Relationship Between Disposable Income and Consumption Expenditure

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October 8, 2016

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Module: ECN1007 - Principles of Economics B

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1479 words

1 Introduction

Both variables provided play a key role in the Keynesian income-expenditure model. Disposable income is equal to the value of "aggregate income minus taxes plus transfer payments."[Parkin et al., 2016] This means it closely depends on the real GDP. A proportion of disposable income is spent by the households on consumption, while the remainder forms savings.

Ceteris paribus, the relationship between consumption expenditure and disposable income is a consumption function [Parkin et al., 2016], which is a linear function with an intercept $C(Y^D = 0) > 0$ and a slope $1 > \frac{dC}{dY^D} > 0$. It consist consists of an autonomous and induced portion.

The consumption function equilibrium occurs at its intersection with an equilibrium condition defined as $E: \ C = Y^D$. The difference between the consumption function and its equilibrium condition is referred to as savings, given that $Y^D > Y_E^D$, or dissaving in the opposite case. Disposable income is sum of consumption expenditure and total savings. The slope of the consumption function is called marginal propensity to consume and indicates proportion of each additional unit of money, which is used for consumption

2 Method

Approximating a consumption function based on a real-world data firstly requires a reliable and consistent source. It is preferred that the range of data points covers shorter periods of time, as in the long-run, the consumption function tends to shift depending of the Real GDP growth of the analyzed economy [Parkin et al., 2016]. However, it is also essential that the sample size is adequate for accurate analysis [Koop et al., 2000], i.e. the frequency over the period is high enough.

After this simple assessment of the dataset, other descriptive statistics should be asessed and compared, in odrer to determine expectations for results of further analysis. The time series and growth rates for both variables will be represented graphically for additional insight into whether the variables react to each other over time.

Then, based on the assumptions established in previous sections, the data will be plotted on a scatter chart, showing disposable income on x-axis and consumption on y-axis. Method of ordinary least squares will be used in order to determine the formula for the line of best fit in form of $Y = \hat{\alpha} + \hat{\beta}X$ [Koop et al., 2000]. In this equation, Y is the predicted variable, i.e. consumption expenditure, $\hat{\alpha}$ represents expected autonomous consumption, and $\hat{\beta}$ is the elasticity of predicted variable towards X, i.e. marginal propensity to consume. Based on this, the relationship can be rewritten as $C = \hat{a} + \hat{m}Y_D$.

In order to verify how closely the predicted relationship describes the real situation, analysis of residuals is conducted and simple regression used for hypothesis testing. Main focus will be oriented on the confidence intervals of $\hat{\beta}$, in order to determine the maximal level of confidence, with which the presence of close statistical relationship between consumption expenditure and disposable income can be confirmed.

3 Results

The provided dataset consists of two time-series, one expressing the real final consumption, and one expressing real household disposable income with one period lag.

3.1 Question A

Descriptive statistics displayed in table 1 provide basic information on each of given variable and its growth rate.

There are 51 values for both consumption expenditure and disposable income, which corresponds to quarterly reports over the period between 2003 Q2 and 2015 Q4. Both exibith with value of median above the mean, which leads to negative values of skewness. This indicates that indicating that values above the mean were experienced for a longer part of the analyzed period than values below mean for both income and consumption expenditure.

However, in order to examine potential presence of relationship between the two variables, it is more useful to analyze the growth rates, which reveal more about the changes in the two variables.

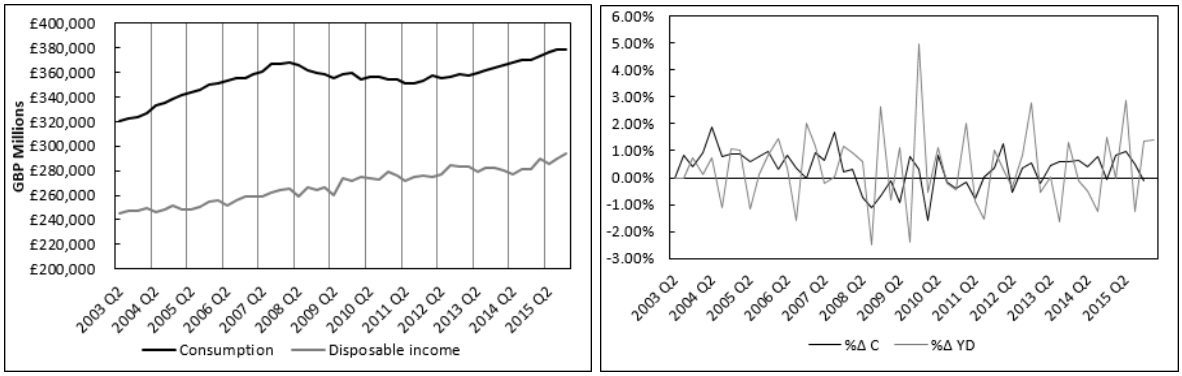
Because the growth rate is represented as percentage difference of value for one period relative to the the previous, i.e. $\%\Delta x = \frac{x_1 - x_0}{x_0}$, there are only 50 observations. as data for growth rate in 2003Q2 is not available. the fact that growth rates for both variables present with positive mean value suggests that over time, the original variable increased over time. Standard deviation and the range of the growth rates suggest that disposable income is more volatile compared to consumption expenditure, which can be also observed in figure 1b.

