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Research on Two Economic Laws of Household Consumption Function: A Case of Kenya

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Abstract:- The paper investigates two economic laws of household consumption over the 1960 to 2020 period by taking Kenya as a case study and using the generalized least (GLS) method. The two laws are: (a) The household marginal propensity to consume (MPC) in the short run is not significantly different from 0.43. (b) In the long run the household MPC is not significantly different from the positive square root of 0.43. These two laws fall within the campus of the Keynesian consumption function. Empirical findings from fifteen consumption models indicate that values of the long run MPC in Kenya during the aforementioned period were around 0.66; and were not significantly different from value of 0.65901. Meanwhile, in the short run the MPC in Kenya during the given period was 0.431; and was not significantly different from 0.4343. The findings could be due to the following facts: (a) The short run MPC is the product of average propensity to consume (APC) and long run MPC. (b) In the long run values of the respective APC and MPC tend to be equal to each other. The implication of the findings is that in the world, the MPC tends to move towards a common global equilibrium, for the simple reason that human beings often tend to have similar demands and consumption pattens.

Keywords:- *Average Propensity to Consume, Household Disposable Income, Household Consumption, Household Consumption Function, Household Consumption Economic Laws and Marginal Propensity to Consume.*

I. INTRODUCTION

For nearly a century, economists have observed the relationship between income and consumption. Keynes (1936) was the first person to theoretically study the relationship between consumption behavior and disposable income under the absolute income hypothesis (AIH). The AIH postulates that current consumption expenditure depends mainly on the current income. The Keynesian economics played a dominant role in the 1950s and 1960s. During this period estimated results by macroeconomists show the relationship between income and current consumption. The results are consistent with the AIH of Keynes (1936). Keynes (1936) proposition is rejected by Romer (2006), based on his empirical finding that aggregate consumption is not proportional to aggregate income. But Consumption accounts for around two thirds (0.667) of national income.

Thus, consumption is considered to be one on the important factors in macroeconomic analysis as well as government policy formulation (Jore and Chowdhary, 2019). Meanwhile, Friedman (1957), postulates in his permanent income hypothesis that there is a linear relation between current consumption and permanent income as opposed to current income. In the PIH, the current income is the sum of permanent and transitory income. According to Friedman (1957), permanent income is the key determinant of the consumption function (Jore and Chowdhary, 2019).

On the contrary, this present paper advances a new hypothesis that anticipated or expected absolute disposable income (Y_{dt}) can accurately determine the current level of absolute consumption ($C_{nt-1} - C_o$) in the current period, where C_o (constant savings) is autonomous consumption. Empirical findings from four out of 15 consumption regression models indicate that the long run MPC in Kenya during the aforementioned period exhibited the following values: 0.646, 0.677, 0.685, 0.686 respectively; and were not significantly different from 0.656.

Thus, in the short run the MPC in Kenya during the given period was 0.431; and was not significantly different from 0.43 by one of the laws of the household consumption function. The findings could be due to the following facts: (a) The short run MPC is the product of average propensity to consume (APC) and long run MPC. (b) In the long run values of the respective APC and MPC tend to be equal to each other. (c) The MPC in the short run is not significantly different from 0.43. (d) In the long run the household MPC is not significantly different from the positive square root of 0.43. The implication of the findings is that in the world, the MPC tends to move towards a common global equilibrium, for the simple reason that human beings often tend to have similar demands and consumption pattens.

At equilibrium the MPC estimates from the neoclassical production is almost equal to the MPC from the consumption function. Therefore, given that quantity of labor equals quantity of HH consumption, implies that MPC is equal to marginal physical product of labor. Moreover, the paper tests the postulate (theory) that "accurate definition of marginal propensity to consume provides accurate values of MPC." Empirical findings confirm this postulate to be true because regression results show that all values of MPC are very close to the global MPC value of 0.65901. Meanwhile, various empirical literature indicates that in the short run MPC is 0.4343, while in the long run the value of MPC is 0.65901. By expressing MPC as $\beta = \log(Y_{dt} / I_{t-1})$ or as follows: $MPC \times log(10) = \log(Y_{dt}/I_{t-1})$, it is possible to express the consumption function in terns of savings and HH disposable income that has the potential of estimating MPC accurately.

II. REVIEW OF LITERATURE

Review of Theoretical Literature

Keynes (1936) hypothesizes that as a rule households increase their utility by consuming more of the produced goods and services as their income increases. They increase their well-being by this major portion of the aggregate demand. The possible determinants of the aggregate consumption function have been analyzed intensively in the economic literature, due to its great economic importance. Economic literature is composed of different consumption theories and there is no single theory of consumption that can possibly explain consumption behavior in all economies (Alimi, 2013).

Before Keynes (1936), people believed consumption to be a passive residual, and the amount of income remaining after saving. Accepting this view implies that the decision of any economic agent to save is determined (a) by the payment for the utility lost from consuming, and (b) by interest rate because consumption is dependent on the interest rate, while interest rate itself is a key determinant in the saving behavior (Bunting, 2001). Meanwhile, Keynes (1936) postulates that "there are not many people who will alter their way of living because the rate of interest has fallen from 5 to 4 percent" (Keynes, 1936: 94).

As a result, the modern consumption begins with Keynes' (1936) "fundamental psychological law of consumption, upon which we are entitled to depend with great confidence a priori both from our knowledge of human nature and from the detailed facts of experience; is that men are inclined, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income" (Keynes, 1936, p.96).

Consumption is composed of the expenditures on goods and services by households such as individuals and non-profit institutions. It excludes expenditures on new houses because they are counted as residential investment. Consumption expenditures can be broken down into three groups as follows: nondurable goods, durable goods, and services. Nondurable goods are tangible goods such as food and clothing. They are supposed to last less than one year. Durable goods are tangible goods that are long-lasting and they consist of goods such as beds, tables, automobiles, radios, TVs sets, appliances etc. Services are intangible consumption expenditures such as recreation, entertainment, education and medical care (DerLorme and Ekelund, 1983; Abel, Bernanke and Smith, 1999; Daka et al., 2016). Consumption function is the representation or relating household consumption in terms of its determinants.

For over five decades Macroeconomists have considered estimation of the aggregate consumption to be an important exercise (Dhakal, Kulkarni and Upadhyaya, 2006). Many economists believe that aggregate consumption function is a key variable for policy makers (Fernondez-Corugedo, 2004). The Absolute Income Hypothesis for Consumption (AIH) explains how the aggregate consumption of individuals is determined by the absolute current level of their income (Keynes, 1936). The consumption function is usually represented as follows:

$$C_n = C_0 + bY_d. \qquad (2.1)$$

Where, C_n is consumption at current time, C_0 autonomous consumption, $b = d(C_n)/d(Y_d)$ is marginal propensity to consume MPC, and $0 < b < 1$.

The hypothesis that the current consumption is determined by the absolute current level of consumption is known as Keynesian Psychological Law of Consumption (Chaudhary, 2017). Equation (1) implies that an increase in aggregate disposable (after tax) income produces and increase in consumption. As a result, the AIH ignores the influence of interest rate, money, exchange, etc. on consumption expenditure. According to lessons from AIH, if the central bank policy instruments can affect disposable income, then they will also affect consumption indirectly, probably with a lag. Consequently, the life cycle hypothesis advanced by Modigliani and Brumbreg (1954); and the permanent income hypothesis advanced by Friedman (1957) had a lasting effect on consumption research (Fernondez-Corugedo, 2004).

Duesenbery (1949), challenged the Keynesian formulation of consumption function due to some two psychological factors: status, attitudes, etc. which dictate more than consumption expenditure in society. The psychology to consume and save more is what guides individuals in relation to others instead of the abstract standard of living. Afterwards, Modigliani and Brumbreg (1954) introduced the Life Cycle Hypothesis (LCH) of consumption. The LCH postulates that people make up decisions based on resources available to them over their lifetime, Thus, people build up assets at active stage, consume a part of assets and separate some assts for future retirement. The LCH can be expressed mathematically as follows:

$$C_n = \alpha W + \delta Y_d. \qquad (2.2)$$

Where C_n is current consumption α is marginal propensity to consume for wealth (W) and δ is marginal propensity to consume for current income Y_d (Chaudhary, 2017).

