425579)	(.2396768)	(.1396169)		(.0131877)	
1990-2000	Log TPES	-10.18754**	-.3849486	.9645539**	1.5682493	-.0321818*	-.02323682
		(2.866802)	(.4250049)	(.2847125)		(.0149697)	
	Log TFEC	-4.639216	.1916971	.5017578	.62075467	-.0094329	-.01167001
		(2.566607)	(.426565)	(.2671683)		(.0132063)	
	Log TFOC	-4.186167	.2685695	.4373681	.59796262	.0073794	.010089
		(2.81753)	(.4758402)	(.2833669)		(.0176837)	
2000-2010	Log TPES	-1.35868	.2468878	.3707006	.49222493	.0089582	.01189491
		(3.605726)	(.3104898)	(.2466358)		(.0273053)	
	Log TFEC	2.845257**	-.2184344	.3940763**	.32342841	.0258257	.02119581
		(.9046293)	(.2158542)	(.0903335)		(.0138379)	
	Log TFOC	3.907283**	-.1138058	.2868794**	.2575668	.0578592*	.0519473
		(1.201919)	(.1504273)	(.078601)		(.0179763)	

Table 2b: Regression Coefficients for the Case of Japan

Period	Dependent Variable	Intercept (a0)	Lag(1) Dependent Variable	Income Elasticity		Price Elasticity	
				Short-run	*Long-run*	*Short-run*	*Long-run*
1990-2010	Log TPES	-14.23713	.4094168*	.7532897*	1.2755014	-.0503335	-.08522677
		(10.17835)	(.2042772)	(.4303289)		(.0292217)	
	Log TFEC	-2.029529	.6078574*	.2400152	.61206102	-.0242187	-.06175993
		(9.816369)	(.2118804)	(.4168093)		(.0306257)	
	Log TFOC	11.08921*	.977847***	-.3719946	-16.79229	-.0014076	-.06354079
		(5.177161)	(.1177779)	(.2210063)		(.0215312)	
1990-2000	Log TPES	3.497499	.837253**	-.0440805	-.2708539	.040905	.25134197
		(12.50444)	(.3045373)	(.5628783)		(.0278046)	
	Log TFEC	-15.85688	.2619132	.8697751	1.1784184	.025686	.03480078
		(18.60061)	(.4748877)	(.8427181)		(.024124)	
	Log TFOC	7.596748	.9384204	-.2338571	-3.7976392	.0215383	.34976356
		(16.78731)	(.5382668)	(.8019942)		(.0301465)	
2000-2010	Log TPES	-27.11455**	.1150082	1.32667**	1.4990817	-.099428**	-.11234952
		(8.295914)	(.1725794)	(.32247)		(.0231338)	
	Log TFEC	-23.72428**	.176857	1.170813**	1.4223689	-.103052**	-.12519356
		(8.464948)	(.3014381)	(.4098922)		(.040805)	
	Log TFOC	2.656399	.714946**	.0259982	.09120447	-.0569338	-.19972988
		(11.76706)	(.2048772)	(.4804607)		(.0574083)	

Table 2c: Regression Coefficients for the Case of China

Period	Dependent Variable	Intercept (a0)	Lag(1) Dependent Variable	Income Elasticity		Price Elasticity	
				Short-run	*Long-run*	*Short-run*	*Long-run*
1990-2010	Log TPES	-1.131446	.657047***	.2155128*	.6284036	.079344**	.23135633
		(.7181653)	(.1654675)	(.1028465)		(.0293599)	
	Log TFEC	-.2297873	.7497355***	.1327402*	.53039964	.0664611*	.26556343
		(.3476051)	(.1232148)	(.0607776)		(.0263207)	
	Log TFOC	-5.261123**	.4100935**	.4447381**	.75391287	.0161523	.02738112
		(1.730542)	(.1845455)	(.1405724)		(.0186623)	
1990-2000	Log TPES	1.746876	.2057866	.3300025*	.4155086	.0238893	.0300792
		(.9760478)	(.3160883)	(.1363938)		(.0308968)	
	Log TFEC	6.642941*	.0631158	.2057965**	.21966055	-.0520304	-.05553557
		(2.451751)	(.3040873)	(.0841594)		(.0457791)	
	Log TFOC	-7.660562**	.219731	.6141269**	.78707074	.0464696	.05955587
		(1.364753)	(.1480769)	(.1097699)		(.0165328)	
2000-2010	Log TPES	-2.94627	.7721307	.2191901	.9619115	-.0133559	-.05861211
		(4.258405)	(.7659666)	(.5275655)		(.1925273)	
	Log TFEC	-3.109939	.099927	.5493963**	.61039082	.1907649	.21194381
		(2.238053)	(.3401377)	(.2316592)		(.0764132)	
	Log TFOC	-4.260871	.177181	.5135611*	.62414832	.0937026	.11387997
		(2.790019)	(.4630842)	(.2612943)		(.1269687)	

Table 2d: Regression Coefficients for the Case of India

Period	Dependent Variable	Intercept (a0)	Lag(1) Dependent Variable	Income Elasticity		Price Elasticity	
				Short-run	*Long-run*	*Short-run*	*Long-run*
1990-2010	Log TPES	-6.130792**	.3800769*	.5141996**	.82945707	-.0253058	-.04082087
		(1.734748)	(.1523335)	(.1335197)		(.0171307)	
	Log TFEC	-1.118278	.8737161***	.1001141	.7927701	.0338111*	.2677388
		(.6779961)	(.12259)	(.0754743)		(.0143254)	
	Log TFOC	-4.087369*	.5898215**	.3211573*	.78296961	-.0639347*	-.15587043
		(1.958854)	(.1926494)	(.1510666)		(.0298486)	
1990-2000	Log TPES	-6.941832*	.3545634	.5564865*	.86218615	-.0214626	-.03325284
		(3.147113)	(.2670283)	(.2380649)		(.0292013)	
	Log TFEC	-3.75939*	.1284346	.5249508*	.60230799	-.0232732	-.02670276
		(1.640811)	(.3232131)	(.1990487)		(.0303528)	
	Log TFOC	-17.71452*	-.0083829	1.079167**	1.0701957	-.0043904	-.0043539
		(5.794674)	(.3374075)	(.3549208)		(.0186666)	
2000-2010	Log TPES	-7.988967*	.4035808	.5699425	.95560723	-.052301	-.08769168

		(3.85254)	(.2735472)	(.2547861)		(.0538911)	
	Log TFEC	-7.731165	.5305846*	.4912964	1.0466133	-.0393069	-.08373586
		(4.379941)	(.2585221)	(.2645691)		(.0606106)	
	Log TFOC	-4.141775	.0315378	.5585576*	.57674693	-.0557643	-.05758025
		(2.76032)	(.303539)	(.2165345)		(.05973)	

