Long term relationship between exports, gross domestic capital formation, transfer fund allocation, and private investment in Jambi Province

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Abstract

This study investigates the relationship between Jambi export with gross domestic capital formation, allocation of transfer funds, and private investment, based on the Vector Error Correction Model (VECM). The results show that, both in the short and long term, the gross domestic capital formation, allocation of transfer funds, and private investment can explain changes in Jambi exports. The gross domestic capital formation strongly influences Jambi's export fluctuations compared to other variables. There is a disequilibrium relationship in the short term, and it becomes equilibrium in the long run. Only 69 percent of export changes can be determined in the current period, and the rest is determined in other periods. Likewise, the gross domestic capital formation, only 38 percent, can be determined in the current period, and the rest is determined in other periods. Based on the impulse response function, the impact of export shocks has a large impact on itself. Shocks have a very significant impact and have a long lead to stable levels. Shocks can cause changes in Jambi exports to gross domestic capital formation. Shocks to the formation of gross domestic capital formation require a long time to reach a stable level.

Keywords: *Cointegration, Export, Private investment, Transfer funds*

JEL Classification: C32, E22, H54.

INTRODUCTION

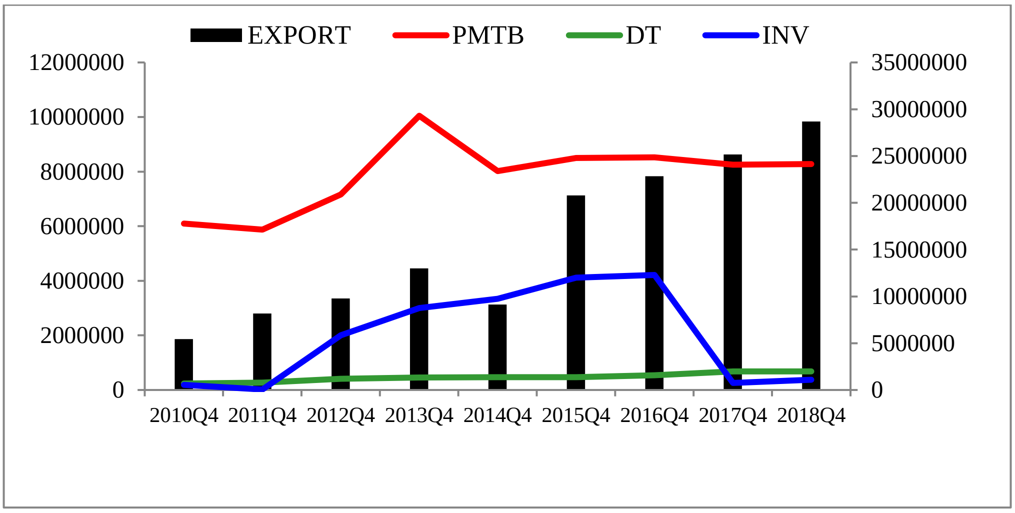
Government reform accompanied by openness has become a demand in Indonesia, especially about transparency, accountability, and the authority of financial governance and development financing. That aspect is important to drive the process of switching from a centralized system to a decentralized system in the format of regional autonomy.

Regional autonomy is the area's right, authority, and obligation to govern and manage government affairs and local communities' interests by statutory regulations. This autonomy is based on Law of the Republic of Indonesia Number 23 of 2014 concerning Regional Government, and Law of the Republic of Indonesia Number 33 of 2004 concerning Financial Balance between Central and Regional Government.

Since the enactment of the fiscal decentralization policy is expected, the local government is more independent. One of its indicators is the increase of financing from the Local Own-source Revenue (PAD) and funding source from the central government. PAD is derived from: a) intensification and extensibility of regional levies in the form of retribution or taxes; b) Exploration of natural resources; c) Capital formation schemes or regional investments through fundraising or attracting investors.

Jambi Province is one of the provinces in Indonesia. Various financing types in the Jambi Province government budget are characterized by a relatively large share of the central government's transfer funds allocation. The realization of PAD is relatively small in financing the implementation of government and development. Therefore this region is still highly dependent on the allocation of transfer funds (DT) in the form of General Allocation Funds (DAU), Special Allocation Funds (DAK), and revenue share, grants, and others. Relatively large dependent conditions will limit regional development, especially economic development by the potential of Jambi's natural resources.

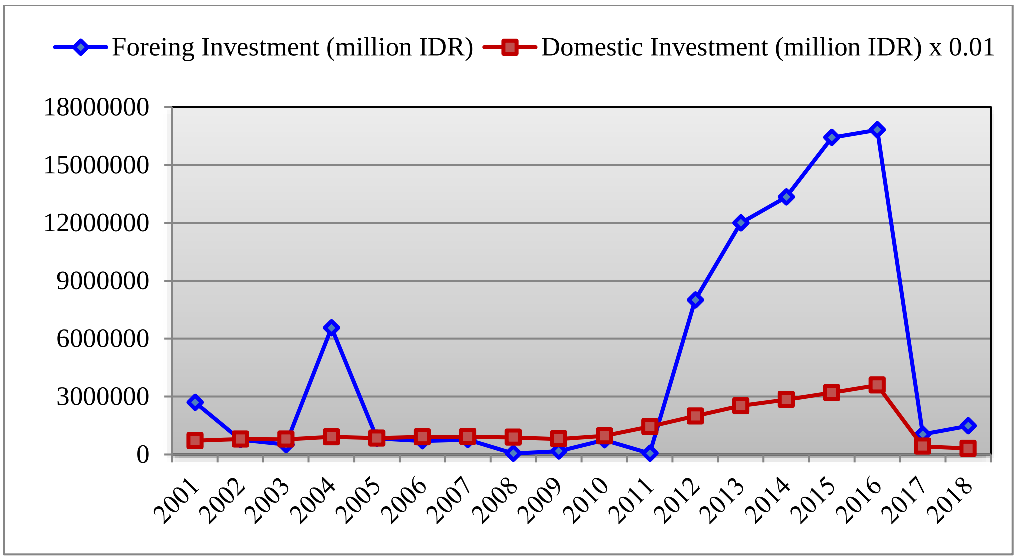
The Jambi Province economy is characterized by a high dependence on the abundance of natural resources, which determines the types of commodities exported to various destination countries. Jambi Province is quite prominent in realizing the export of plantation commodities and various processed plantation products. Exports of agricultural commodities in the form of primary commodities increased by 2.26 percent (Figure 1). The primary commodities exported are areca nuts, coffee beans, tea, spices, fish, and shrimp. Exports of various processed products from the plantation and forestry industry also experienced a relatively higher increase of 4.39 percent (BPS Jambi, 2020a). The types of processed industrial products predominantly exported to various countries are crude palm oil (CPO), coconut oil (VCO), SIR rubber and various processed rubber, plywood and various other wood products, pulp and paper, and charcoal.



Sources: BPS Jambi (2020a), BPS Jambi (2020b), BPS Jambi (2020c)

Figure 1. Export trends, gross fixed capital formation, allocation of transfer funds, and private investment in Jambi (million IDR)

With the realization of investment, both PMDN (Domestic Investment) and PMA (Foreign Investment) also have increased. The highest percentage increase, both PMDN, and PMA occurred from 2012 to 2016. More details can be seen in Figure 2.



Source: BPS Jambi (2020b)

Figure 2. Investment trends come from domestic (PMDN) and foreign (PMA)

Based on the descriptions, the authors are interested in researching the relationship between exports, gross domestic capital formation, transfer funds, and private investments in Jambi Province. The purpose of the research is to analyze the short-run and long-term (long-run) relationship between exports, gross domestic capital formation, transfer funds, and private investments in Jambi Province period 2001Q1 to 2018Q4.

