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CONSUMER DEBT AND THE DIFFERENT PREDICTORS THAT AFFECTS ITS GROWTH: A NORMAL EQUATION FOR MULTIPLE REGRESSION ANALYSIS

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Abstract: *This study involves the econometric modeling to determine the factors affecting the growth of consumer credit in the Philippines such as exchange rates, gross domestic product per Capita and unemployment rates in the year 1983 to 2013. The data collected and used came from statistical agencies, World Bank website and www.indexmundi.com. Regression analysis are used to determine the result of the study. The researcher used MATLAB to estimate the parameter or coefficient and verify the significant linear association through Eviews. The final model for the consumer loan is . Through this result, the researcher has a sufficient evidence to recommend that the government may allot attention to attention to monitor the Exchange rate, Unemplyment rate, Gross Domestic Product per Capita, Interest Rate, and Inflaton Rate.*

Keywords: *consumer debt, exchange rate, unemployment rate, gross domestic product per capita, interest rate, inflation rate normal equation, regression, correlation, normality test, goodness-of-fit test, autocorrelation, structural stability, multicollinearity, eviews, matlab*

1. INTRODUCTION

In economics, consumer debt is outstanding debt of consumers as opposed to that of businesses or government. In macroeconomic terms, it is debt which is used to fund consumption rather than investment. It includes debts incurred on purchase of goods that are consumable and/or do not appreciate.

It also refers to the debt one experiences to purchase goods or services through credit card, payday loans, and other consumer finance (Investopedia, 2015; Phyoe, 2015). This constitutes a loan to the consumer for a short period of time, for the purchase of specific commodity.

Credit and debt are key issues for consumers around the world. Through credit, the consumers can help to absorb the cost of luxurious item over time. Nevertheless, if consumer do not have ability to pay his or her debt such as miscalculation in the affordability of the loan, or due to change circumstances, then levels of debt can

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become unsustainable. This causes anxiety and ultimately hardship as debt repayments usurp funds needed to purchase essentials and possessions are sold at reduced prices, or seized, to repay debts (Jami Hubbard-Solli, 2013; Tangpornpaiboon, S., & Puttanapong, 2016).

There are various classifications of Consumer Credit: (1) installment credit which involves credit that is repaid by the borrower in several periodic payments. This as expanded inpopularity with an increasing number of consumers buying goods on credit in order to spread repayment of the purchase price and the interest owed on the principal borrowed over an extended time; and (2) non-installment credit are loans repaid in one lump sum.These loan is usually encouraged by strong demand for goods and services which is not met or satisfied by the consumer's personal income. Because of this, they look for extra money to support and meet their demands in the form of loans.

Both consumers and providers have responsibilities in relation to credit and debt. The consumer has to make a proper assessment of their ability to repay the loan, and must provide accurate information to the provider so that it can assess the suitability of the loan. Consumers also need to be clear that they have entered a contract that they should honour. Nevertheless, the provider also has serious responsibilities. Part of the responsibility of the provider is summed up as policies and practices adopted by lenders that seek to ensure a borrower can repay a loan without suffering hardship. It is also include the assessment of a borrower's ability to repay the loan, nonetheless must also include transparent and fair fees, charges and contract terms, responsible marketing practices, and managing client relations with respect for consumer rights, including having systems in place to assist debtors in difficulty.

Internationally, there is numerous concentration in the topic of responsible lending. At the request of the G20, the Financial Stability Board produced a report "Consumer finance protection with particular focus on credit" which includes the results of a survey of its membership on regulatory approaches to consumer credit. FinCoNet, the international network for financial consumer protection, has also included responsible lending in its work plan for 2013/2014. A number of other international initiatives that look more broadly at financial consumer protection also include recommendations highly relevant to credit. These include the G20 High Level Principles on Financial Consumer Protection (2011), the World Bank Good Practices for Financial Consumer Protection (2012) and initiatives such as the Smart Campaign Client Protection Principles.

There are literatures and studies that argue more about the consumer loan for us to understand its concepts and the factors affecting it. Cecchetti, Mohanty and Zampolli (2011) mentioned that borrowing allows individuals to smooth their consumption in the face of a variable income. It allows corporations to smooth

investment and production in the face of variable sales. It allows governments to smooth taxes in the face of variable expenditures. And it improves the efficiency of capital allocation across its various possible uses in the economy. At least in principle, it should also shift risk to those most able to bear it.

Furthermore, the type of consumer credit also varies, some are for personal loans and some are for productive business loans. A personal loan is driven by improvidence or misfortune, to offset fluctuations and outgo and to anticipate improvement to financial conditions. Productive business loans can be short or periodic loans and long or permanent loan. Moreover, according to Smith, consumer credit institutions lend billions of dollars each year, much of it to people they have never seen before, yet their losses often seen before and their losses often seem surprisingly low. It is not clear whether this favorable experience reflects the efficiency of their screening systems of the honesty and dependability of the public.

