Dynamics of inflation and its impact on economic growth in selected East African Countries: Ethiopia, Sudan and Kenya

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Despite Ethiopia's, Sudan's, and Kenya's fastest-growing economies' performance over the last two decades, the overall average inflation rate remains double digits. It subsequently incorporates a detrimental impact to support economic growth in an extended period. This study aims to assess the dynamics of inflation and its impacts on economic growth Ethiopia, Kenya, and Sudan using time-series macroeconomic data collected from the African Development Bank. The research used the Autoregressive Distributed Lag (ARDL) econometrics model and investigated the presence of cointegration and long-term relationships between macroeconomic factors. The result indicates that the exchange rate and the supply of the long-run economic growth rate influence Ethiopia's money supply. Inflation rates and foreign direct investments have impacted economic growth rates in Kenya and Sudan. The economic growth rate in all counties is generally influenced by both the availability of money and the exchange rate—also, real per capita GDP affecting the economic growth rate of Sudan and Ethiopia. Policies on introducing new technologies, building capacities in public and private sectors, youth and gender parity, mobilizing domestic resources, and public participation are recommended for Ethiopia, Kenya, and Sudan.

Key words: Inflation dynamics, real GDP growth rate, ARDL model, Ethiopia, Kenya and Sudan.

INTRODUCTION

The economic growth results from fiscal, monetary, and various other economic policies recommended by policymakers. Several factors affect economic growth. Indeed, inflation and economic growth relationship are complicated. The sophistication of the link has been explored in many studies. Earlier empirical research showed a negative relationship between inflation and economic growth. On the contrary, analyses focusing on
developing countries' sample found a positive relationship between inflation and economic growth. The relationships involving inflation and economic growth have been studied substantially. Nevertheless, the specific connection is not very well defined (Stephanie, 2012).

Considering the East African countries, it is quite relevant to wisely look at the relationship over the years to ensure that inflation does not affect economic growth. During the past in Ethiopia, inflation has been maintained at a lower rate because the authorities controlled the price. The Government was providing products at a set price towards the public. Even more, the lower exchange rate also has a lower inflation rate. Likewise, the inflation level has been reduced in the earlier years of the present Government (Sisay, 2008; World Bank, 2016). However, recently, inflation continues to be high in Ethiopia. Inflation increase in Ethiopia averaged 18.69% from 2006 until 2015, reaching the highest all-time, a lot of 64.20% in 2008, and a record low of -4.10% in 2009 (CSA, 2020).

From 1999 to 2011, Sudan had a time in Sudan where it advanced from widespread natural resources discoveries via oil. Economic growth surpassed the historical average of 4.9 during the "oil economy," and 6.1% on average per year. Sudan lost nearly 75% of its returns and much of its prime economic activity due to South Sudan's secession in 2011, growth for 2014 was 3.1% and indicated some continuation of recovery; however, growth was 3.1% in 2015 (World Bank, 2015).

From 1995 to 2010, the overall economy's growth rate did not display a steady or perhaps regular Kenya pattern. In 1995 and 1996, the real GDP growth rate was 4.3 and 4.0%, respectively. Nevertheless, in 1997, the growth rate decreased considerably to a depressing level of 0.2%. The growth rate rose to 4.6 and 7.0% in 2004 and 2007, correspondingly (AfDB, 2018).

Motivated by Fischer's pioneering work, several studies have found proof of non-linearities inside the inflation-growth nexus using different estimation methods. Alternatively, Ahmed (2010) claims approximately that panel data approaches are superior in recording the inflation-growth relationship than country-specific investigations. Current investigation reveals blended pieces of evidence on the level of inflation restraint achieved by distinctive ponders, just like Ahmed (2010), Stephanie (2012), and Ibarra and Trupkin (2016) investigations. The variations in the calculation methods used can easily explain the inflation resistance figures. Indeed, different tests use different estimation techniques: Bick (2007) uses non-dynamic regression of the panel limit, and Ibarra and Trupkin (2016) uses regression of the smooth shift panel. Stephanie (2012) does, however, include dynamic plank threshold regression. When analyzing non-linearities in the inflation-growth nexus, the option of an excellent estimation technique plays an important role. Ahmed (2010) and Bick (2007) all provide actual income within the growth equation among all the control variables but use tools and methods that do not question responding to the endogeneity problem. The integrated analysis that tells the inflation threshold's truth may also depend on the countries' sample. Study of developing countries in Africa, South America and Asia, as per Ahmed (2010), Bick (2007), Stephanie (2012) and Ibarra and Trupkin (2016), showed varying levels of economic development. According to Moshiri (2004), this could lead to a bias in the inflation threshold idea. Furthermore, in all developing countries, it is inappropriate to set a single policy target.

