Determinants of domestic saving in Ethiopia: A vector error correction approach

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Abstract

The intent of this paper is to determine determinants that affect domestic saving in Ethiopia using a 30 years' time series data. VECM were used to identify the major long run and short run determinants that affect domestic saving in Ethiopia. The estimated result of the study revealed that in long run, level of real per capital income and consumer price index are positive while government consumption ratio and inflation rate have negative influence on domestic saving. However, in the short run, consumer price index affect domestic saving negatively. Thus, minimizing government consumption expenditures are required to enhance domestic saving.

Keywords: Domestic saving, error correction model, Ethiopia

Introduction

Saving is a key determinant of economic growth that create investment for any country (Solow, 1956) [17]. There are growth variation among country in the world. This disparity in growth arises mainly due to the difference in the rate of saving and investment (Getnet, 2017) [8]. Saving can also be classified as gross domestic saving and external saving. Gross domestic saving, which is the concern of this paper, is a type of saving which incorporate private and public savings within the country, that left over and saved after subtracting taxes, consumption and other expenditures. It is the key determinants of domestic investment and sustainable growth for Ethiopia (Hassen, 2016) [2].

Ethiopia country obtain finance both from external or internal sources. However, Since there is no continuous and perfect capital inflows to the country in terms of foreign direct investment, depending on external sources of finance is not a guaranty for the country to eradicate poverty. Hence, the government of Ethiopia should enhance domestic saving as the main sources of finance for domestic investment than depending on foreign capital inflows (Haile, 2013) [10]. However, the average saving rate for Ethiopia which was 22.28 percent of GDP in the year 2019 was very low compared to African countries likes; Congo Republic and Gabon which were 61.4 percent of GDP and 52.2 percent of GDP for the same period respectively (WB, 2020). Thus, unless the rate of domestic saving is changed, the country may face problems of current account deficit (Akshaya, 2017) [3].

In Ethiopia, Abu (2004) [1], Kidane (2009) [13], Worku (2010) [19], Haile (2013) [10], Getnet (2017) [8] have been conducted their study on determinants of domestic saving and found that, growth rate of income and inflation were the common significant factors that affect domestic saving in Ethiopia. However, the data they used were outdated and from limited sources. Hence, it did not indicate the current situation of the country. Thus, this paper aimed to determine the major determinants of domestic saving in Ethiopia by using a more recent data, important variables and analytical model. To realize this objective, this paper try to answer the following two basic research questions:

- What are the major determinants of domestic saving in short run and long run in Ethiopia?
- Is there a long run relationship between domestic saving and its determinants? If so, how the deviation will adjust towards the long run equilibrium?

Materials and Methods
Types and sources of data

This study has applied secondary data sources that was collected from five different sources for the period from 1988/89 to 2018/19. Hence, while the data for gross domestic saving (GDSR), per capital real GDP (PGDP), real GDP, government consumption ratio (GCR) and degree of financial depth (DFD) were obtained from National Bank of Ethiopia (NBE), the data for inflation (INFLN) and depositing interest rate (IR) rate were collected from International Financial Statistics (IFS). Besides, while the data for consumer price index (CPI) was collected from world bank (WB), the data for dependency ratio (DR) and foreign aids ratio (FADR) were collected from OECD and MOFED.

Variables and their Descriptions

After a thorough review of the work of different researchers on determinants of domestic saving, earliest consumption and saving theories, the following variables were hypothesized to affect gross domestic saving in Ethiopia.

Annual gross domestic saving ratio (LnGDSR): It is domestic saving in millions of birr to the ratio of nominal GDP in millions of birr. It is the dependent variable of the model.

Annual Per capital real GDP (LnPGDP): It is the ratio of real GDP in millions of birr to the total population of the country. According to Keynesian absolute income hypothesis, since saving is constant over time, higher level of current income leads to higher domestic saving. Similarly in developing countries, the saving rate is low since per capita income levels do not exceed the subsistence level. Thus, saving rate rises with per capita income and its impact on domestic saving is expected to be positive.