Table 2e: Regression Coefficients for the Case of the Philippines

Period	Dependent Variable	Intercept (a0)	Lag(1) Dependent Variable	Income Elasticity		Price Elasticity	
				Short-run	*Long-run*	*Short-run*	*Long-run*
1990-2010	Log TPES	-1.453254	.754726***	.1557718	.6350940	-.0584492	-.2383020
		(2.947949)	(.1720946)	(.1819976)		(.0451797)	
	Log TFEC	-1.452149	.675309***	.1792897	.55218579	-.0863156	-.2658393
		(2.621494)	(.1445072)	(.1480663)		(.0646904)	
	Log TFOC	.4712048	.651223***	.1054292	.3022830	-.1340568	-.38436316
		(2.356504)	(.1253073)	(.1171409)		(.0723053)	
1990-2000	Log TPES	-15.35369	.4999256	.8148572	1.629471	-.0622235	-.1244284
		(11.44311)	(.3561224)	(.5965046)		(.0556633)	
	Log TFEC	-48.31333	-.419478	2.467074	1.738015	-.202464	-.1426327
		(34.19109)	(.8811999)	(1.689294)		(.1643402)	
	Log TFOC	-52.80794	-.4418452	2.639264*	1.830476	-.2299752*	-.15950062
		(38.20067)	(.8585023)	(1.830934)		(.1695918)	
2000-2010	Log TPES	14.7114***	-.867569**	.1827789*	.09786993	.0032185	.00172336
		(2.081402)	(.195655)	(.080504)		(.0372207)	
	Log TFEC	-5.122191	.628275	.3401551**	.91507189	-.1274693**	-.34291291
		(6.234581)	(.3922668)	(.1165449)		(.0429298)	
	Log TFOC	-.6045702	.5143002	.1967961	.40518053	-.1713919**	-.3528762
		(8.623857)	(.2749281)	(.2391446)		(.060756)	

Table 2f: Regression Coefficients for the Case of Singapore

Period	Dependent Variable	Intercept (a0)	Lag(1) Dependent Variable	Income Elasticity		Price Elasticity	
				Short-run	*Long-run*	*Short-run*	*Long-run*
1990-2010	Log TPES	-6.153743	.2945013	.5173473	.73330723	-.0939268	-.1331353
		(5.948274)	(.2848456)	(.3361874)		(.1270521)	
	Log TFEC	-11.11586**	.574350**	.598164**	1.4052974	.0149655	.03515919
		(4.509567)	(.161125)	(.2292214)		(.0555867)	
	Log TFOC	-12.82271	.545705**	.671832**	1.4788495	.0223782	.04925928
		(5.23611)	(.1747217)	(.2592553)		(.0674263)	
1990-2000	Log TPES	.943668	.4822788	.159412	.3079109	-.1027717	-.19850781
		(7.535468)	(.3763139)	(.4272159)		(.2697849)	
	Log TFEC	-10.7388	.5064947*	.6053215*	1.2265755	-.0023776	-.00481778
		(5.749355)	(.2016679)	(.2865566)		(.1295645)	
	Log TFOC	-11.93361	.4887197*	.6530095*	1.2772045	-.0094149	-.0184143
		(6.966708)	(.2270357)	(.3380328)		(.1710508)	
2000-2010	Log TPES	-41.2175**	.3771364	1.84091**	2.9555636	-.667761**	-1.0720832
		(12.44275)	(.36558)	(.5100345)		(.2506498)	
	Log TFEC	-19.57583**	1.085742**	.7269637**	-8.4785018	-.3574961*	4.1694397
		(5.916247)	(.3592339)	(.2273317)		(.1942162)	
	Log TFOC	-23.03989**	.9542293**	.9115172**	19.914863	-.357452	-7.8096249
		(7.823706)	(.3411908)	(.2844408)		(.2301098)	

Table 2g: Regression Coefficients for the Case of Thailand

Period	Dependent Variable	Intercept (a0)	Lag(1) Dependent Variable	Income Elasticity		Price Elasticity	
				Short-run	*Long-run*	*Short-run*	*Long-run*
1990-2010	Log TPES	-8.575189**	.631737***	.492024**	1.336069	-.0095186	-.0258473
		(3.070005)	(.0856154)	(.1521031)		(.027153)	
	Log TFEC	-12.78834**	.556492***	.6803714**	1.534069	-.038385	-.0865486
		(3.723789)	(.1118474)	(.1881028)		(.0310849)	
	Log TFOC	-10.3827**	.586428***	.567328**	1.371776	-.0533772	-.1290639
		(3.37087)	(.1162429)	(.1724208)		(.0387591)	
1990-2000	Log TPES	-10.9585**	.595117***	.606628**	1.498281	.0716131*	.17687378
		(2.733072)	(.0779265)	(.133091)		(.0357097)	
	Log TFEC	-16.2797**	.4928067**	.85014***	1.676172	.0600301	.11835744
		(2.692303)	(.0811746)	(.1313182)		(.034441)	
	Log TFOC	-15.096***	.4980964**	.795728**	1.585420	.0693726	.13821897
		(2.93785)	(.0905636)	(.1417692)		(.0420216)	
2000-2010	Log TPES	-17.8979**	.5222926*	.891801**	1.866836	-.1675388**	-.3507142
		(4.796381)	(.2640651)	(.2692523)		(.0518605)	
	Log TFEC	-21.4965**	.7310183**	.931869**	3.464435	-.268297***	-.9974555
		(3.8157)	(.1585742)	(.2057924)		(.0397785)	
	Log TFOC	-22.0060***	.7907673***	.9200519	4.397266	-.321107***	-1.534692
		(2.255733)	(.1265676)	(.1171911)		(.040767)	

5. Analysis of the results

The above regression results by country allow for the elaboration for both short and long-run income and price elasticities of energy demand. As argued in the literature, the income and price elasticity varies country by country based on the social, environmental and economic structure of the country's characteristics. The analysis below will use only the condition of $\beta_1 \succ 0 \; and \; \beta_2 \prec 0$, and $\beta_1 and \; \beta_2$ as statistically significant, to elaborate on the result.

