

# Innovations

## Key drivers of capital formation in East Africa: The application of Dynamic Panel Model

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### Abstract

Evidences show that developing countries' economies are inherent with structural and institutional rigidities and variations of basic economic variables like capital formation are explained beyond macroeconomic determinants. This paper analyzes the capital formation determinants beyond macroeconomic factors and tries to uncover the role of institutional factors on determining size and sign of capital formation function within neoclassical framework. The study is mainly dependent on secondary data obtained from WDI, EFW and PWT which covers panels of 6 East African countries from periods 2003-2020. Dynamic panel model is mainly chosen to estimate the capital formation function. Accordingly, AB- GMM estimation result shows that among Neoclassical's variables, economic size, economic growth and economic control variables are found to be significant. On the other hand, among institutional variables, business environment, financial development and political stability are found to be significant determinants of capital formation in the region. The simple insight for policy arising from this paper is that in addition to the traditional Macroeconomic policy areas, the capital formation climate in East Africa is explained by the broader structural and institutional environment in which investment functions. Therefore, policy interventions should give emphasis to improvement of such institutional factors to promote the level of capital formation of the region.

**Key words:** 1.AB-GMM; 2.economic size; 3.institutional factors; 4.capital formation; 5.Neo-classicalframework

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## 1. Introduction

### 1.1 Background of the study

The fundamental of macroeconomic theory starts with the preposition that “there exist a positive and strong relationship between capital formation and economic growth”. Capital formation, theoretically and

empirically, has proven to be critical for employment, productivity, poverty reduction and economic growth (Solow 1956, Levine 2005 and Zou 2006). It is therefore worthwhile to investigate the factors that determine the level of capital formation.

As far as macroeconomic factors of capital formation are concerned, the major theoretical formulations used to define investment behavior are; the accelerator theory which is postulated by Keynes (1936) which states that the main variable which determines an capital formation is GDP growth, the profit model which suggests that an increase in gross profits enhances internally created funds, which in turn boost capital formation activities, the neoclassical flexible accelerator model which identifies output, availability of domestic credit, cost of external financing, depreciation, interest rates and tax structure as the main factors affecting capital formation (Eklund, 2013), the Tobin's "q" theory of capital formation which identifies interest rates as the major determinant of investment where interest rates affect capital formation in a negative manner in the sense that a rise in interest rates results in the increased user cost of capital.

In addition to the above macroeconomic determinants, studies by Lim (2014) and Bailey (2018) argues that institutional factors are important factors in influencing foreign direct capital formation particularly and gross capital formation generally. Bailey (2018) further argues that institutional factors are more influential in attracting capital formation in developing countries compared to developed countries.

This study tries to explain the roles of institutional and structural variables along with macroeconomic determinants on gross capital formation by selecting 6 East African countries as a case study. similarly, this study employs latest panel data of the period 2003-2020.

### **1.1. Statement of the problem**

Giving sufficient emphasis and recognition to the development of capital formation sector is only recent phenomena. Recently East African countries founded specific capital formation organization like Uganda capital formation authority, Kenya capital formation promotion center, Tanzania capital formation center and Ethiopia capital formation authority and etc...with an intention to give much emphasis and energy to attract capital formation believing that it will overcome constraints on economic growth through promoting technology transfer, creating employment opportunity and attracting investors in a more diversified economy. However, the level and the rate of capital formation activities in these countries are yet not satisfactory. Hence there is a need to analyze the determinants of capital formation beyond the traditional macro-economic factors.

Conventional models such as the flexible accelerator proved to be quite successful in explaining aggregate capital formation in industrial countries. However, these models assume an economy with perfect capital markets, absence of liquidity constraints, and no or minimal government intervention which is not consistent with the case of developing countries as these economies are inherited with institutional and structural rigidities. Romer et al. (1995), Ajide and Lawanson (2012). Specifically, East African countries are suffered from institutional and structural constraints like ethnic conflicts, corruption, lack of law and order, poor governance and poor business environment for a long period. Hence there is a need to consider the analysis of the role of these factors and the level of their impacts on capital formation of the region.

There are evidences with regard to why institutional and structural factors in determining capital formation. For example, study by Lim, 2014 shows the quality and structure of institutional mechanisms aggregate capital formation through altering incentive for new capital formation, or by increasing the sensitivity of

capital formation to technological shocks at the macroeconomic level. Similarly study by Ucan, 2014 shows the role of financial development on capital formation expansion for G7 countries.

On the other hand, this study tries to analyze the determinants of capital formation activity by taking East African countries as a case study and by including additional institutional and structural indexes like governance indicators, human capital index, business environment, political stability and financial development along with basic neoclassical macroeconomic determinants of capital formation.

**1.2. Objective of the study**

The general objective of the study is to analyze macroeconomic determinants of capital formation with the application of dynamic panel model in the case of East African Countries.

**Specific objectives**

- ✪ To assess macroeconomic determinants of capital formation
- ✪ To analyze the role of institutional factors in explaining capital formation variation

**2. Methodology of the study**

**2.1. Data Sources**

This paper work is dependent on secondary data. Data of macroeconomic variables are obtained from data banks of world development indicators. Data of institutional and structural variables are obtained from the Economic Freedom of the World-index (EFW), Penn World Table(PWT)and World governance indicators (WGI). The data set covers 6 East African countries; Ethiopia, Kenya, Uganda, Tanzania, Mozambique and Rwanda.The study covers 18 year’s recent panel data from the period 2003-2020. Before using the data for econometrics analysis purpose, data cleaning and stationarity tests are conducted.

