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**ENERGY AND ITS IMPACT ON ECONOMIC SECTORS
AND THE ENVIRONMENT**



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**DOCTOR OF PHILOSOPHY
UNIVERSITI UTARA MALAYSIA
October 2017**

**ENERGY AND ITS IMPACT ON ECONOMIC SECTORS AND THE
ENVIRONMENT**

By

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UUM
Universiti Utara Malaysia

**Thesis Submitted to
Othman Yeop Abdullah Graduate School of Business,
University Utara Malaysia,
in Fulfillment of the Requirement for the Degree of Doctor of Philosophy**



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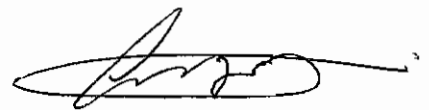
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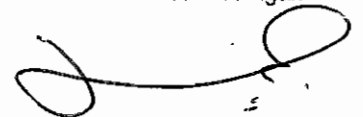
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ABSTRACT

The issue of energy has come to the fore since the proliferation of studies on the effects of its consumption on the environment. A vast array of empirical evidence related to this issue has lent credence to the environmental Kuznets curve (EKC) that economic growth causes greater environmental degradation at the early stages but improves the environment at the final stages. Therefore, this study endeavours to investigate the effects of energy (electricity, gas and oil) consumption on sectorial output and CO₂ emission in Malaysia from 1990 to 2014. Panel data analysis methods (namely, Fully Modified Ordinary Least Square, Pooled Mean Group and Mean Group) are employed in this study. The results show that, in the long run, aggregate output hinges on energy consumption. In the short run, energy consumption does not contribute to any change in output. It is found that gas consumption can have an influence on output in the industrial and transportation sectors but oil and electricity consumption does not have any impact on all sectorial output in Malaysia. The findings show that the consumption of electricity, gas and oil can have detrimental effects on the environment in the long run. However, in the short run, only oil consumption can be hazardous to the environment. Oil consumption in the agricultural and transportation sectors has a significant effect on CO₂ emission. Gas consumption in the transportation sector can also cause pollution albeit a little. Electricity consumption in the transportation sector has a favourable effect on the environment as it can reduce CO₂ emission. The results show that increasing aggregate output can inflict pollution only in the long run. Enhancing output in the agricultural, transportation and industrial sectors does not trigger any environmental issue. Therefore, the consumption of non-renewable energy such as oil, gas and electricity should be reduced in order to conserve the environment.

Keywords: energy consumption, sectorial, output, CO₂ emission, panel data analysis

ABSTRAK

Isu mengenai tenaga semakin mendapat perhatian semenjak terdapat percambahan kajian berkenaan kesan penggunaan tenaga terhadap alam sekitar. Banyak bukti empirik berkaitan dengan isu ini telah menyokong keluk persekitaran *Kuznets (EKC)* bahawa pertumbuhan ekonomi menyebabkan peningkatan kerosakan alam sekitar pada peringkat awal tetapi alam sekitar menjadi bertambah baik pada peringkat akhir. Oleh itu, kajian ini cuba mengkaji kesan penggunaan tenaga (penggunaan minyak, gas dan elektrik) ke atas output sektor dan pelepasan CO₂ di Malaysia dari tahun 1990 hingga 2014. Kaedah analisis data panel (iaitu *Fully Modified Ordinary Least Square, Pooled Mean Group and Mean Group*) digunakan dalam kajian ini. Dapatan kajian menunjukkan bahawa output agregat bergantung kepada penggunaan tenaga dalam jangka panjang. Dalam jangka pendek, penggunaan tenaga tidak menyumbang kepada sebarang perubahan dalam output. Penggunaan gas didapati mempengaruhi output sektor perindustrian dan sektor pengangkutan tetapi penggunaan minyak dan penggunaan elektrik tidak mempunyai sebarang kesan terhadap output dalam semua sektor di Malaysia. Dapatan kajian juga menunjukkan bahawa penggunaan elektrik, gas dan minyak boleh membahayakan alam sekitar dalam jangka panjang. Walau bagaimanapun, hanya penggunaan minyak yang boleh membahayakan alam sekitar dalam jangka pendek. Penggunaan minyak dalam sektor pertanian dan sektor pengangkutan boleh memberi kesan yang signifikan terhadap pelepasan CO₂. Penggunaan gas dalam sektor pengangkutan juga menyebabkan pencemaran meskipun sedikit. Penggunaan elektrik di dalam sektor pengangkutan memberi kesan yang baik terhadap alam sekitar kerana ia dapat mengurangkan pelepasan CO₂. Dapatan kajian menunjukkan peningkatan output agregat menyebabkan pencemaran hanya dalam jangka masa panjang. Peningkatan output dalam sektor pertanian, pengangkutan dan perindustrian tidak akan mencetuskan sebarang isu alam sekitar. Justeru itu, penggunaan tenaga yang tidak boleh diperbaharui seperti minyak, gas dan elektrik perlu dikurangkan untuk memelihara alam sekitar.

Kata kunci: penggunaan tenaga, output, sektor, pelepasan CO₂, analisis data panel

ACKNOWLEDGEMENT

Foremost, I would like to express my sincere gratitude to my first supervisor, Associate Professor Dr. Nor Azam Abdul Razak and my second supervisor, Associate Professor Dr. Bakti Hasan Basri for their continuous support of my Ph.D study and research, for their patience, motivation, enthusiasm, and immense knowledge. Their guidance helped me in all the time of research and writing of this thesis. I could not have imagined having better supervisor and mentors for my PhD studies.

Besides my supervisors, I would like to thank the rest of my thesis committee: Associate Professor Dr. Lim Hock Eam, Associate Professor Dr. Azlina Abdul Aziz and Dr. Syamsul Bahrain Rawi for their encouragement, insightful comments and hard questions.

My sincere thanks also goes to Associate Professor Dr. Hussin Abdullah and Dr. Norliza Kushairi for giving me some ideas in completing my thesis.

I thank also my friends, Dr. Nor Ermawati Hussain, Nur Salimah Alias, Diana Nabila Chau Abdullah, Faiz Masnan and Mohd Jurajj Abdul Rani for their moral support and encouragement in completing this thesis.

Last but not the least, I would like to thank my late mother, Khatijah Saidin, for giving birth to me at the first place and supporting me spiritually throughout my life. With her prayer before, I am able to complete this thesis.

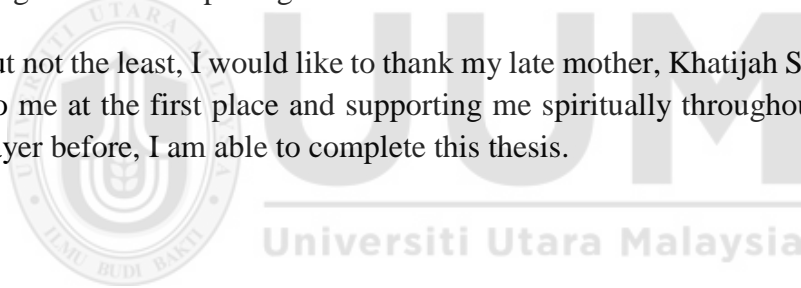


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Abbreviations

ARDL	Autoregressive Distributed Lag
CO ₂	Carbon Dioxide
DOLS	Dynamic Ordinary Least Squares
ECM	Error Correction Model
EKC	Environmental Kuznets Curve
FDI	Foreign Direct Investment
FMOLS	Fully Modified Ordinary Least Squares
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GHG	Green House Gas
GMM	Generalized Method of Moment
GNP	Gross National Produce
GWh	Gigawatt Hour
ktoe	Kiloton of Oil Equivalent
LMDI	Logarithmic Mean Divisia Index
MENA	Middle East and North Africa
MG	Mean Group
OECD	Organisation For Economic Co-Operation And Development
OLS	Ordinary Least Squares
PMG	Pooled Mean Group
STSM	Structural Time Series Technique
TJ	Terajoule
UEDT	Underlying Energy Demand Trend
VAR	Vector Auto-Regression
VECM	Vector Error Correction Model

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

The relationship between national output and energy consumption has attracted many researchers. This is because developing an economy highly requires energy and energy is the main factor of production in every country (Stern & Cleveland, 2004; Hou, 2009; Imran & Sidiqqi, 2010). Energy is consumed to generate various economic activities especially in industries, agriculture, and transportation. Therefore, adequate energy supply is indispensable to ensure that national output can be increased. However the supply of energy is unpredictable as energy sources such as oil, gas and coal can be exhausted.

The scarcity of energy is a great challenge to all countries in deciding how to manage the limited energy resources efficiently. Zaleski (2001) highlighted that although energy acts as a catalyst for a desirable change in the economy, its supply is uncertain. This is because the process of their formation takes billions of years. The rising demand for energy especially in developing countries which rely substantially on energy for development can be met by alternative energy sources. However, the alternative energy sources are costly for example the use of renewable energy. Therefore, the supply cannot meet the rising demand.

