How are Relationships between Export, Inflation, and Exchange Rate? The Case of Pangasius in Vietnam

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ABSTRACT

Vector Autogressive Model (VAR), variance decomposition, and impulse response function are used, with three variables under consideration: the exchange rate between VND and USD, the export value of pangasius, and the inflation rate of Vietnam. The data used are monthly time series covering the period from January 1999 to December 2012. Our analysis shows that there is a long-run cointegration relationship between the exchange rate, the export value of pangasius, and the inflation rate. The results also show that the export value of Vietnamese pangasius is a main determination to explain the exchange rate. We could not find evidence of response of the exchange rate to the inflation, but the inflation rate reacts positively and significantly to one standard deviation shock in the exchange rate and the export value. In sum, our results contribute to the debate about choice of exchange rate regime for Vietnam to maintain the upward trend of pangasius export and of strategy to face the inflation situation. To prevent a currency and balance of payments crisis, the government can take a tough tightening stance. This could dampen growth in the near future, but the benefits outweigh the downside, as it would take an extended period for an economy to recover from a major shock.

Keywords: pangasius, crisis, Vector Autoregressive Model (VAR)

1. INTRODUCTION

Exports may be a major source of economic growth, both directly because export is a component of production and indirectly as export facilitates import of goods, services, and capital along with new ideas, knowledge, and technology (Gylfason, 1999).

Inflation and exchange rate are two of the key "barometers" of economic performance, indicating growth (output), demand conditions, and the levels and trends in monetary and fiscal policy stance. Exchange rate policy emerged as one of the controversial policy instruments in developing countries in the 1980s, with vehement opposition to devaluation for fear of its inflationary impact, among other effects. Many countries, especially small open developing countries, e.g. Vietnam, tend to stabilize their exchange rates to the dollar during non-crisis periods.

Traditional trade theory suggests that exchange rate uncertainty would depress trade because exporters would view it as an increase in the uncertainty of profits on international transactions, under the assumption of risk aversion. On the other hand, a number of authors such as Giovannini (1988), Franke (1991), and Sercu and Vanhulle (1992) illustrate, in the context the theoretical models, that exchange rate uncertainty might benefit trade.

The risks associated with volatile exchange rate are viewed as major impediments for countries that attempt to grow through export expansion strategy. Many countries, especially small open developing ones, tend to stabilize their exchange rates against a basket of currencies or against the US dollar.

Currently, the global crisis has spread worldwide, in which Vietnam is not exclusive, so the fishery export situation of Vietnam can be affected by that crisis, in which pangasius industry is the case of this study. As a result, this paper is going to investigate impacts on each other of three elements, e.g. the export value of Vietnamese pangasius, the exchange rate between VND and USD, and the inflation rate of Vietnam. This is helpful in finding out the relationships between those elements, and for intending to investigate the long-run ones between them. In order to be objective, the Vector Autoregressive (VAR) model is employed. Next, variance decomposition and impulse response are taken into account. Estimate results will guide policy makers on promoting the Vietnamese pangasius development

This paper starts with a brief introduction of the main concepts involved. Next is an overview of the industry. Subsequently, the econometric time series literature on VAR model is reviewed, as the theoretical framework is derived, followed by the presentation of the data used. The results are presented and discussed in the last section.

2. BACKGROUND

Fast development of pangasius industry in Vietnam is an impressive status and makes a valuable lesson for others sector. Changes in market strategy of Vietnamese exporters are remarkable achievements contributing to GDP improvement (Binh, 2009a), particularly after the trade dispute between Vietnam and the USA in 2002 (Binh, 2006).

According to VASEP's statistics[1], until 2011, there are 520 seafood processing plants in Vietnam, in which 400 plants are the freezing factories, with a daily capacity of 7,500 tons. Because of quality consideration of Vietnamese plants, 96% of total seafood processing plans meet national standards of hygiene and safety, e.g. HACCP, GMP, SSOP.