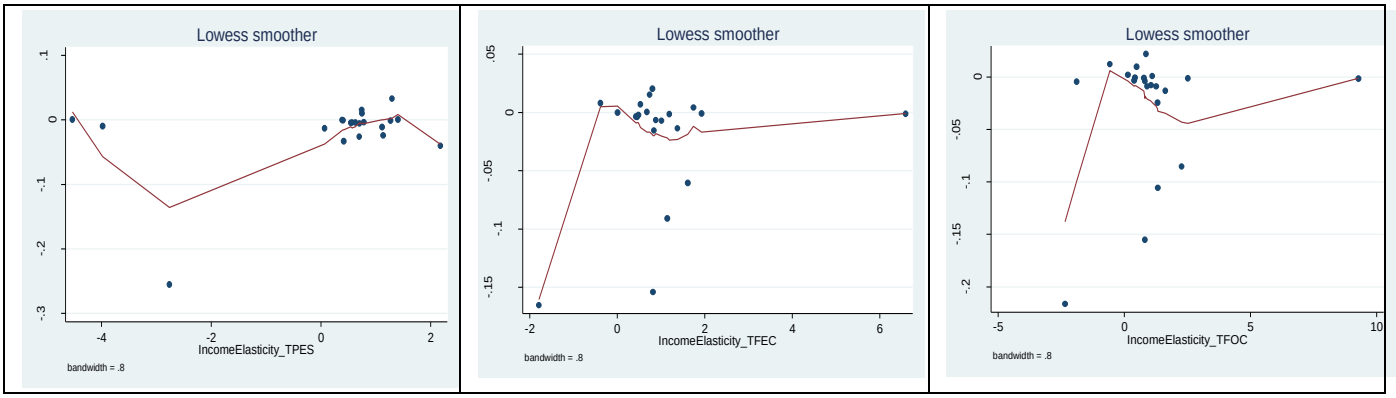
a. Analysis of Sensitivity by Country

Australia: For both short and long-run price elasticities for Australia, the range goes from -.022 to -.038. This means that energy price is inelastic in Australia. Figure 1a shows that price elasticity generally centers on just below or above zero. However, income elasticity ranges from 0.25 to 1.5, meaning that the income elasticity has moved from inelastic or less sensitive to more than unity or responsive.

The above inelastic energy price and elastic income in the Australian context could be explained by the fact that Australia is a large exporter of energy resources such as oil, coal and gas. High energy price would bring an increase of revenue and thereby induce domestic energy consumption due to income effect rather than to

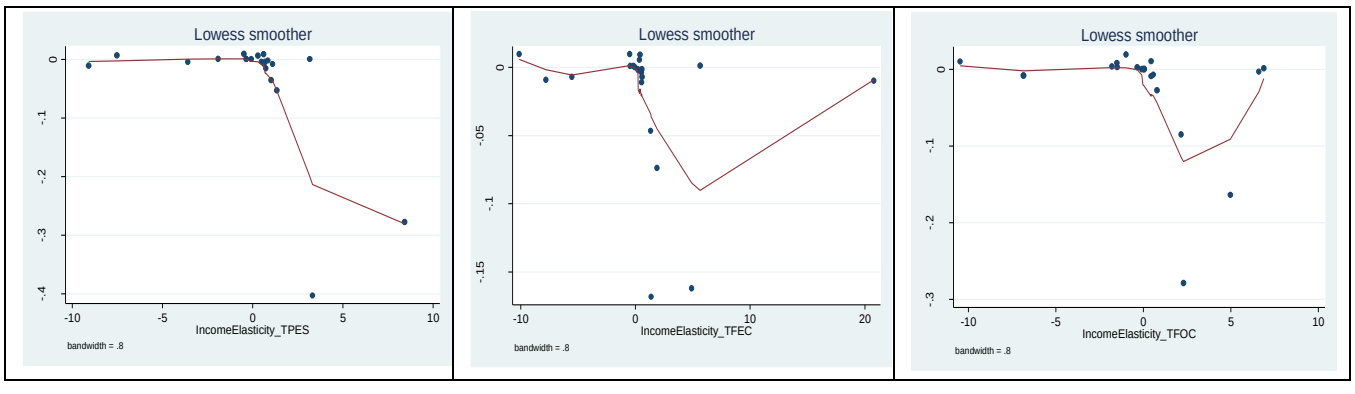
price effect. In short, any change in energy price will not induce an equal change in energy demand.

Figure 1a: Price and Income Elasticity in Australia



Japan: Price elasticity for Japan ranges from -.10 to -0.12. This means that price is very inelastic or insensitive in the case of Japan but the impact of price sensitivity is higher than that of Australia. For income elasticity, it ranges from 1.27 to 1.49. This means that the income elasticity is elastic or more sensitive in the case of Japan. Again, compared to Australia, Japan's income elasticity has been more sensitive whereas the price elasticity is the same. . Figure 1b shows that income elasticity is greater than price elasticity, with price elasticity centering around or below zero and income elasticity centering mostly above zero to more than unity.

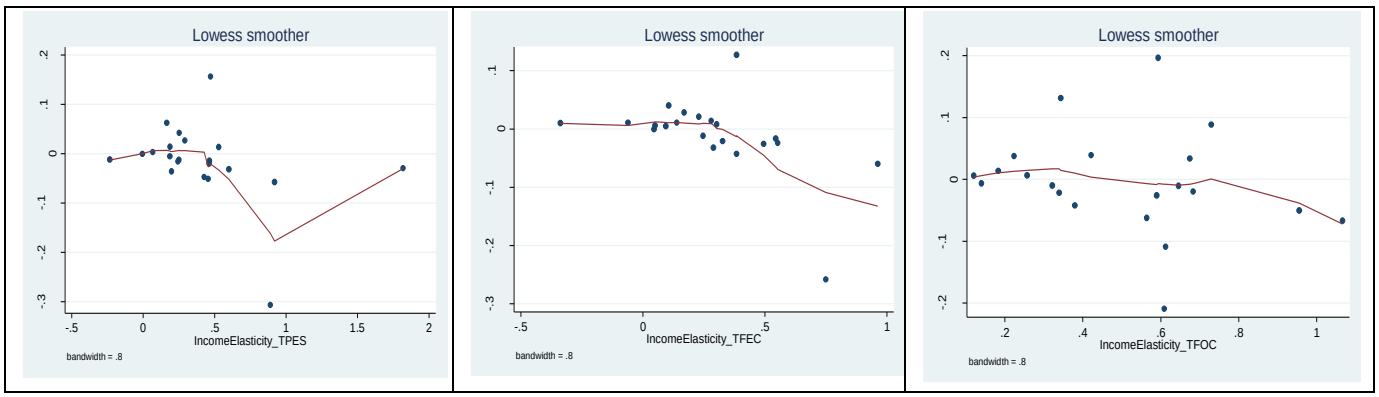
Figure 1b: Price and Income Elasticity in Japan



China: The strangeness of price elasticity in China is that the sign is positive (+) and significant. This could be explained more by the structural transformation in China during the economic growth where industries need more energy and price keeps on increasing. Thus, in this case, the price is very insensitive in China. Additionally, energy subsidies such as gasoline price in China are a reason why the energy price increase shows plus effect to energy demand. For income elasticity, meanwhile, it ranges from 0.13 to 0.78, indicating that income elasticity has moved from being inelastic or less sensitive to being close to unity or sensitive.

