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Investigating the Effect of Energy Price on Food Price Inflation in Three Asian Countries

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Abstract

The rising of energy prices resulting from the turmoil in the Middle East may be responsible for the recent food price inflation in the world, which may occur through transmission mechanism. This study investigates the effect of energy prices on food price inflation in three Asian countries, namely, China, Philippine, and Vietnam using monthly data from 2002:M01 to 2020:M12. Employing the Panel Vector Autoregressive (PVAR) model with Impulse Response Functions (IRFs), the results provided that shocks in energy prices and economic growth have a positive and significant effect on food price inflation while shocks in exchange rate and agricultural production have a negative but insignificant effect on food prices inflation. The PVAR causality results revealed that economic growth is a predictor of food price inflation, energy prices, exchange rate, and agricultural production. Also, a causality runs from economic growth and exchange rate to energy prices and again, from economic growth to exchange rate and agricultural production. This implies that a feedback effect is found between economic growth and exchange rate as well as economic growth and agricultural production. Therefore, the study recommended the need to stabilize energy prices through effect energy policies in Asian countries.

Keywords: Food prices inflation, Energy prices, Food insecurity, Economic growth

JEL classification: O15, M51

1. Introduction

Due to the importance of energy and food commodities in our daily activities in an economy, it is considered as a valuable natural resource which enhance economic sustainability for human

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development. Energy particularly crude oil, electricity, biofuel, ethanol, biomass, uranium, water and coal stand as the road map for economic transformation, promote factor of production in the area of agriculture, tourism, industry (infrastructure), and households. Energy market and food security encompasses a resource that provide services for human capital sustainability, zero hunger in the world and growth to economy through efficiency (FAO, 2010).

Let us recall from the crude oil embargo in 1970s that happened between Iran, Israel, and OPEC nations, which made some of the Arab crude oil producing nations to put a banned on the supply of crude oil to U.S., Netherlands and Portugal, and due to the restriction of crude oil export to U.S. and other developed nations, it has resulted to a global challenges that create shock and irregularities in the prices of energy market (crude oil and electricity) and agricultural sector (food commodities), (Taghizadeh-Hesary et al. (2013). Some studies have identified that sudden increase in the prices of crude oil and electricity may enhance to recession, food insecurity and economic transformation, yet still causes starvation or poverty through the rise in the prices of food commodities like maize, grain, wheat, rice, groundnut oil which may result to a decline in the aggregate demand and aggregate supply function of an economy. Considering the study outcome of Hamilton (1983), it is wrap up that all economic depression such as high unemployment rate, GDP contraction, poverty, food insecurity, hunger in some part of the developed nations and developing countries, like U.S. has occurred due to increase in prices of energy market (crude oil, electricity) and agricultural sector (food commodities). It is considered that crude oil price shocks possess a high significant reaction on agricultural products prices, which may enhance sudden increase in the prices of food system, and sometime result to sustainability, and food insecurity in an economy, using European economic as an illustration (Cunado and Gracia (2013).

Current studies identified that the prices of WTI crude oil and Brent crude oil have a stimulus on China economies and may enhanced to inflation significantly on the prices of staple foods using Panel VAR model. In a current study, two economies were examined to conduct the sequel of crude oil prices movement with agricultural commodities prices over time at macro-economy level on two parameters, such as GDP growth rate and food prices index (FCPI), and the result show a lessen stimulus on the GDP of a developing economy (the People of China), while the economic growth rate show a calmness on the developed economies (U.S. and Japan) (Taghizadeh-Hesary and Yoshino (2015).

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The indicator to hyperinflation of food commodities prices in the two economies, namely as developed nations and vulnerable nations can either be traced through natural disaster, error in population growth, climate change and inflation in energy market prices, like sudden hike in crude oil prices, electricity prices which may also be influence by agricultural products - maize, sugarcane, starch and due to the role they contributed to both ethanol oil for tourism services and food crops for consumable foods, like rice, corn, wheat, grains. If the prices of purchasing energy market is high, it may result to a sudden increase in the price of agricultural market, because maize is a staple food commodity that is use for both energy market (biofuel, ethanol) and food market (maize for cereal and boil corn).

