Do spot and future palm oil prices influence the stock market prices of a major palm oil producer? the Malaysian experience

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Abstract

The growth of the financial sector such as, the stock market is usually found to be highly correlated with the growth of the real sector of an economy. It is important to examine the existence of the commodity-stock market nexus since there is expectation that commodity prices may influence stock market prices of commodity-based companies. Many studies have investigated this nexus most of them focused on either gold or oil, and there still persists a lack of consensus in the literature. Palm oil is the largest produced vegetable oil in the world. Traditionally, palm oil is an important component of soap, detergent, pharmaceutical products, cosmetics, fuels, food, cooking oil and oleo chemical products. Despite the growing importance of palm oil as an alternative source of cheap and clean energy, not much attention has been given to this "golden fruit". This study is the first to investigate the dynamic relationship between spot and futures palm oil prices and stock market prices of a major palm oil producer. The methodology employed various unit root tests and Johansen's cointegration test, followed by long-run structural modelling and vector error-correction modelling, variance decompositions, impulse response functions and persistence profile. The results showed that stock market prices lead spot and futures palm oil prices rather than vice versa for the Malaysian markets. In addition, the findings indicated that the performance of the stock market is dependent on fundamental macroeconomic variables. This has important policy implications in the regulation of the palm oil market whereby stock market performance and fundamental macroeconomic factors are key predictive inputs on the expected performance of the palm oil prices.

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1.0 Introduction

Palm oil is the largest produced vegetable oil in the world with 65 million metric tons in 2014[3]. About 85% of total global supply of palm oil is produced in Indonesia and Malaysia. The fruit of the oil palm has an oil content of about 50% while the palm kernel has 45% oil content. This high oil content makes palm oil by far the most efficient vegetable oil crop in the world. An oil palm produces 10 times as much oil per hectare as soybeans, 5 times that of rapeseed and 2 times as much as coconuts. Palm oil prices are in general one of the lowest between the different types of oils such as rapeseed and soybean oils. However, the long maturity period needed for palm trees to mature (about 30 months) and start producing palm oil means that production is inflexible which results in highly volatile palm oil prices (MPOB, 2014).

Palm oil is an important global fats and oil commodity. Several products can be produced from palm trees: palm oil, palm kernel oil, palm olein, palm kernel olein, palm stearin, palm kernel stearin, palm fatty acid distillate and palm kernel expeller. These oils have different characteristics and all have their different uses in products. Palm oil is an important component of soap, detergent, pharmaceutical products, cosmetics, fuels and oleo chemical products. Nevertheless, approximately 75% of global palm oil is used for food and cooking purposes. The palm oil is a staple in Asia, similar to soybean oil is a staple in the US and rapeseed oil in Europe (MPOB, 2014). Due to this high regional demand there are clear seasonal spikes in palm oil prices. Furthermore, the usage of palm oil for biodiesel has gone up significantly in recent years. In Europe, palm oil is used as a cheap feedstock for biodiesel plants and as a source of cheap, clean and efficient energy for use in cars. Thus, biodiesel directly competes with fossil fuels in certain energy markets in developed countries. Similar to other high-demand energy commodities, there is a growing trend of palm oil prices to correlate with petrol prices in the global commodity markets (Baffes, 2007).

Many empirical studies have investigated the commodity-stock nexus. There are several reasons for examining the commodity-stock market nexus. Firstly, investors are interested in whether stock returns of companies primarily in the business of extracting or trading of commodities actually reflect changes in the prices of the underlying commodities. Understanding this connection is important as stocks of commodity-based companies are regarded as an investment instrument to gain exposure to commodities, and they enjoy long-standing popularity, especially among individual investors, due to their convenient accessibility and low cost

[3] Extracted from ''Oil Seeds: World Markets and Trade'', Global Oil Seeds Report, US Department of Agriculture, November 2015

(Ntantamis and Zhou, 2015). Another reason to examine the relationship between commodity prices and the stock market is the increasing importance of stock market wealth as a component in household wealth. Through this channel, commodity fluctuations can have an indirect effect in aggregate demand, and thus in the real economy (Ntantamis and Zhou, 2015). However, most of these empirical studies are focused on either gold or oil commodities. There seemed to be a lack of consensus in existing literature. The nature of the relationship between commodity prices and stock market prices is still debatable and inconclusive.

Despite the growing importance of palm oil as an alternative source of cheap and clean energy, not much attention has been given to this "golden fruit". To date, there is a dearth of existing literature on the interaction of palm oil prices and on the stock market prices. This study is the first to explore the dynamic relationship between palm oil prices and stock market prices for a major palm oil producer, namely, Malaysia. There are a few reasons why Malaysia is deemed suitable for this study. Firstly, Malaysia is the second largest global palm oil producer accounting for over a third of total global palm oil supply. Crude palm oil production reached 20 million metric tons by end of 2014 (MPOB, 2014). Secondly, Malaysia hosts the world's largest and third largest public listed palm oil companies (in terms of total plantation acreage), namely, Sime Darby Berhad and Felda Global Ventures Holdings Berhad, with market capitalization of RM53 billion and RM6 billion respectively as at 1H2015[4] on its stock exchange, Bursa Malaysia. Finally, and perhaps the most important, Malaysia is a hub for Islamic Finance, which widely uses crude palm oil (CPO), RBD palm olein and plastic resin as underlying assets for Islamic financial transactions. Bursa Malaysia in collaboration with Central Bank of Malaysia and Securities Commission of Malaysia and closely supported by industry players through the Malaysian Palm Oil Board (MPOB), Malaysian Palm Oil Association (MPOA) and Malaysian Palm Oil Council (MPOC), has established a trading platform, Bursa Suq-al-Sila', which is dedicated to facilitate Islamic liquidity management and financing by Islamic banks. Bursa Suq-al-Sila' has an average daily value traded of about RM12.8 billion and average daily contract of CPO futures have surpassed 50,000 contracts as at 1H2015[5]. Although Malaysia's commodity derivatives market may not be as well developed as the US and European markets, it plays an important role as benchmark for price discovery of palm oil in the international markets.

Apart from contributing towards existing literature, this study would certainly be of interest to policymakers. This time series regression study uses month-end data for the period from July 2005 to September 2015. The methodology employed consists of various unit root tests and Johansen's cointegration test, followed by long-run structural modelling and vector error-correction modelling, variance decompositions, impulse response functions and persistence profile in order to capture both the within-sample and out-of sample Granger

[4]Source: Bloomberg, 30 June 2015

[5] Source: Bursa Malaysia Monthly Market Statistics as at 30 June 2015

causal chain of palm oil prices, stock market prices and macroeconomic activity. The results showed that stock market prices lead spot and futures palm oil prices rather than vice versa for the Malaysian markets. In addition, the results indicated that the performance of the stock market is dependent on fundamental macroeconomic variables. This has important policy implications in the regulation of the palm oil market whereby stock market performance and fundamental macroeconomic factors are key predictive inputs on the expected performance of the palm oil prices.

This paper is structured in that Section 2 provides a brief background of the Malaysian palm oil industry; Section 3 reviews the existing literature and theories; Section 4 outlines the methodology and data used in the study while Section 5 provides a discussion on the results of the study. Finally, Section 6 wraps up the paper and concludes the major findings of the study and its policy implications.

2.0 Overview of palm oil industry in Malaysia

Malaysia produces about a third of all palm oil in the world. It is the second largest producer and exporter of palm oil. The palm oil is produced in Peninsular Malaysia as well as East Malaysia. Total average palm oil production in the country is around 20 million tons per year. Around 15% of the palm oil is for domestic consumption, while the remainder 85% is exported. Since Malaysia is dependent on exports, palm oil prices in Malaysia are driven by international supply and demand. Similar to Indonesia, Malaysia has a flexible export tax rate. For example, when Indonesia cut its tax rate for palm oil to 0% at the end of 2014, Malaysia followed suit. Malaysia currently has a biodiesel mandate of 7%. The government has indicated it is looking at possibilities to increase the mandate to 10% in order to increase demand for the product (MPOB, 2014).

Unlike Indonesia, Malaysia has a futures exchange for palm oil price discovery. Palm oil is traded in three forms: the physical market, the paper market and the futures market. Palm oil prices in the physical market are normally quoted FOB Malaysia/Indonesia. Physical palm oil can be picked up at the major ports in Malaysia and Indonesia. The most important futures exchange on which palm oil is traded is the Bursa Malaysia. The exchange is the most important indicator of palm oil prices in the world (MPOB, 2014).

3.0 Literature review

Recently, the relationship between commodity markets and the stock market have received substantial attention. Although many studies have investigated this nexus, most of them focus on either gold or oil, and there is a lack of consensus in the literature. In this section, the underlying theoretical framework will be discussed briefly and a review of existing body of knowledge related to this topic.