More than 90% of total Vietnamese pangasius output is exported to the world market, and the expansion of this market explains much of the high rate of growth in farm-raised pangasius[2]. Vietnamese pangasius exports increased from 425 tons in 1997 to 28,000 tons in 2002 (just before the period of trade dispute between Vietnam and USA), and to 857,000 tons in 2011 (rising by 3% compared to that of 2010), with a total value of US$1.8 billion (Figure 1), up 26.5% on that of 2010. According to Khoi (2009) and Binh (2009b), factors that contributed to the recent success of pangasius farming in the Mekong Dleta include: (i) the development of modern production and control systems ensuring that international standards for food safety and hygiene could be met; (ii) the specific characteristics of 377 of pangasius species in Vietnam in terms of flavor, color, and low cholesterol content, which resulted in a high demand (Orban et al.2008); (iii) low production costs, which allowed farmers to keep prices low; and (iv) improvements in the production chain, such as the introduction of the fingerling socialization program, which created a more reliable source of pangasius fingerlings.

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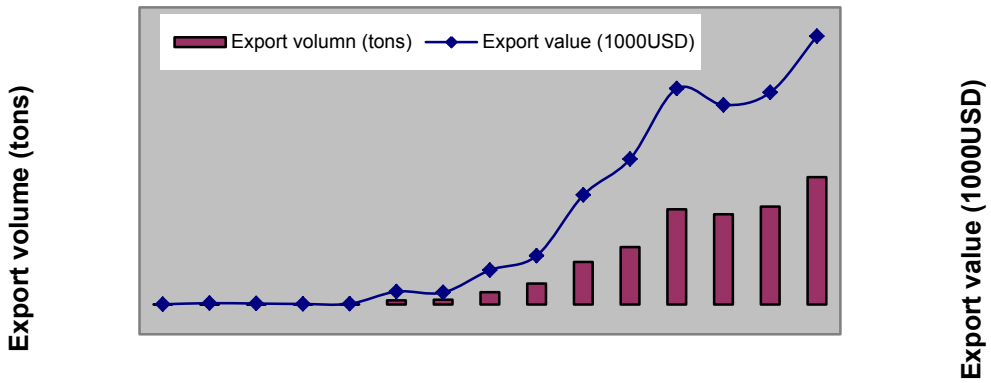
[1] VASEP = Vietnam Association of Seafood Exporters and Producers

[2] Farming areas of 2011 is 5 times of 2000 and reached 6,000 hectares - VASEP.

Figure 1: Vietnam's Exports of Frozen Pangasius Fillets



Source: VASEP

Value-added products were only one percent. Among more than 130 countries and territories importing pangasius from Vietnam, the USA is the leading importer of frozen fish fillet while the Netherlands was the largest consumer of processed fish products with the export value of US$5.4 million, making up 38.8% of the total export value of processed fish. However, current exports of Vietnam to European markets are affected by the global crisis. Evidently, frozen pangasius fillet export to Egypt in 2011 tended to decline over that of the previous year[3].

In general, the USA and EU were still the biggest consumers of Vietnamese pangasius, making up 47% of total export value of Vietnam's pangasius in 2011. Among two these markets, Vietnam's pangasius export to the USA touched US$331.6 million, up 87.8% with the increasing in its market share from 11% to 18%. The pangasius export proportion to EU fell by 37% to 29.7% because of impacts of the crisis of Eurozone, such as Spain, the largest fish consumer in EU block, fell 9.4 percent.

3. METHODOLOGY AND PREVIOUS EMPIRICAL STUDIES

According to Edwards (2006), the exchange rate is one of the most important macroeconomic variables in the emerging and transition economies. It affects inflation,

[3] http://vietnamseafoodnews.com/?p=3505

export, import and all economic activities. Exchange rate variations can also affect aggregate demand. To a certain extent, exchange rate depreciations (appreciations) increase (decrease) foreign demand for domestic goods and services, causing increase (decrease) in net export and hence aggregate demand (Hyder and Shah, 2004). However, when there was considerable market pressure in times of crisis, large devaluations occurred. As in the case of the Asian and Mexican crises, common features, such as large devaluations or high levels of depreciation in domestic currency and significant output losses, were experienced after both the 1994 and the 2001 crises (Berument and Pasaogullari, 2003). Domestic factors that lead to crises in various countries are different, but there are also common features of these crises: big devaluations or depreciations in domestic currency and the subsequent significant output losses of the crisis-hit countries.

Aghion et al. (2009) argued that productivity in developing countries is affected by exchange rate volatility. This is consistent with what Vietnam is facing at present. Export companies pay very much attention to the exchange rate, because the volatility of exchange rate is one of main reasons for their decision on how much to export. Therefore, when the export activity is relatively riskier than others, fewer resources will be allocated to it.