Real GDP (LnGDP): It is real GDP of the country at the 2000 base year price. The effect of real GDP on saving depends up on the associated benefit obtained from income growth, steepness of earning profiles, and the extent to which borrowing constraints apply (Modigliani and Cao, 2004) [15]. However, permanent-income hypothesis shows that increased growth would imply higher projected future income, which would urge people to disserve against future earnings. Hence, the effect of

real GDP growth on domestic saving can take negative or positive value.

Annual depositing interest rate (LnIR): It is average annual depositing interest rate. The impact of depositing interest rate on domestic saving is mainly depends up on substitution, income and wealth effect. Thus, the effect of interest rate on domestic saving can be positive or negative.

Consumer Price Index (LnCPI): It is consumer price index computed based on the 2005 base year price. Its effect on domestic saving expected to be negative.

Annual dependency ratio (LnDR): It is the ratio of population below 15 and above 65 years old to the total population. Since dependency ratio is expected to be high in most developing countries due to increased population rate, it is expected to be an important variable to affect domestic saving negatively in Ethiopia.

Annual government consumption ratio (LnGCR): It is government consumption expenditure in millions of birr as the ratio of nominal GDP in millions of birr. Increase in government consumption reduces the amount of saving directly (Corbo and Hebbel, 1991) [7]. However, if government Consumption increases on developmental projects, it can increase domestic saving in the long run (Chaudhry *et al.*, 2010) [5]. Thus, the effect of government consumption on domestic saving can be positive or negative.

Annual foreign aids ratio (LnFADR): It is foreign aids in millions of birr to the ratio of nominal GDP in millions of birr. There are theories that advocate an additive role of foreign aids to domestic saving (Chenery and Strout, 1966) [6]. Nevertheless, there are theories that argue the impact of foreign aid on domestic saving to be negative (Griffine, 1970) [9]. Thus, for this paper, the effect of foreign aid on domestic saving would be inconclusive.

Degree of financial depth (LnDFD): It is broad money (M2) in millions of birr as the ratio of nominal GDP in millions of birr. Financial depth like, the range and availability of financial assets, accessibility to banking facilities, and extent of credit opportunity is very important factor to promote or discourage the domestic saving rate. Hence, the potential impact of financial development on domestic saving can be positive or negative.

Inflation (LnINFLN): It is the value of inflation rate in the study period. In one sense, the buffer stock saving theory predicts that greater uncertainty would rise saving, on the other hand higher inflation reduces domestic saving (Modigliani and Cao, 2004) [15]. Thus, the effect of inflation on domestic saving can be negative or positive.

Methods of Data Analysis
This paper used both descriptive and econometric model. Thus, in descriptive part, mean and standard deviation were used. In Econometric models, Johansen co-integration test and Error correction model were used to examine the determinants of saving in the long run and short run. Johansen co-integration test was used to examine the existence of long run relationship among variables. However, prior to co-integration test unit root test were conducted by using Augmented Dickey- Fuller (ADF) test in order to identify order of integration. Moreover, Since co-integration tests are applied for variables of order one integration, ADF test is used for long run analysis. Furthermore, since the result of Johansen co-integration test found the existence of co-integration, a vector error correction model (VECM) was used against that of ARDL model, in order to capture the short run and long run dynamics of the whole system. Hence, for this empirical investigation, the following model is estimated:

$$LnGDSR_t = \beta_0 + \beta_1 LnGDP_t + \beta_2 LnPGDP_t + \beta_3 LnCPI_t + \beta_4 LnDR_t + \beta_5 LnGCR_t + \beta_6 LnDFD_t + \beta_7 LnINFLN_t + \beta_8 LnIR_t + \beta_9 LnFDR_t + U_t \text{-----------------------1}$$

Where
β_0 represents the constant term, β_i represents coefficient(slope) of independent variables, $LnGDSR_t$, $LnGDP_t$, $LnPGDP_t$, $LnCPI_t$, $LnDR_t$, $LnGCR_t$, $LnDFD_t$, $LnINFLN_t$, $LnIR_t$ and $LnFDR_t$ represents the logarithms of determinants of domestic saving described above and U_t represents random error term.