Friedman (1957) postulates that consumption is determined by expected or anticipated to be received over a long period of time (permanent income rather than current income) starching over a number of years; the income explained is overall (human and non-human) wealth. Permanent income is expected long term average income and it is determined entirely by wealth in form of both human (education and experience) and physical assets (share, bond property, etc.).

On the other hand, the paper postulates that expected or anticipated income (bY_{dt}) determines expected or anticipated consumption (C^*_{nt}), and in turn the psychological consumption can exactly determines current level of consumption (C_{nt-1}) and constant savings ($\bar{S} = C_0$) as follows:

$$C^*_{nt} = C_{nt-1} - C_o = bY_{dt}. \quad (2.3)$$

Equation (3) gives rise to the savings motive hypothesis and produces a new consumption function.

$$C_{nt-1} = C_o - bY_{dt}. \quad (2.4)$$

- *Review of Empirical Literature*

Empirical studies show that all forms of consumption altogether make up two-thirds (0.667) of GDP (Mankiw 2006). Therefore, a little disturbance in this component will have a far-reaching effect on the nation's aggregate demand performance (Daka et al., 2016). However, empirical research finds that Equation (1) cannot explain aggregate data, leading economists to try and correct the inadequacy of the Equation (Fernondez-Corugedo, 2004). For instance, by using the Autoregressive Distributed Lag (ARDL) method Ahmed et al. (2015), find the long run values of MPC of real GDP for Korea and New Zealand to be 0.640 and 0.657 respectively (Ahmed et al., 2015). The household final consumption expenditure typically constitutes the largest part of final uses of GDP, representing in general around 60% of GDP and it is an essential variable for economic analysis of aggregate demand (OECD, 2009).

Akekere and Yousuo, (2012) use the ordinary least squares method to investigate the effect of income changes on private consumption expenditure in Nigeria during the period 1981-2010. Their empirical results show that the long run MPC during the given period was 0.6708 (Tapsin and Hepsag, 2014). Alimi (2013), employs the Nigerian economic data and the empirical evidence obtained as suggested by the simple Keynesian consumption function, shows that that over the 41 years the average propensity to consume (APC) is at about 0.68, on average and declining to a trough of 0.66. Furthermore, Altunc and Aydin (2014) use ARDL bound test approach and find that the MPC for Pakistan and Malysia were 0.669 and 0.656 respectively.

In Swedish research based on both the life-cycle hypothesis and the permanent-income hypothesis, Matthiessen (1972) finds the marginal propensity to consume (MPC) of disposable income to be 0.43 (Polder, 2017, p.7). Wright, Shroff and Smith (2017) find the short run MPC for Hungary over the 1989-2014 period to be 0.408.

Meanwhile, by using the Autoregressive Distributive Lag (ARDL) method Ahmed et al. (2015), find the long run values of MPC of real GDP for Korea and New Zealand to be 0.434 and 0.418 respectively (Ahmed et al., 2015). Keho (2019), employs the Autoregressive Distributed Lags (ARDL) bounds testing approach to cointegration and finds that the estimated short run MPC to be 0.473 when the 1970 to 2016 data is used. In Bangladesh, India, Nepal, Pakistan and Sri Lanka private consumption constitutes a proximate share 66% of the GDP of each of the respective countries (Khan et al., 2015).

In macroeconomic theory, aggregate demand is considered as aggregate planned (expected or anticipated) expenditure where actual expenditure is equal to output. (Dornbush, Fisher and Startz, 1994, p.237). Kuznets (1952) objects to Keynesian Theory when he analyzed the long run relationship between consumption and income in US and found contradictory results with Keynes. The empirical results of his study show that consumption does not decline as income increases.

As a result, these findings reveal the existence of short run and long run consumption functions. In the short run, Keynesian consumption function gives accurate results. But in the long run consumption function has a constant average propensity to consume (Mankiw, 2010, p.516). In the short run, marginal propensity to consume is smaller than average propensity to consume as Keynes indicated. Meanwhile, in the long run average propensity to consume is constant and equals to marginal propensity to consume (Branson, 1995:222-223; Tapsin and Hepseg, 2014). Ibrahim (2014), applies the log form of the relevant variables in regression and finds that the analysis of 1986-2008 data for Saudi Arabia by using dynamic ordinary least squares (DOLS) method provides MPC of 0.40.

Mukherjee and Bhattacharya (2018) use data on national income and household consumption expenditure of the Indian economy for the period 1995-96 to 2009-10 and finds that the estimated value of marginal propensity to consume during this period is 0.63 during the 1995 to 2010 period. Polder (2017) uses the error correction model (ECM) to investigate the Swedish consumption function and finds MPC of the country during the period to be 0.42.

The empirical findings also vary from results involving Keynesian consumption function in terms of relationship between current consumption and current income, which is actually current receipts (Keithahn, 1973, p.4). That is because Keithahn empirically finds MPC to be more than 0.7 instead of being around 0.65901. Therefore, Keynes (1936) was right to postulate that "aggregate income ... is, as a rule, the principal variable upon which the consumption-constituent of the aggregate demand function will depend" (Keynes, 1936, p.91; Rayner, 1972, p.1). Also, Keynes (1973) is right to argue that "the amount of aggregate consumption mainly depends on the amount of aggregate income (Keynes, 1973, p. 96; Johnsson and Kaplan, 1999). By estimating the consumption function using Australian data based upon the Keynesian function, Lawler (1949) empirically finds MPC for Australia to be 0.672.

Meanwhile, by using US post war data (1946-11960) with single equation least squares (SELS) and two stage least squares technique, Rayner (1972, p.158) finds the MPC to be 0.66. Khan et al. (2015) note that Nepal, Pakistan and Sri Lanka private consumption take the majority share of the

Gross Domestic Product (GDP) of each respective country: approximately 66 percent (World Bank, 2013; Khan, 2015). Many empirical long MPC values in existing literature are closer to the computed MPC values: 0.685, 0.686, 0646, 0.677 and 0.658 for Kenya as shown in Equations (4.1) to (4.2) respectively. The value of MPC is very critical for the estimation multiplier effect.

Through multiplier economies will accelerate and control their aggregate economic activities in their countries because the higher the value of MPC the higher the value of multiplier effect and vice versa. It is very important for policy makers to know the correct value of MPC in a country. Knowing the MPC enables a country to understand the consumption behavior of households regrading what types of consumption hypothesis is prevailing in a country.

Moreover, economic growth and employment depends on the value of multiplier and MPC, as well. Aggregate real private consumption is composed of over half of aggregate economic expenditure and half of GDP. Thus, making consumption a very important and indeed very interesting area for research. Furthermore, almost all the researchers and policy makers are interested in aggregate real private consumption because it plays an important role in achievement of a high and stable long run economic growth (Khan et al., 2020). Typically, empirical results show that income effects have a much stronger effect on consumption patterns than price effects (Brown and Deaton, 1972; Lavoie, 1994; Clements et al., 2006, Chai, 2018).

The original motivation to the estimation of consumption function is empirical. It questions why the econometric estimates of the marginal propensity to consume, derived from models using short and long periods of time series data, vary so widely? Answering this research question gives rise to competing hypotheses. As a result, it has generated a range of difficulties encountered in obtaining clear-cut econometric evidence that could establish the superiority of any of them (Christiano et al., 2018).

China's, consumption is composed of 42 percent of the GDP, while India's consumption constitutes about 64 percent of GDP (Jore and Chowdhray, 2019). One of the key macroeconomic relationships is the relation between income and consumer expenditure (Friedman, 1957; Branson, 1972). Kuznets (1952) finds that the existence of both long run and short run consumption functions. In the short run the Keynesian function of consumption provides the true MPC values. But in the long run it provides the true average propensity to consume (Mankiw, 2010, Razzaq and Razzaq, 2015). Out of seven regression results, Hansen et al. (2001) obtains MPS results as follows: 0.467, 0.458, 0.474, 4.58, 0.445, 0.443 and 0.462 in Denmark during the 1956 to 1996 period. These results are very close to 0.431. Thus, confirming the Global MPC estimate (0.431) as well as its law is valid.