According to Gonzaga (1997), two assumptions are crucial for the volatility of the exchange rate to affect the export decision. One is that there is no perfect hedging access to exchange rate forward market that would reduce the effect. The other is that exporters have to be very risk averse. Consequently, more volatility of the exchange rate would then make export less responsive to variation in the exchange level (Dixit, 1989).

VAR model is usually considered by authors who want to find out relationships between macroeconomic variables. For example, Rogers and Wang (1995) use VAR model for Mexico with four variables-output, government expenditure, inflation, and money growth. They found that most of output variation is attributable to its own shocks, but the response of output to devaluation is negative. Similarly, Berument and Pasaogullari (2003) apply VAR model to analyze the interrelationships among inflation, output, and the real exchange rate in Turkey, with time series of quarterly data from 1987-2001. Their findings confirm that a long-run relationship exists among the real exchange rate, inflation, and output, together with a negative correlation

between output and the real exchange rate. Movements in the real exchange rate are important in the variability of output.

Like Berument and Pasaogullari, Binh (2009b) also found long-run relationships among the VND exchange rate to the US dollar, the export value of fishery products and the inflation rate through his application of Error Correction Model based on the monthly data from January 2003 to June 2009. Additionally, he confirmed that, the export value of Vietnamese fishery products and the exchange rate were affected by the inflation rate in Vietnam.

As aforementioned, this study is going to employ VAR model. Although, it may not have strong theoretical foundations, it does provide dynamic interaction among variables of interest and have high predictive power. In order to investigate how Vietnamese export of pangasius is affected by the inflation trend and the exchange rate between VND and USD, we will use the model developed by the Engle and Granger (1987) in order to establish the long-run equilibrium relationship.

VAR imposes few theoretical assumptions on the structure of a model. With a VAR, one needs to specify only two things (Pindyck and Rubinfeld, 1991): (i) the *set of variables* (endogenous and exogenous) that are believed to interact and hence should be included, and (ii) the *largest number of lags* that is needed to capture most of the effects that the variables have on each other. The equations of the model are constrained to be linear so one need not worry about functional forms.

Based on findings on the theoretical framework suggested by Kamin and Rogers (2000), the core model used is expressed as follows

$$x_t = \sum_{i=1}^{p} A_i x_{t-i} + \sum_{i=1}^{r} B_i z_{t-i} + \varepsilon_t$$

Where x_t is a vector of three endogenous variables: EX (exchange rate of the VND to the US dollar), EV (export value of Vietnamese pangasius), IN (inflation rate of Vietnam); z_t is a vector of exogenous variable; A_i and B_i are matrices of coefficients; p is the number of lags of the endogenous variables, and r the number of lags of the exogenous variables. As there are no unlagged endogenous variables on the right-hand side and the right-hand side variables are the same in each equation, OLS provides a consistent and efficient estimator (Pindyck and Rubinfeld, 1991).

Variance decomposition and impulse response functions reveal the dynamic interactions and the strength of causal relations among the variables considered. Variance decomposition indicates the percentage of a variable's error variance that can be attributed to shocks (own shocks and shocks to other variables). Impulse response functions show the directional response of a variable to a one standard deviation shock in other variables. By capturing both direct and indirect effects of shocks on a variable of interest these functions permit to analyze in detail the dynamic linkages in the system (Ibrahim, 2007).

