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PREFACE

The 2nd International Conference on Contemporary Economic Issues (ICCEI) was held on 2 - 3 November, 2016, at the Ramada Bintang Bali Resort in Bali, Indonesia. This conference is under the umbrella of the 2016 Humanities, Social Sciences and Environment Conference, jointly organized by the School of Social Sciences, School of Humanities and School of Housing, Building and Planning, Universiti Sains Malaysia. The 2nd ICCEI was organized to bring together experts and academics to discuss issues in the field of social sciences to help pave the way for the betterment of the society and the environment we live in. This conference is also in line with Universiti Sains Malaysia's ambition to become a global university.

The 2nd ICCEI attracted a total of thirty-three papers from various institutions and organizations across the world. All the full papers were subjected to double-blind peer review and in some cases a third reviewer was invited to review a paper. The quality of these papers is attributed to the authors as well as the reviewers who gave their feedback and comments. Ten selected papers were accepted to be included in the Proceedings of the 2nd International Conference on Contemporary Economic Issues which will be submitted to Thomson Reuters for the Conference Proceedings Citation Index. It is hoped that the collection of these conference papers are a valuable source of information and knowledge to conference participants, researchers, scholars, students and policy makers.

We would like to thank all the authors and paper presenters for their noteworthy contribution and support. We also extend our sincere gratitude to all the reviewers for their invaluable time and effort in reviewing the papers. We would especially like to thank our editorial assistant, Mr. Kizito Uyi Ehigiamuso, who undertook the arduous task of assisting the editorial team in editing the proceedings. Last but not least, the editors graciously acknowledge the role played by the chair of the USM-Bali Conference, Associate Professor Dr. Saidatulakmal Mohd, and all committee members, namely, Dr. Nor Asmat Ismail, Dr. Razlini Mohd Ramli and Dr. Shariffah Suraya Syed Jamaludin. Together we were able to make the USM Bali Conference 2016 and the 2nd ICCEI a success.

We hope that all of you will enjoy reading this selection of articles.

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Editors
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Inflation hedging property of housing market in Malaysia

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Abstract

This paper aims to examine the relationship between house prices and inflation to determine the inflation hedging ability of housing in Malaysian. We examine the long-run and short-run hedging ability of house prices against both consumer and energy inflation by using ARDL approach. Consumer inflation will be calculated from consumer price index while energy inflation is calculated from crude oil price. We find that, in the long-run, housing is a good hedge against consumer inflation but a poor hedge against energy inflation. In the short-run, housing is only partially hedge against energy inflation but not able to hedge against consumer inflation. The results show that housing is not a good investment asset in Malaysia.

Keywords: House prices; consumer inflation; energy inflation; hedge; Malaysia.

1. Introduction

Housing is the most expensive human needs because a large amount of money is needed for down-payment and a large proportion of income is spent on paying the instalment for housing loan. It is considered as the largest form of saving or investment for households and its value represents a person financial wea7lth. Besides serving as shelter, housing is considered as an investment good because it provides an excellent return to the homeowners in terms of rent and capital gains. Hence, housing is viewed as a good investment asset which can protect the wealth of property investors from increasing general price level. Nevertheless, Shiller (2005) disagrees that housing is a good investment because housing as consumption good needs maintenance and its real value will depreciate over time.

Historically, people invest in real estate because of its attractive return and its ability to hedge against inflation. Real estate market has lower volatility compare to equity market and the cash flows from property operation provides return on investment that grows with economy (Frankel and Lippmann, 2006). From the investment perspective, inflation risk is one of the major concerns for most property investors. This is because we cannot predict inflation with certainty. The presence of inflation could lower the real return of an investment, especially for long-term investment which has greater exposure to uncertainty in the economy (Arnott and Greer, 2006). Hence, to manage the risk of inflation, investors target assets that can effectively hedge against inflation. However, the real returns that an investment can sustain will change when inflation changes.

This study aims to examine the hedging ability of housing in Malaysia against both consumer inflation and energy inflation. During the period from 2010 to 2014, investment returns in housing surpassed the country's inflation (Table 1). Investment in residential real estate is seemed to offer greater return against the stable and low inflation rate in the country. However, Malaysian market is highly responsive to several events such as fluctuations in crude oil price and exchange rate. These events will cause unexpected changes in the general

price level and might have affected the real return of investment. For instance, oil price hikes will cause supply side inflation as a result of higher production and transportation cost. On the demand side, through the income effect, rising oil price leads to lower real disposable income and diminishes households' purchasing power (Kilian, 2008; Tsai, 2015; Breitenfellner et al., 2015). During period of rising energy inflation, investors require higher return as well to protect the purchasing power of savings.

Table 1: Annual growth in Malaysian house price index and consumer price index, 2010-2014

Annual growth (%)	2010	2011	2012	2013	2014
MHPI	6.7	9.9	11.8	11.6	10.7
CPI	1.7	3.2	1.6	2.1	3.4

Source: Bank Negara Malaysia

This paper contributes to the literature in several ways. First, in addition to consumer inflation, we also examine the hedging ability of housing against energy inflation. Considering the potential influence of oil price fluctuations on the country's general price level, we directly examine the relation between house price and oil price. Second, we present the study based on ARDL approach. Although the inflation hedging ability of Malaysian residential property has been investigated by Lee (2014), this study is based on Fama and Schwert (1977) framework to test the short-run hedging ability against expected and unexpected inflation while the long-run linkages between house prices and inflation is examined using dynamic OLS. The use of ARDL allows us to examine the long-run and short-run relationship simultaneously. Third, while Lee (2014) and Le (2015) both employs the sample period from 1999Q1 to 2012Q1 and from 1999Q1 to 2012Q3 respectively, we extend the sample period from 1999Q1 to 2015Q4. The recent oil price drops and depreciation of the Ringgit should have affected the general price level in the country and hence affect the returns of investment. As declared by Arnold and Auer (2015), the inflation is forecasted to increase in the near future resulting from the recent decrease in oil prices. In view of this, it is needed to continue monitor and understand whether housing sector in Malaysia is performing well against inflation over time.

The remainder of the paper is organized as follows. The next section provides literature review on inflation and house prices and the relationship between housing and oil markets. Section 3 discusses the data and methodology and Section 4 reports the empirical results. The last section concludes the study.

2. Literature Review

2.1 The relationship between inflation and house prices

Fama and Schwert (1977) is the first study to investigate the expected and unexpected inflation hedge of different assets such as residential real estate, bonds, treasury bills, common stock and household income. The results show that residential real estate provides a perfect hedge against both expected and unexpected inflation. Following Fama and Schwert (1977) framework, other studies in the developed countries like the U.S. and the U.K. include Rubens et al. (1989), Barkham et al. (1996), Bond and Seiler (1998), Stevenson (1999 & 2000), Anari and Kolari (2002). These studies find significant positive relationship between real estate returns and both expected and unexpected inflation. As such, residential real estate is found to be an effective inflation hedging asset in developed countries.

Besides the hedge against expected and unexpected inflation, some authors also examine the hedge against inflation in the long-run and short-run. Barkham et al. (1996) suggest that housing in the UK is hedge against inflation in the long-run based on Johansen cointegration

and standard VECM approach. They also find that inflation Granger causes property prices in the U.K. Although Stevenson (1999) find no evidence of cointegration between residential real estate and inflation in the U.K., Stevenson (2000) provide a substantial different results where there is a strong evidence of cointegrating relationship between inflation and housing market and house prices lead inflation. Furthermore, Anari and Kolari (2002) find that house prices in the U.S. are a stable inflation hedge in the long-run using ARDL approach.

Similar studies in other countries have also reported varies results about the inflation hedging of residential real estate. Ganesan and Chiang (1998) and Lee (2013) find that Hong Kong residential real estate return is significantly related with both expected and unexpected inflation which show the ability of housing to hedge against inflation. On the other hand, Sing and Low (2000), Li and Ge (2008) and Amonhaemanon et al. (2013) show insignificant relationship between real estate return with both expected and unexpected inflation. They report the inability of housing to hedge against inflation in the respective countries.

In Malaysia, Lee (2014) examines the inflation hedging ability of residential real estate for the period between 1999 and 2012. The results conclude that residential real estate is able to hedge against expected inflation in the short-run and long-run but this is not for the unexpected inflation. Ibrahim et al. (2009) only focus residential real estate in Selangor between 2000 and 2006. They report residential real estate in Malaysia is a poor hedge against actual, expected and unexpected inflation. These authors provide different results on inflation hedging ability of Malaysian housing market which may due to different time period examined. The results reported by Ibrahim et al. (2009) that focus on a single state i.e. Selangor raise the concern of generalizability to the overall housing market in the country.

2.2 The relationship between oil and house prices

The study that directly examines the relationship between oil prices and house prices is relatively less. In the study between house prices and macroeconomic fluctuations, Beltratti and Monara (2010) find that oil price shocks have a statistically significant negative effect on house prices. Besides that, Breitenfellner et al. (2015) examine the direct relationship between energy inflation and house prices. Consistent with Beltratti and Monara (2010), they find significant negative relationship between changes in energy inflation and house prices in which they suggest that the increased price of crude oil in the past decade may be the reason that cause housing market crash in the U.S. in 2008. Both of these studies have evidenced a negative relationship between crude oil and house prices that show an increase in oil price leads to a decrease in house price.

More recently, Le (2015) attempts the link between house and oil prices in Malaysia. As an oil exporting country, Le (2015) explains that the increase in oil prices would increase the demand for housing and increase the price of housing. Le (2015) evidences a positive relation between oil and house prices in Malaysia for the period between March 1999 and September 2012. Although the author fail to find cointegration among oil price, inflation and labor force with house prices based on Gregory and Hansen (1996) test, Toda-Yamamoto (1995) test reveals that oil price and inflation lead the changes in house prices in Malaysia.

Overall, prior studies tend to find housing is as an effective hedge against consumer inflation in the long-run. The long-run hedging ability of housing against energy inflation remains unknown since none of the study attempted this question. Perhaps the significant negative relationship between oil price and house prices (Beltratti and Monara, 2010; Breitenfellner et al., 2015) would indicate the inability of housing to act as an effective hedge against energy inflation. However, due to the argument of Le (2015) where Malaysia is assumed to be an oil-

exporting country, the positive relationship found could be an indication that housing is hedge against energy inflation.

3. Data and Methodology

3.1 Data

The house price is proxy by House Price Index (HPI) collected from National Property Information Centre (NAPIC). We use the West Texas Intermediate crude oil price to proxy for energy price (WTI) which is expressed in Ringgit by multiplying with RM/USD exchange rate. According to Cunado and de Gracia (2005), the inflationary effect of oil price is more prevalent when oil price is defined in local currency[1]. Consumer inflation is calculated from Consumer Price Index (CPI). Control variables i.e. income and interest rate are proxy by nominal gross domestic product (GDP) and base lending rate (BLR). The CPI, GDP and BLR are collected from Bank Negara Malaysia. The sample period is from 1999Q1 until 2015Q4 with 68 observations. All data are transformed into natural logarithm series except BLR.

3.2 Methodology

We first perform the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root test to examine the stationarity properties of the data. We then analyze the long-run and short-run relationship among the variables based on Autoregressive Distribution Lag (ARDL) (Pesaran et al., 2001). The unrestricted ECM is formulated as follows:

$$\Delta HPI_t = \alpha + \beta_1 HPI_{t-1} + \beta_2 CPI_{t-1} + \beta_3 GDP_{t-1} + \beta_4 BLR_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta HPI_{t-1} + \sum_{i=0}^{q} \theta_i \Delta CPI_{t-1} + \sum_{i=0}^{r} \phi_i \Delta GDP_{t-1} + \sum_{i=0}^{s} \gamma_i \Delta BLR_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta HPI_t = \alpha + \beta_1 HPI_{t-1} + \beta_2 WTI_{t-1} + \beta_3 GDP_{t-1} + \beta_4 BLR_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta HPI_{t-1} + \sum_{i=0}^{q} \theta_i \Delta WTI_{t-1} + \sum_{i=0}^{r} \phi_i \Delta GDP_{t-1} + \sum_{i=0}^{s} \gamma_i \Delta BLR_{t-1} + \varepsilon_t \quad (2)$$

where Equation (1) shows the relationship between house price and consumer price while Equation (2) shows the relationship between house price and energy price. HPI represents house price index while CPI and WTI represent consumer and energy prices respectively. GDP and BLR are added to control for income and interest rate effect. Income and interest rate have been found to show significant relationship with house prices in the long-run (e.g. Chen et al., 2007; Ibrahim and Law, 2014). The β_i in both equations are the long-run parameters. The optimum lag order of the estimation is selected based on Schwarz Information Criteria (SIC) with a maximum lag of four. F-test is used to examine the presence of cointegration among the variables by comparing the F-statistic with the critical values provided by Narayan (2005). In Equation (1) and (2), the long-run coefficient for both consumer and energy prices is $-(\beta_2/\beta_1)$ and the short-run coefficient is $\Sigma\theta_i$.

Brown and Matysiak (2000) highlight that an asset with high rate of real returns does not necessary means that it hedges against inflation. To adequately hedge the inflation, the return of an asset must be positive related with inflation. The role as an inflation hedge must be at least examined by the positive correlation between an asset's return and inflation (Bekaert and Wang, 2010). Arnold and Auer (2015) add that a positive relation between asset returns and inflation rates implies that asset returns compensate a rising inflation rate. Applying this concept in our analysis, we expect positive long-run and short-run coefficients for both consumer and energy prices i.e. $-(\beta_2/\beta_1)$ and $\Sigma\theta_i$ to be positive and statistically significant to consider housing as an effective hedge against consumer and energy inflation respectively.

[1] Ibrahim (2015) and Le (2015) are both studies that express crude oil price in *Ringgit*.

4. Results

The summary statistics of the data are presented in Table 2. The mean house price is relatively higher than the consumer prices but lower than energy prices over the sample period. The standard deviation of energy price is higher than the consumer price indicates that energy price is more volatile than consumer price. The results of Jarque-Bera statistic show the null hypothesis of normal distribution is rejected for all variables except WTI.

Table 2: Descriptive statistics

Variables	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
HPI	4.8926	0.2621	0.6701	2.2574	6.6518**
CPI	4.5392	0.1158	0.0980	1.6342	5.3940*
WTI	5.2417	0.4870	-0.6150	2.4316	4.5065
GDP	11.9550	0.4333	-0.1781	1.7215	4.9907*
BLR	6.4532	0.4228	0.0948	5.0840	12.4073***

Note: All data are expressed in natural log except BLR. ***, ** and * indicate significant at 1%, 5% and 10% level respectively.

The results of ADF and PP unit root tests presented in Table 3 show that WTI and BLR are I(0) while all other series are I(1). The results of the ARDL bounds test for cointegration are reported in Table 4. The F-statistic shows that variables in Equation (1) are cointegrated. This finding is consistent with Lee (2014) who finds evidence to support the hypothesis of the cointegration between Malaysian housing market and inflation over the long-run by using Johansen cointegration test. Anari and Kolari (2002) and Lee (2012 and 2013) also provide evidence to support the hypothesis of long-run relationship between house price and inflation using ARDL approach. Similarly, the F-statistic for Equation (2) shows the existence of cointegration among the variables. In contrast, Le (2015) fails to find cointegration among crude oil price and Malaysian house prices based on Gregory and Hansen (1996) cointegration test which is able to account for the presence of structural break.

Table 3: Unit root test

	Level		First diff	
	ADF	PP	ADF	PP
HP	3.1969	3.0031	-1.9858	-6.8296***
CPI	0.5431	0.9425	-7.4639***	-7.6571***
WTI	-2.8776*	-2.8600*	-6.7846***	-6.5240***
GDP	-0.9060	-2.3230	-5.1484***	-9.3929***
BLR	-2.6976*	-4.0925***	-6.6782***	-6.6782***

*** and * indicate significant at 1% and 10% level respectively.

We report the long-run and short-run coefficients of Equation (1) and (2) in Table 4. The long-run coefficient of house price with respect to consumer price is greater than one but statistically insignificant. This implies that housing is an effective hedge against consumer inflation in the long-run. On the other hand, the energy price affects house price negatively in which its long-run coefficient is less than zero. This implies that housing is a poor hedge against energy inflation in the long-run.

Table 4: ARDL cointegration results

Equation (1): ARDL(1,0,0,0)		Equation (2): ARDL(1,1,0,0)	
Bounds test			
F-statistic	20.5488***	F-statistic	21.0657***
Long-run coefficient:			
CPI	25.8159	WTI	-3.3867
GDP	1.1132	GDP	13.7697
BLR	0.5633	BLR	0.9546
Constant	-120.2497	Constant	138.3780
Short run coefficient:			
ECT_{t-1}	-0.0014***	ECT(-1)	-0.0013***
CPI	-0.1428	WTI	0.0194*
GDP	0.0695**	GDP	0.0268
BLR	0.0088	BLR	0.0071
Diagnostic test			
Normality test, Jarque-Bera	1.9136	Normality test, Jarque-Bera	0.1202
Serial correlation, LM(4)	5.1976	Serial correlation, LM(4)	4.9778
Heteroskedasticity, ARCH(4)	3.6871	Heteroskedasticity, ARCH(4)	5.3508

***, ** and * indicate significant at 1%, 5% and 10% level respectively. The optimum lags are selected based on Schwarz Information Criteria. The critical values for F-test with k=3, n=64, case II given by Narayan (2005): 4.056–5.158 (1% level), 2.976–3.896 (5% level) and 2.492–3.350 (10% level).

The coefficient of the error-correction term (ECT_{t-1}) for both consumer and energy prices is negative and statistically significant. It demonstrates that there is a long-run relationship between house price and both consumer and energy inflation. Besides that, the error-correction term represents the speed of adjustment of house prices to the long-run equilibrium. House prices adjust slowly to restore to the long-run equilibrium in response to consumer and energy inflation with adjustment speed of 0.14% and 0.13% respectively. The short-run coefficients are negative for consumer inflation but significantly positive for energy inflation. This shows that housing is a poor hedge against consumer inflation in the short-run but a partial hedge against energy inflation in the short-run.

Our results reveal that Malaysian residential real estate is a good hedge against consumer inflation in the long-run but a poor hedge against consumer inflation in the short-run. The increasing price level in the country would lower the real return of investment in the housing market. For the energy inflation, although housing in Malaysia could not hedge against energy inflation in the long-run, it is only a partial hedge against energy inflation in the short-run. With positive coefficient for CPI in the long-run, the hedging ability of Malaysian housing is more effective for consumer inflation than the energy inflation. Property investors may lose their purchasing power over increasing price of energy due to the negative link between house price and energy price in the long-run. This shows that buying a house in Malaysia is not for short-term speculation. Investors should target other form of financial assets to gain short-term return. Besides that, government policy should seriously aim at curbing speculation in the housing market and providing more affordable housing for the people.

As discovered by Lee (2014), housing market in Malaysia could not provide a complete hedge against actual inflation. Unlike housing market in the developed countries, Malaysian housing market offers a poor hedge against consumer inflation in the short-run. Real returns from residential property will decline if inflation rises. This finding has important implication for property investors and policymakers. Rising inflation resulted from increasing crude oil prices would threaten the desired level of real housing returns. On the other hand, the

implementation of Goods and Services Tax (GST) could lead to higher consumer inflation in the country and seriously impact on the housing returns. The real return from housing investment may not be well sustained under these circumstances.

5. Conclusion

This study examines the inflation hedging ability of Malaysian residential property by investigating the relationship between house prices and both consumer and energy prices. We would like to determine whether residential property in Malaysia is a hedge against consumer and energy inflation over 1999-2015 periods. From the ARDL results, we find that Malaysian residential property provides a complete hedge against consumer inflation over the long-term sample period. However, it is not hedge against energy inflation in the long-run. In the short-run, housing is able to hedge against energy inflation partially but not the consumer inflation. Investors should consider both consumer and energy inflation in their decision making process. Inflation risk arises from increasing oil price could reduce the wealth of property investors. Investors seeking inflation protection should be aware of the degree of hedging ability against energy inflation. Malaysian residential property is not a good investment asset that providing protection on investors' wealth against energy inflation.

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The Effect of Public Debt on Energy-Growth Nexus: Threshold Regression Analysis

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Abstract

ASEAN countries are dealing with challenging external environment recently with the deterioration of the global commodity price and the volatility of oil price. Most of the developing countries rely heavily on the energy consumption for the economic development purpose especially ASEAN countries which are the major energy exporter like Malaysia and Indonesia. This study aims to examine the relationship between energy consumption and economic growth from the perspective of public debt for Indonesia and Malaysia between periods of 2000 - 2013 via the threshold regression analysis. Our empirical results indicate that there are significant relationship between energy consumption and economic growth from the public debt threshold perspective for both countries. The analysis of Indonesia shows that higher level of public debt will lead to greater impact on energy consumption and economic nexus. In contrast, the impact of the energy consumption on economic growth for the case of Malaysia indicates a diminishing trend in the energy and economic growth nexus when the public debt is above the threshold level. Important policy implication from this study suggests that Indonesia and Malaysia should be more careful in formulating the energy consumption related policy by considering different perspectives such as public debt level of the nation. Moreover, both countries should consider reducing their dependence on the non-renewable energy resources and shifting to renewable energy resources such as solar, hydro, landfill gas for their economic development in the future.

Keywords: Energy consumption; economic growth; public debt; threshold regression analysis.

JEL classification: Q43; O40; H63; C32

1. Introduction

Energy is key resources that contribute to the industrial and economic development in any nation. The contribution of energy in economy of production can be viewed from demand and supply perspectives. On the demand side, electricity consumption is one of the form of energy that used by customer to satisfy their utility. Meanwhile, energy is viewed as vital factor of production from the supply side to increase the national output and stimulate the economic growth of a nation (Mathur et. al, 2016). High demand on energy which engaged in the process of economic development is rising from year to year especially in developing countries over the last 50 years (Omay et.al, 2015). Developing countries like Association of Southeast East Asian Nations (ASEAN) member countries are playing essential roles to influence the trends of world energy consumption. However, most of the ASEAN countries are dealing with challenging external environment recently with the deterioration of the global commodity price and the volatility of oil price. These countries rely heavily on the energy consumption where the energy serves as one of the driver for growth in this region

especially those major fossil-fuel producer and exporter like Indonesia and Malaysia. According to World Energy Outlook Special Report (2015), energy demand of ASEAN member countries escalated over 50% between 2000-2013. Besides, this report revealed that Indonesia is the largest energy consumer among the ASEAN member countries as well as the world largest coal exporter and major liquefied natural gas (LNG). Meanwhile, Malaysia ranks third largest energy consumer among the ASEAN countries and the world's second largest liquefied natural gas (LNG) in 2014 other than the oil exporter.

There are numerous studies on the energy consumption and economic growth nexus. Most of them suggested that economic growth have significant relationship with energy consumption. (Ang, 2008; Sharma, 2010; Loganathan et.al, 2010; Mathur, 2016). Nevertheless, there are some researchers disagreed with this finding. In fact, they indicated that the impact of energy consumption on economic growth is minimal. (Okonkwo and Gbadebo, 2009 and Noor et.al, 2010).The mixed findings of previous literatures failed to show consensus among the researchers either on the relationship of energy consumption and economic growth in general or the direction of causality for these two variables in specific. Most of the previous literatures study on the short run and long run relation or the direction of causality between energy consumption and economic growth nexus. There were very few studies examined the energy consumption and economic growth nexus from other perspectives.

One of the elements that might influence energy consumption and economic growth nexus is public debt. The swelling of public debt has become an emergence issues after the European debt crisis. Public debt crises raise the awareness of policy makers on the public debt issue such as dealing with the risk of credit slowdown and or bust that might affect the economic growth. Public debt is an important instrument that used to measure the sustainability of the country's finances. It reflects the repayment ability of a country to their debtors. High level of public debt will lead to the financial risk in term of outright default or capital flight. Moreover, it will also crowd out domestic spending via the escalating of interest risk premium and limit economic growth (Makin, 2005). Reinhart and Rogoff (2010) stated that growth performance of country will be deteriorated when public debt surpasses 90% of GDP threshold level. However, reasonable levels of public debt are likely to enhance its economic growth by financing productive investment. Therefore, this study aims to investigate the influence of threshold level of public debt on energy consumption and economic growth nexus. This paper is differs from other literatures from two aspects. Firstly, this study focuses on Indonesia and Malaysia through threshold regression model for the period of 2000-2013. The sample period reflects up-to-date development for Indonesia and Malaysia in 2000s. Secondly, this study is examining the energy consumption and economic growth nexus from threshold level of public debt. As per our knowledge, there are hardly to find literatures that review on the relationship between energy consumption and economic growth from public debt perspectives. The findings of this paper will provide new insight to the current literatures as well as to fulfill the existing gaps. The rest of this paper is organized as follows. Section 2 discusses on literature reviews. Section 3explain the data and methods. Section 4 presents the empirical results and the last section provides conclusion and policy implication.

