Analysis of correlation between Consumption and Revenue in Rwandan Economy (Econometric Approach)

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Abstract

This study was designed to make analysis of correlation between consumption and revenue in Rwandan Economy; but for having a deep analysis; other macroeconomic variables have been included such as: consumer price index and interest rate. The econometric approach has been used for dissecting those macroeconomic variables, and various tools have been applied for avoiding the problem of spurious, nonsense regression. After running the model, the different results have been shown. Considering the model as whole, the correlation is high, R^2 is 98%. The regression has provided the long-run relation between those macroeconomic variables, but the error correction model has not provided any information. Meaning that the revenue explains at very high rate the consumption, which is the core stone of the sustained economy. Without a deep and safe analysis of the macroeconomic variables, our economy will not have a trend to follow.

Key words: Disposable income, Consumer price index, Marginal propensity to consume, and Interest rate.

Introduction

All over the world the consumption plays a major role in macroeconomic framework, a steady stream of theoretical and empirical research has been carried out on it, because the decisions conducted are crucial for long run analysis as far as the economic growth is concerned. The way the households decide how much of their income to consume today and how much to save for the future, testify that consumption and revenue are inseparable. The welfare of the people in developed and developing countries has been shown by the different studies conducted on the consumption.

Two major questions for the policymakers in natural resource rich developing countries are how much of resource revenues to consume and how to save and also how to cope with the uncertainty and velocity of resource revenues?

Economists are particularly interested in the correlation between consumption and revenue, and therefore in economics the consumption function plays a major role. (Dorlando and Sanfilippo, 2010: 1035-1046).

The landlocked country with the high increase of the population, Rwanda, is one of the countries in which the consumption has been promoted and also increased. Surely the consumption in Rwanda has increased at a certain level. The country has been familiar with the fluctuations in consumption due to the different factors. The statistics show that in Rwanda there has been the increase of consumption resulted from the increase of the disposable revenue, for example the level of consumption was 103 billion Rwf in 1980while the Disposable income was 112 billion Rwf; it became 200 billion RWF in 1990 and the Disposable income was 203 billion Rwf; 667 billion Rwf in 2000 against 675 billion Rwf of Disposable income; in 2010 the level of consumption was estimated at 3266 billion Rwf against the level of income estimated at 3281 billion Rwf, and finally in 2012, the consumption was 4225 billion Rwf and the Yd was 4243 billion Rwf. Available from: http://data.worlbank.org (Accessed 28 June 2013).

As far as the development is concerned, revealed also in the consumption, the variables which have the great impact on the consumption should be analyzed for having a sustained trend of development. In nutshell the analysis of correlation between consumption and revenue constitutes the great issue world widely particularly in less developed countries in which Rwanda is included; reason why this problem of not knowing the exact correlation of these macroeconomic variables, consumption and revenue, in which the instability of the economy resulted from, has inspired the researcher to conduct the research in this paper. Really this is indispensable work on every economic policy and particularly to Rwanda, in which the promotion of the welfare of the people is the engine of the good governance and the elaboration of various National Economic Programs.

Any research is conducted because there are the objectives the researchers are targeting;

reason why the following are the objectives in this study: To analyze the level of consumption in Rwanda; To find out the importance, and the rate, of macroeconomic variables as the key element of the stability of Rwandan economy; and finally, examining the correlation between consumption and revenue in Rwandan economy.

In the way of attempting to disclose the hidden truth in consumption and revenue, the following hypothesizes will be verified through this research:

- ✓ H_O: There is no significant correlation between consumption and revenue in Rwandan economy.

- ✓ H1: There is significant correlation between consumption and revenue in Rwandan economy.

The development is guaranteed through the safe and deep analysis of those macroeconomic variables.

Theoretical framework

Every scientific research requires the literature review for understanding what are going to be discussed, so reason why this part is concerned.

➢ **Consumption**

In macroeconomic theory, consumption defined as the spending by all households in the economy upon goods and services produced within the economy. (Ray, 1996a: 213); and also it represents purchases of goods and services by households and governments.

The consumption is linked with:

▸ *Marginal Propensity to Consume*

In Economics, the marginal propensity to consume (MPC) is the empirical metric that quantifies the level of the consumption, the concept that the increase in personal consumer spending, consumption, occurs with an increase in disposable income, income after taxes and transfers.

According to Ray (1996b:2140), the MPC is defined as the change in planned consumption (ΔC) as a ratio of change in the level of income (ΔY); in other words, is the proportion of additional income that an individual desires to consume.