	CGBP M	$\%\Delta C$	Y^D GBP M	$\%\Delta Y^D$
Mean	355381.9049	0.003390674	267692.5644	0.003710864
Median	356853.3475	0.004284033	271846.6661	0.003261651
Std Deviation	13615.52627	0.006870742	13732.39411	0.014220529
Variance	185382555.5	4.72071E-05	188578648	0.000202223
Kurtosis	0.782	0.589554	-1.223976078	1.190702246
Skewness	-0.845	-0.535790129	-0.101359163	0.501111312
Range	58944.101	0.034696262	48429.60201	0.074622001
Minimum	320003.876	-0.015717905	245114.6135	-0.024787447
Maximum	378947.977	0.018978357	293544.2155	0.049834555
Count	51	50	51	50

Table 1: Key descriptive statistics

As seen in figure 1, both variables increase over time, however disposable income presents with higher volatility. On the other hand, Between 2007Q3 and 2011Q2, there

is a downward trend in the consumption expenditure, which may be explained by the financial crisis of 2008. However, the disposable income does only seem to react to this condition by increase in volatility, rather than change in short-term trend.



(a) Consumption and disposable income (b) Growth rates

Figure 1: Line charts for variables and their growth rates

3.2 Question B

The figure 2 shows disposable income on the x-axis and consumption expenditure on the y-axis. Based on observation of the positions of individual data points and clusters they form, it can be established that with an increase in disposable income, the lowest observed value of consumption increases. The correlation of these two variables is equal to 0.767, which suggests presence of a strong positive relationship between the two variables.