2. Literature Review

Energy consumption is an eminent issue that has been thoroughly discussed by scholars, academician, researcher as well as government policy maker over the past decade. There were numerous empirical literatures on the relationship between energy consumption and economic growth. Most of the literatures on energy consumption and economic growth nexus focus on developing countries especially ASEAN region. Ang (2008) examined the relationship of energy and output of Malaysia for the period of 1971 to 1999 revealed that

energy consumption have positive relationship with economic growth in the long run. Besides, the causality result indicates that economic growth has causal effect on energy consumption for long run and short run in Malaysia. The case of Malaysia was further investigated by Loganathan et.al (2010) who discovered the existence of bidirectional co-integration effects between the total energy consumption and the economic growth of Malaysia over the period of 1971 to 2008. They applied different methods such as Ordinary Least Square Engel-Granger (OLS-EG), Dynamic Ordinary Least Square (DOLS), Autoregressive Distributed Lag (ARDL) Bounds testing approach and Error Correction Model (ECM) to examine the sustainability of energy consumption and economic performance of Malaysia. Furthermore, their findings revealed that energy consumption was on supportable perimeter with 57% speed of adjustment to achieve the long run equilibrium due to the short run shock in economic growth of Malaysia. Besides the case of Malaysia, Gross (2012) who study the non-causality between energy and economic growth in the US for the period of 1970 to 2007 through Granger causality test for three sectors consists of industry, commercial sector and transport sector. The empirical result shows that there is unidirectional long run Granger causality in the commercial sector from growth to energy and bi-directional long-run Granger causality in the transport sector.

On the other hand, some researchers investigated the relationship of energy consumption and economic growth based on many countries at the same region or different regions such as Sharma (2010), Apergis and Payne (2010), Razzaqi et. al (2011) and Omay et.al (2015). Study of Sharma (2010) focus on the linkage between energy consumption and economic growth for 66 countries across few regions such as Asia Pacific region, Europe and Central Asian region, Latin America and Caribbean region and sub-Saharan, North Africa and Middle Eastern region. Dynamic panel data models have been applied in the study and the result stated that energy consumption (both electricity and non-electricity type energy variables) has significant relationship with economic growth in Europe and Central Asian region. Meanwhile, Apergis and Payne (2010) who study on the renewable energy consumption and economic growth for 20 OECD countries over the period of 1985-2005 provide evidence to show that there are long run significant relationship between energy consumption and economic growth through panel cointegration test. The Granger causality test shows that there is bi-directional causality between energy consumption and economic growth in short run as well as long run. Apparently, their funding was supported by Razzaqi et. al (2011) who examined on the relationship between energy consumption and economic growth for developing-8 (D8) countries (Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan and Turkey) via Johansen's cointergation test proved that the existence of dynamic relationship between energy consumption and GDP occur in all D-8 countries. Moreover, their research also provides the evidence of bi-directional long run causality between energy consumption and economic growth exist through VECM and VAR causality test for the case of Indonesia and Malaysia. Another study of Omay et.al (2015) on the relationship of energy consumption and economic growth for eight developing countries from Europe and Central Asia (Azerbaijan, Bulgaria, Kzakhstan, Latvia, Lithuania, Romania, Russia Federation and Turkey) via the non-linear causality test suggested that the existence of two way relationship running from economic growth to energy consumption. The causality test revealed that one way causality running from economic growth to energy consumption was found.

There is another strand of researchers who show their disagreement on the findings of causal relationship exist between energy consumption and economic growth such as Chiou-Wei et. al (2011) and Mathur (2016). Chiou Wei et.al (2011) conduct their research based on meta-

analysis on the energy consumption and economic growth nexus stated that not all the developing countries shows the unidirectional causality from energy consumption to economic growth as compare with developed countries. Their finding was supported by Mathur (2016) who studied on the energy-growth nexus for 52 countries that consist of 18 developing countries, 16 transition ad 18 developed countries via various panel data estimation methods such as panel data cointegration, panel causality, panel VECM, panel VAR and panel data ARDL and SURE. Their result revealed that energy consumption has a negative impact on the economic growth for developing countries and transitional economies. In contrast, there are positive effect of energy consumption towards economic growth exists for the case of developed countries.

3. Data and Medothology

Sample period used in this study covers from 2000:Q1-2013:Q4. Gross domestic product is the dependent variable whereas energy consumption as independent variable. In addition, the public debt expressed as percentage of GDP is the threshold variable. All the variables are obtained from World Development Indicator (WDI).

Initially, the stationarity test of the time series variables will be performed prior estimation. This is crucial as to avoid spurious regression due to regressing non-stationary variables. Augmented Dickey-Fuller (ADF) unit root test proposed by Dickey and Fuller (1979) is adopted in this study as shown in Equation (1).

$$\Delta Y_t = \alpha + \beta_1 Y_{t-1} + \sum_{i=1}^{p} \beta_2 Y_{t-i} + \varepsilon_t \qquad (1)$$

where ΔY_t refers to the first difference of Y_t, α refers to the intercept while βs refers to the coefficients. p refers to the number of lagged terms chosen, t is time and ε_t is the white noise. The selection of optimal lag length is based on Schwartz Information Criterion (SIC). In addition, Kwiatkowski-Philips Schmidt-Shin (KPSS) unit root test also performed to test the stationarity of the time series variables. Once the time series variables are stationary with the same order of integration, then we can proceed with the Johansen and Juselius (1990) cointegration test as shown in Equation (2).

$$\Delta Z_t = \Pi \Delta Z_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \theta + \varepsilon_t \qquad (2)$$

where Z_t denotes $(n \times 1)$ vector of stationary $I(1)$ variables, Γ and Π represent $(i = 1, \ldots, k-1)$ of a $(n \times n)$ coefficients matrices, θ denotes constant, ε_t denotes error term and Δ represents difference operator and k is the optimal lag length. If Π has zero rank, this indicates there is no stationary linear combination and Z_t are not cointegrated. On the other hand, if the rank r of Π is positive, this indicates possible r stationary linear combinations. Thus, Π can be divided into two matrices, α and β where $\Pi = \alpha\beta'$. Meanwhile, β consists of the r cointegration relationship and α refers to the necessary adjustment coefficient matrix.

There are two types of test statistics, which are trace statistics and maximum eigenvalue.

Trace Test

$$T_{trace} = -T\sum_{i}^{k} log(1-\lambda_i) \qquad (3)$$

where T denotes the number of observation, k denotes the number of variables, λ_i is the i^{th} largest estimated eigenvalue. The null hypothesis of the trace test is stated as followed:

H_0: Number of cointegration vector is less or equal to r

H_A: At most r cointegration vectors

Maximum Eigenvalue

$$\lambda_{max} = -Tln(1-\lambda_{r+1}) \qquad (4)$$

where T refers the number of observation and λ_i is the i^{th} largest estimated eigenvalue. The null hypothesis of the maximum eigenvalue is as followed:

H_0: r cointegrating relation

H_A: r + 1 cointegrating relation

With regards to this, the interaction between the energy consumption and economic growth can be estimated based on the different level of public debt as the threshold variable. The determination of the public debt threshold is based on the minimization sum of squared errors. Subsequently, the heterogeneous effects of the energy consumption on economic growth can be examined based on either country has high public debt level (above the threshold level) or low public debt level (below threshold level). Following is the equation of the threshold regression approach:

$$GDP_t = \beta E_t + \partial_1 PD_t(\gamma) + \varepsilon_t \qquad if \ -\infty < PD_t < \gamma_1 \qquad (5)$$

$$GDP_t = \beta E_t + \partial_2 PD_t(\gamma) + \varepsilon_t \qquad if \ \ \gamma_1 < PD_t < \infty \qquad (6)$$

where GDP_t refers to Gross Domestic Product, E_t refers to Energy Consumption, PD_t refers to Public debt as % of GDP and γ refers to Threshold level.

4. Empirical Results

Initially, all the variables are examined via Augmented Dickey-Fuller (ADF) and Kwiatkowski-Philips Schmidt-Shin (KPSS) unit root test to the stationarity of the time series variables. Based on the ADF unit root test results shown in Table 1, the null hypothesis cannot be rejected at level as the *t*-statistic values are negative and greater than the critical value. This indicates that the variable is non-stationary or *I*(0). Nevertheless, null hypothesis can be rejected at 1st difference as the *t*-statistic values are negative and less than the critical value. In terms of KPSS unit root test, the interpretation of unit root is dissimilar due to the null hypothesis of stationarity. The KPSS results indicate non-stationary at level but stationary after first difference. We can conclude that the variables used in this study are stationary at first difference and integrated of order one.

Table 1: Unit Roots Test Results

	Augmented Dickey-Fuller		Kwiatkowski-Philips Schmidt-Shin	
Indonesia	Level	1st Difference	Level	1st Difference
LGDP	-2.028	-3.593***	0.3339	0.3917**
LE	-2.694	-2.946**	0.2050	0.1503***
LGD	1.535	-9.127***	0.2401	0.7267*
Malaysia	Level	1st Difference	Level	1st Difference
LGDP	-2.645	-4.053***	0.2697	0.1958***
LE	-2.676	-4.496***	0.2257	0.1155***
LGD	-2.229	-2.950**	0.5105	0.1402**

Notes: Asterisks *, ** and *** denote significance levels: 10%, 5% and 1%. LGDP = logarithm GDP, LE = logarithm energy consumption and LGD = logarithm government debt. Automatic lag selection by Schwarz Info Criterion (SIC) for ADF. Null hypothesis under ADF test is time series variable is non-stationary while null hypothesis under KPSS test is time series variable is stationary.

Table 2: Johansen and Juselius Cointegration Test Result

Null	Alternative	Trace Statistic	Critical Value	Max-Eigen Value	Critical Value
Indonesia					
r = 0	r = 1	20.164**	15.495	16.895**	14.265
r ≤ 1	r = 2	3.269	3.841	3.269	3.841
Malaysia					
r = 0	r = 1	42.519**	15.495	42.518**	14.265
r ≤ 1	r = 2	0.001	3.841	0.001	3.841

Asterisk ** denotes rejection of the null hypothesis at 0.05 significance level.

Since all the variables are stationary or integrated at order one, we can proceed to Johansen and Juselius (1990) cointegration test with the aim to determine the existence of equilibrium in the long-run. Table 2 shows the cointegration test results between economic growth and energy consumption for all the four countries. The null hypothesis of none cointegrated vector can be rejected at 5% significant level for both maximum eigen value and trace statistic value as they are greater than their respective critical values. However, the null hypothesis of two cointegrated vectors cannot be rejected due to the smaller values of both maximum eigen value and trace statistic value than their critical values. Hence, this indicates that there is a single cointegrating vector or long-run equilibrium between economic growth and energy consumption.

The threshold regression results are depicted in Table 3. The overall results indicate existence significant relationship of energy consumption and economic growth from the perspective of public debt threshold for Indonesia and Malaysia. Specifically, For the case of Indonesia, the empirical result shows that higher level of public debt will lead to greater impact of energy consumption on economic growth. The public debt threshold for Indonesia case is approximately 34% of GDP. There is a significant positive association between energy consumption and economic growth with coefficient of 5.89% when the public debt is below the threshold level. Nevertheless, the coefficient of the energy consumption of growth increase to 7.76% when the public debt level exceeds the threshold level of 34% of GDP. This might due to the debt accumulation is used for the development purpose which lead to more energy consumption for economic growth in Indonesia. On the other hand, the empirical result for Malaysia shows that higher level of public debt will only lead to minimal

impact on the energy consumption and economic growth nexus. In the case of Malaysia, the public debt threshold is approximately 52% of GDP. There is a declining effect from 2.89% to 1.68% of energy consumption on growth when the public debt is above the threshold level. This might due to not all public debt is used for the development purpose but used for debt repayment. The empirical result shows the existence of significant relationship between energy consumption and economic growth for the case of Indonesia and Malaysia is consistent with the findings of Ang (2008), Loganathan et.al (2010) and Razzaqi et.al (2011). This signified that public debt play certain roles in both countries to influence the energy consumption and growth nexus especially Indonesia.

Table 3: Result of Threshold Regression Analysis

Country	Above/Below Threshold Level	Coefficients	Standard Error	Observations	Threshold Level
Indonesia	Public Debt < 34.0217	**5.899*** **	0.789	28	**34.0217**
	Public Debt ≥ 34.0217	**7.755*** **	0.823	28	
Malaysia	Public Debt < 51.6763	**2.898*** **	0.137	38	**51.6763**
	Public Debt ≥ 51.6763	**1.684*** **	0.367	18	

Notes: Gross Domestic Product as dependent variable. Asterisk *** indicates significant at15% level.

5. Policy implications and conclusions

Energy consumption is key factor to stimulate economic development and growth in most of the developing countries as suggested by some literatures such as Ang (2008), Sharma (2010), Loganathan et.al (2010) and Razzaqi et.al (2011). In order to provide new insight to the existing literature on the energy consumption and growth nexus, this study aims to investigate the relationship between energy consumption and economic growth from public debt perspective for Indonesia and Malaysia. This study adopts secondary data for the period of 2000 to 2013 and analyzes the heterogeneous impacts of different debt levels toward energy consumption and growth nexus via threshold regression analysis. Our findings indicate the existence of significant relationship between the energy consumption and growth from the public debt threshold perspective in Indonesia and Malaysia. This means that the public debt plays important role in mediating the energy–growth nexus. In detail, the empirical result for Indonesia shows that higher level of the public debt or when the public debt exceeds the threshold level, this will lead to greater impact on energy consumption and economic nexus. In contrast, the results for Malaysia case show different outcomes where there is a diminishing trend of the impact of energy consumption on economic growth when the public debt exceed the threshold level. This indicates that higher level of public debt have minimal impact to energy consumption and growth nexus in Malaysia. The important policy implication from this study suggests that Indonesia and Malaysia should be more careful in formulating the energy consumption related policy by considering from different perspective such as public debt level of the nation. Debt has become unavoidable options for a country due to the need to cushion any severe external economic shocks such as oil price and currency fluctuations. Nevertheless, managing optimal debt position remains a challenge for Indonesia and Malaysia in order to ensure sustainable growth. Besides that, both countries should consider reducing their dependence on the non-renewable energy resources and shifting to renewable energy resources such as solar, hydro, landfill gas for their economic development in the future.

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Estimation of Malaysia Public Debt Threshold

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Abstract

The objective of this study is to examine the implication of the public debt on the economic growth of Malaysia from the perspective of different public debt levels threshold. Threshold Regression method is utilized to identify the public debt threshold from 1991:Q1-2014:Q4 and examine the heterogeneous impacts of the public debt on growth based on certain threshold levels. Empirical results indicate that there is a positive association between the public debt and economic growth when the public debt is below 41% of GDP threshold level. Furthermore, there is a marginal positive impact when the public debt level falls between 41%-53% of GDP threshold levels. However, there is a harmful impact on growth when public debt is above 53% of GDP threshold level. As a result, managing the public debt position and the quality of the debt are important to ensure sustainable economic growth.

Keywords: Public debt; threshold; growth

JEL Classification*: H63, C24, O10*

1. Introduction

Debt is unavoidable and is viewed as a tool to curtail the adverse impacts of economic shock. In the inter-temporal perspective, a country may run into deficit and leads to accumulation of debt in the circumstances of economic shock with the purpose to mitigate the negative impacts of the shock. This is with the assumption that the country will experience surplus in the future due to the recovering of the economy. Nevertheless, the debt level of most of the countries are showing rising trend and can be harmful to the economic growth of the countries. For instance, Reinhart and Rogoff (2010) indicate that the threshold of the public debt is 90% of GDP where countries may experience positive economic growth when the public debt level is below 90% of GDP threshold level. However, economic growth of the countries may worsen when the public debt of the countries is beyond the 90% of GDP threshold level. Therefore, this indicates that the implication of the debt on the economic growth may diverge depending on the threshold levels.

Malaysia recorded remarkable gross domestic product (GDP) growth in the 1990s with average 9.2% from 1990 until 1997 (World Economic Outlook, IMF). However, the economic growth deteriorated drastically due to the Asian Financial crisis in 1997. The economic growth of Malaysia preserves at the range 4-5% from 2011 to 2014 and recorded around 4.9% in 2015 (World Economic Outlook, IMF) due to the prudent fiscal and monetary policies in safeguarding rapid recovery of the economy.

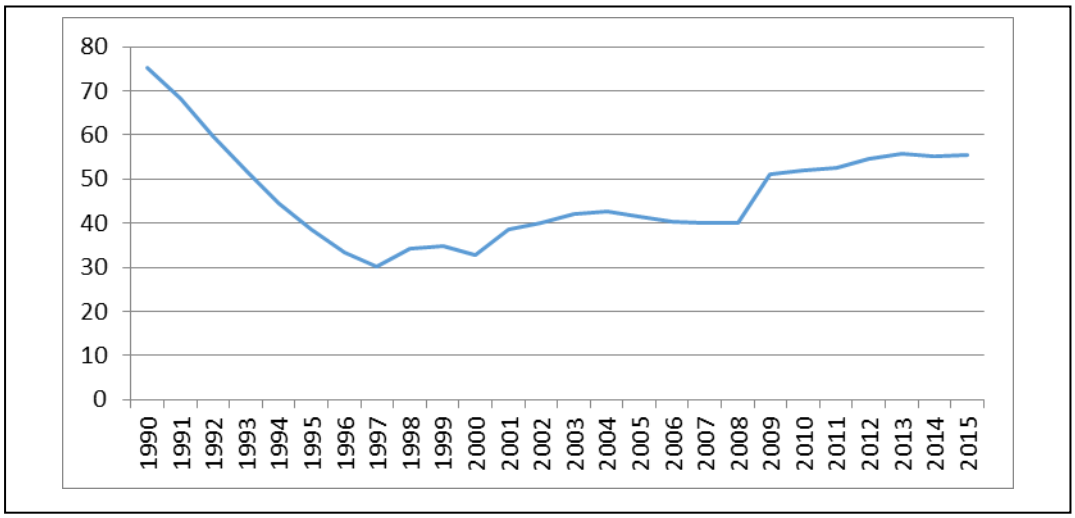

Figure 1: Malaysia Gross Government Debt (% of GDP) from 1990-2015
Source: World Economic Outlook, International Monetary Fund.

Meanwhile, the trend of the government debt of Malaysia depicts a declining pattern from around 75% of GDP in 1990 to 30% of GDP in 1997. The dependency on the public debt was reducing due to the fact that Malaysia was one of the favorite destinations of foreign direct investment in the 1990s. Nonetheless, the size of the public debt level began to expand in 1998 onwards and recorded a new level of 43% of GDP in 2004. The accumulation of the public debt was due to the needs to minimize the severe economic turbulence during the Asian Financial crisis in 1997. Subsequently, the recovery of the economy was linked with the decline in the debt level from 2004 until 2008. There was a severe rise in the debt level in 2009 due to the 2008 global financial crisis. The debt level recorded around 51% of GDP in 2009 and exhibited increasing trend since then and reached around 55% of GDP in 2015. Therefore, it is crucial to identify the threshold level of Malaysia public debt and further understand the effect of the public debt on economic growth when the public debt is above or below certain threshold levels.

The main objective of this study is to investigate the diverse impacts of the public debt on economic growth of Malaysia considering different threshold levels. This study varies from other studies in the following features: Firstly, the public debt threshold is determined endogenously based on the threshold regression approach, instead of predetermined threshold levels. This is dissimilar from the public debt threshold stated by Reinhart and Rogoff (2010), which is based on descriptive statistical analysis. In addition, the extreme critical threshold level such as 90% of GDP of debt threshold where debt will have negative impact of growth is based on large sample countries used in their study, which covers developed and developing countries. This threshold level may not be applicable in the case of individual country specific. Secondly, there are limited studies investigating the implications of the public debt on economic growth of Malaysia from the perspective of threshold levels. For instance, Lee and Ng (2015) examined the long-run impact of public debt on growth without identifying the level of threshold. Besides, most of those studies investigated on either external debt, such as Mohd Daud et al. (2013) or debt composition such as Choong et al. (2010).

The remainder of the paper is organized as follows: section two provides literature review on public debt and growth, followed by section three discussing the methodology, section four provides empirical findings and discussion and last section is conclusion.

2. Literature Review

The impact of the debt on economic growth can be associated to debt overhang hypothesis. This hypothesis states that there is no incentive for the government to implement macroeconomic policies to stimulate the economy if a country has high level of debt. This is due to the yields of successful policies will shift to finance the high level of debt, in terms of debt interest payment (Clements et al., 2003). Subsequently, the empirical findings provide mixed conclusion on the effect of debt on growth.

Choong et al. (2010) investigated the impact of various type of debt on economic growth of Malaysia from 1970 to 2006 using cointegration test and Granger causality test. Empirical findings indicated that existence of negative impact of the external debt on growth in the long-run. Meanwhile, Mohd Daud et al. (2013) examined the association between external debt and economic growth of Malaysia from 1991:Q1 to 2009:Q4 using Autoregressive Distributed Lag (ARDL). They further estimate the threshold effect via Hansen (2000) threshold method. The findings indicated that accumulation of external debt is link to expansion in economic growth of Malaysia until level of RM170,757. This means that there will be opposite association between external debt and growth when the external debt is above the threshold level. Lee and Ng (2015) examined the effect of the public debt towards economic growth of Malaysia for the sample period of 1991-2013. Their findings showed that public debt has negative impact on the economic growth with coefficient of 1.17%.

In terms of non-linearity perspective, there are several studies emphasize on the turning point of the debt effect on growth, particularly external debt. For instance, Pattilio et al. (2004) examined 93 developing countries for a sample period of 1969-1998. Their findings indicated that the impact of debt on growth become negative when debt level exceed 160-170% of export and 35-40% of GDP. Meanwhile, Kumar and Woo (2010) investigated the debt effect on growth for advanced and emerging economies from 1970-2007. Empirical results indicated that there is an inverse between initial debts on growth with 0.2% point for advanced countries and 0.15% point for emerging countries upon 10% point increase in initial debts. Furthermore, there is also evidence of non-linearity where negative effect of debt on growth when the public debt level is beyond 90% of GDP threshold level. Baum et al. (2013) investigated the implication of the public debt and economic growth based on sample countries of 12 Euro area countries from 1990 to 2010. Their empirical findings indicated that debt contributed positively to the economic growth when the debt is below 67% of GDP threshold level. Spilioti and Vamvoukus (2015) examined the relationship between debt and economic growth for Greece from 1970 to 2010. They discovered that debt becomes detrimental to economic growth when the debt is above 110% of GDP threshold level.

3. Methodology

The data used in this study comprises of gross domestic product per capita expressed in US dollar and public debt expressed as % of GDP covering the sample period of 1991:Q1 to 2014:Q4. All the variables are obtained from World Economic Outlook, International Monetary Fund. Initially, this study performs stationarity test on the variables to examine the order of integration in order to avoid spurious regression. The Augmented Dickey-Fuller (ADF) unit root test is applied to test the time series properties. Equation (1) shows the equation for the ADF test.

$$\Delta Y_t = \beta_0 + \beta_1 t + \theta_1 Y_{t-1} + \sum \theta_2 \Delta Y_{t-1} + \varepsilon_t \qquad (1)$$

where Y_t refers to variable of interest, Δ refers to differencing operator, *t* refers to time trend and ε refers to the error term. The non-rejection of the null hypothesis indicates that Y_t has unit root or non-stationary. On the other hand, the rejection of the null hypothesis indicates that Y_t is stationary.