Purpose and the Aim of the Study

The purpose of this research is to examine the effects of energy prices on food price inflation by controlling for economic growth, exchange rate, and agricultural production in three selected Asian countries (China, Philippine, and Vietnam) over the period 2002:M01 to 2020:M12. The choice of the countries is based on the data availability. Therefore, this study contributes to the existing literature in several ways: First, the study investigates the effect of energy prices on food price inflation in Asian countries, which is the largest energy producer and consumer in the world. Second, the study uses the panel VAR method, which can address the empirical issue of simultaneous bias by using impulse response functions to examine how other variables with the panel VAR system respond to the shocks in impulse variable over time. Finally, the study uses Panel VAR Granger causality to examine the causal relationship between the variables, which can be used by policy makers to formulate appropriate policies to mitigate the energy price effect of food price inflation in the Asian region.

The remaining part of this study is structured as follows: Section 2 categorically reviews the related literature. Section 3 describes the data and methodology employed in this study. Section 4 presents and analyses the empirical results as well as discussing these results. Section 5 provides concluding remarks with policy recommendations.

2. Literature Review

The interdependence of natural resources (crude oil, biofuel, ethanol) with agricultural products (maize, soybean, sugar cane) have played an essential role in our daily consumption, which result to a great necessity for every economy to focus their priority on it for sustainability.

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Multiple scholars according to their finding and result, identified that sudden increase in the prices of natural resources (crude oil, biofuel) was among the major element that contributed a shocks occurrence in the agricultural sector in an economy (Abbot, Tyner, Hurt 2008), (Baffes 2007, Balcombe and Rapsomanikis 2008), (Chang and Su 2010), (Yang et al. 2008) (Mitchell 2008), (Rosegrant et al. 2008). In comparison, a number of scholars has identified by their experiment and results, no straight correlation between crude oil prices and agricultural commodities prices (Zang et al. 2010), and sudden increase in the prices of crude oil does not support increase to food commodities prices (maize or sugarcane). It was investigated using elasticity of demand and supply theory, that the correlation of cotton, wheat, gold, copper, petroleum oil, cocoa, and lumber prices result to zero, Rotemberg and Pindyck (1990).

2.1 Starvation Versus Food Security

Starvation is a demerit factor to good health. Some scholars and FAO report 2010s have identified a plan to resurface or recover the global economy from starvation, poverty, food insecurity, terrorism, and environmental crisis like climate change, flooding. Besides, it is accounted by FAO report that global food reserve is higher than the number of human being population in the world, yet poverty, starvation, and hyperinflation in the staple foods still high in the blink of the developing nations and developed nations (Gustavsson et. al., 2011).

The objective of Food and Agriculture Organization (FAO, 2022) with support from IFAD, UNICEF, WFP is to enhance proper administration of food security and to end starvation in the world before 2030. Due to the emergence of covid-19 in 2020 and other economy factor from global Government institutions, it results to low level for FAO to achieve food security, and end starvation in the world, which increase the number of people with starvation or hunger in the world from 7.9% to 8.93% in 2019 to 2020 and rise at a lower point in 2021 to 9.8%.

2.2 The Volatility between Energy Prices and Agricultural Food Prices

According to this thesis, the volatility correlation between crude oil prices and staple food prices in some of the regions in Asia. Currently from 2015 to 2014, it was recorded that some parts of developing countries, like Asia reduce inflation from 2.2% to 3.0%. During the process of fall in inflation in the Asia region, it results to economic depression, and caused cost inflation on the demand side. In the supply side it caused decline to global crude oil market and food cost, and result to inflation. In 2015, Brent crude oil prices drop to average which result to $52 per barrel in 2015 from 99$ per barrel in 2014. Besides, agricultural products experienced a fall in

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total prices to 13%, which result to credit crunch economies and food costs 15.4% as an outcome from supply side effect due to volatility in energy prices. The supply side effect has contributed to a fall in prices, in connection to demand side assistance.

3. Data and Methodology

3.1 Data

For the purpose of this study, the study uses data based on five (5) variables, namely; food customer price inflation, energy price, GDP, exchange rate, agriculture crop production from 2002:M01 to 2020:M12. The Asian countries selected are China, Philippines, and Vietnam based on data availability. The food price inflation is a new index computed by the World Bank, which is obtained from the website of the World Bank. All the remaining variables are obtained from the World Development Indicators. Therefore, Table 1 presents the variables used and their measurements, including their sources.

