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PROPERTY DYNAMICS: DISSECTING THE INFLATION-REAL ESTATE GROWTH NEXUS IN THE KENYAN CONTEXT

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Abstract
The real estate industry, renowned for its flexibility and profitability, has experienced exponential growth in Kenya. It has significantly contributed to the country's GDP, increasing from 10.5% in 2000 to 13.8% in 2016. This remarkable expansion is attributed to stable GDP growth, rapid urbanization at 4.4% annually (compared to the world's 2.5%), and a population growth rate of 2.6% per annum. The surging middle-class population has intensified demand for housing, resulting in a national housing deficit of 200,000 units annually and a cumulative shortage of over 2 million units.
Affordable housing, in particular, is in high demand, with 61% of urban dwellers residing in slums and a 40% deficit in student accommodation. Recognizing this need, the Kenyan Government's "Big Four Agenda" included affordable housing as a strategic priority in its Medium Term Plan Three (MTP III) for 2018-2022.
To achieve affordable housing objectives, understanding the determinants of real estate growth is crucial. Prior studies have explored the relationship between real estate and economic factors, with findings indicating that interest rates negatively impact real estate performance. Additionally, the study suggests the importance of regulating inflation rates to ensure stability in the real estate industry.
This research aims to provide empirical evidence on how short-term inflationary changes adjust toward long-term equilibrium, offering insights into the dynamic relationship between inflation and real estate industry performance.

Keywords: real estate growth, affordable housing, inflation, Kenya, economic factors

1.0 Introduction

Real estate has been one of the supple, effervescent and lucrative in industry world over (Kangogo 2013). In kenya, the industry has grown exponentially as shown by its contribution to the country's GDP which grew from 10.5% in 2000 to 12.6% in 2012 and 13.8% in 2016 (Annon, 2016). The growth has been mainly ascribed to stable GDP growth, demographic trends such as rapid urbanization at 4.4% p.a against the world's 2.5% and population growth averaging at 2.6% p.a (Annon, 2016). Due to the rapidly growing population, particularly the middle class, the residential sector has recorded the highest demand with the nationwide housing deficit standing at 200,000 units annually and an accumulated deficit of over 2 million units (Cytonn, 2020). The largest demand has been for affordable housing to cater for 61% of the urban dwellers who live in slums and shortage in student accommodation accounting for 40% of the deficit (Cytonn, 2020; GoK, 2020; World Bank Group, 2017). Therefore, the Kenyan Government in its Medium Term Plan Three (MTP III) 2018-2022 of

March 2017 where it is envisaged that the economy would have achieved a 10% growth rate by the end of the plan period, coined up the "*Big Four Agenda*" in which affordable housing was identified among other initiatives as a key strategic focus area (GoK, 2019).

In order to achieve the objective of ensuring affordable housing to the Kenya's populace, information on the potential determinants of real estate growth is necessary. A number of empirical studies have been done on the relationship between real estates and numerous economic factors. For instance, Kamweru and Ngugi (2017) investigated the effects of interest rates on performance of real estate industry in Nairobi county of Kenya and established that lending rates had negative but significant relationship with real estate growth, thus the need to reduce lending rates to ensure stability in the real estate industry. Although inflation rate was not explicitly the focus of the study, it was asserted that there was need to generate policies that would regulate volatility of the inflation rate in the long run as the investors in the real estate subsector were likely to suffer losses characterized by unstable rates of inflation.

Such assertions in economic sense should be supported with empirical results that show how short-run dynamics of inflationary changes adjust towards the long run equilibrium thereby giving clear nexus between inflation and performance of the real estate industry.

An overview of macro-economic determinants of real estate price in Nigeria showed that inflation rate is an important determinant of real estate price (Alkali, Sipan and Razali, 2018).