➢ **Revenue**

The revenue is the macroeconomic variable that helps the more analyses when it has

been taken into the consideration. Many researchers and many economists have referred to it in the way of analyzing different aspects of the economy.

Disposable income has been defined as the total personal income minus personal current taxes. (Robert, et al.1984a:97-107).

> ➤ **Consumer Price Index**

A **consumer price index** (**CPI**) measures changes in the price level of a market basket of consumer goods and services purchased by households. (Robert, et al.1984b:67-68).

- *Consumer Price Index in Rwanda*

The data concerning CPI in Rwanda are available, and basing on those data there an increase of CPI. In Rwanda the CPI is a Modified Laspeyres index that currently measures changes in prices of 1,136 goods and services in five provinces in Rwanda.

The value for Consumer price index (2005 = 100) in Rwanda was 154.82 as of 2010. As the graph on that site shows, over the past 44 years this indicator reached a maximum value of 154.82 in 2010 and a minimum value of 3.55 in 1966. Available from: http://www.data.Internationalmonetaryfund.org (Accessed 10 June 2013).

The CPI permits monthly inflation monitoring. It is equally used as a deflator for a number of economic aggregates (consumption, revenues…) for measuring evolution in real terms (at constant prices).Available from: http://www.statistics.gov.rw (Accessed 12 June 2013).

> ➤ **Interest Rate**

Interest rate targets are the vital tool of monetary policy and are taken into account when dealing with the variables like investment, inflation, unemployment, consumption, etc. The central banks of countries generally tend to reduce interest rates when they wish to increase investment and consumption in the country's economy.

An interest rate is the extra money that you pay back when you borrow money or that you receive when you invest money. Specifically, the interest rate (I/m) is a percent of principal (P) paid a certain amount of times (m) per period (usually quoted per annum. (Advanced learner's dictionary 1997: 783)

Empirical Studies

No specialty in macroeconomics has been profoundly influenced by the rational expectations revolution than has on the consumption. From the early 1950s, when the life cycle, permanent income hypothesis, has taken over the thinking up to 1970, the consumption carrier was dormant.

Work on consumption from the period of Keynes's general theory focused on the development of consumption function that is a structural relation between income, possibly interest rate and consumption. By using a model it is shown as follows: $C_t = f(Y_t, r_t)$. Because we are dealing with the econometric analysis, there should be the other factors that can influence the consumption but which are not taken into the consideration; reason why the model becomes:

$C_t = \beta_0 + \beta_1 Y_t - \beta_2 r_t + \varepsilon_t$. (Hall, 1990a:127-141).

The opening shot in the rational expectation revolution was Robert Lucas's (1976) famous critique of econometric policy models that was presented in 1973. Rather, he said that there is no such thing as a consumption function. There is a structural relation between permanent income and consumption, but the consumption function asserts a structural relation between observed income and permanent income, and there is no reason to expect a stable relation of that type changes elsewhere in the economy.

The view of consumption that followed from the Lucas's work is that today's level of consumption is the level chosen by consumers to maximize expected life-utility, given all available information about current and future income and prices. By putting it into the model form, we get: $C_t = f(Y_t, Y_{t-1}, CPI_t, CPI_{t-1})$; by using also the expected signs the model is written as follows: $C_t = \beta_0 + \beta_0 Y_t + \beta_0 Y_{t-1} - \beta_0 CPI_t - \beta_0 CPI_{t-1} + \varepsilon_t$. (Hall, 1990b:127-141).

Referring to the following site, http://economicsexposed.com (Accessed 18 June 2013), the consumption function can be summarized as follows:

> ➢ **Level of Real Income**: This is the basic factor which determines the consumption.

> ➢ **Price**: the price is negatively related to the consumption; when it has increased the purchasing power of the consumers decreases and vice versa.

> ➢ **Interest rate**: this factor is negatively correlated with the

consumption level. Meaning that a change in the interest rate exercises influence on the propensity to consume.

By modeling, the consumption function becomes: $C_t = f(Y_t, CPI_t, r_t)$ or

$$C_t = \beta_0 + \beta_1 Y_t - \beta_1 CPI_t - \beta_2 r_t + \varepsilon_t.$$

Methodology

According to Bailey (1978:26), Methodology means the philosophy of research process. This includes the assumptions and values that server as rational for research and standards of criteria that the researcher uses for data interpretation and drawing conclusion.

For dissecting the analysis of those macroeconomic variables, where consumption has been considered as the dependent variable, while the revenue, CPI and interest rate have been taken as the independent ones, the different methods have been used.