**2.2. Model Framework**

**2.2.1. Theoretical model frame work**

Following Lim, 2014 and Hycent et.al, 2016, the model framework of the paper is specified from the famous Cobb-Douglas’s Neo-classical production function of constant returns to scale whose equation is given by

$$Q_{it} = A_t K_{it}^\alpha L_{it}^\beta \dots\dots\dots (1)$$

Where  $Q_{it}$  is the level of national output in country  $i$  in period  $t$ ,  $A_t$  is state of technology which is exogenous,  $K_{it}$  and  $L_{it}$  are the capital and labor used in production in country  $i$  in period  $t$  respectively and  $\alpha$  and  $\beta$  are the share of capital and labor in production respectively.

Then the capital formation equation is given by

$$K_{i,t} = K_{i,t-1} - \delta K_{i,t-1} + I_t \dots\dots\dots (2)$$

where  $\delta$  is depreciation rate of capital.

According to the neoclassical flexible accelerator model, the optimal capital stock of country  $i$ , in period  $t$  is given by the ratio of real output to rental cost of capital as represented by the following equation (3)

$$K_{it}^* = \frac{\gamma Q_{it}}{R_{it}^\sigma} \dots\dots\dots (3)$$

where  $\sigma$  is the elasticity of substitution of capital.

Substituting the optimal level of capital of equation (3) in to equation (2) and solving for capital formation at steady state yields

$$I_{it} = \frac{\gamma(\delta+\theta)Q_{it}}{R_{it}^\sigma} \dots\dots\dots (4)$$

Where  $\theta$  is growth rate of capital which is also equal to growth rate of output and consumption in steady state.

Since, the above capital formation equation (4) is non-linear, it can be made linear by taking natural logarithm to both sides as follows

$$\ln I_{it} = \ln \gamma + \ln(\delta + \theta) + \ln Q_{it} - \sigma \ln R_{it} \dots\dots\dots (5)$$

The term  $\ln(\delta + \theta)$  is depreciation adjusted growth rate in country,  $i$ , lets denote it by letter ' $g$ ' and also lets express the  $\ln$  terms with lower case, then the complete model of capital formation with inclusion of institutional variables is given by the next equation (6)

$$I_{it} = \beta_0 + \beta_1 g_{it} + \beta_2 q_{it} - \beta_3 r_{it} + \eta I_{it-1} + \varphi S_{it} + e_{it} \dots\dots\dots (6)$$

Where,  $S_{it}$  are a set of institutional variables included in the model over the neo classical specification,  $I_{it-1}$  past year's capital formation which serve as capital formation smoothing term. The Empirical model of the study is specified as follows.

Empirical Model Specification

**I. Differenced GMM (Arellano-Bond) estimator**

Dynamic panel models are considered for the study where the chosen estimator is differenced GMM, also named Arellano-Bond (1991) estimator after Manuel Arellano and Stephen Bond. The estimator is chosen for based on the fact that it corrects endogeneity problem by transforming all regressors through differencing and using them as instruments. This provides sufficient supply of instruments and produces efficient result.

A few description of the model is made as follows

Starting point: the first difference (FD) estimator

$$\Delta y_i = \lambda \Delta y_{i-1} + \beta \Delta x'_{i-1} + \Delta e_{it} \dots\dots\dots (7)$$

Where

$$\Delta y_i = \begin{bmatrix} \Delta y_{i2} \\ \Delta y_{i3} \\ \vdots \\ \Delta y_{iT} \end{bmatrix}, \Delta y_{i-1} = \begin{bmatrix} \Delta y_{i1} \\ \Delta y_{i2} \\ \vdots \\ \Delta y_{iT} \end{bmatrix}, \Delta x_{i-1} = \begin{bmatrix} \Delta x_{i2} \\ \Delta x_{i3} \\ \vdots \\ \Delta x'_{iT} \end{bmatrix} \text{ and } \Delta e_i = \begin{bmatrix} \Delta e_{i2} \\ \Delta e_{i3} \\ \vdots \\ \Delta x'_{iT} \end{bmatrix}$$

Then valid instruments

- ✓  $[t = 2 \text{ or } t = 1]$ : No instruments
  - ✓  $[t = 3]$ : the valid instruments for  $\Delta Y_{i2} = (Y_{i2} - Y_{i1})$  is  $Y_{i1}$ ,
  - ✓  $[t = 4]$ : the valid instruments for  $\Delta Y_{i3} = (Y_{i3} - Y_{i2})$  is  $Y_{i2}$  as well as  $Y_{i1}$ ,
  - ✓  $[t = T]$ : the valid instruments for  $\Delta Y_{iT-1} = (Y_{iT-1} - Y_{iT-2})$  is  $Y_{iT-2}$  as well as  $Y_{iT-3}, \dots, Y_{i1}$ .
- Hence there is a total of  $(T-1) (T-2)/2$  available instruments or moment conditions for  $\Delta Y_{iT-1}$ .