A study by Kibunyi (2015) on the real estate prices in Kenya revealed a weak negative relationship between the real estate prices and inflation. However, the results contradict Kangogo (2013) who established a positive association between inflation and real estate prices in Nairobi county of Kenya. Kituyi (2015) further revealed that housing prices had strong positive relationship with the lending rates. Perhaps this points to the need for lower lending rates that would stimulate investment in the real estate industry in Kenya. The negative relationship between inflation rates and the real estate prices suggests that the higher the rate of inflation, the lower is the real estate price *ceterisparibus* and vise versa. Inflation denotes a general rise in prices and fall in the purchasing value of money, and if not checked can be harmful to an economy (Costantino, Lionel and Millicent, 2007). This implies that unless the rate of inflation is low and stable over time, investment in the real estate industry would not be stimulated to eventually lead to a reduction in prices *ceteris paribus*.

High inflation rate generally discourages investment while low but stable inflation rate enhances investment other factors held constant (Kneller et al., 1999; Erkin, 1988). Njaramba (2017) who focused on growth of housing prices in Kenya and its dynamic relationship with selected macroeconomic variables agrees with this argument from the standpoint that housing prices continue to increase leading to a decline in the access to descent housing in Kenya. This is a likely indicator that a policy that seeks to reduce prices would *ceteris paribus* enhance accessibility to the housing services leading to high demand for the same, a scenario that is likely to stimulate investment in the subsector. The argument is also in tandem with Arvanitis (2013) who noted that the high demand against the low supply of housing services has pushed the affordability of housing beyond the reach to majority of Kenyans and this resulted to many households living in slum dwellings. In Malaysia Umi, Haniza and

Gairuzazmi (2018) observed that high increase in food prices often elicit policy responses that can either cushion or exacerbate the impact on vulnerable households in many countries. Such a situation may in turn affect their purchasing power and impact on their house hold decisions to acquire descent housing. Brumer (2020) and Nguyen (2018) support the same argument in an article dated 17th August 2020, where it was noted that the likely positives during the times of high inflation are the rising prices of property rates. During high inflationary times, it can be difficult to get a mortgage. High-cost mortgage rates imply buyers have less purchasing power, thus many continue to rent. This surge in demand results in increased rental rates, which is beneficial to the landlords. However, the household who may not afford such houses are bound to move to slum areas. Reagan (2018) added that during inflation, passive investors in commercial real estate should expect good results in their portfolio and it may be an opportune time to rebalance their portfolio toward private real estate. A study by Ngumo (2017) which addressed the relationship between inflation rate and real estate development using pooled OLS approach, revealed an insignificant negative relationship between real estate development and inflation rate. However, Loyford and Moronge (2014) in a descriptive study established a significant negative relationship between Inflation rate and real estate industry performance. The findings were corroborated by Muli (2013) through Pearson correlation analysis that yielded a significant negative association between inflation rate and real estate investment in Kenya. Frometa (2019) however, argues that it might be counterproductive to invest in new real estate transactions at the time of high inflation. Similarly, low inflation tends to spur new investments. Therefore, the effect of inflation on real estate investment is more the result of perception rather than hard economics. It is an individual's perception of inflation that guides the decisions on real estate investment. According to Gallagher (2018) there are a number of complex, dynamic and interactive factors influencing the economy. Therefore, it isn't really possible to predict inflation. However, a substantial influx of Government spending in the short run coupled with an increase in money supply by the treasury can be inflationary.

In Taiwan Wang and Nguyen (2008) conducted a study of causality with Structural breaks involving housing returns, inflation and economic growth. The study revealed that GDP growth affects inflation, but it does not cause the growth in housing returns. When time trend was considered, it emerged that inflation had a negative effect on housing return while housing return had a positive effect on inflation. The revelations suggest that during the study period, Inflation hedged unavailability of Taiwan's housing. They also show the opportunistic characteristic of investors in the real estate market. In addition, the growth of housing market was not beneficial for economic growth in the long-run. The results are in line with Ewinga and Payne (2005) who estimated a vector autoregressive model (VAR) and established that inflation lead to lower than expected housing returns in the United States of America (USA).