3.1 Theoretical overview

There are a few theories that are related to the valuation of the stock market and the commodity market. One of the key theories is the arbitrage pricing theory (APT) advocated by Ross (1976), which relates changes in returns on investment to unanticipated changes in a range of key drivers for these investments. Hence, APT framework deemed all investments to have expected returns that are affected by macroeconomic factors (Rjoub et al, 2009).

On the other hand, the capital asset pricing model (CAPM) describes the relationship of expected return and risk premium. It is used in pricing of risky assets or securities. The general idea behind CAPM is that investors need to be compensated in two ways: time value of money and risk. The CAPM is applicable to the valuation of stock markets and commodity markets prices. This means that investors demand a higher rate of return commensurate with the risk of a security. The risk premium is reflected in the prices of risky securities. In the case of the commodities market, CAPM establishes the relationship between the futures price and expected future spot price, conditional on an information set i.e. the futures price is a biased estimate of the future spot price based on risk premium and risk adjusted discount rate (Nicolau and Palomba, 2015). This means that the futures price is typically lower than the expected future spot price due to the positive risk premium because holding the commodity alone entails risk, and as a reward for that risk, we expect the future spot price to be above the current futures price (Hernandez and Torero, 2010).

Another common way of valuing commodity futures contracts is using the cost-of-carry model which states that the futures prices should depend upon the current spot price and the cost of storing the physical commodity from now until delivery (Nicolau and Palomba, 2015). Typically the carrying chargers includes insurance, storage and interest on the invested funds as well as other incidental costs. According to Hernandez and Torero (2010), the cost-of-carry or non-arbitrage theory has two implications: firstly, the futures price could be greater or less than the spot price, depending on the net (of storage costs) marginal convenience yield. If the net marginal convenience yield is positive and large, the spot price will exceed the futures price (futures market exhibits strong backwardation); however, if the net marginal convenience yield is negative, the spot price will be less than the futures price (the futures market is in contango). Secondly, spot and futures prices should move together across time to avoid arbitrage opportunities. This means that the price movements of spot and futures markets are expected to be correlated.

3.2 Empirical studies

Numerous studies have investigated the dynamic relationship of macroeconomic variables to the stock market performance. However, these studies tend to focus on developed countries in the US and Europe. Recently, there is a shift in focus towards emerging markets as globalization accelerated economic growth in developing countries. The stock market, a key component of the financial sector, plays a major role in supporting the real sector growth of these economies. Since the stock markets in many emerging markets tend to be poorly developed, majority of studies are focused on the interrelationship between macroeconomic variables and the performance of the stock market.

One of the earliest single country studies in emerging markets, Masih and Masih (1996) investigated the causal relationship among real output, money, interest rate, inflation and exchange rate of Indonesia. They suggested that the real output predominantly leads (rather than lags) money supply and the other three endogenous variables, namely, interest rate, exchange rate and prices, are consistent with the real business cycle theory than with the Keynesian and the monetarist theories. In Malaysia, Ibrahim (1999) examined the dynamic interactions between seven macroeconomic variables and the stock prices. The results strongly suggested informational inefficiency in the Malaysian market. There are cointegrating relationships between the stock prices and three macroeconomic variables – consumer prices, credit aggregates and official reserves. He also noted that the stock prices are Granger-caused by changes in the official reserves and exchange rates in the short run. In a related study of Malaysia, Ibrahim and Wan Yusof (2001) analyzed the dynamic interactions among macroeconomic variables of real output, price level, money supply, exchange rate, and equity prices. Consistent to earlier Ibrahim (1999) study, the results showed that the Malaysian stock prices seem to be driven more by changes in domestic factors, particularly money supply. Specifically, money supply exerted a positive effect on the stock prices in the short run. However, money supply and stock prices are negatively associated in the long run. They concluded that the stock prices contained valuable information for future variations in macroeconomic variables, especially the price level. The study showed that currency depreciation has both contractionary and inflationary effect on money supply. Since the Malaysian monetary authorities seemed to focus mainly on stabilizing the exchange rate, the money supply tend to be pro-cyclical and inflationary. In the same context of monetary supply, Ibrahim and Aziz (2003) cautioned that although stock prices may be used as an indicator for monetary stabilization policies, the shocks in money supply may feed into the economy making the market more instable through increased expectations of market contraction and higher risks. Thus, policy makers have to be cautious in controlling money supply since monetary disturbances can generate disruptions to financial markets.

On the links between emerging market and developed markets, Ibrahim (2003) evaluated the long-run relationship and dynamic interactions between the Malaysian equity market, various economic variables, and major equity markets of the US and Japan. There is evidence for cointegration between the Malaysian stock price index, Malaysian macroeconomic variables, and US and Japanese stock price indices. From the cointegrating relationship, the Malaysian stock price index is positively related to money supply, consumer price index, and industrial production. However, negatively linked to movement in the exchange rate. Although the Malaysian equity market is positively related to the Japanese market, it is negatively associated with the US equity market. According to Ibrahim (2003), the findings of the study reflected the financial integration among these markets, mainly through flows of portfolio investments, whereby the Japanese and Malaysian markets are considered as one East Asian market while the US market is an alternative market. The study also observed dominant influence of nominal variables such as money supply, consumer price index, and exchange rate on the stock price. Consistent with Ibrahim (1999) and Ibrahim et al (2003), the money supply appears to be dominant, generating positive responses from the equity market. These results suggested the predictability of the Malaysian equity prices based on relevant macroeconomic variables and the informational content of equity prices from macroeconomic variables. It is important to note that the influences of international equity market innovations extend beyond their spillovers over the domestic share market, resulting in significant responses from domestic real output, money supply, price, and exchange rate. The study also noted that these spillovers from the two major financial markets of US and Japan, become more pronounced during the financial crisis.

Other notable single country studies of emerging markets are the African study by Kyereboah-Coleman and Agyire-Tettey (2008) that examined how macroeconomic indicators affect the performance of the Ghana stock market. The study suggested that lending rates from deposit money in banks have an adverse effect on the stock market performance, which particularly served as major hindrance to business growth in Ghana. Again, while inflation rate is found to have a negative effect on stock market performance, the results indicated that it takes time for this to take effect due to the presence of a lag period; and that investors will benefit from exchange-rate losses as a result of domestic currency depreciation. Similarly in a Vietnam study, Hussainey and Ngoc (2009) suggested significant associations among the domestic production sector, money markets, and stock prices. They also noted that the US macroeconomic fundamentals have a significant effect on Vietnamese stock prices and that the influence of the US real sector is stronger than that of the money market. In a separate study of the Istanbul stock exchange from the arbitrage pricing theory (APT) perspective, Rjoub et al (2009) suggested significant pricing relationship between the stock return and macroeconomic variables, namely, unanticipated inflation, term structure of interest rate, risk premium and money supply. However, the findings showed a weak explanatory power, implying existence of other out of sample macroeconomic factors affecting the stock market returns. Likewise, a Jordanian study using ARDL, confirmed a long-term equilibrium relationship between stock market prices and the macroeconomic variables of industrial production, money supply, exchange rates and monetary interest rates (Bekhet and Matar, 2013).

From a comparative study perspective, Masih and Masih (1995) examined the causal relationship among real output, money, interest rate, inflation, and exchange rate for Thailand and Malaysia. There is evidence of cointegration among these variables suggesting that these five macro-aggregates are bound together by common trends or long-term equilibrium relationships. Contrary to Masih and Masih (1996) study on Indonesia, they noted that in the case of Malaysia and Thailand, the money supply (particularly M1) appears to have played the leading role of a policy variable being the most exogenous, while the other variables, specifically, output, rate of interest, exchange rate and prices, appear to be endogenous. The differences noted between the countries could be explained by the fact that Indonesia is an agriculture and resource-based economy while Malaysia and Thailand have more substantial manufacturing and industry-based economy. Hence, the macroeconomic variables are driven by different fundamentals and policies in the respective countries. Extending this research hypothesis to a regional comparative study of ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore and Thailand), Wongbangpo and Sharma (2002) investigated the dynamic interaction of macroeconomic variables (GNP, consumer price index, money supply, interest rate, and exchange rate) and stock prices. They observed long-run relationships between the macroeconomic variables and stock prices. The Granger causality linked the macroeconomic variables and stock prices. The findings indicated that the past values of macroeconomic variables in these ASEAN countries were able to predict the future changes in their stock price indices.