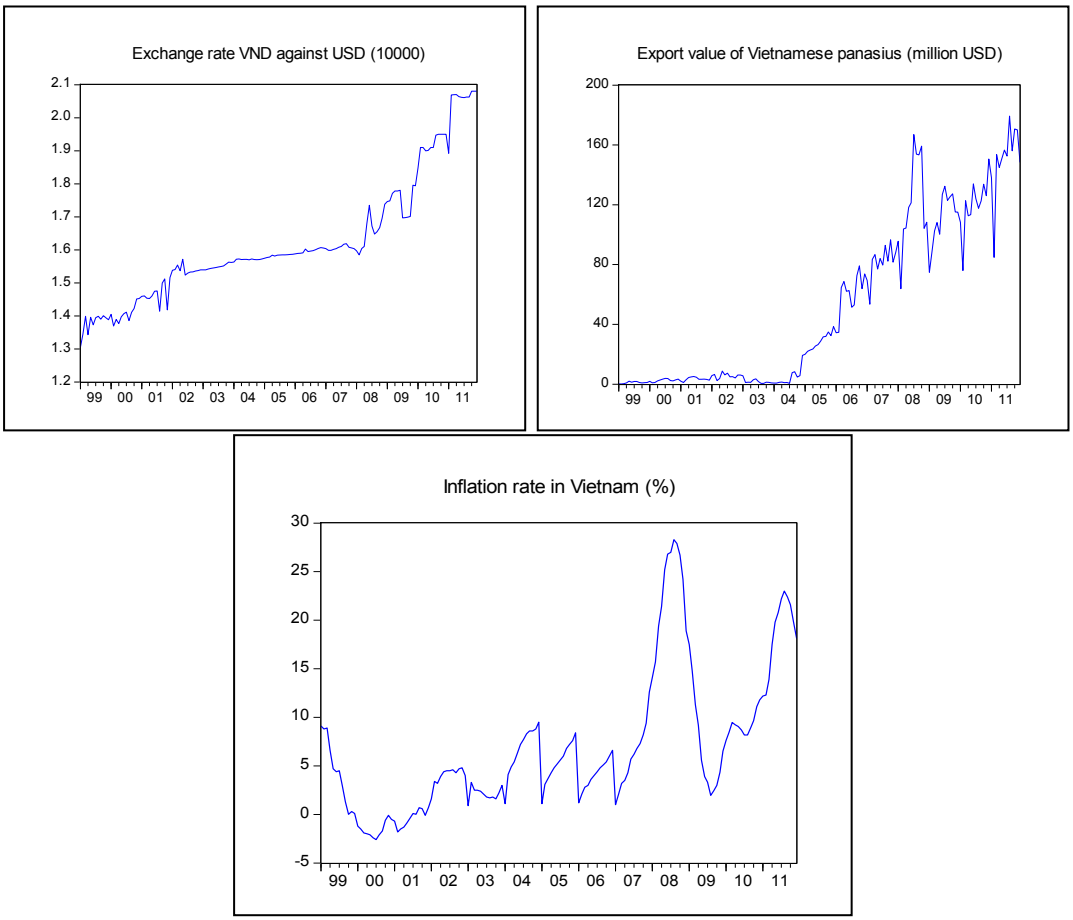
4. DATA

The data used in our analysis are monthly time series covering the period from January 1999 to December 2012. We are considering the following variables: EX is the exchange rate of Vietnamese Dong (VND) to US dollar (USD), in VND/USD; EV is the export value of Vietnamese pangasius, in million USD; IN is the inflation rate of Vietnam, in percent. Those three variables presented in Figure 2 are at level.

The data are from the Vietnam Association of Seafood Exporters and Producers (VASEP) and http://www.vietnam-report.com. As shown in Figure 2. The exchange rate between VND and USD is an increasing trend, in which big changes are during 2008 and 2011, with a monthly growth rate of 0.8% and 0.9% respectively, while duration 2004-2007, its monthly growth rate experiences very few changes, around 0.05%. High growth rate of the exchange rate is due to high inflation rates that reaches 22% in 2008 and 18% in 2011. As a result, the Vietnamese Dong is weaker, due to the exchange rate (VND/USD) depreciation, which could cause greater harm to the Vietnamese economy for a long time.

Although the inflation rate is high in 2008, the export value of Vietnamese pangasius peaks. This can be consistent with the economic theory that an increase in the inflation rate is advantageous for exporters to increase their exporting, or it may be said that the exchange rate uncertainty might benefit trade (Sercu and Vanhulle, 1992).

Figure 2: Monthly Series at Level of Exchange Rate, Export Value and Inflation Rate



Source: Vietnam Association of Seafood Exporters and Producers (VASEP) and http://www.vietnam-report.com

a. Stationarity Test, Cointegration Test, Causality Test and Estimation Result:

- Stationarity test:

In this paper, Dickey-Fuller (Dickey and Fuller, 1979) and Phillips-Perron (Schwert, 1989) tests are used to identify the order of integration of three time series. The results of the unit root tests of Augmented Dickey and Fuller (ADF) and Phillips-Perron (PP) are reported in Table 1. In each test the null hypothesis of a unit root of

three time variables is not rejected, it means that those three variables are not stationary at level. However the first differences of these three series are found to be stationary with a statistical error level below one percent, these three series appear to be integrated of order 1.