This study shows the factors affecting the consumer credit especially in the Philippines and its behaviour as well. This will also look into the best model in order to determine whether Exchange Rate, Unemployment Rate and Gross Domestic Product per Capita have a siginificant linear association with the Consumer Credit. One of the methodologies used to determine whether there is a significant relationship between the selected explanatory variables is regression analysis such as the ordinary least squares (OLS) regression and other tests assumptions.

2. METHODOLOGY

Ordinary Least Squares (OLS)

In statistics, ordinary least squares (OLS) or linear least squares is a method for estimating the unknown parameters in a linear regression model, with the goal of minimizing the differences between the observed responses in some arbitrary dataset and the responses predicted by the linear approximation of the data. The resulting estimator can be expressed by a simple formula, especially in the case of a single regressor on the right-hand side. It is a statistical technique which attempts to find the function which most closely approximates the data (a "best fit"). For the case of k independent variables $X_1, X_2, \ldots, X_k$ the mean of response variable $Y \mid x_1, x_2, \ldots, x_k$ is given by the multiple linear regression model

$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + \varepsilon$$

where: X_i = non – income variables, $i = 1, 2, 3, .., k$

$\beta_j = regression\ coefficient\ of\ regression.$ $\quad j = 1,2,3,..,k$

$\varepsilon = error\ term\ or\ residual$

and the estimated response is obtained from the sample regression equation

$$\hat{y} = b_0 + b_1 x_1 + \cdots + b_k x_k$$

where each regression coefficient β_j is estimated by b_j from the sample data using the method of least squares.

The researchers used a combination in backward stepwise methods for OLS to identify significant indicator that can determine the model for the consumer loan of the Philippines. If the least-significant term is not significant remove it and re-estimate, otherwise, stop.

2.1. Research Design

This paper will employ both descriptive and statistical method in analysis. This refers to the theories, data, statement, concepts, arguments and ideas, analysis or synthesis of published statement, conflict or ideas. It describes the nature of the situation as it existed at the time the study is conducted and discovers the causes of particular phenomena. Statistical method will establish the relationship of the parameters under study.

2.2. Data Gathering Procedure

This paper used secondary data gathered from different statistical agencies. The researchers are able to access an international institution that provides financial aid and technical assistance to the developing countries all over the world; this is popularly known as World Bank with the aid of their website. World Bank provides a databank of different indicators by countries across the world. The data about Gross Domestic Product per Capita were gathered from the economic indicator section. The data of Consumer loan, Exchange rate came from the Bangko Sentral ng Pilipinas (BSP). While the data of unemployment rate came from website of *www.indexmundi.com/philippines/unemployment_rate.html.* Through the research documents from the different government institutions, it will provide principal knowledge to answer the research problem and to the readers to consciously and well-informed about the topic.

In order to see whether the independent variables has its significant linear association with the dependent variable, the trends were observed and the data were analyzed through the use of E-views which is a statistical software used in forecasting, data analysis and regression which can substantiate statistical relation from the data and use it to forecast future values of the data.

2.3. Statistical Treatment

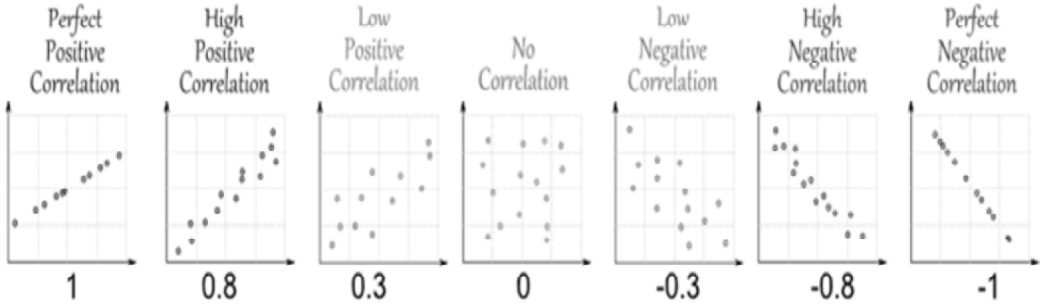
2.3.1 Measure of Correlation

Correlation refers to any of a broad class of statistical relationships involving dependence. Correlation coefficient is the measurement of correlation. It indicates how well the two set of data are interconnected.

