Greener Journal of Economics and Accountancy

ISSN: 2276-7762

Submission Date: 26/06/014

Accepted: 15/08/014

Published: 15/08/014

Subject Area of Article: Economics

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By

Charles Ruranga
Bruno Ocaya
William Kaberuka

Research Article

VAR Analysis of Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade in Rwanda

Charles Ruranga^{1,2*}, Bruno Ocaya¹ & William Kaberuka¹

¹School of Statistics and Planning, Makerere University, Kampala, Uganda.

²School of Economics, University of Rwanda, P.O. Box 117, Butare, Rwanda.

*Corresponding Author's Email: c.ruranga@ur.ac.rw, Tel: +250 788 484 421

ABSTRACT

This paper analyses real Gross Domestic Product (GDP), Domestic Investment (DI), Foreign Direct Investment (FDI), Domestic Savings (DS) and Trade (TR) in Rwanda for the period 1970 to 2011. GDP and DI have an upward trend and annual growth of real GDP was around 8% in average for all period. FDI and DS have remained below 2% of GDP each and trade balance of Rwanda is always negative. Augmented Dickey-Fuller (ADF) tests show that GDP, DI and FDI are not stationary at the level but the first differences are stationary. VAR (1) was identified as the appropriate model according to Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion. Granger causality tests show that there is bi-directional causality between GDP and TR and TR and DI and unidirectional causality from GDP to DI, from DS to GDP, from DS to DI and from DS to TR. These findings show that GDP can be used to promote Domestic Investment and Trade. Domestic savings have significant effects on GDP, DI and TR. VAR was estimated and the forecasted values of GDP, DI and FDI in 2011 are respectively, 3,843.6233 million, 22.67% and 0.95% while their actual values in 2011 are 3891.9million, 22.7% and 1.66%. There is under-prediction for GDP, DI and FDI. The differences can be explained by the efforts of the Government of Rwanda to promote GDP, Domestic Investment and Foreign Direct Investment.

Keywords: VAR model, Granger causality tests, economic growth, foreign direct investment, domestic savings, trade.

1. INTRODUCTION

Foreign Direct Investment, Domestic Investment, Domestic Savings and trade provide a crucial basis for economic development of any country. The scholars have found different results on the kind of relationship between Foreign Direct Investment, Domestic Investment, Domestic Savings, growth and trade and the significance of the effect of one variable to another.

Rwanda is located in East and Central Africa with 26,338 square kilometres of land. In 2012, Rwandan population was 10.5 million with 416 inhabitants per square kilometre (National Institute of Statistics of Rwanda, 2012). It borders Tanzania to the east, the Democratic Republic of Congo to the west, Uganda to the north, and Burundi to the south. Rwandan economy is not diversified and trade balance is always negative.

The Government of Rwanda has elaborated a set of targets in order to promote investments, savings and trade. Targets for a mid-term are presented in Economic Development and Poverty Reduction Strategy (EDPRS) and Vision 2020 for long-term. Targets related to investment, savings and trade in vision 2020 are:

- To Increase National investment's share of the GDP from 18% in 2000 to 23% in 2010 and 30% in 2020;
- To Increase the national Savings rate from 1% in 2000 to 4% in 2010 and 6% in 2020;
- To Reduce the deficit of the Balance of Payments (except official transfers) from 17% of GDP in 2001 to 9% in 2010

Specific policies related to investment, savings and trade have been adopted in order to promote domestic and foreign investment, domestic savings and national and international trade, especially by increasing exports.

Rwanda is among developing countries which have put more effort in promoting domestic and foreign investment, domestic savings and international trade, especially exports in recent two decades in the purpose of

accelerating economic growth. However, at my knowledge very few studies have been conducted on behaviour and relationship between those variables.

The specific objectives of this paper are to:

1. Examine the individual trend of Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade.
2. Examine the causality effects between Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade.
3. Examine the linear interdependencies among Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade.