Various researchers attempted to investigate the relationship between inflation and economic growth in Ethiopia, Kenya, and Sudan using different econometrics approaches. Still, there is a lack of comparative studies that compare the dynamics of inflation and its effect on economic growth between Ethiopia, Kenya, and Sudan, which showed the highest inflation rates in the East African Region. Conducting a comparative study helps to understand the differences and similarities, as well as share experiences and what macroeconomic policies can be used for in the three countries by assessing inflation dynamics and economic growth effects.

**MATERIALS AND METHODS**

**Data types and sources**

The analysis relies primarily on secondary time series data from the African Development Bank (AfDB) socio-economic database for Ethiopia, Kenya and Sudan. Economic growth will be used as a dependent variable, though inflation, FDI, exchange rate, growth rate of money supply growth, and real per capita GDP variables are explanatory variables. To summarize and present the data, various statistical techniques were used. In Ethiopia, Kenya, and Sudan, the econometric method of ARDL is then used to verify the relationship and impact.

**Data analysis**

The study used descriptive and econometric analysis. In this study, we used standard time series equation of the form:

$$\text{RealGDP}_t = \beta_0 + \beta_1 \text{Inf}_t + \beta_2 \text{Exch}_t + \beta_3 \text{MonSup}_t + \beta_4 \text{PerCap}_t + \epsilon_t$$  

(1)

Where real GDP is the Real GDP growth rate, Inf is inflation rate measured by a consumer price index, Exch is the normal exchange rate, MonSup is money supply growth rate, growth rate, and PerCap is per capita GDP. Following Gujarati (2004), Equation 1 is written in the standard autoregressive disturbed lag form:

$$\text{RealGDP}_t = \beta_0 + \sum_{i=4}^{K} \beta_{t-i} \text{RealGDP}_{t-i} + \sum_{i=0}^{K} \beta_{t+1} \text{Inf}_{t+1} + \sum_{i=0}^{K} \beta_{t+2} \text{Exch}_{t+2} + \sum_{i=0}^{K} \beta_{t+3} \text{MonSup}_{t+3} + \sum_{i=0}^{K} \beta_{t+4} \text{PerCap}_{t+4} + \epsilon_t$$  

(2)
K is the lag length capturing the adjustment process and potential simultaneity bias among the macroeconomics variables.

**Unit Root test - The Augmented Dicky Fuller (ADF) test**

We should be concerned whether or not the time series is stationary. Autocorrelation sometimes occurs when the underlying time series is non-stationary. The regression shows a strong correlation even when there is no substantive relationship among the variables under investigation. This concept is known as spurious, spurious relationship with very high R squared (approximately unity) and substantial t and F-statistics. Therefore, the outcomes will be ambiguous for economic analysis. The stationary tests should be carried out before conducting any time-series analysis. If the series is stationary without any differences, it is integrated with zero [l(0)] or stationary at the level. The series is integrated by order one, or [l(1)]. If it is stationary at level two [l(2)], it becomes stationary after two differentiations (Gujarati, 2004).

The Unit Root test is a test of Stationarity that has become widely popular over the past several years (Gujarati, 2004). Suppose we have the following relationship;

\[ Y_t = \rho Y_{t-1} + U_t \]  
\[ Y_t = \rho Y_{t-1} + U_t \]

Where \( \rho \) is between -1 and 1; and \( U_t \) is a white noise error term.