In a cross country comparative study, Tsouma (2009) investigated the dynamic interdependencies between stock returns and economic activity in mature and emerging markets in 22 countries. The empirical evidence supported the existence of a dependence relationship between the financial and the real sectors for a good number of the economies examined. In most cases, the analysis suggested that the uncovered relationship is not bi-directional. There is evidence for a strong positive unidirectional relationship running from stock returns to future economic activity. However, the evidence that supported the directional relationship from economic activity to future stock returns is weak. Since Granger causality runs in the direction from stock returns to economic activity, the forecasting ability of stock returns is supported. However, there were no evidence on a significant forecasting ability of economic activity for stock returns or a bi-directional Granger causality relation.

Now we shift our attention to the empirical studies investigating the relationship between the commodity markets (representing the real sector) and the stock market (representing the financial sector) in existing literature. Most of these studies have been focused on energy commodities, such as crude oil and gas and precious metals of gold and silver. There seems to be a lack of consensus in the literature regarding the gold-stock market nexus. For instance, Khoury (1984) argued that unstable dividends, political risks, currency exchange risks and business risks disassociate the price of gold from the returns of the firm's securities. Rock (1988) suggested that investing in mining stocks is the worst way to expose in gold due to the non-gold price related risk associated with these companies. Furthermore, Blose and Shieh (1995) set-up a model that described the influence of gold price on the value of gold mining stocks and then tested its implication empirically. They found that for companies whose primary business is gold mining, the gold price elasticity of the company's stock is greater than unity. In contrast, some studies that examined the relationship between the gold price and the aggregate stock market, have generated mixed results. Aggarwal and Soenen (1988) and Jaffe (1989) found that the correlation between gold and the stock market is positive but small. Moreover, Tschoegl (1980), Carter et al (1982), Larsen and McQueen (1995), Lawrence (2003) and McCown and Zimmerman (2006) found that gold is uncorrelated with the stock market. While Blose (1996) noted that gold is negatively correlated with the stock market, Baur and Lucey (2010) showed that gold served as a good safe haven for stocks in falling stock markets, as gold can be considered as an asset that is uncorrelated with a portfolio of stocks in times of market stress.

For the case of crude oil price changes, even though they are considered as an important factor for understanding fluctuations in stock prices, the direction of such a relationship is not clear. For example, Kling (1985) found that crude oil price increases are associated with stock market declines, but Chen et al (1986) suggested that oil price changes actually have no effect. Similarly, even though Jones and Kaul (1996) observed a stable negative relationship between oil price changes and aggregate stock returns, Huang et al (1996) discovered no negative relationship between stock returns and changes in the price of oil futures. In terms of Canadian studies, Sadorsky (2001) noted a positive relationship between changes in oil price and the Toronto Stock Exchange oil and gas index, while Boyer and Filion (2007) found a similar relationship by using a sample of oil and gas companies.

On the contrary, some recent studies indicated that the debate on the oil-stock market nexus is far from settled. For instance, Gorton and Rouwenhorst (2006) found evidence that the equities of commodity-based companies cannot serve as substitutes for commodity futures because they have a much higher correlation with the equity market than with commodity futures. Likewise, Kilian and Park (2009) reviewed the impact of oil price shocks on the US stock market and found that the effect depended on whether the change in the price of oil is driven by demand or supply shocks in the oil market. Moreover, Miller and Ratti (2009) analyzed the long-run relationship between the crude oil price and international stock markets. They observed that there is a change in the relation between real oil price and real stock prices in the last decade compared to earlier years, suggesting an unstable relationship over time. Additionally, Zhu et al (2011) examined the long-run relationship between oil prices and stock markets for the OECD and a panel of non-OECD countries using a panel threshold cointegration approach. Their results showed that a long-run relationship holds and that long-run Granger causality exists in both directions. Furthermore, Narayan and Sharma (2011) examined the relationship between oil price and stock returns for 560 US firms. They discovered that oil price increases have a positive effect in the returns of firms belonging only to the energy and transportation sectors and this effect is manifested with a lag. In addition, Wang et al (2013) investigated the response of stock markets to oil shocks across different countries that are either net exporters or net importers. They identified that supply shocks in oil have no or short-lived impact while aggregate demand shocks have a stronger significant impact in oil-exporting countries.

Other notable studies that have focused on a wider range of commodities are by Creti et al (2012) that investigated the links between prices for 25 commodities and their related stocks. They found that the correlations between commodity and stock markets have evolved through time and are highly volatile, particularly since the 2007-2008 financial crisis. The latter had played a key role, emphasizing the links between commodity and stock markets, and underlining the financialization of commodity markets. At the idiosyncratic level, a speculation phenomenon is highlighted for oil, coffee and cocoa, while the safe-haven role of gold is evidenced. Recently, Mensi et al (2015) examined the time-varying linkages of a major oil-based frontier stock market, Saudi Arabian Tadawul, with major commodity futures markets that included WTI oil, gold, silver, wheat, corn and rice, and highlighted implications for portfolio risk management using a bivariate DCC–FIAPARCH model with and without structural breaks. The results revealed evidence of asymmetry and long memory in the conditional volatility and insignificant dynamic conditional correlations between the considered commodity and Saudi stock markets except for the silver–Tadawul pair. Moreover, for the mixed commodity–stock portfolios, there is strong evidence of diversification benefits, hedging effectiveness and downside risk reductions. These findings highlighted the usefulness of including commodities in a traditional portfolio of risk management.

Aboura and Chevallier (2015) assessed how financial markets and commodities are inter-related using "volatility-surprise" component. They found evidence that return and volatility spillovers do exist between commodity and financial markets and that in turn, their relative impact on each other is very substantial. From the perspective of the bull and bear markets, Ntantamis and Zhou (2015) looked at the commodity-stock market nexus to assess whether commodity price fluctuations are reflected in the stock prices of firms whose primary business is in extracting and trading the particular commodity. Interestingly, the study found that there are substantial differences with respect to the market duration characteristics. Commodity markets tended to have longer durations compared to stock markets. The results showed that commodity prices exhibited longer bear phases compared to bull phases, however, the opposite being true for individual stocks. Nevertheless, there is little evidence that the market states identified for the individual stocks are related to those for the commodity prices. Instead, it seemed that the commodity markets provided information about their respective stock market sector indices.

In summary, there seemed to be a dearth of empirical studies linking palm oil prices and stock market prices in existing literature. This paper hopes to contribute and fill this gap in existing literature by examining the dynamic relationship between spot and futures palm oil prices and stock market prices of a major palm oil producer, Malaysia.

4.0 Methodology

The data collected, and methodology were designed for the purpose of examining the dynamic relationship between spot and futures palm oil prices and stock market prices of a major palm oil producer, Malaysia.

4.1 Data used in study

The study employs monthly data which are extracted from Thompson Reuters DataStream database for the period from 31 July 2005 to 30 September 2015. The data sample begins from 31 July 2005 following the removal of capital controls and fixed exchange rate imposed by the Malaysian Government on 21 July 2005. To measure the stock market prices, month-end closing values of Bursa Malaysia Kuala Lumpur Composite Index (KL) were used. The index, which is based on a sample of 30 component stocks and value weighted, is normally used to reflect the Malaysian stock market performance. Real output is measured by real industrial production index (IP) and consumer price index (CP) as a measure of aggregate price level. M2 represents the broad-based M2 monetary aggregate which satisfies both wealth and substitution effects of monetary holdings. The bilateral exchange rate *vis a vis* US dollar as a measure of exchange rate (EX) was used. The month-end closing spot price of the Malaysia palm oil as a measure for palm oil spot price (SP) and month-end closing 3 month contract Malaysian palm oil futures price as a measure for palm oil futures price (FU) as quoted on Bursa Malaysia. The selection of macroeconomic variables used in the study are consistent with Ibrahim (1999, 2003), Masih and Masih (1995, 1996), Ibrahim et al (2001, 2003), Wongbangpo and Sharma (2002), Kyereboah-Coleman et al (2008), Rjoub et al (2009), Tsouma (2009), Hussainey et al (2009) and Bekhet and Matar (2013).

As a prerequisite for later analysis, the stationary properties of the data series is examined by using the augmented Dickey-Fuller (ADF) test and Phillips-Peron (PP) tests. For robustness, the Kwiatkowsi, Phillips, Schmidt and Shin (KPSS) is also carried out. The results of these unit root test are presented in Table 1 of the Appendix. Panel A of the test statistics presents the log-levels of the data series while Panel B presents the test statistics of the first differences. It is evident from the results in Panel A that the log-levels comprised of a mixture of non-stationary and stationary variables. However, Panel B showed that all variables are stationary at first differences. Thus, the results consistently suggested that all variables are integrated of order 1 or I(1).