LITERATURE REVIEW

Local autonomy dan transfer funds

Regional autonomy is defined as the granting of authority by the central government to local governments to regulate and manage local communities' interests based on people's aspirations by applicable laws and regulations. In the implementation of regional autonomy, which is in the interests of local governments at least include: (1) realizing what is called political equality, regional autonomy opens more opportunities for people to participate in political activities at the local level; (2) creating local accountability, regional autonomy will increase the ability of regional governments to fulfill the rights of the people; (3) facilitate the anticipation of various problems that arise and at the same time increase the acceleration of social and economic development in the region (Abdullah & Halim, 2003).

Transfer funds from the central government to regional governments are sources of income from The Indonesian Budget (APBN) to support regional governments' implementation in granting autonomy to the regions, especially carried out to improve regional communities' services and welfare. Transfer funds are given to local governments to increase revenue with the priority to finance salaries and employee benefits, operational and maintenance activities, construction of facilities and infrastructure in public services, basic services, and public services needed by local communities. Regional revenues originating from general allocation funds (DAU) and special allocation funds (DAK) are a form of transfer funds from the central government to regional governments. Fund transfers also function in the correction of fiscal inefficiencies and fiscal equality between regions.

The public and private investment relationship

Nguyen & Trinh (2018) conducted a study of the effects of public investment and private investment during the 1990-2016 period in Vietnam with the ARDL model. The findings show that public investment has a pattern of influence on private investment, encouraging in the short term but crowding-out in the long run. It implies that when the economy requires an investment environment to attract private investment, public investment plays an important role; however, public investment is reduced in the long run.

From an empirical point of view, Gjini & Kukeli (2012) estimate public investment's crowding-out effect in private investment. They combined cross-sectional data from eleven selected Eastern European countries to estimate the marginal effects of public investment, bank credit available to private investors, inflation, and the real interest rate on private investment. The results show that there is no crowding-out effect from public investment on private investment. The marginal effect of public investment on private investment is positive and decreases as the country moves from less developed regions to more developed regions.

Mallick (2016) evaluates the effect of shocks in government investment on private investment and national income, focusing on the crowding-in or crowding-out effect in India. Recent studies do not deal with this issue by considering the heterogeneous effect of public investment regarding infrastructure uses structural vector auto-regressions (SVAR). The study finds evidence of government investment's crowding-out effect, mainly due to the non-infrastructure part of government investment. Private investment is vital to achieving higher growth in market-led economies, and public investment should complement each other. Hence, the Indian government should design policies to attract more investment expenditure in infrastructure and other productive activities to encourage (crowded-in) private investment.

The positive effects of public investment resulting from the government budget on private investment are often found from previous studies. Hatano (2010) investigates the effects of public investment on private investment based on Japanese empirical data. The results show that there is a cointegration relationship between private capital and public capital. Accordingly, the relationship between private and public investment should be represented by an error correction mechanism designed to achieve a long-run stock equilibrium.

Export, gross fixed capital formation, and investment relationship

Rajni (2013) studied the relationship between exports, imports, and gross domestic capital formation in a developing country. The study variables have a long-run equilibrium relationship between them, although they may be in disequilibrium in the short-run. The analysis results conclude that both exports and gross capital formation are significantly influencing each other.

Feddersen et al. (2017) concluded in their study in South Africa that capital has a significant positive long-run association with both Gross Domestic Expenditure and exports, respectively. Moreover, the short-run VECM shows that capital positively impacts Gross Domestic Expenditure at one lag. Therefore, the results suggest a capital-output connection and that exports play a role in supporting capital stock accumulation. Zhanje & Garidzirai (2018), in their study, concluded that the ARDL cointegrating and long-run results indicated that FDI and other control variables, economic growth, and terms of trade are significant and positively related to export performance in Zimbabwe. In his empirical study in Bangladesh, Khan & Sultana (2013) identified whether foreign investment significantly affected the Bangladeshi economy by investigating the relationship between foreign investment and exports. They analyzed the data needed for the last ten years (2001-2010), the findings show that foreign investment has a significant positive relationship with exports, which helps Bangladesh's economic growth.

Furthermore, Sharma & Kaur (2013) found a unidirectional causal relationship between foreign direct investment and exports in China. He also discovered a different relationship in India, which showed a bidirectional relationship between foreign direct investment and exports. Karimov (2019) also found that investment (FDI) had a positive relationship with Turkey's trade.

VEC Models

The relationship between economic variables by modern econometrics often uses the VAR and VEC models. The VAR model usually involves several endogenous variables together. However, each endogenous variable is described by its own lag value, current endogenous, and other lag endogenous variables. Deriving the structural form from the VAR model produces several Autoregressive Distributed Lag (ARDL) models. If the data on all variables used are stationary I (0), use the conventional VAR model. Conversely, if the data on all variables are not stationary I (0) but only stationary I (1), it is recommended to use the Vector Error Correction Model (VEC).

Suppose that in the long-run equilibrium, the relationship between economic variables as a model (1):

$$Y_t = a_0 + a_1 X_t \quad \text{...} \quad (1)$$

This relationship can also be formed as a model that describes the dynamic behavior between X and Y (model 2). The model is also in the form of an Autoregressive Distributed Lag (ARDL) model.

$$Y_t = b_0 + b_1 Y_{t-1} + c_0 X_t + c_1 X_{t-1} \quad \text{...} \quad (2)$$

Certain conditions will be determined under which model (2) is consistent with a model (1). The initial step ignores the dynamics and stochastic fluctuations in a model (2), so that

$$Y_t = Y_{t-1} = Y^* \quad \text{dan} \quad X_t = X_{t-1} = X^*$$

which results in changes like the model (3).

$$Y^* = b_0 + b_1 Y^* + c_0 Y^* + c_1 Y^* = \frac{b_0}{1-b_1} + \frac{c_0+c_1}{1-b_1} X^* \quad \text{..............................} \quad (3)$$

Model (3) will be consistent with a model (1) if:

$$a_0 = \frac{b_0}{1-b_1} \quad \text{dan} \quad a_1 = \frac{c_0+c_1}{1-b_1} \quad \text{...} \quad (4)$$

Furthermore, by substituting the relationship (4) in a model (2), by making the simplification, an Error Correction (EC) model is obtained as (5).

$$\Delta Y_t = c_0 \Delta X_t + (1 - b_1)(a_1 + a_1 X_{t-1} - Y_{t-1}) \quad \text{...} \quad (5)$$

The derivation of the Error Correction (EC) model above adopts what has been done by Engle & Granger (1987), who combine cointegration and error correction models to form a trace error correction model. They explained that if there is a cointegration relationship between economic variables, the error correction model can be derived from the Autoregressive Distributed Lag (ARDL) model or a model in the dynamic form of a system of equations in the form of Vector Autoregressive (VAR). Therefore, the VEC model is a VAR model with cointegration limitations. The VEC model requires a cointegration relationship to explain the long-term relationship between economic variables, besides explaining dynamic behavior in the short term. The dynamic short-term behavior of endogenous variables will converge towards long-term equilibrium in several periods