Table 1
Philippine Consumer Loan and Factors from 1983 to 2013

	CL in billion	*GDP*	*LR*	*IR*	*ER*	*REMIT in Billion*	*UR*	*Money Supply in billions*	*Interates*
1983	5.168	706.83	19.2	5.252	14.002	944,450	10.25	0.1142110	4.39
1984	4.773	652.28	28.2	46.673	19.76	658,890	10.654	0.1224320	-16.4
1985	3.022	622.87	28.6	23.215	19.032	693,704	11.058	0.1341400	9.33
1986	3.503	590.94	17.5	-0.325	20.53	695,660	11.682	0.1443250	14.16
1987	3.937	640.76	13.3	3.042	20.7985	808,810	11.062	0.1618240	5.43
1988	6.585	715.08	15.9	12.230	21.335	874,070	9.402	0.1984090	5.72
1989	6.305	784.88	19.3	11.367	24.6675	1,001,911	9.129	0.2539210	9.39
1990	7.09	796.27	24.1	13.201	28	1,203,009	8.4	0.3005410	9.87
1991	12.165	797.08	23.1	18.492	26.65	1,649,374	10.5	0.3470790	5.62
1992	15.925	911.42	19.5	8.947	25.096	2,221,788	9.8	0.3853850	10.7
1993	18.025	914.07	14.7	7.609	27.699	2,276,395	9.3	0.4803290	7.35
1994	36.573	1051.68	15.1	9.035	24.418	3,008,747	9.475	0.6076140	4.61
1995	37.082	1200.43	14.7	8.080	26.214	3,868,578	9.525	0.7614300	6.63
1996	37.590	1311.13	14.8	9.074	26.288	4,306,491	8.525	0.8814040	6.67
1997	32.163	1273.33	16.3	5.848	39.975	5,741,835	8.675	1.0660170	9.46
1998	122.918	960.71	16.8	9.703	39.059	7,367,989	10.05	1.1445520	-4.58
1999	108.809	1080.95	11.8	6.391	40.313	6,794,550	9.75	1.3650980	4.87
2000	175.2545	1055.12	10.9	3.968	49.998	6,050,450	11.175	1.4273970	4.92
2001	241.700	970.38	12.4	6.834	51.404	6,031,271	11.125	1.5250320	6.49
2002	257.579	1014.94	9.1	2.969	53.096	7,189,243	11.4	1.6696620	4.78
2003	266.087	1024.77	9.5	3.450	55.569	7,639,955	11.4	1.7249740	6.08
2004	283.747	1093.48	10.1	5.976	56.267	8,550,371	11.825	1.8837620	4.32
2005	309.446	1208.91	10.2	7.626	53.067	10,689,005	11.35	2.3390120	4.12
2006	343.178	1405.21	9.8	6.244	49.132	12,761,308	8	2.8695680	4.6
2007	402.611	1683.69	8.7	2.810	41.401	14,449,928	7.325	3.1743650	5.43
2008	325.906	1918.26	8.8	9.299	47.485	16,426,854	7.4	3.6684330	1.12
2009	249.200	1827.38	8.6	3.249	46.356	17,348,052	7.475	3.9739700	5.64
2010	284.537	2123.08	7.7	3.829	43.885	18,762,989	7.2	4.3968110	3.31
2011	351.002	2223.44	6.7	4.761	43.928	20,116,992	7.3	4.6742580	2.5
2012	392.074	2328.53	5.7	3.371	41.192	21,391,333	7.2	5.1716890	3.7
2013	448.196	2438.07	5.8	4.140	44.414	20,604,789	7.4	68.8077660	3.7

Legend: YR-year, CL- Consumer Loan, GDP- Gross Domestic Product, LR-Lending Rate, IR-Inflation Rate, ER-Exchanged Rate, REMIT-remittances, UR – Unemployment Rate and Interates-Interest Rates



Correlation can have a value:

- 1 is a perfect positive correlation
- 0 is no correlation (the values don't seem linked at all)
- -1 is a perfect negative correlation

The coefficient will be used to determine if there exists a strong relationship among the Consumer Loan, Exchange Rate (US$ to PHP), GDP per Capita, Unemployment rate.

The researchers used the Pearson Correlation which is the most common of all measures of correlation. Pearson correlation coefficient for sample data is denoted by "r". The formula for Pearson correlation coefficient r is given by:

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2]\,[n\Sigma y^2 - (\Sigma y)^2]}}$$

Where:

r = Pearson correlation of coefficient

x = Values in first set of data

y = Values in second set of data

n = Total number of values

Ho: there is no significant relationship between the variable

2.3.2. Histogram : Normality Test

The test results indicate whether you should reject or fail to reject the null hypothesis that the data come from a normally distributed population. You can do a normality test and produce a normal probability plot in the same analysis. The normality test and probability plot are usually the best tools for judging normality, especially for smaller samples.

2.3.3. Jarque-Bera

The Jarque–Bera test is a goodness-of-fit test of whether sample data have the skewness and kurtosis matching a normal distribution. The test is named after Carlos Jarque and Anil K. Bera. The test statistic *JB* is defined as

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}(K-3)^2\right)$$

Ho: The residual distribution is normally distributed

Where n is the number of observations (or degrees of freedom in general);

S is the sample skewness,

K is the sample kurtosis:

$$K = \frac{\hat{\mu}_4}{\hat{\sigma}^4} = \frac{\frac{1}{n}\Sigma_{i=1}^{n}(x_i - \overline{x})^4}{\left(\frac{1}{n}\Sigma_{i=1}^{n}(x_i - \overline{x})^2\right)^2}, \; S = \frac{\hat{\mu}_3}{\hat{\sigma}^3} = \frac{\frac{1}{n}\Sigma_{i=1}^{n}(x_i - \overline{x})^3}{\left(\frac{1}{n}\Sigma_{i=1}^{n}(x_i - \overline{x})^2\right)^{3/2}},$$

where : μ^3 and $\hat{\mu}_4$ are the estimates of third and fourth central moments, respectively,

$\overline{x}$ is the sample mean,

$\hat{\sigma}^2$ is the estimate of the second central moment, the variance.