The corresponding matrix of instruments for the lagged difference is given by

$$\omega_i = \begin{bmatrix} y_{i1} & 0 & \dots & 0 \\ 0 & y_{i1}, y_{i2} & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & y_{i1}, y_{i2} \dots y_{iT-2} \end{bmatrix}$$

The moment conditions can be described as

$$E[\omega_i' \Delta e_i] = 0 \dots\dots\dots (8)$$

Finally, the GMM estimator that takes into account the formulated moment conditions is:

$$\hat{\lambda}^{GMM} = (G' Z S_N Z' G)^{-1} G' Z S_N Z' \Delta y \dots\dots\dots (9)$$

Where  $G = (\Delta y_{i-1}, \Delta x)$ ,  $Z = (\omega, \Delta x)$

$S_N = (\sum_{i=1}^N z_i' \hat{e}_i \hat{e}_i' z_i)^{-1}$  is the optimal weighting matrix which is calculated from initial estimate.

Description of important variables included in the model and their expected sign is made as follows

## II. Description of variables included in analysis

### Dependent variable

**Investment:** represents gross capital formation, where natural logarithm form is taken to reduce dimension. The gross capital formation, previously domestic investment contains the value of acquisitions of new or existing fixed assets by the business sector, governments and households and also inventory accumulation.

### Independent variables

**Invest<sub>-1</sub>:** Denotes last year's capital formation is included as capital formation smoothing variable and its effect on capital formation is expected to be positive. (Eberly et.al, 2012)

**Real GDP:** is an indicator of economic size. In the model natural logarithm of Real GDP is taken to reduce dimension.

**Real GDP growth rate:** is considered as an indicator of economic growth.

Both real GDP and real GDP growth rate are expected to have positive effect on capital formation which follows from the flexible accelerator model that assumes there is a fixed relationship in the production function between the desired capital stock and the level of output as well as output growth rate (Fry, 1980).

**Real Interest rate:** interest rate is cost of capital and from Tobin's "q" theory of capital formation, its impact is generally hypothesized to be negative.

**Inflation rate:** denotes the percentage annual growth rate in general price level (GDP deflator) of the economy. It is one of economic management/control variable. The impact of inflation is ambiguous as on one hand, inflation reduces real wage rate which raises employment capability of the firms and then capital formation, on the other hand, inflation creates macroeconomic uncertainties which may hurt capital formation decision. (Romer et. al, 1995)

**The share of government spending in national GDP:** - is another economic control variable. The impact of government spending on capital formation activity is theoretically ambiguous. Early empirical evidence (Blejer & Khan, 1984) shows that on one hand overwhelming government expenditure creates crowd out effect, which is partial displacement of private capital formation activities by creating high fiscal deficits. On

the other hand, government spending which is targeted toward infrastructural expansion and social development complements private capital formation and may boost general capital formation activities.

**Human capital index:** -The index is constructed based on composite indexes of years of schooling and returns to education which lies between range of 1 (low) to 4(high) which is retrieved from Penn World Table Version 10. It is hypothesized to have positive impact on capital formation following Barro and Lee (2013)

**Financial development:** Financial development is indexed with domestic credit to private sector share of GDP. Its effect on capital formations works directly through the stock of credit available to firms. This positive impact has been found in many studies for developing economies (Levine, 2005; Fry, 1980)

**Quality of business environment:** The index is constructed from scores of property rights, credit market regulation, ownership of banks, interest rate controls, labor market regulations, administrative requirements to start business, regulatory burden, extra payments (bribes or favoritism), licensing restrictions and cost of tax compliance. The weighted average of the score of the listed components are taken as indicator of business environment. Improvements in quality of business environment promotes of ease of doing business and hypothesized to have positive effect on capital formation.

**Political instability:** Denotes indexes of the extent of political stability and Absence of Violence, terrorism and war in countries of the region. The index ranges from -2.5 (poor performance) to 2.5 (best performance) and obtained from world governance indicators (WGI).Following Uddin et al, 2018, the presence of war, instability and violence (the smaller the stability index) are expected to negatively affect capital formation function.

**Table 1: Summary of Description of explanatory variables included in the model**

Variable	Symbol	Nature of the variable	Expected sign
Capital formation	lninvestment	Continuous natural logarithm of gross capital formation	dependent
Last Year capital formation	invest <sub>t-1</sub>	Continuous ~natural logarithm of one period lag in capital formation	+
Real GDP	lnRGDP	Continuous ~ natural logarithm of real GDP of the countries	+
Real GDP growth rate	RGDPgrowth	Continuous ~ the rate of growth of real GDP of economies of the countries	+
Real interest rate	interest	Continuous ~ the rate of interest	(-)
Inflation rate	inflation	Continuous ~the percentage growth in general price level.	+ or (-)
The share of government spending in national GDP	govspending	Continuous ~ the percentage share of government spending in GDP of the economies of the countries	+ or (-)
Human capital index	HCI	Scale~ composite index of health and education which lies from 1 (low) to 4 (high) which is constructed by PWT	+
Financial development	Financedevt	Continuous ~ measured by the percentage of domestic credit provided to private sector as a share of GDP	+

Quality of business environment	Businessenvt	Scale ~ composite index of several proxy of business environment which ranges from 0 (low performance) to 10 (high performance) which is constructed by EFW	+
Political instability	politicalinst	Scale ~ composite index of several proxy of instability and ethnic violence which ranges from -2.5 (high instability) to 2.5 (high stability) which is retrieved from PWT	(-)

**III. Stationarity test; Levin, Lin, Chu (LLC) approach**

Before employing the variables for analysis purpose, panel unit root tests are conducted for each variable. One of the first panel unit root tests formulated by Levin et al. (2002) suggests the following hypotheses for testing stationarity in panel data. Under null hypothesis, LLC test shows that each time series contains a unit root,

i.e.,  $H_0: \rho_i = 0 \forall i$ , and

for alternative hypothesis, each time series is stationary,

i.e.,  $H_1: \rho_i = \rho < 0 \forall i$ .