The relationship between economic variables can also be presented in vector and matrix form. As Verbeek (2017) assumed $Q_t = (Q_{1t}, Q_{2t}, \ldots\ldots, Q_{pt})'$ as p-dimensional stochastic time series, t =1,2,...,T and $Q_t \sim I(1)$, each $Q_{pt} \sim I(1)$, i=1,2,...,p is affected by exogenous time series of q-dimension $X_t = (X_{1t}, X_{2t}, \ldots\ldots, X_{qt})'$; then the VAR model can be established as follows:

$$Q_t = A_1Q_{t-1} + A_2Q_{t-2} + \cdots + A_pQ_{t-p} + BX_t + \mu_t, \quad t=1,2,3,\ldots,T \qquad \ldots\ldots\ldots (6)$$

If Q_t is not affected by exogenous time series of q dimension $X_t = (X_{1t}, X_{2t}, \ldots\ldots, X_{qt})'$, then the VAR model of formula (6) can be written as follows:

$$Q_t = A_1Q_{t-1} + A_2Q_{t-2} + \cdots + A_pQ_{t-p} + \mu_t, \quad t=1,2,3,\ldots,T \qquad \ldots\ldots\ldots\ldots\ldots (7)$$

With cointegration transformation of formula (7), we can get that

$$\Delta Q_t = \prod Q_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta Q_{t-i} + \mu_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (8)$$

where: $\prod = \sum_{i=1}^{p} A_i - I, \qquad \theta_i = -\sum_{j=i+1}^{p} A_j$

If Q_t has cointegration relationship, then $\prod Q_{t-1} \sim I(0)$ and formula (8) can be written as follows:

$$\Delta Q_t = \alpha\beta' Q_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta Q_{t-i} + \mu_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (9)$$

$\beta' Q_{t-1} = ECM_{t-1}$ is the error-correction term, which reflects long-term equilibrium relationships between variables. The formula (9) can be written as follows:

$$\Delta Q_t = \alpha ECM_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta Q_{t-i} + \mu_t \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (10)$$

Formula (10) is the vector error correction model (VECM), in which each equation is an error correction model.

METHODS

Data and variables

The analysis period uses the data used in the study from 2010Q1 to 2018Q4. Data collected includes the total export value of Jambi (EX), gross fixed capital formation (PMTB), transfer fund allocation (DT) in the Jambi Province budget, and private investment (INV) originating from domestic private investment and foreign direct investment. Data sources were obtained from related institutions, namely BAKEUDA, Jambi Province Bappeda, Jambi Central Statistics Bureau, and other relevant agencies.

The specification of the econometric model

The allocation of transfer funds and private investment in Jambi Province from 2001Q1 to 2018Q4 used a more appropriate analysis model to analyze the long-term relationship between export variables and gross domestic capital formation. If the statistical test results show that the data on all variables used in the analysis are only stationary in the first difference I (1), the Vector Error Correction (VEC) model is used. All the variables in the VEC model take the form of a first difference as in the following model:

$$\begin{aligned} D(\log EX) \;=\; & \beta_{10} + \textstyle\sum_1^n \beta_n D(\log PMTB)_{t-n} + \sum_1^n \beta_{2n} D(\log DT)_{t-n} + \sum_1^n \beta_{3n} D(\log INV)_{t-n} \\ & + \gamma_1\{D(\log EX)_{t-1} - \alpha_1 D(\log PMTB)_{t-1} - \alpha_2 D(\log DT)_{t-1} - \alpha_3 D(\log INV)_{t-1}\} + e \end{aligned}$$

$$D(\log PMTB) = \beta_{20} + \textstyle\sum_1^m \beta_m D(\log PMTB)_{t-m} + \sum_1^m \beta_{2m} D(\log DT)_{t-n} + \sum_1^m \beta_{3m} D(\log INV)_{t-m}$$

$$+ \ \gamma_2\{D(logPMTB)_{t-1} - \alpha_1 D(logEX)_{t-1} - \alpha_2 D(logDT)_{t-1} - \alpha_3 D(logINV)_{t-1}\} + e$$

$$D(logDT) = \beta_{30} + \sum_1^p \beta_p D(logPMTB)_{t-p} + \sum_1^p \beta_{2p} D(logDT)_{t-p} + \sum_1^p \beta_{3p} D(logINV)_{t-p}$$

$$+ \ \gamma_3\{D(logDT)_{t-1} - \alpha_1 D(logEX)_{t-1} - \alpha_2 D(logPMTB)_{t-1} - \alpha_3 D(logINV)_{t-1}\} + e$$

$$D(logINV) = \beta_{40} + \sum_1^q \beta_q D(logPMTB)_{t-q} + \sum_1^q \beta_{2q} D(logDT)_{t-q} + \sum_1^q \beta_{3q} D(logINV)_{t-q}$$

$$+ \ \gamma_4\{D(logINV)_{t-1} - \alpha_1 D(logEX)_{t-1} - \alpha_2 D(logPMTB)_{t-1} - \alpha_3 D(logDT)_{t-1}\} + e$$

Where:
D(logEX) = difference in exports (logarithms) between quarters last period.
D(logPMTB) = difference in the gross fixed capital formation (logarithms) between quarters
last period.
D(logDT) = difference in transper funds (logarithms) between quarters last period.
D(logINV) = difference in private investment (logarithms) between quarter's last period.
α dan β = parameters; γ is adjustment parameter; e is error terms

RESULT AND DISCUSSION

Stationarity test

The commonly accepted ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) unit root tests are adopted to the stationary test of EX, PMTB, DT, and INV series. The test results in Table 1 show that the three sequences' level value is nonstationary. The further test indicates that EX, PMTB, DT, and INV sequences are first-order difference stationary. In order to reduce data fluctuation, a first-order difference is made on the four sequences. Value in brackets in Table 1 is P values. ADF and PP values are less than the significant value of 5%, which indicates that the four sequences are stationary.

Table 1. Unit roots test results of variables

Variables	Augmented Dickey-Fuller (ADF) Test	Phillips-Perron (PP) Test
Level		
EX	-1.1166 (0.6982)	-0.7850 (0.8110)
PMTB	-2.6837 (0.2532)	-2.6375 (0.2698)
DT	-3.2862 (0.1001)	-3.1548 (0.1243)
INV	-3.7080 (0.0571)	-1.4363 (0.8108)
First Difference		
EX	-7.0287 (0.0000)	-13.9486 (0.0000)
PMTB	-4.8476 (0.0066)	-4.8425 (0.0067)
DT	-4.2005 (0.0261)	-14.3023 (0.0001)
INV	-3.6519 (0.0167)	-3.6518 (0.0167)

Estimation of VAR models

The first issue of the VAR model is to determine lag intervals for endogenous. The larger the lag intervals for endogenous is, the more it can entirely reflect the model's dynamic nature. However, in this case, more parameters will be needed to be estimated to reduce the freedom degrees of the model constantly. It is a contradiction in the selection of proper lag intervals for endogenous. Many methods can determine the optimal lag period for the VAR model. In careful consideration of selecting lag intervals for endogenous, this paper adopted lag length criteria and Ar roots graph to determine lag intervals for endogenous, as shown in Table 2. According to Table 2, after the comparison of lag length criteria, it can be found that the optimal lag order for the VAR model is 6. The VAR (lag period is sixth order) model is established, shown in Appendix 2.

The value of the log-likelihood function for the model is relatively large, and the AIC value is small, indicating that the model's explanatory ability is very strong. After determining the lag order of 6, the VAR (6^{th} order) model is reestablished. Then test stationarities of the VAR model and modulus of AR characteristic root reciprocal of VAR model are shown in the circle. That is to say, a lag order of 6 is appropriate, and the established VAR model is stable after going through a stability test.