Summary of domestic saving and its determinants
A number of studies have been examined both in developing and developed countries. Here below is the summary of the types of data, models and results of their analysis:

Table 1: Summary of domestic saving and its determinants

Name of Author and year of publication	Type of data	Model	Outcome of variables					
			Growth rate of income	Depositing interest rate	Inflation	Budget deficit ratio	Current account deficit ratio	Degree of financial depth
Baharumshah *et al* (2002)	Time series	Johansen co-integration test	Positive	Mixed				
Ozcan *et al* (2003)	time series	OLS			positive			Positive
Abu (2004) [1]	Time series	Unrestricted VAR	Positive		Positive		Positive	Positive
Authukoral and Sen (2004) [4]	Time series	General to specific modeling procedure	Positive	Positive	Negative			Positive
Agrawal *et al* (2007)	Time series	Dynamic OLS procedures of co-integration test		Negative		Positive	Positive	Positive
Adewuyi *et al* (2007) [2]	panel data	Fixed and random effect models		Negative	Negative	Positive		
Nwachukwu and Egwaikhide (2007) [16]	Time series	Johansen co correction integration test and ECM	Negative	Negative	Positive			
Touny (2008)	Time series	Engle-Granger co-integration test and ECM	Positive	Positive	Positive	Negative	Negative	Positive
Kidane (2009) [13]	Time series	Co-integration and ECM	Positive		Negative			
Obwona and SSentamu (2010)	Time series	OLS	Positive			Negative		
Worku (2010) [19]	Time series	Engle-Granger co-integration test and ECM	Positive		Negative			
Keho (2011)	Time series	ARDL bounds testing approach	Positive	Mixed	Mixed		Mixed	

| Haile (2013) [10] | Time series | ARDL bounds testing approach | Positive | | Negative | Negative | | |
| Getnet (2017) | Time series | co-integration test and ECM | | | Negative | | | |

Result and Discussions
Descriptive Statistics Result
Before embarking on presenting and discussing the results obtained from various tests and the Error correction model, it is important to look at the trends of overall mean of domestic saving and its determinants in Ethiopia.

Table 1: Trends of overall mean of domestic saving and its determinants in Ethiopia

| Variables | Average years | | | | | |
| | 1988/89-1997/98 | | 1999/2000-2008/09 | | 2009/10-2018/19 | |
	Mean	St. dev.	Mean	Sd. dev.	Mean	Sd. dev.
GDSR	7.23	3.375	2.228	0.684	9.820	3.149
GDP	193.37	57.052	145.928	42.800	530.390	172.858
PGDP	7715.97	2233.826	4308.180	697.344	10369.76	5843.19
CPI	27.000	5.962	47.609	17.202	200.473	69.061
DR	49.665	0.113	2.229	0.176	46.218	1.624
GCR	2.066	0.316	49.521	0.236	5.097	1.675
DFD	22.5	4.927	30.892	4.391	32.217	5.804
INFLN	7.8	8.921	11.374	12.893	9.725	14.729
IR	6.376	4.234	4.1	1.370	5.182	0.982
FDR	4.3	1.160	4.05	0.956	7.091	1.921

Although, there were an indication of a declined trend in average gross domestic saving ratio, real GDP, per-capital GDP, dependency ratio, depositing interest rate and foreign depth ratio during the period from 1988/89-2008/09, they were an indication of increasing trend during 2009/10-2018/19 (Table-2). A rise in foreign depth ratio to 7.091 from the year 2009/10-208/19 for instance, indicates a coverage of country's capital expenditures that were financed from external assistance. On the other hand, government consumption ratio increased during the period from 1988 to 2008/09 and declined from 2009/10-2018/19 which may be because of a rise in the saving rate and a decline in investment on developmental projects. The above Table 2 also indicates that, on average consumer price index and degree financial depth had an increasing trend in the whole periods of study. This increments indicated the rise in general price level of goods and services and the involvement of people on financial institutions to increase the saving rate.