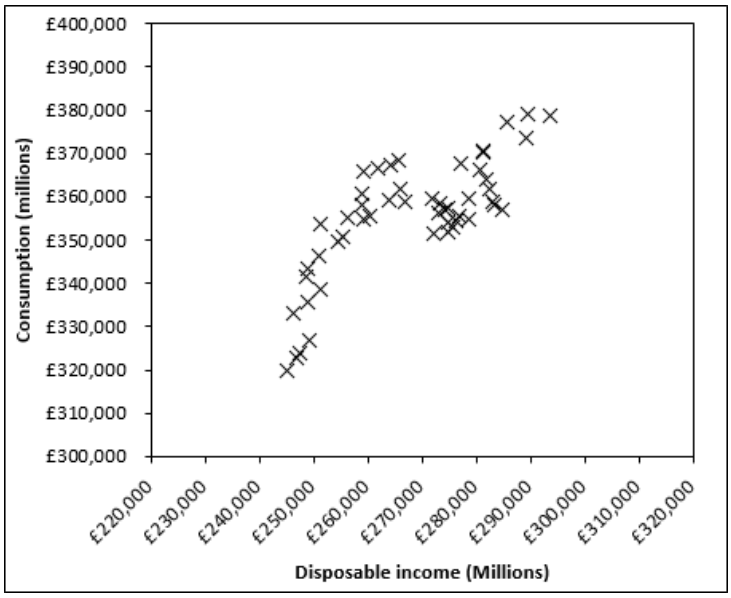


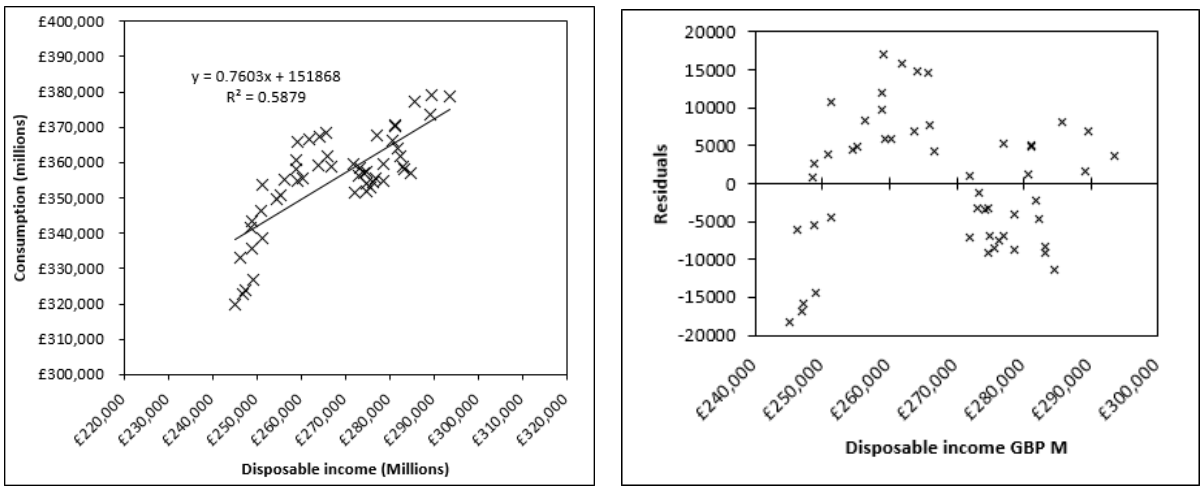
Figure 2: Scatterplot

3.3 Question C

In order to analyze this relationship more closely, focusing on its linear characteristics, simple regression is ran, line of best fit determined and residuals observed. Firstly, the output of regression presents value of 151867.8 as an intercept and 0.76025. Shown in figure 3a, the line of best fit is representing the output of the regression analysis in a form of curve, where intercept $\hat{\alpha}$ is a value for $X = 0$, and the coefficient β determines the slope. The mathematical formula for the line of best fit therefore is $Y = 151868 + 0.7603X$

Relating this to the theory of consumption function, it can be rewritten using the original variables as $C = 151868 + 0.7603 \times Y^D$. This suggests that C for $Y^D = 0$, which is refered to as autonomous consumption, for the economy is equal to the statistically determined intercept coefficient $\hat{\alpha}$, i.e. GBP 151,867,800,000. The induced consumption will then be equal to $0.7603 \times Y^D$, meaning that every additional unit of disposable income induces an increase of roughly 76 pence in consumption expenditure. This coefficient is also referred to as marginal propensity to consume by [Parkin et al., 2016], for which reason it can be established that$MPC = \frac{\Delta C}{\Delta Y^D} = \frac{0.7603}{1} = 0.7603 = \hat{\beta}$.

In order to further analyze, whether there may be any closer non-linear relationship betwen the two variables, the residuals are plotted in figure 3b. It can be seen that there does not seem to be any general rule to the relationship between disposable income and residuals. Although they present with negative values for lower Y^D and then they increase, this relationship is interrupted around the disposable income of GBP 270 billion. kredenc For this reason, it can be established that there does not seem to be any non-linear relationship.



(a) Line of best fit (b) Residuals

Figure 3: Line of best fit and the residuals

3.4 Question D

However, in order to confirm that the relationship discovered in section 3.3 is valid and therefore supports the theory of consumption function, confidence intervals for the determined coefficients have to be calculated.

For confirmation of presence of significant statistical relationship it is important to reject hypothesis $H_0 : \hat{\beta} = 0$ with a decent level of confidence, as it would indicate that there may be no relationship at all. The regression output for 95% confidence level shows that $\hat{\beta} \in < 0.578,\ 0.943 >$, which means that $\hat{\beta} \neq 0$ with 95% confidence. Increasing confidence level to 99% proves that $\hat{\beta} \in < 0.517,\ 1.004 >$ confirming that even at this level, H_0 can be rejected. In fact, the lowest confidence interval to confirm H_0 is equal to $1 - Pvalue = 99.999999995\%$. Therefore, the presence of significant statistical relationship between the two variables is confirmed.

4 Discussion

The statistical analysis conducted in section 3 has proven presence of close statistical relationship between the consumption expenditure and disposable income. Linear formula of the consumption function based on this dataset has been approximated as $C = 151868 + 0.7603 \times Y^D$. The marginal propensity to consume was estimated to be between 0.58 and 0.94 with 95% confidence, with the best-fit value of 0.76. Although the confidence interval is relatively wide, the regression analysis has proven the validity of this relationship and hence the theory.

On the other hand, relating to the equilibrium condition outlined in Section 1, the data seems to indicate that the UK has experienced dissaving over the analyzed period, which does seems inconsistent in relation to examples given in literature, for which reason the sources and collection methods of the data may need revision.

5 Conclusion

In conclusion, this report has conducted an analysis of data on real household disposable income and consumption expenditure over the period between 2003Q2 and 2015Q4. It has proven existence of relationship between the two variables and related it to the macroeconomic concept of consumption function.

References

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M. Parkin, M. Powell, and K. Matthews. *Economics: European Edition, 9th Edition*. Pearson Higher Education, 2016.