Figure 1c shows that most of the time, price elasticity in China centers above and below zero value due to its insensitiveness, while income elasticity stays above zero all the time, reflecting an income sensitivity for energy demand. However, China's income sensitivity is smaller than that of Japan.

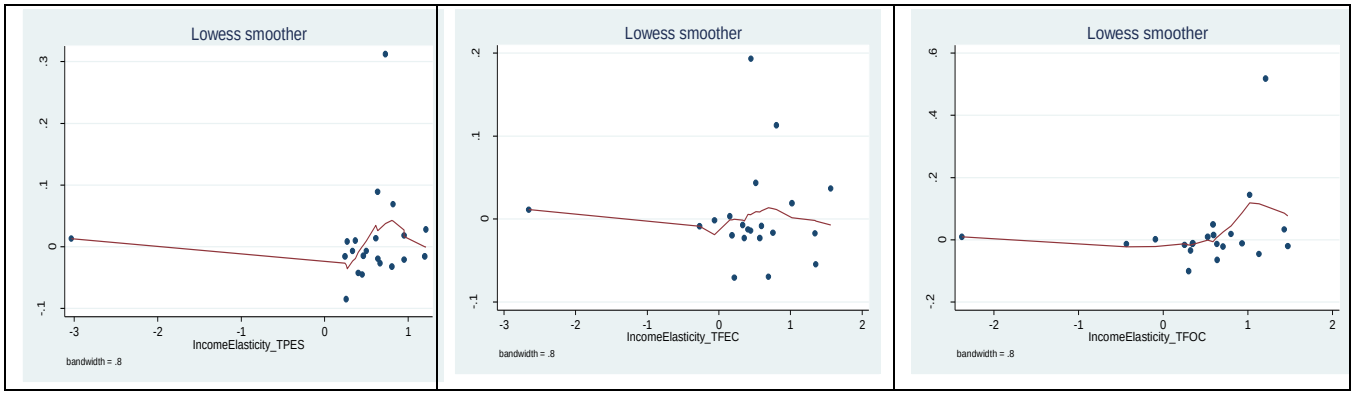
Figure 1c: Price and Income Elasticity in China



India: Price elasticity for India ranges from -0.06 to -0.15. This means that price is inelastic or insensitive. The inelastic price in India could be explained by several reasons such as fuel subsidy by the state and lack of alternative mode of fuel substitution especially for the transportation sector. For income elasticity, it ranges from 0.31 to 1.07. This means that the income elasticity has moved from inelastic or less sensitive to more than unity or became sensitive in India. In this case, income elasticity is more responsive than price elasticity.

Figure 1d shows that price is inelastic and centers above and just below zero value, while income elasticity is more responsive and centers mostly around unity or close to 2 value.

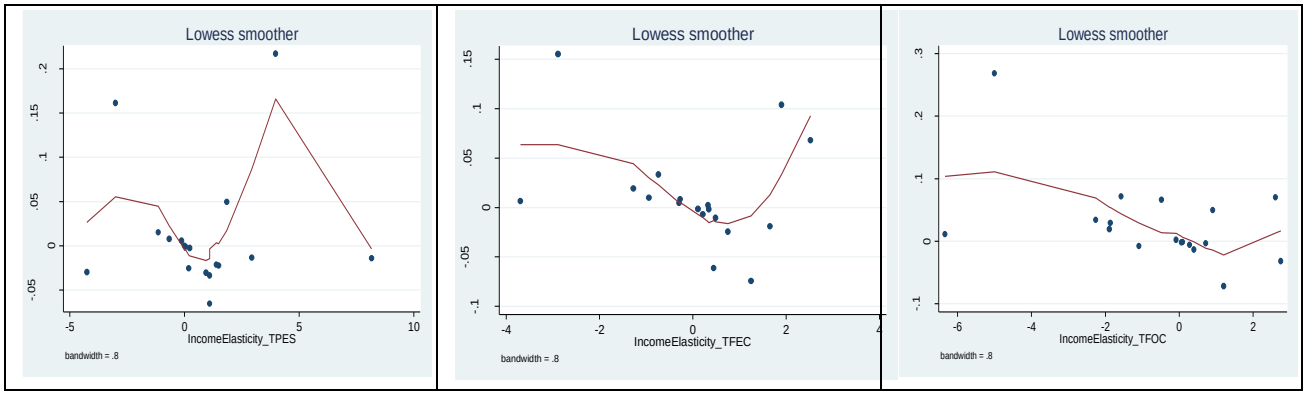
Figure 1d: Price and Income Elasticity in India



Philippines: Price elasticity for the Philippines ranges from -0.12 to -0.35. This means that price is inelastic, but it appears to be very much more sensitive than Australia, Japan, India and China. For income elasticity, it ranges from 0.18 to 2.63. This means that the income elasticity has moved from inelastic to very elastic or sensitive in the Philippines.

Figure 1e shows that most of the time, price elasticity centers just above and below zero value while income elasticity scatters above zero and more than unity, and some times, even more than the value of 2.

Figure 1e: Price and income elasticity in the Philippines

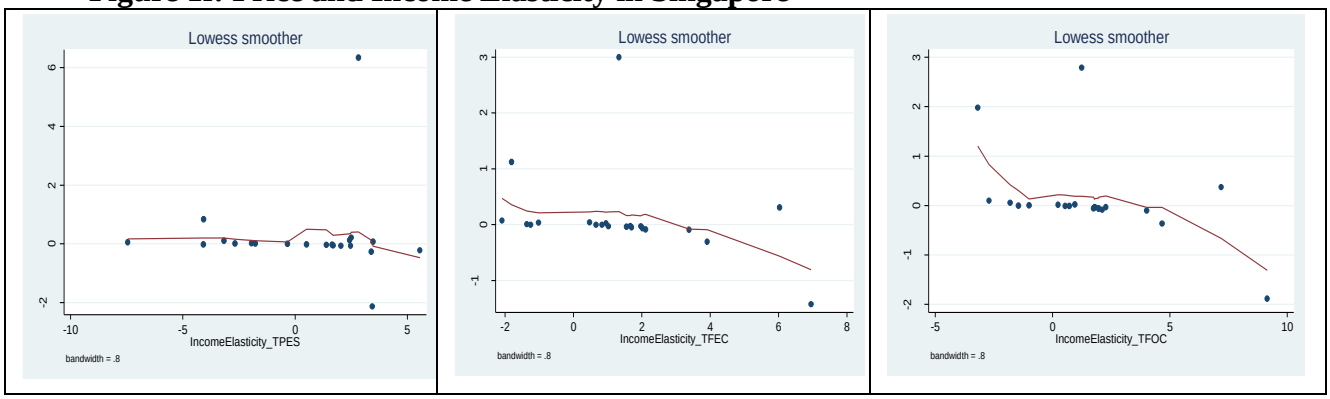


Singapore: Price elasticity for Singapore ranges from -0.35 to -1.07. This means that price has moved from elastic or unity in the case of Singapore. It appears that price elasticity in Singapore is higher than all countries in this study, except Thailand. For income elasticity, it ranges from 0.59 to 2.95. This means that the income elasticity has been sensitive or more than unity in Singapore.