Table 1: Variable Measurement and Source

Variable	Measurement	Source
Food Price Inflation FCPI	Food price index	World Bank
Energy Price	Energy price index	World Development Indicators
GDP	Gross Domestic Product (Constant 2002 in USD)	World Development Indicators
Exchange Rate	Official exchange rate in a domestic currency measured in current USD	World Development Indicators
Agriculture Crop Production	The crop production index (2004-2006=100) shows an index of all crops for each year relative to the base period 2004-2006 excluding fodder crops.	World Development Indicators

Source: compilation from Author’s

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3.2 Panel VAR Model Specification

In this study we identify the model function to examine the relationship between energy prices and food price inflation in Asian countries by incorporating other control variables such as exchange rate and agricultural production as follows:

FCPI= f (EPR, GDP, EXCH, AGPR) Equation (1)

EPR= f (FCPI, GDP, EXCH, AGPR) Equation (2)

GDP = f (FCPI, EPR, EXCH, AGPR) Equation (3)

EXCH = f (FCPI, EPR, GDP, AGPR) Equation (4)

AGPR = f (FCPI, EPR, GDP, EXCH) Equation (5)

FCPI = Food inflation

EPR = Energy price

GDP = Real output growth

EXCH = Exchange rate through interest rate

AGPR = Crops production

The short form to write Panel VAR model in a mathematical language is

$$Y_{i,t} = \alpha_i + \Gamma(L) Y_{i,t} + \varepsilon_{i,t} \quad \text{Equation (6)}$$

Where i(i=1, N) represent the country; t (t = 1, T) represent time; Y represent the endogenous stationarity variable; Γ(L) denotes the matrix polynomial sign in the lag operator *L*; α_i represent the vector of country-fixed effects $\varepsilon_{i,t}$ is a vector of error terms.

4. Data Analysis and Discussion

4.1 Descriptive Statistics

Table 2 provides the descriptive statistics of all the variables used in this study in their natural logarithm form. The mean of GDP is the largest with a value of 8.051975. The second variable with the largest mean is exchange rate while the Food CPI is the smallest with a value of 4.240954. The maximum value among the variables is that of exchange rate, which is 10.05280 while agricultural production has the smallest maximum value of 4.666802. For the minimum, exchange rate has the smallest minimum number while GDP has the largest minimum number. Furthermore, the exchange rate seems to be the only most volatile series among all variables employed. While food CPI and EPR variables are negatively skewed, the remaining variables

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have a positive skewness, and they are all close to zero. Also, the Kurtosis of the variables employed are all positive with evidence of excess kurtosis for the case of EPR while exchange rate and agricultural production have values that are less than normal value. Therefore, the Jarque-Bera statistic for all variables are large, rejecting the null hypothesis of normal distribution of series.

Table 2: Descriptive Statistics

	LNFCPI	LNEPR	LNGDP	LNEXH	LNAGPR
Mean	4.240954	4.410863	8.051975	5.226132	4.491251
Median	4.357990	4.525586	7.938361	3.869783	4.544174
Maximum	4.900076	4.750136	9.247053	10.05280	4.666802
Minimum	3.153590	3.440418	7.142127	1.813824	4.171825
Std. Dev.	0.425671	0.316230	0.538635	3.367905	0.143347
Skewness	-0.803850	-1.477955	0.722375	0.537713	-0.622759
Kurtosis	2.821911	4.499819	2.660630	1.506253	2.105807
Jarque-Bera	74.56788	313.1255	62.77045	96.55284	67.00062
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	2900.813	3017.030	5507.551	3574.674	3072.015
Sum Sq. Dev.	123.7570	68.30095	198.1570	7747.122	14.03455
Observations	684	684	684	684	684

4.2 Results of Unit Root Tests

In other to check the stationarity property of the series employed in this study, we apply a series of panel unit root tests such as Levin-Lin-Chu unit root test, Im-Pesaran-Shin W-stat unit root test, ADF – Fisher Chi-square unit root test, and the PP – Fisher Chi-square unit root test. The results as shown in Table 2. The results suggest that all the series are not stationary in their levels; however, after taking their first differences, it is observed that the variables are all stationary. These results imply that the variables are all integrated of order one, I (1). This means that the analysis of this study will be based on the first difference variables.

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Table 3: Panel VAR Unit Root Result