Table 1: Unit Root Tests

Variable	Level		First difference	
	ADF	**PP**	**ADF**	**PP**
EX	0.528 (0.987)	0.646 (0.991)	-15.657 (0.000)	-17.234 (0.000)
EV	1.004 (0.997)	-0518 (0.883)	-7.471 (0.000)	-25.347 (0.000)
IN	-2.520 (0.113)	-1.955(0.307)	-3.689 (0.005)	-10.193 (0.000)

Note: EX = Exchange rate between VND and USD; EV = Export value of pangasius; IN = Inflation rate of Vietnam; P-Value is given in the brackets; *; **; *** are significant at 10%; 5% and 1% respectively.

- Cointegration test:

According to Engle and Granger (1987), and Selover and Round (1996), the findings that the variables are non-stationary and are not cointegrated suggest the use of a VAR model in first differences. However, if they are cointegrated, an unrestricted VAR in levels can be used. The results of the Johansen-Juselius cointegration test shown in Table 2 indicate that there is cointegration among the variables. Both the trace and the maximum eigen-value (Max-Eigen) test reject the null hypothesis at the five percent significance level, indicating that there is a statistically significant cointegrating vector, i.e., one linear long-run equilibrium relationship among three series (e.g. the exchange rate between VND and USD, the export value of Vietnamese fishery products, the inflation rate of Vietnam). As a result, the VAR technique of three time series of the exchange rate, the export value, and the inflation rate is appropriate.

Table 2: Johansen-Juselius Cointegration Tests

Hypothesized No. of CE(s)	Trace Statistic	Max-Eigen Statistic	Critical Values (5%)	
			Trace	Max-Eigen
None*	30.18103	19.06772	29.79707	18.13162
At most 1	11.11331	9.140260	15.49471	14.26460
At most 2	1.973050	1.973050	3.841466	3.841466

Note: Trace and Max-Eigen tests indicate no cointegration at the 5% level.

* denotes rejection of the hypothesis (the null hypothesis, no cointegration) at the 5% level.

VAR specification

Krolzig (1996) and Lütkepohl and Saikkonen (1997) use four different criteria: Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information (HQ) to specify the order of the VAR (see Lütkepohl, 1991).

According to Lütkepohl and Saikkonen (1997), choosing h (the upper bound of lag selection)somewhat smaller than $T^{1/3}$ would be a possibility suggested by the upper bound $h \sim o(T^{1/3})$. For $T=151$, this implies an order $h< 5$ ($151^{1/3}$), meaning that any order of the VAR below 5 is possible. As pointed out in Table 3, based on the different criteria, VAR(2) and VAR(4) are employed. According to Kamaly and Erbil (2001), if a given lag has the lowest AIC and SC then that lag is used. If, however, one criterion increases while another one decreases as the number of lags rises, then the likelihood ratio (LR) can be used to determine the right lag. As a result, VAR(4) is preferred.

Table 3: Lag Order Selection of the VAR Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1137.348	NA	728.0087	15.10394	15.16389	15.12830
1	-554.8900	1134.057	0.366002	7.508477	7.748261	7.605890
2	-520.7129	65.18548	0.262258	7.175006	7.594627*	7.345478*
3	-510.1612	19.70588	0.257021	7.154453	7.753913	7.397985
4	-497.8926	22.42481*	0.246304*	7.111160*	7.890457	7.427751

5	-489.9753	14.15670	0.250140	7.125500	8.084636	7.515151

* indicates lag order selected by the criterion

LR: sequential modified Likelihood Ratio test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

From the VAR, we generate variance decomposition and impulse response function as bases for inferences. The decomposition of Babula, et.al. (2003) of forecast error variance is closely related to Granger causality analysis as they both analyze causal relationship between two variables: the variance decomposition of an endogenous variable is considered for alternative horizons to shocks in each variable (including itself). Forecast error variance decomposition provides evidence of the existence of a relationship between two variables, but it also illuminates the strength and the dynamics of this relationship (Bessler, 1984; Babula and Rich, 2001; Sagharian et al., 2002). The results of variance decomposition for 3, 6, 9, 12, 18, 24 months days horizons respectively are presented in Table 4. A leading variable is one of which its variance can explain a large percentage of the error variance of others while its own forecast error is not explained by shocks in others.

In the same table, for six months, the exchange rate explains roughly 4-5% of the export value and roughly 12-13% after 24 months. But this exchange rate hardly explains the inflation rate for a short run as well as a long run, roughly 1-2%. The exchange rate forecast error is its own innovations, which accounts for 86-94% of the variance of its forecast.