This paper uses different econometric techniques to analyze or test the relationship between the variables. Graphical analysis is used to analyse the trend of those time series, Granger causality tests helps in analysis of causality and VAR model in the investigation of the existence of linear relationship between Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade. Macroeconomic variables are often not exogenous and to avoid endogeneity problem VAR model is used. A VAR model assumes that all variables are endogenous where each variable is explained by its own lags and the lags of the others.

After this introduction, the paper is subdivided in four sections. Section 2 presents literature review, section 3 gives data and model specification; section 4 presents results and discussions and section 5 gives conclusion.

2. LITERATURE REVIEW

An investigation of the causality relationship between domestic investment and economic growth show that the findings are not the same for all researchers. Researchers found that there is a bi-directional causality between domestic investment and economic growth (Tang et al., 2008; Ghazali, 2010; Tan and Lean, 2010), there is a single-directional causality from economic growth to domestic investment (Choe, 2003; Quin et al., 2006) and few others, a single-directional causality from domestic investment to economic growth (Villa, 2008).

Causality analysis between FDI and growth show that there is a single-directional causality from FDI to economic growth (Tang et al., 2008; Ghazali, 2010; Katircioglu and Naraliyeva, 2006; Majagaiya and Qingliang, 2010), there is no causality between FDI and growth (Frimpong and Oteng-Abayie, 2006). Dhakal et al (n.d) revealed that FDI-to-growth causality is strengthened by the presence of greater trade openness, more limited rule of law, lower receipts of aid, and lower income level of the host country. There is a unidirectional causality relationship from exports to FDI (Jayachandran and Seilan, 2010). There is bi-directional causality between FDI and domestic investment (Ghazali, 2010) while others found that there is a single-directional causality from FDI to domestic investment (Tang et al., 2008). There is bi-directional causality between FDI and domestic savings (Katircioglu and Naraliyeva, 2006).

Savings and growth reinforce each other and the causality runs from both directions (Schmidt-Hebber et al., 1996). There is unidirectional causality from savings to economic growth (Ramesh, 2011). Unidirectional causality from growth to savings (Verma, 2007; Sahoo et al., 2001; Mühleisen, 1997, Sinha and Sinha, 2007), there is no causality between GDP and savings (Sinha, 1996). Bi-directional causality between savings and investment (Onafowara et al., 2011), there is causality running from savings to investment (Esso and Kehoe, 2010, Tehranchian and Behraves, 2011), there is causality from investment to savings (Onafowara et al., 2011), there is no causation between savings and investment (Esso and Kehoe, 2010, Ramakrishna and Venkateshwar, 2012). There is bidirectional long-run causality between export and GDP growth (Mehra and Firouzjaee, 2011; Ekanayake, 1999).

The results on relationship between economic growth, domestic investment, foreign direct investment, domestic savings and trade are controversial. In order to have appropriate policy recommendations, scholars recommended specific country studies.

3. DATA AND MODEL SPECIFICATION

3.1 Data

The data used in this analysis consists of 42 observations, collected from World Bank (2012a) for the period 1970-2011. The variables are real GDP (at constant 2000 in US\$) as proxy of Economic Growth, Gross Fixed Capital

formation as percentage of GDP, proxy of Domestic Investment, Foreign Direct Investment net inflows as percentage of GDP, Gross Domestic Savings as percent of GDP and trade of goods and services measured as a share of GDP.

3. 2 Model specification

VAR models allows interpretations on the dynamic relationship between the variables. The VAR model of economic growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade is formulated as:

$$GDP_t = \delta_1 + \sum_{i=1}^p \beta_{1i} GDP_{t-i} + \sum_{i=1}^p \beta_{2i} DI_{t-i} + \sum_{i=1}^p \beta_{3i} FDI_{t-i} + \sum_{i=1}^p \beta_{4i} DS_{t-i} + \sum_{i=1}^p \beta_{5i} TR_{t-i} + u_{1t} \quad (1)$$

$$DI_t = \delta_2 + \sum_{i=1}^p \alpha_{1i} GDP_{t-i} + \sum_{i=1}^p \alpha_{2i} DI_{t-i} + \sum_{i=1}^p \alpha_{3i} FDI_{t-i} + \sum_{i=1}^p \alpha_{4i} DS_{t-i} + \sum_{i=1}^p \alpha_{5i} TR_{t-i} + u_{2t} \quad (2)$$