The different approaches have been used through this study: Documentary technique (Books, Papers, Articles, sites etc), Statistical analysis, and Econometric approach.

For analyzing those macroeconomic variables, the Econometric package has been used. Basing on the econometric analysis the model specification, test of stationarity, cointegration tests, error correction model, the estimation procedure, etc, the hypotheses has been built on it.

Model Specification

The model is $C_t = f(Y_t, CPI_t, r_t)$, then $C_t = \beta_0 + \beta_1 Y_t - \beta_1 CPI_t - \beta_2 r_t + \varepsilon_t.$

Where: C_t: Consumption at time t.; Y_t: Revenue at time t; CPI_t: Consumer Price Index at time t; r_t: Interest rate at time t, and ε_t: Error term.

The method or model, adopted for measuring the elasticity in the way of expressing the effect of one variable (independent) on the dependent one is called the log- linear or constant elasticity model. It becomes log-linear because of linearity in the logs of the variables. (Gujarati,1999: 240-243).

Hence the log-linear model used is:

$$LnC_t = \beta_0 + \beta_1 lnYt - \beta_2 lnCPIt - \beta_3 lnrt + \varepsilon_t.$$
Where ln is natural logarithm.

The below test has been adopted because of the problem of spurious that almost the data collected over the period of time (time series) have.

Tests of stationarity

The Econometricians have proposed several tests that can be used in testing the problem of stationarity, but for this current paper only the Unit root test in which the Augmented Dicky-Fuller test is included, has been used.

- *T he Augmented Dickey-Fuller (ADF) Test*

Sometimes the error term μ_t is uncorrelated, but in the case the μ_t are correlated, Dickey and Fuller have developed a test, known as the **augmented Dickey-Fuller test.** This test takes care of higher- order correlation in the way of conducting it, by "augmenting", by adding the test the lagged values of the dependent variable ΔY_t to the right side of the regression. The procedure is shown below:

$\Delta Y_t = \beta_1 + \beta_{2t} + \Delta Y_{t-1} + \Sigma \alpha i \Delta Y_{t-i} + \mu$

Or $\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \varepsilon_t$;

Where ε_t is a pure white noise error term and where $\Delta Y_{t-1} = (\Delta Y_{t-1} - \Delta Y_{t-2})$, $\Delta Y_{t-2} = (\Delta Y_{t-2} - \Delta Y_{t-3})$, etc; while $\beta 1, \beta 2$, and δ are the parameters for being estimated. (Gujarati, 2004a: 817).

Y represents each variable for which a unit root test is conducted in this research namely C_t, Y_t, CPI_t, and finally r_t.

Decision for acceptance or rejection

The following hypotheses were tested by using the ADF test:

Null hypothesis, $H_{0:}$ $\mu=0$ that a series, Y_t, has a unit root. That is a series is non-stationary.

Alternative hypothesis, $H_{1:}$ $\mu \neq 0$ that a series has not a unit roots. That is, a series is stationary.

For testing the stationarity, if the value of the ADF statistic is less than the value of the significance level, here is 5%, we accept H1, and failing to accept H0. This has been used on the t values. On the other hand, if the probability value is less than the value of the probability of 5%, the stationarity is confirmed, meaning that we accept H1, and rejecting H0.

Once the stationary tests are carried out they lead us to the cointegration tests.

- *Transforming non-stationary time series*

The Econometrician Gujarati, (2004b:820-822), has proposed how the non-stationary

time series can be transformed into stationary for avoiding the problem of spurious regression. Two processes have been used: the Difference- Stationary Process and Trend-Stationary Process.

  ✓   ***Di fference-Stationary Process***

If a time series has a unit root, the first differences of such time series are stationary. Most economic time series are generally I(1).

  ✓   ***Tr end-Stationary Process***

This process has been conducted, the OLS has been applied for estimating the model; and this confirms the cointegration theory, and after ECM has been used for verifying the equilibrium in the short run. (Gujarati, 2004c:824-825).

Generally, the formula looks like: **$\Delta Y_t = \beta_1 + \beta_2 \Delta X_t + \beta_3 \upsilon_{t-1} + \mathcal{E}_t$**

Then   for   the   current   model:
$$D(lnCt) = \beta 0 + \beta 1 D(lnYt) + \beta 2 D(lnCPIt) + \beta 3 D(lnIrt) + R(-1) + \mu t$$

A part from those tests that have been used, there are also the other tests that have been used also, such as: T-test, R^2 and F-test.