4.2 Methodology

The study employed standard procedures of cointegration and Granger causality. The cointegration technique was pioneered by Engle and Granger (1987), Hendry (1986) and Granger (1986). The variables are said to be cointegrated, i.e. they exhibit long-run equilibrium relationship, if they share common trends. As long as the set of variables have a common trend, causality must exist at least in one direction, either unidirectional or bidirectional (Granger, 1986, 1988). In brief, a set of variables are cointegrated if they are individually non-stationary and integrated of the same order, and yet their linear combination is stationary. Statistically, the presence of cointegration rules out non-causality between the variables. In contrast, the absence of cointegration suggests there might be only short-run interactions between the variables. In this case, all variables need to be expressed in first differences to avoid spurious regression.

Generally, there are two common test for cointegration – the residual-based Engle-Granger (1987) tests and the VAR-based test of Johansen (1988) and Johansen and Julius (1990). The Engle-Granger (EG) test is a two-step procedure involving (i) an OLS estimation of a pre-specified cointegrating regression and (ii) a unit root test of the residuals (excludes both trends and constant) saved from the first step. The null hypothesis of no cointegration is rejected if it is found that the residuals are non-stationary. The EG test has some weaknesses. The test may be sensitive to which variable is normalized. Moreover, the test is widely noted to have low power. A major disadvantage of the test is that the critical values are highly sensitive to sample size since the test statistics have no well-defined limiting distribution (Ibrahim, 2000).

The Johansen-Julius (JJ) procedure of cointegration test is based on the maximum likelihood estimation of the VAR model. Based on the estimation, two statistics – the trace and maximal Eigenvalue – are calculated to test for the presence of r cointegrating vectors. The trace statistics test the null hypothesis that there are at most r cointegrating vectors against the alternative of r or more cointegrating vectors whereas the maximal Eigenvalue statistics test for r cointegrating vectors against the alternative of r + 1 cointegrating vectors. The JJ approach treats all variables as potentially endogenous. Hence, it avoids the problem of normalizing the cointegrating vector on one of the variables or imposing a unique cointegrating vector as in the EG test. Besides the ability of the test to determine the number of cointegrating vectors, the JJ procedure is widely noted to be more powerful than the EG test (Ibrahim, 2000).

Once the number of cointegrating vectors have been determined, the Long-Run Structural Modelling (LRSM) attempts to estimate theoretically meaningful long-run or cointegrating relations by imposing on those long-run relations (and then testing) both identifying and over-identifying restrictions based on theory. This means that for the cointegration analysis to be theoretically meaningful in the long-run, the stock market prices need to contribute significantly to the long-run relationship (Ibrahim and Aziz, 2003).

Although cointegration indicates the presence or absence of Granger-causality, it does not indicate the direction of causality between variables. This direction of the Granger-causality can be detected through the vector error correction model (VECM) derived from the long-run cointegrating vectors. Engle and Granger (1987) demonstrated that once the number of variables are found to be cointegrated, there always exist a corresponding error-correction representation which implies that changes in the dependent variable are a function of the level of disequilibrium in the cointegrating relationship (captured by the error-correction term) as well as changes in the other explanatory variables (Ibrahim and Aziz, 2003). The endogeneity of the dependent variable can be evidenced through the statistical significance of the t-test of the lagged error-correction term and/or F-test applied to the joint significance of the sum of the lags of each explanatory variable. The non-significance of both the t-test and F-test in the VECM indicates econometric exogeneity of the dependent variable. The VECM approach also distinguishes between short-term and long-term Granger-causality. When variables are cointegrated, deviations from the long-run equilibrium will feedback on the changes in the dependent variable in order to force the movement towards the long-term equilibrium. If the dependent variable is driven directly by this long-term equilibrium error, then it is responding to this feedback. If not, it is responding only to the short-term shocks to the stochastic environment (Masih and Masih, 1995, 1996). The F-test of the differenced exploratory variables indicates the short-term causal effects while the long-term causal relationship is implied through the significance of the t-test of the lagged error-correction terms which contains the long-term information since it is derived from the long-run cointegrating relationships. The coefficients of the lagged error-term is a short-term adjustment coefficient. It represents the proportion by which the long-term disequilibrium in the dependent variable is being corrected in the short-run (Masih and Masih, 1995, 1996). Non-significance of the error-correction term affects the implied long-term relationship and may be a violation of theory. However, the non-significance of the differenced variable (reflects the short-term relationship) does not violate theory since theory typically has nothing to say about the short-term relationships (Thomas, 1993).

The VECM, F-test and t-tests may be interpreted as within-sample causality tests that only indicate exogeneity or endogeneity of the dependent variable within the sample period. They do not provide information on the degree of exogeneity or endogeneity between the variables beyond the sample period (Ibrahim and Aziz, 2003). On the other hand, Variance Decomposition (VDC), an out of sample causality test, partitions the variance of the forecast error of a certain variable into proportions attributable to innovations or shocks in each variable in the system including its own (Masih and Masih, 1995, 1996). This means VDC can provide relativity between the variables in the system. A variable that is optimally forecast from its own lagged values will have all its forecast error variance accounted for by its own disturbances (Sims, 1982). Since the frequency of data used in the sample are monthly, the time horizon selected in the VDC are 12, 24, 36, 48 and 60 months in order to determine the degree of exogeneity/ endogeneity of the variables.

The information in the VDC can be graphically represented through impulse response functions (IRF). Both the VDC and IRF are derived from the moving average (MA) representation of the original VAR model (Masih and Masih, 1995, 1996). The IRF essentially maps out the dynamic response path of a variable due to a one standard deviation period shock from a specific variable. The IRF are normalized in such a way that zero represents the steady state value of the response variable (Masih and Masih, 1995, 1996). On the other hand, the persistence profit (PP) estimates the speed with which the economy or the market return to equilibrium owing to a system-wide shock on the cointegrating relations. Both the IRF and PP map out the response path of the long-run relationships between the variables.

5.0 Discussion of results

The results of the tests are tabulated in the Appendix.

5.1 Results of the study

Microfit 5.0 was unable to generate the necessary critical value for the EG test due to the number of regressors (in this study, 8 variables). The determination of the lag order of the VAR model is a pre-requisite for the cointegration test using the Johansen-Julius procedure. The selection of the lag order is given by Akaike Information Criterion (AIC) to be 1 while Schwarz Bayesian Criterion (SBC) indicated lag order to be 0 as tabulated in Table 2A. The contradictory results for different lag specifications is unsurprising since JJ procedure is sensitive to lag length selection (Hall, 1991). However, in selecting the lag length, the minimum requirement is the error terms for all the equations in the system must be serially uncorrelated. Consequently, the Lagrange Multiplier (LM) test to detect for serial autocorrelation is conducted. The null hypothesis of no serial correlation is rejected for 3 of the variables, namely, consumer price index, palm oil spot and futures prices as presented in Table 2B. Hence, the higher order of lag based on AIC is chosen over SBC since the variables are serially autocorrelated. The lag order of 1 is chosen for use in the JJ procedure. The results of the JJ procedure for cointegration tests are presented in Table 3. At 95% critical value, the test statistics indicated that the maximal Eigenvalue alternative of $r = 4$ and the trace value alternative of $r>=4$ are selected after rejecting the null of $r=0$. Hence, the JJ cointegration test indicated that there are 4 cointegration in the regression. This implies that the 8 variables are bound together in a long-run equilibrium relationship. The LRSM test also confirmed the importance of the stock market price in the cointegrating relationship as presented in Table 4.

The VECM results in Table 5 indicated that all the variables are exogenous except for 3 endogenous variables, namely, consumer price index, industrial production index and interest rates through the statistical significance of the t-test of the error-correction term and F-test of the independent variables. It is not surprising that these variables are the most endogenous since the Malaysian Government seemed to focus on boosting economic growth during the period. This meant that these variables are policy instruments used to achieve such an objective. In order to boost the economic growth, the real economic activity is stimulated through various fiscal and non-fiscal incentives for specific industries and manufacturers while inflation rate is kept within a reasonable level through the setting of ceiling prices on a basket of consumer goods. Likewise, interest rates are controlled by the Central Bank through its overnight policy rates which has a direct impact of bank's lending rates and capital reserves. Intuitively, the mechanics behind the VECM results implied that stock market prices, spot and futures palm oil prices, exchange rate, and money supply are the initial receptors of an exogenous shock to the long-term equilibrium relationship while interest rate, inflation rate and real economic activity had to bear the burden of short-run adjustment endogenously in different proportions to bring back the system to its long-term equilibrium.

The relative exogeneity and endogeneity of the variables are given by VDC results in Table 6. Unsurprising, the results of the orthogonalized and generalized VDC are different in terms of the most exogenous and endogenous variable. This is attributable to the nature of orthogonalized VDC which is not unique and depend on the particular ordering of the variable in the VAR and assumes that the other variables in the system are switched off when a particular variable is shocked. In contrast, the generalized VDC does not have such restrictions. For these reasons, the results from the generalized VDC is treated as superior over orthogonalized VDC.