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REFERENCE

- Abdul, R. M. & Lee, K. T. (2004). Energy Policy for Sustainable Development in Malaysia. *The Joint International Conference on Sustainable Energy and Environment (SEE)*, Hua Hin, Thailand, 1-3 December.
- Adhikari, D. & Chen, Y. (2012). Energy Consumption and Economic Growth: A Panel Cointegration Analysis for Developing Countries. *Review of Economics and Finance*, vol. 34, 68-80.
- Adom, P. K. (2011). Electricity Consumption - Economic Growth Nexus: The Ghanaian Case. *International Journal of Energy Economics and Policy*, vol. 1 (1), 18-31.
- Ahmed, S. S. & Ahmed, M. F., (2016). Renewable Energy Source: An Overview. *Journal of Applied Science*, vol. 2 (3), 1-7
- Akin, C. S. (2014). The Impact of Foreign Trade, Energy Consumption and Income on CO2 Emissions. *International Journal of Energy Economics and Policy*, vol. 4 (3), 465-475.
- Akinwale, Y., Jesuleye, O., & Siyanbola, W. (2013). Empirical Analysis of Causal Relationship between Electricity Consumption and Economic Growth in Nigeria. *British Journal of Economics, Management and Trade*, vol. 3 (3): 277 – 295.
- Aktas, C. & Yilmaz, V. (2008). Causal Relationship between Oil Consumption and Economic Growth in Turkey. *Kocaeli Universitesi Sosyal Bilimler Enstitusu Dergisi*, vol. 15, 44-55.
- Alam, M., & Huylenbroeck, G.V., (2011). Energy Consumption, CO2 Emissions and The Economic Growth Nexus in Bangladesh: Cointegration and Dynamic Causality Analysis. *Presented at the AAS-ICAS Joint Conference*, Honolulu, Hawaii, USA, Mar, 31-Apr, 3.

- Alberta Utilities Commission. (2011). Hydroelectric Power Generation Development Inquiry. *Proceeding*, no 561.
- Alkathlan, K., Alam, M., & Javid, M. (2012). Carbon dioxide Emissions, Energy Consumption and Economic Growth in Saudi Arabia: A Multivariate Cointegration Analysis. *BrJ Econ Manag Trade*, vol. 2 (4): 327–39.
- Amin, S. B., S. S. Ferdous & A.K. Porna (2012). Causal Relationship among Energy Use, CO2 Emissions and Economic Growth in Bangladesh: An Empirical Study. *World Journal of Social Sciences*, vol. 2 (4), 273-290.
- Amri, F. (2017). Carbon Dioxide Emissions, Output and Energy Consumption Categories in Algeria. *Environmental Science and Pollution Research*. Vol. 24 (17), 14567-14578.
- Apergis, N., & Danuletiu, D. (2012). Energy Consumption and Growth in Romania: Evidence from a Panel Error Correction Model. *International Journal of Energy Economics and Policy*, vol. 2 (4), 348-356.
- Apergis, N. & Payne, J. E. (2010). The Emissions, Energy Consumption, and Growth Nexus: Evidence from the Commonwealth of Independent States. *Energy Policy*, vol. 38 (1), 650-655.
- Apergis, N. & Ozturk, I. (2015). Testing Environmental Kuznets Curve Hypothesis in Asian Countries. *Ecological Indicators*, vol. 52, 16-22
- Asici, A. A. (2011). Economic Growth and its Impact on Environment: A Panel Data Analysis, *MPRA Paper 30238*, University Library of Munich, Germany.
- Atakhanova, Z. & Howie, P. (2007). Electricity Demand in Kazakhstan. *Energy Policy* vol. 35 (7), 3729-3743.
- Atif, S. M. & Siddiqi, M. W. (2010). The Electricity Consumption and Economic Growth Nexus in Pakistan: A New Evidence. *Econstore*, 1-13.

- Aytac, D. & Guran, M. C. (2011). The Relationship between Electricity Consumption, Electricity Price and Economic Growth in Turkey. *Argumenta Oeconomica*, vol. 27 (2), 101-123.
- Azlina, A. A., Law, S. H., & Mustapha, N. H. N. (2014). Dynamic Linkages among Transport Energy Consumption, Income and CO₂ Emission in Malaysia. *Energy Policy*, vol. 73, 598-606.
- Azomahou, T., Laisney, F. & Van, P., P. N., (2006). Economic Development and CO₂ Emissions: A Nonparametric Panel Approach. *Journal of Public Economics*, vol. 90, 1347-1363.
- Bayar, Y. & Ozel, H. A. (2014). Electricity Consumption and Economic Growth in Emerging Economies. *Journal of Knowledge Management, Economics and Information Technology*, vol. 4 (2), 1-18.
- Bedi-uz-Zaman, Farooq, M. & Ullah, A. (2011). Sectorial Oil Consumption and Economic Growth in Pakistan: An ECM approach. *American Journal of Scientific and Industrial Research*, vol. 2 (2), 14-156.
- Begum, R. A., Sohag, K., Abdullah, S. M. S. & Jaafar, M., (2015). CO₂ Emissions, Energy Consumption, Economic and Population Growth in Malaysia. *Renewable and Sustainable Energy Reviews*, vol. 41, 594-601.
- Belke, A, Dobnik, F. & Dreger, C (2011). Energy Consumption and Economic Growth: New Insights into the Co-Integration Relationship. *Energy Economics*, vol. 33 (5), 782-789.
- Bernamea. (2010). Malaysia Komited Jadi 'Negara Hijau'. *Utusan Malaysia*. Retrieved from [http://ww1.utusan.com.my/utusan/info.asp?y=2010&dt=0119&pub=Utusan Malaysia&sec=Muka_Hadapan&pg=mh_03.htm](http://ww1.utusan.com.my/utusan/info.asp?y=2010&dt=0119&pub=Utusan_Malaysia&sec=Muka_Hadapan&pg=mh_03.htm)
- Bildirici, M. E., Bakirtas, T., & Kayikci, F. (2012). Economic Growth and Electricity

- Consumption: Auto Regressive Distributed Lag Analysis. *Journal of Energy in Southern Africa*, vol. 23 (4), 29-45.
- Bildirici M., & Ozaksoy, F. (2013). The Relationship between Economic Growth and Biomass Energy Consumption in Some European Countries, *J. Renewable Sustainable Energy*, vol. 5, 023141.
- Bloch, H., Rafiq, S. & Salim, R. (2011). Coal Consumption, CO₂ Emission and Economic Growth in China. Empirical Evidence and Policy Responses. *Energy Economics*, 518-528.
- Bozkurt, C., & Akan, Y. (2014). Economic Growth, CO₂ Emissions and Energy Consumption: The Turkish Case. *International Journal of Energy Economics and Policy*, vol. 4 (3), 484-494
- Breitung, J. (2000). The Local Power of Some Unit Root Tests for Panel Data, in: B. Baltagi (ed.), *Nonstationary Panels, Panel Co-integration, and Dynamic Panels, Advances in Econometrics*, vol. 15, 161-178
- Campbell, J. Y. & Perron, P. (1991). Pitfall and opportunities: What Macroeconomists Should Know about Unit Roots. *Technical Working Paper 100, NBER Working Paper Series*, Massachusetts, USA: National Bureau Economic Research.
- Carmona, M., Feria, J., Golpe, A.A., & Iglesias, J. (2017). Energy consumption in the US Reconsidered. Evidence across Sources and Economic Sectors. *Renewable and Sustainable Energy Reviews*, vol. 77, 1055–1068
- Cassim, R., Akinboade, O.A., Niedermeier, E. W., Sibanda, F. & Jackson, W. (2004). Sustainable Development: The Case of Energy in South Africa. *TKN Paper*. International Institute for Sustainable Development.
- Chebbi, H. E., & Boujelbene, Y. (2008). CO₂ Emissions, Energy Consumption and Economic Growth in Tunisia. *12th Congress of the European Association of*

- Agricultural Economists*. Retrieved from <http://ageconsearch.umn.edu/bitstream/44016/2/367.pdf>
- Chen, J., & Huang, Y. (2013). The Study of the Relationship between Carbon Dioxide (CO₂) Emission and Economic Growth. *Journal of International and Global Economic Studies*, 45–61.
- Chen, W., Wu, F., Geng, W., & Yu, G. (2016). Carbon Emissions in China's Industrial Sectors. *Resources, Conservation and Recycling* (2016), <http://dx.doi.org/10.1016/j.resconrec.2016.10.008>
- Cheng, B. S. (1999). Causality between Energy Consumption and Economic Growth in India: An Application of Cointegration and Error-correction Modeling. *Indian Economic Review* vol. 34, 39-49.
- Cherniwchan, J. (2012). Economic Growth, Industrialization, and the Environment. *Resource and Energy Economics* vol. 34, 442-467.
- Chouaibi, N., & Abdessalem, T. (2011.). Causality between Electricity Consumption and Economic Growth in Tunisia: Policy Implications. *World Review of Science Technology and Sustainable Development*. Vol. 11 (1), 43 - 60
- Christopoulos, D. K. & Tsionas, E. G. (2004). Financial development and Economic Growth: Evidence from Panel Unit Root and Cointegration Tests. *Journal of Development Economics*, vol. 73, 55-74.
- Ciarreta, A. & Zarraga, A. (2010). Electricity Consumption and Economic Growth in Spain. *Appl. Econ. Lett.* Vol. 17, 1–5
- Ciolkosz, D. P. E. (2017). Why is Renewable Energy? *Pennstate Extension* from extension.psu.edu
- Cobb, C. W. & Douglas, P. H. (1928). *A Theory of Production*. *American Economic Review*, vol. 18 (Supplement), 139–165.