The LLC approach assumes that the individual processes in each cross section are independent. The test is mainly based on the estimation of the equation;

$$\Delta y_{i,t} = \alpha_i + \delta_{it} + \theta_t + \rho_i y_{i,t-1} + e_{i,t} \dots\dots\dots (10)$$

Where  $i=1, 2, \dots, 6$  and  $t=1, 2, \dots, 18$

Then the parameter  $\rho_i$  on which we conduct stationarity test is  $\rho_i$ .

**IV. Sargan test of over identifying restrictions**

This test verifies the validity of the instruments used in the analysis (Roodman,2009). The test is used for One Step estimations and in samples where there is not a risk of overestimation. The statistics reported is  $\chi^2$ . The number close to the  $\chi^2$  in parentheses, correspond to the quantity of instruments over the instruments needed. The difference between the total instruments and the instruments leftover, is the optimal number of instrument for the model.

The interpretation of the Sargan test will be as follow:

*Null hypothesis*

**Ho:** All the restrictions of over identification are valid.

*Criteria of rejection or acceptance:*

$$Prob > \chi^2 \geq 0.05(5\%)$$

i.e. If the probability obtained is equal or higher to 0.05, the used instruments in the estimation are valid, and therefore over identification doesn't exit. Therefore, there is no evidence to reject the null hypothesis.

**V. Arellano and Bond Autocorrelation Test**

Dynamic panel data introduces the condition of correlation in the error terms (Cameron & Trivedi 2009). For testing that, the Arellano and Bond test is employed in the paper. The hypothesis is formulated as follows:

*Null hypothesis:*

Ho: Autocorrelation doesn't exit.

*Criteria of rejection/acceptation*

To reject that null hypothesis, we will use *AR (2)*. This rejection implies the probability  $p_{i> z}$  is higher than 0.05, that is to say, the errors terms are not serially correlated.

### 3. Results and discussions

This section presents and discusses several findings of the study. Several descriptive statistics and Econometrics analysis of panel data are made and presented as follows. The statistics are computed with STATA v.16 software package.

#### 3.1. Stationarity test

For panel stationarity test, the result of the Levin, Lin and Chu (2002) is presented as follows and variables which retained their stationarity are included in the regressions at level. Table 2 shows that All variables are stationary at level except financial development which became trend stationary process. For financial development, the cyclical component is removed and the deterministic part is included in the regression.

**Table 2: panel stationarity test, LLC approach**

Variable	t* Statistics	p-value	Remark
invest <sub>1</sub>	-4.9740	0.0000	Stationary at level
Lnrgdp	-6.4170	0.0000	Stationary at level
RGDPgrowth	-4.1434	0.0000	Stationary at level
Interest	-4.0906	0.0000	Stationary at level
inflation	-2.8622	0.0021	Stationary at level
govspending	-1.3976	0.0811	Not stationary at P-value 5%
govspending with trend term	-2.3238	0.0101	Stationary at p5% after including trend term
HCI	-1.8214	0.0343	Stationary at level
financedevt	-6.1691	0.0000	Stationary at level
businessenvt	-5.0297	0.0000	Stationary at level
politicalinst	-2.3231	0.0101	Stationary at level

### 3.2. Descriptive statistics

#### I. Summary of descriptive statistics

##### a. Aggregate summary

Table 3: Summary of descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lninvestment	108	22.41491	1.03008	19.456	24.2444
lnrgdp	108	23.80056	.7587081	21.9745	24.936
gdpgrowthre	108	6.520116	2.936982	-3.35547	13.5726
interestrate	108	7.785073	2.738586	2.67365	12.8627
inflation	108	8.449025	9.480367	-3.62143	84.5574
govspendinre	108	13.50962	4.272079	6.61373	26.4707
hci	108	1.676489	.387585	1.14748	2.5179
financialdvt	108	18.04515	7.363786	6.18238	34.9907
businessenvt	108	6.960463	.9575098	4.75	8.62
politicalinst	108	-.7593518	.6194122	-1.8	.63

On table 3 above, the standard deviation statistics show that among macroeconomic variables, inflation is the one with highest volatility (9.48) while among institutional variables, financial development is the one with highest volatility (7.36). Institutional variables like financial development and business environment exhibits higher standard deviation than some macroeconomic variables like real GDP, which is preliminary indication of how institutional variables and may matter in determining capital formation.