Cointegration test can be performed if the time series variables are stationary and integrated in the same order or *I*(1). The purpose of the cointegration test is to determine the existence of the long-run equilibrium between the parameters of interest. The Johansen and Juselius (1990) cointegration test is represented in Equation (2).

$$\Delta Z_t = \gamma + \Pi \Delta Z_{t-k} + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \varepsilon_t \qquad (2)$$

where Z_t is column vector of stationary *I*(1) variables, Γ and Π denote coefficients matrices, γ is constant, ε_t is error term and Δ is difference operator and *k* is the optimal lag length. If Π has zero rank, there is no stationary linear combination and this indicates that Z_t are not cointegrated. In contrast, if the rank *r* of Π is greater than zero, there is possible *r* stationary linear combinations. Π can be divided into two matrices, α and β where $\Pi = \alpha\beta'$. In detail, β consists of the *r* cointegration relationship and α denotes the necessary adjustment coefficient matrix.

Johansen and Juselius (1990) introduced two types of test statistics, which are trace statistics and maximum eigenvalue. In terms of trace statistic, the null hypothesis of *r* cointegrating vector while the alternative hypothesis of *k* cointegrating vector for *r* = 0, 1, …, *k* – 1. The trace statistic test is computed as in Equation (3).

$$T_{trace} = -T \sum_{i}^{k} log(1 - \lambda_i) \qquad (3)$$

where *T* denotes the number of observation, *k* denotes the number of variables, λ_i is the i^{th} largest estimated eigenvalue.

The maximum eigenvalue statistic examines the null hypothesis of *r* cointegrating vector against alternative hypothesis of *r* + 1 cointegrating vector. The maximum eigenvalue statistic test is computed as in Equation (4).

$$\lambda_{max} = -T ln(1 - \lambda_{r+1}) \qquad (4)$$

where *T* refers the number of observation and λ_i is the i^{th} largest estimated eigenvalue.

The threshold regression model includes non-linear regression estimation and regime switching with the aim to capture the interaction between parameters of interest when the variables exceed certain unknown threshold level.

Following is the equation on the threshold regression approach:

$$Y_t = \beta X_t + \partial_1 X_t(\gamma) + \varepsilon_t \qquad if \ -\infty < \theta_t < \gamma_1 \qquad (5)$$

$$Y_t = \beta X_t + \partial_2 X_t(\gamma) + \varepsilon_t \qquad if \ \ \gamma_1 < \theta_t < \infty \qquad (6)$$

where Y_t = Gross Domestic Product per capita, X_t = Public debt as % of GDP, θ_t = Threshold variable

The coefficients of ∂_1 and ∂_2 reflect the interaction of the public debt on economic growth when the public debt is below and above the threshold level, respectively. In addition, budget balance expressed as percentage of GDP will be included in the model as control variable. The threshold level is determined by selecting the minimized sum of squared errors:

$$S_t(\beta, \partial, \gamma) = (Y - \beta X - \partial X_\gamma)'(Y - \beta X - \partial X_\gamma) \qquad (7)$$

where the least squares estimators, $\hat{\beta}, \hat{\partial}, \hat{\gamma}$ minimized the function $S_t(\beta, \partial, \gamma)$ and thus γ is restricted to a bounded set $[\underline{\gamma}, \overline{\gamma}]$. The interaction of the parameters of interest can be estimated based on different threshold levels as either above or below the respective levels.

4. Empirical Findings

It is important to confirm the stationarity of the time-series variables in the same order in the time-series analysis. Table 1 shows the unit root test results based on Augmented Dickey-Fuller (ADF) test. All the times series variables are non-stationary at the level since the null hypothesis of variable contain unit root cannot be rejected. This is due to the *t*-statistic values are negative and greater than the critical values. However, the null hypothesis can be rejected at first difference as the *t*-statistic values are negative and less than the critical values. This indicates that they are stationary at first difference. Since the variables are integrated with the same order and stationary at first difference, cointegration test can be performed in order to determine the existence of the long-run association between the GDP per capita and public debt. Table 3 depicts the result for the Johansen and Juselius Cointegration Test. Both the trace statistic and max-eigenvalue exceed their critical value at none cointegrated vector. This means that the null hypothesis of none cointegrated vector can be rejected. In contrast, both the trace statistic and max-eigenvalue are less than their critical value at most 1 and 2 cointegrated vectors. This shows that the null hypothesis of at most 1 and 2 cointegrated vectors cannot be rejected. Thus, we can conclude that there is a long-run association between parameter of interests.

Due to the existence of the long-run relationship between GDP per capita and public debt, we can proceed to estimate the implication of the public debt on economic growth based on Threshold Regression approach. This is important in terms of providing additional information regarding the heterogeneous impact of the public debt on economic growth when the public debt is above or below the certain threshold level. Table 3 indicates the results of the relationship between public debt and budget balance towards GDP per capita of Malaysia based on without threshold and with threshold perspectives. Public debt has a positive relationship with economic growth in the long-run. This result is inconsistent with the finding from Lee and Ng (2005) and may due to the frequencies of the data used where they used annually data while quarterly data are used in this study. However, the impact of the public debt becomes diverse when considering the different threshold levels. There is a positive impact of the public debt towards economic growth when the public debt is below around 41% of GDP threshold level. This means that the accumulation of the debt initially contributes positively to the growth via the need in financing the development projects. The effect of the public debt on growth reduces when the public debt is between around 41% and 53% of GDP threshold level. Nevertheless, there is an inverse relationship between public debt and economic growth when the public debt is above the 53% of GDP threshold level. This indicates that accumulation of the public debt beyond 53% of GDP threshold level may be harmful to economic growth.

Table 1: Unit Root Test Results

	Level		1st Difference	
	Trend & Intercept	**Intercept**	**Trend & Intercept**	**Intercept**
GDPPC	-2.435	-0.898	-4.024**	-4.047***
DEBT	-3.055	-2.032	-3.705**	-3.289**
BB	-2.337	-1.873	-2.795	2.807*

Notes: Asterisks *, ** and *** denote significance levels: 10%, 5% and 1%. GDPPC = logarithm GDP per capita, DEBT = logarithm gross government debt as % of GDP and BB = budget balance as % of GDP. Automatic lag selection by Schwarz Info Criterion (SIC).

Table 2: Johansen and Juselius Cointegration Test Result

Null	**Alternative**	**Trace Statistic**	**Critical Value**	**Max-Eigen Value**	**Critical Value**
r = 0	r = 1	35.344**	29.797	22.969**	21.132
r ≤ 1	r = 2	12.375	15.495	11.539	14.265
r ≤ 2	r = 3	0.836	3.8415	0.836	3.841

Notes: Asterisks *, ** and *** denote significance levels: 10%, 5% and 1%.

Table 3: Threshold Regression Results Based on Two Threshold Levels

Dependent Variable	**Coefficients**	**Standard Error**	**Public Debt Threshold**
Non-threshold:			
Debt	0.085*	0.045	-
Budget Balance	-0.057***	0.014	
Constant	1.919***	0.108	
With Threshold:			
Debt <40.74			**40.74**
Debt	0.392***	0.094	
Budget Balance	0.027***	0.012	
Constant	1.276***	0.204	
40.74<= Debt <53.16			**40.74; 53.16**
Debt	0.364***	0.089	
Budget Balance	-0.062***	0.011	
Constant	1.237***	0.216	
Debt =>53.16			**53.16**
Debt	-0.647***	0.164	
Budget Balance	-0.266***	0.034	
Constant	3.760***	0.454	

Notes: Gross Domestic Product per Capita as dependent variable. Asterisks *, ** and *** denote significance levels: 10%, 5% and 1%.

5. Conclusion

Although public debt is important to sustain economic growth, however, the association between the public debt and growth deserve attention due to the heterogeneous impact

depending on the different public debt threshold levels. In the case of Malaysia, there is positive relationship between public debt and economic growth when the public debt is below around 41% of GDP threshold level. In addition, the effects weaken when the public debt level is around 41% to 53% of GDP threshold levels. In contrast, there is an inverse association between public debt and economic growth when the public debt level exceeds around 53% of GDP threshold level. This means that the preliminary accumulation of the public debt leads to the growth of the economy. Nevertheless, additional debt will be harmful to the economic growth when the debt reaches the optimum level. This is essential to the policy maker in developing strategies as the impact of public debt on growth differ when the public debt is above or below certain threshold level.

In terms of policy perspective, managing optimal debt position is crucial for Malaysia in order to overcome the external economic uncertainties such as oil price fluctuation and fluctuation in the exchange rate. Besides, the quality of the debt deserve serious attention as the accumulation of the debt must be compensated with favorable yield in the future. Therefore, policy developed should monitor closely the public debt level in order to ensure optimal debt position and the quality of the debt.

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Energy Subsidy and Economic Production: The Evidence from Malaysia and Indonesia

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Abstract
Energy subsidy policy is one of the most favorable policies implemented by many oil producer countries in improving their economic development. However, the economic outcome is still debatable due to the implications on economic efficiency, fiscal policy and et cetera. As two main oil producer countries in ASEAN 5, both Malaysia and Indonesia had allocated 5% of energy subsidy (% of GDP) averagely throughout the period of 1990-2014. This paper is intended to study the impact of energy subsidy on economic production in Malaysia and Indonesia by employing a dynamic panel data analysis. Our finding suggests that the energy subsidy affects the growth output positively in the long run. We conclude that energy subsidy is significant to promote economic growth in both countries. The absence of energy subsidy will bring harm to the economic growth. However, if a reduction of energy subsidy is essential to improve efficiency and fiscal pressure, we suggest the policymaker to implement some offsetting policies to cushion the economy from any shocks.

Keywords: Energy; subsidy; output; panel data analysis

1. Introduction

Malaysia and Indonesia are the net oil exporting countries in ASEAN 5. Accumulatively, they have recorded -117 average value of net energy import throughout 2010-2013. As part of the oil production countries in the world, Malaysia and Indonesia earned averagely 5.8% and 2.4% of oil rent (% of GDP) throughout 2010-2014. Tellingly, their revenue was contributed much by oil production. With the combination of GDP, they have contributed about 52% share of GDP in ASEAN 5 economies for the year 2014. In addition, both Malaysia and Indonesia have achieved the highest economic growth in ASEAN 5 economies which is about 6% and 5% in the year 2014, respectively. Malaysia and Indonesia have allocated a huge amount of subsidy, about 74% share of total subsidies in ASEAN 5 economies were contributed by Malaysia and Indonesia in 2014. Out of this value, 74% were allocated for energy subsidy[2]. In general, as the oil producer countries in the world, it gives them many advantages to invest much on energy subsidy to drive a good performance of their macroeconomics and to increase the economic welfare.

There are many arguments on the role of subsidy in promoting economic growth recently. In one side, it is believed that the subsidy can give a cost advantage to the producer and increase the economic welfare of a society in the market (Van Beers and Van den Bergh, 2001). Consequently, it forms a conducive economic environment to promote a rapid national growth. On the other side, the subsidy program is believed not to form a conducive economic environment derived from the existence of the death weight loss in the market and fiscal pressure problem. Thus, it brings to a situation of where the economic system is unproductive to encourage a rapid national growth (Isaak, 2015; Arzedel Granado et al, 2012). In respect to

[2] All numbers and percentage quoted are retrieved from World Bank Development Indicator (WDI), Bank Negara Malaysia and *Bank* Sentral Republik *Indonesia.*

this matter, the government has initiated to rationalize its subsidy policy to ensure that the subsidy becomes a productive tool to promote growth and reduce its fiscal pressure, concurrently. One aggressive action that has been taken is that to reduce significant amount to be allocated for energy subsidy. To date, Indonesia had managed to reduce its subsidy growth about -85% derived from its initiatives to reduce 148% growths for energy subsidy in 2015. Same as Malaysia, it managed to reduce 16% of its subsidy growth derived from a reduction of 9% growth for energy subsidy in 2014. As both economies are highly dependent on subsidy, specifically energy subsidy, this policy will definitely affect their economic activity as a whole via various channels.

In regards to this matter, we argue that it is important for the current literature to discover the impact of economic shock derives from the absence of energy subsidy in an economy toward the sustainable growth of macroeconomic performance. Thus, this paper is intended to explore the long run impact of energy subsidy on economic output by employing the dynamic panel data analysis. The objective of this paper is to determine the long-run impact of energy subsidy on economic output and its magnitude impact on economic output.

This paper is structured as follows. Next section is the literature review. Section 3 explains the data and methodology employed in this study. The last two sections discuss the empirical result, conclusion and policy implication.

2. Literature Review

Three main conclusions have been made by the previous studies related to the study of energy subsidy and its impact on an economy. First, it has a strong evidence to support that energy subsidy removal will eventually reflect adverse performance on the macro economy and economic welfare (Jiang and Lin, 2014; Lin and Jiang, 2011; Liu and Li, 2011 and Plate, 2014; and Solaymani and Kari, 2014). Jiang and Lin (2014) and Lin and Jiang (2011) have clearly documented their result which shows that the GDP is expected to decrease affected by energy subsidy removal in China. It is also supported by Plate (2014) where it is expected to have the same experience in the net oil importer and net oil exporter countries. Apart of that, energy subsidy removal also reduces the employment rate (Jiang and Lin, 2014; Lin and Jiang, 2011). Basically, an absent of energy subsidy will eventually increase the inflation as the price level increase reflect the increase of production cost (The International Institute of Sustainable Development, 2012). This hypothesis is supported by Manzoor et al, (2009), Jiang and Tan (2013) and Solaymani and Kari (2014).

Second, it has a strong evidence to prove that the energy subsidy removal will eventually improve economic efficiency and reduce fiscal pressure (Jiang and Tan, 2013; Jiang and Lin, 2014; Lin and Jiang, 2011). This evident is clearly stated in Jiang and Tan (2013), Jiang and Lin and Solaymani and Kari (2014). In China, it is expected to increase national saving up to 30% and improve its energy intensity simultaneously due to the execution of energy subsidy removal (Jiang and Lin , 2014; Jiang and Tan, 2013). This empirical result also supported by Solaymani and Kari (2014) where the energy subsidy removal is expected to improve Malaysian fiscal pressure and also economic efficiency.

Third, it has a positive impact on the environment as it is expected to reduce the carbon emission by removing energy subsidy in an economy. Lin and Jiang (2011), Liu and Li (2011), Solaymani and Kari (2014) and Jiang and Lin (2014) have empirically proved that the energy subsidy removal is significant to reduce the carbon emission. It is because the energy subsidy removal reflects a reduction in energy demand as the price of energy become expensive.

All studies above employed an input-output analysis. To the best of our knowledge, there is no study employs panel econometric method in exploring the relationship between energy subsidy and output. To fill the gap in the current literature, this paper employs a dynamic panel data analysis to contribute a new empirical finding on this issue. Since the time series data for energy subsidy is limited for both sample countries, we employ a dynamic panel data analysis in respect to its advantage to treat large sample size derive from a combination of two time series dataset for two sample countries.

3. Data and Methodology

This study employs neo-classical production function. We take into account the factors of labor and capital as control variables in the model. The suggested model is as follows:

$$GDP_{it} = ES_{it} + K_{it} + L_{it} + \varepsilon_{it} \quad (1)$$

where,
Y- Gross Domestic Product (USD constant 2005)
ES – Energy Subsidy (USD constant 2005)
K – Gross Capital Formation (USD constant 2005)
L – Number of Total Employment

A panel data of Malaysia and Indonesia from 1990 to 2014 are employed in this study. The data for all series are taken from World Bank database, Department of Statistics of Malaysia and Indonesia and the central bank of Malaysia and Indonesia.

The panel econometric methods that are employed in this study are as follows:

3.1 The Panel Unit Root Test

The Im, Pesaran and Shin (IPS) unit root test is employed to examine the stationary process of all series in the model. It is based on the heterogeneous panel assumption that allows heterogeneity of the autoregressive coefficient (Im, Pesaran and Shin, 2003). The equation for IPS test is as follows:

$$Y_{it} = \alpha_i + \beta_i Y_{i,t-k} + \sum \varphi_k Y_{i,t-k} + \delta_{it} + \mu_{it} \quad (2)$$

The null hypothesis is expressed as follows:

$H_0 : \beta_i = 0$ For all i

$H_1 : \beta_i < 0$ For at least one i

In a normal practice, if all series are found to be I(1), it allows us to execute the cointegration test for long run cointegration. However, there are some methods that allows us to regress the long run estimator regardless all series are I(1).

3.2 Cointegration Test

We employ Pedroni (1999) cointegration test to analyze the cointegration relationship in eq. (1). It allows heterogeneity of the autoregressive coefficient in panel data model. There are seven different cointegration statistics used to capture the pooled effect and group mean effect.

3.3 Long Run Estimator

We carry out the Pooled Mean Group (PMG) regression to estimate the long-run equation. The PMG regression is a combination of pooling and calculating the average means (Pesaran et. al., 1999). Assuming ARDL (1,1,1,1) equation:

$$Y_{it} = \alpha_i + \beta_{10i} ES_{it} + \beta_{11i} ES_{it-1} + \beta_{20i} K_{it} + \beta_{21i} K_{it-1} + \beta_{30i} L_{it} + \beta_{31i} L_{it-1} + \tau_i Y_{it} + \varphi_{it} \quad (3)$$

Thus, the error correction equation is as follows:

$$Y_{it} = \omega_i [Y_{it-1} - \rho_{0i} - \rho_{1i} ES_{it} - \rho_{2i} K_{it} - \rho_{3i} L_{it}] - \beta_{11i} ES_{it-1} - \beta_{21i} K_{it-1} - \beta_{31i} L_{it-1} + \varphi_{it} \quad (4)$$

where

$$\rho_{0i} = \frac{\alpha_i}{1-\tau_i}, \quad \rho_{1i} = \frac{\beta_{10i} + \beta_{11i}}{1-\tau_i}, \quad \rho_{2i} = \frac{\beta_{20i} + \beta_{21i}}{1-\tau_i},$$

$$\rho_{3i} = \frac{\beta_{30i} + \beta_{31i}}{1-\tau_i}, \quad \omega_i = -(1-\tau_i)$$

As a robustness check, we re-estimate the model using pooled OLS, dynamics OLS (DOLS) and fully modified OLS (FMOLS) estimations. Pooled OLS is static model estimation, while DOLS, FMOLS and PMG are dynamic model estimation. The lag length selection for DOLS, FMOLS and PMG are determined by Akaike's Information Criterion (AIC).

4. Empirical Results

Table 1: IPS Test Results

Variable	I(0)		I(1)	
	Constant	Trend	Constant	Trend
LES	0.3362	-3.0815*	-9.3126*	-7.9185*
LK	-0.2388	-0.2468	-4.3603*	-3.439*
LL	-1.2598	-0.1805	-4.6812*	-4.4763
LY	0.6716	-0.6072	-3.7531*	-2.9817*

***, ** and * indicates significant at 1%, 5% and 10% level

The results of panel unit root tests are presented in Table 1. In summary, all panel unit root tests tend to conclude that all series are I(1). Thus, we can proceed to execute the cointegration test.

Table 2: Pedroni Cointegration Test Results

Cointegration Test	No Time Effect	Time Effect
Panel v-Statistic	-0.0038	20.7022*
Panel rho-Statistic	-1.4109***	1.331
Panel PP-Statistic	-3.8733*	0.361
Panel ADF-Statistic	-2.6804*	1.6507
Group rho-Statistic	-0.9471	0.9487
Group PP-Statistic	-4.8483*	0.6234
Group ADF-Statistic	-2.4848*	0.9443
Panel v-Statistic (Weighted Statistic)	-0.0961	22.9694*
Panel rho-Statistic (Weighted Statistic)	-1.3984***	1.2973
Panel PP-Statistic (Weighted Statistic)	-3.727*	0.2963
Panel ADF-Statistic (Weighted Statistic)	-2.7784*	1.3614

***, ** and * indicates significant at 1%, 5% ans 10% level

The results for cointegration test are presented in Table 2. The result for Pedroni (1999) cointegration tests with no time effect indicates that eight out of eleven tests significant to

reject the null hypothesis. For the result of Pedroni (1999) cointegration tests with time effect, two out of eleven tests significant to reject the null hypothesis. Thus, we can conclude that our cointegration tests tend to support that all series are cointegrated in the long run.

Table 3: Long Run Estimator

Variable	Pooled OLS	DOLS	FMOLS	PMG
ES	0.08175*	0.1151*	0.0981*	0.0897*
K	0.6778*	0.6022*	0.6412*	0.9326*
L	-2.6239*	-4.6808*	-4.7661***	-1.8363*

***, ** and * indicates significant at 1%, 5% and 10% level

The result for long-run estimator is presented in Table 3. We use PMG estimator to interpret the long-run coefficients. According to the ceteris paribus assumption, we can say that for every 1% increase of ES leads to 0.09% increase on Y while other factors are constant. 1% increases of K tend to increase 0.93% of Y while other factors are constant. 1% increases of L leads to a decrease of Y about 1.83% while other factors are constant. All in all, ES has the smallest magnitude change respect to a change of the exogenous variable of Y. In general, our robustness checks (pooled OLS, DOLS and FMOLS) support our previous findings with PMG estimation.

5. Conclusion and Policy Implication

In summary, this paper employs dynamic panel data analysis to explore the impact of energy subsidy on economic production in Malaysia and Indonesia. Malaysia and Indonesia are oil net exporter countries in ASEAN 5 while allocate a very high amount of energy subsidy in their economy. We conclude that both countries are highly dependent on energy subsidy to drive their economic growth. Our finding indicates that energy subsidy and capital have a positive relationship with the output. Conversely, labor has a negative impact on output.

The finding that energy subsidy gives a positive impact on output is consistent with Jiang and Lin (2014), Lin and Jiang (2011) and Plate (2014). The International Institute of Sustainable Development (2012) reported that energy subsidy leads to the increase of income directly and indirectly. Energy subsidy is directed to an increase of income when a private sector pays less for energy; its consumer surplus is increased. On the other hand, energy subsidy is indirect causes an increase of income when the price level is low from a cheaper energy cost that reduces the cost of production. However, the cost of energy subsidy may transfer to the other parties through the tax collection and deadweight loss. In the current development, Malaysia and Indonesia are trying to rationalize their subsidy program subject to economic efficiency improvement and to reduce their fiscal pressure. Octavian et al. (2005) and Rosli (2012) suggested that the policymaker needs to introduce some effective offsetting policies to cushion the adverse impact in respect to the absent of energy subsidy. Our empirical result proved that the magnitude impact of energy subsidy is low compared to the other selected factors.

Two types of policies with two different scenarios are recommended. First, the policymaker could concentrate on offsetting policy if a reduction of subsidy is paramount for economic sustainability. Optimizing an occupied labor as a wastage number of labor is expected to increase energy wastage in the production as well. A part of that, a monetary regime needs to be contemporary improved to accumulate enough capital to be invested in an economy to support any progress of economic development. According to the fundamental of the neo-classical production function, the energy input production is absorbed in both labor and capital in the production to produce output (Alam, 2006). In a simple word, the more the number of labor and capital are used in the production, the more the energy is consumed.

Second, if the policymaker would like to continue the energy subsidy program, we recommend to rationalize the subsidy policy so that the subsidy becomes a productive tool to improve economic development. International Institute of Sustainable Development (2013) indicated that a direct energy subsidy distribution is not effective to increase the standard of living of the targeted group. This is because a direct distribution of energy subsidy is enjoyed much by the non-targeted group. The statistics show that 50% of high-income group enjoys about 90% energy subsidy provided by the government in Indonesia (International Institute of Sustainable Development, 2012). The same scenario was happened in Malaysia (The International Institute of Sustainable Development, 2013). Hence, subsidy policy needs to be rationalized to improve the energy subsidy distribution and become more effective to increase the standard of living of a targeted group. Jiang and Lin (2014) suggested that selected subsidy on energy resource or energy commodities should be removed based on its magnitude impact in giving an adverse impact on an economy as a whole. The less the magnitude impact of one subsidy of any energy resource or commodity, the more important it is to be removed. The International Institute of Sustainable Development (2012) suggests the policy maker should introduce an effective subsidy distribution which can exclude the non-targeted group to excess to energy subsidy. Through that, it can be more effective to increase the economic welfare as a whole as the targeted group will be benefited more.

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The relationship between Malaysia's residential property price index and residential properties loan supply

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Abstract
This paper aims to examine the linkages between residential properties prices and residential properties loans in Malaysia from 1999 to 2015, in addition to income level and the impact of the economic crisis. Even though residential properties are a basic necessity, there is no previous study that attempts to estimate the long-run and short-run relationship between loans and price level in residential properties in Malaysia. It is believed that property price level moves in the same direction as loan supply. The estimations are divided into two parts: the detection of long run relationships and the estimation the long-run and short-run elasticities from an ARDL model. The results support the hypothesis that the loan supply has a positive impact on the residential price levels; the robustness test also supports this conclusion. This implies the importance of closely monitoring the housing loan activities of banks to control residential property prices.