- *Research Gaps*

In macroeconomics the circular flow of income shows the relationship between economic sectors and the causes of changes in economic activity. The circular flow of income explains how business, household, the government, and foreign sectors operate within the four major markets (goods and services, resources, loanable funds, and foreign exchange). These markets regulate the movement of money throughout the entire national economy. In brief, the circular flow of income (CFI) depicts the flow of income between producers (investment) and consumers (consumption) (Capa, Vigonte and Abante, 2023).

Therefore, in the product market money is traded for goods and services. Meanwhile, in the factor market, factors of production such as land, labor and capital are traded for factor payments (Farley et al., 2013). In the CFI model, money moves in one direction while goods and intangible services move in the other direction (Hall and Klitgaard, 2018). The CFI connects the household sector to the goods and services market as well as to the business sector. It shows that money is transferred from the household sector to the business sector when households purchase from the goods and services market, where firms are suppliers.

Meanwhile, the resource market connects households and firms. But in this market, the income flows in the opposite direction. Since the households get factor income in the form of salaries, rent, interest, and profits, they make up the supply side of this market. On the other hand, firms generate revenue by selling goods and services (Capa, Vigonte and Abante, 2023). In the CFI, the households receive income (Y_d) in form of salaries and wages for their labor (L) and spend all their earning in form of consumption (C_n), when they buy the goods and services that produces generate in form of investment (I). The contribution the paper makes is to demonstrate that in the CFI, labor and consumption are equal in terms of money transferred from firms to households to pay for labor.

As a result, the household consumption (C_n) depends on household income as expressed by the household consumption function given as follows:

$$C_n = C_0 + \beta Y_d. \quad (2.5)$$

Since labor consumes earning from labor, the labor supply function is a reflection of the consumption function, and can be represented as follows:

$$L = C_0 + \beta Y_d. \quad (2.6)$$

Hence, the quantity of household consumption depends on the amount of labor supplied.

$$C_n = L. \quad (2.7)$$

Thus, in the paper the household production function is represented as follows:

$$Y_{dt} = I_{t-1}^{\alpha} C_{nt-1}^{\beta}. \quad (2.8)$$

Where Y_{dt} is annual household disposable income, I_t is yearly investment spending (capital formation), C_{nt} is annual household consumption and α, β are parameter of returns to scale on investment and is returns to scale on labor (measured by consumption expenditure) respectively.

Secondly, in addition to the household consumption function, the paper makes an empirical contribution to demonstrate that $C_n = L$. Thirdly, the paper demonstrates that at the household level, the phycological savings hypothesis $C_{n-1} = C_0 + \beta Y_{dt}$ is at play (Alani, 2022). Fourthly, on comparing the household consumption (HH) function and the HH production function, it can be discerned that MPC equals marginal physical product of labor: $\partial C_{n-1}/\partial Y_{dt} = \partial Y_{dt}/\partial C_{n-1}$.

Fifthly, review of various empirical literature indicates that in the short run $MPC_s = 0.4343$, while in the long run the value of $MPC_L = 0.6590$, where $APC \times MPC_L$. That is because the short run is the product of average propensity to consume and long run MPC: $MPC_s = APC \times MPC_L$.

Sixthly, by manipulation of Equation (2.8), the paper finds that investment appears to influence HH income through consumption (labor) since $\log(Y_{dt}/C_{n-1}) = \beta \log(10)$, implying that $\log(Y_{dt}) = \omega\beta_0 . \log(10) + \beta . \log(I_{t-1})$. Seventh, the neoclassical estimate of the MPC measurement depicted by the HH production appears to be inaccurate because it estimates MPC as β^* instead of β. Therefore, in neoclassical production function the HH production function can be represented in a simple way as follows:

$$Y_{dt} = \alpha^* I_t + \beta^* C_{nt}. \quad (2.9)$$

Or

$$1 = \alpha^* \frac{I_t}{Y_{dt}} + \beta^* \frac{C_{nt}}{Y_{dt}}. \quad (2.10)$$

Meanwhile, the best analytical framework for the estimation of MPC must be represented as

$$1 = \alpha \frac{Y_{dt}}{I_t} + \beta \frac{Y_{dt}}{C_{nt}}. \quad (2.11)$$

Eighthly, by using causality theory it can be deduced that the MPC is given by

$$d(C_{nt}) = \beta . d(Y_{dt-1}) + \omega . d(d(C_{nt})). \quad (2.12)$$

See Alani, Yawe and Mutenyo (2022) for details. Ninthly, from Equation (2.11) and employing the principle of causality it can be verified that

$$1 = \alpha(Y_{dt}/I_{t-1}) + \beta(Y_{dt}/C_{nt-1}) + \omega(Y_{dt}/\mathrm{d}(Y_{dt})). \quad (2.13)$$

Tenthly, by a theoretical model can be obtained by redefining the consumption function by using the causality principle where $\log(C_{nt-1}) = \log(C_{nt}) - d(\log(C_{nt}))$.

$$\log(C_{nt}) = \beta . \log(10) + \omega . \log(Y_{dt-1}) + \tau . \mathrm{d}(\log(C_{nt})). \quad (2.14)$$

Lastly, in the paper a theoretical model is derived depicted by introducing the savings (S_t) variable into the consumption function. Thus, given the consumption function as $C_{nt-1} = S_t + \beta . Y_{dt}$, where $S_t =$ is $[C_{nt-1} - (1/[\log(Y_{dt})/(\log(I_{t-1})] * Y_{dt})]$ is expressed by

$$C_{nt-1} = \omega[C_{nt-1} - (1/[\log(Y_{dt})/(\log(I_{t-1})] * Y_{dt})] + \beta . Y_{dt}. \quad (2.15)$$

III. METHODOLOGY

➢ *Theoretical Framework*

This present section aims at deriving both short and long run models for the estimation of marginal propensity to consume. The theoretical framework derives the logarithmic form of the consumption function from the usual Keynesian Consumption function. The usual consumption function is given by

$$C_{nt} = C_0 + \beta Y_{dt}. \quad (3.1)$$

Where C_n is aggregate household consumption, C_0 is a constant, β is marginal propensity to consume and Y_{dt} is aggregate household disposable income. Differentiation of Equation (3.1) with respect to time provides the following expression.

$$d(C_{nt}) = \beta d(Y_{dt}). \quad (3.2)$$

Meanwhile, Equation (3.2) can be rewritten as follows:

$$d(C_{nt}) = \frac{\partial C_{nt}}{\partial Y_{dt}} d(Y_{dt}). \quad (3.3)$$

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$$\frac{d(C_{nt})}{C_{nt}} = \left[\frac{\partial C_{nt}}{\partial Y_{dt}}\frac{Y_{dt}}{C_{nt}}\right]\frac{d(Y_{dt})}{Y_{dt}}. \qquad (3.4)$$

Therefore, from Equation (3.4) the short run (MPC) can be represented as

$$\frac{\partial C_{nt}}{\partial Y_{dt}} = \left[\frac{dC_{nt}}{dY_{dt}}.\frac{Y_{dt}}{C_{nt}}\right]\frac{C_{nt}}{Y_{dt}}. \qquad (3.5)$$

From Equation (3.5) it can be deduced that the short run MPC (MPC_s) equals the product of long run MPC MPC_L) and the APC and this relationship can be represented as follows:

$$MPC_s = MPC_L.APC. \qquad (3.6)$$

Thus

$$MPC_s = \frac{d(\log(C_{nt}))}{d(\log(Y_{dt}))}APC. \qquad (3.7)$$

But integration of Equation (3.4) while keeping $\left[\frac{\partial C_{nt}}{\partial Y_{dt}}\frac{Y_{dt}}{C_{nt}}\right]$ constant provides

$$\log(C_{nt}) = \left[\frac{\partial C_{nt}}{\partial Y_{dt}}\frac{Y_{dt}}{C_{nt}}\right]\log(Y_{dt}). \qquad (3.8)$$