##### b. Across country summary; mean statistics

Table 4: Across country mean statistics of the variables

Countries	Variables (mean)									
	Ln investment	ln RGDP	RGDP growth	interest	inflation	gov spending	HCI	finance devt	business envt	Political inst
Ethiopia	23.11	24.15	9.13*	3.13	12.79*	11.05	1.32	18.04	6.29	-1.55
Kenya	22.85	24.5*	4.93	8.01	8.52	14.59	2.18*	30.19*	7.36	-1.22
Uganda	22.38	24.05	6.19	10.48*	9.64	10.35	2.07	12.28	7.9*	-0.95
Tanzania	23.15*	24.28	6.16	7.98	7.39	10.24	1.62	11.56	6.79	-0.36
Mozambique	22.11	23.20	5.93	8.53	5.45	20.3*	1.18	20.05	5.51	-0.13*
Rwanda	20.91	22.61	6.75	8.54	6.87	14.5	1.66	16.12	7.9*	-0.33

\*: - denotes maximum figure

The across country mean statistics of the table 4, (the details which includes other statistics are reported on Appendix III) shows that over the periods covered by the study, on average, Tanzania has highest capital formation level which is 11.32 billion\$ (antilog of 23.15) per year, Ethiopia has highest GDP growth rate and highest inflation rate which are 9.13% per year and 12.79% per year respectively, Kenya has highest real GDP size, 43.67 billion\$ (anti ln of 24.5) per year and Mozambique has highest government size as a % of GDP which is 20.3% per year.

Similarly, in the case of institutional variables over the periods covered by the study, in comparing with the other countries, on average Kenya has highest human capital index and highest financial development index which are 2.18 and 30.19 per year respectively. In terms of creating good business environment Uganda's and Rwanda's average figure are higher (7.9). On the other hand, in terms of political stability and no violence score, Mozambique's figure is relatively better ( -0.33) while Ethiopia's figure is the smallest (-1.55).

## II. Pairwise Correlation analysis

Table 5: Pairwise correlation table

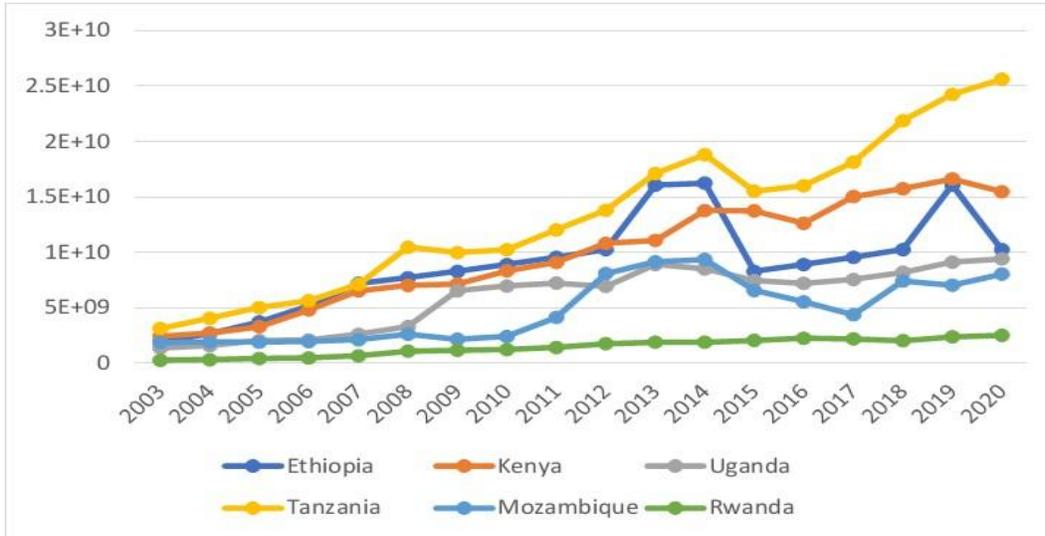
	lninvest
lninvestment	1.0000
lnrgdp	0.9046*
gdpgrowthr~e	-0.0199
interestrate	-0.3653*
inflation	0.0569
govspendin~e	-0.3635*
hci	0.2054*
financiald~t	0.3184*
businessen~t	-0.1252
politicaliy	-0.2753*

\*: -correlation is significant at 5% significance level.

The significant simple pairwise correlation tests show that among macroeconomic variables real GDP is highly and positively correlated with capital formation while interest rate and government spending are highly and negatively correlated with it. In the case of institutional variables, capital formation has high positive significant correlation with financial development and high negative significant correlation with political instability.