Variable	Unit Root Tests	At Level		At First Difference	
		Statistic	**P-value**	**Statistic**	**P-value**
lnFCPI	Levin-Lin-Chu	-2.00585	0.0224	-5.19898**	0.0000
	Im-Pesaran-Shin W-stat	0.72068	0.7644	-8.73083***	0.0000
	ADF - Fisher Chi-square	2.52764	0.8654	88.7963***	0.0000
	PP - Fisher Chi-square	2.53470	0.8646	194.372***	0.0000
InEPR	Levin-Lin-Chu	1.28462	0.9005	-7.58856***	0.0000i
	Im-Pesaran-Shin W-stat	2.71061	0.9966	-8.51288***	0.0000
	ADF - Fisher Chi-square	0.51571	0.9976	76.5367***	0.0000
	PP - Fisher Chi-square	0.18606	0.9999	186.313***	0.0000
InGDP	Levin-Lin-Chu	3.83171	0.9999	-12.3573***	0.0000
	Im-Pesaran-Shin W-stat	3.52280	0.9998	-14.0986***	0.0000
	ADF - Fisher Chi-square	0.82051	0.9915	172.511***	0.0000
	PP - Fisher Chi-square	0.10449	1.0000	117.170***	0.0000
lnEXH	Levin-Lin-Chu	-1.61042	0.0537	-0.81877***	0.2065
	Im-Pesaran-Shin W-stat	-0.25702	0.3986	-1.32956***	0.0918
	ADF - Fisher Chi-square	5.15714	0.5238	9.53446***	0.1457
	PP - Fisher Chi-square	2.55519	0.8622	152.050***	0.0000
lnAGPR	Levin-Lin-Chu	0.42947	0.6662	-4.14430***	0.0000

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Im-Pesaran-Shin W-stat	1.44357	0.9256	-4.17529***	0.0000
ADF - Fisher Chi-square	1.99208	0.9204	28.8862***	0.0001
PP - Fisher Chi-square	0.80143	0.9920	226.701***	0.0000

Note: and denote 1% and 4% is the significance levels. The result is compiled by the researcher from the EVIEW 12

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4.3 Impulse-response functions (IRFs) results

Due to the inaccurate estimation outputs of the Panel VAR, Sim (1980) suggested that the impulse-response function (IRFs) have to be used.[1] This is because, IRFs provide adequate estimates of panel VAR model for policy analysis. Therefore, Figure 1 provides the responses of all the variables to a shock in food price inflation in the selected countries of Asia. As can be seen, the response of lnFCPI to own shock is positive and statistically significant across the horizon. This means that a 1% standard deviation shock in food price inflation causes food price inflation to rise in the countries studied. The study also finds evidence of a positive response of energy prices to a shock in food prices, while a shock in food price causes a negative and significant response in economic growth. In addition, the response of exchange rate is positive and significant. This indicates that as food prices is increasing exchange rate is rising as well. Note that a rise in exchange rate implies depreciation of domestic currency. Finally, the response of agricultural production to a shock in food prices is positive and insignificant. This crosses to the negative region after the second horizon.

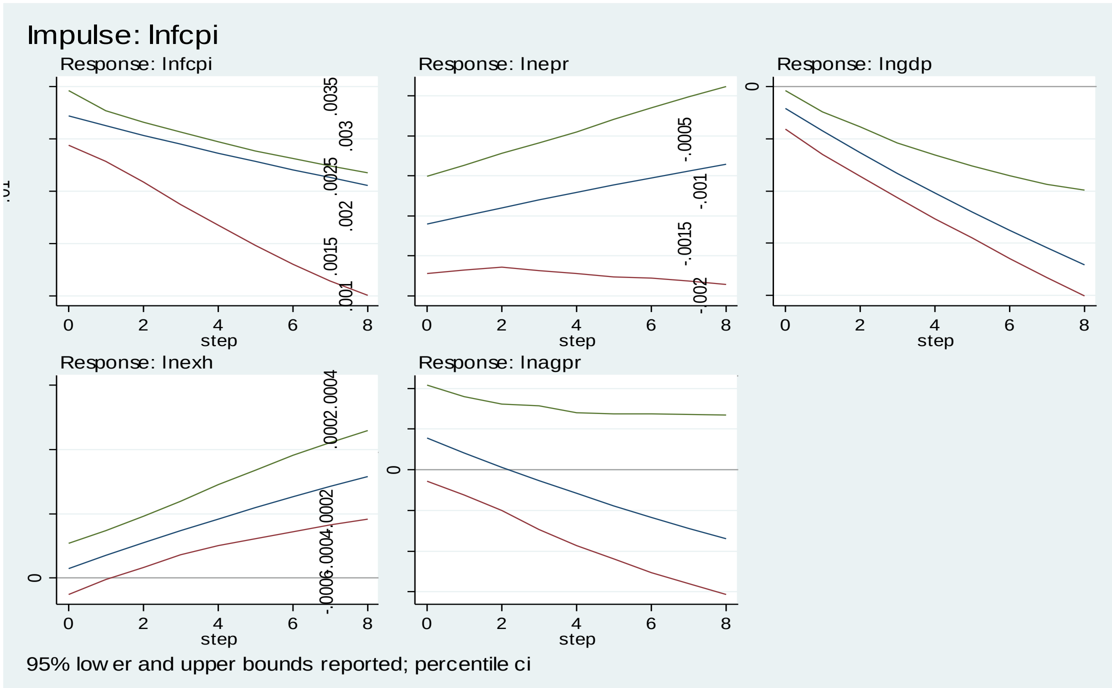

Figure 1: Shock to food price inflation

[1] For brevity, we did not report the results of the Panel VAR estimates since it is inaccurate and unreliable