If the value of \( \rho \) is equal to 1, then this is a unit root cause, and the equation becomes a random walk model without drift which is a non-stationary stochastic process. Then, to check whether \( \rho \) is equal to 1 or not we regress \( Y_t \) on its one-period lagged value of \( Y_{t-1} \). If \( \rho \) is statistically equal to 1, then \( Y_t \) is non-stationary. We perform the following to see whether there is a unit root or not in the above relationship;

\[ Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + U_t \]  
\[ Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + U_t \]

This can also be rewritten as;

\[ \Delta Y_t = \delta Y_{t-1} + U_t \]  
\[ \Delta Y_t = \delta Y_{t-1} + U_t \]

Where \( \delta = (\rho - 1) \) and \( \Delta \), as usual, is the first difference operator. We, practically estimate the above equation and test the null hypothesis of \( \delta = 0 \). If \( \delta = 0 \), then \( \rho = 1 \), and we have a unit root which indicates that we have time-series data that is non-stationary.

It confirmed that the Augmented Dicky Fuller (ADF) test could be used to test for Stationarity. In the case of ADF test, Gujarati (2004) specified the following equation:

\[ \Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + U_t \]  
\[ \Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + U_t \]

Where \( U_t \) is a pure white noise error term and where \( \Delta Y_{t-i} = (Y_t - Y_{t-1}) \); \( \Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}) \), etc.

**Lag length selection criterion**

The ARDL technique researchers estimate \((p+1)k\) as the number of regressions to achieve an optimal length of lag by each variable, \( p \) is the maximum number of lags that can be used, and \( k \) is the equation’s number of variables. The model can be made based on model selection criteria such as Schwartz-Bayesian Criteria (SBC) and Akaike’s Information Criteria (AIC). SBC is known as the parsimonious model: selecting the lowest possible lag length, while AIC is known for choosing the maximum relevant lag length (Gujarati, 2004). To apply these criteria, we calculate the following system statistics for each lag.

\[ \text{AIC} = \log | \Sigma | + 2g/n \]
\[ \text{SBC} = \log | \Sigma | + g \log(n)=n \]

Where \( | \Sigma | / \) is the cause of the variance-covariance matrix of the system’s residuals, \( g \) is the total number of parameters estimated in all equations and \( n \) is the number of observations.

**Test for cointegration (bounds test)**

Co-integration is an econometric principle that simulates long stability between the associated economic time series that converges over time. Therefore, cointegration provides a better statistical and economic basis for the quantitative error correction model, which combines short-term and long-term data in modeling variables. Cointegration testing is an essential step toward establishing whether a model has useful long-term relationships scientifically. In this investigation, a bound testing technique is being used to assess the presence of long-term relationships between the real Gross Domestic Product and the repressors and is focused primarily on the F-test. The F-test is a test of the hypothesis which reveals that there is no cointegration between different factors against Cointegration’s existence or appearance between variables (Gujarati, 2004; Johansen and Juselius, 1990). It also includes determining the mentioned unrestricted error correction model (UECM) using OLS.

\[ \Delta Y_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \Delta Y_{t-i} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + U_t \]

The F-test hypothesis is denoted as:

\[ \text{H0: } \beta_1 = \beta_2 = 0 \text{ (null, that is, the long run relationship does not exist).} \]
\[ \text{H1: } \beta_1 \neq \beta_2 \neq 0 \text{ (Alternative, that is, the long-run relationship exists).} \]

This is tested in each of the models as specified by the number of variables.

The ARDL bound testing is performed on the Wald test (F-statistic). The Wald-Test’s asymptotic distribution is non-standard under the null hypothesis that there is no cointegration between the variables. The smaller value bound implies that all variables are I(0), indicating no cointegration relationship between the variables studied. The upper bound implies that all variables are I(1), which means cointegration between variables. If the calculated F-statistic is higher than the critical value, the H0 is rejected (the variables are cointegrated). When the F-statistic test is less than the lower bound
critical value, the $H_0$ cannot be rejected (no cointegration among
the variables). Suppose the computed $F$-statistics falls between
both the minimum and maximum values, in that case, the results
are unsatisfactory, and we need to verify the stationarity error term.
Depending on the outcomes of the ARDL bounds test, we use
either the Error Correction Model (ECM) in the event of a long-term
relationship or the short-term ARDL model in the event of no
cointegration.