Keywords: Residential properties price; residential property loan; Malaysia

1. Introduction

In recent decades, the increasing of housing prices in Malaysia attracted the attention of researchers to investigate the determinants of housing prices. Among various types of properties, residential properties are particularly important because housing is a basic need. However, the residential price index of Malaysia increased almost two times from 1999 to mid-2015. Concurrently, loans for residential properties also increased significantly. Many researches have been conducted to determine the determinants of house prices in Malaysia such as Ng (2006), Ahmad Faizal (2011), Dziauddin et al. (2013) and Tang and Tan (2015), covering hedonic, bivariate and multivariate models. Besides, there are several papers test the same issue using disaggregate data such as Ibrahim and Law (2014). These studies identify several significant variables in their estimations. For instance, Ahmad Faizal (2011) and Tang and Tan (2005) find cointegration relationships among house prices and interest rate. and the Malaysia total and state-level house price index. Previous studies also tried to determine the dynamic between housing prices with stock prices, covering national and state level data (Lean, 2012; Lean and Smyth, 2014)

Nonetheless, to the best of my knowledge, only Ng (2006) and Ibrahim and Law (2014) empirically analyse the impact of housing loans on the house price levels in Malaysia. Ng (2006) focuses on investigating the determinants of the house prices using the Engle-Granger estimation; he concludes that the long-run impact of loan supply on the properties prices is positive. Nonetheless, his study has two weaknesses. First, the conclusion of cointegration based on the unit roots test on the error terms in the Engle-Granger estimation are influenced by dependent and independent variables; the impact is more obvious when more than two variables are examined. Second, the Engle-Granger test involves two-step estimation. If the error terms are erroneous in the first stage estimation, it will lead to a wrong conclusion. On the other hand, the vector error correction model estimated by Ibrahim and Law (2014) subject to the properties of the variables. In fact, they assume that a variable is differenced stationary when there is a mixed conclusion from different unit root tests and exclude level stationary variables. This paper attempts to fill the gap of knowledge by examining the linkages between the residential price and residential loan. Additionally, the income level is

also examined. This paper applies an autoregressive distributed lag (ARDL) model to illustrate the short-run and long-run relationships among the variables. The largest advantage of the ARDL model is that we can determine the existence of long-run relationships among variables without knowing the order of integration of the variables through Wald statistics. The identification of order of integration is needed only when the Wald statistics fail to confirm the variables are connected in the long-run (Narayan, 2004).

2. Data Descriptions

This paper includes two potential determinants of residential price levels, namely gross domestic products (GDP) and loans for residential properties. This paper also includes dummies that measure the impact of the subprime mortgage crisis in the US on Malaysia's residential market. According to Frankel and Saravelo (2012), the impact from the subprime mortgage crisis was the most severe from the third quarter of 2008 to the first quarter of 2009. Table 1 shows the indicator for each variable and the data sources. Quarterly data from the first quarter of 1999 to the second quarter of 2015 are tested. All variables are seasonally adjusted using the Census X-13 technique and are transformed into natural logarithm form.

Table 1: Variables Indicators and Data Sources

Variables	Indicators	Data Sources
Residential properties prices	Residential properties prices index (base year=2010)	Bank for International Settlements
Loans for residential properties prices	The loans disbursed for residential properties	Monthly Statistical Bulletin, Bank Negara Malaysia
Income level	Gross domestic products (current price)	Monthly Statistical Bulletin, Bank Negara Malaysia

In particular, the residential properties prices cover all types of new and existing dwellings in Malaysia. The loan for residential properties, on the other hand, refers to the loans for residential properties from the Malaysian banking system. Gross domestic product (GDP) is a common indicator of income level of a country in many previous studies. All estimations are conducted using Eviews 9.

3. Methodology and Model Specification

Due to relatively small sample size and to preserve the degree of freedom, this paper limits the examined variables into two potential determinants of housing prices, namely housing loan and output level. The first estimation is to determine the existence of cointegration among the variables by constructing an unrestricted error correction model that can be illustrated by equation (1).

$$\Delta LRP_t = \alpha_0 + \beta_1 LRP_{t-1} + \beta_2 LLOAN_{t-1} + \beta_3 LGDP_{t-1} + \sum_{i=1}^{p} \theta_{1i} \Delta LRP_{t-1} + \sum_{j=1}^{p} \theta_{2j} \Delta LLOAN_{t-1} \sum_{k=1}^{p} \theta_{3k} \Delta LGDP_{t-1} + \theta_4 CRISIS + \varepsilon_t \quad (1)$$

where Δ denotes the first differenced of variables, α_0 is the constant, *LRP* is the natural logarithm of residential price index, *LGDP* is the natural logarithm of GDP, *LLOAN* is the natural logarithm of residential loans and *CRISIS* are the dummies representing the subprime mortgage crisis. The lag length is decided using the Hendry general to specific method. In order to test the existence of long-run relationship, F-statistic or Wald test is applied to test the null hypothesis of $\beta_1 = \beta_2 = \beta_3 = 0$ against the alternative hypothesis of $\beta_1 \neq \beta_2 \neq \beta_3 \neq 0$. The failure to reject the null hypothesis means there are no long-run relationships among the variables in the model. However, the F-statistics do not have standard distribution and therefore this study applies the critical values of F-statistic generated by Narayan (2005) that are appropriate when the number of observations in a study range from 30 to 80. There are

two bounds of critical values: the upper bound where all variables are I(1) and the lower bound where all variables are I(0). There is evidence that the variables have long-run relationships if the F-statistic value is higher than the critical values. The opposite conclusion is arrived if the F-statistic value is below the critical value. Nonetheless, the outputs are inconclusive when the F-statistic value falls between the bounds. As mentioned in the introduction, we can skip the unit root tests if there are long-run relationships among the variables.

If the cointegrated relationship is confirmed, the next step is to construct a long-run relationship from an ARDL (p, p1, p2) model, as showed below:

$$\mathrm{LRP}_t = \delta_0 + \sum_{p=1}^{p} \omega_0 \, \mathrm{LRP}_{t-p} + \sum_{p=0}^{p1} \omega_1 \, \mathrm{LGDP}_{t-p} + \sum_{p=0}^{p2} \omega_2 \, \mathrm{LLOAN}_{t-p} + \omega_3 \mathrm{CRISIS} + \vartheta_t \quad (2)$$

The model is estimated using OLS estimation procedure and the number of lag in equation (2) is determined by Akaike information criterion (AIC); the model with the lowest AIC will be selected. There are two important outputs from the ARDL equation: long-run and short-run elasticities. The long-run equation has the following general form.

$$\mathrm{LRP}_t = \phi_0 + \phi_1 \mathrm{LGDP}_t + \phi_2 \mathrm{LLOAN}_t + \phi_3 \mathrm{CRISIS}_t + \upsilon_t \quad (3)$$

We apply the following formulae to measure the long-run elasticity of residential properties loan (ϕ_1), GDP (ϕ_2) and crisis (ϕ_3), respectively.

$$\phi_1 - \left(\frac{\sum_{p=0}^{p1} \omega_1}{1 - \sum_{p=1}^{p} \omega_0} \right)$$

$$\phi_2 = - \left(\frac{\sum_{p=0}^{p1} \omega_2}{1 - \sum_{p=1}^{p} \omega_0} \right)$$

$$\phi_3 = - \left(\frac{\omega_3}{1 - \sum_{p=1}^{p} \omega_0} \right)$$

On the other hand, the short-run equations can be illustrated as below:

$$\Delta \mathrm{LRP}_t = \delta_0 + \sum_{i=1}^{p} \delta_1 \, \Delta \mathrm{LRP}_{t-i} + \sum_{j=0}^{p} \delta_2 \, \mathrm{LGDP}_{t-j} + \sum_{k=0}^{p} \delta_3 \, \mathrm{LLOAN}_{t-k} + \delta_4 \mathrm{CRISIS} + \delta_5 \upsilon_{t-1} \quad (4)$$

where ν_{t-1} is the error correction terms (ECT) and are derived from equation (2). Its coefficient represents the speed-of-adjustment. Hendry general to specific method is applied to determine the appropriate lag length. The error terms should be statistically significant and have a negative sign; this is important because it means any deviation from the long-run equilibrium in the short term will be eliminated. The following diagnostic tests are conducted to ensure the fitness of the model: Jarque-Bera normality test, Breusch-Godfrey serial correlation LM test and Breusch-Pagan-Godfrey serial heteroskedasticity test. In addition, the stability of the error correction model is also tested by observing the roots of the equation. Eviews 9 is applied for all estimations in this paper.

4. Results Discussion

The results discussion begins with the construction of unrestricted error correction model. Table 2 illustrates the F-statistics and the relevant critical values at 1%, 5% and 10% significance levels. The result indicates that the null hypothesis is rejected at the 5% significance level. Hence, there is cointegration in the model. Following this, an ARDL (p, p1 and p2) model is constructed and the optimal lag length is decided by using the AIC. Figure 1 shows that the optimal model of ARDL model is found when the ARDL (4,0,4) that has four lags is included for LRP and LLOAN. Table 3 contains the estimation outputs of the ARDL (4,0,4) model.

Table 2: F-statistic Output

F-statistic	4.4015
Critical Value	
1%	I(0)= 4.068 I(1)=5.250
5%	I(0)= 2.962 I(1)=3.910
10%	I(0)= 2.496 I(1)=3.346

Note: Restricted intercept and no trend (k=3, n=60), available from Narayan (2005)

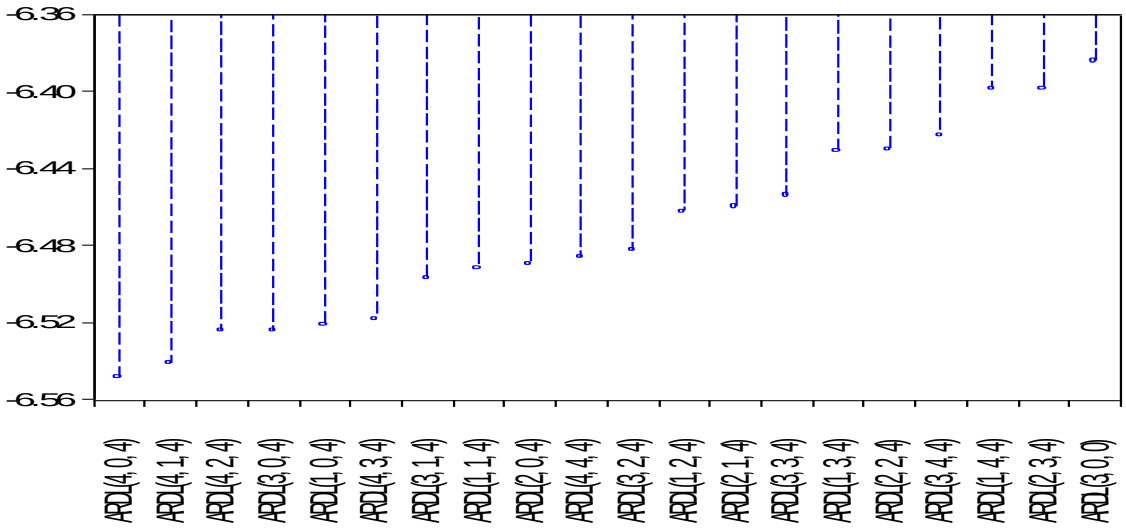

Figure 1 : The top 20 models based on AIC

From the outputs in Table 3, the long-run elasticities of the independent variables are generated and presented in the Table 4. The results show that only the residential properties loans and the global financial crisis have statistically significant impact on the residential price at the 1% and 10% significance level, respectively. In particular, one percent increases in the residential properties loan rises the residential price by 0.99%. On the other hand, the global financial negatively affects the residential price by decreasing it by 0.42%. Particularly, an increase in the loan supply could raise the ability to own a property through bank borrowing, which subsequently pushes up the residential price level if the house supply is inelastic. This is also in accordance to the demand-pull inflation contributed by credit supply. The occurrence of economic crisis is expected to arouse negative sentiment among the properties buyers and investors. This inevitably reduces their appetite for the properties, including residential dwellings, which is in accordance with the risk aversion hypothesis. Finally, the error correction terms (ECT) term indicates the adjustment of deviation back to long-run relationship is small (3.9%).

The next discussion focuses on the error-correction model from the ARDL (4,0,4) model where short-run elasticities can be obtained. According to Table 5, there is only one variable that is statistically significant in the short-run. In the short-run, the residential price will be affected by the residential loans only. The absence of short-term impact from the subprime mortgage crisis implies that the negative effect of that crisis is emanated from weaker economic conditions and the bank performances in the long-run. The ECT also has a negative statistically significant sign. However, the speed-of-adjustment is rather slow. The error correction model also passes the diagnostic tests of normality (Jarque-Bera normality test), autocorrelation (Breusch-Godfrey) and heteroscedasticity (Breusch-Pagan-Godfrey). The model also fails to reject the null hypothesis of Ramsey RESET test at the 5% significant level. Finally, the dynamic stability of the model is confirmed when all the inverse roots are inside the unit circle.

Table 3: ARDL (4,0,4) model

Variable	Coefficient	Std. Error
LRP(-1)	0.925***	0.132
LRP(-2)	0.290*	0.157
LRP(-3)	-0.038	0.168
LRP(-4)	-0.213*	0.125
LGDP	-0.028	0.017
LLOAN	0.138	0.087
LLOAN(-1)	-0.277	0.187
LLOAN(-2)	0.285**	0.126
LLOAN(-3)	-0.272***	0.094
LLOAN(-4)	0.161***	0.041
CRISIS	-0.015***	0.005
C	0.095	0.094

Note: Heteroskedasticity and Autocorrelation consistent standard errors are reported. ***, **, * represent the statistical significance of 1%, 5%, and 10%, respectively.

Table 4: Long-run elasticities from ARDL (4,0,4)

Variable	Coefficient	Standard Error
LGDP	-0.807	0.515
LLOAN	0.999	0.385***
CRISIS	-0.421	0.220*
C	2.703	2.316

Note: ***, * represent the statistical significance of 1%, and 10%, respectively.

Table 5: Error correction model from ARDL (4,0,4)

Variable	Coefficient	Std. Error
ECT(-1)	-0.039***	0.01
D(LRP(-1))	-0.07	0.121
D(LRP(-2))	0.145	0.113
D(LRP(-3))	0.271**	0.117
D(LGDP)	-0.03	0.052
D(LLOAN)	0.136	0.095
D(LLOAN(-1))	-0.177*	0.091
D(LLOAN(-2))	0.097	0.072
D(LLOAN(-3))	-0.164***	0.044
CRISIS	-0.005	0.006
C	0.001	0.007
Jarque-Bera normality test	0.0789 (0.9613)	
Breusch-Godfrey (AR2)	3.7602 (0.1526)	
Breusch-Godfrey (AR4)	4.4011 (0.3544)	
Breusch-Pagan-Godfrey	12.1444 (0.2755)	
Ramsey RESET	3.4885 (0.0618)	
Inverse roots of the associated characteristic equation		
0.801667, -0.379974 ± 0.567706i, 0.683132		

Note: ***, **, * represent the statistical significance of 1%, 5%, and 10%, respectively. The values in the parentheses are the p-values of respective tests.

The robustness of the results is tested by using the adjusted R-squared criterion to determine the lag length of the ARDL (p, p1, p2) where the highest adjusted R-squared will be selected. It is possible that the different lag length will affect the long-run and short-run elasticity of the variable. The adjusted R-squared criterion proposes that ARDL (4,1,4) is suitable. According to Table 6, the sign of the estimated coefficients is the same with the first estimation. However, only the properties loans have a statistically significant coefficient. This confirms the findings that the residential properties prices are linked to residential properties loans.

Table 6: Long-run elasticities from ARDL (4,1,4)

Variable	Coefficient	Standard Error
LGDP	-1.131	0.799
LLOAN	1.217***	0.607
CRISIS	-0.310	0.212
C	3.908	2.896

Note: *** represents the statistical significance of 10%.

Next, the error correction model from ARDL (4,1,4) is estimated and presented in Table 7. It is found that the error correction term is negative and statistically significant with the size of speed-of-adjustment that is similar to that of ARDL (4,0,4). Furthermore, the dynamic linkages among the variables are also detected in this error correction model. In short, the results from ARDL (4,0,4) are largely supported by ARDL (4,1,4) and the ECT is also similar to the initial estimation (3.6%). The null hypothesis of the RESET test where the

model is fit is again not rejected at 5% significance level. Normality and the non-existence of autocorrelation and heteroscedasticity are confirmed by Jarque-Bera normality test, Breusch-Godfrey and Breusch-Pagan-Godfrey, respectively. The model also fails to reject the null hypothesis of Ramsey RESET test at the 5% significant level. Finally, the inverse roots show the model is stable.

Table 7: Error correction model from ARDL (4,1,4)

Variable	Coefficient	Std. Error
ECT (-1)	-0.036***	0.009
D(LRP(-1))	-0.072	0.12
D(LRP(-2))	0.179	0.11
D(LRP(-3))	0.271**	0.116
D(LGDP)	-0.013	0.05
D(LLOAN)	0.162*	0.096
D(LLOAN(-1))	-0.165*	0.091
D(LLOAN(-2))	0.101	0.072
D(LLOAN(-3))	-0.168***	0.044
CRISIS	-0.005	0.006
C	0.002	0.007
Jarque-Bera normality test	0.0005 (0.9998)	
Breusch-Godfrey AR(2)	3.2028 (0.2016)	
Breusch-Godfrey AR(4)	3.5432 (0.4727)	
Breusch-Pagan-Godfrey	11.1333 (0.3472)	
Ramsey RESET	3.3632 (0.067)	
Inverse roots of the associated characteristic equation		
0.801667, -0.379974 ± 0.567706i, 0.683132		

Note: ***, **, * represent the statistical significance of 1%, 5%, and 10%, respectively. The values in the parentheses are the p-values of respective tests.

5. Conclusion

The objective of this paper is to estimate the impact of residential properties loans on the residential price index. In addition, income level and the occurrence of subprime mortgage crisis are also included in the model as independent variables. There are three conclusions that can be drawn. First, there is a positive long-run linkage between residential properties loans and the residential properties prices. Second, the subprime mortgage crisis causes a reduction in the residential properties prices in the long-run. Third, dynamic short-run linkages are found with the detection of negative and statistically significant error correction terms. Except for the second conclusion, the other two conclusions are supported by the robustness test. From the results, policymakers should intervene through the properties loan market if they intend to control residential properties prices. Excessive price speculation in the residential properties segment could be contained if the approval of residential properties loans is monitored.

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The Prevalence of Overemployment in Penang: A Preliminary Analysis

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Abstract
Nowadays, workers tend to face the problem of overemployment where desired working hours are less than their actual working hours. Some overemployed workers desire to work less hours although there may be a concomitant decline in earnings. This research is conducted to study the factors that are related to the employment status of workers in Penang with regard to being overemployed or otherwise. This research uses primary data that was collected in a survey that was done in one particular state in Malaysia, namely Penang. The questionnaires were distributed to workers in different areas in Penang. A total of 525 respondents were surveyed in this study. This paper reports the preliminary findings of the study by presenting the bivariate relationship between the employment status of workers and various demographic, socio-economic and work-related variables. The initial findings of this study provide the basis for some general conclusions and policy implications on the issue of overemployment in Penang.

Keywords: Overemployment; hours mismatch; actual hours of work; preferred hours of work.

1. Introduction

One important aspect of working conditions is working time. In industrialised countries, 22 percent of the workforce surveyed worked more than 48 hours a week, which the International Labour Organisation defines as excessive (Lee, McCann and Messenger, 2007). In Malaysia, the Malaysian Employment Act defines the standard work week as 48 hours, with a maximum of 8 working hours per day and 6 working days per week. However, in a survey that was done by an online recruitment firm involving 954 employees across various industries in Malaysia, it was revealed that 70 percent of the workers worked 2-5 extra hours daily due to unreasonable deadlines and work overload. It was also reported that 63 percent of workers felt that they were not spending enough time with their families due to long working hours (JobStreet, 2013).

Although there are statutory regulations on working time in most countries, the problem of hour mismatches still persists. Hour mismatches arise when workers actual hours of work differ from their desired or preferred hours of work. There are two types of hour mismatches; the first is *overemployment* which occurs when actual hours of work exceeds desired hours of work and the second is *underemployment* which occurs when actual hours of work falls short of desired hours of work. The focus of this paper is overemployment. The issue of overemployment merits attention because of its negative consequences on work-life balance, workers well-being and their job performance. The main objective of this paper is to identify empirically the factors associated with overemployment.

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2. Literature Review

Overemployment is often related to demographic, socio-economic and work-related factors. The first group of factors is demographic variables which include age and gender; the second set of factors is socio-economic factors which encompasses income, presence of full-time homemaker and childcare responsibilities. The last category of factors is work-related factors such as hours of work, job satisfaction and occupation.

Most studies take into account the relationship between overemployment and two key demographic variables, which are age and gender. Age may influence desired work hours as younger workers who are just entering the workforce are likely to have very different work preferences than those who are older and nearing retirement. Previous studies (e.g. Golden and Gebreselassie, 2007; Angrave and Charlwood, 2015) show a clear pattern by age, with overemployment low among young workers but rising with age. Another demographic variable that is of interest is gender. Women tend to do a greater share of household work than men; in addition, gender inequalities in the work place tend to reduce women's job commitment and tendency to make labour market work their central priority (Reynolds, 2005). As a result, women tend to desire fewer hours of work. Empirical evidence (e.g. Sousa-Poza and Henneberger's (2002) study which covers twenty one countries; Golden and Gebreselassie's (2007) research in the United States) indicates that women are more likely to be overemployed than men.

The second group of factors that is linked to overemployment is socio-economic factors. One of these factors is income. Theoretically, an increase in wage income induces an increase in the allocation of time for leisure (due to the income effect), thus decreasing the likelihood of overemployment. On the other hand, an increase in wages increases the opportunity cost of leisure; therefore a higher wage may encourage workers to sacrifice leisure for wages/work (due to the substitution effect), thus increasing the likelihood of overemployment. The net effect of an increase in wage income on overemployment is theoretically indeterminate. In the United States, employees who have higher wage incomes do more work than their lower paid peers but they do not have a stronger passion for work (Reynolds and Aletraris, 2007). It is argued that higher paid employees seem to be working more hours reluctantly because employers have packaged their high incomes with long workweeks (Clarkberg and Moen, 2001).

The other socio-economic variables are family characteristics such as the presence of a full-time homemaker and childcare duties. All workers have to allocate time for labour market work and their personal life. The time squeeze may be more pronounced in the absence of a full-time homemaker (e.g. in the case of single working parents and dual-earner couples with children) and this can give rise to an unmet desire for fewer working hours (Jacobs and Gerson, 2001). In contrast, breadwinners (particularly men) can work many hours because they have spouses who perform unpaid domestic work (Reynolds, 2014). Furthermore, these men may feel responsible for the economic well-being of their families (Kaufman & Uhlenberg 2000), and this would increase their desire for additional work hours and reduce the likelihood of overemployment. Another important family characteristic is childcare duties, which is proxied by number of children in the household and age of the youngest child. The difficulty of integrating paid work and childcare increases the probability of individuals wanting less working hours in order to spend more time with their children. This occurs among women workers (Van der Lippe, 2001) as well as men workers (Abendroth, Pausch and Bohm, 2014).

The last category of factors is work-related factors such as hours of work, job satisfaction and occupation. The link between hours of work and overemployment can be understood in the context of the work-leisure model of time allocation. The hour mismatch problem arises when an individual has not attained his/her optimum position. Workers who spend many hours at work often want to reduce their working hours. According to Sousa-Poza and Henneberger (2002), the percentage of workers who desire fewer hours of work rises as working hours increase. Empirical studies show that overemployment is significantly related to hours of work (Reynolds, 2003; 2004; 2005). Golden and Gebreselassie's (2007) study shows that full-time workers have a progressively higher probability of being overemployed corresponding to the length of their usual weekly hours, relative to those working 35-39 hours. Another work-related variable is job satisfaction. Satisfaction with paid labour is expected to decrease the likelihood that individuals encounter hour mismatches. The negative impact of job satisfaction on hour mismatches is documented in the literature (e.g. Bloch and Taylor, 2012; Reynolds and Aletraris, 2007). The last factor is type of occupation. Some jobs require more working hours. Golden and Gebreselassie (2007) opine that overemployment is more likely to occur in occupations for which there are no legally required overtime pay premia for increasing hours as well as occupations that tend to be paid by salary rather than hourly wages. These job characteristics are more common among white-collar workers. According to Reynolds (2003), professionals are more likely to desire fewer hours of work in comparison to blue-collar workers. Golden's (2004) study also found that white-collar workers in managerial and professional groups have significantly higher levels of overemployment while blue-collar workers are less likely to experience overemployment.