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Figure 2 reports the responses of food prices, economic growth, exchange rate, agricultural productions, and own shock to the shock in energy prices. The result show that food prices is positively and significant related to a shock in energy prices. The effects of own shock and economic growth as well as agricultural production are positive and statistically significant. This implies that a shock in energy prices causes food prices, economic growth, and agricultural production to rise significantly. However, the effect of shock in energy price to exchange rate is negative and significant. This implies that as energy prices change, agricultural production would reduce significantly.

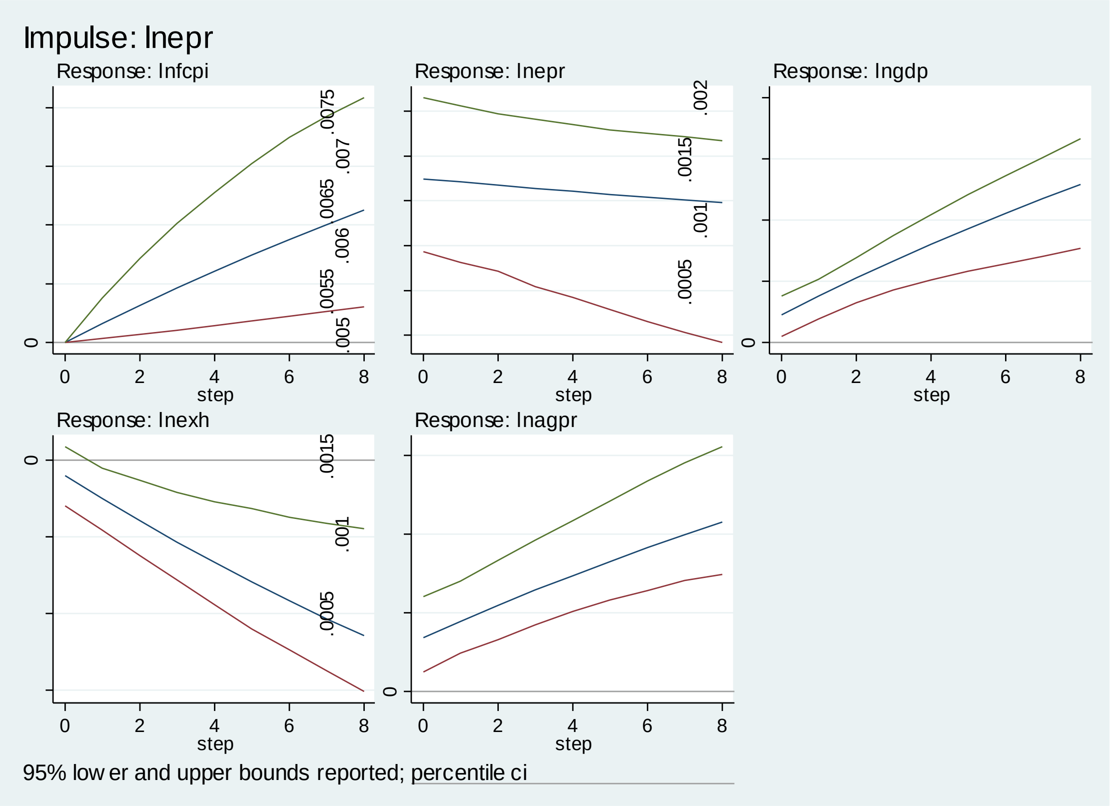

Figure 2: Shock to energy prices

Figure 3 presents the graph of the impulse-response functions of the variables in the panel VAR model. As we can see, the response of food prices to a shock in GDP is positive and significant. Equally, the response of GDP to own shock is also positive and significant. However, the effects of energy prices, exchange rate, and agricultural production are not significant with the effect of agricultural production having a negative sign.