Tests and their results
Unit root test and co-integration test were conducted prior to select the types of model to be used for the final analysis. Here below are the result of each tests:

Unit root test
Prior to unit root test Schwarz Bayesian Criterion (SBC) was used to determine an optimal number of lags due to its presence of more parsimonious specifications. Thus, a maximum lag order of one is obtained and used in the unit root test, Johansen co-integration test and VECM.

Table 2: Unit root test (ADF)

| Variables | ADF results at their level form | | ADF results at the first difference form | | Order of integration |
	With constant only	With constant and trend	With constant only	With constant and trend	
LnGDSR	-.1437183	-1.038403	-1.377453***	-1.424286***	I(1)
LnGDP	-.1710035	-.254425	-.4846394**	-.6232012***	I(1)
LnPGDP	-.0268171	-.0247927	-.2501655*	-.4495743**	I(1)
LnCPI	.0053341	-.0980511	-.116454*	-.5235553**	I(1)
LnDR	-.0092308	-.0191339	-.8475482***	-1.305314***	I(1)
LnGCR	.0272944	-.1225214	-.8489905***	-.9218704***	I(1)
LnDFD	.008597	-.2768859	-1.302769***	-1.312904***	I(1)
LnINFLN	-.8240732	-.9220112	-1.536491***	-1.567226***	I(1)
lnIR	-.318715	-.3200928	-1.109966***	-1.170644***	I(1)
lnFDR	-.3244323	-.5683623	-1.106695***	-1.153697***	I(1)

Where *,** and *** represents level of significance at 10%, 5% and 1% respectively
Source: Model Output

The result of ADF test showed that at their level form, for all observation the calculated value of F statistics is greater than the upper bound critical value and lower than the critical value for the first difference. Hence, the series are non-stationary at level form and stationary at the first difference for all variables (Table-3). In another word, the ADF test of variables in their first difference shows that the null hypothesis of there is a unit root test can be rejected at the conventional 1%, 5% and 10% level of significance. Thus, since these variables become stationary after differencing once, they are said to be integration of level one (I (1)) order (Maddala, 2001) [14]. Hence, it is possible to employ Johansen procedure to test for co-integration.

Co-integration Test
Prior to make Johansen Co-integration test, multicollinearity test was made and found high correlation coefficient between DR and GCR with correlation coefficient of 0.9228 as well as DFD and GCR with correlation coefficient of 0.8266. Thus, LnDR and LnDFD are dropped from the final analysis. Then, Johansen co-integration test were examined in order to look at the existence of long run equilibrium relationship between variables by two methods namely; trace static and maximum-

Eigen value test static. With this tests, the decision to reject or not to reject the null hypothesis is made by comparing the computed trace and maximum Eigen values with given critical values at 1% and 5% level of significance.

Table 3: Johansen co-integration test

Hypothesized No. of CE(s)	Trace statistic	0.05 critical value	0.01 critical value	Max Eigen statistic	0.05 critical value	0.01 critical value
None	210.9548	156.00***	168.36***	62.9840	51.42***	57.69***
At most 1	147.9708	124.24***	133.57***	42.1465	45.28	51.57
At most 2	105.8243	94.15***	103.18***	38.5652	39.37	45.10
At most 3	67.2591	68.52	76.07	24.5652	33.46	38.77
At most 4	42.6939	47.21	54.46	22.3245	27.07	32.24
At most 5	20.3694	29.68	35.65	12.6880	20.97	25.52
At most 6	7.6814	15.41	20.04	6.8936	14.07	18.63
At most 7	0.7878	3.76	20.04	0.7878	3.76	6.65