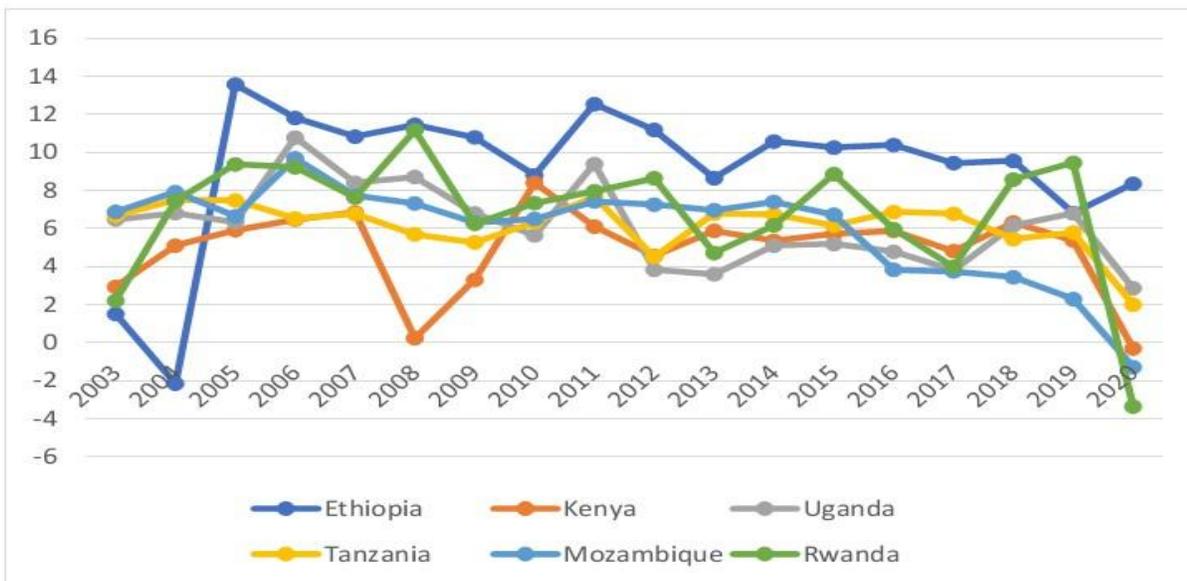
### III. Trend Analysis

Figure 1: Trends of capital formation in East African countries (2003-2020)



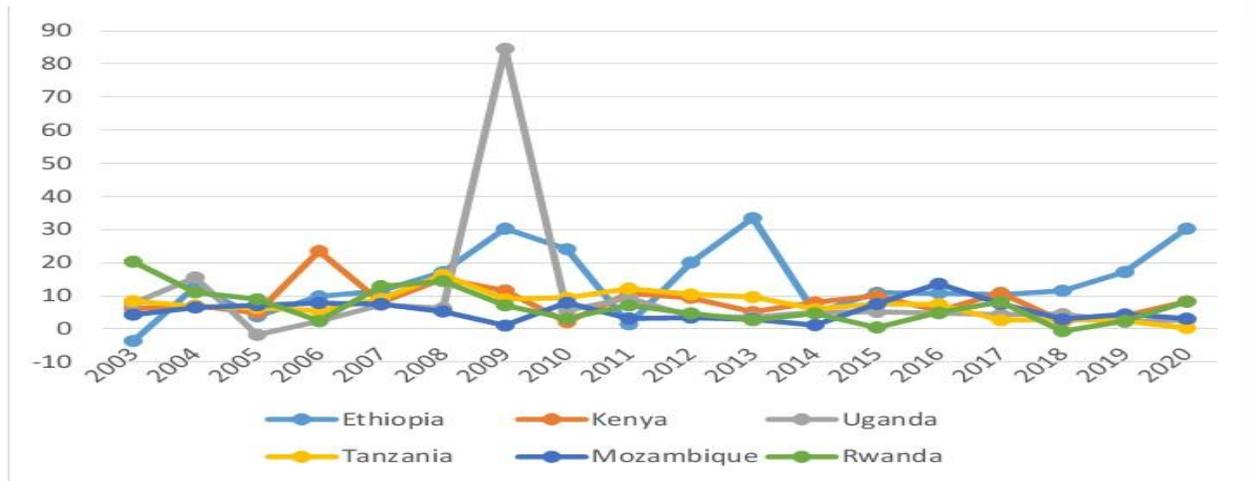
Source: own computation from WB data

Figure 2; Trends of GDP growth rate in East African countries (2003-2020)



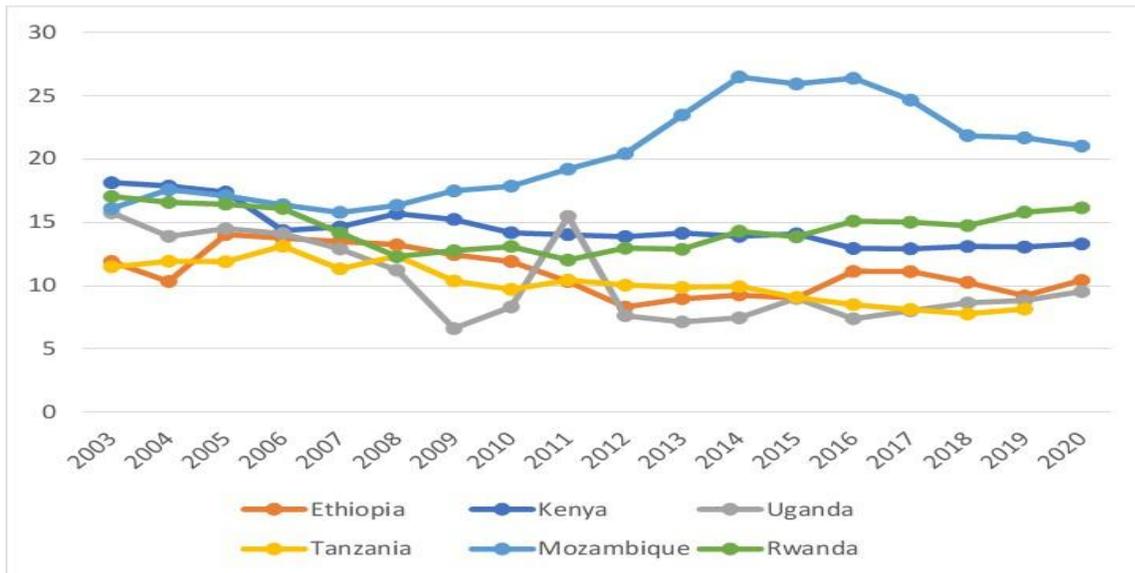
Source: own computation from WB data

**Figure 3: Inflation trends in East African countries (2003-2020)**



Source: own computation from WB data

**Figure 4: Trends of share of government spending in GDP, in East African countries (2003-2020)**



Source: own computation from WB data

The above figures show the trends of selected macroeconomic variables. For example, Figure 1 shows the trends of capital formation or cumulative capital formation in the sample of East African countries. When we observe the trend of each country, Tanzania has the highest capital formation levels than the other countries in the sample and it shows that there is a high increasing trend followed by Kenya and Ethiopia. Ethiopia's capital formation trend shows large fluctuation specifically 2011 G.C. onwards. On the other hand the figure shows capital formation trends in Rwanda and Mozambique is relatively smaller.