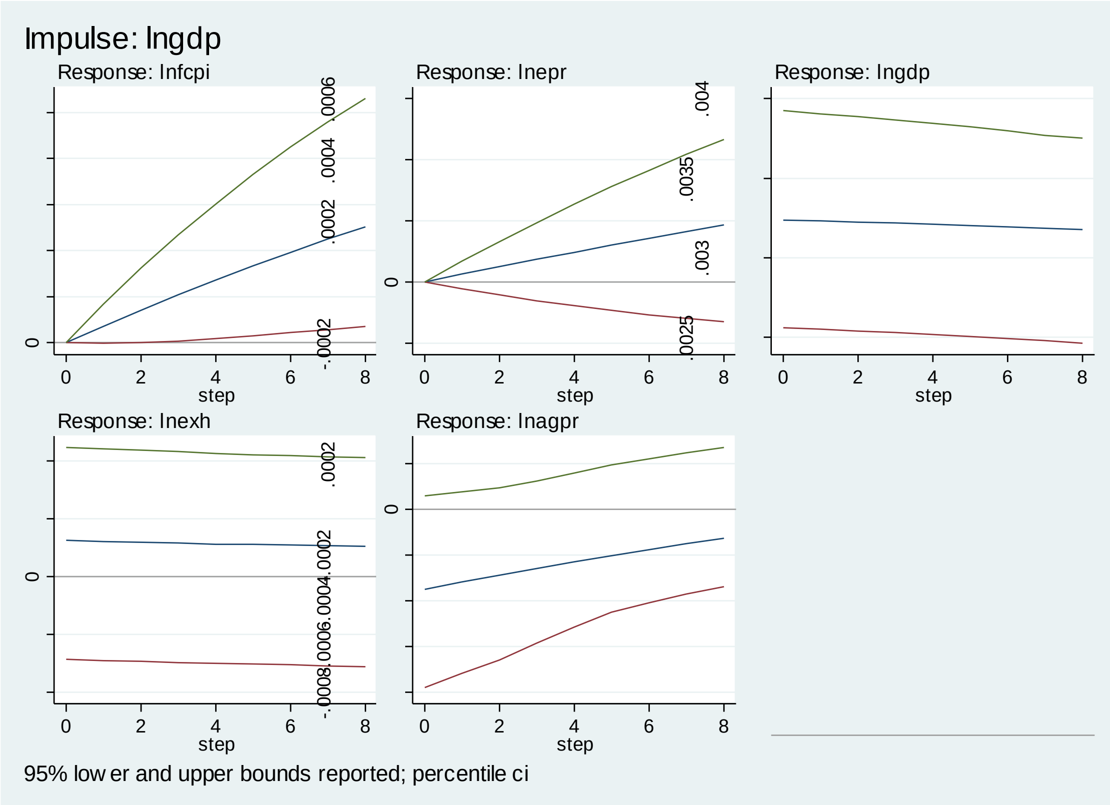

Figure 3: Shock to GDP

Figure 4 presents the impulse-response graph of the variables in the panel VAR system. Particularly, the Figure show how a shock to exchange rate causes food prices, energy prices, economic growth, exchange rate itself, and agricultural production to change over time. The effect of food prices is negative and statistically insignificant. Also, energy prices respond a small manner to the shock in exchange rate, which is insignificant. The response of economic growth captured by GDP is also negative and statistically insignificant. The response of agricultural production is negative but only significant after the 4th horizon. Finally, the effect of own shock is positive and highly significant. This implies that exchange rate changes are determined mostly by own shock.