$$FDI_t = \delta_3 + \sum_{i=1}^p j_{1i} GDP_{t-i} + \sum_{i=1}^p j_{2i} DI_{t-i} + \sum_{i=1}^p j_{3i} FDI_{t-i} + \sum_{i=1}^p j_{4i} DS_{t-i} + \sum_{i=1}^p j_{5i} TR_{t-i} + u_{3t} \quad (3)$$

$$DS_t = \delta_4 + \sum_{i=1}^p \phi_{1i} GDP_{t-i} + \sum_{i=1}^p \phi_{2i} DI_{t-i} + \sum_{i=1}^p \phi_{3i} FDI_{t-i} + \sum_{i=1}^p \phi_{4i} DS_{t-i} + \sum_{i=1}^p \phi_{5i} TR_{t-i} + u_{4t} \quad (4)$$

$$TR_t = \delta_5 + \sum_{i=1}^p \lambda_{1i} GDP_{t-i} + \sum_{i=1}^p \lambda_{2i} DI_{t-i} + \sum_{i=1}^p \lambda_{3i} FDI_{t-i} + \sum_{i=1}^p \lambda_{4i} DS_{t-i} + \sum_{i=1}^p \lambda_{5i} TR_{t-i} + u_{5t} \quad (5)$$

Where, δ , β , α , ϕ , ϕ and λ are parameters, GDP represents real Gross Domestic Product, DI Domestic Investment, FDI Foreign Direct Investment, DS represents Domestic Savings, TR Trade and u are the stochastic error terms. Assumptions about the error terms:

1. The expected residuals are zero: $E(u_{1t}) = E(u_{2t}) = E(u_{3t}) = E(u_{4t}) = E(u_{5t}) = 0$
2. The vector error terms are not auto-correlated:

$$E(u_t u'_s) = \sigma_i^2 \text{ if } s = t$$

and

$$E(u_t u'_s) = 0 \text{ if } s \neq t$$

Different tests were conducted using equations (1) to (5) in order to analyse the dynamic relationship between those variables.

4. RESULTS AND DISCUSSIONS

This section presents graphical analysis and VAR model analysis of economic growth, domestic investment, foreign direct investment, domestic savings and trade.

4.1 Graphical analysis

Trend analysis of Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade of goods and services and results are presented in figures (1) – (5).

Figure 1: GDP and GDP growth, Rwanda, 1970-2011 (annually)

Source: World Bank, World development indicators, 2012.

Figure 1 shows that the real GDP has increased significantly, especially after 1994. This increment after 1994 can be explained by government effort and policies adopted and implemented related to economic development. Annually, real growth of GDP has fluctuated but remains around 8% in average.

Figure 2: DI and DI as share of GDP, Rwanda, 1970-2011 (annually)

Source: World Bank, World development indicators, 2012.

Figure 2 related to Domestic Investment show that DI in current US dollar has increased from 0.015 billion in 1970 to 1.45 billion in 2011. DI as share of GDP has also increased from 7.18% to 22.7% of GDP. The target of 2020 is 30% of GDP which seems achievable.

Figure3: FDI and FDI as share of GDP, Rwanda, 1970-2011 (annually)

Source: World Bank, World development indicators, 2012.

FDI in current US Dollar had remained constant in trend before 2006, after that period it had increased dramatically until 2009. In 2010 FDI had decreased, this can be explained by international financial crisis. In 2011, FDI has increased due to stability of Rwandan economy. For all periods, FDI has increased and the FDI as share of GDP has increased but, it is still below 2% of GDP.

Figure 4: DS and DS as share of GDP, Rwanda, 1970-2011 (annually)

Source: World Bank, World development indicators, 2012.

Figure 4 shows that Gross Domestic Savings in current US Dollar fluctuated and were negative between 1994 and 2003 and the share of DS in GDP is 1.9% in average. Domestic savings remains important for investment even in the open country; the government of Rwanda has realized that it is very important and recently cooperatives of savings have been established at lower levels where population have easy access to financial facilities.