3. Data and Methodology

Primary data is used in this study. The survey data was collected using a structured questionnaire that was distributed to workers in Penang, a northern state in Malaysia. A total of 525 respondents were surveyed comprising 207 (39.4 percent) Malays, 239 (45.5 percent) Chinese and 79 (15 percent) Indians and others. This is similar to the ethnic composition of Penang's population which is 40.9 percent Malays, 41.5 percent Chinese and 17.6 percent Indian and others. The sample comprises 253 (48.2 percent) males and 272 (51.8 percent) females which also reflects the state's gender composition of 50.01 percent males and 49.99 percent females.

An analysis of overemployment in Penang is presented in the next section based on cross tabulations in order to examine the association between overemployment and demographic, socio-economic and work-related variables. The Chi-square statistic is used to examine whether the relationship between overemployment and the variable in question is significant or not. The employment status of workers is divided into two categories that is overemployed and not overemployed. In this study, overemployed workers refer to individuals who desire to work fewer hours for less pay. Workers who are not overemployed are those who either prefer to maintain current working hours for the same pay or prefer to work more hours for more pay.

4. Empirical Results

The sample in this study consists of 525 workers, of which 114 individuals (21.71 percent) are overemployed and the remaining 411 individuals (78.29 percent) are not overemployed. Table 1 provides a snap shot of the employment status of respondents who are categorised into different groups based on selected demographic, socio-economic and work-related factors, and the chi-square statistics.

The sample of 525 workers used in this study comprises 253 males (48.2 percent) and 272 females (51.8 percent). Among the 114 workers who are overemployed, 51 (44.7 percent) are males and 63 (55.3 percent) are females. Table 1 shows that the incidence of overemployment is slightly higher for women than for men, that is 23.2 percent of women and 20.2 percent of men prefer fewer working hours. However, the Chi-square test shows that gender is not significantly related to overemployment. This may be due to the influence of countervailing forces of other factors (which are linked to overemployment and gender) that are not held constant in this tabular analysis, which obliterates the relationship between the two variables.

The majority of the respondents (70 percent) are relatively young workers, below the age of 35. By comparing the percentage of workers who are overemployed in each age group, it can be seen that the incidence of overemployment tends to increase with age; less than 20 percent of workers below the age of 30 are overemployed; the corresponding figure is between 20 – 30 percent in the 31 – 50 age bracket and it is greater than 40 percent for older workers above the age of 50. This result is similar to the findings of previous studies (Golden and Gebreselassie, 2007; Angrave and Charlwood, 2015) which show that the incidence of overemployment is positively related with age. It is speculated that the higher prevalence of overemployment (the desire to work fewer hours for less pay) among older workers may be due to health reasons, greater financial stability and the preference for flexible working options prior to retirement.

Next, we turn to the socio-economic variables which include income and family characteristics. There is a positive relationship between income and the incidence of overemployment. The incidence of overemployment is positively related to the level of wage income; it is lowest (18.9 percent) in the low wage income group and highest (40 percent) in the high wage income group. The positive relationship between income and overemployment suggests that as income rises, there is an increase the percentage of workers who desire fewer hours of work and are willing to forgo some portion of their earnings for reduced hours of work. This implies that higher income affords workers this choice since they are well off economically and have strong financial footing as argued by Reynolds (2003).

Family characteristics include factors such as presence of full-time homemaker (proxied by spouse's working status) and childcare responsibilities. There are 175 dual earner families without a full-time homemaker (166 respondents with spouses who are working full-time and 9 with spouses working part-time). There are 350 respondents who are either single or with spouses who are not employed. The data shows that slightly over 30 percent of respondents with a working spouse desire fewer hours of work. In the case of those with a non-working spouse or are single, only 17.1 percent are overemployed. In short, the incidence of overemployment is greater for those who have a working spouse; this is possibly because of the time squeeze that both partners encounter in dividing their time for labour market work and household duties.

Childcare responsibilities are reflected by the number of children and age of youngest child. The incidence of overemployment varies by the number of children in the household. Table 1 shows that 44 percent of respondents with 4 children or more are overemployed; the

corresponding figure is about 30 percent for those with 2 or 3 children, 23 percent for those with 1 child and only 16.4 percent for those with no children. This shows that the incidence of overemployment increases as the number of children increases. The incidence of overemployment also varies by the age of the youngest child in the household. The data shows that 50 percent of workers with youngest child more than 17 years old desire to reduce their working hours; the corresponding figure is between 23-26 percent for workers whose youngest child is below 17 years and it is 16.5 percent for those with no children. The results suggest that overemployment is highest for workers with older children (above 17 years) in comparison to those with younger children. There are at least two possible reasons why workers whose youngest child is above 17 years old are overemployed. Firstly, these workers are likely to be in the older age group and more likely to face overemployment given that the desire for few hours is positively related to age. Secondly, workers whose youngest child is above 17 years old probably have older children who are working and providing financial support to the family and this gives these workers the option to reduce hours of work and earn a lesser salary. But the incidence of overemployment does not vary greatly for those with pre-school children (below 6 years), primary level children (6-12 years) and secondary level children (13-17 years). This may be because workers with pre-school or school-age children can rely on unpaid / paid caregivers to provide childcare and so the desire for fewer hours of work is not markedly different for those with children in these age groups.

In this study, almost 70 percent of workers work less than 48 hours per week, while 23 percent work more than 48 hours per week and 7.8 percent work exactly 48 hours per week. The high proportion of workers working less than 48 hours per week could probably be because there are a number of organisations that operate five days per week. The incidence of overemployment tends to increase with working hours. The incidence of overemployment is highest among workers working more than 48 working hours (31.7 percent), followed by those working exactly 48 hours per week (26.8 percent) and lowest for those working less than 48 hours per week (17.9 percent). The low incidence of overemployment among workers with less than 48 hours per week is not surprising since this group would include part-time workers who work short hours. The result of the chi square test indicates that the relationship between working hours and employment status is significant at 1%.

Workers' job satisfaction is measured by a 5-point Likert scale ranging from 1 (lowest job satisfaction) to 5 (highest job satisfaction). Job satisfaction of workers is classified as low if the score is 1 or 2, medium if the score is 3 and high if the score is 4 or 5. Among the 525 respondents, more than three-fifths of them have high job satisfaction, and followed by 27.6 percent with medium job satisfaction and 9.1 percent with low job satisfaction. Overemployment appears to be inversely related to the level of job satisfaction. The incidence of overemployment among workers with high job satisfaction (19.6 percent) is lower than those with medium job satisfaction (23.4 percent). Similarly, the incidence of overemployment for workers with medium job satisfaction is lower than those with low job satisfaction (31.2 percent). Workers with low job satisfaction tend to have the greatest desire to reduce their working hours. Nevertheless, the result of the chi square test indicates that there is no significant relationship between employment status and job satisfaction at 1 % level.

Table 1: Distribution of Workers by Employment Status and Incidence of Overemployment

Variables	Chi-square statistics	Categories	Employment Status		
			Overemployed (%)	Not Overemployed (%)	Incidence of overemployment
Gender	0.696	Male	44.7	49.1	20.2
		Female	55.3	50.9	23.2
Age	28.68***	15-20	1.8	12.2	3.9
		21-25	16.7	23.1	16.7
		26-30	22.8	25.8	19.7
		31-35	17.5	12.7	27.8
		36-40	11.4	10.2	23.6
		41-45	7.0	54.6	25.8
		46-50	6.1	5.1	25.0
		51-55	10.5	3.2	48.0
		56-60	6.1	2.2	43.8
Wage Income (RM)	6.27**	<2000	40.4	47.9	18.9
		2001-4000	36.0	36.7	21.4
		4001-7000	16.7	12.4	27.1
		>7000	40.0	2.9	40.0
Spouse's Working Status	12.94***	Working full time	44.7	22.8	30.7
		Working part time	2.6	1.5	33.3
		Not working/ no spouse	52.6	70.6	17.1
No of Children	17.65***	No children	45.6	64.5	16.4
		1	10.5	9.7	23.1
		2	20.2	12.9	30.3
		3	14.0	9.5	29.1
		4 & above	9.6	3.4	44.1
Age of Youngest Child (years)	24.42***	No children	45.6	64.2	16.5
		< 6	20.2	15.6	26.4
		6-12	11.4	10.5	23.2
		13-17	6.1	5.1	25.0
		> 17	16.7	4.6	50.0
Hours of work (hours)	10.81***	< 48	57.0	72.7	17.9
		48	9.6	7.3	26.8
		> 48	33.3	20.0	31.7
Job Satisfaction	3.72	Low	13.2	8.0	31.2
		Medium	29.8	27.0	23.4
		High	57.0	65.0	19.6
Occupation	14.24**	Managerial	12.3	5.1	40.0
		Professional	31.6	34.5	20.2
		Technicians	7.9	8.8	20.2
		Clerical	14.0	15.6	20.2
		Sales & Service	20.2	27.0	17.2
		Craft	0.9	2.2	10.0
		Elementary	6.1	2.9	36.8
		Others	7.0	3.9	33.3

Source: Authors' computation based on survey data.

Note: ***, ** ,* indicate the chi-square statistic is significant at 1, 5 and 10 per cent levels, respectively.

This study uses the Department of Statistics' classification of occupations. The sample comprises 35 managerial workers (6.7 percent), 178 professional workers (33.9 percent), 45 technicians (8.6 percent), 80 clerical workers (15.2 percent), 134 sales and service workers (25.5 percent), 10 craft/related trade workers (1.9 percent), 19 elementary workers (3.6 percent), and 24 in other occupations (4.6 percent). The highest incidence of overemployment is among managerial workers (40 percent). The high incidence of overemployment in the managerial group is noted in other studies e.g. Golden (2004), Golden and Gebreselassie (2007). Another group with a high incidence of overemployment is elementary workers (36.8 percent). The chi square test shows that the relationship between occupations and employment status is significant at 5%.

5. Conclusions and Policy Implications

The incidence of overemployment tends to be higher for the following groups: older workers, high-income workers, individuals with a working spouse, more children and older children, workers who clock in more than 48 hours as well as managerial and elementary workers.

The above findings are used to discuss tentative policy implications. The high incidence of overemployment among older workers suggests a need to offer them part-time jobs or job-sharing options. This will enable firms to retain senior and experienced employees. Another key finding is the positive relationship between overemployment and number of children. This implies the need for family-friendly policies (e.g. parental leave) to reduce overemployment. Providing childcare facilities in or near the workplace is another possible solution.

The results show that overemployment is prevalent among workers who work more than 48 hours per week. The move to reconfigure working time policies and limit overtime work is a step in the right direction to reduce overemployment. The five dimensions of decent working time propagated by ILO - healthy working time, "family-friendly" working time, gender equality through working time, productive working time and choice and influence regarding working time – provide a framework for policies which can advance the goal of decent working time. The prevalence of overemployment also increases with earnings. It is suggested that high income workers be given the option of working remotely (if the nature of their work permits it) in order to reduce overemployment. Finally, there is a prevalence of overemployment among managerial and elementary workers. Mitigating overemployment in the latter group is seen as a matter of greater urgency because this group is relatively more vulnerable. Labour laws should ensure that these workers are not subject to exploitation in terms of their hours of work.

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Globalization and Sustainable Development: Evidence from Indonesia

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Abstract

In this study, we analyze the impact of globalization which are characterized by higher foreign direct investment (FDI) inflows, increase in openness to trade (TO), and deepening in financial development (FD) on the three main pillars of sustainable development (SD) consisting of model of growth, model of income distribution and model of environmental quality for Indonesia. The results based on Autoregressive Distributed Lag Model (ARDL) estimation showed that FDI inflows have led towards higher growth, lower income inequality and better environmental quality in Indonesia. Meanwhile, the study found that TO has led towards higher economic growth, worsening environmental quality, but no significant effect on income distribution. As for FD, it was found that it has a positive impact on growth and income equality but leads to negative impact on environmental quality. The outcome of this study reveals that only FDI has the potential to be the driver for SD in Indonesia while the other two variables, TO and FD have appropriately influenced at least one out of three pillars of SD. Thus, it is important for the policy makers to improve their existing policies to attract more FDIs in order to ensure that the country's SD goal is attainable.

Keywords: Sustainable development; economic growth; income distribution; environmental quality; globalization; trade openness and financial development.

1. Introduction

As one of the founders of the Association of South East Asian Nation (ASEAN) group, Indonesia has always been considered as one of the most promising developing economies in the Southeast Asian region especially in the early 1990s. With the overall average growth of 6%, this country has experienced a steady growth which resulted in more job opportunities and higher trading activities in the country. Besides, the reformation of the financial sector has increased the confidence of foreign investors to invest in Indonesia. Throughout 2009 until 2011, Indonesian economy has grown steadily as a result of strong demand for her major export commodities (rubber, palm oil and minerals). The increase in trade value and FDI inflows, as well as the deepening of the financial sector, had initially indicated the characteristics of globalization that has widely influenced Indonesia and her neighboring region. However, in 2013, due to world economic slowdown, Indonesia, which relied heavily on consumer spending and exports of raw commodities had faced some serious challenges on its economic growth. Both FDI and international trade for Indonesia have recorded a declining amount in that year. Despite all these challenges, the country's goal to achieve SD was never forgotten.

The Brundtland committee report produced by World Commission on Environment and Development (1987) defined SD as development that meets the needs of the present without

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compromising the ability to meet the needs of future generations. The concept of SD has become one of the mainstream on development in Indonesia and stated in the National Medium Term Development Plan (RPJMN) in 2010-2014. Among the objective of this national plan is to adopt the economic, social and environmental into planning and implementation of development in various sectors and regions. In other words, SD can be achieved through its three main pillars, namely, economic growth, income distribution and environmental quality. Among the characteristics of globalization, TO and FDI have been suggested by world organizations such as United Nations Conference on Trade and Development (UNCTAD) as drivers for SD. However, besides growth, recent studies have shown that more scholars are increasingly interested in studying the impact of financial development (FD) on income distribution (Basu and Guariglia, 2007) as well as on environmental quality (Shahbaz et al. 2013). Thus, FD can be treated as another potential driver for SD. Although globalization can bring about economic growth to the country, it can also come with enormous costs such rising income disparities and massive environmental destructions which can hinder the country from achieving SD. Given the scenario described above, this research paper aims to analyze the impact of globalization (FDI, TO, and FD) on the three pillars of SD (growth, income distribution and environmental quality) for Indonesia. This objective was set in order for us to assess how far this country has prepared itself towards achieving the SD mission as set under the ASEAN Vision 2025. The rest of the paper is structured as follows: Section 2 presents literature review. Section 3 describes the methodology, while Section 4 will focus on empirical analysis. Section 5 concludes the paper with some policy recommendations.

2. Literature review

Given that the scope of this research is quite broad as it involved three different economic aspects (economic, social and environment), the review of the literature was limited to previous studies that included at least two out of three characteristics of globalization, namely, FDI, TO and FD in a singular framework. Klasra (2011) investigated the relationship between FDI and TO on economic growth for Pakistan and Turkey using ARDL estimation over the period of 1975 to 2004. The long run estimation results showed that exports and TO are both positive and have significant impact on Pakistan's economic growth while FDI is found to be insignificant at any levels. As for Turkey, the only significant determinant is export where it has a positive relationship with growth and thus confirming export-led growth hypothesis in this country. Similar studies were performed by Solarin and Shahbaz (2015) who incorporated a new variable, natural gas consumption into the growth model of Malaysia, beside capital, FDI and TO for the period from 1971 to 2012. The outcome of the estimation shows that natural gas consumption, FDI, capital and TO have a positive relationship with economic growth for Malaysia during the period of the study. Based on model of income distribution, Lee (2006) has tested the impact of globalization proxied by FDI and TO on income inequality for eight Asian countries for the period of 1970 until 2002. The estimation revealed that TO has a positive relationship with income distribution proxied by GINI while FDI, does not have any significant relationship with GINI. This mean that the increase in openness to trade in the countries has widen the income gap in the country. Mushtaq et al. (2014), on the other hand, studied the impact of inward FDI on income distribution in five SAARC countries, namely, Bangladesh, India, Nepal, Pakistan, and Sri Lanka using panel data from 1980 to 2011. FDI inflow and inflation have improved the income distribution. Higher inflation tends to increase investment, and hence more production in the future, while an increase in production will create more jobs and thus the demand for labor may result in better income distribution. The increase of TO and per capita GDP, on the other hand, has worsened the income distribution in these countries. Based on

the environmental quality model, Shahbaz et al. (2013) have incorporated all important variables such as income, energy consumption, TO, FDI and FD for Malaysia over the period from 1971 to 2011. The model was tested by using the ARDL estimation technique. The empirical evidence indicated that FD reduces CO2 emissions. This means that FD can play a positive and significant role in combating environmental degradation in the country as greater FD can facilitate more financing at lower costs including financing of investments in environment-friendly projects. Meanwhile, energy consumption, FDI, and economic growth have worsened the air quality. Based on the above studies, it can be seen that most existing studies have adopted both FDI and TO in the singular framework. According to Mah (2003), these two determinants can be taken to represent globalization. However, there is a lack of studies on FDI and TO that include FD together in a single framwork. To the best of writer's knowledge, there was no previous study detected to find the impacts of globalization experienced by Indonesia on SD. Thus, it is the aim of this paper to fill the gap and contribute more new findings on the above issue.

3. Methodology

The formulation of the three econometric models representing the three pillars of SD is explained briefly in this section. All variables were transformed into log-linear form to translate the result into long run elasticities.

Model of Growth

$$LNGDP_t = \delta_0 + \alpha_1 LNLAB_t + \alpha_2 LNDI_t + \alpha_3 LNFDI_t + \alpha_4 LNHC_t + \alpha_5 LNTO_t + \alpha_6 LNFD_t + \mu_{t_t} ...(1)$$

where GDP is real gross domestic product per capita (constant 2005 US$), LAB is total labor force, DI is domestic investment proxied by fixed capital formation to GDP, FDI is foreign direct investment inflows to GDP, HC is human capital proxied by secondary school enrollment rate, TO is trade openness measured by sum of export and import to GDP and lastly FD is financial development proxied by money supply, M2 to GDP. The derivation of the model of growth was based on the Cobb-Douglas production function that was extended to include other relevant variables as introduced in this study to avoid omitted variables problem. All coefficients (α_1, α_2, α_3, α_4, α_5 and α_6) are expected to be positive, indicating a positive relationship between variables and the country's GDP.

Model of Income Distribution

Following the model introduced by Mah (2003), we expanded the model as follows:

$$LNGINI_t = \nu_0 + \beta_1 LNGDP_t + \beta_2 LNDI_t + \beta_3 LNFDI + \beta_4 LNTO_t + \beta_5 LNFD + \mu_t ...(2)$$

where GINI is Gini coefficient representing income distribution. The rest of the variables in this model are similar to the variables in our previous growth model. β_1 is expected to be positive while a mix of expected signs (either positive or negative) is expected for other coefficients, β_2, β_3, β_4, and β_5.

Model of Environmental Quality

Next, based on the model introduced by Lee (2013), we expanded his model as follows:

$$LNCO2_t = \varsigma_0 + \gamma_1 LNGDP_t + \gamma_2 LNFDI_t + \gamma_3 LNFD + \gamma_4 LNEN_t + \gamma_5 LNTO + \mu_t ...(3)$$

where CO_2 is carbon dioxide in metric ton per capita representing environmental quality while EN is energy consumption. The remaining variables comprising GDP, FDI, FD and TO are similar to the variables that we used in the above two models. In summary, γ_1 and γ_4 are expected to have a positive sign while other coefficients (γ_2, γ_3, γ_5) are expected to have a mix expected signs indicating positive or negative effects of the variables on CO2 emissions.

The time series analysis begins with the testing of the stationarity of the variables using ADF test and Phillips–Perron (PP) test. To proceed with ARDL test, the variables must be stationary either at I(0) or I(1) or a mix between I(0) and I(1). Next, the ARDL cointegration

test is applied to test the existence of a long run relationship between variables in the model. This bound test is mainly based on the joint F-statistic whose asymptotic distribution is non-standard under the null hypothesis of no cointegration. The null hypothesis of no cointegration is rejected when the value of the test statistic exceeds the upper critical bounds value, and it is not rejected if the F-statistic is lower than the lower bounds value. Otherwise, the cointegration test is inconclusive. The ARDL model based on Unrestricted Error Correction Model (UECM) are listed below:

$$\Delta LNGDP_t = \beta_0 + \theta_0 LNGDP_{t-1} + \theta_1 LNLAB_{t-1} + \theta_2 LNDI_{t-1} + \theta_3 LNFDI_{t-1} + \theta_4 LNHC_{t-1} + \theta_5 LNTO_{t-1} + \theta_6 LNFD_{t-1}$$
$$+ \sum_{i=1}^{p} \beta_i \Delta LNGDP_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta LNLAB_{t-i} + \sum_{i=0}^{r} \delta_i \Delta LNDI_{t-i} + \sum_{i=0}^{s} \lambda_{t-i} \Delta LNFDI_{t-i} + \sum_{i=0}^{t} \vartheta_{t-i} \Delta LNHC_{t-i} + \sum_{i=0}^{u} \zeta_{t-i} \Delta LNTO_{t-i}$$
$$+ \sum_{i=0}^{v} \psi_{t-i} \Delta LNFD_{t-i} + \upsilon_t ...(4)$$

$$\Delta LNGINI_t = \beta_0 + \theta_0 LNGINI_{t-1} + \theta_1 LNGDP_{t-1} + \theta_2 LNDI_{t-1} + \theta_3 LNFDI_{t-1} + \theta_4 LNTO_{t-1} + \theta_5 LNFD_{t-1} + \sum_{i=1}^{p} \beta_i \Delta LNGINI_{t-i}$$
$$+ \sum_{i=0}^{q} \gamma_i \Delta LNGDP_{t-i} + \sum_{i=0}^{r} \delta_i \Delta LNDI_{t-i} + \sum_{i=0}^{s} \lambda_{t-i} \Delta LNFDI_{t-i} + \sum_{i=0}^{t} \vartheta_{t-i} \Delta LNTO_{t-i} + \sum_{i=0}^{u} \zeta_{t-i} \Delta LNFD_{t-i} + \upsilon_t ...(5)$$

$$\Delta LNCO2_t = \beta_0 + \theta_0 LNCO2_{t-1} + \theta_1 LNGDP_{t-1} + \theta_2 LNFDI_{t-1} + \theta_3 LNFD_{t-1} + \theta_4 LNEN_{t-1} + \theta_5 LNTO_{t-1} + \sum_{i=1}^{p} \beta_i \Delta LNCO2_{t-i}$$
$$+ \sum_{i=0}^{q} \gamma_i \Delta LNGDP_{t-i} + \sum_{i=0}^{r} \delta_i \Delta FDI_{t-i} + \sum_{i=0}^{s} \lambda_{t-i} \Delta LNFD_{t-i} + \sum_{i=0}^{t} \vartheta_{t-i} \Delta LNEN_{t-i} + \sum_{i=0}^{u} \zeta_{t-i} \Delta LNTO_{t-i} + \upsilon_t ...(6)$$

where Δ is the first difference operator and u_t is the white-noise disturbance term. Residuals for the UECM should be serially uncorrelated and the models should be stable. This study used annual data starting from 1970 up to 2013 comprising 44 years of observations. Summary of the data and its sources is shown in Table 1 below:

Table 1: Sources of data

Variables	Description	Sources
CO2	CO_2 emission metric tonne per capita	WDI and EDGAR
DI	Gross Fixed Capital Formation as % of GDP	WDI
EN	Energy consumption kg of oil equivalent	WDI
FD	Money supply, M2 as % of GDP	WDI
FDI	FDI inflows as % of GDP	WDI
GDP	Real GDP per capita, constant (2005)	WDI
GINI	Gini coefficient	GCIP and UTIP
HC	Secondary school enrollment rate	Barro and Lee (2011)
LAB	Total labor force	ILO and WDI
TO	Sum of export and import divided by GDP	WDI

Note: WDI stands for World Development Indicator 2015, EDGAR stands for Emissions Database for Global Atmospheric Research, GCIP stands for Global Consumption Income Project, and ILO stands for International Labor Organization.