2.3.4. Test of Goodness of Fit

The goodness of fit of a statistical model describes how well it fits a set of observations. Measures of goodness of fit typically summarize the discrepancy between observed values and the values expected under the model in question. Such measures can be used in statistical hypothesis testing, e.g. to test for normality of residuals, to test whether two samples are drawn from identical distributions (Kolmogorov–Smirnov test), or whether outcome frequencies follow a specified distribution (Pearson's chi-squared test). In the analysis of variance, one of the components into which the variance is partitioned may be a lack-of-fit sum of squares.

2.3.5. Test of Autocorrelation

Autocorrelation refers to the correlation of a time series with its own past and future values. Common statistic for testing for autocorrelation is the Durbin-Watson statistic.

The researchers made use of the Durbin-Watson statistic at a 5 percent level of significance for 31 observations and 3 independent variables. It was used to determine the autocorrelation in the simple linear regression model. The formula given as:

$$d = \frac{\Sigma_{t=2}^{t=n} (\hat{\mu}_t - \hat{\mu}_t - 1)^2}{\Sigma_{t=1}^{t=n} \hat{\mu}^2}$$

It can be shown that the value of d will be between zero and four; zero corresponding to perfect positive autocorrelation and four to perfect negative autocorrelation. If the expected value of d is 2, it corresponds that it is uncorrelated. If the computed d statistic is greater than the critical upper limit of d but less than the four minus the critical limit (i.e., $<d_u<d<4-d_u$) at 5 percent level of significance, then there is no significant evidence of positive or negative autocorrelation.

Ho: There is no autocorrelation between the dependent variable and the independent variables

2.3.6. Test for Structural Stability

A series of data can often contain a structural break, due to a change in policy or sudden shock to the economy. In order to test for a structural break, we often use the Chow test. The model in effect uses an F-test to determine whether a single regression is more efficient than two separate regressions involving splitting the data into two sub-samples.

The Chow test basically tests whether the single regression line or the two separate regression lines fit the data best. The stages in running the Chow test are:

1) First, run the regression using all the data, before and after the structural break, collect RSS
2) Run two separate regressions on the data before and after the structural break, collecting the RSS in both cases, giving RSS_1 and RSS_2.

Using these three values, calculate the test statistic from the following formula:

$$F \equiv \frac{RSS_c - (RSS_1 + RSS_2)/k}{RSS_1 + RSS_2 / n - 2k}$$

4) Find the critical values in the F-test tables, in this case it has F (k, n-2k) degrees of freedom.
5) Conclude, the null hypothesis is that there is no structural break.

Ho: The model has no structural break

2.3.7. Test of Multicollinearity

This study make used of Tolerance and variance inflation factor to diagnose multicollinearity. The variance inflation factor defined as:

$$VIF = \frac{1}{1 - r_{j^3}^2}$$

As R_j^2, the coefficient of determination in the regression in regressor X_j on the remaining regression model, increases toward unity, that is, as the collinearity of X_j with the other regressors increases, VIF also increases and in the limit it can be infinite.

The larger the value of VIF_j, the more "troublesome" or collinear the variable X_j, thus if VIF of a variable exceeds 10, which will happen if R_j^2 exceeds 0.90, that variable is said to be highly collinear.

The measure of tolerance was also be used to detect multicollinearity. It is formulated as:

$$TOL = \frac{1}{VIF} = (1 - R^2)$$

If TOL_j = 1, X_j is not collinear with the other regressors, whereas if it is zero, there is a greater evidence of collinearity of that variable to the other regressors (Gujarati, 2003).

Ho: There is no multicollinearity between the depndent variable and the independent variables

2.3.8. Test of Specific Error

To test if the model is correctly specified, Ramsey's RESET was applied. The formula given as:

$$F = \frac{(R_{new}^2 - R_{old}^2) / \text{number of new regressors}}{(1 - R_{new}^2) / (n - \text{number of parameters in the model})}$$

If the result that was obtained in the calculation of F-ratio is higher than the critical value at a specified level of significance, there existed a specification error. On the other hand, if the calculated F-ratio is smaller than the critical value, we concluded that there is no specification error in the model used. It also test whether the relationship between the dependent variable and the independent variables should be linear or whether a non-linear form would be more appropriate.

Ho: There is no misspecification in the model/ The true specification is linear.

2.3.9. Heteroskedasticity Test : White Test

White (1980) derived a heteroskedasticity consistent covariance matrix estimator which provides consistent estimates of the coefficient covariances in the presence of conditional heteroskedasticity of unknown form. Under the White specification we estimate using:

$$\hat{\Omega} = \frac{T}{T-k}\sum_{t=1}^{T} \hat{\in}_t^2 X_t X_t' / T$$

Where

$\hat{\in}_t$ are the estimated residuals,

T is the number of observations,

k is the number of regressors, and

$\frac{T}{T-k}$ is an optional degree-of-freedom correction.