A similar pattern can also be noted the other variables. The export value forecast error is also its own innovations, which accounts for 80-92% of the variance of its forecast. At the 24-month horizon, a change in the exchange rate accounts for about 15.8% of the variation in the export value, but at the 12-month range, this variation accounts for 7.5%. As a result, the exchange rate and the export value is a mutual influence, consistent with the previous finding that the exchange rate and the export value have a bi-directorial causal relationship. In terms of comparison, the export value is a leading factor to explain the exchange rate.

Similarly, the inflation rate's own innovations account for the high faction of its forecast error variance of 74-90%. Because the export value variations explain roughly

18-22% of the inflation rate forecast error variable for a long run, while the exchange value variations explain roughly 2-4% after one year. This implies that movements of the export value rate are more important than those of the exchange rate in the variability of the inflation forecast error.

Table 4: Generalized Forecast Error Variance Decomposition for VAR(4)

Period	S.E.	EX	EV	IN
Variance Decomposition of EX:				
3	0.04	94.23	5.14	0.64
6	0.05	93.64	4.63	1.72
9	0.06	94.42	3.75	1.83
12	0.06	94.15	4.33	1.51
18	0.07	90.79	7.78	1.42
24	0.08	86.44	12.36	1.20
Variance Decomposition of EV:				
3	16.42	5.67	92.03	2.30
6	21.47	4.91	92.54	2.54
9	24.50	5.91	90.93	3.15
12	26.77	7.53	88.70	3.77
18	30.19	11.48	84.32	4.20
24	32.86	15.76	80.32	3.92
Variance Decomposition of IN:				
3	2.89	0.93	8.16	90.91
6	4.64	1.07	11.28	87.66
9	5.51	1.37	14.88	83.75
12	5.82	1.78	18.08	80.14
18	6.00	2.75	21.13	76.13
24	6.10	3.90	21.82	74.27

The vector autoregressive (VAR) model is estimated using variables in level. We fix the lag order of VAR to four, which is sufficient to whiten the noise process. Ordering of the variables is EX, EV, IN

EX = Exchange rate of VND to USD; EV = Export value of pangasius; IN = Inflation rate of Vietnam

Following the analysis on variance decomposition, impulse response technique was used to investigate the pattern of dynamic impulse response of the export value of pangasius to shocks from the exchange rate and the inflation rate. Figure 3 shows impulse response functions for a period of 24 months, and traces the responses of EX, EV, and IN to each other. Notably, we present the impulse response functions together with two standard deviation bands. Roughly speaking, if the bands contain zero, the variables' reaction to innovations or changes in other variables is not significant.

Although there is a significant response of the exchange rate to the export value, it is positive after the second half of year onwards, while the export value reacts positively and significantly to shock in the exchange rate overtime.

While we could not find evidence of response of the exchange rate to the inflation, the inflation rate reacts positively and significantly to one standard deviation shock in the exchange rate and the export value.

- Granger causality test:

To test causality of the aforementioned three variables, the Granger causality test is employed and its results are presented in Table 5, in which four lags are used, due to the lag length criteria. There is one pair of significant causal relationships. This shows evidence of bi-directional causality between the export value of Vietnamese pangasius and the exchange rate (see Figure 4).

Table 5: Results of Granger Causality Tests between Pairs of Variables

Null hypothesis	Observation	F-Statistic	Prob.
EV -------x-------> EX	152	3.82792	0.0055
EX -------x-------> EV	152	4.14550	0.0033
IN -------x-------> EX	152	0.32487	0.8609
EX -------x-------> IN	152	1.40972	0.2337
IN -------x-------> EV	152	1.96722	0.1027
EV -------x-------> IN	152	1.88299	0.1166

Note: EX = Exchange rate between VND and USD; EV = Export value of pangasius; IN = Inflation rate of Vietnam.