Where*** represents rejection of null hypothesis at 1% level of significance
Source: Model Output

The result of Johansen co-integration test clearly shows that the null hypothesis of no co-integration is rejected by both λmax and the λtrace statistics (Table4). While the trace statistics shows three co-integration equations at 1% level of significance, maximum Eigen value statistics shows 1 co-integration equations at 1% level of significance. According to Harris (1995) [11] in Johansen approach to co-integration trace statistics rejects null hypothesis whenever it is true because of small sample size of the data. Thus, the rejection of three co-integration approach by trace statistics may be due to small sample size. Hence, taking the major objective of determining the determinants of domestic saving into consideration, this paper use only three co-integrating vectors that relates domestic saving to its determinants. Thus, the variables do not drift too much apart and are tied together by some long run equilibrium relationships.

Econometric model results
The long run equation
The structural long run relationship derived from the co-integrating vector normalized with respect to logarizim of gross domestic saving ratio indicated that level of per capital income(per capital GDP) and consumer price index are positively affecting domestic saving in the long run. Whereas government consumption ratio and inflation have a negative influence on domestic saving in the long run.

Table 4: The long run Model

Variables	Coefficient	Std. Err.	*P*. value
LnPGDP	2.966***	0.595	0.000
LnCPI	3.262***	0.6307	0.000
LnGCR	-9.349***	1.2631	0.000
LnINFLN	-2.107***	0.1640	0.000
LnIR	-0.361	0.326	0.269
LnFADR	-0.471	0.543	0.386
LnGDP	-0.115	0.107	0.281
Cons	-24.625		

Where*** represents rejection of null hypothesis at 1% level of significance
Source: Model Output

Its mathematical form is represented as follows:

$$LnGDSR = 2.966lnPGDP + 3.262LnCPI - 9.349LnGCR - 2.107LnINFLN + 0.361LnIR - 0.470LnFADR - 0.115LnGDP - 4.65 \dots 2$$

The discussions of each significant variables on long run can be presented as follows:

Per capital GDP(PGDP): The positive and significant values of per capital GDP revealed that domestic saving highly responds to changes in PGDP. Thus, a one percent increase in per capital GDP increases domestic saving by 2.966 percent over the long run period. This result is in line with the finding of Abu (2004) [1] and Touney (2008), the lifecycle hypothesis and against that of Nwachukwu and Egwaikhide (2007) [16] who found asymmetric relationship between saving and growth rate of income.

Consumer Price Index (CPI): The result also revealed that domestic saving highly responds to changes in CPI in Ethiopia. Hence, a one percent increase in consumer price index increases domestic saving by 3.26 percent over the long run period. Even though similar result were obtained by Abu (2004) [1] and Touney (2008), it contradict with that of Nwachukwu and Egwaikhide (2007) [16].

Government Consumption Ratio(GCR): It affects domestic saving negatively. Hence, an increase in government consumption ratio by one percent decreases domestic savings by 9.35 percent over the long run period holding others factors remain constant. Similar result were obtained by Adewuyi *et al*. (2007) [2], Kidane (2009) [13], Worku (2010) [19] and Haile (2013) [10] due to rising in government consumption reduces domestic saving rate by reducing government spending on developmental projects.

Inflation Rate(INFLN): It also affects domestic saving negatively. Thus, an increase in inflation rate by one percent decreases domestic savings by 2.11 percent over the long run period. It is also in line with the finding of Adewuyi *et al*. (2007) [2], Kidane (2009) [13], Worku (2010) [19], Haile (2013) [10] and Getnet (2017) [8] due to rising in inflation rate reduces domestic saving rate by decreasing the purchasing power of individual's income.

Vector Error correction model (Short run dynamic modeling)
After determining the long run model and its coefficients, the next step is the determination of short run dynamics. The values of difference represents the coefficients of short run dynamics whereas the value of lagged error correction term ECM (-1) captures the speed of adjustment towards the long run equilibrium relationship.