The degree-of-freedom White heteroskedasticity consistent covariance matrix estimator is given by:

$$\hat{\Sigma}_W = \frac{T}{T-k}(X'X)^{-1}\left(\sum_{t=1}^{T} \hat{\in}_t^2 X_t X_t'\right)(X'X)^{-1}$$

Ho: The residual variance is not heteroscedastic

2.3.10. Measure of Regression

This study predicted the influence of, Exchange Rate (US$ to PHP), GDP per Capita, Unemployment rate on Consumer Loan from 1983 to 2013 making use of multiple linear regression model as follows:

$$\text{ConLoan} = \beta_0 + \beta_1 \text{ER} + \beta_2 \text{UR} + \beta_3 \text{GDPpC} + \beta_4 \text{INTERATES} + \beta_5 \text{IR} + \mu_i$$

Where:

ConLoan	= Total Consumer Loan
ER	= Exchange Rate (U.S. Dollar to Philippine Peso)
UR	= Unemployment Rate
GDPpC	= Gross Domestic Product per Capita

INTERATES	= Interest Rate
IR	= Inflation Rate
β_0	= Constant term
β_i	= Regression coefficients, i = 1, 2, 3, 4 & 5
μ_i	= error term

The above model has been modified to state the presence of the first order serial correlation. In order to get the results for the analysis and interpretation in verifying the answers to the given problems which are presented in the statement of the problem, the researchers employed the following statistical tests.

2.3.11. Test of the Individual Significance of the Regression

The make use of t-test to be able to test the significance of the parameter estimated. A one sample t-test allows to test whether a sample mean (of a normally distributed interval variable) significantly differs from a hypothesized value. The formula for *t* is given as:

$$t = \frac{\hat{\beta}_k - \beta_k}{Se(\beta_k)}$$

Where: $\hat{\beta}_k$ = estimator

β_k = parameter

Se(β_k) = estimated standard error of the estimator

If the p-value associated with the t-test is smaller than the alpha value (0.05 is often used as the significance), there is evidence that the mean is different from the hypothesized value or simply the parameters are statistically significant. If the p-value associated with the t-test is not smaller than the alpha value ($p > 0.05$), then the null hypothesis is not rejected and can conclude that the mean is not different from the hypothesized value otherwise the parameters are not statistically significant

If the value of the computed t statistic exceeds the critical value of the t distribution at 5 percent level of significance with n-k-1 degrees of freedom then the parameters are statistically significant.

Ho: There is no significant indiviual relationship between the dependent and independent variable

2.3.12 Test of Overall Significance of the Regression

While the t-test is used to determine if a single variable is statistically significant, the F-test is applied to define if a group of variables are jointly significant statistically including the whole regression model. The researchers test the overall significance of the regression by getting the ratio of the explained to the unexplained variables by means of the use of the F-statistics.

$$F = \frac{ESS/(n-1)}{RSS/n-k}$$

Where:

ESS = Explained sum of squares

RSS = Residual sum of squares

If the value of the F-statistics exceeds the official value of the distribution at 5 percent level of significance with k-1 and n-k degree of freedom, it can be inferred that not all of the regression coefficients are not equal to zero and thus the regression estimate is significant and the model is considered valid (Gujarati, 2003)

Ho: There is no significant relationship between the dependent variable and the independent variables.

2.3.13. Paired T-test

A paired sample t-test is used to determine whether there is a significant difference between the average values of the same measurement made under two different conditions. Both measurements are made on each unit in a sample, and the test is based on the paired differences between these two values. The usual null hypothesis is that the difference in the mean values is zero. It is calculated by the provided formula:

$$t = \frac{\overline{d}}{\sqrt{s^2/n}}$$

where $\overline{d}$ is the mean difference, s^2 is the sample variance, n is the sample size and t is a Student t quintiles with n-1 degrees of freedom.

2.3.14. Normal Estimation Equation using Matrices

In fitting a multiple linear regression model, knowledge of matrix theory can facilitate the mathematical manipulations considerably. Using matrix notation, the equation can be written as:

$$y = X\beta + c$$

$$y = \begin{bmatrix} y_0 \\ y_1 \\ \vdots \\ y_k \end{bmatrix}, \qquad X = \begin{bmatrix} 1 & x_{11} & x_{21} & \cdots & x_{k1} \\ 1 & x_{12} & x_{22} & \cdots & x_{k2} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ 1 & x_{xn} & x_{2n} & \cdots & x_{kn} \end{bmatrix}, \qquad \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_k \end{bmatrix}, \qquad \epsilon = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_n \end{bmatrix}$$