### **3.3. Econometrics Estimation Result**

This section presents the results from econometrics' model estimation of the differenced GMM for the Capital formation equation (6). The results from the alternative linear panel models are presented for the purpose of checking robustness and consistency of the results. Before presenting the results of AB estimator, the test of over identifying restrictions and the test of serial correlation are conducted with Sargan test and AB test for zero autocorrelation in first-differenced errors respectively. In addition, Wald  $\chi^2$  test is employed for checking overall model significance.

3.3.1. Determinants of Capital formation; Arellano-Bond GMM Estimator

Table 6: Macroeconomic determinants of capital formation; Arellano bond estimator

```

Arellano-Bond dynamic panel-data estimation      Number of obs      =      96
Group variable: panelid                        Number of groups   =      6
Time variable: year

Obs per group:
    min =      16
    avg =      16
    max =      16

Number of instruments =      97                Wald chi2(5)      =      3622.55
                                                Prob > chi2       =      0.0000

One-step results
                                                (Std. Err. adjusted for clustering on panelid)

```

	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
lninvestment						
L1.	.6563343	.0326673	20.09	0.000	.5923076	.720361
businessenvironment	.1243525	.0609499	2.04	0.041	.004893	.243812
hci	.0584874	.0683473	0.86	0.392	-.075471	.1924457
politicalinstability	-.0382348	.0124633	-3.07	0.002	-.0626624	-.0138073
financialdevt	.016456	.0034494	4.77	0.000	.0096952	.0232167
interestrte	-.0049185	.0059219	-0.83	0.406	-.0165252	.0066883
inflation	.0046429	.0007868	5.90	0.000	.0031008	.006185
lnrgdp	.3107794	.0864953	3.59	0.000	.1412518	.480307
gdpgrowthrate	.0078825	.0022544	3.50	0.000	.003464	.0123009
govspendingshare	-.0167116	.0026158	-6.39	0.000	-.0218385	-.0115848
_cons	-.7275316	1.260149	-0.58	0.564	-3.197379	1.742316

```

Instruments for differenced equation
GMM-type: L(2/4).lninvestment L(1/1).businessenvironment L(1/1).hci
           L(1/1).politicalinstability L(1/1).financialdevt
           L(1/1).interestrte L(1/1).inflation
Standard: D.lnrgdp D.gdpgrowthrate D.govspendingshare
Instruments for level equation
Standard: _cons

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The above AB-GMM estimation results (table 6) shows that most of macroeconomic variables are statistically significant and most of the sign of coefficients of the variables are inline with expected priori criteria. the last year capital formation and the economic size (ln RGDP) are among the variables having strong positive effect on capital formation with the coefficients of 0.65 and 0.31 respectively. Among economic control variables,

inflation is found to be positively affecting capital formation. A percent increase in general price level raises capital formation by 0.46%. The result for inflation may not be very surprising as the economy of most East African countries are inherent with inflation problem. Even if the result seems against priori, it has some implication for East African countries. On one hand stable inflation reduces the real wages which in turn enables firms to hire large amounts of labor with cheap wage and expand productivity or capital formation. On the other hand inflation reduces real interest rate and then promotes capital formation activity in the region which is consistent with Philips curve consensus. This result is consistent with Hycent's finding for central African countries' capital formation function, where they found the positive impacts of inflation. (Hycent et al., 2014).

Expansion of government spending found to have significant negative impact on capital formation in the region. One percent rise in percentage share of government spending in GDP results in about 1.6% decline in capital formation. As the share of government spending in GDP increases, this may create partial displacement of private sector investment and may raise costs of capital which may in turn negatively affect the gross capital formation of the region. However contrary to this study, Lim (2014) and Bailey (2018) found the positive impacts of government spending on capital formation activities.

One interesting point of the finding of the study is even if its insignificant, the impacts of interest rate on capital formation is found to be negative as postulated by neo-classical's theory. One percent increase in interest rate entails 0.49 % reduction in capital formation.

Analyzing the role institutional factors included in the model, the result on table 6 shows that except for human capital, the impacts on capital formation of all institutional variables included in the model are statistically significant and their magnitude of effects are in accordance with expected priori. The impacts of business environment and financial development on capital formation is found to be positive. The positive impact of improvement in quality of business environment on capital formation is strongest one. One percent improvement in quality of business environment promotes capital formation in the region by 12.4%. The improvement in business environment includes improvements in credit market regulation, labor market regulations, administrative requirements to start business, the property rights, participation of private banks in business, degree of combatting corruption, relaxing licensing restrictions and reducing cost of tax compliance. Similarly, one percent improvement in financial development increases capital formation by 1.64%.

Even though it is statistically insignificant, the coefficient of human capital index shows that the human capital development has positive effect on capital formation.