Similar results were generated by Elsa and Razali (2019) in Asia. However, the nexus between inflation and real estate investment trust returns is generally not clear (Chatrath and Liang, 1998). Furthermore, conditional volatility of an unexpected inflation is important to explain the differences in listed real estate returns in some Asian-Pacific markets but the level of the impact differs by country as observed by Liow and Huang (2006).

From the foregoing literature, it is clear that conflicting results exist on the relationship between inflation rate and various aspects of real estate industry in Kenya and beyond. In addition, the focus has been on aggregate inflation. However, a country's inflation can be disaggregated into core inflation which represents the long run trend in the price levels, food inflation which denotes increase in the wholesale price index of a basic food item relative to the general index or the consumer price index (CPI) (Shankar, 2019) and Energy inflation which refers to the inflation ascribed to the contribution of energy prices (Rubene, 2018). Disaggregating inflation will necessitate formulation of clear policy interventions in the real estate industry in Kenya. Apparently no known study of a considerable depth has addressed this paucity of information in Kenya.

2.0 Theoretical Frame Work

This study was anchored on both the Perfect competition theory of housing market and the Tobin's Q theory of housing prices. The Perfect competition theory of housing market presents the interaction between housing prices and quantity of housing supplied and demanded. The slopes of the two curves obey the law of demand and supply for normal goods (Alonso, 1964). The equilibrium output and price in this market is established at the intersection of the two curves. Although the market assumes a perfect scenario which is rather difficult to find in real life situation, it lays foundation for the determination of the shift factors of the demand and supply curves for housing which are generally important to policy makers in management of housing prices. Housing market like some other markets is subject to market imperfections or distortions (Njaramba, 2017).

According to Tobin (1969), if the expected marginal physical product of capital increases, the desired level of capital rises. With regard to housing market, the corresponding analysis is that the higher the housing prices households are willing and able to pay due to growth in the demand for housing, the higher is the marginal return in the housing market which further stimulates housing investment demand. Households will be willing and able to pay higher prices if their expected future income is higher or if there is an increase in the number of households that demand for housing services, thus leading to an upward shift in the housing demand curve. This theory therefore, addresses the role of investments and demand in the housing market under the assumption of developed financial and property market. It also gives room to incorporate more variables in situations where oligopoly tendencies exist.

3.0 Research Methodology

3.1. Research Philosophy Design

The study was based on the positivist's philosophy. Positivism follows the view that only factual knowledge gained through observation and measurement is dependable. It depends on quantifiable observations that lead to statistical analyses. As a philosophy, it is in tandem with the empiricist view that knowledge stems from human experience and observed facts of life (Collins, 2010). In addition, the researcher is independent from the study and there are no provisions for human interests within the study. As a rule of thumb, positivist studies normally follow a deductive approach and that the researcher needs to concentrate on facts (Crowther and Lancaster, 2008). To achieve the study objective, correlational research design was adopted. The design is suitable for studies that seek to establish relationships Glenn and Glen (2005).

3.2. Study area

This study was conducted in Kenya which is located at the latitude of 0.0236° S, and longitude of 37.9062° E. The GPS coordinates of Kenya show that the country is bisected by the equator and approximately half of it is in the northern hemisphere. The country's total area is approximately 224,080 square miles. Including all fourty-seven distinct counties, the total area is 98% land and 2% water. In numbers, these percentages equate to 219,745 square miles of land and 4,335 square miles of water. The geography of Kenya spans for a width of 374.03 miles and a length of 485.51 miles. Currently, the population is approximately 51,629,122 people (United Nations, 2019; KNBS, 2018). Figure 1 below shows the map of Kenya and its geographical location.

Figure 1: The map of Kenya and its geographical location.

3.3. Data type and Sources

Monthly time series data from the World Bank, based on the data from Kenya National Bureau of Statistics which covered January 2017 to February 2020 were used. The dependent variable was real estate growth while the independent variables were core inflation rate, food inflation rate and energy inflation rate.