Except Thailand, both price and income elasticity in Singapore are responsive more than all countries in this case study.

Figure 1f shows that price elasticity in Singapore centers from below zero to unity, while income elasticity scatters above zero to more than unity. These mean that both price and income elasticities are responsive.

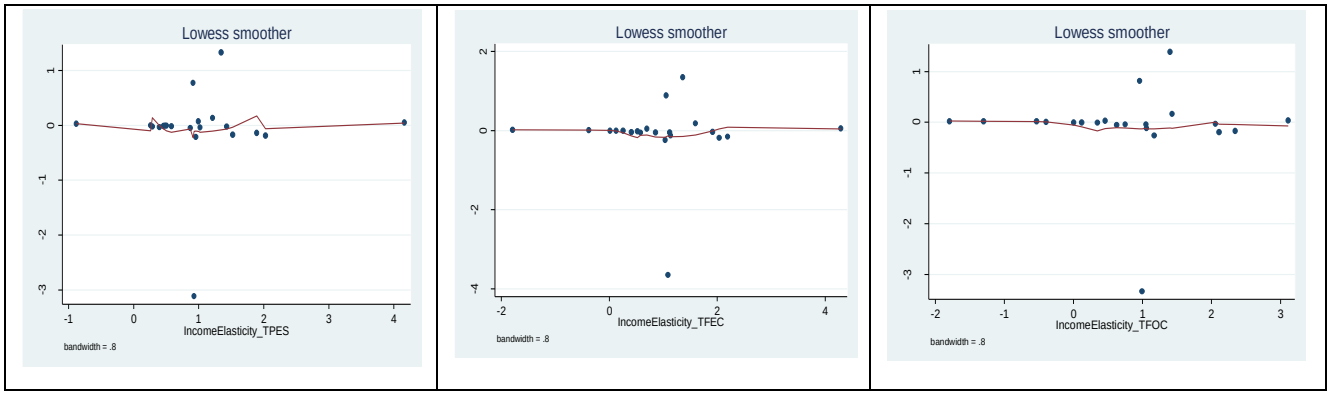
Figure 1f: Price and Income Elasticity in Singapore



Thailand: Price elasticity for Thailand ranges from -0.16 to -1.53, meaning that price has moved from inelastic to very elastic or sensitive. This could be explained by the use of alternative fuels in the transport sector where Thailand has introduced both gas and biofuels for transportation. Therefore, price elasticity in Thailand seems to be the most responsive to change in energy price. For income elasticity, it ranges from 0.56 to 3.46. This means that the income elasticity has moved from inelastic or less sensitive to very sensitive or very elastic in Thailand.

Figure 1g shows that both price and income elasticities are very elastic as they move from the short to the long run.

Figure 1g: Price and Income Elasticity in Thailand



b. Analysis of Sensitivity by Period

The analysis of sensitivity of both price and income elasticity looks into selected three countries for the price and income elasticity during the period 1990-2000, and 2000-2010 as follows:

For the Philippines: The price elasticity in the Philippines was -0.22 during the period 1990-2000, lower than -0.35 during the period 2000-2010. For income elasticity, the impact was 2.63 in 1990-2000 compared with 0.91 in 2000-2010. This means that price elasticity in the case of the Philippines was higher in the period 1900-2000 than in the period 2000-2010. Income elasticity, on the other hand, was lower in the period 1990-2000 than in the period 2000-2010. The average per capita income of the Filipino in 1990-2000 was about USD 1,005 while in 2000-2010, it was about USD 1,200 at the constant price for the year 2000.

For Singapore: The price elasticity in Singapore was insignificant during the period 1990-2000 compared to -1.07 during the period 2000-2010. For the income elasticity, it showed that the impact of income elasticity was 1.27 in the period 1990-2000 which was lower than 2.95 in the period 2000-2010. The average per capita income of the Singaporean in 1990-2000 was about USD 20,265 while in 2000-2010, it was about USD 28,185 at constant price for the year 2000.

For India: The price elasticity in India was insignificant in both periods of 1990-2000 and 2000-2010. For the income elasticity, it showed that the impact of income elasticity was 1.07 in 1990-2000 compared with 0.57 in 2000-2010. The average per capita income of the Indian in 1990-2000 was about USD 475 while in

2000-2010, it was about USD 763 at constant price for the year 2000.

c. Analysis of Sensitivity by Energy Type

In terms of energy type, this study generally observed that the price elasticity of demand by TFOC has a greater impact than the price elasticities of TPES and TFEC. Furthermore, the price elasticity of TFEC has a smaller impact than the price elasticity of TFOC. However, for the income elasticity, it is observed that the income elasticity of TFOC is bigger than the income elasticity of TFEC and TPES. However, this result is really theoretical because crude oil price is used as overall energy price for TPES and TFEC albeit the fact that the two latter variables also include a variety of other energy sources such as hydro and nuclear.

6. Key Findings

The pattern of price elasticity largely depends on whether the income level is for developed countries or for developing countries. Price elasticity in developing counties is more sensitive than in developed countries. In this study, it was found that Thailand, Singapore and the Philippines have been price sensitive compared to other developing and developed countries. For income elasticity, this study also found that income has been very sensitive toward energy consumption, except in countries like India, China and Australia due to energy supply limitation in the cases of India and China, and to less energy intensive industrial structure in the case of Australia. Among the countries that have high income elasticity are Japan, the Philippines, Singapore, and Thailand.

Inelastic price of energy demand has been observed in all the case studies. However, the degree of sensitivity of price elasticity varies from country to country depending on the characteristics of the country's economic structure and on the dichotomy of the income levels between developed and developing countries. In theory, price signal has played a central role in adjusting demand and supply for the market clearing. However, the energy commodity has been highly regulated and thus price signal may not be functioning as the way it used to be. The sensitivity of

price helps to reduce the energy demand although this may not be true, to a large extent, in a fully liberalized market. The findings clearly point to the effect of energy subsidies on energy prices wherein any increase in price helps to reduce energy consumption by less than unity.

On the other hand, income elasticity has a higher sensitivity than price. This could be attributed to the income effects on an individual who would like to consume more energy with his/her higher income through the purchase of vehicles and appliances. This income effect could apply to all end-user sectors in which the transportation sector is likely to have the greatest impact.