Tabel 2. Determine lag intervals for endogenous with lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	12.26493	NA	6.65e-06	-0.569995	-0.381402	-0.510930
1	22.82391	17.47694	9.81e-06	-0.194753	0.748210	0.100572
2	30.84835	11.06819	1.82e-05	0.355286	2.052619	0.886869
3	46.43398	17.19793	2.27e-05	0.383864	2.835567	1.151706
4	76.15002	24.59259	1.33e-05	-0.562070	2.644003	0.442032
5	127.5147	28.33911*	2.72e-06	-3.001011	0.959432	-1.760650
6	198.6962	19.63628	4.37e-07*	-6.806633*	-2.091819*	-5.330012*

** indicates lag order selected by the criterion*
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Cointegration test

The key to the cointegration test lies in selecting the proper form of cointegration test and lag order. The cointegration relationship between variables in the VAR model is generally tested with the Johnsen (1988) and Juselius (1990) method. Here the selected sequences are linear trend terms, and then the test form of the cointegration equation is "intercept only".

Table 3 shows the Johansen cointegration test on four variables: EX The test shows that, both in the trace test and the maximum eigenvalue test, statistically accept the null hypothesis. It means that there is a stable and long-term equilibrium relationship between the variables. Based on the cointegration relationship, VEC modeling can be carried out further.

Table 3. Results of cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.991949	198.8956	47.85613	0.0000
At most 1 *	0.790497	59.05919	29.79707	0.0000
At most 2	0.242722	13.73163	15.49471	0.0906
At most 3 *	0.177560	5.668913	3.841466	0.0173
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.991949	139.8364	27.58434	0.0000
At most 1 *	0.790497	45.32756	21.13162	0.0000
At most 2	0.242722	8.062719	14.26460	0.3724
At most 3 *	0.177560	5.668913	3.841466	0.0173

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values*

VECM estimation and analysis

The VEC model's estimation results The adjustment coefficient of 0.69 shows that exports (EX) are in a condition of short-run imbalance but experience dynamics towards long-run equilibrium relationships in some periods with other variables.

The short-term imbalance and dynamic structure can be expressed as VECM. Since the lag order of VAR is 6, VECM's lag order should be 3. The estimated results of the VECM model are the first equation treated as the cointegration equation of the VEC model. The equation's results are shown in Table 4. The cointegration equation is

logEX (−1) = -0.1399 +5.1971*logPMTB(-1) +1.4565*logDT(−1) +0.1442*logINV(−1)

Table 4. Results of cointegration equations

Variables	Coefficients
logEKSPOR (-1)	1,0000
logPMTB (-1)	5.1971 (5.3087)
logDT (-1)	1.4565 (1.4544)
logINV (-1)	0.1442 (0.9122)
C	-0.1399

From this equation, it can be seen that other things being equal, an increase in PMTB will increase exports by 5.19 percent. Likewise, an increase in the allocation of transfer funds by one percent will increase exports by 1.45 percent. The investment response also points in the same direction that a one percent increase in INV will increase exports by 0.14 percent.

The VEC model analysis results found a short-term and long-term relationship between Jambi exports with gross domestic capital formation, allocation of transfer funds, and private investment. In the short term, there is a disequilibrium relationship, and that becomes a long-term balance. Only 69 percent of export changes can be determined in the current period, and the rest is determined in other periods. Likewise, in the gross domestic capital formation, only 38 percent can be determined in the current period, and the rest is determined in other periods. Vector error correction model (VECM) is as follows:

$$\begin{bmatrix} \Delta \mathrm{logEKSPOR_t} \\ \Delta \mathrm{logPMTB_t} \\ \Delta \mathrm{logDT_t} \\ \Delta \mathrm{INV_t} \end{bmatrix} = \begin{bmatrix} -0{,}0304 \\ -0{,}0128 \\ -0{,}0012 \\ -0{,}0057 \end{bmatrix} + \begin{bmatrix} -0.3241 & 0.2312 & -0.1157 & 0.0695 \\ 3.0831 & 0.6490 & 0.0806 & 0.3374 \\ 1.7489 & 0.5767 & -1.0233 & 0.2288 \\ 0.1214 & 0.0439 & -0.0236 & -0.7600 \end{bmatrix} \begin{bmatrix} \Delta \mathrm{logEKSPOR_{t-1}} \\ \Delta \mathrm{logPMTB_{t-1}} \\ \Delta \mathrm{logDT_{t-1}} \\ \Delta \mathrm{INV_{t-1}} \end{bmatrix}$$

$$+ \begin{bmatrix} -0.0493 & 0.1958 & -0.0964 & 0.1448 \\ 2.7728 & 0.2829 & 0.1190 & 0.2131 \\ 2.8159 & 0.9148 & -0.7699 & 0.5870 \\ 0.0778 & 0.0600 & -0.0332 & -0.5110 \end{bmatrix} \begin{bmatrix} \Delta \mathrm{logEKSPOR_{t-2}} \\ \Delta \mathrm{logPMTB_{t-2}} \\ \Delta \mathrm{logDT_{t-2}} \\ \Delta \mathrm{INV_{t-2}} \end{bmatrix}$$

$$+ \begin{bmatrix} 0.2063 & 0.0997 & -0.0514 & 0.1944 \\ 1.3325 & -0.1953 & 0.2038 & -0.0922 \\ 1.8327 & 0.8505 & -0.4446 & 0.3433 \\ 0.0830 & 0.0668 & -0.0487 & -0.3008 \end{bmatrix} \begin{bmatrix} \Delta \mathrm{logEKSPOR_{t-3}} \\ \Delta \mathrm{logPMTB_{t-3}} \\ \Delta \mathrm{logDT_{t-3}} \\ \Delta \mathrm{INV_{t-3}} \end{bmatrix}$$

The data in Appendix 3 show that the fitting degree of VEC model R2 >0.5, and AIC and SC criteria values are relatively small, indicating the model estimation's reasonability. Zero average lines represent a stable and long-term equilibrium relationship among variables. There was a large fluctuation at the end of 2014, which shows that the short-term fluctuation significantly deviated from the long-term equilibrium relationship. The effect of short-term fluctuations is the sharp decline in exports of Jambi Province caused by the sharp decline in the price of natural rubber starting in 2014, shown in Figure 1.

Furthermore, the long-term relationship between EX and PMTB, DT, and INV in Jambi Province is still in line with economic theory thinking. Increasing infrastructure stocks financed by public and private investment and increasing education and health financing from local government expenditures, especially transfer funds, are important in achieving regional development goals. The increase in infrastructure stocks and human resources quality have been linked directly or indirectly to the increase in Jambi Province exports in the long term.

The relationship between exports and investment, especially in infrastructure, is also shown by Sorianoa & Garridoa (2015). They tested the hypothesis of whether a public-private investment in infrastructure had a positive impact on agricultural exports, using a panel data approach covering 52 developing countries from 1995 to 2011. One of the conclusions in their article states that public-private investment in infrastructure has contributed positively to increased agricultural exports in developing countries. There is a positive and significant relationship between public-private investment in infrastructure and agricultural trade.

An increase in public investment under certain conditions can promote the increasing number of private investments by domestic and foreign investors. Jambi Province has advantages in the abundance of natural resources, especially land. In the span of the analysis period, it shows that Jambi's export products are dominated by natural resource content. Therefore, more private investors invest in utilizing these natural resources, such as plantations, forestry, and mining. The previous VEC model estimates provide empirical evidence that there is a link between private investment and increased exports in the long run.