-------x-------> means “does not Granger Cause”

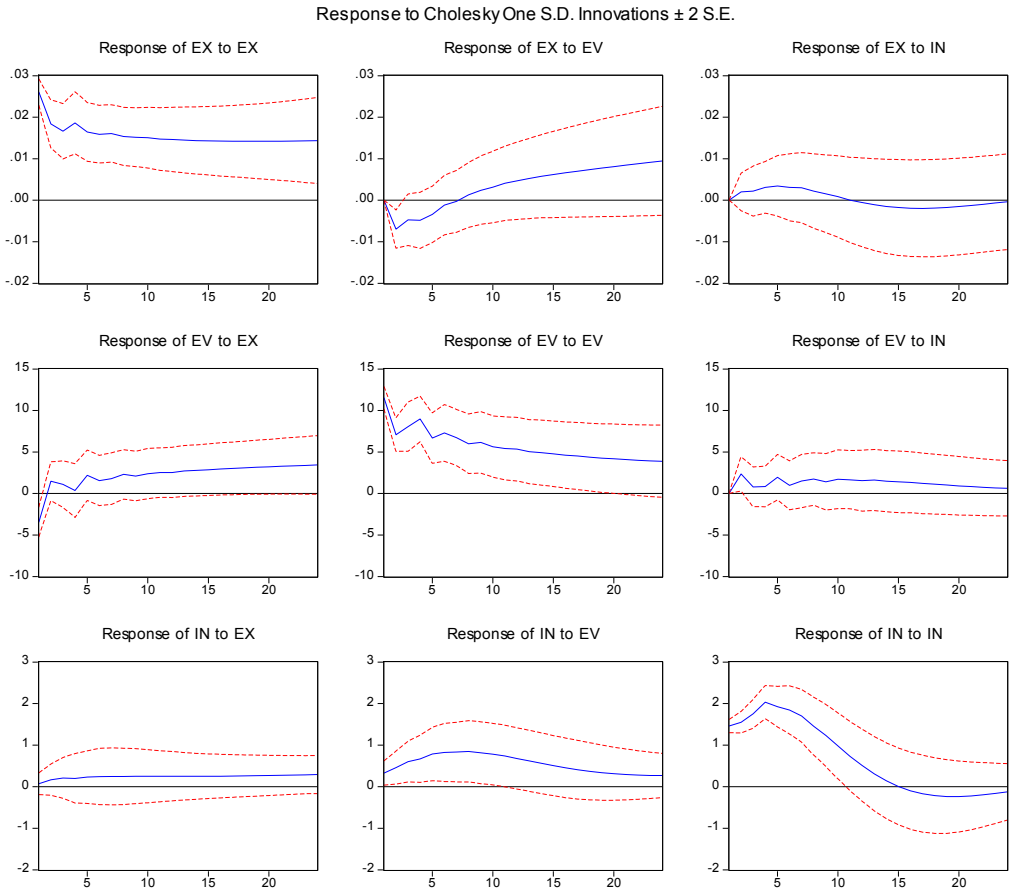
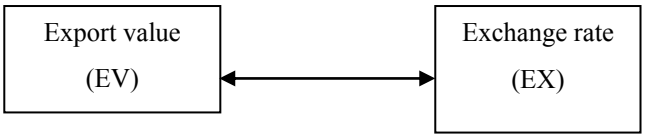


Figure 3: Impulse Response Functions

Figure 4: Causal Relationships between Export Value and Exchange Rate



5. CONCLUSION

In this paper, VAR, variance decomposition and impulse response function are used to investigate relationships between three series: the exchange rate between VND and USD, the export value of pangasius, and the inflation rate of Vietnam. Our analysis shows that there is a long-run cointegration relationship between the exchange rate, the export value of pangasius, and the inflation rate. This finding is consistent with Binh (2009). Both Granger causality test and VAR show evidence of bi-directional causality between the export value of Vietnamese pangasius and the exchange rate. However, the export value is a leading factor to explain the exchange rate. Thus, a significant response of the exchange rate to the export value is positive after the second half of year onwards, while the export value reacts positively and significantly to shock in the exchange rate overtime.

While we could not find evidence of response of the exchange rate to the inflation, the inflation rate reacts positively and significantly to one standard deviation shock in the exchange rate and the export value.

The effect of the inflation on the macroeconomic situation (e.g. exchange rate, output of export) presented in a long run, which many authors had already discussed. In sum, our results contribute to the debate about choice of exchange rate regimes for Vietnam to maintain the upward trend of pangasius export, and of the strategy to face the inflation situation.

To prevent a currency and balance of payments crisis, it is necessary that the government take a tough tightening stance. This could dampen growth in the near term, but the benefits outweigh the downside, as it would take an extended period for an economy to recover from a major crisis■

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