Rearranging Equation (3.8) gives

$$MPC_s = \frac{\log(C_{nt})}{\log(Y_{dt})}\frac{C_{nt}}{Y_{dt}}. \qquad (3.9)$$

Since in practice

$$\frac{\log(C_{nt})}{\log(Y_{dt})} = 1. \qquad (3.10)$$

Implying that Equation (3.9) can be rewritten as follows:

$$C_{nt} = MPC_s Y_{dt}. \qquad (3.11)$$

In logarithm form Equation (11) can be represented as follows:

$$\log(C_{nt}) = MPC_s \log(Y_{dt}). \qquad (3.12)$$

Therefore

$$\frac{\log(C_{nt})}{\log(Y_{dt})} = MPC_s.\log(10). \qquad (3.13)$$

Let

$$\log(A_t) = \frac{\log(C_{nt})}{\log(Y_{dt})} = \log(10^{MPC_s}). \qquad (3.14)$$

Then

$$A_t = 10^{MPC_s}. \qquad (3.15)$$

Implying that

$$\ln(A_t) = \frac{\ln(C_{nt})}{\ln(Y_{dt})} = \ln(10^{MPC_s}) = 1. \qquad (3.16)$$

Hence

$$MPC_s.\ln(10) = 1. \qquad (3.17)$$

Therefore

$$MPC_s = 1/\ln(10). \qquad (3.18)$$

Implying that

$$MPC_s = 0.4342944819. \qquad (3.19)$$

Given a household production function in terms of household disposable income (Y_{dt}) as a function of investment spending (I_t) and household consumption (C_{nt}) under causality principle. If it has parameters α, β, then the production function can be expressed as follows:

$$Y_{dt} = I_{t-1}^{\alpha} C_{nt-1}^{\beta} = I_{t-1}^{\alpha} C_{nt-1}^{1-\alpha} = I_{t-1}^{\alpha} C_{nt-1} C_{nt-1}^{-\alpha}. \qquad (3.20)$$

Manipulation of Equation (3.20) provides the following:

$$\frac{Y_{dt}}{C_{nt-1}} = +\left(\frac{I_{t-1}}{C_{nt-1}}\right)^{\alpha}. \qquad (3.21)$$

Transformation of Equation (3.21) into logarithm form gives

$$\therefore \quad \log\left(\frac{Y_{dt}}{C_{nt-1}}\right) = \alpha\log\left(\frac{I_{t-1}}{C_{nt-1}}\right). \qquad (3.22)$$

$$\therefore \quad -\log(10)\,.\log\left(\frac{Y_{dt}}{C_{nt-1}}\right) = -\alpha\log(10)\,.\log\left(\frac{I_{t-1}}{C_{nt-1}}\right). \qquad (3.23)$$

Rewriting Equation (3.23) in double log form provides

$$log\left[\log\left(\frac{Y_{dt}}{C_{nt-1}}\right)\right] - [\log(10)\,.] = -\alpha[\log(10)] + log\left[\log\left(\frac{I_{t-1}}{C_{nt-1}}\right)\right]. \qquad (3.24)$$

Manipulation of Equation (5.6) yields a reduced form of Equation (3.24) as follows:

$$log\left[\log\left(\frac{Y_{dt}}{C_{nt-1}} \times \frac{C_{nt-1}}{I_{t-1}}\right)\right] = (1-\alpha).\,log[\log(10)]. \qquad (3.25)$$

Hence, Equation (3.25) can be rewritten in a more compact form as follows:

$$log\left(\frac{Y_{dt}}{I_{t-1}}\right) = \beta\log(10). \qquad (5.26)$$

Rearrangement of the model represented by Equation (3.26) tends to show that in the long run investment spending affects household disposable income through the household consumption since in the model the MPI is equal to the MPC.

$$\log(Y_{dt}) = \omega\log(10) + \beta\log(I_t). \qquad (3.27)$$

The principle of causality states that if events C_{nt-1}, I_{t-1} come before event Y_{dt} then events C_{nt-1}, I_{t-1} must been the cause of event Y_{dt-1}. Therefore, the causality can be represented as

$$Y_{dt} = \alpha^*(I_{t-1}) + \beta^* C_{nt=1} + \omega^* d(Y_{dt}). \qquad (3.28)$$

Dividing through Equation (3.40) by $\log(Y_{dt})$ provides

$$1 = \alpha^*(I_{t-1}/Y_{dt}) + \beta^*(C_{nt-1}/Y_{dt}) + \omega^*(\mathrm{d}(Y_{dt})/Y_{dt}). \qquad (3.29)$$

The true parameters in Equation (3.28) can be represented as follows:

$$1 = \alpha(Y_{dt}/I_{t-1}) + \beta(Y_{dt}/C_{nt-1}) + \beta(Y_{dt}/\mathrm{d}(Y_{dt})). \qquad (3.30)$$

- *Econometric Models*

The first econometric model is built out of the usual Keynesian consumption function.

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$$C_{nt-1} = C_0 + \beta Y_{dt} + e_t. \quad (3.31)$$

Where C_n is consumption, Y_d is disposable income, C_0 is the constant term, β is the MPC and e_t is the error term (Alani, 2022). The second econometric model is from what Alani (2022) derived the usual consumption function and presented as follows:

$$d(C_{nt}) = \beta_1 d(Y_{dt}) + \beta_2 d\big(d(C_{nt})\big) + e_t. \quad (3.32)$$

The third econometric model comes from Alani et al. (2022) and can be presented as follows:

$$1 = \beta_1 (Y_{dt}/C_{nt-1}) + \beta_2 . (Y_{dt}/I_{t-1}) + e_t. \quad (3.33)$$

The fourth econometric model comes from Alani (2022) and can be presented as follows:

$$log(Y_d/I_{t-1}) = \beta . \log(10) + e_t. \quad (3.34)$$

The fifth econometric model involves handling of the usual Keynesian model in logarithm form, whereby the appropriate model may be presented as follows:

$$d(log(C_{nt-1})) = \beta d(\log(Y_{dt})) + e_t. \quad (3.35)$$

While all the five econometric models presented above depict the long run behavior of the consumption function, the sixth model portrays the short run behavior of the consumption function. This short run consumption function as an econometric model is given by

$$\log(C_{nt}) = \beta . [\log(10) . \log(Y_{dt})] + e_t. \quad (3.36)$$

The seventh econometric model portrays in logarithm form, the long run behavior of the neoclassical production function. This long run consumption function as an econometric model is represented by Equation (3.37) but consisting of the $MPC = \beta$. The implication of this model is that the growth in investment appears to affect disposable income through consumption. For the derivation of Equation (3.37), see Equations (2.20) to (2.27).

$$1 = \beta_0 . \log(Y_{dt}) + \beta . \log(Y_{dt}) / \log(I_{t-1}) + e_t. \quad (3.37)$$

The Eighth econometric model portrays another model in logarithm form, signifying the long run behavior of the neoclassical production function in a more compact form. This long run consumption function as an econometric model is represented by Equation (3.38) but consisting of the $MPC = \beta$. For the derivation of Equation (3.38), see Equations (2.20) to (2.26).

$$1 = \beta . [\log(10) / \log(Y_{dt}/I_{t-1})] + e_t. \quad (3.38)$$

Equation (3.39) the ninth model and it is an extended version of Equation (3.37). The implication of this equation is that investment influences disposable income through consumption.

$$\log(Y_{dt}) = \beta_0 . \log(10) + \beta . \log(I_{t+1}) + e_t. \quad (3.39)$$

Given a household production function in terms of household disposable income (Y_{dt}) as a function of investment spending (I_t) and household consumption (C_{nt}) while ignoring the causality principle. The parameters α, β, of the production function can be expressed as follows:

$$Y_{dt} = I_t^{\alpha} C_{nt}^{\beta} = I_t^{\alpha} C_{nt}^{1-\alpha} = I_t^{\alpha} C_{nt} C_{nt}^{-\alpha}. \quad (3.40^*)$$

Manipulation of Equation (3.40*) provides the econometric Equation (3.40). This tenth equation also indicates that investment influences disposable income though the household consumption.

$$\log(Y_{dt}) = \beta_0 . \log(10) + (\alpha + \beta) . \log(C_{nt}) + \alpha . \log(I_t) + e_t. \quad (3.40)$$

The eleventh econometric model is an extended version of Equation (3.39). Equation (3.41) is derived from the theoretical model depicted by Equation (3.30).

$$1 = \beta_0 . \log(Y_{dt}) / \log(10) + \beta . \log(Y_{dt}) / \log(I_{t-1}) + e_t. \quad (3.41)$$