The positive relationship between private (domestic) investment and government spending and foreign direct investment (FDI) is shown in previous studies. Choong et al. (2015) investigate the linkages between private investment, government investment, foreign investment (FDI), and Malaysia's economic growth. Based on the cointegration test, the results reveal a single cointegrating vector in the system. It implies that private investment, government spending, FDI, economic growth, and interest rate move together to achieve their steady-state long-run relationship. Besides, they find that both government spending and FDI have a positive effect on private investment and these two types of investments are “crowd in” private investments in the long run and the short run.

Previous empirical facts also show a positive relationship between private investment, especially foreign direct investment (FDI), and export performance in several countries. Khan & Sultana (2013) identified whether foreign investment significantly affected the Bangladeshi economy by investigating the relationship between foreign investment and exports. They analyzed the data needed for the last 10 years (2001-2010), the findings show that foreign investment has a significant positive relationship with exports, which helps Bangladesh's economic growth.

A study by Mukhtarov et al. (2019) investigates the impact of investment (FDI) on exports in the case of Jordan, employing Autoregressive Distributed Lag Bounds Testing (ARDL BT) cointegration approach to the data ranging from 1980 to 2018. The results indicate that there is a long-run relationship among the variables. Also, we find a positive and statistically significant impact of FDI on export in the long-run. The estimation results indicate that a 1% increase in FDI increases exports by 0.13%.

In contrast, the study results by Jana et al. (2020) encourage new empirical evidence on how FDI is relevant to the growth of foreign trade in India using an autoregressive vector specification. The Johansen’s cointegration test documents a significant and positive long-run co-movement between FDI and foreign trade in India. The vector error correction model suggests a unidirectional long-run causality from foreign trade to FDI. However, the Granger causality test confirms a bidirectional short-run causal relationship between these variables. Further, the variance decomposition analysis approves a strong exogeneity of foreign trade. Again, the impulse response function analysis reveals that the responses generated from a positive shock of foreign trade to FDI and vice versa are small and initially negative and, after that, remain persistently positive at a constant level. The study finally concludes that the absence of long-run causality from FDI to export results from foreign investors' domestic market orientation and less emphasis on India's export-oriented sectors.

VECM stability test

Figure 4 shows The root of 6 residual stability test results in 1, and the root of other residual stability test results in less than 1. So the VECM model satisfies the stability condition.

Testing autocorrelation to residuals shows the majority of there is no specific relationship patterns shown in Figure 3. Thus it can be concluded that, at the same time, it does not have autocorrelation. On the whole, the VECM model has good effects.

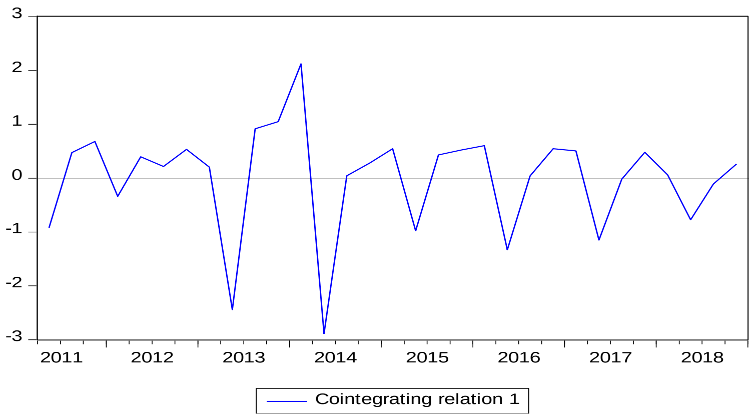


Figure 3. Cointegration relationship graph

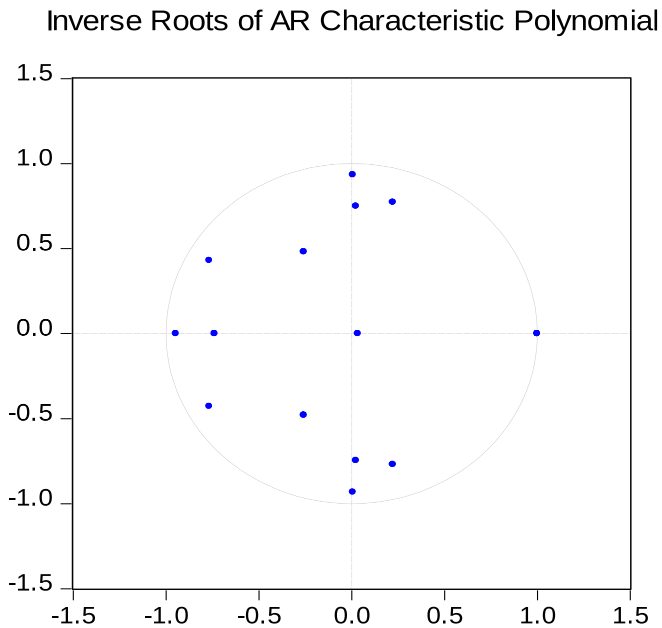


Figure 4. Residual stability test of ECM model

Impulse response function

Further analysis is made through impulse response function and variance decomposition based on VECM. It aims to analyze the model's dynamic effects responding to certain shocks and how the effects are among the four variables.

According to Figure 5, the positive export shock has a large impact. Exports fell rapidly after the shock, reached the lowest point in the second period, then rose slowly, reaching a peak in the fourth to sixth period, then dropped again in the seventh period. After that, it goes up to the eighth period to a stable level. It shows that positive export shocks significantly affect their improvement and have relatively long effectiveness towards a stable level.

Figure 5 shows the impulse response function of export changes caused by the shock of gross fixed capital formation. The positive shock of one standard deviation of gross fixed capital formation reduces exports relatively sharply to the lowest point in the fourth period. Then it rises sharply again until the sixth period, after which it falls again until the ninth period. Furthermore, exports rose again until the eleventh period and towards a stable level.

Gross fixed capital formation shocks significantly affect Jambi export fluctuations and require a long enough period to reach a stable level. Most of Jambi's export commodities come from the natural resource-based economic sector. Therefore it is necessary to adjust the capital stock level to increase production and exports.

Figure 5 shows the impulse response function of export changes caused by shocks to allocating transfer funds. The positive shock of one standard deviation of transfer fund allocation has increased exports in the initial period but has declined sharply until the fifth period. Exports sharply increased until the sixth period, and after that, exports headed to a stable level condition.