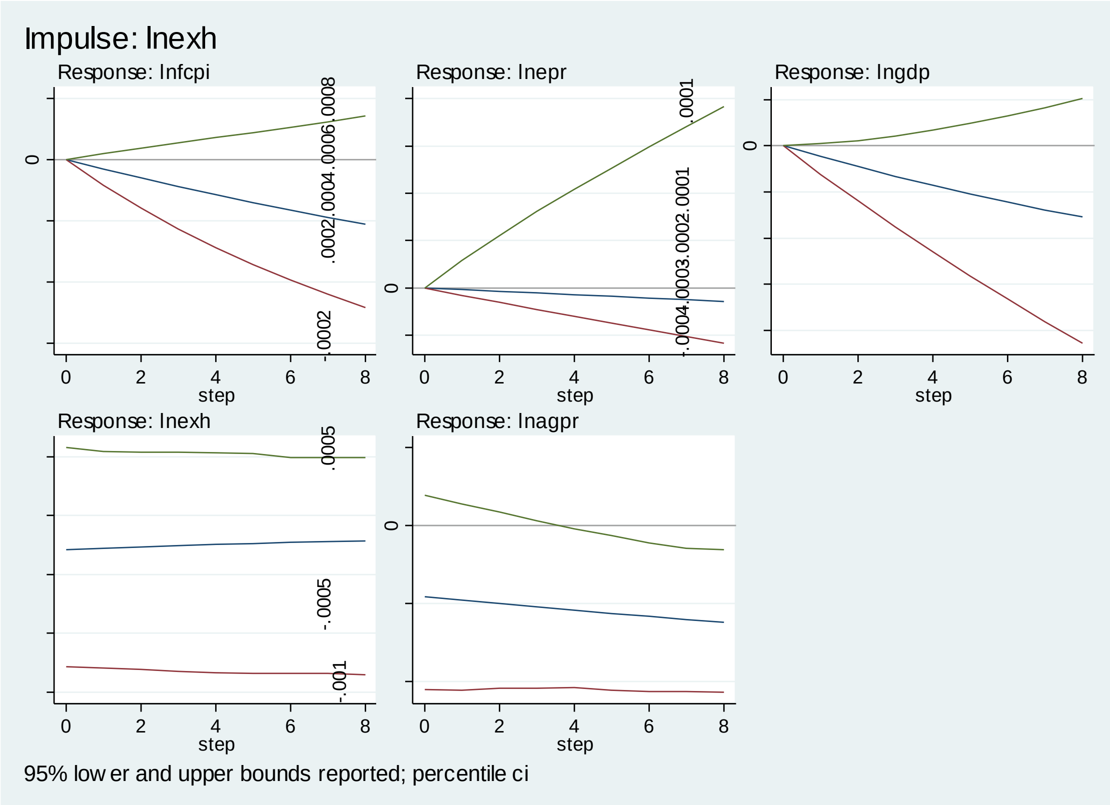

Figure 4: Shock to exchange rate

Figure 5 reports the results of the effect of a change in agricultural production on food prices, energy prices, economic growth, exchange rate, and agricultural production itself. We observe that the effect of a shock in agricultural production causes food price inflation and energy prices to decrease but this decrease is not statistically significant over the study period. The response of economic growth is positive and equally not significant. For exchange rate, the effect is not noticeable and also insignificant. The effect of own shock is positive and statistically significant. This implies that agricultural production responds wholly to own shock than any other shock in the system.