- Coskey, S. K. M. & Kao, C. (1998). A Residual-base Test of the Null of Cointegration in Panel Data. *Econometric Reviews*, vol. 17, 57 – 84.
- Cover, M. (2010). *Government Report Says Global Warming May Cause Cancer, Mental Illness*. Retrieved from <http://www.cnsnews.com/news/article/government-report-says-global-warming-may-cause-cancer-mental-illness>.
- Darmanto, S. & Sigit, I, A. (2006). Analisa Biodiesel Minyak Kelapa Sebagai Bahan Bakar Alternatif Minyak Diesel. *Traksi*, vol. 4 (2), 64-71
- DeMates, L.(2013). *What are the Differences between Biofuels, Bioethanol, Biodiesel, and Biogas? The Sustainability Co-op*. Retrieved on 23 January 2018 at <https://thesustainabilitycooperative.net/2013/12/26/the-difference-between-biofuel-bioethanol-biodiesel-and-biogas/>
- Department of Agriculture Australia. (2013). *Australian Agriculture: Reducing Emissions and Adapting to a Changing Climate Key Findings of the Climate Change Research Program*. Department of Agriculture; Australia.
- Department of Statistics, Malaysia (2014). Retrieved on 24 September 2016 from https://www.statistics.gov.my/index.php?r=column/ctimeseries&menu_id=NHJlaGc2Rlg4ZXlGTjh1SU1kaWY5UT09
- Domingo, J., Miguel, E. D., & Hurtado, B. (2014). *Measures at Farm Level to Reduce Greenhouse Gas Emissions from EU Agriculture*. Directorate-General for Internal Policies, Agriculture and Rural Development; Europe Parliament.
- Dritsaki C., & Dritsaki M. (2014). Causal Relationship between Energy Consumption, Economic Growth and CO2 Emissions: A Dynamic Panel Data Approach. *International Journal of Energy Economics and Policy*, vol. 4 (2), 125-136.
- Engle, R. & Granger, C. W. J. (1987). Cointegration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55, 251-276.

- Environmental Quality Act. (1974). *Act 127*. Malaysia Law; Malaysia.
- Farhani, S. & Rejeb, J.B. (2012). Energy Consumption, Economic Growth and CO2 Emissions: Evidence from Panel Data for MENA Region. *International Journal of Energy Economics and Policy*, 2, 71-81.
- Ghadimzadeha, A., Makmomb, A. A., Mustapha, S., Ho, S., Askaric, A.A., Chngd, J., Naranie, T. S., & Shamsipour, R., (2015). Highlighting of the Factors, Interventions and Policies Affecting CO2 Emissions Level in Malaysian Transportation Sector. *International Journal of Advanced Scientific and Technical Research*, vol. 7 (5), 198-313.
- Ghali, K. H. & El-Sakka, M. I. T. (2004). Energy and Output Growth in Canada: A Multivariate Co-integration Analysis. *Energy Economics*. vol.26 (2), 225–238.
- Grossman, G. M. & Krueger, A. B. (1995). Economic Growth and the Environment. *Quarterly Journal of Economics*. Vol.110 (2). 353-377.
- Hamilton, T. (2009). Biofuels vs Biomass Electricity. *MIT Technology Review*. Retrieved on 23 January 2018 at <https://www.technologyreview.com/s/413406/bio-fuels-vs-biomass-electricity/>
- Harres. (2017). *Tanaman Solar*. Dalam Myagri Consulting di <http://myagri.com.my/2017/01/tanaman-solar/>
- Haryanto, B. (2002). *Bahan Bakar Alternatif Biodiesel*. USU Digital Library; Indonesia.
- Hassaballa, H. (2014). Testing for Granger Causality between Energy Use and Foreign Direct Investment Inflows in Developing Countries. *Renewable and Sustainable Energy Reviews*, vol. 31, 417–426.
- Hitam, M. B., & Borhan, H. B. (2012). FDI, Growth and the Environment: Impact on Quality Life in Malaysia. *Procedia Social and Behavioural Sciences*, vol. 50,333-

42.

- Hodges, A. W., Stevens, T. J. & Rahmani, M. (2010). *Economic Impacts of Expended Woody Biomass Utilization on the Bioenergy and Forest Products Industries in Florida*. Retrieved from <http://www.fred.ifas.ufl.edu/pdf/economicimpact-analysis/Woody-Biomass-Utilization.pdf>
- Holtry, M., Anderson, C., Conry, B., Freer, J., Helfst, A., & Sheetz, R. (2009). Carbon Footprint 101: A Guide For Food Retailers. *Carbon Footprint 101*
- Hou, Q. (2009). The Relationship between Energy Consumption Growth and Economic Growth in China. *Journal of Economics and Finance*, vol. 1(2), 232-237
- Ighodaro, C.A.U. & Owendseri-Ogbomo, F. (2008). Causality Relationship between Energy Demand and Economic Growth in Nigeria. *The Indian Journal of Economics*, vol. 89 (353).
- Ighodaro, C. A. (2010). Co-Integration and Causality Relationship between Energy Consumption and Economic Growth: Further Empirical Evidence for Nigeria. *Journal of Business Economics and Management*, vol. 11 (1), 97-111.
- Im, K. S., Pesaran, M. & Shin, Y. (1997). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*, vol. 115 (1), 53-74.
- Imran, K. & Siddiqui, M. M. (2010). Energy Consumption and Economic Growth: A Case Study of Three SAARC Countries. *European Journal of Social Sciences*, vol. 16 (2), pp. 206-213.
- International Energy Agency (2014). Retrieved on 22 September 2016 from <https://www.iea.org/countries/non-membercountries/malaysia/>
- International Union of Railways. (2016). *Carbon Footprint of Railway Infrastructure*. International Union of Railways (UIC); Paris.
- Istikoma, Qurat-ul-Ain & Dahlan, A. A. A. (2015). The Transformation of Agriculture

- Based Economy to an Industrial Sector Through Crowd Sourcing in Malaysia
International Journal of Computer Science and Information Technology Research.
Vol. 3 (1). 34-41.
- Jalil, A. & Mahmud, S. F. (2009). Environment Kuznets Curve for CO2 Emissions:
A Co-Integration Analysis. *Energy and Policy*, vol. 37 (12), 5162-5172.
- Javid, A. Y., Javid, M., & Azwan, Z. A. (2013). Electricity Consumption and
Economic Growth: Evidence from Pakistan. *Economics and Business Letters*, vol.
2 (1), 21-32.
- Jebli, M. B., Yousef, S. B., & Ozturk, I. (2016). Testing Environmental Kuznets Curve
Hypothesis: The role of Renewable and Non-renewable Energy Consumption and
Trade in OECD countries. *Ecological Indicators*. Vol. 60, 824-831
- Jennejohn, D. (2011). Annual U.S. Geothermal Power Production and Development
Report. *Geothermal Energy Association*, April 2011.
- Kao, C. & Chiang, M. H. (2000). On the Estimation and Inference of a Cointegrated
Regression in Panel Data, *Advances in Econometrics*, vol. 15, 179-222.
- Kasgeri, M. T., Etesami, H. & Chemazketi, M. A. (2014). Relationship between
Petroleum Taking and Economic Development ARDL Testing-Iran Case Study.
International Journal of Management and Human Sciences, vol. 3 (2), 1378-1383.
- Khan, S. R. (2002). The Kyoto Protocol and Sustainable Development. *Working Paper
Series*, no 81.
- Kumar, S., & Shahbaz, M., (2010). Coal Consumption and Economic Growth
Revisited: Structural Breaks, Cointegration and Causality Tests for Pakistan.
MPRA Paper 26151, University Library of Munich, Germany
- Kuznets, S. (1955). Economic Growth and Income Inequality. *The American
Economic Review*. Vol. XLV. (1).

- Kim, H., Oh, K-Y. & Jeong, C.-W. (2005). Panel Cointegration Results on International Capital Mobility in Asian Economies. *Journal of International Money and Finance*, vol. 24, 71-82.
- Kraft, J. & Kraft, A. (1978). On the Relationship between Energy and GNP, *Journal of Energy and Development* vol. 3, 401-403.
- Lee, J. W. (2013). The Contribution of Foreign Direct Investment to Clean Energy Use, Carbon Emissions and Economic Growth. *Energy Policy* vol. 55: 483–489.
- Leung, G. C. K. (2009). Sectoral consumption of oil in china, 1990 – 2006. *Oil, Gas and Energy Law*, No. 3. at www.ogel.org/article.asp?key=2928
- Levin, A., Lin, C-F. & Chu, C.-S. J. (2002). Unit Root Test in Panel Data: Asymptotic and Finite-sample Properties. *Journal of Econometrics*, vol. 108 (1), 1-24.
- Li, F., Dong, S., Li, X., Liang, Q. & Yang, W. (2011). Energy Consumption Economic Growth Relationship and Carbon Dioxide Emissions in China. *Energy Policy*, vol. 39, 568–574
- Li, J. K. & Li, Z. X. (2011). A Causality Analysis of Coal Consumption and Economic Growth for China and India. *Natural Resources*, vol. 2, 54-60.
- Lin, B. & Xie, C. (2013). Estimation on Oil Demand and Oil Saving Potential of China's Road Transport Sector. *Energy Policy*, vol. 61, 472-482.
- Lin, X. & Lin, H. (2011). An ADRL Boundes Test Approach to CO2 Emissions, Energy Consumption and Economic Growth in China, *Proceedings of the ICEE*, Shanghai, May 6–8, 1–4.
- Lise, W. & Montfort, K. V. (2007). Energy consumption and GDP in Turkey: Is There a Co-integration Relationship?. Retrived on 21 September 2016 from <http://www.ecn.nl/docs/library/report/2005/rx05191.pdf>
- Madaleno, M., Moutinho, V. & Mota, J. (2015). Time Relationships among Electricity