Initially, the results from VDC appears to be conflicting with those from the VECM approach. However, it is important to take note that no such contradictions exist since the VECM, F-test and t-tests are within-sample causality tests while VDC is an out of sample causality test. Hence, the VDC is most suitable for studies on policy implications as it examines the effect of exogenous shocks or innovations to the long-run equilibrium for future periods. From the results of the generalized VDC, the most exogenous variable is interest rate followed by money supply and inflation for all time horizons and the most endogenous is spot price of palm oil for all time horizons except for the 60-months period in which real economic activity is indicated as the most endogenous. The result for the 60-months period can be discounted since the predictive power of a 5-years forecast is much lower than a 1-year or 3-years horizon. Therefore, the findings can be interpreted as interest rates being the most exogenous followed by money supply and inflation as the initial receptors to exogenous shocks while palm oil spot prices seemed to bear the burden of short-run adjustment endogenously to bring back the system to its long-term equilibrium.

From the perspective of the stock market–commodity market price nexus, the stock market prices appeared to be leading both futures prices and spot prices of palm oil and lagging interest rates, money supply, inflation and exchange rates. This means that the stock market prices are mainly influenced by macroeconomic fundamentals rather than the prices of the commodity market. The results seemed to support the APT since the stock market represents investments with expected returns that are affected by macroeconomic fundamentals. In addition, the relationship between spot prices and futures prices is not consistent with the cost-carry model, which states that futures price should depend on current spot price and other incidental costs, instead the results seemed to support CAPM in explaining the spot-futures price nexus.

5.2 Policy implications

According to Nicolau and Palomba (2015), the energy commodities are recognized as leading indicators of inflation (Pecchenino, 1992; Moosa, 1998; Browne and Cronin, 2010), but also for their role in formulating monetary policy (Awokuse and Yang, 2003), while the role of gold is to hedge against inflation and exchange rate movements, and to diversify the risk in investment portfolios. Other contributions also suggested that price changes in commodity markets precede speculators' position changes, and not vice-versa (Büyükşahin and Harris, 2011). However, the results indicated that palm oil prices is not an indicator for inflation nor an important input for monetary policy rather the spot and futures prices follows the stock market performance and fundamental macroeconomic variables. This has important policy implications in the regulation of the palm oil market whereby stock market performance and fundamental macroeconomic factors are key predictive inputs on the expected performance of the palm oil prices.

5.3 Limitations of study and future research

This study has limitations, specifically, this is a single country study that suffers from limited data availability. The study could be expanded to incorporate other major palm oil producers such as Indonesia and Thailand. The scope of research may also be extended to include an investigation into price volatility and related risk premium of spot and future prices of palm oil.

6.0 Conclusion

This study is the first to investigate the dynamic relationship between spot and futures palm oil prices and stock market prices of a major palm oil producer. The methodology employed consists of various unit root tests and JJ's cointegration test, followed by LRSM and VECM, VDC, IRF and PP in order to capture both the within-sample and out-of sample Granger causal chain of palm oil prices, stock market prices and macroeconomic activity. The results showed that stock market prices lead spot and futures palm oil prices rather than vice versa for the Malaysian markets. In addition, the performance of the stock market is dependent on fundamental macroeconomic variables. This has important policy implications in the regulation of the palm oil market whereby stock market performance and fundamental macroeconomic factors are key predictive inputs on the expected performance of the palm oil prices.

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APPENDIX

TABLE 1: UNIT ROOT TEST RESULTS

AUGMENTED DICKEY FULLER (ADF)

Panel A

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
LEVEL FORM	LKL	ADF(2)=SBC	215.4442	- 2.556	- 3.481	Non-Stationary
		ADF(5)=AIC	223.7156	- 3.539	- 3.524	Stationary
	LSP	ADF(1)=SBC	117.0756	- 2.015	- 3.368	Non-Stationary
		ADF(1)=AIC	122.5999	- 2.015	- 3.368	Non-Stationary
	LFU	ADF(1)=SBC	119.5494	- 2.115	- 3.368	Non-Stationary
		ADF(1)=AIC	125.0738	- 2.115	- 3.368	Non-Stationary
	LCP	ADF(1)=SBC	465.5372	- 3.400	- 3.368	Stationary
		ADF(1)=AIC	471.0616	- 3.400	- 3.368	Stationary
	LIP	ADF(2)=SBC	208.0571	- 2.470	- 3.481	Non-Stationary
		ADF(2)=AIC	214.9625	- 2.470	- 3.481	Non-Stationary
	LEX	ADF(1)=SBC	288.1642	- 2.626	- 3.368	Non-Stationary
		ADF(1)=AIC	293.6885	- 2.626	- 3.368	Non-Stationary
	LM2	ADF(1)=SBC	371.5273	- 2.071	- 3.368	Non-Stationary
		ADF(1)=AIC	377.0516	- 2.071	- 3.368	Non-Stationary
	IN	ADF(1)=SBC	100.5432	- 2.009	- 3.368	Non-Stationary
		ADF(2)=AIC	107.2927	- 2.368	- 3.481	Non-Stationary

Panel B

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
FIRST DIFFERENCE	DKL	ADF(1)=SBC	212.1041	- 5.686	- 3.454	Stationary
		ADF(1)=AIC	217.6113	- 5.686	- 3.454	Stationary
	DSP	ADF(1)=SBC	113.8899	- 6.554	- 3.454	Stationary
		ADF(5)=AIC	121.7208	- 5.510	- 3.466	Stationary
	DFU	ADF(1)=SBC	115.7991	- 6.874	- 3.454	Stationary
		ADF(5)=AIC	122.2901	- 5.552	- 3.466	Stationary
	DCP	ADF(1)=SBC	457.9526	- 6.882	- 3.454	Stationary
		ADF(5)=AIC	463.6128	- 5.354	- 3.366	Stationary
	DIP	ADF(1)=SBC	205.4103	-12.394	- 3.454	Stationary
		ADF(1)=AIC	210.9175	-12.394	- 3.454	Stationary
	DEX	ADF(1)=SBC	284.6197	- 7.997	- 3.454	Stationary
		ADF(1)=AIC	290.1269	- 7.997	- 3.454	Stationary
	DM2	ADF(1)=SBC	366.5795	- 7.603	- 3.454	Stationary
		ADF(1)=AIC	372.0797	- 7.603	- 3.454	Stationary
	DIN	ADF(1)=SBC	98.4945	- 4.779	- 3.454	Stationary
		ADF(1)=AIC	104.0017	- 4.779	- 3.454	Stationary

Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP = spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015). The optimal lag used for ADF test statistic was selected based on minimizing Akaike Information Criterion (AIC)'s FPE using a range of lags. Schwarz Bayesian Criterion (SBC).H_0: Non-stationary; T-stat < CV: non-stationary; *, ** and *** denote significance at 10%, 5% and 1%

PHILLIPS-PERON (PP)

Panel A

	VARIABLE	T-STAT.	C.V.	RESULT
LEVEL FORM	LKL	- 2.405	- 3.468	Non-Stationary
	LSP	- 1.800	- 3.468	Non-Stationary
	LFU	- 1.587	- 3.468	Non-Stationary
	LCP	- 1.869	- 3.468	Non-Stationary
	LIP	- 7.397	- 3.468	Stationary
	LEX	- 5.125	- 3.468	Stationary
	LM2	- 1.840	- 3.468	Non-Stationary
	IN	- 2.176	- 3.468	Non-Stationary

Panel B

	VARIABLE	T-STAT.	C.V.	RESULT
FIRST DIFFERENCE	DKL	- 9.098	- 3.462	Stationary
	DSP	-10.457	- 3.462	Stationary
	DFU	-10.559	- 3.462	Stationary
	DCP	- 6.583	- 3.462	Stationary
	DIP	-37.461	- 3.462	Stationary
	DEX	-10.408	- 3.462	Stationary
	DM2	- 6.606	- 3.462	Stationary
	DIN	-10.751	- 3.462	Stationary

Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP = spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015). H_0: Non-stationary; T-stat < CV: non-stationary; *, ** and *** denote significance at 10%, 5% and 1%

KWIATKOWSKI, PHILLIPS, SCHMIDT, SHIN (KPSS)

Panel A

	VARIABLE	T-STAT.	C.V.	RESULT
LEVEL FORM	LKL	0.064	0.144	Stationary
	LSP	0.150	0.144	Non-Stationary
	LFU	0.148	0.144	Non-Stationary
	LCP	0.108	0.144	Stationary
	LIP	0.156	0.144	Non-Stationary
	LEX	0.155	0.144	Non-Stationary
	LM2	0.140	0.144	Stationary
	IN	0.123	0.144	Stationary