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3.4. Model Specification

The functional nexus between the explained and the explanatory variables was expressed as shown in Equation 1

$Y \square f(CR,FR,ER)$.. Equation 1

Where: Y = Real estate growth, CR = Core inflation, FR = food inflation, ER = energy inflation, Deterministic relationship was then stated as indicated in Equation 2 below;

$Y_t \square \square_0 \square \square_1 CR_t \square \square_2 FR_t \square \square_3 ER_t$ ....Equation 2

Since there are other potential factors that may influence the real estate growth and were outside the scope of this study, Equation 2 was modified to capture their likely contributions. The stochastic form was then specified as shown in Equation 3

$Y_t \square \square_0 \square \square_1 CR_t \square \square_2 FR_t \square \square_3 ER_t \square \square_t$ ....Equation 3

Where: $\square_0$ = Constant term; $\square_1$, $\square_2$, $\square_3$ are parameter estimates; $\square_t$ = error term which is assumed to be independent, identically distributed with zero mean and constant variance.

2.2. Data Analysis

Data analysis begun with the determination of lag length using a set of criteria namely: Sequential modified LR test statistic, Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). However, selection of the appropriate lag length was guided by Venus (2004), who asserted that estimating the lag length of autoregressive process for a time series is a crucial econometric exercise and that Akaike's information criterion (AIC) and final prediction error (FPE) are superior than the other criteria in studies with small sample (≤ 60 observations) in that they minimize the chance of under estimation while maximizing the chance of recovering the true lag length. The current study had less than 60 observations thus, the choice was guided by AIC and FPE criteria.

After lag length determination, the data were tested for stationarity using Correlogram and Q-statistics on the basis of a null hypothesis that the time series were stationary (i.e. p-value for Q-stat > 0.05) and alternative hypothesis that the time series were non stationary (i.e. p-value for Q-stat < 0.05). Johansen test for co-integration was then employed to determine if the study variables (Core inflation, energy inflation and food inflation and real estate growth) had long-run association, or co-integrated. The general form of Johansen's methodology takes its starting point in a VAR of order $\square$ given by Hjalmarsson and Osterholm (2007) as specified in Equation 8 : $y_t \square \square \square \square_1 y_{t \square 1} \square \ldots \square \square_{\square} y_{t \square \square} \square \square_t$ ....Equation 8

Where: y_t is an nx1 vector of variables that are integrated of order one while $\square_t$ is an nx1vector of innovations. Vector Error Correction Model (VECM) was estimated to establish the possible long-run relationship between the endogenous and exogenous variables (Gujarati, 2004) and the possibility of short run causalities was tested using the Wald statistics.

4.0 Results and Discussions

Table 1 shows the lag order selection criteria for the study variables (Real estate growth, Core inflation, food inflation and energy inflation). Out of the six criteria, sequential modified LR test statistic, Final prediction error (FPE) and Akaike information criterion (AIC) indicate that the preferred lag length was four (4). As guided by Venus (2004), Akaike's information criterion (AIC) and final prediction error (FPE) are superior to the other criteria in studies with small sample (≤ 60 observations), since the observations in this study were less than sixty, the recommended lag length was four (4).

Table 1. VAR Lag Order Selection Criteria for the study variables

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-280.0016	NA	211.5656	16.70598	16.88555	16.76721
1	-165.5211	195.2903	0.650567	10.91300	11.81086*	11.21920
2	-143.9987	31.65055	0.490809	10.58816	12.20430	11.13931*
3	-133.6901	12.73419	0.767293	10.92295	13.25738	11.71905
4	-105.0131	28.67697*	0.458489*	10.17724*	13.22996	11.21831