- and Fossil Fuel Prices: Industry and households in Europe. *International Journal of Energy Economic and Policy*. Vol. 5 (2). 525-533
- Maddison, D. & Rehdanz, K. (2008). Carbon Emissions and Economic Growth: Homogeneous Causality in Heterogeneous Panels, *Working Paper* No. 1437, Kiel Institute for the World Economy.
- Maddala, G. S. & Wu, S. A. (1999). Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics* vol. 61, 631-652.
- Malaysia Energy Statistic Handbook (2015). Retrieved on 20 September 2016 from meih.st.gov.my/documents/.../f3b9119e-e139-4527-9da6-d77e2eab1c34
- Malaysian Department of Environment. (2010). *Annual Report*. Retrieved on 21 September 2016 from <https://www.doe.gov.my>
- Malaysian Energy Information Hub. (2014). Retrieved on 21 September 2016 from <http://meih.st.gov.my/statistics>
- Manan, A. F. N. A., Baharuddin, A. & Chang, L. W. (2015). Ex-Post Critical Evaluations of Energy Policies in Malaysia from 1970 to 2010: A Historical Institutionalism Perspective. *Energies* 2015, vol. 8, 1936-1957.
- Masduzzaman, M. (2012). Electricity Consumption and Economic Growth in Bangladesh Co-integration and Causality Analysis. *Global Journal of Management and Business Research*, vol. 12 (11), 46-56.
- Menyah, K., & Wolde-Rufael, Y., (2010). CO2 Emissions, Nuclear Energy, Renewable Energy and Economic Growth in the US. *Energy Policy*, vol. 38, 2911-2915.
- Mirza, F. M., & Kanwal, A. (2017). Energy Consumption, Carbon Emissions and Economic Growth in Pakistan: Dynamic Causality Analysis. *Renewable and*

Sustainable Energy Reviews vol. 72, 1233–1240.

- Mohamed, A. R. & Teong, L. K. (2004). Energy Policy for Sustainable Development in Malaysia. *The Joint International Conference on Sustainable Energy and Environment (SEE)*. 1-3 December 2004, Hua Hin, Thailand. 940-944.
- Muhammad, J.. & Abdul, Q. (2013). Electricity Consumption GDP Nexus: A Structural Time Series Analysis. MPRA Paper No. 47448
- Mulyana, E., & Istiqomah, A. (2013). Energi Alternatif Untuk Indonesia di Masa Depan. *Penelitian Masalah Lingkungan di Indonesia*, 269-277.
- Mushtaq, K., Abbas, F., Abedullah, and Ghafoor, A. (2007). Energy Use for Economic Growth: Cointegration and Causality Analysis from the Agriculture Sector of Pakistan. *The Pakistan Development Review*, 1065-1073.
- Narayan, P. K., Saboori, B., & Soleymani, A. (2015). *Economic Growth and Carbon Emissions, Economic Model*. Retrieved on 25 February 2016 from, <http://dx.doi.org/10.1016/j.econmod.2015.10.027>
- Naser, H. (2011). Causal Dynamic between Oil Consumption, Nuclear Energy Consumption, Oil Price and Economic Growth. *MPRA Paper*. no. 65252.
- Nasiru, I. (2012). Coal consumption and Economic Growth in Nigeria: A Two-step Residual Test Approach to Co-integration. *European Scientific Journal*, vol. 8 (9), 140- 155.
- Nasreen S. & Anwer S. (2014). Causal Relationship between Trade Openness, Economic Growth and Energy Consumption: A Panel Data Analysis in Asian Countries. *Energy Policy*; vol. 69, 82-91.
- Ngah, N., Parzi, M. N. & Karim, L. A. A. (2017). Kerajaan Bincang Turunkan Harga Panel Solar. *Berita Harian*. Retrieved from <https://www.bharian.com.my/berita/nasional/2017/11/353012/kerajaan-bincang-turunkan-harga-panel-solar>

- Norlaila, A. C. & Khalid, A.R. (2013). Impact of Malaysian Industrial Energy Use on Carbon Dioxide Emissions. *Pertanika Journal of Social Sciences & Humanities*, vol. 21 (8): 13 - 28 (2013)
- Nyamdash, B. & Denny, E. (2010). The Causal Relationship between GDP and Electricity Demand at a Disaggregate Level: A Case Study of Ireland. *Energy Economics*. Retrieved from <http://www.eprg.group.cam.ac.uk/wp/content/uploads/2010/03/Batsaikham-Ntamdash.pdf>
- Ocal, O., Ozturk, I., & Aslan, A. (2013). Coal Consumption and Economic Growth in Turkey. *International Journal of Energy Economy and Policy*, vol. 3 (2), 193-198.
- Odularu, G. O., & Okonkwo, C. (2009). Does Energy Consumption Contribute to Economic Performance? Empirical Evidence from Nigeria. *East West Journal of Economics and Business*, vol. 12 (2), 43-79.
- Olusegan, G. (2007). Crude Oil and the Nigerian Economic Performance. *Oil and Gas Business*, 1-29.
- Omri, A. & Kahouli, B. (2014). Causal Relationships between Energy Consumption, Foreign Direct Investment and Economic Growth: Fresh Evidence from Dynamic Simultaneous-equations Models. *Energy Policy*. Vol. 67, 913-922.
- Operinde, A. (2010). Investigating the Relationship between Income, Health and Biomass Consumption: A panel Data Analysis. *Munich Personal RePEc Archive*, 1-49.
- Ozturk, I., Aslan, A. & Kalyoncu, K. (2010). Energy Consumption and Economic Growth Relationship: Evidence from Panel Data for Low and Middle Income Countries. *Energy Policy*, vol. 38 (8), 4422-4428.
- Panwar N. L., Kaushik, S. C. & Kothari, S. (2011). A Role of Renewable Energy Sources in Environmental Protection: A Review. *Renewable and Sustainable*

Energy Reviews Journal, vol.15, 1513–1524

- Pao, H. T. & Tsai, C. M. (2010). Multivariate Granger Causality between CO2 Emissions, Energy Consumption, FDI (Foreign Direct Investment) and GDP (Gross Domestic Product): Evidence from a Panel of BRIC (Brazil, Russian Federation, India, and China) countries. *Energy Policy*, vol. 38, 7850–60.
- Paul, S. & Bhattacharya, R. N. (2004). Causality between Energy Consumption and Economic Growth in India: A note on Conflicting Results. *Energy Economics*. vol. 26, 977– 983.
- Pedroni, P. (1996). Fully modified OLS for Heterogenous Cointegrated Panels and the Case of Purchasing Power Parity. *Indiana University Working Papers in Economics*, No. 96–020.
- Pedroni, P. (1999). Critical Values for Cointegration Tests in Heterogenous Panel with Multiple Regressors. *Oxford Bulletin of Economics and Statistics*, vol. 61, 653-670.
- Pedroni, P. (2000). Fully Modified OLS for Heterogenous Cointegrated Panels. *Advances in Econometrics*, vol. 15, 93 – 130.
- Pemptsoglou, M. (2014). Electricity Consumption and Economic and Growth: A Linear and Nonlinear Causality Investigation for Turkey. *International Journal of Energy Economics and Policy*, vol. 4 (2), 263-273
- Peng, S. & Sun, Z. (2010). Energy Consumption, Structural Breaks and Economic Growth: Evidence from China. *Proceedings of the International Conference on E-Business and E-Government*. 754-757.
- Pesaran, M. H., Shin, Y. & Smith, R. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*. vol. 94, 621-634.
- Phillips, P. (1995). Fully Modified Least Squares and Vector Autoregression.