Source of data

For this econometric empirical research, the data used are collected from different institutions such as: National Institute of Statistics in Rwanda (NISR), Banque Nationale du Rwanda (BNR), World Bank (WB), and International Monetary Fund's (IMF) websites.

Results and Discussion

The econometrics serves as the tool of explaining the identified data in economic language. It helps the economists who refer to it in their research, to confirm or to reject the different hypothesis basing on the model they have constructed. The yard-stick for the measurements effects of the explanatory variables have on the explained one is clearly shown. The regression of the model and the hypothesis testing are conducted at critical value of 5%.

Tests of Stationarity

In nutshell, all variables tested are non-stationaries at levels, I(0), then transforming

the non-stationary to stationary time series and then after the OLS have be used.

Transforming non-stationary time series

After transforming the lnct becomes stationary at first difference, Dlnct is stationary at I~(1). The value of t calculated is less than the one of t table, -0.8630938 < -0.3568379; its probability is less than 0.05, and the value of d is greater than the one of R^2, 2.131302 > 0.73.

The lnyt has become stationary after transforming it, Dlnyt is stationary at I~(1), t statistic is less compared to the t from the table, -8.545615< -3.568379; and also the d> R^2, 2.178411> 0.730131.

The lncpit has become stationary, Dlncpit is integrated at order one, Dlncpit at I~(1). The value of t calculated is -0.7.597378 which is less than the one of the table -3.568379; and again the value of Durbin Watson, 2.105591, is greater than the one of the R^2, 0.681815.

The lnirt became integrated on the order one, Dlnirt at I~(1). The followed data have confirmed that conclusion; t calculated, -4.97163 is less than the value of t from the table which is -3.612199; the R^2 is less than d, 0.915365 < 2.184918.

Finally for being assured with the long run relationship of those macroeconomic variables, the residuals have been tested and have been found that are stationary at level, u_t~I(0). Its value of t calculated is less than the value of the t from the table, -5.959901< -1.952910, and the probability is less than 5%. Meaning that are corrected along time, turning around to zero straight linear of zero.

The model estimation

After transforming the non-stationary time series data, those data that have become stationary are going to be used for the way of plotting a given estimation of our model. The estimation run helped to test the hypotheses for the deep analysis between consumption and revenue.

After transforming the model became: **DlnCt = β$_0$ + β1DlnY$_t$ − β2DlnCPIt − β3Dlnrt + ε$_t$.** This is the model that has been regressed, and the estimation is here below:

DLNCT= 0.0064+0.98DLNYT-0.025DLNCPIT+0.0007DLNIRT

Please note that our model is: **DlnCt = β$_0$ + β1DlnY$_t$ − β2DlnCPIt −β3Dlnrt + ε$_t$,** after transformation.

The following table summarizes the values of lags, levels and differences found in the previous tests.

Table 1: Summary of the values

Variables	Laglength	Model	Level		First Difference		Conclusion
			ADF t-Stat	CV at 5%	ADF t-Stat	CV at 5%	
DlnCt	0	Trend and Intercept			-8.630938	-3.568379	DlnCt is stationary at first difference. DlnCtis I(1)
DlnYt	0	Trend and Intercept			-8.545615	-3.568379	DlnYt is stationary at first difference. DlnYtis I(1)
DlnCPIt	0	Trend and Intercept			-7.597378	-3.568379	DlnCPIt is stationary at first difference. DlnCPItis I(1)
DlnIrt	6	Trend and Intercept			-4.979163	-3.612199	DlnIrt is stationary at first difference. DlnIrtis I(1)
R(-1)	0	None	-5.959901	-1.952910			R(-1) is stationary at level. R(-1) is I(0)

Error Correction Model

As has been appointed out previously the Error Correction Model is used for finding out the short run relation between the variables, because having the long run relationship does not mean that there is the automatically equilibrium in the short run; so, it is applied for knowing if there is the reaction of the dependent variable to the independent ones when the shocks are around.

The model is: $D(lnCt) = \beta 0 + \beta 1 D(lnYt) + \beta 2 D(lnCPIt) + \beta 3 D(lnIrt) + R(-1) + \mu t$

$$D(lnCt) = 0.006 + 0.98 D(lnYt) - 0.01 D(lnCPIt) + 0.001 D(lnIrt) + 10 R(-1)$$

The main thing that is interesting in the result found above, is the coefficient of the R(-1). Theoretically its sign must be negative for meaning that as long as time is concerned the errors, deviations, will be corrected. Then, the coefficient of R(-1) is 10, even though its probability is significant but the coefficient could be negative for having the economic sense. As conclusion, the R (-1) does not provide the information in ECR.