$$
\Delta \ln(\text{Real GDP}_t) = \alpha_0 + \sum_{i=1}^{K} \alpha_{i1} \Delta \ln(\text{Real GDP}_{t-1}) + \sum_{i=1}^{K} \alpha_{i2} \Delta \ln(FA_{t-1}) + \sum_{i=1}^{K} \alpha_{i3} \Delta \ln(LF_{t-1}) + \delta \text{ECM}_{t-1} + \epsilon_t
$$

Where; $\delta$ is the speed of adjustment parameter with a negative
sign which shows convergence over time and ECM is the error
correction term.

**Long run representation of the ARDL model**

The long-run representation of the ARDL model specified using
Gujarati (2004) and Johansen and Juselius (1990). OLS will help
estimate this long-run model if the $F$-statistic exceeds the upper
bound critical value, and the long-run relationship is confirmed.

**Short run representation of the ARDL model**

The short-run interactions of the ARDL model specified as follows:

$$
\Delta \ln(\text{Real GDP}_t) = \alpha_0 + \sum_{i=1}^{K} \alpha_{i1} \Delta \ln(\text{Real GDP}_{t-1}) + \sum_{i=1}^{K} \alpha_{i2} \Delta \ln(FA_{t-1}) + \sum_{i=1}^{K} \alpha_{i3} \Delta \ln(LF_{t-1}) + \epsilon_t
$$

**RESULTS AND DISCUSSION**

**Macroeconomic development**

**Comparison of trends of economic growth rate in
Ethiopia, Sudan, and Kenya**

The Ethiopian Government committed to improving the
country’s economic well-being and work towards
eradicating poverty. In the current Five-Year Growth and
Transformation Plan (GTP I) of Ethiopia, the primary
objective was to sustain at least decent real GDP growth rate of 11% per year and attain the Millennium
Development Goals (MDGs) by 2014/15. The Government has committed itself to mobilizing the
required resources, including the efficiency to achieve the
GTP II Plan, to fulfill Ethiopia’s vision of becoming a low-
middle-income country by 2025 and sustaining growth.

In Sudan, Figure 1, real GDP growth was estimated to
be 4.1% in 2018 and 3.3% in 2017. The main drivers of growth were supply mining (growth of 6.3%), agriculture (3.7%) and manufacturing (1.5%). On the demand side, private consumption was the primary contributor to growth, while the current account deficit, estimated at 2.4% of GDP in 2018, declined from growth. Higher inflation, as well as the phase-out of energy tax assistance, worsened growth. Although unemployment rose to 18% due to rapid exchange rate depreciation and chronic inflation, poverty and inequality dropped significantly between 2010 and 2015. Growth is expected to rise due to ongoing macroeconomic policy and structural reforms, elimination of tax privileges, a reduction in government spending, incentives to boost exports, a rebound in the industrial sector, and reducing the impact of the previous government through peace dialogue to end the civil war.

Moreover, the shutdown in South Sudanese oil production strictly affected Sudan’s economic indicators. Further worsening matters, economic sanctions remain in place on Sudan, while aid and external economic activity are inadequate. The structural economic shift caused by South Sudan’s secession has adversely affected virtually all of the country’s economic growth prospects.

In Kenya, GDP increased by about 5.9% in Figure 1 in 2018; supported by demand-side household consumption and investment and supply-side public administration facilities, IT, finance and insurance, and transport and storage). GDP fell from 6.5% in 2018, mainly due to unfavourable conditions and lowered government investment.

**Comparison of trends of inflation in Ethiopia, Sudan, and Kenya**

Oil prices tend to be pushing inflation in Kenya, accounting for 20%. Money growth has, however, contributed significantly to rapid inflation rises. Disparities in the strength of expansionary monetary policies may explain the discrepancy in massive inflation. Inflationary pressures express the monetization of the fiscal deficit in Ethiopia. Simultaneously, private sector credit growth could be the primary means of achieving extensive cash growth in Kenya, resulting in aggregate monetary expansion.