The twelfth econometric model is an extension of theoretical model depicted by Equation (3.30).

$$1 = \alpha(Y_{dt}/I_{t-1}) + \beta(Y_{dt}/C_{nt-1}) + \omega(Y_{dt}/\mathrm{d}(Y_{dt})) + e_t. \qquad (3.42)$$

Dividing through Equation (3.36) by $\log C_{nt}$) and taking square root gives an expression with the long run $MPC = \beta$. That is because in the long run $MPC = APC$, and $MPC_L = (MPC_s)^{0.5}$. Therefore, the thirteenth econometric model is an extension given by

$$1 = \beta.[(\log(10) * \log(Y_{dt})/\log C_{nt})]^{0.5} + e_t. \qquad (3.43)$$

The fourteenth econometric model depicted by Equation (4.44) can be derived by introducing savings (S_t) variable into the consumption function. Therefore, given the consumption function as $C_{nt-1} = S_t + \beta.Y_{dt}$, where $S_t = C_{nt-1} - (Y_{dt} * \log(Y_{dt})/(\log(C_n)\log(10)))^{0.5})$ is defined as follows:

$$C_{nt-1} = \omega(C_{nt-1} - (Y_{dt} * \log(Y_{dt})/(\log(C_n)\log(10)))^{0.5})) + \beta.Y_{dt} + e_t. \qquad (3.44)$$

The fifteenth econometric model depicted by Equation (4.45) can be derived by introducing savings (S_t) variable into the consumption function. Thus, given the consumption function as $C_{nt-1} = S_t + \beta.Y_{dt}$, where $S_t =$ is $[C_{nt-1} - (1/[\log(Y_{dt})/(\log(I_{t-1})] * Y_{dt})]$ is expressed by

$$C_{nt-1} = \omega[C_{nt-1} - (1/[\log(Y_{dt})/(\log(I_{t-1})] * Y_{dt})] + \beta.Y_{dt} + e_t. \qquad (3.45)$$

The last econometric model is obtained by redefining the consumption function by using the causality principle where $\log(C_{nt-1}) = \log(C_{nt}) - d(\log(C_{nt}))$.

$$\therefore \quad \log(C_{nt}) = \beta.\log(10) + \omega.\log(Y_{dt-1}) + \tau.\mathrm{d}(\log(C_{nt})) + e_t. \qquad (3.46)$$

- *Econometric/Statistical Tests*

The generalized least squares (GLS) method is used to perform the linear regression analyses on secondary data collected from the World Bank/OECD Data Base on Kenya covering the period 1960 to 2020. Data set used in empirical analyses consists of aggregate household consumption and investment spending, government spending, exports and imports. The generated data are for two variables, gross domestic product (GDP) and household disposable income. The quantity of labor is taken to be equal to the quantity of household disposable income as depicted in the circular theory of income. From this theory the assumes that all the earning from labor by the households is consumed. The t, F, DW and H_T statistical tests are conducted by comparing the computed t, F, DW and heteroskedasticity (H_T) values with their respective critical values from the standard Statistical Tables. The H_T is the computed t value used in testing for heteroscedasticity (variances that are not constant) by conducting the usual t tests.

IV. RESULTS AND DISCUSSIONS

A. Results

The Keynesian theories of consumption were very popular up until the 1950s and 1960s. During this period several economists refuted the postulate that consumers do not take future income into account when deciding how much to consume (Landsem, 2016, p.11). On the contrary, empirical finding show that in year $t-1$, a 1% increase in (anticipated, future, planned or expected) income could have caused consumption to rise annually by 0.685% in year t during the 1962 to 2020 period in Kenya (see Equation (4.1) for corroboration).

$$C_{nt-1} = 4.71 \times 10^{11} + 0.685.Y_{dt}. \qquad (4.1)$$

$$t \qquad 22.37 \qquad 156.28$$

$$R^2 = 0.9999 \qquad DW = 2.15 \qquad F = 1044360 \qquad H_T = 0.124$$

$$N = 59 \;\; Period: 1962 - 2020 \qquad V = 1/d(d((I_t/\log(I_t))^2))$$

The model built in terms of the first derivative give almost the same level of $MPC_L = 0.661$, as the $MPC = 0.685$ given in Equation (4.1). This particular empirical finding is corroborated by the fact that; in Bangladesh, India, Nepal, Pakistan and Sri Lanka private consumption take the major share of the Gross Domestic Product (GDP) of each respective country; approximately 66 percent5 of the GDP is spent on private consumption (Khan et al., 2015).

Moreover, consumption constitutes about two-third of national income. That is because aggregate household consumption depends mainly on aggregate disposable income (Jore and Chowdhary, 2019).

$$d(C_{nt}) = 0.661.d(Y_{dt-1}) + 0.633.d(d(C_{nt})). \quad (4.2)$$

$$t \quad 9.74 \quad 42.05$$

$$R^2 = 0.9935 \quad DW = 1.97 \quad F = 8752 \quad H_T = 0.316$$

$$N = 59 \ \ Period: 1962 - 2020 \quad V = 1/d(d((I_t/\log(I_t))^2))$$

According to Drakopoulos (2021) current consumption (C_{nt}) depends on current disposable income (Y_{dt}). But our model postulates that anticipated or expected income (Y_{dt}) determines the current consumption (C_{nt-1}) as denoted by the $MPC = 0.646$. According to Mankiw (2010), in the short run the Keynesian consumption function provides accurate MPC but in the long run it gives average propensity to consume.

$$1 = 0.646.(Y_{dt}/C_{nt-1}) + 0.026.(Y_{dt}/I_{t-1}). \quad (4.3)$$

$$t \quad 131.1 \quad 24.59$$

$$R^2 = 0.9998 \quad DW = 2.14 \quad F = 294373 \quad H_T = 0.394$$

$$N = 56 \quad Period: 1963 - 2020 \quad V = 1/d(d((I_{t-1}/\log(I_t))^2))$$

Moreover, Bayar and McMorrow (1999) assert the in the long run marginal propensity to consume equals average propensity to consume ($MPC = APC$). The reason why in the long run MPC equals APC is given under the discussions.

Given the neoclassical household production function $Y_{dt} = I_t^{\alpha} C_{nt}^{\beta}$, it can be discerned that $\log(\mathrm{Y_d}/\mathrm{I_{t-1}}) = \beta$. See Equations (3.20) to (3.27) for derivations. Results in Equation (4.4) are clear indications that investment affects disposable income through the consumption function.

$$\log(\mathrm{Y_d}/\mathrm{I_{t-1}}) = 0.677.\log(10). \quad (4.4)$$

$$t \quad 156.7$$

$$R^2 = 0.9977 \quad DW = 2.03 \quad H_T = 0.173$$

$$N = 57 \ \ Period: 1964 - 2020 \quad V = 1/d(Yd))/d(d((d(Y_{dt-1}))^2))$$

According to Alani (2022) the consumption function can be represented as a psychological savings hypothesis (PSH) as follows: $C_{nt-1} = \bar{S} + Y_{dt}$. Regression of the first difference of this function provides results as given by Equation (4.5). The result shows that in the long run the APC and the MPC are equal and their value is the square root of the short run MPC, $MPC_S = 0.66$. Results pertaining to Equation (4.5) show that in the equilibrium long run, consumption in year $\mathrm{t} - 1$ depends on quantity of anticipated, planned or expected disposable income. The MPC in Equation (4.5) is very close to the global equilibrium value of 0.666.

$$d(log(C_{nt-1})) = 0.658.d(\log(Y_{dt})). \quad (4.5)$$

$$t \quad 523.9$$

$$R^2 = 0.9998 \quad DW = 1.92 \quad H_T = 0.005$$

$$N = 58 \ \ Period: 1963 - 2020 \quad V = (1/d(d(\log(C_n)))/d(d((C_{nt}^2))$$

Short run estimates for the MPC are often computed by regressing the consumption function in logarithm form. For instance, by using logarithm, Ahmed (2015) finds that in the short run, the real GDP has positive impact on ARPC. Implying that the value of MPCs out of real GDP for South Korea was 0.434 during the 1985 to 2013 period. Therefore, in the short run a 1% increase in the real GDP could have raised the ARPC in South Korea by 0.434% during the given period.