Panel B

	VARIABLE	T-STAT.	C.V.	RESULT
FIRST DIFFERENCE	DKL	0.078	0.144	Stationary
	DSP	0.065	0.144	Stationary
	DFU	0.072	0.144	Stationary
	DCP	0.100	0.144	Stationary
	DIP	0.095	0.144	Stationary
	DEX	0.143	0.144	Stationary
	DM2	0.086	0.144	Stationary
	DIN	0.089	0.144	Stationary

Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP =

spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015). H_0: Stationary; T-stat < CV: stationary; *, ** and *** denote significance at 10%, 5% and 1%

TABLE 2A: VAR LAG ORDER

Order	AIC	SBC	p-Value	C.V.
1	2048.9	2014.0	[.072]	5%

Note: select lag order with p>5% and highest AIC and SBC value

TABLE 2B: LAGRANGE MULTIPLIER TEST OF RESIDUAL SERIAL CORRELATION

VARIABLE	LM-STAT.	PROB.	RESULT
DKL	3.542	0.060	No Autocorrelation
DSP	0.437	0.509	Autocorrelation
DFU	1.539	0.215	Autocorrelation
DCP	0.118	0.731	Autocorrelation
DIP	16.761	0.000	No Autocorrelation
DEX	19.942	0.000	No Autocorrelation
DM2	5.963	0.015	No Autocorrelation
DIN	2.828	0.093	No Autocorrelation

Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP = spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015). H_0: No autocorrelation; p> 5%: no autocorrelation; *, ** and *** denote significance at 10%, 5% and 1%

TABLE 3: COINTEGRATION

JOHANSEN METHOD

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

Null	Alternative	Statistic	95% Critical Value	90% Critical Value	Result
r = 0	r = 1	97.851	55.140	52.080	4 cointegration
r<= 1	r = 2	52.625	49.320	46.540	
r<= 2	r = 3	49.506	43.610	40.760	
r<= 3	r = 4	44.782	37.860	35.040	
r<= 4	r = 5	36.016	31.790	29.130	

Cointegration LR Test Based on Trace of the Stochastic Matrix

Null	Alternative	Statistic	95% Critical Value	90% Critical Value	Result
r = 0	r>= 1	320.183	182.990	176.920	4 cointegration
r<= 1	r>= 2	222.332	147.270	141.820	
r<= 2	r>= 3	169.707	115.850	110.600	
r<= 3	r>= 4	120.201	87.170	82.880	
r<= 4	r>= 5	75.42	63.000	59.160	

Note: r indicates number of cointegrating relationships. Stat > 95% CV denote cointegration

TABLE 4: LONG RUN STRUCTURAL MODELLING (LRSM)

VARIABLE	EXACT ID	OVER ID #1	OVER ID #2	OVER ID #3	OVER ID #4	OVER ID #5	OVER ID#6	OVER ID #7	OVER ID #8
LKL	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)	(*NONE*)
LSP	.27927	0.00	-.22586	.37425	-1.0417	.27951	.22437	0.00	0.00
	(.77463)	(*NONE*)	(.14574)	(.85297)	(.51664)	(.73586)	(.48218)	(*NONE*)	(*NONE*)
LFU	-.48645	-.22946	0.00	-.56256	.61646	-.46669	-.45435	0.00	0.00
	(.72697)	(.13599)	(*NONE*)	(.80895)	(.51125)	(.68609)	(.45509)	(*NONE*)	(*NONE*)
LCP	1.3131	1.4895	1.3535	0.00	2.3129	1.7622	2.8133	0.00	0.00
	(3.1364)	(2.9178)	(2.9932)	(*NONE*)	(2.8196)	(2.7736)	(1.8639)	(*NONE*)	(*NONE*)
LIP	-6.4189*	-6.1186*	-6.1424*	-7.2020*	-5.7731*	-6.1542*	-2.7862*	-8.0559*	-5.5282
	(2.7229)	(2.3597)	(2.4532)	(2.5445)	(2.3547)	(2.4258)	(.54670)	(2.9829)	(3.1228)
LEX	2.2135	1.8561	1.6856	2.5593	0.00	2.0220	1.1430	2.7126*	0.00
	(1.3966)	(.82926)	(.93887)	(1.3695)	(*NONE*)	(1.2200)	(.66931)	(.80134)	(*NONE*)
LM2	.69298	.67464	.67373	.92332	.18986	0.00	-.31930	0.00	0.00
	(1.3143)	(1.2491)	(1.2547)	(1.3761)	(1.1885)	(*NONE*)	(.75306)	(*NONE*)	(*NONE*)
IN	.31700	.30204	.30771	.36573	.29121	.29587	0.00	.42938*	0.00
	(.17916)	(.16089)	(.16675)	(.17205)	(.16330)	(.15715)	(*NONE*)	(.20405)	(*NONE*)
CHSQ(1)	NONE	.14748[.701]	.53874[.463]	.13097[.709]	.59986[.014]	.32636[.568]	21.8982[.000]	NA	NA
CHSQ(4)	NA	NA	NA	NA	NA	NA	NA	2.2664[.687]	NA
CHSQ(6)	NA	NA	NA	NA	NA	NA	NA	NA	45.9618[.000]

SE in parentheses. Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP = spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015). *, ** and *** denote significance at 10%, 5% and 1%. T-test >2 denote significance of variable for exact identification. P>5% denote restriction is correct for over-identification.

TABLE 5: VECTOR ERROR CORRECTION MODEL (VECM)

ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLKL	-.012742	.011960	-1.0654[.289]	5%	Exogenous
dLSP	-.045116	.027673	-1.6303[.106]	5%	Exogenous
dLFU	-.052125	.026623	-1.9579[.053]	5%	Exogenous
dLCP	.0042899	.0014930	-2.8734[.005]*	5%	Endogenous
dLIP	.11200	.011390	9.8331[.000]*	5%	Endogenous
dLEX	-.0056743	.0071927	-.78890[.432]	5%	Exogenous
dLM2	.0052666	.0031123	1.6922[.093]	5%	Exogenous
dIN	.070435	.033580	2.0975[.038]*	5%	Endogenous

Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP = spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015). * denote significance at 5% P>5% denotes exogenous.

TABLE 6: VARIANCE DECOMPOSITIONS (VDC)

GENERALIZED APPROACH

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	54.5%	14.8%	11.7%	1.0%	6.3%	10.6%	1.0%	0.0%
	LSP	13.6%	42.4%	34.6%	0.0%	0.7%	6.2%	2.3%	0.3%
	LFU	11.7%	36.3%	45.3%	0.0%	2.1%	1.5%	2.8%	0.3%
	LCP	3.1%	0.1%	0.0%	85.7%	8.7%	0.0%	0.9%	1.6%
	LIP	5.8%	0.3%	0.3%	0.2%	70.9%	11.8%	0.2%	10.4%
12	LEX	13.0%	9.8%	2.2%	0.0%	1.6%	69.2%	0.1%	4.2%
months	LM2	0.9%	4.6%	4.9%	0.6%	1.0%	0.1%	87.8%	0.1%
	IN	0.0%	0.2%	0.3%	0.8%	5.7%	4.2%	0.3%	88.6%
	Exogeneity	54.50%	42.37%	45.32%	85.68%	70.92%	69.21%	87.84%	88.57%
	Ranking	6	8	7	3	4	5	2	1

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	54.5%	14.8%	11.6%	1.0%	6.5%	10.6%	1.0%	0.0%
	LSP	13.7%	42.3%	34.6%	0.0%	0.7%	6.2%	2.3%	0.3%
	LFU	11.7%	36.2%	45.2%	0.0%	2.2%	1.5%	2.8%	0.3%
	LCP	3.1%	0.1%	0.0%	85.2%	9.0%	0.0%	0.9%	1.6%
	LIP	5.7%	0.5%	0.4%	0.2%	57.8%	18.7%	0.2%	16.7%
24	LEX	12.9%	9.8%	2.2%	0.0%	1.6%	69.2%	0.1%	4.2%
months	LM2	0.9%	4.6%	4.9%	0.6%	1.1%	0.1%	87.8%	0.0%
	IN	0.0%	0.2%	0.3%	0.8%	5.9%	4.1%	0.3%	88.4%
	Exogeneity	54.46%	42.31%	45.24%	85.24%	57.76%	69.19%	87.83%	88.38%
	Ranking	6	8	7	3	5	4	2	1