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

Because the study utilized time series data, the data were tested for stationarity using Correlogram and Q-statistics. The results are presented in Tables 2a to 5b. Tables 2a, 3a, 4a and 5a all show the results of various stationarity tests for the variables at levels. The autocorrelation coefficients (AC) for all the variables drift away from zero even if rounded off to the nearest whole number. Thus, the four variables are non stationary at levels, an inference confirmed by the probabilities of Q-statistic which are less than 5% at various lag lengths (Mishra et al, 2010). After first difference as shown in Tables 2b, 3b, 4b and 5b, the autocorrelation coefficients (AC) for all the series are revolving around zero. Therefore, the real estate growth, core inflation, energy inflation, and food inflation series are stationary. This is also confirmed from the fact that the probabilities of Q-statistic at various lag lengths are greater than 5% (Mishra et al, 2010).

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Table 2 a. Stationarity test for Real estate growth before 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.927	0.927	35.290	0.000
		2	0.877	0.124	67.731	0.000
		3	0.812	-0.105	96.370	0.000
		4	0.713	-0.315	119.08	0.000

Table 2 b. Stationarity test for Real estate growth after 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.193	-0.193	1.5007	0.221
		2	-0.096	-0.139	1.8835	0.390
		3	0.263	0.227	4.8115	0.186
		4	-0.155	-0.078	5.8607	0.210

Source: Author's computation (2020)

Table 3 a. Stationarity test for Core inflation before 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.892	0.892	32.707	0.000
		2	0.813	0.084	60.630	0.000
		3	0.658	-0.402	79.441	0.000
		4	0.522	-0.090	91.602	0.000

Table 3 a. Stationarity test for Core inflation after 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.128	0.128	0.6594	0.417
		2	0.180	0.166	1.9970	0.368
		3	-0.122	-0.170	2.6266	0.453
		4	-0.172	-0.180	3.9277	0.416

Source: Author's computation (2020)

Table 4 a. Stationarity test for Energy inflation before 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.915	0.915	34.430	0.000
		2	0.831	-0.042	63.607	0.000
		3	0.716	-0.241	85.849	0.000
		4	0.590	-0.139	101.40	0.000

Table 4 b. Stationarity test for Energy inflation after 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.284	0.284	3.2275	0.072
		2	0.184	0.112	4.6190	0.099
		3	0.122	0.048	5.2455	0.155
		4	0.118	0.062	5.8506	0.211

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Table 5 a. Stationarity test for Food inflation before 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.920	0.920	34.790	0.000
		2	0.807	-0.261	62.281	0.000
		3	0.689	-0.050	82.898	0.000
		4	0.554	-0.190	96.604	0.000

Table 5 b. Stationarity test for Food inflation after 1st difference

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.164	0.164	1.0837	0.298
		2	-0.080	-0.110	1.3457	0.510
		3	0.065	0.102	1.5258	0.676
		4	0.115	0.080	2.1082	0.716

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Author's computation (2020)

Table 6 and Table 7 show both the Trace statistic and Maximum Eigenvalue respectively. Both approaches indicate that, there were three (3) cointegrating equations at 0.05 level of significance. When study variables are co integrated, Gujarati (2004) as well as Brockwell and Davis (2016) advice that a vector error correction model (VECM) be estimated. On this basis, the study determined a VECM whose results are presented in Table 8.

Table 6. Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.850477	102.0268	47.85613	0.0000
At most 1 *	0.505573	39.31663	29.79707	0.0030
At most 2 *	0.385226	16.07286	15.49471	0.0409
At most 3	0.000556	0.018342	3.841466	0.8922

Table 7.