As shown in Figure 2, inflation in Ethiopia began to grow steadily in 2004, with gross inflation rising to 17.7% in 2008, with a maximum inflation rate of 39.5%. High inflation causes may be attributed to monetary policy intervention, the disruption of agricultural supply and inflation due to higher international prices.

The trend of inflation is fluctuating in the three countries, but is very inconsistent in Sudan due to the instability and war issues. Although promising recorded macroeconomic performance starting from 2003 compared to the previous years in three studied countries, inflation in Sudan spiraled out of control right from 2016 onwards. The unprecedented increase in inflation leads to reduced economic growth and exacerbates the cost of living in Sudan’s urban areas, leading to a government regime change.

**Econometrics model results**

**Unit root test using Augmented Dickey-Fuller test**

The ADF outcome for Ethiopia presented in Table 1 that all the variables examined in this research are integrated either in level or first order. The findings show that GDP growth, inflation, the growth rate of money supply and GDP per capita are stationary at the level I(0). Simultaneously, the FDI and exchange rate variables are
The outcome of stationary tests for Kenya show that GDP growth, money supply growth rate, and GDP per capita are stationary at the level I(0) and at the first level I(1). Similarly, GDP growth, money supply growth rate, and per capita GDP are stationary I(1) at the level for Sudan, and inflation, FDI, and exchange rate variables at the first level I are stationary.

**Bounds test for co-integration result**

The short data cycle is driven by the use of the ARDL Bounds method. As each variable is treated as a dependent variable, the computed F-statistics are listed in Table 2. For the conditional ARDL vector error correction model, we select a maximum lag order of 2 using the Akaike knowledge criterion (AIC).

Table 2 shows that the F-calculated for real GDP, inflation, FDI, exchange rate, money supply rate, and real per capita GDP is greater than the F test's standard bound at a 5% significant level. They are suggesting that there is a long-run relationship between variables when the Error Correction Model (ECM) was used. It thus emerged that the dependent and independent variables are significant in long-run relationship.

**Long-run ARDL result**

The long-term dynamics among real GDP, inflation, FDI, exchange rate, growth rate of money supply growth, and real per capita GDP are shown in the results in Table 3. The predicted long-term outcomes show a negative and statistically significant long-term relationship between real GDP and inflation and the exchange rate. The long-run relationship between the variables shows that at minimum one direction, there is Granger-causality. Therefore, at a 5% level of significance, the null hypothesis that inflation has no major impact on actual GDP was dismissed. This suggested that keeping all factors stable indicated a 1% rise in inflation lowered the real GDP by 0.0027%.

Similarly, the projected long-term outcome showed a positive and significant relationship between real GDP growth, real per capita GDP, and money supply. Thus, at a 5% significance level, the null hypothesis was dismissed, which implies that a 1% change in the real per capita GDP rate contributes to an increase in real GDP of 1.034%. The FDI was linked to the real GDP in a positive yet negligible way. Therefore, the null hypothesis that
foreign direct investment has no meaningful effect on real GDP has not been dismissed.

The previous result on the evidence of a robust long-run relationship between our variables of interest indicates the need to investigate further the nature and type of causal relationship between them. The presence of a long-run relationship does not say anything about the directions and of causation between the variables. The demands for further tests for Granger causality determine the direction of the association is needed. The long-run estimated model for Ethiopia is presented as follows:

\[
\text{GDP Growth} = \text{Inflation} -0.5785933 + \text{FDI} \times 0.0047 + \text{Exchange rate} \times 1.111 + \text{Money supply growth rate} \times 1.034 + \text{Per Capita GDP} \times -0.003\]

The results of the long negative relationship between inflation and economic growth are consistent with Fisher's theories and his study "role of a macroeconomic factor in growth." The data obtained in his analysis consists of some macroeconomic parameters, including 93 countries' inflation. Research has shown that the channel by which inflation adversely affects economic growth is by reducing investment and limiting productivity growth. Fisher also claims that price mechanisms are skewed by inflation, reducing resource distribution quality, thereby adversely impacting economic growth. Due to strict monetary policy, inflation in Ethiopia was lower, and the Government supplied goods to the public at a fixed price.