In this regard, it can be said that the subsidies will surely reduce the momentum of promoting energy efficiency and diversification of energy sources.

7. Policy Implications

The finding of price inelasticity of energy consumption in the country case studies implies that subsidies were applied in these countries, thereby preventing price increases from curbing energy demand. In this situation, price alone failed to affect energy demand. In view of this, it may be prudent for countries in ASEAN to take the following actions in order to curb the continuous growth of energy demand:

- Gradual removal of energy subsidies as a blanket policy,; rather than providing subsidies, said countries can focus instead on granting access to marginalized groups to energy uses; and

- Promotion of energy efficiency which is a key to curb energy demand in cases where consumers in countries showing high income elasticity or low price elasticity can purchase more energy-*efficient* products.

References

Cooper, J. C. B. (2003), 'Price Elasticity of Demand for Crude Oil: Estimates for 23 Countries', *Organization of the Petroleum Exporting Countries (OPEC) Review* 27(1), pp.1-8.

Fan, S. and R. J. Hyndman (2010), 'The Price Elasticity of Energy Demand in South Australia', Working paper 16/10. Department of Econometrics and Business Statistics of Monash University.

Meier, P. M. (1986), *Energy Planning in Developing Countries: An Introduction to Analytical Methods*. New York: State University of New York, Westview Press.

Research and Economic Analysis Division (READ) of the Department of Business, Economic Development and Tourism, State of Hawaii (2011), *Income and Price Elasticity of Hawaii Energy Demand. Economic Issues*. Available at: http://hawaii.gov/dbedt/info/economic

Wooldridge, J. M. (2003), *Introductory Econometrics. A modern Approach*. USA: Thomson, South-Western.

ERIA Discussion Paper Series

No.	Author(s)	Title	Year
2014-05	Han PHOUMIN and Shigeru KIMURA	Analysis on Price Elasticity of Energy Demand in East Asia: Empirical Evidence and Policy Implications for ASEAN and East Asia	Apr 2014
2014-04	Youngho CHANG and Yanfei LI	Non-renewable Resources in Asian Economies: Perspectives of Availability, Applicability, Acceptability, and Affordability	Feb 2014
2014-03	Yasuyuki SAWADA and Fauziah ZEN	Disaster Management in ASEAN	Jan 2014
2014-02	Cassey LEE	Competition Law Enforcement in Malaysia	Jan 2014
2014-01	Rizal SUKMA	ASEAN Beyond 2015: The Imperatives for Further Institutional Changes	Jan 2014
2013-38	Toshihiro OKUBO, Fukunari KIMURA, Nozomu TESHIMA	Asian Fragmentation in the Global Financial Crisis	Dec 2013
2013-37	Xunpeng SHI and Cecilya MALIK	Assessment of ASEAN Energy Cooperation within the ASEAN Economic Community	Dec 2013
2013-36	Tereso S. TULLAO, Jr. And Christopher James CABUAY	Eduction and Human Capital Development to Strengthen R&D Capacity in the ASEAN	Dec 2013
2013-35	Paul A. RASCHKY	Estimating the Effects of West Sumatra Public Asset Insurance Program on Short-Term Recovery after the September 2009 Earthquake	Dec 2013
2013-34	Nipon POAPONSAKORN and Pitsom MEETHOM	Impact of the 2011 Floods, and Food Management in Thailand	Nov 2013
2013-33	Mitsuyo ANDO	Development and Resructuring of Regional Production/Distribution Networks in East Asia	Nov 2013
2013-32	Mitsuyo ANDO and Fukunari KIMURA	Evolution of Machinery Production Networks: Linkage of North America with East Asia?	Nov 2013
2013-31	Mitsuyo ANDO and Fukunari KIMURA	What are the Opportunities and Challenges for ASEAN?	Nov 2013
2013-30	Simon PEETMAN	Standards Harmonisation in ASEAN: Progress, Challenges and Moving Beyond 2015	Nov 2013

No.	Author(s)	Title	Year
2013-29	Jonathan KOH and Andrea Feldman MOWERMAN	Towards a Truly Seamless Single Windows and Trade Facilitation Regime in ASEAN Beyond 2015	Nov 2013
2013-28	Rajah RASIAH	Stimulating Innovation in ASEAN Institutional Support, R&D Activity and Intelletual Property Rights	Nov 2013
2013-27	Maria Monica WIHARDJA	Financial Integration Challenges in ASEAN beyond 2015	Nov 2013
2013-26	Tomohiro MACHIKITA and Yasushi UEKI	Who Disseminates Technology to Whom, How, and Why: Evidence from Buyer-Seller Business Networks	Nov 2013
2013-25	Fukunari KIMURA	Reconstructing the Concept of "Single Market a Production Base" for ASEAN beyond 2015	Oct 2013
2013-24	Olivier CADOT Ernawati MUNADI Lili Yan ING	Streamlining NTMs in ASEAN: The Way Forward	Oct 2013
2013-23	Charles HARVIE, Dionisius NARJOKO, Sothea OUM	Small and Medium Enterprises' Access to Finance: Evidence from Selected Asian Economies	Oct 2013
2013-22	Alan Khee-Jin TAN	Toward a Single Aviation Market in ASEAN: Regulatory Reform and Industry Challenges	Oct 2013
2013-21	Hisanobu SHISHIDO, Shintaro SUGIYAMA, Fauziah ZEN	Moving MPAC Forward: Strengthening Public-Private Partnership, Improving Project Portfolio and in Search of Practical Financing Schemes	Oct 2013
2013-20	Barry DESKER, Mely CABALLERO-ANTHONY, Paul TENG	Thought/Issues Paper on ASEAN Food Security: Towards a more Comprehensive Framework	Oct 2013
2013-19	Toshihiro KUDO, Satoru KUMAGAI, So UMEZAKI	Making Myanmar the Star Growth Performer in ASEAN in the Next Decade: A Proposal of Five Growth Strategies	Sep 2013
2013-18	Ruperto MAJUCA	Managing Economic Shocks and Macroeconomic Coordination in an Integrated Region: ASEAN Beyond 2015	Sep 2013