Figure 5: Trade, exports, imports and Trade balance, Rwanda, 1970-2011 (annually)

Source: World Bank, World development indicators, 2012.

Figure 5 shows that the trade balance is always negative and export levels remains below the imports. The imports of Rwanda are classified in four main categories that are the consumer goods, equipment goods, intermediate goods and energy and lubricants. The imports of consumer goods occupy the first place among the imports. The exports of Rwanda are dominated by coffee, tea and some minerals. Different policies and programs for promotion of agriculture, industry and services adopted by the Government of Rwanda such as crop intensification program, land registration, formation of agricultural cooperatives, national land policy, farm inputs subsidization through voucher system, agriculture insurance will contribute to increase domestic production. This will reduce imports and promote exports.

4.2 Unit root test

Tests for unit roots are used to determine the stationarity of GDP, DI, FDI, DS and TR and the Augmented Dickey-Fuller (ADF) tests are used in this paper. ADF used three type of models to test unit root on the first differenced series. Those models are:

$$1. \text{ Model without constant and trend: } \Delta y_t = \alpha y_{t-1} + \sum_{i=1}^k \beta_i \Delta y_{t-i} + \varepsilon_t \quad (6)$$

$$2. \text{ Model with constant and no trend: } \Delta y_t = \gamma_0 + \alpha y_{t-1} + \sum_{i=1}^k \beta_i \Delta y_{t-i} + \varepsilon_t \quad (7)$$

$$3. \text{ Model with constant and trend: } \Delta y_t = \gamma_0 + \gamma_1 t + \alpha y_{t-1} + \sum_{i=1}^k \beta_i \Delta y_{t-i} + \varepsilon_t \quad (8)$$

y_t represents any series i.e. GDP, DI, FDI, DS and TR, $\Delta y_t = y_t - y_{t-1}$ is the first difference of the series y_t , γ , α and β are parameters of the model and ε_t is a stochastic disturbance term.

The results of stationarity tests of GDP, DI, FDI, DS and TR at the levels and the first differences using ADF are reported in table 1.

Table 1: ADF Test for Unit Root

Variables	Model (1) no Constant & no trend	Model (2) Constant & no trend	Model (3) Constant & trend
ADF test for unit root on the level series			
GDP	2.678123	1.536266	0.060024
DI	1.112827	-1.253728	-2.664687
FDI	-0.776590	-1.837688	-1.826925
DS	-3.013283**	-3.089552*	-3.236892
TR	-0.131666	-3.107049*	-3.430289
ADF test for unit root on the first differences series			
GDP	-2.778282**	-3.457517*	-3.938781*
DI	-5.354767**	-5.691892**	-5.621788**
FDI	-4.768361**	-4.757889**	-4.709165**
DS	-6.722612**	-6.631071**	-6.538303**
TR	-7.144459**	-7.103692**	-7.007497**

Note:** & * denotes significance at the 1 per cent and 5 per cent respectively.

The results presented in Table 1 shows that the null hypothesis of a unit root is: (i) accepted for the level series of GDP, DI and FDI E in all three models at 1% of significance level; and (ii) rejected for the level series of DS at 1% of significance level in model (1) and 5% of significance level in model (2) for DS and TR. ADF test for unit root on the first differenced series show that all series are stationary at 1% of significance level.

4.3 Selection-order criteria

The Akaike information criteria (AIC), Schwarz information criteria (SC) and Hannan-Quinn information criterion (HQ) were used to determine the maximum lag p. The lower the values of Akaike, Schwarz and Hannan-Quinn statistics, the better is the model. The results are presented in Table 2.