- Econometrica*, vol. 63, 1023-1078.
- Phillips, P., & Hansen, B. (1990). Statistical Inference in Instrumental Variables Regression with I (1) Processes. *Review of Economic Studies*, vol. 57, 99–125.
- Qazi, A. Q., Ahmed, K., & Mudassar, M. (2012). Disaggregate Energy Consumption and Industrial Output in Pakistan: An Empirical Analysis. *The Open-Access, Open Assessment E-journal*, 1-14.
- Ramirez, M. D. (2007). A Panel Unit Root and Panel Cointegration Test of the Complementarity Hypothesis in the Mexican Case: 1960-2001. *Atlantic Economic Journal*, vol. 35, 343-356.
- Regional Forum on Environmental Compliance in Industrial Sector. (2015). Retrieved on 10 February 2017 from http://www.aecen.org/sites/default/files/agenda_of_regional_forum_final.pdf
- Ren, S., Yuan, B., Ma, X. & Chen, X. (2014). International Trade, FDI (Foreign Direct Investment) and Embodied CO2 Emissions: A Case Study of China's Industrial Sectors. *China Economic Review*, vol. 28: 123–134.
- Roudet S., Saxeggard, M. & Tsangarides C. G. (2007). *Estimation of Equilibrium Exchange Rates in the WAEMU: A Robustness Analysis*, IMF-WP-07/194. Washington-DC
- Saidi, K., Rahman, M., & Amamri, M. (2017). The Causal Nexus between Economic Growth and Energy Consumption: New Evidence from Global Panel of 53 Countries. *Sustainable Cities and Society*, 33(April). 45-56
- Salahuddin, M., Alam, K., Ozturk, I., & Sohag, K. (2017). The Effects of Electricity Consumption, Economic Growth, Financial Development and Foreign Direct Investment on CO2 Emissions in Kuwait. *Renewable and Sustainable Energy Reviews*, (2017), <http://dx.doi.org/10.1016/j.rser.2017.06.009>

- Sarwar, S., Chen, W. & Waheed, R. (2017). Electricity Consumption, Oil Price and Economic Growth: Global Perspective. *Renewable and Sustainable Energy Reviews*. Vol. 76. 9-18.
- Satti, S. L., Hassan, M. S., Mahmood, H. & Shahbaz, M. (2014). Coal Consumption: An Alternate Energy Resource to Fuel Economic Growth in Pakistan. *Economic Modelling*, vol. 36, 282-287.
- Schwert, G. W. (1989). Tests for Unit Roots: A Monte Carlo Investigation. *Journal of Business & Economic Statistics*. Vol. 7 (2). 147-159
- Shaari, M. S., Hussain, N. E., & Ismail, M. S. (2012). Relationship between Energy Consumption and Economic Growth: Empirical Evidence for Malaysia. *Business Systems Review*, vol. 2 (1), 17-28
- Shaari, M. S., Rahim, H. A. & Rashid, I. M. A., (2013). Relationship among Population, Energy Consumption and Economic Growth in Malaysia. *The International Journal of Social Sciences*, vol. 13 (1). 39-45.
- Shaari M. S., Razak, N. A. A., & Basri, B. H. (2017). Energy Consumption in Various Sectors, Output and Carbon Dioxide Emission in Malaysia. *International Journal of Business and Technopreneurship*, Vol. 7 (2), 181-188.
- Shahbaz, M., Chandran, V.G. R & Pervaiz, A. (2011). Natural Gas Consumption and Economic Growth: Co-integration Causality and Forecast Error Variance Decomposition test for Pakistan. *MPRA Paper* No. 35103.
- Shahbaz, M. & Dube, S. (2012). Revisiting the Relationship between Coal Consumption and Economic Growth: Cointegration and Causality Analysis in Pakistan. *Applied Econometrics and International Development*, vol. 12 (1).
- Shahbaz, M., Farhani, S. & Rahman, M. M. (2013). Natural Gas Consumption and Economic Growth Nexus: The Role of Exports, Capital and Labor in France.

- MPRA Paper* No. 50619,
- Shahbaz, M., Lean, H. H. & Farooq, A. (2012). Natural Gas Consumption and Economic Growth in Pakistan. *MPRA Paper* No. 40959.
- Shahiduzzaman, M. & Alam, K. (2012). Co-integration and Causal Relationships between Energy Consumption and Output: Assessing the Evidence from Australia. *Energy Economics*, vol. 34 (6), 2182–2188.
- Silva, S., Soares, I., & Pinho, C. (2012). The impact of Renewable Energy Sources on Economic Growth and CO2 Emissions - a SVAR Approach. *European Research Studies*, XV (Special Issue), 133-144
- Squalli, J. & Wilson, K. (2006). A Bound Analysis of Electricity Consumption and Economic Growth in the GCC. *Working Paper Series* No. 06-09
- Stern, D. I. (1993). Energy and Economic Growth in the USA: A Multivariate Approach. *Energy Economics*, vol. 15 (2), 137–150.
- Stern, D. I & Cleveland, C. J. (2004). Energy and Economic Growth, *Rensselaer Working Papers in Economics 0410*, Rensselaer Polytechnic Institute, Department of Economics.
- Stern, D. I. (2000). A Multivariate Co-integration Analysis of the Role of Energy in The US Macroeconomy. *Energy Economics*, vol. 22 (2), 267–283.
- Stolyarova, E. (2009). Carbon Dioxide Emissions, Economic Growth and Energy Mix: Empirical Evidence from 93 Countries. *Climate Economics Chair Paris-Dauphine University*.
- U. S. Energy-Related Carbon Dioxide Emissions. (2015). Retrieved on 1 February 2017 from <https://www.eia.gov/environment/emissions/carbon/>
- Talbi, B. (2017). CO2 Emissions Reduction in Road Transport Sector in Tunisia. *Renewable and Sustainable Energy Reviews*, (2016), from <http://dx.doi.org/10.>

1016/j.rser.2016.11.208

- Tang, C. F., & Shahbaz, M. (2013). Sectoral Analysis of the Causal Relationship between Electricity Consumption and Real Output in Pakistan. *Energy Policy*, vol. 60, 885-891
- Tian, P., & Cul, H. (2013). Economic Growth and Coal Consumption in China. *Telkomnika*, vol. 11 (3), 1449-1455.
- Tiwari, A. K. (2011). Energy Consumption, CO2 Emissions and Economic Growth: Evidence from India. *Journal of International Business and Economy*, vol. 12: 85- 122.
- Truckee Meadows Water Authority. (2015). Water Topic in Our Community: Hydroelectric Power Plants. *Truckee Meadows Water Authority* at www.tmwa.com
- Wang, W. C., Mu, H. L., Kang, X. D., Song, R. C., & Ning, Y. D. (2010). Changes in Industrial Electricity Consumption in China from 1998 to 2007. *Energy Policy*, vol. 38, 2684-2690.
- Wei, P., Yaoguo, D., & Xia, Z. (2009). Analysis on Grey Relation of the Impact of China's Energy Consumption on Environment Quality. *Proceeding of 2009 IEEE International Conference on Grey Systems and Intelligent Services*, November 10-12, Nanjing, China, 290-294.
- World Bank (2015). Retrieved from worldbank.org
- Yatim, P., Mamat, M., Mohamad-Zailani, S. H., & Ramlee, S., (2016). Energy Policy Shifts towards Sustainable Energy Future for Malaysia. *Clean Technologies and Environmental Policy*, vol. 18 (88), 1-11.
- Yazdan, G. F., & Hossein, S. S. M. (2012). Causality between Oil Consumption and Economic and Iran: An ARDL Testing Approach. *Asian Economic and Financial Review*, vol. 2 (6), 678-686.

- Yildirim, E., Sarac, S., & Aslan, A. (2012). Energy Consumption and Economic Growth in the USA: Evidence from Renewable Energy. *Renewable and Sustainable Energy Review*, vol. 16, 6770-6774.
- Yusoff, S. & Kardooni, R. (2012). Barriers and Challenges for Developing RE Policy in Malaysia. *International Conference on Future Environment and Energy IPCBEE* vol. 28.
- Zaleski, P. (2001), Energy and Geopolitical Issues, In Rao, D. B., D. Harshyita (eds.), *Energy Security*, Discovery Publishing House, New Delhi.
- Zhang, X. P., & Cheng, X. M. (2009). Energy Consumption, Carbon Emissions, and Economic Growth in China. *Ecological Economics*, 68 , 2706–2712.
- Zhang, M., Li, H. N., Zhou, M., & Mu, H. L. (2011). Decomposition Analysis of Energy Consumption in Chinese Transportation Sector. *Applied Energy*, vol. 88, 2279-2285.
- Zhang, W., Dou, Z., He, P., Ju, X., Powlson, D., Chadwick, D., Norse, D., Lu, Y., Zhang, Y., Wu, L., Chen, X., Cassman, K. G., & Zhang, F. (2013). New Technologies Reduce Greenhouse Gas Emissions from Nitrogenous Fertilizer in China. *PNAS*, vol. 110 (21), 8375-8380
- Zhao, D. (2014). Analysis of Relationship between Rural Energy Consumption of Biomass Resources and Income Alteration of Farmers. *Interdisciplinary Journal of Contemporary Research in Business*, vol. 5 (10), 76-84.
- Zikovic, S., & Dizdarevic, N. V. (2011). Oil Consumption and Economic Growth Interdependence in Small European Countries. *Ekonomika Istrazivanja*, vol. 24 (3), 15- 32.