No.	Author(s)	Title	Year
2013-17	Cassy LEE and Yoshifumi FUKUNAGA	Competition Policy Challenges of Single Market and Production Base	Sep 2013
2013-16	Simon TAY	Growing an ASEAN Voice? : A Common Platform in Global and Regional Governance	Sep 2013
2013-15	Danilo C. ISRAEL and Roehlano M. BRIONES	Impacts of Natural Disasters on Agriculture, Food Security, and Natural Resources and Environment in the Philippines	Aug 2013
2013-14	Allen Yu-Hung LAI and Seck L. TAN	Impact of Disasters and Disaster Risk Management in Singapore: A Case Study of Singapore's Experience in Fighting the SARS Epidemic	Aug 2013
2013-13	Brent LAYTON	Impact of Natural Disasters on Production Networks and Urbanization in New Zealand	Aug 2013
2013-12	Mitsuyo ANDO	Impact of Recent Crises and Disasters on Regional Production/Distribution Networks and Trade in Japan	Aug 2013
2013-11	Le Dang TRUNG	Economic and Welfare Impacts of Disasters in East Asia and Policy Responses: The Case of Vietnam	Aug 2013
2013-10	Sann VATHANA, Sothea OUM, Ponhrith KAN, Colas CHERVIER	Impact of Disasters and Role of Social Protection in Natural Disaster Risk Management in Cambodia	Aug 2013
2013-09	Sommarat CHANTARAT, Krirk PANNANGPETCH, Nattapong PUTTANAPONG, Preesan RAKWATIN, and Thanasin TANOMPONGPHANDH	Index-Based Risk Financing and Development of Natural Disaster Insurance Programs in Developing Asian Countries	Aug 2013
2013-08	Ikumo ISONO and Satoru KUMAGAI	Long-run Economic Impacts of Thai Flooding: Geographical Simulation Analysis	July 2013
2013-07	Yoshifumi FUKUNAGA and Hikaru ISHIDO	Assessing the Progress of Services Liberalization in the ASEAN-China Free Trade Area (ACFTA)	May 2013
2013-06	Ken ITAKURA, Yoshifumi FUKUNAGA, and Ikumo ISONO	A CGE Study of Economic Impact of Accession of Hong Kong to ASEAN-China Free Trade Agreement	May 2013
2013-05	Misa OKABE and Shujiro	The Impact of AFTA on Intra-AFTA Trade	May

No.	Author(s)	Title	Year
	URATA		2013
2013-04	Kohei SHIINO	How Far Will Hong Kong's Accession to ACFTA will Impact on Trade in Goods?	May 2013
2013-03	Cassey LEE and Yoshifumi FUKUNAGA	ASEAN Regional Cooperation on Competition Policy	Apr 2013
2013-02	Yoshifumi FUKUNAGA and Ikumo ISONO	Taking ASEAN+1 FTAs towards the RCEP: A Mapping Study	Jan 2013
2013-01	Ken ITAKURA	Impact of Liberalization and Improved Connectivity and Facilitation in ASEAN for the ASEAN Economic Community	Jan 2013
2012-17	Sun XUEGONG, Guo LIYAN, Zeng ZHENG	Market Entry Barriers for FDI and Private Investors: Lessons from China's Electricity Market	Aug 2012
2012-16	Yanrui WU	Electricity Market Integration: Global Trends and Implications for the EAS Region	Aug 2012
2012-15	Youngho CHANG, Yanfei LI	Power Generation and Cross-border Grid Planning for the Integrated ASEAN Electricity Market: A Dynamic Linear Programming Model	Aug 2012
2012-14	Yanrui WU, Xunpeng SHI	Economic Development, Energy Market Integration and Energy Demand: Implications for East Asia	Aug 2012
2012-13	Joshua AIZENMAN, Minsoo LEE, and Donghyun PARK	The Relationship between Structural Change and Inequality: A Conceptual Overview with Special Reference to Developing Asia	July 2012
2012-12	Hyun-Hoon LEE, Minsoo LEE, and Donghyun PARK	Growth Policy and Inequality in Developing Asia: Lessons from Korea	July 2012
2012-11	Cassey LEE	Knowledge Flows, Organization and Innovation: Firm-Level Evidence from Malaysia	June 2012
2012-10	Jacques MAIRESSE, Pierre MOHNEN, Yayun ZHAO, and Feng ZHEN	Globalization, Innovation and Productivity in Manufacturing Firms: A Study of Four Sectors of China	June 2012
2012-09	Ari KUNCORO	Globalization and Innovation in Indonesia: Evidence from Micro-Data on Medium and Large Manufacturing Establishments	June 2012

No.	Author(s)	Title	Year
2012-08	Alfons PALANGKARAYA	The Link between Innovation and Export: Evidence from Australia's Small and Medium Enterprises	June 2012
2012-07	Chin Hee HAHN and Chang-Gyun PARK	Direction of Causality in Innovation-Exporting Linkage: Evidence on Korean Manufacturing	June 2012
2012-06	Keiko ITO	Source of Learning-by-Exporting Effects: Does Exporting Promote Innovation?	June 2012
2012-05	Rafaelita M. ALDABA	Trade Reforms, Competition, and Innovation in the Philippines	June 2012
2012-04	Toshiyuki MATSUURA and Kazunobu HAYAKAWA	The Role of Trade Costs in FDI Strategy of Heterogeneous Firms: Evidence from Japanese Firm-level Data	June 2012
2012-03	Kazunobu HAYAKAWA, Fukunari KIMURA, and Hyun-Hoon LEE	How Does Country Risk Matter for Foreign Direct Investment?	Feb 2012
2012-02	Ikumo ISONO, Satoru KUMAGAI, Fukunari KIMURA	Agglomeration and Dispersion in China and ASEAN: A Geographical Simulation Analysis	Jan 2012
2012-01	Mitsuyo ANDO and Fukunari KIMURA	How Did the Japanese Exports Respond to Two Crises in the International Production Network?: The Global Financial Crisis and the East Japan Earthquake	Jan 2012
2011-10	Tomohiro MACHIKITA and Yasushi UEKI	Interactive Learning-driven Innovation in Upstream-Downstream Relations: Evidence from Mutual Exchanges of Engineers in Developing Economies	Dec 2011
2011-09	Joseph D. ALBA, Wai-Mun CHIA, and Donghyun PARK	Foreign Output Shocks and Monetary Policy Regimes in Small Open Economies: A DSGE Evaluation of East Asia	Dec 2011
2011-08	Tomohiro MACHIKITA and Yasushi UEKI	Impacts of Incoming Knowledge on Product Innovation: Econometric Case Studies of Technology Transfer of Auto-related Industries in Developing Economies	Nov 2011
2011-07	Yanrui WU	Gas Market Integration: Global Trends and Implications for the EAS Region	Nov 2011
2011-06	Philip Andrews-SPEED	Energy Market Integration in East Asia: A Regional Public Goods Approach	Nov 2011