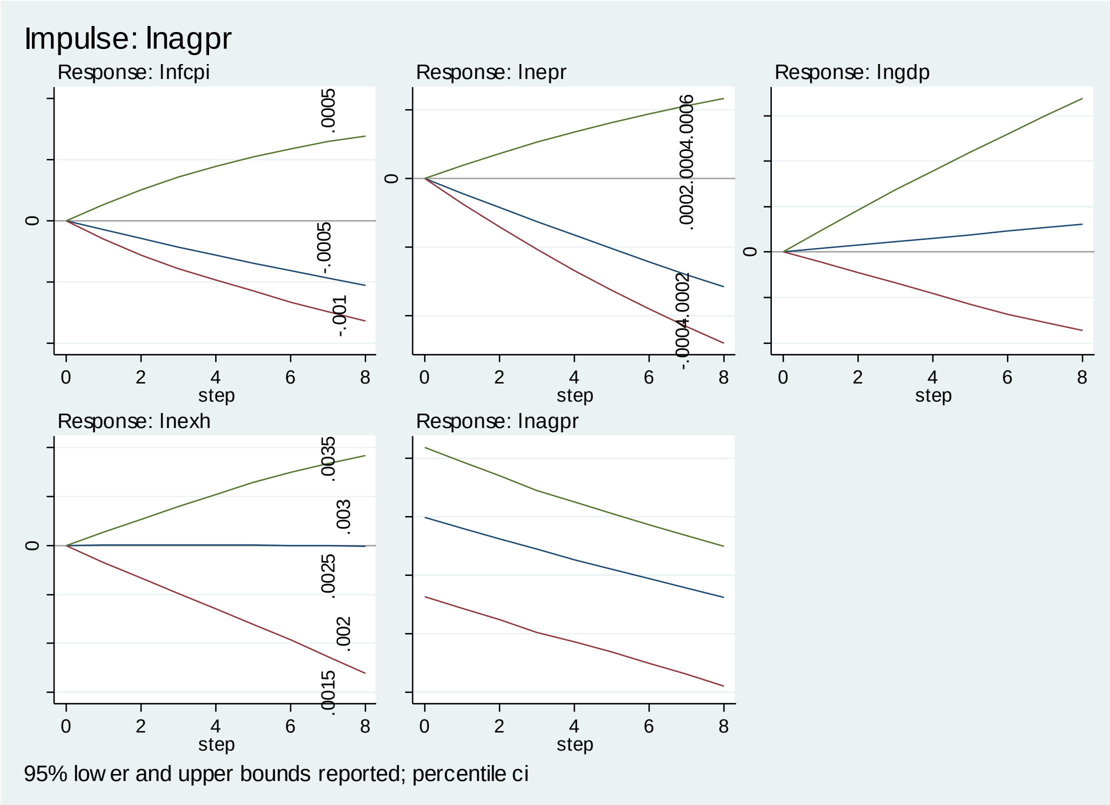

Figure 5: Shock to agricultural production

4.4 Results of Panel Granger Causality Test

Table 4 presents the results of the panel Granger causality test. The results show that there is no Granger causality running between food price inflation and energy price, economic growth, exchange rate, and agricultural production. In other words, energy prices, economic growth, exchange rate, and agricultural production are not a good predictor of food price inflation in the selected countries of Vietnam, China and Philippine. The results further show that food price, economic growth, exchange rate are predictors of energy prices. This implies that there is only a causality running from food prices and economic growth to energy prices in the selected countries. However, overall, the causal relationship is also significant. Furthermore, the results reveal that food price inflation, economic growth, exchange rate, and agricultural production are a good predictor of economic growth. In other words, there is a causal relationship running from all the variables controlled for in the model to economic growth in the selected countries.

Table 4: Results of Panel VAR (1) Granger Causality Test

Equation	Excluded	Test Statistic	dF	p-value
LnFCPI.	LnEPR	0.820	1	0.365
	LnGDP	0.251	1	0.616
	LnEXH	0.021	1	0.804
	LnAGPR	1.432	1	0.231
	ALL	6.798	4	0.147
LnEPR	LnFCPI	1.623	1	0.203
	LnGDP	3.231*	1	0.072
	LnEXH	7.419**	1	0.006
	LnAGPR	0.014	1	0.747
	ALL	13.046**	4	0.011
LnGDP	LnFCPI	12.458***	1	0.000
	LnEPR	6.405**	1	0.011
	LnEXH	24.522***	1	0.000
	LnAGPR	13.542***	1	0.000
	ALL	57.350***	4	0.000
LnEXH	LnFCPI	0.042	1	0.838
	LnEPR	0.000	1	1.000
	LnGDP	3.555*	1	0.059
	LnAGPR	1.211	1	0.271
	ALL	64.660***	4	0.000
LnAGPR	LnFCPI	1.338	1	0.247
	LnEPR	0.846	1	0.358
	LnGDP	3.077*	1	0.079
	LnEXH	1.686	1	0.194
	ALL	9.730*	4	0.045

Note: ***, ** and * signify rejection of the null hypothesis at 1%, 5%, and 10 % level of significance

4.5 Conclusion and Policy Recommendations

This study primarily aims to examine the effects of energy prices on food price inflation in three economies of Asian countries, namely: Vietnam, China, and Philippines over the period 2002:M1 to 2020:M12. The study further incorporates the effects of other variables such as economic growth, exchange rates, and agricultural production on food price inflation. The results suggested that energy prices and economic growth increase food price inflation while exchange rate and agricultural production reduce food price inflation but such reduction is not statistically significant. On the basis of panel Granger causality test, our result revealed that economic growth is a good predictor of energy prices, exchange rate, and agricultural production. Also, the study found that exchange rate causes energy prices, food price inflation and energy prices cause economic growth, while exchange rate and agricultural production predict economic growth.

Based on the findings of this study, the following policy recommendations are carefully and adroitly made to address food price inflation in the selected countries:

(i) There is the need to boost agricultural production in these countries to stabilize food prices and hence reduce inflation. This can be achieved by providing incentives such as tax rate reduction in agricultural sector for the famers to subsidize the agricultural outputs.

(ii) Government and policy makers should be encouraged to promote stable energy prices, particularly energy products that are used in the cultivation of food commodities. For example, the price of energy like crude oil, electricity should be regulated to achieve a low and affordable price by the consumers. This will help to boost agricultural production, which will enhance exports of the countries.

(iii) Given the increasing food price inflation, there is need to have a stable growing and accelerating economic growth as a panacea to regulate prices of food in the countries. Once economic growth is achieved, it stimulates agricultural commodities and effective demand for these commodities.

(iv) Government and policy makers should ensure that there is stability of exchange rate in these countries. Once exchange rate is not stable, it affects firms and households' decisions on production and consumption of good and services.

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