APPENDIX A

Descriptive Statistics

	K	Q/L	Q/P	L	O	CO2	G	E
Mean	10088861786.9402 6	19513457.8513932 3	63622467456.2022 5	109091943.181818 2	7995795.45454545 5	33889772.7272727 3	91292.7840909090 9	19941.6818181818 2
Median	381066000	1021171.84463421 3	47740146325.5957	43729000	5462000	33380000	29168	14188.5
Maximum	56684245170.7055 3	59688788.0552844 5	155250637309.920 3	437077000	20998000	59000000	394198	63205
Minimum	41450000	279384.880868697 2	13332240016.8137 9	400700	1424000	15300000	183	12
Std. Dev.	14752360199.7122 3	22511727.9260144 7	42844399188.8371 4	132619680.261721	4785426.29424519 2	9195784.04124370 4	112419.495235189 8	20941.8866465037 1
Skewness	1.64129351381242 9	0.43687707439982 07	0.57537692190446 71	0.93347581017198 65	0.78427181459486 9	0.40465591176840 73	1.14355843111606 4	0.51140117687433 42
Kurtosis	4.98976725720090 8	1.40251814799316 7	2.04464944715919 8	2.59045663587225 7	2.71744667776712 6	3.63096510144045 1	3.22324109758102 6	1.85960879108505 1
Jarque-Bera	27.0133441082263 5	6.07822339673224 1	4.10103666106614 8	6.69759588631110 3	4.65697007705700 4	1.93068807607911 3	9.68135690345213 9	4.30213073437457 9
Probability	1.36184242038872 6e-06	0.04787740018305 431	0.12866819364699 55	0.03512655284638 921	0.09744325810625 465	0.38085214957060 92	0.00790169131650 8198	0.11636012545567 83
Sum	443909918625.371 1	858592145.461300 9	2799388568072.90 1	4800045500	351815000	1491150000	4016882.5	877434
Sum Sq. Dev.	9.35818165286829 7e+21	2.17914494512407 e+16	7.89326292996544 1e+22	7.56283122487007 9e+17	984713107159091	3636185097727273	543440145084.199	18858192501.5454 4
Observations	44	44	44	44	44	44	44	44

APPENDIX B
Unit Root Test

Panel unit root test: Summary

Series: LNCO2

Date: 02/21/17 Time: 10:20

Sample: 1990 2014

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.10371	0.1349	3	69
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.17503	0.5695	3	69
ADF - Fisher Chi-square	4.49606	0.6099	3	69
PP - Fisher Chi-square	7.16476	0.3059	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: D(LNCO2)

Date: 02/21/17 Time: 10:23

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.00983	0.0000	3	69
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.51260	0.0000	3	69
ADF - Fisher Chi-square	50.9798	0.0000	3	69
PP - Fisher Chi-square	50.9316	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNCO2

Date: 02/21/17 Time: 10:23

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.62467	0.7339	3	69
Breitung t-stat	0.36951	0.6441	3	66
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.00363	0.8422	3	69
ADF - Fisher Chi-square	2.03896	0.9161	3	69
PP - Fisher Chi-square	3.46535	0.7486	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNCO2)

Date: 02/21/17 Time: 10:24

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.02832	0.0000	3	69
Breitung t-stat	-3.55750	0.0002	3	66
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.71871	0.0000	3	69
ADF - Fisher Chi-square	41.3626	0.0000	3	69
PP - Fisher Chi-square	41.6789	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNE

Date: 02/21/17 Time: 10:25

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.71961	0.2359	1	23
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.64725	0.7413	1	23
ADF - Fisher Chi-square	0.52941	0.7674	1	23
PP - Fisher Chi-square	0.74617	0.6886	1	23

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNE)

Date: 02/21/17 Time: 10:25

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on AIC: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.99752	0.0000	1	23
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.12182	0.0000	1	23
ADF - Fisher Chi-square	28.2539	0.0000	1	23
PP - Fisher Chi-square	43.8305	0.0000	1	23

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNE

Date: 02/21/17 Time: 10:26

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on AIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.37000	0.0004	1	23
Breitung t-stat	-2.42029	0.0078	1	22
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.32363	0.0101	1	23
ADF - Fisher Chi-square	-1.03794	0.1526	1	23
PP - Fisher Chi-square	8.14456	0.0170	1	23

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNE)

Date: 02/21/17 Time: 10:26

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on AIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.95478	0.0000	1	23
Breitung t-stat	-5.10802	0.0000	1	22
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.61594	0.0000	1	23
ADF - Fisher Chi-square	24.0002	0.0000	1	23
PP - Fisher Chi-square	112.149	0.0000	1	23

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNG

Date: 02/21/17 Time: 10:27

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.13888	0.1274	2	47
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.29976	0.6178	2	47
ADF - Fisher Chi-square	2.28352	0.6838	2	47
PP - Fisher Chi-square	2.10079	0.7172	2	48

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: D(LNG)

Date: 02/21/17 Time: 10:27

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.07559	0.0011	2	45
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.33939	0.0004	2	45
ADF - Fisher Chi-square	18.6918	0.0009	2	45
PP - Fisher Chi-square	25.1414	0.0000	2	46

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNG

Date: 02/21/17 Time: 10:27

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 4

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.57588	0.7177	2	47
Breitung t-stat	0.83899	0.7993	2	42
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.22730	0.4101	2	47
ADF - Fisher Chi-square	5.27929	0.2598	2	47
PP - Fisher Chi-square	0.63394	0.9592	2	48

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: D(LNG)

Date: 02/21/17 Time: 10:28

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.55165	0.0054	2	45
Breitung t-stat	-2.71857	0.0033	2	43
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.86426	0.0021	2	45
ADF - Fisher Chi-square	15.7183	0.0034	2	45
PP - Fisher Chi-square	21.0132	0.0003	2	46

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNK

Date: 02/21/17 Time: 10:29

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on AIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.09098	0.0183	3	72
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.42863	0.6659	3	72
ADF - Fisher Chi-square	4.95024	0.5502	3	72
PP - Fisher Chi-square	21.4789	0.0015	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: D(LNK)

Date: 02/21/17 Time: 10:30

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.44741	0.0003	3	68
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.24536	0.0006	3	68
ADF - Fisher Chi-square	21.7433	0.0013	3	68
PP - Fisher Chi-square	23.3722	0.0007	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNK

Date: 02/21/17 Time: 10:29

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.93544	0.0017	3	71
Breitung t-stat	2.05458	0.9800	3	68
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.68656	0.2462	3	71
ADF - Fisher Chi-square	9.66574	0.1395	3	71
PP - Fisher Chi-square	21.6771	0.0014	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNK)

Date: 02/21/17 Time: 10:30

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.51530	0.0000	3	69
Breitung t-stat	-3.80199	0.0001	3	66
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.06219	0.0000	3	69
ADF - Fisher Chi-square	24.8429	0.0004	3	69
PP - Fisher Chi-square	24.8612	0.0004	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNL

Date: 02/21/17 Time: 10:31

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.01880	0.1541	3	72
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.11018	0.4561	3	72
ADF - Fisher Chi-square	6.57694	0.3617	3	72
PP - Fisher Chi-square	6.32055	0.3883	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNL)

Date: 02/21/17 Time: 10:32

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.51086	0.0000	3	69
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.56123	0.0000	3	69
ADF - Fisher Chi-square	44.2361	0.0000	3	69
PP - Fisher Chi-square	44.2372	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNL

Date: 02/21/17 Time: 10:31

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.19350	0.4233	3	71
Breitung t-stat	0.55219	0.7096	3	68
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.34823	0.6362	3	71
ADF - Fisher Chi-square	5.24444	0.5129	3	71
PP - Fisher Chi-square	3.23773	0.7785	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNL)

Date: 02/21/17 Time: 10:32

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.95541	0.0000	3	69
Breitung t-stat	-5.31748	0.0000	3	66
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.14633	0.0000	3	69
ADF - Fisher Chi-square	37.8368	0.0000	3	69
PP - Fisher Chi-square	38.9865	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNO

Date: 02/21/17 Time: 10:33

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.08224	0.5328	3	72
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.19246	0.8835	3	72
ADF - Fisher Chi-square	3.10946	0.7950	3	72
PP - Fisher Chi-square	2.88143	0.8236	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNO)

Date: 02/21/17 Time: 10:34

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.12972	0.0000	3	68
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.01275	0.0000	3	68
ADF - Fisher Chi-square	48.0100	0.0000	3	68
PP - Fisher Chi-square	46.2902	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNO

Date: 02/21/17 Time: 10:34

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 2

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.27709	0.6091	3	70
Breitung t-stat	2.21541	0.9866	3	67
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.28037	0.8998	3	70
ADF - Fisher Chi-square	2.72449	0.8425	3	70
PP - Fisher Chi-square	2.62184	0.8546	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNO)

Date: 02/21/17 Time: 10:35

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.83288	0.0000	3	68
Breitung t-stat	-2.34685	0.0095	3	65
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.16144	0.0000	3	68
ADF - Fisher Chi-square	44.8179	0.0000	3	68
PP - Fisher Chi-square	43.7267	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNQ_L

Date: 02/21/17 Time: 10:35

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 2

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.95632	0.0252	3	70
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.00347	0.4986	3	70
ADF - Fisher Chi-square	4.01222	0.6750	3	70
PP - Fisher Chi-square	3.65647	0.7230	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNQ_L)

Date: 02/21/17 Time: 10:36

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.68812	0.0000	3	67
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.09166	0.0000	3	67
ADF - Fisher Chi-square	48.9127	0.0000	3	67
PP - Fisher Chi-square	82.8891	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNQ_L

Date: 02/21/17 Time: 10:35

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.51483	0.3033	3	71
Breitung t-stat	0.12739	0.5507	3	68
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.26890	0.3940	3	71
ADF - Fisher Chi-square	7.88390	0.2467	3	71
PP - Fisher Chi-square	12.6506	0.0489	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: D(LNQ_L)

Date: 02/21/17 Time: 10:36

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.71620	0.0000	3	67
Breitung t-stat	-5.82075	0.0000	3	64
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.34172	0.0000	3	67
ADF - Fisher Chi-square	40.0101	0.0000	3	67
PP - Fisher Chi-square	113.695	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNQ_P

Date: 02/21/17 Time: 10:37

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.70620	0.0440	3	72
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.25860	0.6020	3	72
ADF - Fisher Chi-square	5.10061	0.5310	3	72
PP - Fisher Chi-square	16.8357	0.0099	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNQ_P)

Date: 02/21/17 Time: 10:37

Sample: 1990 2014

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.72449	0.0000	3	69
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.78764	0.0000	3	69
ADF - Fisher Chi-square	45.9172	0.0000	3	69
PP - Fisher Chi-square	52.0781	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary

Series: LNQ_P

Date: 02/21/17 Time: 10:37

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.10948	0.0175	3	72
Breitung t-stat	-0.87009	0.1921	3	69
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.78780	0.2154	3	72
ADF - Fisher Chi-square	7.70713	0.2604	3	72
PP - Fisher Chi-square	10.9673	0.0894	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.