No.	Author(s)	Title	Year
2011-05	Yu SHENG, Xunpeng SHI	Energy Market Integration and Economic Convergence: Implications for East Asia	Oct 2011
2011-04	Sang-Hyop LEE, Andrew MASON, and Donghyun PARK	Why Does Population Aging Matter So Much for Asia? Population Aging, Economic Security and Economic Growth in Asia	Aug 2011
2011-03	Xunpeng SHI, Shinichi GOTO	Harmonizing Biodiesel Fuel Standards in East Asia: Current Status, Challenges and the Way Forward	May 2011
2011-02	Hikari ISHIDO	Liberalization of Trade in Services under ASEAN+n : A Mapping Exercise	May 2011
2011-01	Kuo-I CHANG, Kazunobu HAYAKAWA Toshiyuki MATSUURA	Location Choice of Multinational Enterprises in China: Comparison between Japan and Taiwan	Mar 2011
2010-11	Charles HARVIE, Dionisius NARJOKO, Sothea OUM	Firm Characteristic Determinants of SME Participation in Production Networks	Oct 2010
2010-10	Mitsuyo ANDO	Machinery Trade in East Asia, and the Global Financial Crisis	Oct 2010
2010-09	Fukunari KIMURA Ayako OBASHI	International Production Networks in Machinery Industries: Structure and Its Evolution	Sep 2010
2010-08	Tomohiro MACHIKITA, Shoichi MIYAHARA, Masatsugu TSUJI, and Yasushi UEKI	Detecting Effective Knowledge Sources in Product Innovation: Evidence from Local Firms and MNCs/JVs in Southeast Asia	Aug 2010
2010-07	Tomohiro MACHIKITA, Masatsugu TSUJI, and Yasushi UEKI	How ICTs Raise Manufacturing Performance: Firm-level Evidence in Southeast Asia	Aug 2010
2010-06	Xunpeng SHI	Carbon Footprint Labeling Activities in the East Asia Summit Region: Spillover Effects to Less Developed Countries	July 2010
2010-05	Kazunobu HAYAKAWA, Fukunari KIMURA, and Tomohiro MACHIKITA	Firm-level Analysis of Globalization: A Survey of the Eight Literatures	Mar 2010

No.	Author(s)	Title	Year
2010-04	Tomohiro MACHIKITA and Yasushi UEKI	The Impacts of Face-to-face and Frequent Interactions on Innovation: Upstream-Downstream Relations	Feb 2010
2010-03	Tomohiro MACHIKITA and Yasushi UEKI	Innovation in Linked and Non-linked Firms: Effects of Variety of Linkages in East Asia	Feb 2010
2010-02	Tomohiro MACHIKITA and Yasushi UEKI	Search-theoretic Approach to Securing New Suppliers: Impacts of Geographic Proximity for Importer and Non-importer	Feb 2010
2010-01	Tomohiro MACHIKITA and Yasushi UEKI	Spatial Architecture of the Production Networks in Southeast Asia: Empirical Evidence from Firm-level Data	Feb 2010
2009-23	Dionisius NARJOKO	Foreign Presence Spillovers and Firms' Export Response: Evidence from the Indonesian Manufacturing	Nov 2009
2009-22	Kazunobu HAYAKAWA, Daisuke HIRATSUKA, Kohei SHIINO, and Seiya SUKEGAWA	Who Uses Free Trade Agreements?	Nov 2009
2009-21	Ayako OBASHI	Resiliency of Production Networks in Asia: Evidence from the Asian Crisis	Oct 2009
2009-20	Mitsuyo ANDO and Fukunari KIMURA	Fragmentation in East Asia: Further Evidence	Oct 2009
2009-19	Xunpeng SHI	The Prospects for Coal: Global Experience and Implications for Energy Policy	Sept 2009
2009-18	Sothea OUM	Income Distribution and Poverty in a CGE Framework: A Proposed Methodology	Jun 2009
2009-17	Erlinda M. MEDALLA and Jenny BALBOA	ASEAN Rules of Origin: Lessons and Recommendations for the Best Practice	Jun 2009
2009-16	Masami ISHIDA	Special Economic Zones and Economic Corridors	Jun 2009
2009-15	Toshihiro KUDO	Border Area Development in the GMS: Turning the Periphery into the Center of Growth	May 2009
2009-14	Claire HOLLWEG and Marn-Heong WONG	Measuring Regulatory Restrictions in Logistics Services	Apr 2009

No.	Author(s)	Title	Year
2009-13	Loreli C. De DIOS	Business View on Trade Facilitation	Apr 2009
2009-12	Patricia SOURDIN and Richard POMFRET	Monitoring Trade Costs in Southeast Asia	Apr 2009
2009-11	Philippa DEE and Huong DINH	Barriers to Trade in Health and Financial Services in ASEAN	Apr 2009
2009-10	Sayuri SHIRAI	The Impact of the US Subprime Mortgage Crisis on the World and East Asia: Through Analyses of Cross-border Capital Movements	Apr 2009
2009-09	Mitsuyo ANDO and Akie IRIYAMA	International Production Networks and Export/Import Responsiveness to Exchange Rates: The Case of Japanese Manufacturing Firms	Mar 2009
2009-08	Archanun KOHPAIBOON	Vertical and Horizontal FDI Technology Spillovers:Evidence from Thai Manufacturing	Mar 2009
2009-07	Kazunobu HAYAKAWA, Fukunari KIMURA, and Toshiyuki MATSUURA	Gains from Fragmentation at the Firm Level: Evidence from Japanese Multinationals in East Asia	Mar 2009
2009-06	Dionisius A. NARJOKO	Plant Entry in a More LiberalisedIndustrialisationProcess: An Experience of Indonesian Manufacturing during the 1990s	Mar 2009
2009-05	Kazunobu HAYAKAWA, Fukunari KIMURA, and Tomohiro MACHIKITA	Firm-level Analysis of Globalization: A Survey	Mar 2009
2009-04	Chin Hee HAHN and Chang-Gyun PARK	Learning-by-exporting in Korean Manufacturing: A Plant-level Analysis	Mar 2009
2009-03	Ayako OBASHI	Stability of Production Networks in East Asia: Duration and Survival of Trade	Mar 2009
2009-02	Fukunari KIMURA	The Spatial Structure of Production/Distribution Networks and Its Implication for Technology Transfers and Spillovers	Mar 2009
2009-01	Fukunari KIMURA and Ayako OBASHI	International Production Networks: Comparison between China and ASEAN	Jan 2009
2008-03	Kazunobu HAYAKAWA and Fukunari KIMURA	The Effect of Exchange Rate Volatility on International Trade in East Asia	Dec 2008

No.	Author(s)	Title	Year
2008-02	Satoru KUMAGAI, Toshitaka GOKAN, Ikumo ISONO, and Souknilanh KEOLA	Predicting Long-Term Effects of Infrastructure Development Projects in Continental South East Asia: IDE Geographical Simulation Model	Dec 2008
2008-01	Kazunobu HAYAKAWA, Fukunari KIMURA, and Tomohiro MACHIKITA	Firm-level Analysis of Globalization: A Survey	Dec 2008