4. Empirical testing

The results of the two unit root tests in Table 2 reveals a mix of stationarities at I(0) and I(1) for the variables used in each model. Given such results, we can proceed to estimate our models using ARDL's estimation technique.

Table 2: Results of Unit Root Tests

Model		Variable	ADF test statistic		PP test statistic	
			Intercept	Trend and intercept	Intercept	Trend and intercept
Model of Growth	Level	LNGDP	-1.28 (0)	-2.22 (1)	-1.20 (1)	-1.92 (2)
		LNLAB	-0.81 (0)	-2.54 (0)	-1.81 (16)	-2.49 (2)
		LNDI	-2.28 (1)	-2.52 (1)	-1.78 (1)	-1.96 (1)
		LNFDI	-2.41 (0)	-2.34 (0)	-2.61 (3)*	-2.45 (2)
		LNHC	-1.42 (0)	-2.00 (0)	-1.41 (4)	-2.03 (2)
		LNTO	-2.66 (0)*	-2.65 (0)	-2.84 (4)*	-2.83 (4)
		LNFD	-1.51 (1)	-0.57 (1)	-2.63 (3)*	-0.90 (2)
	First difference	LNGDP	-4.73 (0)***	-4.76 (0)***	-4.73 (0)***	-4.76 (0)***
		LNLAB	-7.44 (0)***	-7.45 (0)***	-8.00 (8)***	-8.57 (9)***
		LNDI	-4.48 (0)***	-4.45 (0)***	-4.42 (5)***	-4.39 (5)***
		LNFDI	-7.06 (0)***	-7.09 (0)***	-7.04 (2)***	-7.09 (1)***
		LNHC	-6.23 (0)***	-6.35 (0)***	-6.23 (1)***	-6.34 (1)***
		LNTO	-8.17 (0)***	-8.07 (0)***	-8.29 (2)***	-8.18 (2)***
		LNFD	-4.74 (0)***	-4.92 (0)***	-4.73 (2)***	-4.93 (1)***
Model of Income Distribution	Level	LNGINI	-1.48 (4)	-1.92 (4)	-1.74 (3)	-1.88 (3)
		LNGDP	-1.28 (0)	-2.22 (1)	-1.20 (1)	-1.92 (2)
		LNDI	-2.28 (1)	-2.52 (1)	-1.78 (1)	-1.96 (1)
		LNFDI	-2.41 (0)	-2.34 (0)	-2.61 (3)*	-2.45 (2)
		LNTO	-2.66 (0)*	-2.65 (0)	-2.84 (4)*	-2.83 (4)
		LNFD	-1.51 (1)	-0.57 (1)	-2.63 (3)*	-0.90 (2)
	First difference	LNGINI	-2.82 (3)*	-2.88 (3)	-4.15 (41)***	-4.16 (41)**
		LNGDP	-4.73 (0)***	-4.76 (0)***	-4.73 (0)***	-4.76 (0)***
		LNDI	-4.48 (0)***	-4.45 (0)***	-4.42 (5)***	-4.39 (5)***
		LNFDI	-7.06 (0)***	-7.09 (0)***	-7.04 (2)***	-7.09 (1)***
		LNTO	-8.17 (0)***	-8.07 (0)***	-8.29 (2)***	-8.18 (2)***
		LNFD	-4.74 (0)***	-4.92 (0)***	-4.73 (2)***	-4.93 (1)***
Model of Environmental Quality	Level	LNCO2	-1.55 (0)	-2.97 (0)	-2.08 (11)	-2.77 (6)
		LNGDP	-0.86 (0)	-2.50 (1)	-0.85 (2)	-2.28 (3)
		LNFDI	-2.41 (0)	-2.34 (0)	-2.61 (3)*	-2.45 (2)
		LNFD	-1.51 (1)	-0.57 (1)	-2.63 (3)*	-0.90 (2)
		LNEN	-0.91 (0)	-1.39 (0)	-0.93 (3)	-1.41 (1)
		LNTO	-2.66 (0)*	-2.65 (0)	-2.84 (4)*	-2.83 (4)
	First difference	LNCO2	-5.96 (0)***	-5.99 (0)***	-6.29 (9)***	-7.17 (11)***
		LNGDP	-4.95 (0)***	-4.90 (0)***	-4.92 (2)***	-4.91 (1)***
		LNFDI	-7.06 (0)***	-7.09 (0)***	-7.04 (2)***	-7.09 (1)***
		LNFD	-4.74 (0)***	-4.92 (0)***	-4.73 (2)***	-4.93 (1)***
		LNEN	-6.18 (0)***	-6.18 (0)***	-6.18 (2)***	-6.19 (3)***
		LNTO	-8.17 (0)***	-8.07 (0)***	-8.29 (2)***	-8.18 (2)***

Note: 1. *, **, and *** represent 10%, 5% and 1% levels of significance, respectively. 2. The optimal lag is selected using the Akaike information criteria for ADF test and the bandwidth had been selected by using the Newey–West method for the PP test.

Table 3 shows the results of ARDL cointegration tests. The maximum lag of 4 was imposed in each model using Akaike Information criterion (AIC). The model of growth followed critical value where k is equivalent to 6 while the model of income distribution and the model of environmental quality followed the second set of critical value table given that the number of variables, k is equivalent to 5. The F-statistics for each model (9.793, 4.067 and 4.029) is higher than the upper I(1) critical value table (for k =6 and 5) and significant at 1 percent and 5 percent levels, thus confirming the existence of long run relationship.

Table 3: Result of ARDL cointegration test

Model	Max. lag	Lag order	F Statistic
Model of Growth	4 (3,4)	(3,4,4,4,4,3,4)	9.793***
Model of Income Distribution	4 (4,3)	(4,3,3,3,0,3)	4.067**
Model of Environmental Quality	4 (1,2)	(1,1,0,2,0,2)	4.029**

Critical Values for *F*-statistics#	k = 6		k = 5	
	Lower I (0)	Upper I (1)	Lower I (0)	Upper I (1)
1%	3.15	4.43	3.41	4.68
5%	2.45	3.61	2.62	3.79
10%	2.12	3.23	2.26	3.35

Note: # The critical values are based on Narayan (2004) case III: unrestricted intercept and no trend, k is the number of variables; *, **, and *** represent 10%, 5% and 1% levels of significance, respectively; and k =5 for the model of income distribution and the model of environmental quality, while k =6 for the model of growth.

The results in Table 4 confirmed that all three models passed diagnostic checking which renders the long term estimates of these models to be reliable. In summary, the models do not have evidence of serial correlation and heteroscedasticity effect in the disturbances, the errors are normally distributed and the models are well specified.

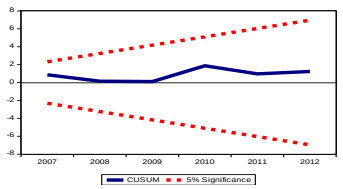
Table 4: Result of Diagnostic Checking

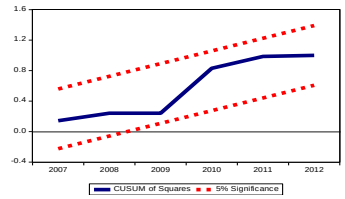
Model	Serial correlation	Functional form	Normality	Heteroscedasticity
Model of Growth	4.03 [0.10]	0.11 [0.74]	1.88 [0.39]	1.61 [0.28]
Model of Income Distribution	0.001[0.99]	2.09 [0.16]	0.75 [0.68]	0.001[0.99]
Model of Environmental Quality	1.79 [0.19]	2.86 [0.10]	0.35 [0.83]	1.44 [0.20]

Note. The numbers in brackets [ ] are p-values.

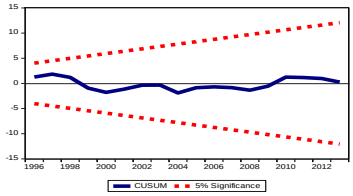
Additional diagnostic tests in the form of CUSUM and CUSUM square tests are performed on each model. The diagrams below show the results of CUSUM test (above three) and CUSUM square test (bottom three) which confirmed that all three models are structurally stable given that the blue line lies between the two dotted red lines.

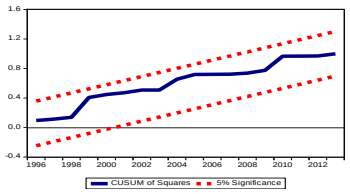
Model of Growth



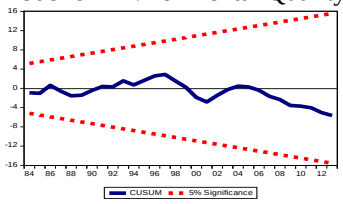


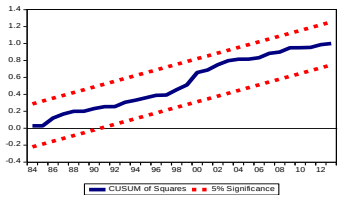
Model of Income Distribution





Model of Environmental Quality





The long run elasticities for each model are displayed in Table 5 below. All determinants of growth are found to be significant at 1% and 5% levels except for HC. Given that the coefficient value for DI is greater than the value for FDI, it supports the dependency theory that suggests Indonesia's domestic investment has a greater influence on growth than foreign investment. Beside FDI, the other two potential drivers for SD, namely, TO and FD, are also shown to have positive influence on Indonesian economy. A 1% increase in TO and FD enhanced the Indonesia's economic growth by 0.29% and 0.61%, respectively.

Table 5: Estimation of Long-Run Elasticities

Model of Growth		Model of Income Distribution		Model of Environmental Quality	
Variables	Coefficient	Variables	Coefficient	Variables	Coefficient
LNLAB	0.809***	LNGDP	1.129***	LNGDP	0.670*
LNDI	0.446***	LNDI	-1.744**	LNFDI	-0.121**
LNFDI	0.077**	LNFDI	-0.155*	LNFD	0.351***
LNHC	0.005	LNTO	0.432	LNEN	0.141
LNTO	0.610***	LNFD	-0.415***	LNTO	0.444*
LNFD	0.293***	C	-3.394***	C	-9.285***
C	-7.191***				

Note: (*), (**), (***) indicate significant at 10%,5% and 1% significance level respectively.

According to Levine (1997), a more developed financial system in the country will give fertile ground for better allocation of resources, better monitoring, more information symmetry, and higher economic growth. Next, based on the model of income distribution, it confirmed that DI, FDI, and FD could improve the income equality while higher GDP could worsen the income equality in the country. TO, on the hand, failed to show any significant impact on the model. Given that FDI has a negative and significant relationship with GINI, it thus confirmed the validity of Mundell hypothesis which stated that increasing existing amount of capital in the host country will lead to a rise in the marginal physical product of labor and this in turn, will lead to a rise in wages. According to Arora (2012), the contribution of FD can be the result of the financial sector's ability to provide loans at a cheaper cost to farmers to promote rural economy that lowers income inequality and hence reduce poverty. Based on the model of environmental quality, it is shown that higher FDI inflows could reduce the environmental degradation at 5% level of significance. FDI may have a negative effect on CO_2 emission when FDI facilitated the adoption of modern technologies during the production process and ensure best environmental practices that lead towards higher energy efficiency, better knowledge transfer, improved labor training, more skill acquisition and the introduction of alternative management practices (Prakash and Potoski, 2007). FD and TO, on the other hand, may worsen the environmental quality in Indonesia. TO may increase the pollution levels because pollution is generated by the production of goods to fulfill the consumption of another country through international trade. Surprisingly, there is no relationship detected between EN and CO_2 emission in this country.

Lastly, Table 6 reveals the outcome for short-run elasticities. Based on lag 0, for a model of growth, FDI is found to positively influence the Indonesia's economic growth. TO on the other hand, has negatively influenced the growth. Based on the model of income distribution, an increase in GDP, TO, and FD could worsen the income distribution in Indonesia, while DI and FDI have managed to improve the country's income distribution. Lastly, based on the model of environmental quality, higher FDI inflow has successfully reduced the release of CO_2 emission. The long run relationship was supported by the negative and significant value of error correction term (ECT) for each model. ECT reflects the speed of adjustment for each model and the negative value means that the variables in each model will converge in the long run. The highest speed of adjustment is detected for a model of growth (-0.90), followed by a model of environmental quality (-0.51) and model of income distribution (-0.33). Approximately, 90 percent, 51 percent and 33 percent disequilibria from the previous year's shock converge back to the long run equilibrium in the current year. Overall, the R-square values for all three models suggest that almost 99 percent and 96 percent of the variables in equations for Indonesia explains the dependent variables (GDP, GINI, and CO_2).

Table 6: Estimation of Short Run Restricted Error Correction Model (ECM)

Model of Growth		Model of Income Distribution		Model of Environmental Quality	
Variables	Coefficient	Variables	Coefficient	Variables	Coefficient
$\Delta LNGDP_{t-1}$	-0.021	Δ $LNGINI_{t-1}$	0.513***	$\Delta LNGDP_t$	1.235***
$\Delta LNGDP_{t-2}$	-0.510**	Δ $LNGINI_{t-2}$	0.467**	$\Delta LNFDI_t$	-0.062**
$\Delta LNLAB_t$	-0.097	Δ $LNGINI_{t-3}$	-0.381**	$\Delta LNFD_t$	0.179
$\Delta LNLAB_{t-1}$	0.160	Δ $LNGDP_t$	0.760***	$\Delta LNFD_{t-1}$	-0.310**
$\Delta LNLAB_{t-2}$	-0.685**	Δ $LNGDP_{t-1}$	-0.444	$\Delta LNEN_t$	0.073
$\Delta LNLAB_{t-3}$	-0.319	Δ $LNGDP_{t-2}$	0.720***	$\Delta LNTO_t$	0.179
$\Delta LNDI_t$	0.131	Δ $LNDI_t$	-0.402***	$\Delta LNTO_{t-1}$	0.128
$\Delta LNDI_{t-1}$	-0.029	Δ $LNDI_{t-1}$	-0.160	ECT_{t-1}	-0.513***
$\Delta LNDI_{t-2}$	0.075	Δ $LNDI_{t-2}$	0.343**		
$\Delta LNDI_{t-3}$	-0.396*	Δ $LNFDI_t$	-0.063**		
$\Delta LNFDI_t$	0.112***	Δ $LNFDI_{t-1}$	0.002		
$\Delta LNFDI_{t-1}$	0.008	Δ $LNFDI_{t-2}$	-0.033**		
$\Delta LNFDI_{t-2}$	0.056**	Δ $LNTO_t$	0.146*		
$\Delta LNFDI_{t-3}$	0.040**	Δ $LNFD_t$	0.377**		
$\Delta LNHC_t$	0.020	Δ $LNFD_{t-1}$	0.212		
$\Delta LNHC_{t-1}$	-0.047	Δ $LNFD_{t-2}$	0.205*		
$\Delta LNHC_{t-2}$	0.078*	ECT_{t-1}	-0.339**		
$\Delta LNHC_{t-3}$	-0.096**				
$\Delta LNTO_t$	-0.138**				
$\Delta LNTO_{t-1}$	-0.171**				
$\Delta LNTO_{t-2}$	-0.343***				
$\Delta LNFD_t$	-0.040				
$\Delta LNFD_{t-1}$	-0.398**				
$\Delta LNFD_{t-2}$	-0.069				
$\Delta LNFD_{t-3}$	0.112				
ECT_{t-1}	-0.909***				
R square	0.99	R square	0.96	R square	0.99
Ad.R square	0.99	Ad.R square	0.92	Ad.R square	0.99

Note: (*), (**), (***) indicate significance at 10%, 5% and 1% levels, respectively. Ad.R refers to adjusted R-square.

5. Conclusion and Policy Recommendation

The impact of globalization on SD in Indonesia has been examined in this research. Among the three characteristics of globalization, FDI inflows are seen as the most suitable candidate to qualify as potential driver for SD in Indonesia as it has led to higher growth, reduced income inequality and improved environmental quality based on the sample studied. FD, on the other hand, only brings about positive impact on two out of the three pillars of SD, namely, growth and income distribution. Meanwhile, TO is found to only bring positive impact on growth, but has caused harm to the environmental quality, just like FD. As for policy recommendation, considering "green economy" initiatives in trade liberalization polices, it is perhaps most crucial for the government to pursue policies that work towards reducing the country's pollution. Towards that end, the government should give more incentives in the form of tax exemptions for banks that provide loans to firms which get involved in environmentally friendly investment projects in Indonesia.

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A Seasonal Approach on Energy Consumption Demand Analysis in Thailand

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Abstract
This study investigates the energy consumption demand in Thailand by using seasonal factors in the analysis. The quarterly data from 2000-2014 which are analyzed by employing the Seasonal Unit Root test, the Cointegration test and the Dynamic Ordinary Least Squares (DOLS) procedures. The results show that all variables are stationary as in the same order integration at I(1, 0, 0). The model is cointegrated. The income factor is positively related to the energy consumption demand in Thailand in both the short run and the long run. Seasonal factors affect the energy consumption demand in only the short run. Therefore, energy consumption in Thailand depends on the income level. Energy policymakers should maintain energy prices at a stable level, develop renewable energy and implement efficient green energy for the upper middle income group to be an alternative energy policy in Thailand.

Keywords: Energy; energy consumption; seasonal unit root; demand of energy.

1. Introduction

At present, billions of people depend on having access to reliable energy and water sources, but due to rising energy costs and limited funds (World Energy Outlook. 2004), there are many countries in the world that have difficulty meeting their energy needs without falling into debt. Energy services are a basic human need and also contribute to economic development in many sectors.

With rising costs of energy, many developing countries are also facing inefficiencies in the energy management of the limited supply because energy management has limited experience with energy conservation, and poor maintenance in energy provision. Hence, each developing country needs to import raw energy and renewable energy. In particular, Thailand is a developing country that needs to address these energy consumption issues. Because Thailand has experienced a period of economic growth since the 1980's, the country has become more industrialized, and the demand for electricity and the consumption of energy have both risen.

Thailand is a small developing country located in Southeast Asia. Thailand has been characterized by a high import/GDP ratio; accompanied by a weak productive sector and a relatively stagnant export sector. In addition to this, during the last few years, the development process in Thailand has been constrained by increased foreign debt servicing and declining foreign exchange reserves because of the decline in the inflow of Southeast Asia aid and worker remittances.

The energy consumption of Thailand is consumed by many sectors such as socio-economic activities, households, industries and the improvement of infrastructure. Especially, electric energy was a significance of economic driving in Thailand (Kandananond, 2011). These continuously contribute to increase energy demand. It should be noted that energy imports amounted to approximately 1,380.89 billion baht in 2013 while the total import value average

was 6,087.11 billion baht during 2006-2013 (see Table 1). Therefore, this sharp increase in energy imports is linked to demand for energy consumption.

Table 1: Volume of Imports in Goods & Services and Energy

Years	Import	Goods & Services	Energy
2006	4,942.92	4,021.72	921.2
2007	4,870.19	3,988.17	882.01
2008	5,962.48	4,787.25	1,175.23
2009	4,601.98	3,825.08	776.91
2010	5,856.59	4,906.29	950.3
2011	6,982.72	5,761.38	1,221.34
2012	7,813.06	6,391.08	1,421.98
2013	7,666.93	6,286.04	1,380.89
Average	6,087.11	4,995.88	1,091.23

Note: Unit, billion baths
Source: Energy Policy and Planning Office (2014)

Generally, econometric models of energy demand are widely employed to provide income and price elasticities because time series data are appropriate for such investigation as a result of the nature of the samples from which the data is obtained. Pindyck (1980) and Bohi (1981) previously studied the demand for energy in industrialized countries, whereas more recent work has addressed the same problems by using primarily error correction methods. Few studies have been directed towards investigating the demand for energy in developing countries such as Dahl (1994), Balabanoff (1994) and Eltony and Al-Mutairi (1995). Previous studies in energy consumption demand have not focused on seasonality especially in Thailand. It is because Thailand is a developing country with a high level of energy consumption (Pongthanaisawan, Sorapipatana, and Limmeechokchai, 2007) and the volume of Thailand's using energy is gradually increasing (Ueasin, et al., 2015). In addition, Thailand is located in a tropical zone so it may consume more energy in the summer than in other seasons.

Hence, the purpose of this study is to investigate an advanced long run model or cointegrated relationship by including seasonal factors in the demand for energy consumption in Thailand. The findings of the research will present an alternative energy consumption demand model and can be a planning guideline for policymakers. This study has been divided into four sections. Section two contains the theoretical model and econometric methodologies. The data and empirical results are discussed in Section three. Finally, this paper presents conclusions and policy implications.

2. Data

This study uses data that are related to the period 2000 to 2014 and were obtained from various sources. Quarterly data on aggregate energy consumption (barrels), diesel and liquefied petroleum gas (LPG) prices (billion baths) were collected from statistical reported by the Energy Forecast and Information Technology Center of Thailand. Real Gross Domestic product (Real GDP) (billion baths) data were collected from the Office of the National Economic and Social Development Board of Thailand.

3. Methodology

3.1. Model

A log linear specification is employed to represent the long-run demand for the energy consumption model. Own price, income level and substitute price factors are included in the

independent variables, which follows demand theory. Generally, energy consumption demand model is presented in a natural logarithm model as follows:

$$\ln Q_t = \alpha + \beta_1 \ln PD_t + \beta_2 \ln Y_t + \beta_3 \ln PG_t + \varepsilon_t \quad (1)$$

where

Q_t	is	aggregate energy consumption at time t
PD_t	is	the real price of diesel per litter at time t
Y_t	is	real income (real Gross Domestic Products at the base year 2005) at time t
PG_t	is	the real price of liquefied petroleum gas per kg. at time t
α	is	a constant term
β_1 to β_3	are	total energy demand elasticities.
ε_t	is	white noise term at time t

In equation (1), the parameter coefficients may be interpreted as elasticities which have to be estimated with an estimating procedure under ideal conditions (i.e., u_t is assumed to be an identically and independently distributed (i.i.d.) white noise series. The expected signs of the parameters are assumed to be $\beta_1 < 0$, β_2 and $\beta_3 > 0$.

The sample period of the study corresponds to the quarterly data sets of the first quarter of 2000 to the fourth quarter of 2014, which adequately covers the turning point periods over 15 years (60 quarters). However, equation (1) lacks seasonal factors in the quarterly energy consumption of each season. We assume a multiplicative seasonal form Eq. (1) which can simply be transformed by being extended to capture the seasonal effects to come up with Eq. (2).

$$\ln Q_t = \alpha + \beta_1 \ln PD_t + \beta_2 \ln Y_t + \beta_3 \ln PG_t + \theta_1 D_{1t} + \theta_2 D_{2t} + \theta_3 D_{3t} + \varepsilon_t \quad (2)$$

For equation 2, the seasonal dummy variables $D_{ij} = 1$ when the t period is the quarter i^{th} ($i = 1,2,3$) zero otherwise, and θ_i represents the differential seasonal effect of the quarter i^{th} relative to the fourth quarter, which in this model is the base quarter. Without this extension, a certain form of omitted variable bias will occur if there truly is seasonality in the quarterly energy consumption of Thailand, whereby estimates of the elasticity parameters will be suspect.

3.2. Seasonal Unit Root Test

The most important features in the time series data used in a research are the estimation and inference procedures with a spurious regression problem. This problem is often found when we use non-stationary data in the analysis. In this study, all of the variables used are known (or at least suspected) to be non-stationary, particularly the dependent variable (energy consumption) which is expected to exhibit significant seasonal tendencies.

The way to counter the spurious regression problem is the cointegration process. Cointegration is the property of a group of time series data which are attached in one or more long run equilibrium relationship. When the group of time series are cointegrated, although the series is non-stationary, we can explain the series in both the short and long run together. Normally, most series are said to be "integrated of order 1 or I(1) since a great majority of available historical time series data have only one unit root, that are I(1). I(0) is the series that is stationary. Hence, when the model has cointegration, it can be captured by undertaking an error correction analysis which presents the speed adjustment of the estimated result from the short run relationship to the long run relationship.