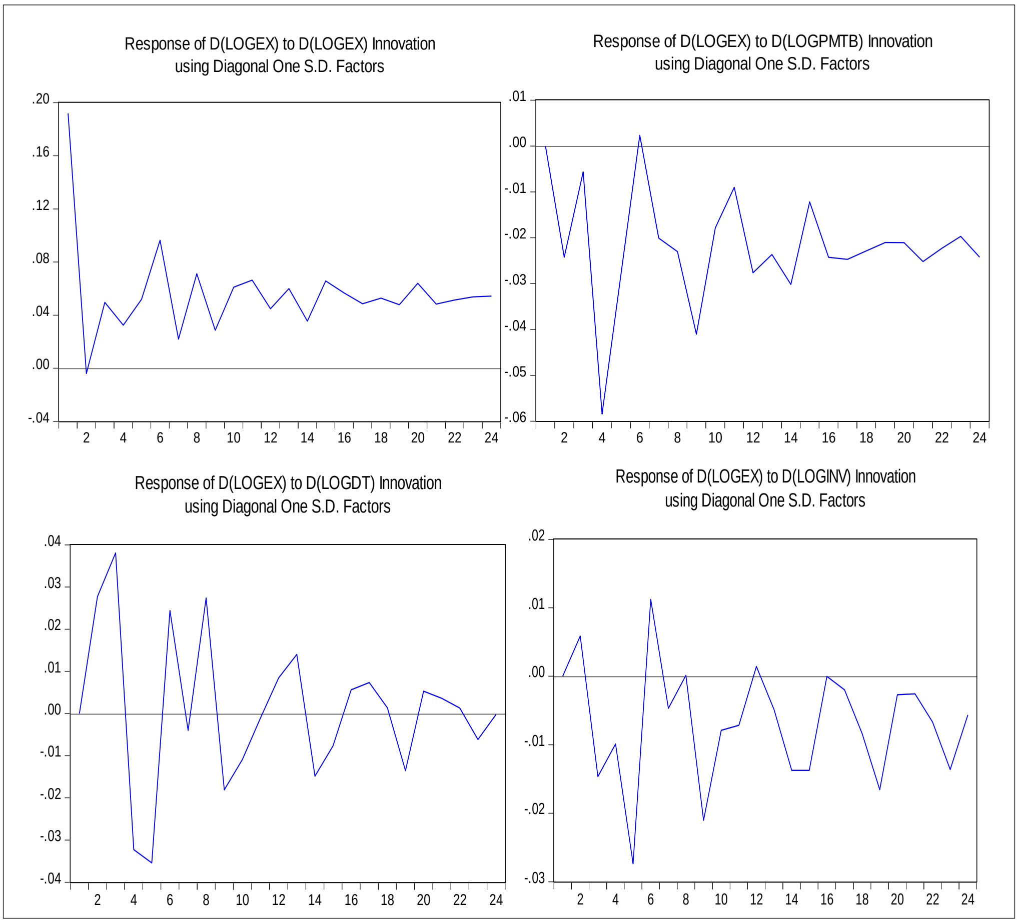


Figure 5. Impulse response to innovations

The transfer fund allocation shock significantly affects Jambi export fluctuations and requires a period fast enough to reach a level of stability. Some of the transfer fund allocations are used to finance the construction of economic infrastructure that takes one to one and a half years (range of the government budget) to be used for economic activities. Whereas the allocation of transfer funds through education and health investment is likely to impact economic activities, especially in the export sector, requiring a longer period.

Figure 5 shows the impulse response function of export changes caused by private investment shocks. Private investment is a combination of domestic private investment and foreign investment. The positive shock of one standard deviation gives the effect of reducing exports relatively sharply to the lowest point in the fifth period. After that, it goes down again until the seventh period. It experienced a relatively weak increase until the eighth period, and subsequently, exports returned to stable levels.

Private investment shocks significantly affect Jambi export (fluctuations and require a long time to reach a stable level. The dominance of Jambi's export commodities in natural rubber, crude palm oil, pulp and paper, coffee beans, and coal. It all comes from natural resource-based economic sectors, which need a longer period to adjust capital stock levels to increase production and exports.

Variance decomposition

The impulse response function is adopted to reflect the shock effect of a system on an internal variable. Variance decomposition refers to the decomposition of mean square error into each variable's contributions. Variance decomposition can be applied to analyze each variable's influence on other variables (Figure 6).

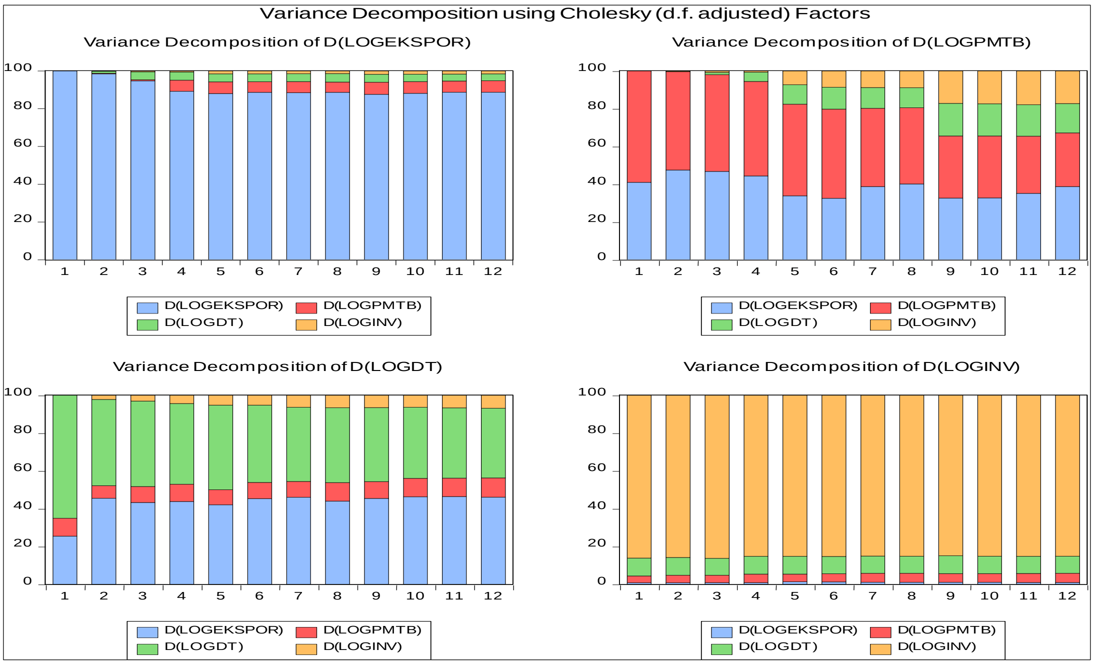


Figure 6. Variance decomposition of the variables

Figure 6 is the predicted export variant. The contribution of exports gradually declined from the third period, reaching 88% from the fourth to the twelfth. Jambi is a producer and exporter of natural resource commodities abundant in the trade-in industrial raw materials. The possibility of patron-client relationships in business activities, trade contracts, and supply chain continuity plays an important role in explaining the analysis results.

The contribution of exports will determine the gross fixed capital formation. Business entities use a portion of the export value to reinvest in adjusting the desired stock of capital. The contribution of exports to the gross domestic capital formation has remained stable from period to period. Gross fixed capital formation is also influenced by itself, but its contribution tends to decrease slowly.

Furthermore, private investment dominates total investment in Jambi. The relative level of contribution is around 85 percent from period to period. The implication of this analysis results is the importance of creating a conducive and attractive investment climate for investors to decide on investments in business activities in Jambi.

Several factors related to creating a conducive and attractive investment climate need to be considered, such as the adequacy of various infrastructures, simplification of regulations, skilled labor, good public services, information on investment opportunities, and security stability. It can be stated that the gross domestic capital formation has a great influence on export. In the long run, the influence is leveling off. As presented in the model, the export is related to the lag period's current variables and the variables.

CONCLUSIONS AND RECOMMENDATION

Conclusion

This article sets out a model of the relationship between exports, gross domestic capital formation, allocation of transfer funds, and private investment in Jambi Province. The results show that, both in the short and long term, the gross domestic capital formation, allocation of transfer funds, and private investment can explain changes in Jambi exports. The gross domestic capital formation strongly influences Jambi's export fluctuations compared to other variables. We know that the stock of fixed capital in the economy in the province of Jambi is influenced by private investment and local government investment.

There is a short-term and long-term relationship between Jambi exports with the establishment of gross domestic capital formation, allocation of transfer funds, and private investment. There is a disequilibrium relationship in the short term, and it becomes equilibrium in the long run. Only 69 percent of export changes can be determined in the current period, and the rest is determined in other periods. Likewise, in the gross domestic capital formation, only 38 percent can be determined in the current period, and the rest is determined in other periods.