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Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.850477	62.71013	27.58434	0.0000
At most 1 *	0.505573	23.24377	21.13162	0.0249
At most 2 *	0.385226	16.05452	14.26460	0.0258
At most 3	0.000556	0.018342	3.841466	0.8922

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Author's computation (2020)

Table 8 shows the Vector Error Correction Model (VECM) that was estimated following the presence of three cointegrating equations. The dependent variable was Real estate growth (Y) while the independent variables were core inflation (CR), energy inflation (ER) and food inflation (FR). The model revealed an error correction term of (C (1) = -0.629212 at t = -1.181677), which shows that the speed of adjustment towards equilibrium was negative though statistically insignificant. According to Nisha (2020), a negatively insignificant error correction term is an indicator of disequilibrium between short run values and long run values in the lagged periods. The disequilibrium is neither corrected nor extended to each period suggesting absence of disturbances. In this study therefore, the disequilibrium between the short run and the long run values suggest absence of long run relationship between the real estate growth and the various dimensions of inflation. The explanatory power of the VECM was 0.814478, suggesting that the exogenous variables could explain approximately 81.44% changes in the endogenous variable. The significant F-statistic (3.003820, p= 0.023719) confirms that the model can be relied on to explain the possible relationships.

Table 8. Vector Error Correction Model (VECM) and the System Equation

D(Y) = C(1)*(Y(-1) - 1.87409474859*CR(-1) + 11.275764878) + C(2)*(ER(-1) - 1.85563834039*CR(-1) + 7.30757245807) + C(3)*(FR(-1) + 3.26768065036*CR(1) - 59.6759931878) + C(4)*D(Y(-1)) + C(5)*D(Y(-2)) + C(6)*D(Y(-3)) + C(7)*D(Y(-4)) + C(8)*D(ER(-1)) + C(9)*D(ER(-2)) + C(10)*D(ER(-3)) + C(11)*D(ER(-4)) + C(12)*D(FR(-1)) + C(13)*D(FR(-2)) + C(14)*D(FR(-3)) + C(15)*D(FR(-4)) + C(16)*D(CR(-1)) + C(17) *D(CR(-2)) + C(18)*D(CR(-3)) + C(19)*D(CR(-4)) + C(20)

	Coefficient	Std. Error	t- Statistic	Prob.
C(1)	-0.629212	0.532474	-1.181677	0.2585
C(2)	-0.487127	0.384477	-1.266987	0.2274
C(3)	0.208256	0.203932	1.021204	0.3258
C(4)	-0.090877	0.335965	-0.270497	0.7910
C(5)	-0.184420	0.336832	-0.547513	0.5933
C(6)	0.152308	0.268468	0.567324	0.5802
C(7)	0.036125	0.220248	0.164021	0.8722
C(8)	0.546480	0.424342	1.287831	0.2203
C(9)	0.375473	0.360527	1.041458	0.3166
C(10)	0.728827	0.289961	2.513533	0.0259
C(11)	-0.344224	0.327380	-1.051450	0.3122
C(12)	-0.295321	0.245220	-1.204314	0.2499
C(13)	-0.056957	0.255144	-0.223235	0.8268
C(14)	-0.196995	0.154461	-1.275375	0.2245
C(15)	0.079890	0.196568	0.406425	0.6910
C(16)	-3.033645	1.976274	-1.535033	0.1487
C(17)	-2.001002	1.672527	-1.196395	0.2529
C(18)	-1.176502	2.467807	-0.476740	0.6415
C(19)	-4.392973	2.048136	-2.144864	0.0514
C(20)	-0.884549	0.281533	-3.141903	0.0078

R-squared	0.814478	Mean dependent var	-0.254545
Adjusted R-squared	0.543331	S.D. dependent var	1.520915
S.E. of regression	1.027793	Akaike info criterion	3.173268
Sum squared resid	13.73267	Schwarz criterion	4.080243
Log likelihood	-32.35893	Hannan-Quinn criter.	3.478438
F-statistic	3.003820	Durbin-Watson stat	2.652478
Prob(F-statistic)	0.023719		

Source: Author’s computation (2020)

Wald statistics was used to test whether or not the estimated coefficients in the VECM were significantly different from zero (i, e: C(8) =C(9)=C(10)=C(11); C(12)=C(13)=C(14)=C(15) and C(16)=C(17)=C(18)=C(19). The Chi-square probability corresponding to the null hypothesis on energy inflation as presented in Table 9a is less than 5%. Thus, the null hypothesis of C (8) =C(9)=C(10)=C(11)=0 is rejected, implying that there is short run causality running from energy inflation to real estate growth. On the contrary, the Chi-square probabilities corresponding to the null hypothesis on food inflation as captured in Table 9b and core inflation in Table 9c are all more than 5%, indicating that there is no short run causality running from core inflation, and from food inflation to real estate growth in Kenya.