Seasonal variables should be considered as they are an integral part of the data. The usual way for the cointegration procedure is to address the presence of seasonality in the data. Hylleberg, Engle, and Granger (1990) developed an empirical procedure known as the HEGY test. A seasonal time series has distinct peaks and troughs at seasonal frequencies. The type of seasonal unit root implies that the seasonal pattern is changing and has to be captured for the model to be reflective of the available information.

For a quarterly time series, say x_t, a simple univariate model reflects its integration in all seasonal and long run frequencies and is represented by the following equation:

$$(1-L^4)x_t = \varepsilon_t \quad (3)$$

where ε_t is white noise for all t in the sample period. L is the lag operator. The series x_t will be integrated if seasonal unit roots are present in the transformed series suggested by equation (3).The seasonal differencing operator $1-L^4$ can be factored mathematically as

$$(1-L^4) = (1-L)(1+L)(1-iL)(1+iL) = (1-L)\varphi(B) \quad (4)$$

The roots of the above equations can be ascertained at 1, -1 and a pair of complex roots which correspond to a root at zero frequency, half- annual frequency and annual frequency, respectively.

The term $1-L$ is used to isolate the unit roots at zero frequency and the lag polynomial $\varphi(L)$ is used to remove the seasonal unit roots. The HEGY test assumes that the series is generated by a stochastic process

$$\psi(L)x_t = (1-L^4)x_t = \varepsilon_t \quad (5)$$

From equation (5), for quarterly time series x_t the HEGY auxiliary regression model to test for the presence of seasonal unit roots is presented as:

$$\psi^*(L)y_{4t} = \pi_1 y_{1t-1} + \pi_2 y_{2t-1} + \pi_3 y_{3t-2} + \pi_4 y_{3t-1} + \varepsilon_t \quad (6)$$

where,

$y_{1t} = (1+L+L^2+L^3)x_t$, which maintains unit root at zero frequency and removes seasonal roots;

$y_{2t} = -(1-L+L^2-L^3)x_t$, which maintains bi-annual unit root and removes all other roots;

$y_{3t} = -(1-L^2)x_t$, which preserves the complex conjugates at annual frequency;

$y_{4t} = (1-L^4)x_t = x_t - x_{t-4}$, which is the quarterly different original series.

Empirical estimation of Equation (6) requires the augmentation of lagged y_{4t} to whiten the stochastic error term ε_t for the OLS procedure to be appropriate. If all $\pi's$ are different from zero, x_t is stationary at all frequencies. The test for the presence of unit root at zero frequency will be a t-test on the null of $\pi_1 = 0$. A t-test on the null $\pi_2 = 0$ will determine the presence of semi-annual unit root. A Wald type F-test on the joint hypothesis $\pi_3 = \pi_4 = 0$ will determine the annual cycle roots. If both of the last two tests are significant, seasonal unit roots are not present. Hylleberg, Engle, and Granger (1990) developed the critical values for the aforementioned tests whose sampling distributions differ from the usual t and F statistics.

Four different auxiliary forms of Equation (6) are to be established in the implementation of the HEGY test – (1) with intercept (2) with intercept and trend (3) with intercept and seasonal dummies, and (4) with intercept, seasonal trend and seasonal dummies. In addition, the HEGY produces reliable results when the four forms of the auxiliary model are consistent in their results.

3.3. Cointegration Test

This study employs the cointegration test of Saikkonen and Lütkepohl (2000a; 2000b) or SL test. Thus, Equations 2 are tested by employing a co-integration test which is based on the general model. Saikkonen and Lütkepohl (2000a; 2000b) explained that SL test shows the critical values remain valid of a shift dummy variable included in the model and it also excludes the trend term from the model. This is because the SL procedure is adopted with any number of (linearly independent) dummies in the model this method is suitable for seasonal dummy variables model (Nonthapot and Ueasin, 2014).

3.4. The Stock Watson Dynamic OLS (DOLS) Approach

An alternative approach, which has certain advantages over both the OLS and the maximum likelihood procedures, is the Dynamic Ordinary Least Squares (DOLS) approach by Stock and Watson (Stock and Watson, 1993). Their method improves on OLS by coping with small samples and dynamic sources of bias. Moreover, the Johansen (1991) method is uncovered with parameter estimates in a single equation that are affected by any misspecifications in other equations. Hence the DOLS is more appropriate than the Johansen method when we employ a single model.Furthermore, the DOLS estimated result has accuracy and robustness with an endogeneity problem of regression by the inclusion of leads and lags of the first differences of the regressors as well as serially correlated errors by a Generalized Least Squares (GLS) procedure. In addition, it has the same asymptotic optimality properties as the Johansen distribution. Therefore, this study appliesthe DOLS method for the estimation of dynamic energy consumption demand model.

4. Results

4.1 Seasonal Unit Root

Before the specified structural models can be implemented to undertake both long run and short run analyses of energy consumption demand in Thailand, the statistical properties of the different variables will have to be investigated. Instead of undertaking the usual unit root tests on the variables of the study to ascertain departures from stationarity, a seasonal unit root test via the HEGY framework is undertaken on both the dependent variable and the regressors. This analysis is necessitated by the quarterly data.

Table 2 presents the results of the HEGY Seasonal Unit Root tests of the different variables. It is seen in the table that the presence of unit root in the zero frequency, or in the level value of the variables in logarithmic form is empirically validated by the tests. This result indicates that all variables are non-stationary with a single unit root in the zero frequency for all auxiliary regression scenarios which means there are non-seasonal unit roots in the series. The second hypothesis is rejected which implies that all variables are stationary at the semi-annual frequency. Finally, the third hypothesis is rejected as all variables are stationary at the annual frequency. Therefore, the first null hypothesis is not rejected whereas the second and third null hypotheses are rejected, which means a quarterly time series may have a non-seasonal unit root but there are not semi-annual and annual unit roots. The order of integration of all variables are shown in Table 3 and are in the same order as I(1, 0, 0).

In the next stage, when we found the order of integration, all variables are examined by employing a Saikkonen and Lütkepohl (2000a; 2000b) Cointegration test, which is presented in Table 4. Table 4 shows that Equation (1) is co-integrated with two cointegrating vectors. It means that Equation (1) can explain the long run estimation result. Therefore, Equation (2) can be extended to capture the seasonal effects for long run estimation.

The existence of cointegration confirms that the demand for energy consumption in Thailand model can be estimated by the Dynamic Least Squares (DOLS) procedure. The long–run coefficients are presented in Table 5 which shows the estimation results of the dynamic models estimated by DOLS. The results show that the income demand factor is positively related to energy consumption in Thailand at the 5 percent confidence level. In contrast, the other variables are not significant.

For the short run, Table 6 shows that the demand for energy consumption deviates from equilibrium to return to the long-run equilibrium by approximately 5 percent. Moreover, this study finds that the income factor is positively related to the demand for energy consumption in Thailand. The second quarter is positively related to demand for energy consumption whereas the third quarter is negatively related to demand for energy consumption at a 1 percent significance level. However, the price factor and substitute price factor are not statistically significant.

Table 2: HEGY Seasonal Unit Root Test Results

Variables	Auxiliary Regression	t-test for $H_0 : \pi_1 = 0$ (Zero frequency)	t-test for $H_0 : \pi_2 = 0$ (Bi-annual frequency)	F-test for $\pi_3 = \pi_4 = 0$ (Annual frequency)
$\ln Q_t$	With Intercept	-1.338	-4.704**	-1.652
	With intercept & Time trend	-1.651	-4.719**	-1.571
	With intercept & Seasonal Dummies	-1.697	-4.885**	-2.992**
	With intercept, Seasonal trend & Seasonal Dummies	-1.653	-4.729**	-1.611
$\ln PD_t$	With Intercept	-1.301	-6.921**	-3.560**
	With intercept & Time trend	-2.601	-7.190**	-3.320**
	With intercept & Seasonal Dummies	-1.160	-6.143**	-3.841**
	With intercept, Seasonal trend & Seasonal Dummies	-2.709	-7.189**	-3.319**
$\ln PY_t$	With Intercept	-0.620	-3.151**	-2.525**
	With intercept & Time trend	-1.890	-3.220**	-2.487**
	With intercept & Seasonal Dummies	-0.680	-3.333**	-2.521**
	With intercept, Seasonal trend & Seasonal Dummies	-1.891	-3.220**	-2.536 **
$\ln PG_t$	With Intercept	-3.171	-4.990**	-4.678**
	With intercept & Time trend	-3.191	-4.981**	-4.544**
	With intercept & Seasonal Dummies	-3.070	-4.862**	-4.725**
	With intercept, Seasonal trend & Seasonal Dummies	-3.211	-4.952**	-4.464**

Note: t- statistics are in the parentheses.The asterisk ** denotes significance at the 5 percent level.

Table 3: Result of seasonal unit root

Variables	$\ln Q_t$	$\ln PD_t$	$\ln Y_t$	$\ln PG_t$
Order of integration	I(1,0,0)	I(1,0,0)	I(1,0,0)	I(1,0,0)

Table 4: Saikkonen and Lütkepohl (2000a; 2000b) Cointegration test results

Trace test	Constant		Constant and trend		Constant and seasonal dummies	
	LR	P-value	LR	P-value	LR	P-value
0	61.19	0.00	58.26	0.00	65.21	0.00
1	31.43	0.00	32.18	0.02	32.40	0.00
2	10.52	0.10	10.00	0.24	9.31	0.15

Source: JMulti's calculation

Table 5: Long Run Coefficients

Independent Variables						
Constant	LPD_t	LY_t	LPG_t	D_1	D_2	D_3
1.75*	-0.03	0.34**	0.14	0.01	0.01	-0.02
(1.95)	(-0.40)	(2.46)	(0.83)	(0.69)	(0.15)	(-1.10)

Diagnostic tests R^2 = 0.85, $\bar{R}^2$ = 0.79, *Jarque-Bera=2.38*, S.E. of regression =0.02

Note: t- statistics are in the parentheses. The asterisk * denotes significance at the 1 percent level.The asterisk ** denotes significance at the 5 percent level.

Table 6: Short-Run Coefficients

Independent Variables							
Constant	ΔLPD_t	ΔLY_t	ΔLPG_t	ECM_{t-1}	D_1	D_2	D_3
.02***	-0.02	0.20**	-0.06	-0.05**	0.01	0.02***	-0.03***
(5.94)	(-0.53)	(2.09)	(-1.49)	(-1.94)	(-1.78)	(-5.24)	(-8.71)

Diagnostic tests R^2 = 0.713, $\bar{R}^2$ = 0.66, Jarque-Bera=2.21, S.E. of regression =0.01, Durbin-Watson=1.87

Note: t- statistics are in the parentheses. The asterisk * denotes significance at the 1 percent level.The asterisk ** denotes significance at the 5 percent level.The asterisk *** denotes significance at the 10 percent level.

5. Conclusions and Policy recommendations

The objective of the study is to investigate the demand factors for energy consumption in Thailand. The main findings of this study are as follows. First, all quarterly time series variables tested by HEGY seasonal unit root have non-seasonal unit roots but there are no semi-annual and annual unit roots. The order of integration of all variables is the same order as I(1, 0, 0). Second, this study has determined the Saikkonen and Lütkepohl (2000a; 2000b) Cointegration test for two cointegrating vectors. It means that the demand for energy consumption in Thailand can be explained by the long run estimation result. Third, the income factor is positively related to the demand for energy consumption in Thailand for both the short run and the long run while the third quarter is negatively related to the demand for energy consumption.

Because the income factor is a factor that is consistent with demand theory, the income of the country offers a robust explanation for energy consumption. It means that energy products in Thailand are normal goods because demand for energy consumption of Thailand is inelastic to changes in income level (income elasticity > 0, it means a normal good). This finding is consistent with Dahl (1994) and Balabanoff (1994).This suggests that the demand for energy consumption increases less than proportionally as the income level rises (Bull, 1991). Furthermore, when the third quarter has statistical significance, it means the seasonality affects the demand for energy consumption in the short run; however, its affect is by only three percent.

It can be concluded that energy consumption in Thailand depends on income level. I suggest that the energy policymakers should maintain a stable level of energy prices. Additionally,

they should develop renewable energy and offer green energy for the upper middle-income group as alternative energy policy in Thailand.

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Motives for Demand for Religion: A Confirmatory Factor Analysis

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Abstract
This study investigates the motivation for religious demand among Christians using the International Social Survey Program (ISSP) data on Religion for 2008. This study using both exploratory and confirmatory factor analysis identified two motives, afterlife motive and the current life motive that influences demand for religion. The afterlife motive, aligned to the Christian doctrine of belief in afterlife, heaven and hell, was one of the dimensions of motives for religious demand. For gains in the current life, although the various studies highlight two construct of personal gains and social gains, however, for this study, all items loaded onto only one construct, which is broadly termed as current life motives where religion is said to provide solace, inner peace; as well as social support and networking opportunities.

Keywords: Religion; economics; demand; afterlife; current life.

1. Introduction

The interdisciplinary studies of economics and religion was initially explored by Adam Smith in the Wealth of Nations (Smith 1976), where economic principles such as demand and supply theories[5] were applied to explain the participation of rational individuals in the religious market. Following the work of Adam Smith, the subsequent publication was the study of allocation of time between consumption products and afterlife products using the household production model by Azzi & Ehrenberg (1975). The first and second publication had a gap of almost two centuries (Iannaccone 1998). The paper by Azzi & Ehrenberg (1975) is considered as the seminal paper which was instrumental in creating a renewed interest in this subfield of economics.

Smith (1976) in the Wealth of Nations deliberated on the economic incentives accruing to religious practitioners adhering to the moral code of conduct propagated by religious doctrines. Religious belief is seen as an "internal moral enforcement mechanism"(Anderson 1988, p.1069) which reinforces the need to abide by moral strictures and practice self-restraint. According to Smith (1976) it is important to adhere to strict moral obligations if an individual wants to gain the respect of society. The question is how does the reinforcement of self-restraint arising from religious belief provides economic incentives to religious practitioners. Anderson (1988) in expounding Adam Smith's proposition highlights that moral reputation is an indication of the human capital worth of an individual. Someone

[5] In the Wealth of nation, Adam Smith explored both demand and supply side of religion, where for demand side the participation in religion was seen as contributing to human capital (Anderson 1988). Iannaccone (1990) adopted this concept and incorporated the human capital analysis in the demand model. For the supply side analysis, Adam Smith described the behavior of suppliers of religious services such as churches from an economic perspective, where the churches were seen as monopolies with rent seeking activities by clergies (Anderson 1988).

abiding to moral strictures as ordained by religious doctrines would be perceived as a highly moral person which enhances his/her human capital worth. Thus, the economic incentive for demand for religion is a higher capital value of an individual resulting from high moral reputation. The aim of this study is to examine the motives for demand for religion in relation to economic incentives. Given that economic incentives are key drivers of religious demand, the proposition of this study is that a better understanding of motives for demand will not only complement existing literatures but also provide an opportunity to identify other possible economic incentives.

2. Literature Review

Both demand for religion and demand for secular products share many similarities. In the case of secular products quantity demanded of a product is identified as a measure, while demand for religion is expressed as the level of religious participation (Iannaccone et. al, 1997). One of the key motives for demand for religion is afterlife rewards. Azzi & Ehrenberg (1975) used church attendance to represent demand for religion and concluded that afterlife rewards influences the allocation of time between afterlife consumption and secular consumption. Hrung (2004) replaced Azzi & Ehrenberg's dependent variable of church attendance with monetary contribution and concurred with Azzi & Ehrenberg that afterlife rewards influence demand for religion. The motives for demand for religion are not exclusively focused in the afterlife gains, as studies have highlighted that individuals seek benefits in the current life as well. For current life gains, studies have focused on two aspects, one is personal and the other social. For personal motives, studies have identified factors such as extrinsic motivations such as providing "security and solace, sociability and distraction, status and self-justification" (Allport & Ross 1967, p.434). Religion is seen among others as a coping mechanism where it provides solace during times of sorrow (Harris et al., 2010; Pargament, 2002) and providing assurance of better health, better financial position, or generally to attain a better quality of life (Baker, 2008; Maltby, Lewis, & Day, 1999). For the motive of social gains, religious participation is seen as creating a sense of belonging as well as allowing individuals to establish a strong social network which provides both formal and informal support (Ellison & George, 1994; Scheitle & Adamczyk, 2009) and allowing better integration among the communities (Hurh & Kim 1990; Peifer 2010). In summary, the existing studies highlight a number of afterlife and current life gains that motivates demand for religion. Motives for afterlife demand are the perceived benefits that an individual expects to gain in their afterlife. Demand for religion in the current life is motivated by personal gains as well as social gains. Personal gains include among others the sense of security that religion provides an individual during times of tribulation; or the reassurance of a better quality of life in terms of better health or even a superior financial position. For social gains, studies have highlighted community bonding, maintaining a social network, social integration as a motivating factor for demand for religion.

3. Method

The data used in this study is from the International Social Survey Program (ISSP) 2008, an international collaborative survey on religion (ISSP Research Group 2012). The survey questioned respondents on their attitude towards religious practices. One of the challenges in using the ISSP dataset is fitting the survey questions to the framework of the present study. In order to align the survey questions to the concepts highlighted in the literature, the present study will focus on operationalizing the motives by identifying items applied in existing literatures which are similar to the questions covered in ISSP survey. For afterlife motive, reference is made to the study by McCleary & Barro (2006) on salvific merits "which connects the perceived probability of salvation to a person's lifetime activities" (p.51).

Salvific merits which is the concept of afterlife rewards or punishments in accordance to an individual's behaviour in his/her lifetime is aligned to afterlife motive of the present study. McCleary & Barro (2006) and Mccleary (2007) in exploring the salvific merits of Christians included measures such as belief in heaven, belief in hell and belief in afterlife in their study. These questions were included in the ISSP survey.

As shown in Table 1, the sequence of questions is as follows: Do you believe in… (a) Life after death, (b) Heaven, and (c) Hell. The questions are Likert-scale items coded 1-5 with the value of 1 representing a strong agreement of 'yes definitely'. For the current life gains, the present study refers to the Religious Orientation Scale (ROS) developed by Allport & Ross (1967) and modified by Darvyri et al. (2014). The ROS focuses on intrinsic and extrinsic orientations. For intrinsic orientation the practitioner internalize the teaching in an attempt to live his/her life as what the religion preaches (Allport & Ross 1967). Extrinsic orientation is focused towards non-religious outcomes where those with a high degree of extrinsic orientation use religion as a means "to provide security and solace, sociability and distraction, status and self-justification" (Allport & Ross 1967, p.434). The extrinsic orientation is aligned to the current life motive proposed by the present study. In order to capture the extrinsic motives, Darvyri et al. (2014) applied a revised ROS which included questions such as "I go to church because it helps me to make friends"; "I go to church mostly to spend time with my friends", "I go to church mainly because I enjoy seeing people I know there" and "What religion offers me most is comfort in times of trouble and sorrow". In order to identify questions which were aligned to the extrinsic orientation, the present study refers to questions categorized as the "attitudes towards the profits of practicing a religion" (GESIS n.d.) in the ISSP questionnaire. There were four questions in the ISSP questionnaire which were aligned to the extrinsic orientation. As shown in Table 1, the sequence of questions were as follows: Do you agree or disagree that practicing a religion helps people to… (a) find inner peace and happiness, (b) make friends, (c) gain comfort in times of trouble or sorrow, and (d) meet the right kind of people. The questions are Likert-scale items and are coded 1 -5 with the value of 1 representing a strong agreement of 'strongly agree'.

According to ISSP Research Group (2012) the dataset captures the religious beliefs and practices of Muslims, Christians, Buddhists, Jews, Hindus, eastern religions, Asian religions and other religions. The present study is only focusing on the motives for demand for religion among Christian, as such only relevant data will be extracted from the dataset. The data will be divided into two groups. The responses of 1252 Christian respondents were extracted from ISSP 2008 dataset which was divided into two groups, the first group is for exploratory factor analysis and the second group is for confirmatory factor analysis. The respondents are from Australia, Austria, Belgium, Chile, Croatia, Denmark, Finland, France, Ireland, Philippines, United Kingdom and United States. The first group has 618 respondents (age range = 15 to 92, M = 49.76, SD = 17.03), 251 males and 367 females. Married respondents are 52%, 28% are single and the remaining 20% are either divorced, widowed or separated. To gauge the demand for religion, the question on frequency of prayer indicates that 30.2% prayed on a daily basis, 23.8% prayed on a weekly basis, 9.9% prayed on a monthly basis, 21.5% prayed once or twice in a year and 14.3% never pray. The second group has 634 respondents (age range = 15 to 88, M = 48.43, SD = 17.5), 269 males and 365 females. Married respondents are 53.1%, 29.7% are single and the remaining are either divorced, widowed or separated. For the second group, 31.7% prayed on a daily basis, 23.7% prayed on a weekly basis, 8% prayed on a monthly basis, 20.5% prayed once or twice in a year and 16.1% never pray.

4. Results

The study carried out both exploratory and confirmatory factor analysis. The seven items were factored using principal component factor analysis with varimax rotation. Two criteria were used to identify the number of factors and factor loadings for each item: an eigenvalue greater than 1.0 and a factor loading greater than 0.5 (Chen & Tsai 2007; Schommer 1990) on any one factor. Two constructs were identified: one is the afterlife motive and the other current life motives. Table 2 on factor loadings indicates that all the items had factor loadings greater than 0.7. The first factor explained 51.9% of the variance in the items (eigenvalue = 3.634). Items loading on the first factor are whether religion helps people find inner peace, make friends, provide comfort and meet right kind of people. Although both Confirmatory Factor Analysis (CFA) and EFA apply factor loadings as an analytical tool but conceptually there are significant difference between the two approaches. For CFA, the number of constructs and the items that are likely to load onto the construct need to be theoretically supported. The present study, looked at existing literatures in proposing the hypothesis, and then carried out an EFA to identify the constructs. The factor loading using CFA produced similar results as EFA analysis where, the items loaded onto two constructs, current life motives and afterlife motives. The factor loading is taken as one of the measures of reliability. The criteria for acceptance is for four or more loadings of at least 0.6 regardless of sample size. (Guadagnoli & Velicer 1988), but studies have applied factor loadings of above 0.5 (Chen & Tsai 2007; Schommer 1990). Table 3 shows the factor loadings are above 0.6 which indicates that all seven items are adequate in their reliability individually.

In carrying out confirmatory factor analysis, it is important to determine if the factors exhibit convergent and discriminant validity as well as reliability. If there are convergent validity problem, this indicates that the items are unable to explain the latent variable, while for discriminant validity it indicates that there are high correlation between items in of one construct with another construct rather than within the same construct (Hair et al., 2010). The threshold measures for validity and reliability as highlighted by Hair et al., (2010) are that the composite reliability value (CR) must be greater than 0.7; to ensure convergent validity, the average variance extracted (AVE) must be above 0.5; and for discriminant validity both maximum shared variance (MSV), and average shared variance (ASV) must be less than AVE. In addition, the square root of AVE must be greater than inter-construct correlations, where constructs meeting these criteria are said to exhibit both validity and reliability. For this study the CR, AVE, MSV and ASV values shows that both factors demonstrate reliability as the CR value is greater than 0.7 for both constructs. The factors also exhibit convergent validity where the AVE for both constructs are more than 0.5. In the case of discriminant validity, the MSV and ASV values for both constructs are less than the AVE value. The third measure for discriminant validity, which is square root of AVE must be greater than correlation value, where the threshold is met for afterlife motive as AVE value is above the correlation value. The construct for current life motive indicates that the AVE value is equals to the squared root of correlation value. In this case, as three out of four threshold values have been met and the AVE value is equals to squared root correlation value, it is taken that the current life motive construct demonstrates discriminant validity.

5. Discussion

The proposition of this study is that there are two key motives for demand for religion. The afterlife motive is where religious consumers seek a desired outcome exclusive to what is prescribed by individual religions. This outcome is closely linked to the concept of a salvation motive proposed by Azzi & Ehrenberg (1975) and the compensator idea proposed

by Bainbridge & Stark (1979). Individuals acknowledging that they believe in an after-life, heaven or hell, outcomes are deemed to be expressing a desire to achieve the after-life rewards promised by the Christian doctrines. The empirical findings of the present study is in line with earlier studies that one of the motives for demand for religion is the perceived gains in afterlife. For current life, religious consumers are motivated by benefits such as getting solace or inner peace or materialistic gains such as better social status or better networking opportunities. The case where individuals practice religion with the hope of receiving solace or comfort in times of trouble or sorrow to "help cope with fear and to pass through crisis situations"(Hubert 2015, p.39) is when individuals are seeking favourable outcome in personal, family or work life. Individuals turn to religion to seek peace and happiness or to obtain solace during times of sorrow, seeking strength and reassurance during period of illness; they seek the reassurance of faith as a promise of better times during hardship and so on. The empirical findings support the proposition of this study that one of the motives for demand for religion is for peace and solace. The other items that loaded into the current life motives are religion helps people make friends and religion helps people meet the right kind of people which is linked to social support and networking opportunities. These items are aligned to Azzi & Ehrenberg's (1975) social pressure motives and Allport & Ross's (1967) extrinsic motivation. Religious consumers are subscribing and adhering to religious requirements with the intention of gaining a favourable position with their congregation.