Table 2: Selection-order criteria

Lag	LogL	LR ^a	FPE ^b	AIC ^c	SC ^d	HQ ^e
0	-690.6562	NA	8.78e+08	34.78281	34.99392	34.85914
1	-562.3655	218.0941*	5077324.*	29.61828*	30.88494*	30.07626*
2	-542.2242	29.20490	6882373.	29.86121	32.18342	30.70085

Note * indicates lag order selected by the criterion

^aLR: sequential modified LR test statistic (each test at 5% level)

^bFPE: Final prediction error

^cAIC: Akaike information criterion

^dSC: Schwarz information criterion

^eHQ: Hannan-Quinn information criterion

The selected order is lag one (1) according to the criteria of Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion. This implies that we have VAR (1). The equations (1) to (5) of VAR model becomes:

$$GDP_t = \delta_1 + \beta_1 GDP_{t-1} + \beta_2 DI_{t-1} + \beta_3 FDI_{t-1} + \beta_4 DS_{t-1} + \beta_5 TR_{t-1} + u_{1t} \quad (9)$$

$$DI_t = \delta_2 + \alpha_1 GDP_{t-1} + \alpha_2 DI_{t-1} + \alpha_3 FDI_{t-1} + \alpha_4 DS_{t-1} + \alpha_5 TR_{t-1} + u_{2t} \quad (10)$$

$$FDI_t = \delta_3 + \phi_1 GDP_{t-1} + \phi_2 DI_{t-1} + \phi_3 FDI_{t-1} + \phi_4 DS_{t-1} + \phi_5 TR_{t-1} + u_{3t} \quad (11)$$

$$DS_t = \delta_4 + \phi_1 GDP_{t-1} + \phi_2 DI_{t-1} + \phi_3 FDI_{t-1} + \phi_4 DS_{t-1} + \phi_5 TR_{t-1} + u_{4t} \quad (12)$$

$$TR_t = \delta_5 + \lambda_1 GDP_{t-1} + \lambda_2 DI_{t-1} + \lambda_3 FDI_{t-1} + \lambda_4 DS_{t-1} + \lambda_5 TR_{t-1} + u_{5t} \quad (13)$$

Matrix notation: $Y_t = B + A Y_{t-1} + U_t$

$$\text{Where, } Y_t = \begin{bmatrix} GDP_t \\ DI_t \\ FDI_t \\ DS_t \\ TR_t \end{bmatrix}; B = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \end{bmatrix}; A = \begin{bmatrix} \beta_1 & \beta_2 & \beta_3 & \beta_4 & \beta_5 \\ \alpha_1 & \alpha_2 & \alpha_3 & \alpha_4 & \alpha_5 \\ \phi_1 & \phi_2 & \phi_3 & \phi_4 & \phi_5 \\ \phi_1 & \phi_2 & \phi_3 & \phi_4 & \phi_5 \\ \lambda_1 & \lambda_2 & \lambda_3 & \lambda_4 & \lambda_5 \end{bmatrix}; Y_{t-1} = \begin{bmatrix} GDP_{t-1} \\ DI_{t-1} \\ FDI_{t-1} \\ DS_{t-1} \\ TR_{t-1} \end{bmatrix} \text{ and } U_t = \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \\ u_{5t} \end{bmatrix}$$

4.4 Causality test

The Granger-causality tests are used to analyse cause-effect relationship between two variables. There are four possible cases of bilateral causality between variable Y and variable X (Gujarati and Porter, 2009):

1. *Unidirectional causality from X to Y* which is indicated if the estimated coefficients on the lagged X in Y model are statistically different from zero as a group and the set of estimated coefficients on the lagged Y in X model is not statistically different from zero.
2. Conversely, *unidirectional causality from Y to X* exists if the set of lagged X coefficients in Y model is not statistically different from zero and the set of lagged Y coefficients in X model is statistically different from zero.
3. *Feedback, or bilateral causality*, suggested when the sets of X and Y coefficients are statistically and significantly different from zero in both regressions.
4. Finally, *independence* suggested when the set of X and Y coefficients are not statistically significant in both the regressions.

The results of Granger causality tests of GDP, DI, FDI, DS and TR are presented in Table 3.