Table 5: Short run model

Variables	Coefficient	Std. Err.	t-statistic	P-value
VECM_1	-0.051155	0.0874904		0.0959*
DLnGDSR (-1)	-0.745730	0.1527997	-4.88	0.000***
DLnGDP (-1)	-0.006625	1.344988	-0.00	0.996
DLnCPI (-1)	-0.715736	0.3029752	-2.36	0.018**
DLnPGDP (-1)	0.075771	0.0669027	1.13	0.257
DLnINFLN (-1)	0.088572	0.1417205	0.62	0.532
Constant	0.037009	0.1441709	0.26	0.797
R-squared	0.7924	Mean dependent variable		0.6610019
Adjusted R- squared	0.7292	S.D dependent variable		1.40370
S. E of regression	46.8392588	Akaike information criterion		10.94214
Sum squared resid	12.272621	Schwarz criterion		11.15133
Log likelihood	-150.1321	HQI criterion		11.59603
Durbin –Watson static	2.299361	F-statistic		12.54
		Prob (F- statistic)		0.0000***
Diagnostic tests				
Test statistics	F Version			
A. Serial correlation LM test	34.4366 (0.1062)			
B. Normality(Jarque-Bera test)	4.76(0.9066)			
C. Eigen value stability condition	6 units moduli			
D. Heteroscedasticity	2.36(0.1244)			

Where*,** and *** represents rejection of null hypothesis at 10%, 5% and 1% level of significance respectively
Source: Model Output

Consumer price index at their difference is the only determinant that affect domestic saving in the short run at 5% level of significance. The sign is negative as expected and significant, mainly due to the rise in price of goods and services. This result is also consistent with the finding of Authukoral and Sen (2004) [4], Adewuyi *et al.* (2007) [2], Kidane (2009) [13], Worku (2010) [19], Haile (2013) [10] and Getnet (2017) [8].

The value of the coefficient for the error-term (the Speed of adjustment term) for the estimated domestic saving equation is statistically significant and negative as expected. The coefficient of the speed of adjustment -0.0512 shows that the gross domestic saving of the country adjust itself towards the long run equilibrium by 5.12 percent during the study period.

The result of diagnostic tests also revealed that the null hypothesis of no serial correlation and homoskedasticity cannot be rejected at any conventional significance level. The Jarque-Bera normality test also indicates as the error term are normally distributed. Moreover, the F- statistic confirmed the adequacy of this domestic saving model. The model stability test using Eigen value stability condition also confirmed that the null hypothesis of parameter stability cannot be rejected at the 5% critical bound. This implies that, the parameters of the estimated saving model do not suffer from any structural instability over the period of study. Thus, the model passed all the diagnostic tests.

Conclusion and Recommendations
Conclusion
This paper was conducted on the determinants of domestic saving in Ethiopia by using a 30 years times series data that has been collected from 1988/89 to 2018/19. The main target of this study was to determine the long run and short run determinants of domestic saving together with its long run relationships with those determinants. To analyze the data, due to ADF test result, vector error correction model of econometrics was used.

The finding of the study revealed that in the long run, level of real per capital income and consumer price index are positively affecting domestic Savings while government consumption ratio and inflation rate have negatively influencing domestic saving. However, in the short run, during the study period, consumer price index is the only factor that determine domestic saving negatively in Ethiopia.

Recommendations
Arising from the result of the study the following recommendations were forwarded.
▪ Effort should be made to raise the level of per capital income through encouraging export, reducing expenses on import, efficient utilization of factors of production, infrastructure development and other activities that enables to raise the level of income.
▪ Government should reduce its level of consumption and rate of inflation through monetary and fiscal policies, control of money supply, supply-side policies and other policy measures.
▪ Finally, due to lack of data, this paper only used a 30 years' time series data. Hence, future researcher should consider this limitation in order to obtain more reliable result.

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