Panel unit root test: Summary

Series: D(LNQ_P)

Date: 02/21/17 Time: 10:38

Sample: 1990 2014

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.86061	0.0000	3	68
Breitung t-stat	-5.87103	0.0000	3	65
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.85706	0.0000	3	68
ADF - Fisher Chi-square	36.5295	0.0000	3	68
PP - Fisher Chi-square	46.9195	0.0000	3	69

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

APPENDIX C
Cointegration

Pedroni Residual Cointegration Test
 Series: LNQ_P LNK LNL LNO LNG LNE
 Date: 02/21/17 Time: 10:50
 Sample: 1990 2014
 Included observations: 75
 Cross-sections included: 2 (1 dropped)
 Null Hypothesis: No cointegration
 Trend assumption: No deterministic trend
 User-specified lag length: 1
 Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	<u>Statistic</u>	<u>Prob.</u>	<u>Weighted Statistic</u>	<u>Prob.</u>
Panel v-Statistic	-1.065404	0.8567	-1.068083	0.8573
Panel rho-Statistic	0.800096	0.7882	0.781489	0.7827
Panel PP-Statistic	-2.332752	0.0098	-2.368964	0.0089
Panel ADF-Statistic	-1.765071	0.0388	-1.753278	0.0398

Alternative hypothesis: individual AR coefs. (between-dimension)

	<u>Statistic</u>	<u>Prob.</u>
Group rho-Statistic	1.457271	0.9275
Group PP-Statistic	-2.196120	0.0140
Group ADF-Statistic	-1.778726	0.0376

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
industrial	0.246	0.001635	0.000430	7.00	24
transportation	0.008	0.001756	0.000954	4.00	24
agricultural	0.245	0.002607	0.002502	2.00	24

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
industrial	-0.067	0.001353	1	--	23
transportation	-0.167	0.001758	1	--	23
agricultural	0.157	0.002651	1	--	23

Pedroni Residual Cointegration Test
 Series: LNCO2 LNQ_L LNO LNG LNE
 Date: 02/21/17 Time: 10:51
 Sample: 1990 2014
 Included observations: 75
 Cross-sections included: 2 (1 dropped)
 Null Hypothesis: No cointegration
 Trend assumption: No deterministic trend
 User-specified lag length: 1
 Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	<u>Statistic</u>	<u>Prob.</u>	<u>Weighted Statistic</u>	<u>Prob.</u>
Panel v-Statistic	2.407576	0.0080	2.080260	0.0188
Panel rho-Statistic	-2.954831	0.0016	-3.118845	0.0009
Panel PP-Statistic	-2.716105	0.0033	-3.034855	0.0012
Panel ADF-Statistic	-0.080404	0.4680	-0.557934	0.2884

Alternative hypothesis: individual AR coefs. (between-dimension)

	<u>Statistic</u>	<u>Prob.</u>
Group rho-Statistic	-2.429812	0.0076
Group PP-Statistic	-3.222113	0.0006
Group ADF-Statistic	-0.113513	0.4548

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
industrial	0.067	0.003605	0.004043	2.00	24
transportation	-0.114	0.001837	0.001674	2.00	24
agricultural	-0.137	0.003411	0.003101	2.00	24

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
industrial	0.267	0.003591	1	--	23
transportation	-0.224	0.001899	1	--	23
agricultural	-0.137	0.003411	1	--	23

APPENDIX D
FMOLS

Dependent Variable: LNQ_P
 Method: Panel Fully Modified Least Squares (FMOLS)
 Date: 02/21/17 Time: 10:54
 Sample (adjusted): 1991 2014
 Periods included: 24
 Cross-sections included: 2
 Total panel (balanced) observations: 48
 Panel method: Grouped estimation
 Cointegrating equation deterministics: C
 Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)
 Warning: one more more cross-sections have been dropped due to estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNK	0.150993	0.068366	2.208583	0.0330
LNL	0.829056	0.194526	4.261933	0.0001
LNO	0.058276	0.032888	1.771958	0.0840
LNG	0.355730	0.147645	2.409365	0.0207
LNE	0.109626	0.060648	1.807573	0.0782
R-squared	-14.630503	Mean dependent var		7.449897
Adjusted R-squared	-17.365841	S.D. dependent var		0.813739
S.E. of regression	3.487310	Sum squared resid		486.4531
Long-run variance	0.001214			

Dependent Variable: LNCO2
 Method: Panel Fully Modified Least Squares (FMOLS)
 Date: 02/21/17 Time: 10:55
 Sample (adjusted): 1991 2014
 Periods included: 24
 Cross-sections included: 2
 Total panel (balanced) observations: 48
 Panel method: Grouped estimation
 Cointegrating equation deterministics: C
 Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)
 Warning: one more more cross-sections have been dropped due to estimation errors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNQ_L	0.394603	0.152878	2.581170	0.0135
LNO	0.589598	0.036080	16.34121	0.0000
LNG	0.357051	0.101985	3.501009	0.0011
LNE	-0.079451	0.077572	-1.024225	0.3117
R-squared	-47.550366	Mean dependent var		17.24946
Adjusted R-squared	-54.655298	S.D. dependent var		0.323089
S.E. of regression	2.410321	Sum squared resid		238.1955
Long-run variance	0.002073			

APPENDIX E

Pooled Mean Group (PMG) and Mean Group (MG)

MG (Q/P)

	D.lnyp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ECT	lnK	2.510359	2.03075	1.24	0.216	-1.469838	6.490555
	lnL	0.0641577	0.8155732	0.08	0.937	-1.534336	1.662652
	lnO	0.0213331	0.1677704	0.13	0.899	-0.3074907	0.350157
	lnG	-0.3026351	0.3280575	-0.92	0.356	-0.945616	0.3403458
	lnE	-0.0539932	0.0446071	-1.21	0.226	-0.1414214	0.033435
Sectors	ECT	-0.4904644	0.3312988	-1.48	0.139	-1.139798	0.1588692
	lnK D1.	0.2023731	0.101031	2.00	0.045	0.0043559	0.4003903
	lnL D1.	0.496837	0.1155154	4.30	0.000	0.270431	0.7232431
	lnO D1.	0.068484	0.0575221	1.19	0.234	-0.0442573	0.1812253
	lnG D1.	-0.0696792	0.0466262	-1.49	0.135	-0.1610648	0.0217064
	lnE D1.	0.0947177	0.1071755	0.88	0.377	-0.1153424	0.3047779
	_cons	-22.98464	16.40747	-1.40	0.161	-55.1427	9.173411

PMG (Q/P)

Panel Variable (i): sector1
 Time Variable (t): year

Number of obs = 72
 Number of groups = 3
 Obs per group: min = 24
 avg = 24.0
 max = 24

Log Likelihood = 111.3156

	D.lnyp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ECT	lnK	0.2942183	0.0891552	3.30	0.001	0.1194774	0.4689592
	lnL	0.3491967	0.2114159	1.65	0.099	-0.0651708	0.7635642
	lnO	0.1614306	0.0452385	3.57	0.000	0.0727648	0.2500965
	lnG	0.0489643	0.0147563	3.32	0.001	0.0200425	0.0778861
	lnE	-0.0202932	0.0230582	-0.88	0.379	-0.0654864	0.0249001
Sectors	ECT	-0.7400665	0.1998044	-3.70	0.000	-1.131676	-0.3484571
	lnK D1.	0.7698131	0.6141246	1.25	0.210	-0.4338489	1.973475
	lnL D1.	0.4340473	0.1203388	3.61	0.000	0.1981876	0.6699069
	lnO D1.	0.0403181	0.0548385	0.74	0.462	-0.0671633	0.1477996
	lnG D1.	0.1466069	0.1224	1.20	0.231	0.3865064	0.0932926
	lnE D1.	0.0580659	0.0701037	0.83	0.408	-0.0793348	0.1954666
	_cons	-3.021617	2.148147	-1.41	0.160	-7.231908	1.188675

PMG (Q/P)

Panel Variable (i): sector1
Time Variable (t): year

Number of obs = 72
Number of groups = 3
Obs per group: min = 24
 avg = 24.0
 max = 24