Table 3: Granger Causality Tests results

	Lags: 1	Obs:41	Lags: 2	Obs:40	Lags: 3	Obs:39
Null Hypothesis:	F-Statistic	Prob.	F-Stat.	Prob.	F-Stat.	Prob.
DI does not Granger Cause GDP	0.54720	0.46401	1.01294	0.37355	0.65607	0.58508
GDP does not Granger Cause DI	7.95147**	0.00759	3.382**	0.04540	2.08297	0.12203
FDI does not Granger Cause GDP	0.08614	0.77074	0.03679	0.96392	0.11224	0.95231
GDP does not Granger Cause FDI	1.99751	0.16570	1.40616	0.25859	0.71990	0.54747
DS does not Granger Cause GDP	2.57319*	0.11697	3.454**	0.04276	2.1354*	0.11515
GDP does not Granger Cause DS	0.15714	0.69402	1.57051	0.22224	1.66425	0.19429
TR does not Granger Cause GDP	8.54179***	0.00582	6.297***	0.00461	4.0289**	0.01540
GDP does not Granger Cause TR	4.08112**	0.05046	1.52024	0.23275	1.08717	0.36859
FDI does not Granger Cause DI	0.64887	0.42553	0.37956	0.68694	0.45539	0.71532
DI does not Granger Cause FDI	0.18073	0.67314	0.74787	0.48078	0.65724	0.58438
DS does not Granger Cause DI	2.57525*	0.11683	0.88492	0.42178	0.59653	0.62190
DI does not Granger Cause DS	1.13910	0.29258	0.59503	0.55703	0.53999	0.65835
TR does not Granger Cause DI	3.31415*	0.07657	1.34118	0.27465	0.79101	0.50789
DI does not Granger Cause TR	8.03127***	0.00732	3.9540**	0.02830	2.23117*	0.10362
DS does not Granger Cause FDI	0.35050	0.55734	0.19211	0.82608	0.52447	0.66860
DI does not Granger Cause DS	0.67649	0.41593	0.59254	0.55837	0.35091	0.78874
TR does not Granger Cause FDI	1.40121	0.24387	0.96301	0.39163	0.52754	0.66656
FDI does not Granger Cause TR	0.76197	0.38820	0.26142	0.77145	0.28444	0.83625
TR does not Granger Cause DS	2.07129	0.15828	0.77698	0.46756	0.44386	0.72328
DS does not Granger Cause TR	3.19047*	0.08205	1.34482	0.27372	0.71731	0.54896

Pairwise Granger Causality Tests

Sample: 1970 2011

Observation: 41

*Note: *, ** and *** reject null hypothesis at 12 per cent, 5 per cent and 1 per cent, respectively.*

The results presented in Table 3 shows that there is bi-directional causality between GDP and TR and TR and DI. There is unidirectional causality from GDP to DI, from DS to GDP, from DS to DI and from DS to TR. Other effects are not statistically significant. Granger causality tests were verified up to lag 3 only for $DS \rightarrow GDP$, $TR \rightarrow GDP$ and $DI \rightarrow TR$. Granger causality results show that GDP can be used to promote domestic investment and trade.

Domestic savings have significant effect on GDP, DI and TR. This implies that promotion of domestic savings is very important in the promotion of Rwandan economy. Trade causes GDP and DI.

4.5 VAR estimation

VAR model is used to determine the inter-relationships among the variables. The VAR model estimation results of equations (9)-(13) are presented in Table 4.