The impact of export shocks has a large impact on itself. The shock has a very significant impact and has relatively long effectiveness towards a stable level. Furthermore, as an impulse response function, changes in Jambi exports can be caused by shocks to gross fixed capital formation. The shock of gross fixed capital formation had a negative effect on Jambi's exports in the initial period, after which it increased and turned to a stable level. The shock of the gross domestic capital formation requires a long period to reach a level of stability.

Recommendation

The economy of Jambi Province is supported by exports, especially agricultural commodities, processed agricultural and forestry products, and coal mining. The increase in exports in 2010 - 2018 has provided employment and business for the community and a share of local taxes. Empirical evidence provides information on a strong relationship with the role of gross fixed capital formation on Jambi's exports. There is also a strong relationship between private investment and transfer funds on gross fixed capital formation.

Efforts to achieve the Jambi economy's sustainability, especially exports, require increasing export growth due to encouraging investment (investment-led exports). This achievement is suggested to the Jambi local government to carry out a regional investment promotion program for potential domestic investors and foreign investors. In the context of a significant increase in investment, it is necessary to prepare local governments to provide adequate infrastructure (public investment) and effective communication about the potential of natural resources and a more conducive socio-cultural security condition for investors. Besides, harmonious interaction between Jambi local government (including local communities) and investors is the key to attracting more investment.

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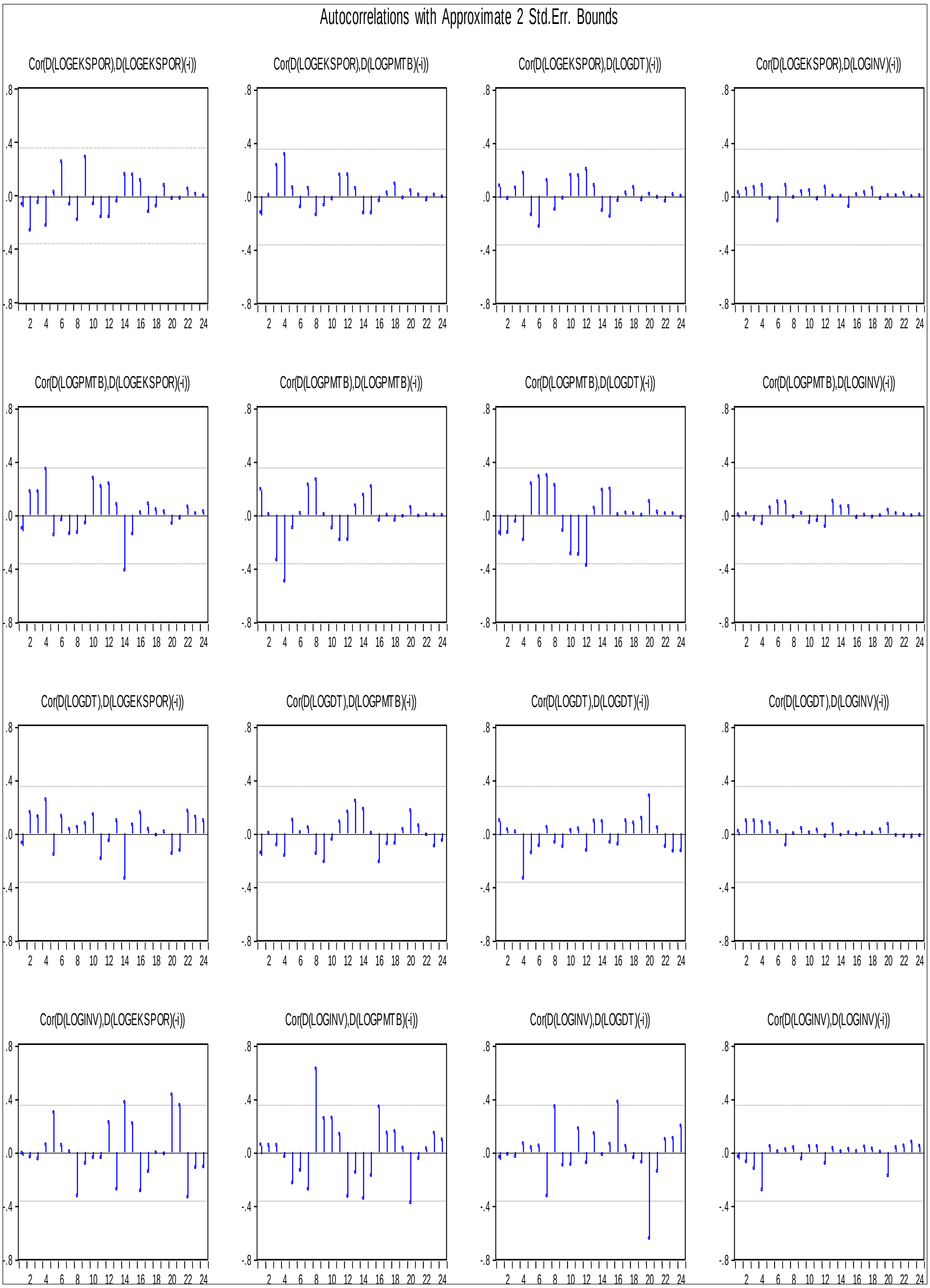
Appendix 1. VECM autocorrelation diagram



Appendix 2. Estimation results the VAR model

	D(LOGEKSPORT	D(LOGPMTB)	D(LOGDT)	D(LOGINV)
D(LOGEKSPOR(-1))	-0.985308	-0.009298	-0.032525	0.578507
	(0.38773)	(0.05867)	(0.07958)	(1.09979)
	[-2.54124]	[-0.15849]	[-0.40873]	[0.52602]
D(LOGEKSPOR(-2))	-1.100396	0.182917	0.196156	0.976243
	(0.55040)	(0.08328)	(0.11296)	(1.56121)
	[-1.99927]	[2.19639]	[1.73649]	[0.62531]
D(LOGEKSPOR(-3))	-0.623262	0.042935	0.139694	0.445921
	(0.34747)	(0.05258)	(0.07131)	(0.98560)
	[-1.79371]	[0.81664]	[1.95887]	[0.45243]
D(LOGEKSPOR(-4))	-0.356863	-0.169702	-0.067678	0.183382
	(0.45892)	(0.06944)	(0.09419)	(1.30173)
	[-0.77761]	[-2.44389]	[-0.71855]	[0.14088]
D(LOGEKSPOR(-5))	-0.206234	-0.094061	-0.150518	0.934813
	(0.50055)	(0.07574)	(0.10273)	(1.41981)
	[-0.41202]	[-1.24193]	[-1.46517]	[0.65841]
D(LOGEKSPOR(-6))	-0.678223	0.255748	0.240832	0.866799
	(0.50599)	(0.07656)	(0.10385)	(1.43523)
	[-1.34040]	[3.34047]	[2.31912]	[0.60394]
D(LOGPMTB(-1))	1.886578	-1.989665	-2.180395	1.640227
	(4.02450)	(0.60895)	(0.82597)	(11.4155)
	[0.46877]	[-3.26739]	[-2.63980]	[0.14368]
D(LOGPMTB(-2))	-3.250732	0.696506	1.040747	2.079601
	(2.25121)	(0.34063)	(0.46203)	(6.38559)
	[-1.44399]	[2.04475]	[2.25255]	[0.32567]
D(LOGPMTB(-3))	-0.893775	-1.342027	-0.683393	1.467093
	(1.84612)	(0.27934)	(0.37889)	(5.23653)
	[-0.48414]	[-4.80435]	[-1.80367]	[0.28017]
D(LOGPMTB(-4))	-0.792306	-0.855196	-1.270325	2.693582
	(2.27445)	(0.34415)	(0.46680)	(6.45151)
	[-0.34835]	[-2.48497]	[-2.72135]	[0.41751]
D(LOGPMTB(-5))	-3.637424	0.932429	1.419795	2.195047
	(2.82232)	(0.42705)	(0.57924)	(8.00554)
	[-1.28881]	[2.18344]	[2.45113]	[0.27419]
D(LOGPMTB(-6))	1.216724	-1.280992	-1.110764	0.513150
	(2.41018)	(0.36468)	(0.49466)	(6.83650)
	[0.50483]	[-3.51260]	[-2.24553]	[0.07506]
D(LOGDT(-1))	-3.136239	1.693243	2.042697	0.443614
	(4.41071)	(0.66738)	(0.90523)	(12.5110)
	[-0.71105]	[2.53713]	[2.25654]	[0.03546]
D(LOGDT(-2))	2.979013	-0.910895	-1.090609	-0.485885
	(2.75085)	(0.41623)	(0.56457)	(7.80283)
	[1.08294]	[-2.18843]	[-1.93174]	[-0.06227]
D(LOGDT(-3))	-0.495640	0.562535	0.779397	-2.450129
	(1.91918)	(0.29039)	(0.39388)	(5.44377)
	[-0.25826]	[1.93716]	[1.97874]	[-0.45008]
D(LOGDT(-4))	0.351202	-1.436071	-0.554544	-0.502857
	(1.83178)	(0.27717)	(0.37595)	(5.19585)
	[0.19173]	[-5.18127]	[-1.47506]	[-0.09678]
D(LOGDT(-5))	0.227284	-0.743403	-1.904535	3.957772
	(3.63914)	(0.55064)	(0.74688)	(10.3225)
	[0.06246]	[-1.35007]	[-2.54998]	[0.38341]
D(LOGDT(-6))	-7.395859	3.312388	3.103022	2.179236
	(5.81953)	(0.88055)	(1.19438)	(16.5072)
	[-1.27087]	[3.76171]	[2.59803]	[0.13202]
D(LOGINV(-1))	0.079647	0.008845	-0.001832	-0.068624
	(0.17242)	(0.02609)	(0.03539)	(0.48906)
	[0.46195]	[0.33903]	[-0.05178]	[-0.14032]