Log Likelihood = 111.3156

D.lnyp		Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ECT	lnK	0.2942183	0.0891552	3.30	0.001	0.1194774	0.4689592
	lnL	0.3491967	0.2114159	1.65	0.099	-0.0651708	0.7635642
	lnO	0.1614306	0.0452385	3.57	0.000	0.0727648	0.2500965
	lnG	0.0489643	0.0147563	3.32	0.001	0.0200425	0.0778861
	lnE	-0.0202932	0.0230582	-0.88	0.379	-0.0654864	0.0249001
Agriculture	ECT	-0.2613786	0.1655233	-1.58	0.114	-0.5857982	0.0630411
	lnK D1.	1.984378	4.367168	0.45	0.650	-6.575114	10.54387
	lnL D1.	0.2060257	0.2745659	0.75	0.453	-0.3321135	0.7441649
	lnO D1.	0.0208206	0.0324441	0.64	0.521	-0.0427686	0.0844099
	lnG D1.		0 (omitted)				
	lnE D1.		0 (omitted)				
	_cons	-1.257843	0.9275497	-1.36	0.175	-3.075807	0.560121
Industrial	ECT	-0.0665685	0.0692176	-0.96	0.336	-0.2022324	0.0690954
	lnK D1.	0.3208678	0.208142	1.54	0.123	-0.087083	0.7288186
	lnL D1.	0.6147579	0.2617032	2.35	0.019	0.1018292	1.127687
	lnO D1.	-0.0434032	0.0532188	-0.82	0.415	-0.1477102	0.0609038
	lnG D1.	0.3896898	0.1884288	2.07	0.039	0.7590035	0.0203761
	lnE D1.	0.1976196	0.2825937	0.70	0.484	-0.3562539	0.7514932

	_cons	-0.5108	0.5026419	-1.02	0.310	-1.49596	0.4743601
Transportation	ECT	-1.143446	0.2021744	-5.66	0.000	-1.539701	-0.7471916
	lnK D1.	0.0041933	0.0863831	0.05	0.961	-0.1651144	0.1735011
	lnL D1.	0.4813582	0.192782	2.50	0.013	0.1035125	0.8592039
	lnO D1.	0.143537	0.1011916	1.42	0.156	-0.054795	0.341869
	lnG D1.	0.050131	0.026509	1.89	0.059	0.1020876	0.0018257
	lnE D1.	-0.0234219	0.0203431	-1.15	0.250	-0.0632938	0.0164499
	_cons	-7.296207	2.749748	-2.65	0.008	-12.68561	-1.906801

Hausman Test (Q/P)

	----- Coefficients -----			Sqrt (diag(V_b - V_B) S.E
	MG (b)	PMG (B)	Difference (b-B)	
lnK	2.510359	0.2942183	2.21614	3.191809
lnL	0.0641577	0.3491967	-0.285039	1.264821
lnO	0.0213331	0.1614306	-0.1400975	0.2598861
lnG	-0.3026351	0.0489643	-0.3515994	0.5156108
lnE	-0.0539932	-0.0202932	-0.0337	0.0662394

b = consistent under Ho and Ha, B = inconsistent under Ha, efficient under Ho;

Test: Ho: difference in coefficients not systematic

$$\begin{aligned} \text{chi2}(5) &= (b-B)'[(V_b-V_B)^{-1}](b-B) \\ &= 1.53 \end{aligned}$$

$$\text{Prob}>\text{chi2} = 0.9091$$

(V_b-V_B is not positive definite)

MG (CO₂)

	D.lnyp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ECT	lnL	0.3492756	0.4066467	0.86	0.390	-0.4477373	1.146288
	lnO	0.7690431	0.2908159	2.64	0.008	0.1990546	1.339032
	lnG	0.3425328	0.3459793	0.99	0.322	-0.3355742	1.02064
	lnE	-0.153237	0.1482676	-1.03	0.301	-0.4438362	0.1373622
Sectors	ECT	-0.2860122	0.3023972	-0.95	0.344	-0.8786998	0.3066754
	lnL D1.	-0.1561356	0.1449777	-1.08	0.281	-0.4402866	0.1280155
	lnO D1.	-0.6562281	0.4622489	-1.42	0.156	-1.562219	0.2497632
	lnG D1.	-0.1324533	0.1011557	-1.31	0.190	-0.3307147	0.0658082
	lnE D1.	0.1139188	0.1085573	1.05	0.294	-0.0988495	0.3266871
	_cons	-1.139123	3.16799	-0.36	0.719	-7.348269	5.070023

PMG (CO₂)

Panel Variable (i): sector1
 Time Variable (t): year

Number of obs = 72
 Number of groups = 3
 Obs per group: min = 24
 avg = 24.0
 max = 24

Log Likelihood = 99.43596

	D.lnyp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ECT	lnL	1.062394	0.4081998	2.60	0.009	0.2623374	1.862451
	lnO	0.1807315	0.0664885	2.72	0.007	0.0504165	0.3110465
	lnG	0.9650822	0.2951339	3.27	0.001	0.3866303	1.543534
	lnE	-0.3988808	0.2319482	-1.72	0.085	-0.8534908	0.0557293
Sectors	ECT	-0.7555251	0.2115024	-3.72	0.000	-1.167953	-0.3504791
	lnL D1.	-0.1571588	0.131413	-1.20	0.232	-0.4147235	0.100406
	lnO D1.	0.5293769	0.3095496	1.71	0.087	-0.0773291	1.136083
	lnG D1.	-0.1246296	0.0942278	-1.32	0.186	-0.3093128	0.0600536
	lnE D1.	0.0878394	0.1163673	0.75	0.450	-0.1402364	0.3159151
	_cons	-1.90334	2.048673	-0.93	0.353	-5.918665	2.111986

PMG (CO₂)

Panel Variable (i): sector1
 Time Variable (t): year

Number of obs = 72
 Number of groups = 3
 Obs per group: min = 24
 avg = 24.0
 max = 24

Log Likelihood = 99.43596

	D.lnyp	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
ECT	lnL	1.062394	0.4081998	2.60	0.009	0.2623374	1.862451
	lnO	0.1807315	0.0664885	2.72	0.007	0.0504165	0.3110465
	lnG	0.9650822	0.2951339	3.27	0.001	0.3866303	1.543534
	lnE	-0.3988808	0.2319482	-1.72	0.085	-0.8534908	0.0557293
Agriculture	ECT	0.028213	0.0323958	0.87	0.384	-0.0352815	0.0917075
	lnL D1.	0.0186736	0.148371	0.13	0.900	-0.2721282	0.3094755
	lnO D1.	1.008415	0.0304652	33.10	0.000	0.948704	1.068125
	lnG D1.		0 (omitted)				
	lnE D1.		0 (omitted)				
	_cons	0.2033031	0.2985	0.68	0.496	-0.3817462	0.7883524
Industrial	ECT	0.0044006	0.0078863	0.56	0.577	-0.0110562	0.0198575
	lnL D1.	-0.4142505	0.3173397	-1.31	0.192	-1.036225	0.2077239
	lnO D1.	-0.0497813	0.100658	-0.49	0.621	-0.2470674	0.1475049
	lnG D1.	0.3093669	0.2251139	1.37	0.169	0.750582	0.1318482
	lnE D1.	0.3184064	0.3663892	0.87	0.385	-0.3997032	1.036516
	_cons	-6.000134	6.343254	-0.95	0.344	-18.43268	6.432416
Transportation	ECT	-0.8906503	0.2322733	-3.83	0.000	-1.345898	-0.4354031
	lnL D1.	-0.0758994	0.1399088	-0.54	0.587	-0.3501156	0.1983168
	lnO D1.	0.6294973	0.1437998	4.38	0.000	0.3476548	0.9113398

lnG D1.	0.064522	0.0352887	1.83	0.067	0.1336865	0.0046426
lnE D1.	-0.0548883	0.0244735	-2.24	0.025	-0.1028556	-0.0069211
_cons	0.0868121	0.0832085	1.04	0.297	-0.0762736	0.2498978

Hausman Test (CO₂)

	---- Coefficients ----			Sqrt (diag(V _b – V _B))
	MG (b)	PMG (B)	Difference (b-B)	S.E
lnL	0.3492756	1.062394	-0.7131186	0.4857157
lnO	0.7690431	0.1807315	0.5883116	0.4488442
lnG	0.3425328	0.9650822	-0.6225494	0.4519856
lnE	-0.153237	-0.3988808	0.2456438	.

b = consistent under Ho and Ha, B = inconsistent under Ha, efficient under Ho;

Test: Ho: difference in coefficients not systematic

$$\begin{aligned} \text{chi2}(4) &= (b-B)'[(V_b-V_B)^{-1}](b-B) \\ &= 1.60 \\ \text{Prob}>\text{chi2} &= 0.8088 \\ &(\text{V}_b\text{-V}_B \text{ is not positive definite}) \end{aligned}$$

APPENDIX F

Section 22 of the Environment Quality Act, EQA, 1974 (Act 127).

22. Restrictions on pollution of the atmosphere.

- (1) No person shall, unless licenced, emit or discharge any wastes into the atmosphere in contravention of the acceptable conditions specified under section 21.

- (2) Without limiting the generality of the subsection (1), a person shall be deemed to emit or discharge wastes into the atmosphere if -
 - (a) he places any matter in a place where it may be released into the atmosphere;
 - (b) he causes or permits the discharge of odours which by virtue of their nature, concentration, volume or extent are obnoxious or offensive;
 - (c) he burns any wastes of the trade, process or industry; or
 - (d) He uses any fuel burning equipment not equipped with any device or control equipment required to be fitted to such equipment.

- (3) Any person who contravenes subsection (1) shall be guilty of an offence and shall be liable to a fine not exceeding the thousand ringgit or to imprisonment for a period not exceeding two years or to both and to a further fine not exceeding one thousand ringgit a day for every day that the offence is continued after a notice by the Director General requiring him to cease the act specified therein has been served upon him.