Inflation has a positive, negligible, long-term association with real GDP for Kenya in Table 3. FDI, the growth rate of money supply growth, and real per capita GDP, on the other hand, have a major effect on real GDP. The calculated long-run results show a negative and statistically significant long-run exchange rate for the real GDP. The long-run relationship between the variables shows that at minimum one direction there is Granger- causality. Therefore, at a 5% level of significance, the null hypothesis that inflation has no substantial impact on real GDP has not been dismissed. This means that keeping all unchanged factors means that a 1% rise in inflation raises the real GDP by 0.00033%.

Similarly, a negative and significant relationship between real GDP and the exchange rate was reported by the projected long-run result. The null hypothesis was dismissed at a degree of 5%. This indicates that a 1% rise in the exchange rate would result in a drop in the real GDP of -0.0012431%.

The long-run estimated model for Kenya is presented as follows:

\[
\text{GDP Growth} = 0.3543642 + \text{Inflation} \times 0.00007 + \text{FDI} \times 0.0047 + \text{Exchange rate} \times 1.111 + \text{Money supply growth rate} \times 1.034 + \text{Per Capita GDP} \times -0.003\]

For Sudan in Table 3, the long-run showed a significant positive relationship between all the variables of interest (real GDP, inflation, FDI, Exchange rate, Money supply growth rate, growth, and real per capita GDP). The positive relation between real GDP and inflation was not as expected. Still, some studies mentioned that inflation impacts economic growth in terms of certain thresholds (World Bank, 2015).

The long-run estimated model for Sudan is presented as follows:

\[
\text{GDP Growth} = 0.0166985 + \text{Inflation} \times 0.0004612 + \text{FDI} \times 0.0009646 + \text{Exchange rate} \times 0.9830015 + \text{Money supply growth rate} \times 1.025894 + \text{Per Capita GDP} \times -0.003\]

Sudan has gained from the vast oil-based exploration. Economic growth surpassed the historical average of 4.9 during the "oil economy," and recorded 6.1% as the highest rate. Sudan lost about 75% of its revenues and much of its prominent economic performance due to South Sudan's separation in 2011: crude oil production. However, growth was 3.1% for 2014 and demonstrated a stabilization progression that began in 2013. The growth was recorded at 3.5% in 2015.
Diagnosis Test and Model Stability Test Result

The model was tested for serial correlation using the Post-estimation Diagnostic Tests, and Durbin-Watson d-statistics shows no serial correlation tested. The result indicated that the Durbin-Watson d-statistic test of 2.19, 2.23 and 2.28, and Breusch-Godfrey LM test for autocorrelation of 0.22, 0.017 and 0.36 for Ethiopia, Kenya and Sudan respectively are higher than 5% failing to reject the null hypothesis (H0: no serial correlation), implying that the model was not serially correlated. In addition, the model was also tested using the model stability by estimating CUSUM and the figure, which shows that the entire model is stable within the 5% boundary.

Conclusions

In this study, despite promising macroeconomic performance in Ethiopia, Kenya, and Sudan countries, inflation in Sudan spiraled out of control starting from 2016 onwards while there is slow growth rate in Kenya and Sudan. The main driver of long-run economic growth in Ethiopia is the exchange rate and money supply. In Kenya and Sudan, inflation, FDI, exchange rate, money supply growth rate commonly affected the economic growth rate. In addition, real per capita GDP affected the economic growth rate of Sudan. Based on the findings, the study recommended the following policy responses. First, the central banks must apply an appropriate macroeconomic policy instrument to maintain low and stable inflation and exchange rate. Second, the Government should continue the strictly fiscal management to enable the monetary policy instrument to sustain economic growth and strengthen poverty reduction programs. Third, promoting and sustaining FDI inflow via creating and providing adequate policy subsidies. Finally, money supply and growth rate is dramatically improving and is adversely influenced by the performance of macroeconomic variables. Hence, there is a need to take into account nature and the effects. In addition, the three countries need to develop policies that benefit from the regional, continental and international commitments such as the Global Agenda for the sustainable development goals and the African Union Agenda 2063 that will help them explore the means and ways of mobilizing the domestic resources to contribute to the economy.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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