Meanwhile, empirical Swedish research by Matthiessen (1972), shows estimate of MPC of disposable income to be 0.43 (Polder, 2017, p.7). These estimates are very close to the estimate of MPC (0.431) that is made in this paper for Kenya during 1960 to 2020 period.

$$\log(C_{nt}) = 0.431.[\log(10).\log(Y_{dt})] \quad (4.6)$$

$$t \quad 17379$$

$$R^2 = 1.0000 \quad DW = 2.23 \quad H_T = 0.531$$

$$N = 58 \quad Period: 1963 - 2020 \quad V = 1/d(d((d(Y_{dt} - C_{nt}))^2))$$

By examining Equations (3.1) to (3.19) it can be confirmed that the theoretical short rum MPC is 0.4343. This value is very close to the short run MPC value (0.431) in the regression Equation (4.6). At equilibrium the long run MPC equal the square root of short run MPC value (0.66).

Considering Equation (3.41) and taking $\log(10) = 1$ and taking regression accordingly provides results represented by Equation (4.7). In the regression Equation (4.7) the MPC is 0.658 and it is very close to the square root of $1/\ln(10) = 0.4343$ which is the short run MPC. This particular result also indicates that investment affects disposable income through consumption.

$$1 = 0.010.\log(Y_{dt}) + 0.658.\log(Y_{dt})/\log(I_{t-1}). \quad (4.7)$$

$$t \quad 45.65 \quad 104.44$$

$$R^2 = 1.0000 \quad DW = 1.75 \quad F = 3.26 \times 10^8 \quad H_T = 0.038$$

$$N = 57 \quad Period: 1964 - 2020 \quad V = 1/d(d((d(TF_{t-1}))^2))$$

Similarly, Equation (4.8) shows that investment affects disposable income through consumption.

The theoretical model corresponding to Equation (4.8) is obtained by dividing through the theoretical model corresponding to Equation (4.4) by $\log(Y_{dt}/I_{t-1})$. The $MPC = 0.678$ given in Equation (4.8) is very close to $MPC = \sqrt{0.434294} = 0.659$ by law of household consumption.

$$1 = 0.678.[\log(10)/\log(Y_{dt}/I_{t-1})] \quad (4.8)$$

$$t \quad 708.93$$

$$R^2 = 0.9999 \quad DW = 2.13 \quad H_T = 0.028$$

$$N = 59 \quad Period: 1962 - 2020 \quad V = 1/d(d((d(Y_{dt} - C_{nt}))^2))$$

Equation (4.9) supports the postulate that investment affects household disposable income through household consumption. The theoretical model (Equation 3.39) of Regression Equation (4.9) is derived from the household production function represented by Equation (3.40*). The $MPC = 0.664$ given in Equation (4.9) is very close to $MPC = 0.659$ by law of the consumption function.

Thorough derivation of the theoretical model shall be handled under the discussion.

$$\log(Y_{dt}) = 4.546.\log(10) + 0.664.\log(I_{t+1}). \quad (4.9)$$

$$t \quad 3.67 \quad 6.11$$

$$R^2 = 1.0000 \quad DW = 2.05 \quad F = 1.60 \times 10^7 \quad H_T = 0.131$$

$$N = 56 \quad Period: 1964 - 2020 \quad V = V = 1/d(d(\log(C_n)))/d(d((C_{nt}^2))$$

The Regression Equation (4.10) is the result of the theoretical model represented by Equation (3.40). The $MPC = 0.829$ and $MPI = 0.167$ are values in Equation (3.30).

They indicate that investment spending affects disposable income through household consumption, since the equilibrium quantity of the consumption is $0.829 - 0.167 = 662$. Hence, regression results of a similar can be interpreted in the same way.

$$\log(Y_{dt}) = 0.249.\log(10) + 0.829.\log(C_{nt}) + 0.167.\log(I_t) \quad (4.10)$$

$$t \quad 8.67 \quad 119.7 \quad 33.80$$

$$R^2 = 1.0000 \quad DW = 2.01 \quad F = 9.59 \times 10^{10} \quad H_T = 0.033$$

$$N = 57 \quad Period: 1964 - 2020 \quad V = 1/d(d(((d(TF_{t-1})))^2))$$

To test whether the long run MPC is 0.66, the corresponding regression Equation (4.11) to the theoretical model in Equation (3.41) is obtained where the MPC is 0.658.

$$1 = 0.024.\log(Y_{dt})/\log(10) + 0.658.\log(Y_{dt})/\log(I_{t-1}). \quad (4.11)$$

$$t \quad 45.65 \quad 104.44$$

$$R^2 = 1.0000 \quad DW = 1.75 \quad F = 3.26 \times 10^8 \quad H_T = 0.018$$

$$N = 57 \quad Period: 1964 - 2020 \quad V = 1/d(d((d(TF_{t-1}))^2))$$

The theoretical model represented by Equation (3.30) corresponds to the regression Equation (4.12). This regression model serves as a robustness check for the other regression models. It shows the equilibrium value of MPC in the consumption model for Kenya was 0.674 during the 1963 to 2020 period, ceteris paribus; which is very close to the value 0.66 by law.

$$1 = 0.022.(Y_{dt}/I_{t-1}) + 0.674.(Y_{dt}/C_{nt-1}) + 0.000.(Y_{dt}/\mathrm{d}(Y_{dt})) \quad (4.12)$$

$$t \quad 8.60 \quad 32.16 \quad 0.03$$

$$R^2 = 0.9997 \quad DW = 2.01 \quad F = 1.01 \times 10^5 \quad H_T = 0.078$$

$$N = 57 \quad Period: 1964 - 2020 \quad V = 1/d(d((d(d(I_t)))^2))$$

Equation (3.43) demonstrates that in the long run MPC and APC are equal, while their value is equal to the level of the short rum MPC. This postulated is tested by the regression results in Equation (4.13). Presenting the MPC in this way also yields accurate values of the MPC.

$$1 = 0.657.[(\log(10) * \log(Y_{dt})/\log(C_{nt})]^{0.5}. \quad (4.13)$$

$$t \quad 18324$$

$$R^2 = 1.0000 \quad DW = 1.76 \quad H_T = 0.187$$

$$N = 58 \quad Period: 1963 - 2020 \quad V = 1/d(d((TC_{t-1})^2))$$

Therefore, the short run value of the MPC is the square of the long run MPC. It also implies that in the long run MPC equals APC. Recall, the relationship connecting APC, long run MPC (MPC_L) and short rum MPC (MPC_S) is given by $MPC_S = APC * MPC_L$ or $MPC_L = MPC_S^{0.5}$.

Regression Equation (4.14) consists of values of MPC (0.663) and desired marginal propensity to save ($MPS_d = 0.985$), where the desired saving is given by $S_{dt} = C_{t-1} - \beta Y_{dt}$ in other word S_{dt} is given by $S_{dt} = C_{nt-1} - (Y_{dt}[\log(Y_{dt})/(\log(C_n)\log(10))]^{0.5})$.