Then the least squares method for estimation of β involves finding for b for which $SSE = (y - Xb)'(y - Xb)$ is minimized. This minimization process involves solving for **b** in the equation $\frac{\partial}{\partial b}(SSE) = 0$. The result reduces to the solution of b in $(X'X)b = X\acute{y}$. By examining the nature of the X matrix, apart from the initial element, the ith row represents the x-values that give rise to the response y_i. The matrix is written as:

$$A = X'X = \begin{bmatrix} n & \sum_{i=1}^{n} x_{1i} & .. & \sum_{i=1}^{n} x_{2i} & \sum_{i=1}^{n} x_{ki} \\ \sum_{i=1}^{n} x_{1i} & \sum_{i=1}^{n} x_{1i}^2 & .. & \sum_{i=1}^{n} x_{1i}x_{2i} & \sum_{i=1}^{n} x_{1i}x_{ki} \\ \vdots & \vdots & .. & \vdots & \vdots \\ \sum_{i=1}^{n} x_{ki} & \sum_{i=1}^{n} x_{ki}x_{1i} & .. & \sum_{i=1}^{n} x_{ki}x_{2i} & \sum_{i=1}^{n} x_{ki}^2 \end{bmatrix}; g = X'y = \begin{bmatrix} g_0 \\ g_1 \\ \vdots \\ g_k \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{n} y_1 \\ \sum_{i=1}^{n} x_{1i}y_i \\ \vdots \\ \sum_{i=1}^{n} x_{ki}y_i \end{bmatrix}$$

Which allows the normal equations to be put in the matrix from

3. RESULTS AND DISCUSSIONS

The study examined the data collected for trends and differences between Exchange rate, Gross Domestic Product per Capita, and Unemployment rate. This chapter will also interpret the data for further statistical analysis regarding the effects of chosen predictors on Consumer Loan.

Figure 1 shows the trend of the total Consumer Loan in the Philippines from year 1983 to 2013. We can generally say that the total consumer loan in the Philippine increases over time. It constantly increases from 1983 to 1997. Then it makes a drastic increase from 1998 to 2007 with a small decrease in 1999. Then it falls dramatically between the year 2008 and 2009, probably because of the Global Financial Crisis. It then recovers from the crisis and continue its growth from 2010 to 2013.

Figure 2 shows the trend of the Exchange rate of U.S. Dollar to Philippine Peso from year 1983 to 2013. From the figure we can say that the Exchange of the two

currencies favors the U.S Dollar. The value of U.S. Dollar continues to increase from 1983 to1996 then it capitalize in the Asian financial crisis that happen in 1998 making it more valuable to the point that the exchange become 56.267 in 2004. After its peak on 2004 the value of U.S. Dollar decreases.

Figure 3 shows the trend of Goss Domestic Product per Capita in the Philippines from 1983 to 2013. We can generally say that the Goss Domestic Product per Capita in the Philippines continues to increase over time, with a little setback from the year 1996 to 2001. But we can say that it is good because it indicates that the economy of the country continues to improve.

Figure 4 shows the trend of Unemployment rate in the Philippines from 1983 to 2013. The graph shows that unemployment rate in the Philippines is unstable. It starts from 10.25 in 1983 then it continues to increase until 1986. Next it decreases to 8.4 on the year 1990. It then increases to 10.5 in the next year. It continue to decrease up to the year 1996. Then it increase until it reach is peak on the year 2004 with unemployment rate of 11.825. It then fall up to 7. 32 on the year 2007. The finally it became stable for the last six years.

Figure 5 shows the Inflation rate in the Philippines from year 1983-2013. The graph shows that the inflation rate in the Philippines is unstable in year 1983 to 1993. Hence, the latter year of the inflation rate depicts a stable fluctuation from 0-10 percent because of the changing in the policy framework of Bangko Sentral ng Pilipinas into inflationary targeting promoting a price stability of goods.

Figure 6 shows the remittance (U.S dollar to Peso) from the year 1983-2013. We generally say that the remittance is continuously increases overtime, thus, showing a good indicator of economic growth. It increases from 1983 to 1997 from $944,450 to $5,741,835 respectively. However it decreases from year 1998 to 2001 probably because of the global Financial Crisis, hence it continued to increase from 2002-2012.

Figure 7 shows the money supply (m3 in Billions) from year 1983 to 2013. The figure shows that the money supply only lies from 1 to5 million from year 1983 to 2012 , hence a dramatic increase has recorded in 2013 showing a serious dearth of data and inaccuracy.

Figure 8 shows the lending rate in the Philippines from 1983 to 2013. From the figure, we can see that the lending rate is decreasing from 1985 to 1987 with 28.6 and 13.6 percent respectively, hence it continued to increase from year 1988 to 1990 with 15.9 to 24.1 percent respectively. Thus it continued to decrease from latter years.

Figure 9 shows the interest rate in the Philippines from 1983 to 2013. From this figure, we can see that the most significant decrease of interest rate occur is in the year 1983 to 1984 and most significant increase in 1984 to 1985. Moreover, the interest rate continues its fluctuation and decrease again significantly from the year 1997 to 1998.