	D(LOGEKSPORT	D(LOGPMTB)	D(LOGDT)	D(LOGINV)
D(LOGINV(-2))	0.000324	0.041854	0.021891	-0.058180
	(0.17152)	(0.02595)	(0.03520)	(0.48653)
	[0.00189]	[1.61265]	[0.62186]	[-0.11958]
D(LOGINV(-3))	0.093702	0.042419	0.035027	-0.221022
	(0.19218)	(0.02908)	(0.03944)	(0.54513)
	[0.48757]	[1.45874]	[0.88804]	[-0.40545]
D(LOGINV(-4))	0.088644	-0.075624	0.052469	-0.079097
	(0.17339)	(0.02624)	(0.03559)	(0.49183)
	[0.51123]	[-2.88246]	[1.47440]	[-0.16082]
D(LOGINV(-5))	0.436570	-0.195121	-0.289847	0.055877
	(0.56134)	(0.08494)	(0.11521)	(1.59224)
	[0.77773]	[-2.29727]	[-2.51589]	[0.03509]
D(LOGINV(-6))	-0.544288	0.288719	0.265203	0.022332
	(0.52529)	(0.07948)	(0.10781)	(1.48998)
	[-1.03617]	[3.63254]	[2.45996]	[0.01499]
C	0.587772	-0.037625	-0.031697	-0.547738
	(0.24067)	(0.03642)	(0.04939)	(0.68267)
	[2.44222]	[-1.03319]	[-0.64172]	[-0.80235]

Appendix 3. VECM estimation results and test

Error Correction:	D(LOGEKSPORT)	D(LOGPMTB)	D(LOGDT)	(LOGINV)
CointEq1	-0.696445	-0.382134	-0.015616	-0.123598
	(0.47395)	(0.11157)	(0.09323)	(0.69206)
	[-1.46945]	[-3.42507]	[-0.16749]	[-0.17859]
D(LOGEKSPOR(-1))	-0.324122	0.231197	-0.115744	0.069554
	(0.48382)	(0.11389)	(0.09518)	(0.70648)
	[-0.66992]	[2.02994]	[-1.21610]	[0.09845]
D(LOGEKSPOR(-2))	-0.049311	0.195846	-0.096397	0.144841
	(0.46485)	(0.10943)	(0.09144)	(0.67878)
	[-0.10608]	[1.78972]	[-1.05416]	[0.21338]
D(LOGEKSPOR(-3))	0.206376	0.099760	-0.051434	0.194406
	(0.30826)	(0.07257)	(0.06064)	(0.45013)
	[0.66948]	[1.37473]	[-0.84818]	[0.43189]
D(LOGPMTB(-1))	3.083097	0.649021	0.080669	0.337429
	(1.89274)	(0.44556)	(0.37234)	(2.76381)
	[1.62890]	[1.45664]	[0.21666]	[0.12209]
D(LOGPMTB(-2))	2.772846	0.282951	0.118981	0.213134
	(1.32861)	(0.31276)	(0.26136)	(1.94005)
	[2.08703]	[0.90469]	[0.45524]	[0.10986]
D(LOGPMTB(-3))	1.332545	-0.195397	0.203877	-0.092263
	(0.69207)	(0.16292)	(0.13614)	(1.01056)
	[1.92545]	[-1.19937]	[1.49754]	[-0.09130]
D(LOGDT(-1))	1.748905	0.576685	-1.023341	0.228866
	(1.27548)	(0.30025)	(0.25091)	(1.86246)
	[1.37118]	[1.92066]	[-4.07854]	[0.12288]
D(LOGDT(-2))	2.815917	0.914808	-0.769932	0.587077
	(1.39715)	(0.32890)	(0.27484)	(2.04013)
	[2.01547]	[2.78145]	[-2.80134]	[0.28776]
D(LOGDT(-3))	1.832729	0.850573	-0.444608	0.343312
	(0.92637)	(0.21807)	(0.18223)	(1.35269)
	[1.97840]	[3.90043]	[-2.43978]	[0.25380]
D(LOGINV(-1))	0.121391	0.043939	-0.023588	-0.760070
	(0.17074)	(0.04019)	(0.03359)	(0.24932)
	[0.71097]	[1.09318]	[-0.70228]	[-3.04859]
D(LOGINV(-2))	0.077881	0.060083	-0.033249	-0.511029
	(0.19098)	(0.04496)	(0.03757)	(0.27887)
	[0.40780]	[1.33644]	[-0.88502]	[-1.83250]
D(LOGINV(-3))	0.083070	0.066823	-0.048690	-0.300851
	(0.16110)	(0.03792)	(0.03169)	(0.23524)
	[0.51565]	[1.76207]	[-1.53642]	[-1.27893]
C	-0.030409	-0.012845	-0.001197	-0.005720
	(0.11133)	(0.02621)	(0.02190)	(0.16256)
	[-0.27314]	[-0.49013]	[-0.05466]	[-0.03519]
DUMMYOIL	0.104604	0.054922	-0.007966	-0.008081
	(0.18607)	(0.04380)	(0.03660)	(0.27171)
	[0.56216]	[1.25386]	[-0.21763]	[-0.02974]
R-s quared	0.653980	0.930790	0.773408	0.435245
Log likelihood	66.90616			
Akaike information criterion	-0.187494			
Schwarz criterion	2.772995			
Number of coefficients	64			