On the other hand, the impact of political instability like presence of war, violence, internal conflict and terrorism on capital formation of the region is found to be negative and significant. This is because as shown in table 2 the political stability index of the region is low which is even below average. The decline in political stability index by 1% (the rise in political instability by 1%) reduces capital formation in the region by 3.8%. A research by Abdelkarim Jabri in Middle east and north Africa (MENA) region reveals the same result on the role of institutional factors where institutional indicators like government stability, capital formation profile, rule of law, internal and external conflict, are found to have a long-run effect on attracting aggregate investment in general and foreign direct investment in particular (Jabri, 2015).

Overall, the regressions presented on table 6 affirms the quantitative and qualitative results obtained in the descriptive parts which then provides some evidence on the effects of institutional variables in addition to the neoclassical determinants of capital formation.

For the purpose of comparison of consistency and robustness of the obtained result, the estimations of the linear panel models are presented on the following table 7. However, the linear panel models are non-instrumented model and their results are not expected to be as efficient as GMM estimator presented above.

**Table 7: Linear panel models' estimation results**

Independent variables	Dependent variable: investment		
	POLS	Fixed Effects	ML-Random Effects
<i>Lnrgdp</i>	1.527*** (.0629734)	1.4300*** (.13113)	1.5012*** (.12298)
<i>gdpgrowthrate</i>	.0051112 (.0115254)	.01771** (.00844)	.01596** (.008134)
<i>interestrates</i>	.0023985 (.0157117)	-.005748 (.01457)	-.00435 (.01391)
<i>Inflation</i>	.0017071 (.002098)	.00488** (.00232)	.004531** (.002234)
<i>govspendingshare</i>	(-.018039 .0178674)	-.0197067 (.012655)	-.02011* (.012018)
<i>Hci</i>	-1.2762*** (.1613727)	.3458709 (.336806)	.05214 (.33688)
<i>Financialdev't</i>	.027213*** (.0068295)	.022854** (.009267)	.02425*** (.00879)
<i>businessenvironment</i>	.1465*** (.0512169)	.19841*** (.0614514)	.16450*** (.05893)
<i>politicalinstability</i>	.3495423*** (.0630456)	-.04059 (.08504)	.01635** (.08502)
<b>Constant</b>	-12.86*** (1.890929)	-13.8709*** (2.5921)	-14.809** (2.434)
<b>Observation</b>	108	108	108
<b>R<sup>2</sup></b>	0.929	Within R <sup>2</sup> =0.91 Overall=0.68	
<b>Adjusted R<sup>2</sup></b>	0.92		
<b>F stat.</b>	513.84***	Wald $\chi^2=114.03$ ***	LR $\chi^2=255.65$ ***

Note: The statistics in the parenthesis are standard errors of the estimators. The \*, \*\* and \*\*\* indicates statistically significant coefficients at 10%, 5% and 1% level of significance.

#### 4. Conclusions and recommendations

The existing and earlier research papers conducted on determinants of capital formation in East Africa mainly focuses on macroeconomic variables like size of an economy, growth rate of an economy, interest rate, inflation rate, trade openness and size of a government. However, given that there are structural and institutional rigidities inherited to an economy of developing world, there is a need to focus on additional institutional determinants of capital formation along with macroeconomic variables.

In this paper the researcher tries to analyze the impacts of institutional and structural variables on capital formation dynamics along with macroeconomic determinants by taking 6 East African countries as a case study. The data covers 18 years' panel and the study employs differenced GMM model as a benchmark estimator. There are two main findings of the study. The first one is the neoclassical's determinants of capital formation function still work for East African economies as well. Among the neoclassical's macroeconomic determinants economic size highly matter in determining capital formation function. Other macroeconomic determinants like interest rate, government spending, inflation rate and economy's growth rate are also significantly matter in determining the size and the sign of capital formation. Another main finding of the study is beyond traditional macroeconomic determinants, there are institutional and structural variables which matters in capital formation of East African countries. The simple insight for policy arising from this paper is that in addition to the traditional Macroeconomic policy areas such as a stable macroeconomic environment, the capital formation climate in East Africa is characterized by the broader structural and institutional environment in which firms and businesses operate. These includes, financial openness, financial development, government size and the governance frameworks such as rule of law, political stability and the extent of control of corruption.

Specifically based on the findings of the study, here it is recommended that for capital formation expansion, in addition prescribing appropriate macroeconomic policies, the policy maker and concerned bodies should target toward improving quality of business environment like improving ease of doing business, private sector participation into capital formation activities, improvement on property rights and business regulation, relaxing administrative requirement and bureaucracy to start business, proper labor market regulation, relaxing licensing restrictions and revising tax structure, providing subsidy and setting attractive interest rates. Similarly improving access to credit and financial sector expansion are better for financial development which in turn is necessary to boost capital formation activity and capital formation in the region. In addition, structural transformation of existing social and political institutions, government strength, protection of human rights, democracy, reduction of war, political instability and terrorism are equally recommended for capital formation expansion and capital formation of the region.

#### Acronyms

WDI: World Development Indicators  
EFW: Economic Freedom of a World  
PWT: Penn World Table  
WGI: world governance indicators  
AB- Arellano- Bond estimator  
GMM- Generalized method of moments  
GDP: Gross domestic product

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