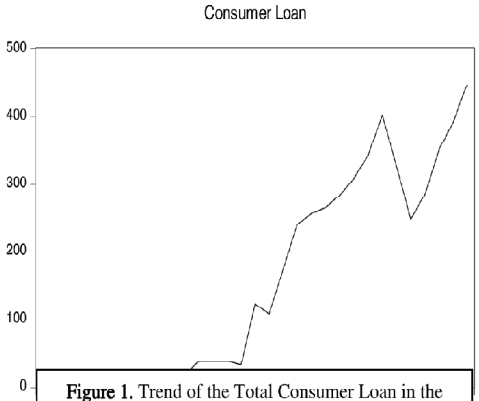


Figure 1. Trend of the Total Consumer Loan in the Philippines from 1983 to 2013

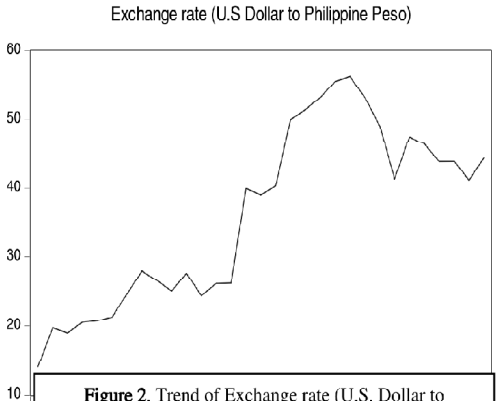


Figure 2. Trend of Exchange rate (U.S. Dollar to Philippine Peso) from 1983 to 2013

Figure 3. Trend of Goss Domestic Product per Capita in the Philippines from 1983 to 2013

Figure 4. Trend Unemployment rate in the Philippines from 1983 to 2013

Figure 5. Trend of Inflation Rate in the Philippines from 1983 to 2013

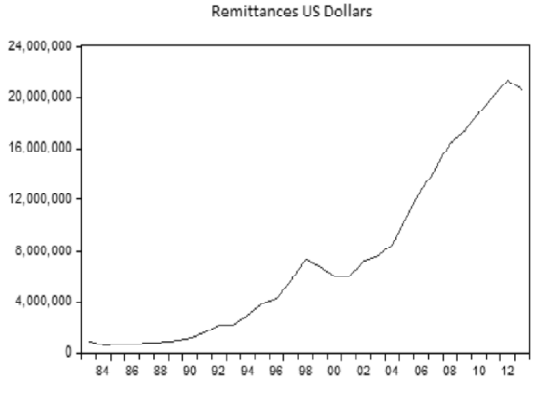


Figure 6. Trends of Remittances in the Philippines from 1983 to 2013

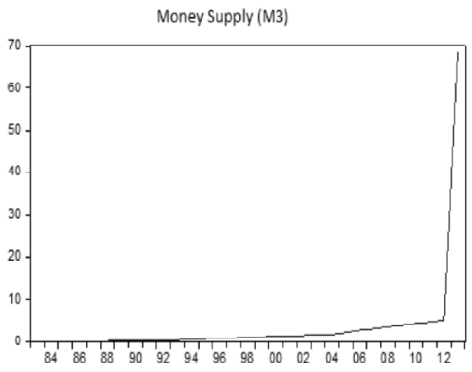


Figure 7. Trends of Money Supply (M3) in the Philippines from 1983 to 2013

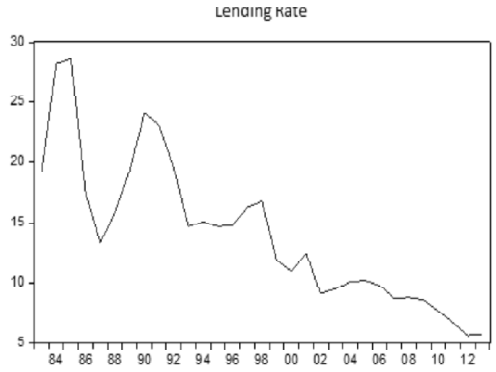


Figure 8. Trends of Lending Rate in the Philippines from 1983 to 2013

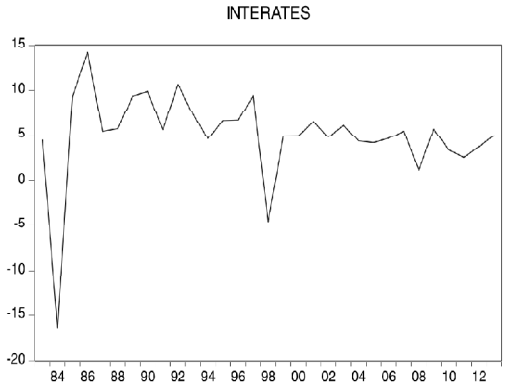


Figure 9. Trends of Intereset Rate in the Philippines from 1983 to 2013

3.3. Measure of Correlation

Table 2 shows the result the correlation between the variables log(CL), log(GDP), log(ER), log(UR) and Inflation rate. The table shows that the pearson correlation between Consumer Loan and GDP per Capita, and Exchange Rate, Unemployment rate and Inflation rate were significant at alpha 0.05. We can also say that Consumer Loan , GDP per Capita, and Exchange Rate were positively correlated while Inflation rate and Unemployment were negatively correlated to the Consumer loan.