Discussion of the results

The interpretation of the regressed model focuses on the long run relationship between the consumption and revenue, as our research topic is the "Analysis of consumption and revenue in Rwanda: 1980-2012", but this does not mean that the other variables included in the model have been ignored; no they have been also explained.

Referring to the measure of goodness of fit of the fitted sample regression line; meanwhile giving the proportion or percentage of the total variation in the dependent variable Ct explained by the explanatory variables. The R^2 is equal to 0.98 or 98%; expressing that all variables are linked.

The revenue, disposable income, is highly linked to the consumption according to the data used in Rwanda. Basing on its coefficient which is equal to 0.98 or 98%, it is obvious that the influence is unavoidable. Please remember that the research deals with the log-log model, meaning that the coefficient takes the place of elasticity. The probability is equal to 0.0000 less than the probability of the critical value, level of significance, 0.05, normally that information given by IMF, theory of different authors such as: Barro 1994 is true at 95%. Even though the MPC is less than one $0.98 < 1$, but that rate does not match with the real situation of Rwandan economy, because the national saving is greater than 2%.

Referring to the coefficient of the CPIt found, is -0.025 or -2.5%. As we have said this is the slope of the elasticity, meaning that when the price increases at one unit the quantity consumed decreases to 0.025, expressing negative relationship between consumption and CPI. Even though its probability is not statistically significant, because is greater than the one of the level of significance, $0.1493 > 0.05$, but basing on the theory its coefficient makes economic sense. When the price increases the purchasing power of the people decreases,

this agrees with the Keynesian psychological law; but has not affected highly the whole consumption because the revenue has greatly increased as has seen in the data collected on the website of IMF that there was the increase of price from 1980-2012.

The last variable that has been included in the model is the interest rate, lending one. Its coefficient, slope of elasticity, because of the introduction of the ln, is 0.00075 or 0.75%. This variable could have negative impact on the consumption in Rwanda, but it is not the case, why? When the interest rate is low on the level of the commercial banks, the people will come and borrow money from the banks; this leads to the increase in consumption, investment, etc. but here is not the case even though its probability also does not provide the economic meaning.

Finally on the behalf of the consumption, there is what is called autonomous consumption, meaning the amount of consumption even all variables were not there. This is equal to 0.006 or 0.06%. It expresses that all explanatory variables cannot be there but there is a certain amount of consumption that will be consumed, this matches with the theory and its probability is true, because is equal to the one the

critical value, 0.05=0.05. The principle of ceteris paribus has been used while the interpreting of the effects of the one explicative variable to the consumption is concerned.

Conclusion and Recommendations

✓ *General Conclusion*

The study shows that there is a high correlation between consumption and revenue in Rwandan economy. The income influences consumption at the rate of 98%, meaning that among the all variables used, the income is the best explicative variable on the consumption in Rwanda for the periodic of 1980-2012. The Rwandans do not consume only, because referring to MINECOFIN, NISR, and BNR data the national saving is estimated at more than 2%, the indicators of human development Index are very clear in Rwanda. In nutshell, there is a significant correlation between consumption and revenue in Rwandan economy, which means if the revenue increases, the economy will be stable due to the increase of the consumption, resulted from the increase of revenue, and the stability of other macroeconomic variables; expressing that the H1 has accepted and the researcher fails to accept Ho. Meaning that

alternative hypothesis has been verified, and also the objectives set in this present research were achieved, because the correlation between consumption and revenue in Rwandan economy, has been examined; the rate at which those macroeconomic variables do influence the consumption has been carried out, and finally that rate showed their importance on the stability of the economy.

Even though, those above elements have been shown, but there are also some challenges met in this present research paper:

- The increase of the interest rate has not discouraged the people to consume less;
- The Rwandan economy still meets with the fluctuations.

✓ *Recommendations*

The developing country, Rwanda, aspires to have the sustained economy and also the increase of the welfare of its population. Referring to this research for achieving those aims, the following recommendations are suggested to the policymakers:

❖ In order to sustain the policies that contribute to the development of the economy, the expansionary fiscal policy for increasing the purchasing power should be consistent;

❖ The government should intervene in the way of setting the prices, in the agricultural sector, for stabilizing the economy;

❖ The monetary policy through the central bank should be reinforced, for avoiding the commercial banks setting the high lending interest rate, because it discourages the consumption, and as a result the decline of the economy;

Further researchers should access on: The impact of Fiscal multiplier on Rwandan economy.

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