Meanwhile, the long run MPC is given by $1 = \beta[\log(Y_{dt})/(\log(C_n)\log(10))]^{0.5}$. From Equation (4.14) it can be discerned that consumption (C_{nt-1}) is affected more by the desired saving (S_{dt}) than by the household disposable income (Y_{dt}).

$$C_{nt-1} = 0.985(C_{nt-1} - (Y_{dt}.\log(Y_{dt})/[\log(C_n)\log(10))]^{0.5})) + 0.663.Y_{dt}. \quad (4.14)$$

$$t \quad 1991 \quad 14134$$

$$R^2 = 1.0000 \quad DW = 1.98 \quad F = 2.00 \times 10^9 \quad H_T = 0.516$$

$$N = 59 \quad Period: 1962 - 2020 \qquad V = 1/d(d((Y_t)^2))$$

Regression Equations (4.14) and (4.15) are similar, except for Equations (4.15) MPS is 0.44, and MPC is 0.679. In the two equations the values of MPC are almost the same and the two values of MPC are very close to the global MPC value, which by law is 0.66.

$$C_{nt-1} = 0.444[C_{nt-1} - (1/[\log(Y_{dt}/I_{t-1})] * Y_{dt})] + 0.679. Y_{dt}. \qquad (4.15)$$

$$t \qquad 29.93 \qquad 113.3$$

$$R^2 = 1.0000 \qquad DW = 2.09 \qquad F = 4.16 \times 10^6 \quad H_T = 0.516$$

$$N = 57 \quad Period: 1964 - 2020 \qquad V = 1/d(d(((C_{nt}/A_t))^2))$$

By applying the philosophical principle of causality provided by Alani, Yawe and Mutenyo (2022), it can be observed that Equation (3.46) redefines the consumption function. The corresponding regression Equation (4.16) can be used to test whether the equilibrium MPC for Kenya during the 1964 to 2020 period was 0.66 as postulated by one of the consumption laws. Hence, the MPC results obtained in Equations (4.1) to (4.16) appear to be robust because the long run estimates for MPC in Kenya are very close to 0.66. Meanwhile, the short run estimates for MPC in Kenya is exactly equal to 0.43.

$$\log(C_{nt}) = 0.659. \log(10) + 0.941. \log(Y_{dt-1}) + 0.818. \mathrm{d}(\log(C_{nt})) \qquad (4.16)$$

$$t \qquad 26.69 \qquad 482.87 \qquad 15.05$$

$$R^2 = 1.0000 \qquad DW = 2.22 \quad F = 4.01 \times 10^9 \quad H_T = 0.009$$

$$N = 57 \quad Period: 1964 - 2020 \qquad V = 1/d(d((d(dTF_{t-1}))^2))$$

B. Discussions

➢ *Reconciliation of Household Production Function with Consumption Function*

The household production function can be represented as follows:

$$Y_{dt} = \alpha^* I_t + \beta^* C_{nt}. \qquad (4.17)$$

Where Y_{dt} is output in terms of disposable income, I_t is investment spending and is C_{nt} consumption, while $\alpha^* = \partial Y_{dt}/\partial I_t$ and $\beta^* = \partial Y_{dt}/\partial I_t$ are parameters. These parameters are short run parameters which cannot be used to estimate the long run parameters accurately. For more accurate estimates of the long run parameters the production function must be defined as follows:

$$\frac{dY_{dt}}{Y_{dt}} = \frac{\partial Y_{dt}}{\partial I_t}\frac{I_t}{Y_{dt}}\frac{dI_t}{I_t} + \frac{\partial Y_{dt}}{\partial C_{nt}}\frac{C_{nt}}{Y_{dt}}\frac{dC_{nt}}{C_{nt}}. \qquad (4.18)$$

Dividing through Equation (4.18) by dY_{dt}/Y_{dt} provides a better form for more accurate parameter estimation where $API = I_t/Y_{dt}$ and $APC = C_{nt}/Y_{dt}$ become the parameters of interest.

$$1 = \left(\frac{I_t}{Y_{dt}}\right)\frac{Y_{dt}}{I_t} + \left(\frac{C_{nt}}{Y_{dt}}\right)\frac{Y_{dt}}{C_{nt}}. \qquad (4.19)$$

Or

$$1 = \alpha\frac{Y_{dt}}{I_t} + \beta\frac{Y_{dt}}{C_{nt}}. \qquad (4.20)$$

Therefore, Equations (4.19) and (4.20) imply that in the long run $API = MPI = \alpha = I_t/Y_{dt}$. Also, Equations (4.19) and (4.20) imply that in the long run $APC = MPC = \beta = C_{nt}/Y_{dt}$. Hence, the long run production function can be represented in the best way as follows:

$$Y_{dt} = \alpha I_t + \beta C_{nt}. \qquad (4.21)$$

On the other hand, the household consumption function can be represented as follows:

$$C_{nt} = C_0 + \beta Y_{dt}. \qquad (4.22)$$

In a dynamic form, the household consumption function can be expressed as follows:

$$\frac{dC_{nt}}{C_{nt}} = \frac{\partial C_{nt}}{\partial Y_{dt}}\frac{Y_{dt}}{C_{nt}}\frac{dY_{dt}}{Y_{dt}}. \quad (4.23)$$

In order to estimate the consumption function more accurately Equation (4.23) can be rewritten as

$$1 = \frac{\partial C_{nt}}{\partial Y_{dt}}\frac{Y_{dt}}{C_{nt}}\frac{dY_{dt}}{Y_{dt}}\frac{C_{nt}}{dC_{nt}}. \quad (4.24)$$

Or

$$1 = \left(\frac{C_{nt}}{Y_{dt}}\right)\frac{Y_{dt}}{C_{nt}} = \beta\frac{Y_{dt}}{C_{nt}}. \quad (4.25)$$

Equation (4.25) implies that the MPC could be represented in the best way by its definition.

$$MPC = APC = \left(\frac{C_{nt}}{Y_{dt}}\right) = \beta. \quad (4.26)$$

Hence, at equilibrium the following condition is maintained.

$$\frac{\partial Y_{dt}}{\partial C_{nt}} = \frac{\partial C_{nt}}{\partial Y_{dt}} = \beta \quad (4.27)$$

Moreover, dividing through Equation (4.14) provides the following.

$$1 = \alpha^*\frac{I_t}{Y_{dt}} + \beta^*\frac{C_{nt}}{Y_{dt}}. \quad (4.28)$$

Comparing Equations (4.20) and (4.28) indicates that the most appropriate parameters for the household production function must be APC and API. Therefore, implying that $\alpha^* = Y_{dt}/I_t$ while $\beta^* = Y_{dt}/I_{nt}$. Hence, the household production function must be represented as given by Equation (4.21) and form the corresponding regression model most appropriate theoretical model is given by Equation (4.20). This model indicates that the household neoclassical production function does not correctly estimate the MPC.

- *Yearly Estimates of Short Run Marginal Propensity to Consume for Kenya: 1960-2020*

Annual estimates of the MPC values can be obtained by using the formula

$$MPC_S = \beta = \frac{\ln(Y_{dt})}{\ln(10)\ln(C_{nt}))}. \quad (4.29)$$

Table 1 provides computed short run yearly MPC series for Kenya during the 1960 to 2020 period. In brief, the first law of consumption states: "In the short run MPC equals 0.4343." Meanwhile, the theoretical value of MPC can be obtained by using the formula

$$MPC_S = 1/\ln(10) = \log(e) = 0.4343. \quad (4.30)$$

Table 1 Annual Values of Short Run Marginal Propensity to Consume for Kenya: 1960-2020

Year	β	Year	β	Year	β	Year	β
1960	0.4310	1975	0.4319	1990	0.4324	2005	0.4322
1961	0.4321	1976	0.4315	1991	0.4326	2006	0.4318
1962	0.4324	1977	0.4309	1992	0.4329	2007	0.4317
1963	0.4321	1978	0.4307	1993	0.4326	2008	0.4314
1964	0.4325	1979	0.4316	1994	0.4325	2009	0.4312
1965	0.4325	1980	0.4313	1995	0.4326	2010	0.4310
1966	0.4319	1981	0.4314	1996	0.4325	2011	0.4310
1967	0.4319	1982	0.4320	1997	0.4324	2012	0.4308
1968	0.4307	1983	0.4322	1998	0.4322	2013	0.4308
1969	0.4307	1984	0.4323	1999	0.4324	2014	0.4304
1970	0.4291	1985	0.4316	2000	0.4322	2015	0.4307
1971	0.4305	1986	0.4324	2001	0.4321	2016	0.4310
1972	0.4312	1987	0.4322	2002	0.4325	2017	0.4308

1973	0.4304	1988	0.4323	2003	0.4324	2018	0.4310
1974	0.4310	1989	0.4323	2004	0.4323	2019	0.4310
The theoretical value of short run MPC is 0.4343.						2020	0.4308

Meanwhile, regression results pertaining to Equation (3.5) show that the equilibrium value of the MPC in the short run is 0.431. A number of research findings under literature review confirm that in the short run the MPC is 0.431.

- *Testing the Theory of Accurate Definition of Marginal Propensity to Consume*

The theory of accurate definition of MPC states that by defining the MPC accurately leads to accurate estimates of the MPC values. Equation (4.20) defines the MPC very well. This particular equation shows that the effects of consumption on disposable income overrides the effects of investment on disposable income. The reason for this could be that investment spending affects household disposable income through household consumption.