Table 9a. Wald Test for Energy Inflation (ER) Coefficients

Test Statistic	Value	df	Probability
F-statistic	5.065165	(3, 13)	0.0153
Chi-square	15.19550	3	0.0017

Null Hypothesis: C(8)=C(9)=C(10)=C(11)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8) - C(11)	0.890705	0.302369
C(9) - C(11)	0.719698	0.271179
C(10) - C(11)	1.073051	0.351210

Restrictions are linear in coefficients.
Source: Author's computation (2020**)**

Table 9b. Wald Test for Food Inflation (FR) coefficients

Test Statistic	Value	df	Probability
F-statistic	1.268325	(3, 13)	0.3261
Chi-square	3.804976	3	0.2833

Null Hypothesis: C(12)=C(13)=C(14)=C(15)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.

C(12) - C(15)	-0.375211	0.195977
C(13) - C(15)	-0.136847	0.174236
C(14) - C(15)	-0.276885	0.216589

Restrictions are linear in coefficients.
Source: Author's computation (2020)

Table 9c. Wald Test for Core Inflation (CR) coefficients

Test Statistic	Value	df	Probability
F-statistic	0.360302	(3, 13)	0.7827
Chi-square	1.080906	3	0.7817

Null Hypothesis: C(16)=C(17)=C(18)=C(19)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(16) - C(19)	1.359328	1.785025
C(17) - C(19)	2.391971	2.802497
C(18) - C(19)	3.216471	3.501660

Restrictions are linear in coefficients.
Source: Author's computation (2020)

Table 10 shows the Long run OLS baseline model with a coefficient of determination of 0.633790, suggesting that 63.3790% changes in the real estate growth is jointly explained by the three explanatory variables (i.e. core inflation, food inflation and energy inflation). From the model, it is overt that energy inflation has a significant negative effect on the real estate growth ($\beta = -0.693905$, $p = 0.0018 < 0.05$). The significant negative effect suggests that ceteris paribus, high energy inflation depresses the growth of real estates. These results are in tandem with Ngumo (2017) and Loyford and Moronge (2014) who although did not disaggregate inflation into various dimensions, revealed a significant negative relationship with real estate development.
Core inflation on the other hand had a significant positive effect on the real estate growth ($\beta = 1.766045$, $p = 0.0001 < 0.05$). The positive and significant effect is a likely indicator that this type of inflation has been low and stable over time as confirmed in Figure 2. It also agrees with Mubarik (2005) who asserts

that when all other factors are held constant, low and stable inflation enhances economic growth and vice versa. Food inflation also had a positive although insignificant relationship with real estate growth (β = 0.166453, p = 0.2015 > 0.05). This is also a likely indicator that during the study period, it has been quite low and changing in the same direction with the real estate growth although no causal relationship exists between the two as confirmed in the VECM.

This study has demonstrated that unlike in the previous studies which have focused on inflation as an aggregate and its effect on real estate industry and economic growth, various dimensions of inflation affect real estate industry differently. It is therefore necessary that focus be directed to specific aspects of inflation to generate policies which may have robust effects on the performance of the real estate industry and the economy in general.