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	54.4%	14.8%	11.6%	1.0%	6.5%	10.6%	1.0%	0.0%
	LSP	13.7%	42.3%	34.6%	0.0%	0.7%	6.2%	2.3%	0.3%
	LFU	11.7%	36.2%	45.2%	0.0%	2.2%	1.5%	2.8%	0.3%
	LCP	3.1%	0.1%	0.0%	85.1%	9.2%	0.0%	0.9%	1.6%
	LIP	5.6%	0.6%	0.4%	0.2%	48.9%	23.3%	0.1%	20.9%
36	LEX	12.9%	9.8%	2.2%	0.0%	1.7%	69.2%	0.1%	4.2%
months	LM2	0.9%	4.6%	4.9%	0.6%	1.1%	0.1%	87.8%	0.0%
	IN	0.0%	0.2%	0.3%	0.8%	6.0%	4.1%	0.3%	88.3%
	Exogeneity	54.45%	42.29%	45.21%	85.09%	48.95%	69.18%	87.83%	88.31%
	Ranking	5	8	7	3	6	4	2	1

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	54.4%	14.8%	11.6%	1.0%	6.5%	10.6%	1.0%	0.0%
	LSP	13.7%	42.3%	34.6%	0.0%	0.7%	6.2%	2.3%	0.3%
	LFU	11.7%	36.2%	45.2%	0.0%	2.2%	1.5%	2.8%	0.3%
	LCP	3.2%	0.1%	0.0%	85.0%	9.2%	0.0%	0.9%	1.6%
	LIP	5.5%	0.6%	0.5%	0.1%	42.6%	26.6%	0.1%	23.9%
48	LEX	12.9%	9.8%	2.2%	0.0%	1.7%	69.2%	0.1%	4.2%
months	LM2	0.9%	4.6%	4.9%	0.6%	1.1%	0.1%	87.8%	0.0%
	IN	0.0%	0.2%	0.3%	0.8%	6.0%	4.1%	0.3%	88.3%
	Exogeneity	54.44%	42.28%	45.20%	85.01%	42.63%	69.17%	87.83%	88.28%
	Ranking	5	8	6	3	7	4	2	1

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	54.4%	14.8%	11.6%	1.0%	6.5%	10.6%	1.0%	0.0%
	LSP	13.7%	42.3%	34.6%	0.0%	0.7%	6.2%	2.3%	0.3%
	LFU	11.7%	36.2%	45.2%	0.0%	2.3%	1.5%	2.8%	0.3%
	LCP	3.2%	0.1%	0.0%	85.0%	9.3%	0.0%	0.9%	1.6%
	LIP	5.5%	0.7%	0.5%	0.1%	37.9%	29.1%	0.1%	26.1%
60	LEX	12.9%	9.8%	2.2%	0.0%	1.7%	69.2%	0.1%	4.2%
months	LM2	0.9%	4.6%	4.9%	0.6%	1.1%	0.1%	87.8%	0.0%
	IN	0.0%	0.2%	0.3%	0.8%	6.1%	4.1%	0.3%	88.3%
	Exogeneity	54.44%	42.27%	45.19%	84.97%	37.89%	69.17%	87.83%	88.26%
	Ranking	5	7	6	3	8	4	2	1

ORTHOGONOLIZED APPROACH

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	99.06%	0.02%	0.01%	0.00%	0.87%	0.02%	0.00%	0.02%
	LSP	31.36%	66.43%	0.01%	0.00%	2.11%	0.04%	0.00%	0.05%
	LFU	24.85%	52.65%	19.38%	0.00%	2.98%	0.06%	0.00%	0.08%
	LCP	3.35%	2.05%	0.56%	87.71%	6.06%	0.11%	0.00%	0.16%
	LIP	5.33%	4.04%	5.50%	0.11%	56.21%	12.13%	0.01%	16.68%
12	LEX	18.62%	2.94%	13.20%	0.04%	3.41%	61.77%	0.00%	0.01%
months	LM2	1.02%	4.11%	0.51%	0.76%	1.15%	0.12%	92.27%	0.06%
	IN	0.02%	0.22%	0.09%	0.94%	7.15%	5.24%	0.05%	86.29%
	Exogeneity	99.06%	66.43%	19.38%	87.71%	56.21%	61.77%	92.27%	86.29%
	Ranking	1	5	8	3	7	6	2	4

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	99.02%	0.02%	0.01%	0.00%	0.92%	0.02%	0.00%	0.02%
	LSP	31.48%	66.20%	0.01%	0.00%	2.21%	0.04%	0.00%	0.06%
	LFU	24.97%	52.38%	19.39%	0.00%	3.12%	0.06%	0.00%	0.08%
	LCP	3.41%	2.08%	0.57%	87.32%	6.33%	0.12%	0.00%	0.16%
	LIP	4.78%	4.14%	7.02%	0.16%	41.26%	17.95%	0.01%	24.68%
24	LEX	18.56%	2.96%	13.22%	0.04%	3.51%	61.70%	0.00%	0.01%
months	LM2	0.98%	4.15%	0.50%	0.76%	1.20%	0.13%	92.22%	0.06%
	IN	0.02%	0.20%	0.09%	0.93%	7.42%	5.17%	0.05%	86.12%
	Exogeneity	99.02%	66.20%	19.39%	87.32%	41.26%	61.70%	92.22%	86.12%
	Ranking	1	5	8	3	7	6	2	4

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	99.00%	0.02%	0.01%	0.00%	0.93%	0.02%	0.00%	0.02%
	LSP	31.52%	66.11%	0.01%	0.00%	2.25%	0.04%	0.00%	0.06%
	LFU	25.01%	52.28%	19.39%	0.00%	3.17%	0.06%	0.00%	0.08%
	LCP	3.43%	2.09%	0.57%	87.19%	6.43%	0.12%	0.00%	0.17%
	LIP	4.46%	4.19%	7.90%	0.19%	32.60%	21.32%	0.02%	29.32%
36	LEX	18.54%	2.97%	13.23%	0.04%	3.54%	61.68%	0.00%	0.01%
months	LM2	0.97%	4.16%	0.50%	0.76%	1.22%	0.13%	92.20%	0.06%
	IN	0.02%	0.20%	0.09%	0.93%	7.51%	5.14%	0.05%	86.06%
	Exogeneity	99.00%	66.11%	19.39%	87.19%	32.60%	61.68%	92.20%	86.06%
	Ranking	1	5	8	3	7	6	2	4

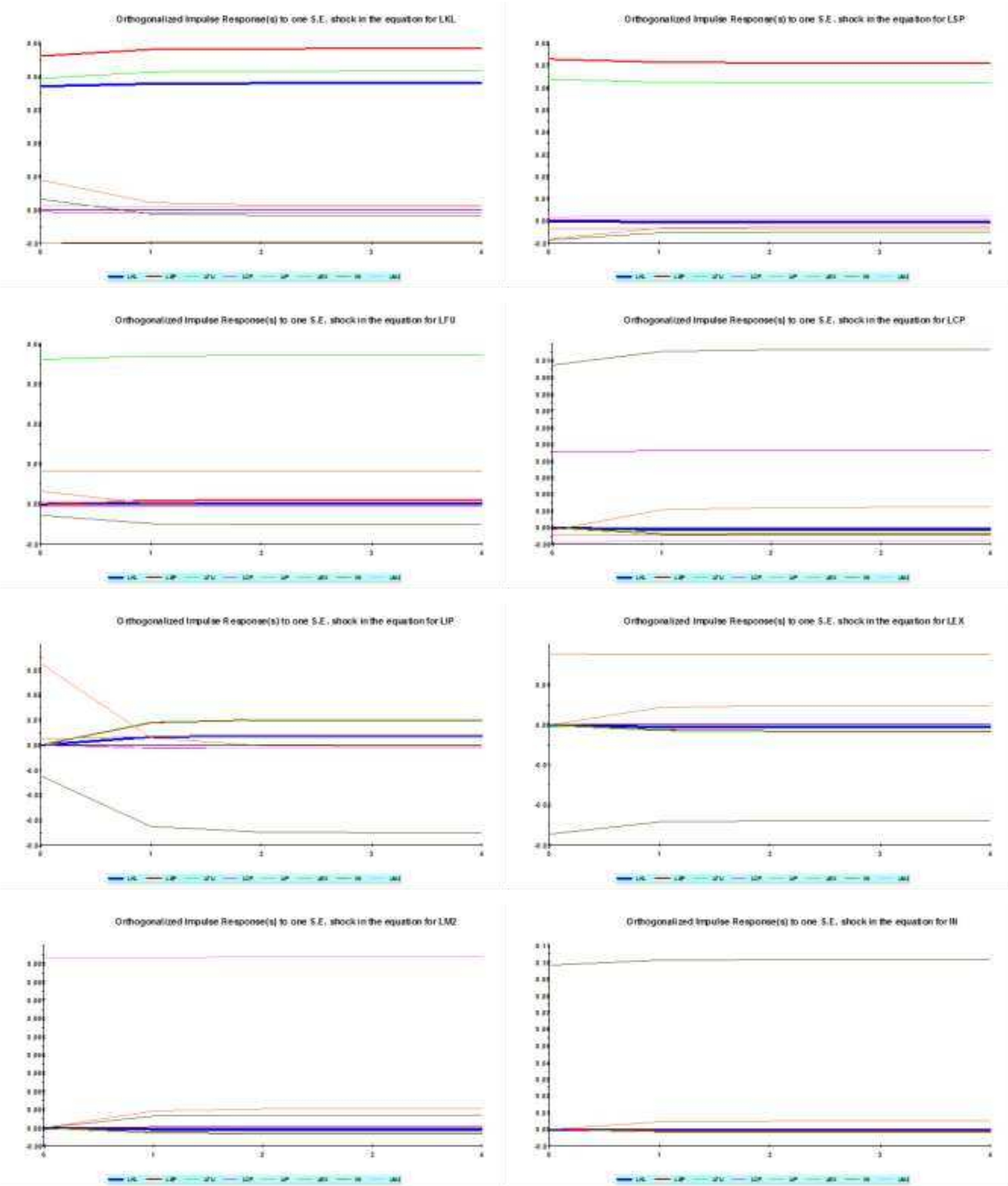
Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	98.99%	0.02%	0.01%	0.00%	0.94%	0.02%	0.00%	0.02%
	LSP	31.55%	66.07%	0.01%	0.00%	2.27%	0.04%	0.00%	0.06%
	LFU	25.03%	52.23%	19.40%	0.00%	3.20%	0.06%	0.00%	0.08%
	LCP	3.44%	2.10%	0.57%	87.12%	6.48%	0.12%	0.00%	0.17%
	LIP	4.25%	4.23%	8.47%	0.21%	26.95%	23.52%	0.02%	32.35%
48	LEX	18.53%	2.97%	13.23%	0.04%	3.56%	61.67%	0.00%	0.01%
months	LM2	0.97%	4.17%	0.50%	0.76%	1.23%	0.13%	92.19%	0.06%
	IN	0.02%	0.19%	0.09%	0.93%	7.55%	5.13%	0.05%	86.03%
	Exogeneity	98.99%	66.07%	19.40%	87.12%	26.95%	61.67%	92.19%	86.03%
	Ranking	1	5	8	3	7	6	2	4