Table 4: VAR estimation results

	GDP	DI	FDI	DS	TR
GDP(-1)	1.108629 (0.06971) [15.9043]	0.001813 (0.00073) [2.49951]	0.000409 (0.00017) [2.40155]	0.003084 (0.00378) [0.81570]	-0.001510 (0.00352) [-0.42958]
DI(-1)	-13.91746 (14.5780) [-0.95469]	0.514648 (0.15170) [3.39262]	-0.074628 (0.03558) [-2.09744]	-1.295082 (0.79073) [-1.63784]	1.212384 (0.73532) [1.64877]
FDI(-1)	-29.87811 (60.3998) [-0.49467]	0.275145 (0.62851) [0.43777]	0.344629 (0.14742) [2.33779]	0.057137 (3.27614) [0.01744]	-1.519932 (3.04660) [-0.49889]
DS(-1)	2.934584 (4.63872) [0.63263]	-0.036996 (0.04827) [-0.76645]	0.032218 (0.01132) [2.84573]	0.591969 (0.25161) [2.35274]	0.244615 (0.23398) [1.04545]
TR(-1)	10.99243 (4.77313) [2.30298]	0.023680 (0.04967) [0.47676]	0.034305 (0.01165) [2.94473]	0.410620 (0.25890) [1.58603]	0.385979 (0.24076) [1.60317]
C	-245.3952 (173.220) [-1.41666]	3.672009 (1.80250) [2.03717]	-0.280701 (0.42278) [-0.66395]	1.262775 (9.39563) [0.13440]	5.794240 (8.73734) [0.66316]
R-squared	0.964575	0.793794	0.614090	0.220805	0.257706
Adj. R-squared	0.959514	0.764336	0.558960	0.109491	0.151664
F-statistic	190.6001	26.94664	11.13894	1.983625	2.430222

Sample (adjusted): 1971 2011

Included observations: 41 after adjustments

Standard errors in () & t-statistics in []

The results presented in Table 4 show that the coefficients of lagged GDP and TR are significant in the regression of the GDP, the coefficients of lagged GDP, DI and constant are significant in the regression of the DI, the coefficients

of lagged GDP, DI, FDI, DS and TR are significant in the regression of the FDI and the coefficients of lagged DS is significant in the regression of the DS. All coefficients in regression of the TR are insignificant (that is,, not statistically different to zero). Forecasting is done for all variables where we have at least one explanatory variable significant, the variables forecasted are GDP, DI and FDI.

4.6 Forecasting

In order to forecast GDP, DI and FDI we have re-estimated equations (9)-(13) after removing data for 2011 which are used in comparison of actual and forecasted values. The results of the re-estimation are given in Table 5.

Table 5: Vector Auto-regression of GDP, DI, FDI, DS and TR

	GDP	DI	FDI	DS	TR
GDP(-1)	1.102238 (0.07478) [14.7388]	0.001819 (0.00078) [2.33467]	0.000326 (0.00018) [1.83799]	0.002792 (0.00406) [0.68798]	-0.002239 (0.00376) [-0.59587]
DI(-1)	-13.62588 (14.8184) [-0.91953]	0.514392 (0.15435) [3.33263]	-0.070878 (0.03519) [-2.01439]	-1.281734 (0.80399) [-1.59421]	1.245598 (0.74438) [1.67334]
FDI(-1)	-26.27920 (62.7570) [-0.41875]	0.271980 (0.65369) [0.41607]	0.390911 (0.14901) [2.62330]	0.221888 (3.40497) [0.06517]	-1.109978 (3.15250) [-0.35209]
DS(-1)	2.819410 (4.72245) [0.59702]	-0.036895 (0.04919) [-0.75005]	0.030737 (0.01121) [2.74114]	0.586697 (0.25622) [2.28979]	0.231495 (0.23722) [0.97585]
TR(-1)	10.81293 (4.88671) [2.21272]	0.023838 (0.05090) [0.46832]	0.031997 (0.01160) [2.75755]	0.402403 (0.26514) [1.51773]	0.365532 (0.24548) [1.48908]
C	-236.6336 (178.760) [-1.32375]	3.664305 (1.86199) [1.96795]	-0.168026 (0.42446) [-0.39586]	1.663864 (9.69891) [0.17155]	6.792282 (8.97974) [0.75640]
R-squared	0.955924	0.763389	0.608142	0.221868	0.222890
Adj. R-squared	0.949443	0.728593	0.550516	0.107437	0.108609
F-statistic	147.4804	21.93912	10.55322	1.938874	1.950365

Sample (adjusted): 1971 2010

Included observations: 40 after adjustments

Standard errors in () & t-statistics in []