Although the regressions model derived out of the theory of accurate definition of MPC provides accurate result of equilibrium MPC value, it is not as versatile as the theory of causality. At equilibrium the MPC estimates from the neoclassical production is almost equal to the MPC from the consumption function.

The theoretical underpinnings governing Equation (3.31) are similar to models governing the long run production models running from Equations (4.17) to (4.28). They are also similar to theories pertaining to parameters of regression Equations (4.3), (4.7), (4.11) and (3.12). The model indicates that a 1% increase in consumption gives rise to 0.666% rise in household disposable income. Meanwhile, the value of MPI is very close to zero.

$$1 = 0.033(Y_{dt}/I_t) + 0.664(Y_{dt}/C_{nt}). \quad (4.31)$$

$$t \quad 160.5 \quad 628.7$$

$$R^2 = 1.0000 \quad DW = 1.91 \quad F = 3.74 \times 10^7 \quad H_T = 0.094$$

$$N = 57 \quad Period: 1964 - 2020 \quad V = 1/d(d((d(d(C_{nt}/I_t)))^2))$$

- *Investment Spending Affects Disposable Income through Household Consumption*

From results pertaining to regression Equations (4.3), (4.7) to (4.11), it can be deduced that at the household level, investment spending affects disposable income through the household consumption.

If that is the case, then the investment function must first cause the consumption function and the consumption function in turn must lead to the disposable income. The effect of investment on consumption can be depicted simply as follows:

$$\log(C_{nt}) = 4.444\log(10) + 0.685\log(I_{t-1}). \quad (4.32)$$

$$t \quad 13.71 \quad 24.13$$

$$R^2 = 1.0000 \quad DW = 1.82 \quad F = 4.16 \times 10^6 \quad H_T = 0.635$$

$$N = 56 \quad Period: 1965 - 2020 \quad V = 1/d(d((d(d(I_{t-1}/TF_t)))^2))$$

The MPC value in Equation (4.32) is 0.685 and it is very close to the global MPC value of 0.659. Hence, it is plausible to conclude that investment affects disposable income through consumption.

- *China's and India's Marginal Propensity to Consume*

Accodong to the review of literature, Jore and Chowdhray (2019) find that China's, consumption is composed of 42 percent of the GDP, while India's consumption constitutes about 64 percent of GDP. These results may imply that China's economy if investment as well as production oriented, while India's economy is consumption oriented.

That is India's economy is dominated by consumption, while China's economy is dominated by investment. From the review of literature, several findings portray global short run MPC to be 0.43 and global long run MPC to be 0.66.

- *Marginal Propensity to Consume as a Function of Savings and Disposable Income*

The regression models represented by Equations (4.14) and (4,15) show that by presenting the consumption function in terms of desired savings and disposable income or in terms of long-term savings and disposable income gives rise to the same value of MPC that is very close to the global value of long run MPC.

Implying that defining the MPC as $\log(C_{nt})/(\log(I_t)\log(10))$ or as $MPC \times log(10) = \log(Y_{dt}/I_{t-1})$ is one of the best ways of defining the long run MPC. Therefore, the MPC values: 0.663 and 0.679 resulting from the two models are and the values are almost the same.

These results support the proposition that the long run global MPC value is 0.65901.

- *Long Run MPC is Equal to the Square Root of Short Run MPC*

The regression models represented by Equations (4.13) and (4.14) tend to empirically show that long run MPC is equal to the square root of short run MPC. These two MPC values 0.657 and 0.663 confirm that the long run equilibrium value of MPC is 0.66. Hence, by law the long run global MPC is 0.66.

- *Empirical Results Confirming that HH Consumption Equals HH labor*

Empirical finding shows that in year $t-1$, a 1% increase in (anticipated, future, planned or expected) income could have caused labor to rise annually by 0.685% in year t during the 1962 to 2020 period in Kenya (see Equation (4.1) for corroboration). Thus, in the long run consumption equals labor.

$$L_{t-1} = 7.70 \times 10^{11} + 0.651.Y_{dt}. \qquad (4.33)$$

$$t \qquad 25.14 \qquad 102.19$$

$$R^2 = 0.9999 \qquad DW = 2.16 \qquad F = 530032 \qquad H_T = 0.281$$

$$N = 59 \;\; Period: 1962 - 2020 \qquad V = 1/d(d((I_t/\log(I_t))^2))$$

- *At Equilibrium the Short Run Marginal Propensity to Consume is One (1)*

To show that at equilibrium the short run marginal propensity to consume is one (1) requires considering Equation (4.18) and rewrite the long run MPC, short run MPC and APC as follows:

$$\frac{dC_{nt}}{dY_{dt}} = \frac{\partial Y_{dt}}{\partial C_{nt}}\frac{C_{nt}}{Y_{dt}}. \qquad (4.34)$$

Other things being equal.

$$\therefore \qquad \frac{dC_{nt}}{dY_{dt}} = \frac{C_{nt}}{Y_{dt}}. \qquad (4.35)$$

Since short run MPC ($\partial C_{nt}/\partial Y_{dt}$) is 1. Therefore, if the short run MPC is 1, then log run MPC equal APC. This relationship can be represented properly by Equation (4.20) as follows:

$$1 = MPI\frac{Y_{dt}}{I_t} + MPC\frac{Y_{dt}}{C_{nt}}. \qquad (4.36)$$

Equation (4.26) is correct if either $MPI(Y_{dt}/I_t) = 1$ or $MPC(Y_{dt}/I_t) = 1$. Thus, Equation (4.36) can be rewritten in a more convenient way without any loss of generality as follows:

$$1 = \frac{MPI}{API_t} + \frac{MPC}{APC_t}. \qquad (4.37)$$

Hence, from the regression results pertaining to Equation (4.27) either $MPI/API_t) = 1$ or $MPC/APC_t) = 1$ is correct. For example, in Equation (4.31) the value of MPC is $0.664 \times (Y_{dt}/C_{nt})$ but the MPI is close to zero i.e., $0.033 \times (Y_{dt}/I_t)$.

V. CONCLUSION

Empirical findings from some four out of 15 consumption regression models indicate that the long run MPC in Kenya during the 1960-2020 period were: 0.646, 0.677, 0.685, 0.686 respectively; and were not significantly different from 0.656; While, in the short run the MPC in the given period was 0.431; and was not significantly different from 0.43.

Also, empirical results confirm that long run MPC is equal to the square root of short run MPC. Thus, justifying the two laws of the consumption function. Empirical results show that in the long run MPC equals APC. Implying that in the long run, at equilibrium the short run MPC is 1, and the ratio of MPC to APC is 1. Therefore, at equilibrium the value of product of MPC and the marginal product of labor is 1. Meanwhile, empirical results show that HH consumption equals labor. Computations of annual short run MPC show that in the short run the annual value of MPC is almost constant at 0.43 (See Table 1.).

At equilibrium the MPC estimates from the neoclassical production is almost equal to the MPC from the consumption function. Therefore, given that quantity of labor equals quantity of HH consumption, implies that MPC is equal to marginal physical product of labor. Moreover, the paper tests the postulate (theory) that “accurate definition of marginal propensity to consume provides accurate values of MPC.” Empirical findings confirm this postulate to be true because regression results show that all values of MPC are very close to the global MPC value of 0.65901. Meanwhile, various empirical literature indicates that in the short run is 0.4343, while in the long run the value of MPC is

0.65901. By expressing MPC as $\beta = \log(Y_{dt}/I_{t-1})$ or as follows: $MPC \times log(10) = \log(Y_{dt}/I_{t-1})$, it is possible to express the consumption function in terns of savings and HH disposable income that has the potential of estimating MPC accurately.

Given $\ln(C_{nt})/\ln(Y_{dt}) = 1$, where $\ln(C_{nt})/\ln(Y_{dt}) = \log(C_{nt})/\log(Y_{dt}) = MPC_s.\log(10)$. So that $MPC_s = 1/\log(10) = 0.4343$. Similarly, that $MPC_s = \log(e) = 0.4343$ where $e = 2.718 \ldots$ is the natural number.

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