Horizon	Variable	LKL	LSP	LFU	LCP	LIP	LEX	LM2	IN
	LKL	98.99%	0.02%	0.01%	0.00%	0.94%	0.02%	0.00%	0.02%
	LSP	31.56%	66.05%	0.01%	0.00%	2.28%	0.04%	0.00%	0.06%
	LFU	25.04%	52.20%	19.40%	0.00%	3.21%	0.06%	0.00%	0.08%
	LCP	3.45%	2.10%	0.57%	87.08%	6.51%	0.12%	0.00%	0.17%
	LIP	4.10%	4.25%	8.88%	0.22%	22.98%	25.07%	0.02%	34.48%
60	LEX	18.52%	2.97%	13.23%	0.04%	3.57%	61.66%	0.00%	0.01%
months	LM2	0.96%	4.17%	0.50%	0.76%	1.23%	0.13%	92.19%	0.06%
	IN	0.02%	0.19%	0.09%	0.93%	7.58%	5.12%	0.05%	86.01%
	Exogeneity	98.99%	66.05%	19.40%	87.08%	22.98%	61.66%	92.19%	86.01%
	Ranking	1	5	8	3	7	6	2	4

Note: Definitions: KL = Bursa Malaysia Kuala Lumpur Composite Index; IP = real industrial production index; CP = consumer price index; M2 = broad-based monetary aggregate; EX = bilateral exchange rate (US$); SP = spot price of palm oil; FU = palm oil futures price. N=123 (2005-2015).

TABLE 7: IMPULSE RESPONSE FUNCTIONS (IRF)

ORTHONOGONALISED



GENERALISED

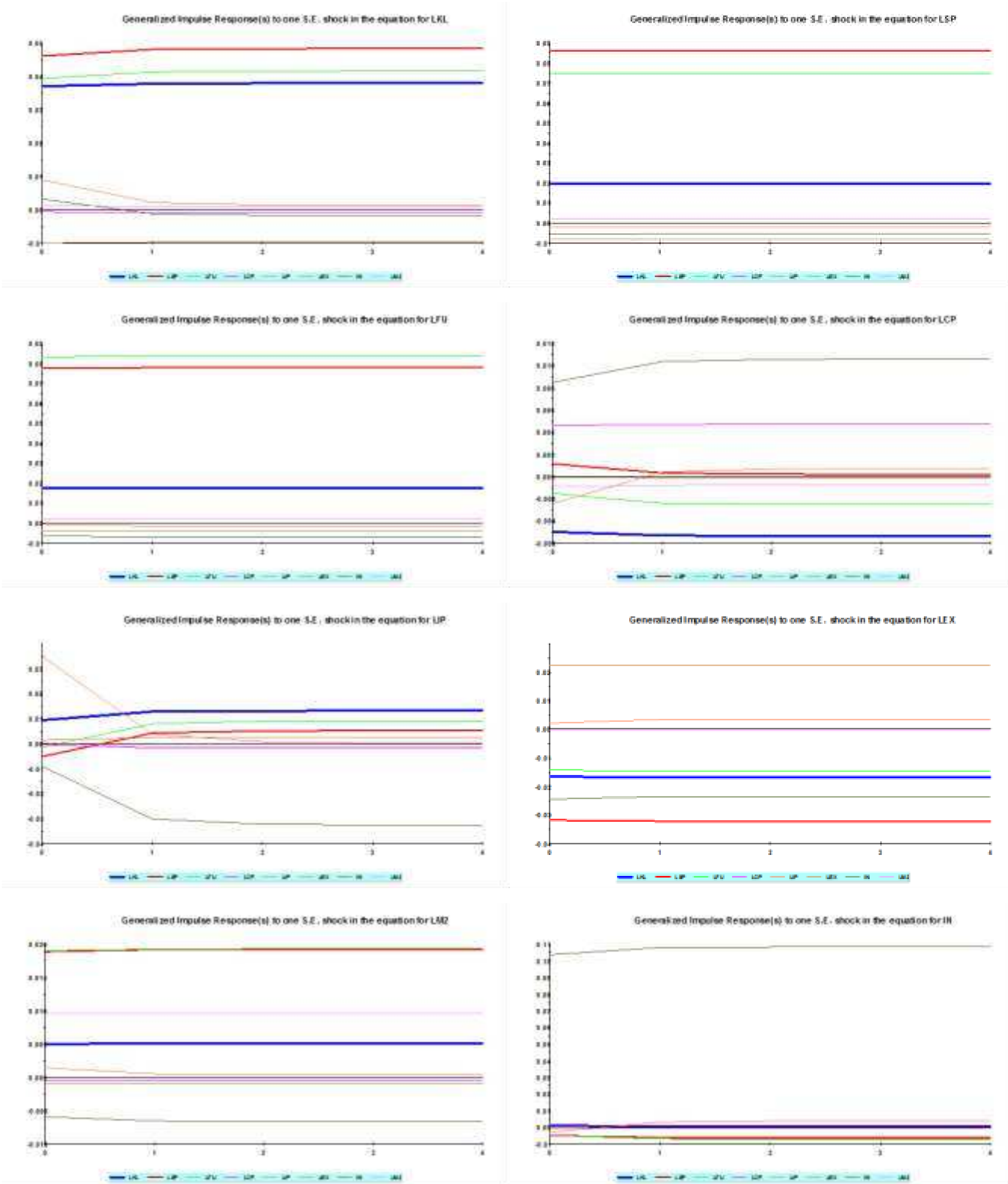
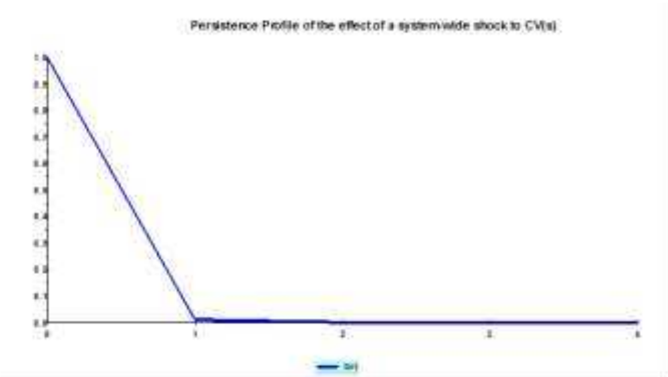


TABLE 8: PERSISTENCE PROFILE (PP)


Persistence Profile of the effect of a system wide shock to CV(s)