The variables to be forecasted are GDP, DI, FDI and E and Regression equations are:

$$\hat{GDP}_{2011} = -236.634 + 1.102GDP_{2010} - 13.6259DI_{2010} - 26.279FDI_{2010} + 2.819DS_{2010} + 10.813TR_{2010}$$

$$\hat{DI}_{2011} = 3.6643 + 0.0018GDP_{2010} + 0.5144DI_{2010} + 0.2720FDI_{2010} - 0.0370DS_{2010} + 0.0238TR_{2010}$$

$$\hat{FDI}_{2011} = -0.1680 + 0.0003GDP_{2010} - 0.0709DI_{2010} + 0.3909FDI_{2010} + 0.0307DS_{2010} + 0.0320TR_{2010}$$

The forecasted values of GDP, DI and FDI in 2011 are:

$$\hat{GDP}_{2011} = 3,843.6233 \text{ million}$$

$$\hat{DI}_{2011} = 22.67\%$$

$$\hat{FDI}_{2011} = 0.95\%$$

The forecasted values of GDP, DI and FDI in 2011 are 3,843.6233 million, 22.67% and 0.95% respectively while their actual values in 2011 are 3891.9124 million, 22.7% and 1.66%. There is under prediction for GDP, DI and FDI. The difference between the actual and forecasted values of GDP, DI and FDI can be explained by policies implemented by Rwandan government to promote GDP, DI and FDI. The difference between the actual and forecasted values can be explained by great improvement done by the Government of Rwanda to increase Gross Domestic Products in all sectors and facilitate domestic and foreign investors in their business (World Bank, 2012b).

5 CONCLUSION

This paper conducted an analysis of Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade. The three techniques used are graphical analysis, Granger causality tests and VAR analysis.

Graphical analysis has shown that GDP and DI have increased; annual growth of GDP remains high at around 8% in average. The DI as share of GDP has also increased from 7.18% in 1970 to 22.7% in 2011. The target set by the Rwandan Government in achieving an increase of 30% of GDP in 2020 seems achievable although, it may require more effort. FDI in current US Dollar has remained constant and below 2% of GDP and Domestic Savings were negative between 1994 and 2003 while the share of DS in GDP was 1.9% in average for the period under study. This implies that there is urgent need of promoting policies to increase domestic and foreign funds for investment. The trade balance of Rwanda has always been negative. Therefore, the promotion of exports and import substitution of some imported products are important for the Rwandan economy.

The variables GDP, DI and FDI are not stationary at this level but, the null hypothesis of a unit root for DS and TR was rejected. DS and TR were however, stationary at 5% level of significance. Augmented Dickey-Fuller (ADF) test on the first differenced series showed that all series are stationary at 1% level of significance. The selection of lag order was done using the criteria of Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion and lag one (1) was selected. Therefore, the appropriate model is VAR (1). Granger causality tests show that there is bi-directional causality between GDP and TR and TR and DI, unidirectional causality from GDP to DI, from DS to GDP, from DS to DI and from DS to TR. These findings show that GDP can be used to promote domestic investment and trade. The results also show that domestic savings have significant effects on GDP, DI and TR.

The VAR estimation shows that the coefficients of lagged GDP, DS and TR are statistically significant in the regression of the GDP. The coefficients of lagged GDP, DI and constant are significant in the regression of the DI. The coefficients of lagged GDP, DI, FDI, DS and TR are significant in the regression of the FDI while the coefficients of lagged DS are significant in the regression of the DS. Forecasting is done for GDP, DI and FDI, where we have at least one explanatory variable which is significant. The forecasted values of GDP, DI and FDI in 2011 are, 3,843.6233 million, 22.67% and 0.95% respectively while their actual values are 3891.9million, 22.7% and 1.66%. These results show that there is under prediction of the three variables; GDP, DI and FDI. The difference between the actual and forecasted values can be explained by policies and strategies adopted and implemented by the Government of Rwanda to promote GDP, DI and FDI.

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Cite this Article: Ruranga C, Ocaya B, Kaberuka W, 2014. VAR Analysis of Economic Growth, Domestic Investment, Foreign Direct Investment, Domestic Savings and Trade in Rwanda. *Greener Journal of Economics and Accountancy*, 3 (2): 030-041.