Table 10. Long Run Ordinary Least Squares (OLS) Base line Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FR	0.166453	0.127862	1.301815	0.2015
CR	1.766045	0.407680	4.331940	0.0001
ER	-0.693905	0.205489	-3.376850	0.0018

R-squared	0.633790	Mean dependent var	14.59211
Adjusted R-squared	0.612864	S.D. dependent var	4.716067
S.E. of regression	2.934349	Akaike info criterion	5.066505
Sum squared resid	301.3642	Schwarz criterion	5.195788
Log likelihood	-93.26360	Hannan-Quinn criter.	5.112503
Durbin-Watson stat	2.312826		

Source: Author's computation (2020)

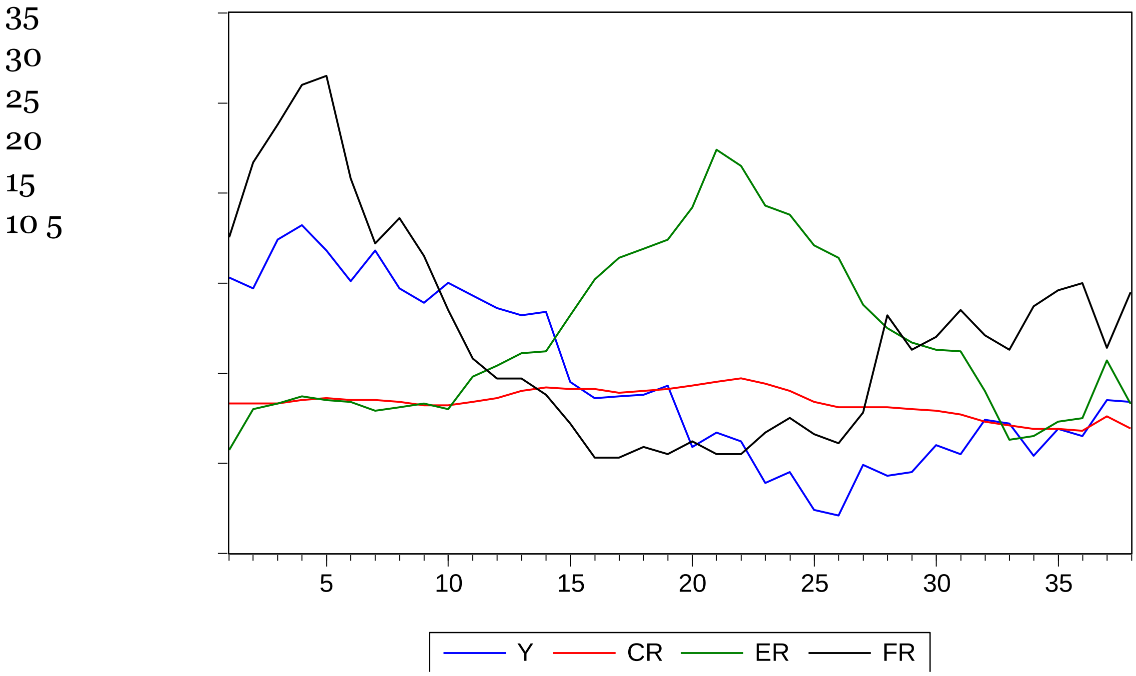

Figure 2: Relationship between dimensions of inflation and Real estate growth in Kenya

Note: Y- axis represent % rate after adjustments to take care of negative values

X-axis represents the monthly observations from Jan 2017 to Feb 2020 Source: Author (2020)

5.0 Conclusion and Recommendations

From the study results, it can be concluded that there was no long run nexus between real estate growth and the various dimensions of inflation (core inflation, energy inflation and food inflation). However, short run causality running from energy inflation to real estate growth exists. Perhaps this demonstrates the significant role that energy plays in the real estate industry. In addition, energy inflation had a significant negative effect on real estate growth. Core inflation had a positive significant effect on real-estate growth while food inflation had an insignificant positive effect on real estate growth. From the results therefore, the study recommends that other factors held constant, in order to enhance growth of the real estate industry with the view to achieving the objective of ensuring affordable housing to Kenyans, there is need to reduce energy inflation. There should also be continued stabilization of core and food inflation as an incentive to potential investors and the households seeking to acquire housing services in the economy. Low and stable inflation generally ensures economic growth of which the real estate subsector is an important component.

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