6. Conclusion

The focus of this study was to investigate the motives of demand for religion in relations to the proposition of economic incentives proposed by Adam Smith in the Wealth of Nations (Smith 1976). The findings of the present study are aligned to Adam Smith's human capital model. Adam Smith's proposition is that individuals would adhere to strict moral strictures to enhance their human capital worth which is supported by the current life motive proposition of the present study. An individual deemed to be adhering and practicing in accordance to religious doctrines would experience a better social standing within his/her religious circle. The capital value of an individual is enhanced through his/her prominent presence in society. This enhancement in capital worth would provide returns in the form of better engagements and networking opportunities leading to material and professional gains. In addition to the current life motive, this study has identified afterlife gains as a motive for demanding religion. However, it is not within the scope of the present study to explore the economic incentives of afterlife motives. Nevertheless, there is an opportunity for future research to study the relationship between afterlife motives and economic incentives.

Table 1: Constructs for Motivates for Demand for Religion and Questions & Source of Data

Latent Construct	Item	Likert Scale	Sources of Data
Afterlife Motive	Do you believe in……. a) Life after death b) Heaven c) Hell	1 Yes, definitely 2 Yes, probably 3 No, probably not 4 No, definitely not 5 Can't choose	International Social Survey Programme: Religion III - ISSP 2008
Current life Motive	Do you agree or disagree that practicing a religion helps people to… a) find inner peace and happiness b) gain comfort in times of trouble or sorrow c) make friends d) meet the right kind of people	1 Strongly Agree 2 Agree 3 Disagree 4 Strongly disagree 5 Can't choose	International Social Survey Programme: Religion III - ISSP 2008

Table 2: Factor Analysis for Motives for Demand for Religion

	Factor 1	Factor 2
Afterlife Motive		
Belief in life after death		0.789
Belief in heaven		0.883
Belief in hell		0.832
Current life Motive		
Religion helps people: Find inner peace	0.825	
Religion helps people: Make friends	0.873	
Religion helps people: Gain comfort	0.816	
Religion helps people: Meet right kind of people	0.723	

Factor	Eigenvalue	% of VAR.	CUM. %
1	3.634	51.919	51.919
2	1.377	19.672	71.591

Note: Factor loadings < .50 are suppressed

Table 3: Factor Loading for Current life and Afterlife Motives

Items	Factor Loading
Current life Motives	
Religion helps people: Make friends	0.892
Religion helps people: Find inner peace	0.715
Religion helps people: Gain comfort	0.606
Religion helps people: Meet the right people	0.851
After-life Motives	
Belief in life after death	0.672
Belief in heaven	0.911
Belief in hell	0.850

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Examining Behaviour of Staple Food Price using Multivariate BEKK-GARCH Model

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Abstract
Understanding of staple food price behaviour is important for determining the unpredictability of staple food market. In this research, we examine the volatility spillover of commodity prices of sugar, rice, soybean and wheat using BEKK-GARCH model. The empirical results show that the own-volatility spillover are relatively significant for all food prices. However, only in wheat market, the price volatility increases during food crisis more than it does when there is stable condition.

Keywords: Staple food price; multivariate BEKK-GARCH; volatility; food crisis.
JEL Classification: C32, E31, G17, Q17

1. Introduction

The food crisis in 2008 took place mainly due to the factors such as biofuel production, income and population growth, rising energy prices and weather disruption (Braun, 2008). When food crisis occurred several problems such as higher food prices, sustainability of certain financial institutions and uncertainty of future nutritional emergencies may arise (Apergis and Rezitis, 2011). Moreover, the food price volatility also creates market risks which enhanced uncertainty about the prices.

Price behaviour of staple food is very critical to people who live in poverty. These poor people are vulnerable to the increase in staple food price as they spent most of their disposable income on food (Naylor and Falcon, 2010). According to FAO (2011) during food crisis, not only price of food increase, but also undernourished people (0.1% in ASIA and 8% in Africa). There were 642 million people suffered from chronic hunger in Asia Pacific and 265 million people also live undernourished in sub-Saharan Africa (Mahon, 2012). Therefore, the relevant authorities should make policy to control food prices, which helps to decrease the number of poor people in the country. The increase in staple food price is strongly relevant to the food policy. Developing countries are concentrated only on commodities that are vulnerable to price fluctuations. International prices can be used as important reference price to stakeholder so we can see the "big picture" of food market condition and volatility. The reference price can be selected on the basis of fit and prediction (Briesch et al., 1997). This paper attempts to analyse the behaviour of staple food prices in the multivariate GARCH framework to find out volatility structure of food prices during food crisis. Volatility structure refers to time varying volatility structure which means that the variance decomposition are no longer constant over the sample, but can change at each point in time as a result of changes in the conditional variance (IMF, 2008). This study also focuses on the effect of own-volatility spillover effect on food prices.

2. Literature Review

There are two basic things that can change the behaviour of staple food, which are supply and

demand. The supply side is ability and willingness to produce staple food. It is important to ensure staple food availability to everyone, although more important to the global poor (Zhang, et al. 2010).

Wu and Li (2013) study volatility spillovers of staple food in China. They used univariate and multivariate GARCH models to examine crude oil, corn and fuel ethanol markets of China's weekly price data. The researcher found that there were unidirectional spillover effects from crude oil market to the corn and fuel ethanol markets. On the other hand, there are no spillover effects from corn and fuel ethanol to the crude oil market.

In addition, Lahiani et al. (2014) study about return and volatility spillovers of wheat, cotton, sugar and corn using VAR-GARCH. The results show that these commodities have different degrees of sensitivity to past own shock and volatility. Although there is significant return and volatility transmission across commodities. Then, Serra et al. (2011) analyse the volatility interactions between crude oil, ethanol and sugar prices in Brazil using a standard BEKK-GARCH model in the year 2000-2008. They found that corn prices have become more connected to the crude oil prices. Based on these literature reviews, there are few researchers that analysed behaviour of staple food price using BEKK-GARCH model, especially for sugar, rice, soybean and wheat.

3. Methodology

There were several formulations of h_t for a model of multivariate GARCH, for example BEKK GARCH. Bollerslev (1986), introduced that h_t is a linear function of the lagged squared errors and cross products of errors and lagged values of the elements of h_t. Then, Engle and Kroner (1995) introduced a new model called BEKK model with new parameterization for H_t to solve the problems that cannot be solved by Bollerslev (1986) with VECH (1,1) model that cannot guarantee H_t variable is positive definite. The multivariate BEKK (Baba, Engle, Kraft and Kroner) GARCH (1,1) model is:

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon_{t-1}'A + B'H_{t-1}B \quad (1)$$

Where H_t is multivariate BEKK-GARCH, C is equal $N \times N$ upper triangular matrix of constants, A_i and B_i are $N \times N$ matrices of parameters, ε_{t-1} is residual for period $t-1$. In the case of Bivariate BEKK-GARCH (1,1) the model can be written as follows:

$$\begin{bmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} \\ 0 & c_{22} \end{bmatrix} \times \begin{bmatrix} c_{11} & 0 \\ c_{12} & c_{22} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \times \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{1,t-1}\varepsilon_{2,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \times \begin{bmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{bmatrix}$$

$$+ \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \times \begin{bmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} \times \begin{bmatrix} b_{11} & b_{21} \\ b_{12} & b_{22} \end{bmatrix} \quad (2)$$

According to Worthington and Higgs (2004), there are matrix B and matrix A. Matrix B is related to GARCH effects, the elements of b_{ij} in matrix B shows the persistence in conditional volatility between market i and j. On the other hand, matrix A is related to ARCH effects, the elements of a_{ij} in matrix A shows the degree of innovation from market i to j.

The covariance specification used to analyse the volatility spillover in sugar price compare to other food price. The model to explain the volatility spillover is a multivariate BEKK model. The BEKK model (Engle and Kroner, 1995) addresses the difficulty with multivariate VECH of ensuring H matrix is positive definite. Assume that the price at time t denoted by P_t and time $t+1$ by P_{t+1}. Moreover, y_t can be defined as $y_t = log(P_{t+1}/P_t)$, a return series that follows an ARMA model given in (3).

$$y_t = c_t + \lambda_1 y_{t-1} + \varepsilon_t + \delta_1 \varepsilon_{t-1} \quad (3)$$

$$H_t = M_t + \alpha_t \varepsilon_{t-1} \varepsilon_{t-1}' \alpha_t + \beta_t h_{t-1} \beta_t \quad (4)$$

where M_t is an indefinite matrix. α_t and β_t are a diagonal matrix. t is time. H_t is multivariate GARCH, M is constant, ε_{t-1} is residual for period $t-1$, h_{t-1} is GARCH for period $t-1$.

4. Results

We use multivariate BEKK-GARCH framework using 359 monthly data from November 1983 to September 2013 to analyse the staple food commodity price behaviour. The staple food commodity variables are Return of Sugar Price (RSP), Return of Rice Price (RRP), Return of Soybean Price (RSBP), and Return of Wheat Price (RWP). We also separate the data into four periods: period before food crisis (before 2008), period of food crisis (2008-2010), period after food crises (2011-2013) and the full period. This separation is made because the world food prices increased more than 100% in the early 2007 to middle 2008 (World Bank, 2013). Furthermore, World Bank (2012) and Cuesta et al. (2014) highlighted that the world food crisis took place during the period of July 2007-June 2008 and June 2010-February 2011.

We modify the standard GARCH mode by introducing a dummy variable which represents the food crisis period. The function of dummy variable is to analyse the behaviour of the conditional variance in this period. The model is to analyse the effects of food crisis on international food price are:

$$y_t = c_1 + \beta_1 y_{t-1} + e_t + \delta_1 e_{t-1} \quad (5)$$

$$\sigma_t^2 = c_2 + \alpha e_{t-1}^2 + \beta_2 \sigma_{t-1}^2 + \beta_3 (D_1 e_{t-1}^2) \quad (6)$$

Where

$$D_1 = \begin{cases} 1 \text{ if Food Crisis} \\ 0 \text{ otherwise} \end{cases} \quad (7)$$

and β_3 is the effect of the food crisis. The effect of food crisis is incorporated in the model using a dummy variable D_1 which assumes a value of 1 during the food crisis period (2008-2010) and a value of 0 otherwise. This model has been used in a research to evaluate the impact of structural changes in the impact of financial crisis by Miniaoui et al. (2014). If β_3 positive and significant, it suggests that volatility during period of food crisis is bigger compared to the volatility during period before and after food crisis.

Table 1: Testing ARMA-GARCH Dummy Variable of Food Crisis on Food Price

Particulars	RSP AR(1)-GARCH (1,1)	RRP MA(1)-GARCH (1,1)	RSBP AR(1)-GARCH(1,1)	RWP MA(1) - GARCH (1,1)
Mean Equation				
Constant 1	0.364	0.196	0.382	0.220
β_1	0.256***	---	0.314***	---
δ_1	---	0.350***	---	0.250***
Variance Equation				
Constant 2	2.939***	3.810***	8.975*	8.307***
α	0.109***	0.227***	0.067**	0.197***
β_2	0.848***	0.654***	0.579***	0.520***
β_3	0.019	0.134	0.232	0.294*
$\alpha + \beta_2$	0.958	0.882	0.647	0.717

Note: ***,**,* represent the levels of significance of 1%,5%, and 10% respectively, Source: writer's calculation

The estimation results in table 1 show that the coefficients of the food crisis dummy (β_3) are positive for all models, but statistically significant only for RWP MA(1)-GARCH(1,1). The significance of the coefficients suggests that during the period of food crisis, the volatility increases more than it does when there is stable condition in wheat markets.

We extend the univariate framework to multivariate GARCH model in analysing the own and cross volatility spillovers between Sugar, Rice, Soybean, and Wheat Prices. We also focused on the simple model of order (1,1). This order was chosen because it is easier to be generalized to higher order. The estimated coefficients in this section are assigned as follows: if the coefficient is β_{ij}, for i,j=1,2,3,4, then Return of Sugar Price (RSP) =1, Return of Rice Price (RRP) =2, Return of Soybean Price (RSBP) = 3, and Return of Wheat Price (RWP) = 4. Moreover, this part estimates the result for the variance-covariance parameters. The volatility spillover (transmissions) across international food markets is an interesting topic for investors, portfolio managers and international traders. If stakeholder can explain the volatility spillover, then they can make successful hedging and trading strategies (Hernández et al., 2011).

The important contribution in this analysis is that it examines Sugar, Rice, Soybean, and Wheat Prices simultaneously. The argument is that these four commodities markets are in the same food basket. According to Schnepf (2013), this food price tends to move together. The researchers seldom analysed the four markets together.

The multivariate diagonal BEKK-GARCH parameter estimations are summarized in the table 2 for the period before food crisis. The parameters show the impact of αt and β_t. In the period before food crisis, α(1,1), α(2,2), α(3,3) and α(4,4) parameters are significant in all ARMA-GARCH(1,1) model. α(2,2). β(2,2) and β(4,4) parameters are also significant in all ARMA-GARCH(1,1) model. β(1,1) parameter is significant in AR(1)-GARCH(1,1) and MA(1)-GARCH(1,1). β(3,3) is significant in MA(1)-GARCH(1,1) model.

Table 2: Estimated Coefficients for Multivariate Diagonal BEKK- GARCH(1,1) for RSP, RRP, RSBP, and RWP Period Before Food Crisis

Period	Parameter	ARMA(0,0) GARCH(1,1)	AR(1) GARCH(1,1)	MA(1) GARCH(1,1)	ARMA(1,1) GARCH(1,1)
		Coefficient	Coefficient	Coefficient	Coefficient
Before Food Crisis	M(1,1)	7.587***	6.114***	6.222***	7.193***
	M(1,2)	-0.129	0.097	0.119	0.034
	M(1,3)	0.463	0.641*	0.557	0.620
	M(1,4)	0.890***	1.488**	1.434***	0.974
	M(2,2)	0.877*	0.755	0.721	0.716
	M(2,3)	1.241	0.463	0.647	0.650
	M(2,4)	0.325	0.441	0.582	0.564
	M(3,3)	4.554***	4.435***	4.149***	4.334***
	M(3,4)	1.879***	2.438***	2.705***	2.652***
	M(4,4)	1.824***	0.002	0.00002	0.000
	α(1,1)	0.518***	0.513***	0.496***	0.538**
	α(2,2)	0.383***	0.326***	0.319***	0.317***
	α(3,3)	0.493***	-0.254**	-0.231**	-0.240**
	α(4,4)	0.415***	-0.253**	-0.247**	-0.239**
	β(1,1)	0.000	0.473***	0.464***	0.000
	β(2,2)	-0.918***	0.937***	0.940***	-0.941***
	β(3,3)	0.070	0.381	0.496**	-0.421
	β(4,4)	-0.753***	-0.785***	-0.752***	0.790***

Note: ***,**,* represent the levels of significance of 1%, 5%, and 10% respectively.
1=RSP,2=RRSP, 3=RSBP, 4=RWP, Source: writer's calculation

The own-volatility spillover effect for sugar price is bigger compare to other staple food price. This condition can be caused by *ratoon management* harvesting method in sugar cane. Most of the sugar cane harvest is using *ratooning method* which leaves the roots, the lower parts of sugar cane uncut and can be harvested again more than ten times (Latief et al., 2010). This method is not applied in other staple food except for a relatively small amount of rice. The

own volatility spillover namely α(1,1), α(2,2), α(3,3) and α(4,4) are significant. This result indicates that the past own-volatility effects are relatively strong for sugar, rice, soybean and wheat prices.

The multivariate diagonal BEKK-GARCH parameter estimations are summarized in the table 3 for the period of food crisis. The parameters show the impact of α_t and β_t. In the period of food crisis, α(2,2) parameter is significant in ARMA(0,0)-GARCH(1,1), AR(1)-GARCH(1,1), and ARMA(1,1)-GARCH(1,1). α(3,3) and α(4,4) parameters are significant in ARMA(0,0)-GARCH(1,1) model. The same result with α(3,3) and α(4,4) that β(3,3) and β(4,4) parameters are significant in ARMA(0,0)-GARCH(1,1) model. The own-volatility of rice α(2,2) in the period of food crisis is significant and higher compared to the period before food crisis. This indicates that the past own-volatility effects in food crisis are stronger for the rice price than for other staple food price.

Table 3: Estimated Coefficients for Multivariate Diagonal BEKK-GARCH(1,1) for RSP, RRP, RSBP, and RWP Period of Food Crisis

Period	Parameter	ARMA(0,0) GARCH(1,1)	AR(1) GARCH(1,1)	MA(1) GARCH(1,1)	ARMA(1,1) GARCH(1,1)
		Coefficient	Coefficient	Coefficient	Coefficient
Food Crisis	M(1,1)	9.789***	9.470***	9.722***	9.447***
	M(1,2)	3.029	2.197	3.492	2.511
	M(1,3)	2.929**	3.418	3.461	3.614
	M(1,4)	2.507	2.530	2.757	2.551
	M(2,2)	0.919	1.169	4.260	1.962
	M(2,3)	-5.645	-2.561	2.448	-0.235
	M(2,4)	-5.639	0.576	3.357	3.650
	M(3,3)	2.30	5.713	4.603	6.373**
	M(3,4)	4.998	7.570***	7.290***	6.721
	M(4,4)	0.038	0.000	0.005	0.001
	α(1,1)	0.000	0.000	0.000	0.000
	α(2,2)	0.796**	0.719*	0.999	0.734**
	α(3,3)	0.246*	0.223	0.117	0.205
	α(4,4)	0.462**	0.440	0.482	0.452
	β(1,1)	0.000	0.000	0.000	0.000
	β(2,2)	-0.597**	-0.668	-0.005	-0.623
	β(3,3)	-0.472**	-0.414	-0.615	-0.403
	β(4,4)	0.340	0.337	0.188	0.298

Note: ***,**,* represent the levels of significance of 1%,5%, and 10% respectively.
1=RSP,2=RRSP, 3=RSBP, 4=RWP. Source: writer's calculation

The multivariate diagonal BEKK-GARCH parameter estimations are summarized in the table 4 for the period after food crisis. The parameters show the impact of αt and βt. In the period after food crisis, α(1,1) parameter is significant in ARMA(0,0)-GARCH(1,1) model and ARMA(1,1)-GARCH(1,1) model. α(2,2) parameter is significant in ARMA(0,0)-GARCH(1,1). β(1,1), β(2,2) and β(4,4) parameters are significant in ARMA(0,0)-GARCH(1,1) model. The ARMA(1,1)-GARCH(1,1) cannot be calculated or it does not exist for this model in the period after food crisis because no convergence (no improvement in line search) using numerical derivatives. The own-volatility spillover effects for sugar price α (1,1) in period after food crisis is higher compared to the period before food crisis. This indicates that after year 2010, the own-volatility spillover for sugar price is stronger compared to the period before 2008.

Table 4: Estimated Coefficients for Multivariate Diagonal BEKK-GARCH(1,1) for RSP, RRP, RSBP, and RWP Period After Food Crisis

Period	Parameter	ARMA(0,0) GARCH(1,1)	AR(1) GARCH(1,1)	MA(1) GARCH(1,1)
		Coefficient	Coefficient	Coefficient
After Food Crisis	M(1,1)	3.300**	4.184	3.881***
	M(1,2)	-1.215	-0.863	-1.035
	M(1,3)	3.301	3.181	2.802
	M(1,4)	4.278*	5.812	5.452
	M(2,2)	1.587	2.176	1.801
	M(2,3)	2.962	0.879	1.283
	M(2,4)	1.628	2.005	2.442
	M(3,3)	0.001	3.274	3.084
	M(3,4)	-0.0002	-1.239	-1.174
	M(4,4)	0.002	0.0004	0.00003
	α(1,1)	0.917***	0.994	0.975**
	α(2,2)	0.594***	0.724	0.608
	α(3,3)	-0.171	-0.0006	-0.093
	α(4,4)	0.125	-0.001	0.019
	β(1,1)	0.396***	0.109	0.221
	β(2,2)	-0.624*	-0.449	-0.572
	β(3,3)	-0.365	0.219	0.358
	β(4,4)	0.655**	0.069	0.234

Note: ***,**,* represent the levels of significance of 1%,5%, and 10% respectively.
1=RSP,2=RRSP, 3=RSBP, 4=RWP. Source: writer's calculation

The multivariate diagonal BEKK-GARCH parameter estimations are summarized in table 5 for full period. The parameters show the impact of α_t and β_t. In the period after food crisis, α(1,1), α(2,2) and α(4,4) parameters are significant in all ARMA-GARCH(1,1) model. α(3,3) parameter is significant in ARMA(3,3)-GARCH(1,1). β(2,2) and β(4,4) parameters are significant in all ARMA-GARCH(1,1) model. β(1,1) parameter is significant in AR(1)-GARCH(1,1) model.

The own-volatility spillover of sugar price α(1,1) in full period is lower compare to period before and after food crisis. Then the own-volatility spillover of rice α(2,2) in full period is lower compare to period of food crisis, but higher compare to the period before food crisis. The significant coefficient of own-volatility spillover of soybean α(3,3) in full period is lower compare to period before food crisis but higher compare to period of food crisis. Lastly, the significant coefficient of own-volatility spillover of wheat α(4,4) in full period is higher compare to period of food crisis.

Table 5: Estimated Coefficients for Multivariate Diagonal BEKK-GARCH(1,1) for RSP, RRP, RSBP, and RWP Full Period

Period	Parameter	GARCH(1,1)	AR(1) GARCH(1,1)	MA(1) GARCH(1,1)	ARMA(1,1) GARCH(1,1)
		Coefficient	Coefficient	Coefficient	Coefficient
Full Period	M(1,1)	8.038***	6.191**	6.330***	6.263**
	M(1,2)	-0.014	0.110	0.128	0.117
	M(1,3)	0.951**	0.807*	0.758**	0.770**
	M(1,4)	1.036**	0.551	0.576	0.585
	M(2,2)	2.016***	1.893***	1.863***	1.888***
	M(2,3)	-0.177	-0.212	-0.081	-0.156
	M(2,4)	-0.085	0.009	0.015	0.024
	M(3,3)	5.183***	4.013	3.766	3.778
	M(3,4)	1.941**	1.155	1.033	1.066
	M(4,4)	1.913	0.000	0.020	0.000
	α(1,1)	0.401***	0.358***	0.345***	0.357***
	α(2,2)	0.622***	0.554***	0.545***	0.545***
	α(3,3)	0.365***	-0.045	-0.023	-0.035
	α(4,4)	0.394***	0.215**	0.201**	0.204**
	β(1,1)	0.000	0.358***	0.563	0.567
	β(2,2)	-0.766***	0.554***	0.802***	0.800***
	β(3,3)	-0.107	0.649	0.704	0.699
	β(4,4)	-0.781***	0.952***	0.959***	0.957***

Note: ***,**,* represent the levels of significance of 1%,5%, and 10% respectively.
1=RSP,2=RRSP, 3=RSBP, 4=RWP, Source: writer's calculation

Most of the variables estimated here are statistically significant. Also, the own-volatility spillover effects, namely α(1,1) α(2,2), α(3,3), and α(4,4) are relatively significant. This result indicates that the past own-volatility effects are relatively strong for sugar, rice, soybean and wheat price.

5. Conclusion

This research gives a significant contribution because sugar, rice, soybean and wheat are basic food commodities that are important and strategic in international commodity trade. It is also related to financial and commodity sectors in the food industry. The conditional variance equation of GARCH finds that the volatility increases more than it does during food crisis in wheat market. Based on the BEKK-GARCH model, there are strong past own-volatility effects for sugar, rice, soybean and wheat. Eventhough, own-volatility spillover effect for sugar price is bigger compare to other staple food price.

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