3.4. Test of Normality

Table 3 shows that the skewness of the distribution is at 0.116286 and the Kurtosis is at 1.497889 therefore, it is skewed to the right and platykurtic . The Jarque-Bera test is at 2.984303 with a probability of 0.224888. The researchers therefore fail to

Table 2
Result of correlation of the variables on Eviews

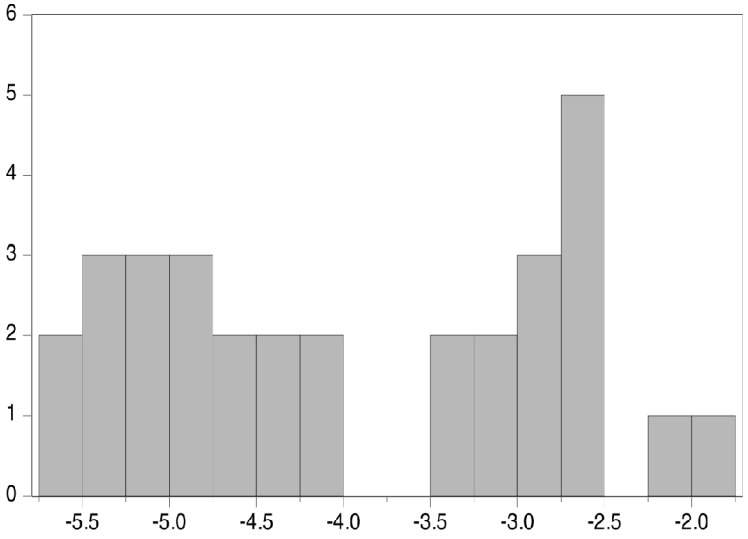
Covariance Analysis: Ordinary
Date: 08/16/15 Time: 14:25
Sample: 1983 2013
Included observations: 31

Correlation Probability	LOG_CL	LOG_ER	LOG_GDP	LOG_UR	IR
LOG_CL	1.000000				

LOG_ER	0.883851	1.000000			
	0.0000	-----			
LOG_GDP	0.721062	0.523825	1.000000		
	0.0000	0.0025	-----		
LOG_UR	-0.363234	-0.082170	-0.776646	1.000000	
	0.0446	0.6603	0.0000	-----	
IR	-0.462044	-0.423131	-0.368129	0.176011	1.000000
	0.0089	0.0177	0.0416	0.3436	-----

reject the null hypothesis and conclude that the residual distribution is normally distributed.

Table 3
Test of Normality run on Eviews



3.5. Test of Goodness of Fit

Table 4 shows that the value of the is 0.962982 and the value of the Adjusted is 0.955579. Which means that 96.30% of the variability of log(Consumer Loans) was explained by the Independent Variables log(Exchange Rate (US$ to PHP)), log(GDP per Capita), log(Unemployment rate), and Inflation rate.

3.6. Test of Autocorrelation

Table 8 shows that the value of Durbin-Watson statistics is 1.876749 which is greater that the upper limit of the Critical value of Durbin-Watson test with 31 observation and 5 independent variable is 1.601. We can say that the then there is no significant evidence of positive or negative autocorrelation.

3.7. Test for Structural Stability

Table 4 shows that the value of F-test is 2.437540 with a probability of 0.0643. From this the researchers fail to reject the null hypothsis and conclude that there is no break at specified breakpoints. There is probably is not a substantial difference between Consumer Loans pre-1999 and post-1999.

Table 4
Result of Chow Breakpoint Test run on EViews

Chow Breakpoint Test: 1999
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 1983 2013

F-statistic	2.437540	Prob. F(6,19)	0.0643
Log likelihood ratio	17.69598	Prob. Chi-Square(6)	0.0070
Wald Statistic	14.62524	Prob. Chi-Square(6)	0.0234

3.8. Test of Multicollinearity

Table 5 shows that the value of all Centered VIF is below 10. The researchers concluded that the independent variables are not collinear to the dependent variable. The probability of accepting "false" hypothesis is low.

3.9. Test of Specific Error

Table 6 shows that the value of F-test is 0.046348 with a probability of 0.8314. Since the computed p-value is greater than the alpha which is 0.05. Therefore the researchers fail to reject the null hypothesis that the true specification is linear. This means that there is no misspecification error in the model.

Table 5
Result of Variace Inflating Factors run on Eviews

Variance Inflation Factors
Date: 08/16/15 Time: 15:43
Sample: 1983 2013
Included observations: 31

Variable	*Coefficient Variance*	*Uncentered VIF*	*Centered VIF*
C	22.74598	4956.597	NA
LOG(ER)	0.100322	273.8504	3.253807
INTERATES	0.000408	4.499373	2.271711
IR	0.000186	5.855551	2.859139
LOG(UR)	0.822763	903.2826	4.918845
LOG(GDP)	0.253694	2723.832	9.089220

Table 6
Result of Ramsey RESET Test run on EViews

Ramsey RESET Test
Equation: UNTITLED
Specification: LOG(CL) C LOG(ER) INTERATES IR LOG(UR) LOG(GDP)
Omitted Variables: Squares of fitted values

	Value	*df*	*Probability*
t-statistic	0.215286	24	0.8314
F-statistic	0.046348	(1, 24)	0.8314
Likelihood ratio	0.059809	1	0.8068

F-test summary:

	Sum of Sq.	*df*	*Mean Squares*
Test SSR	0.006855	1	0.006855
Restricted SSR	3.556499	25	0.142260
Unrestricted SSR	3.549644	24	0.147902
Unrestricted SSR	3.549644	24	0.147902

LR test summary:

	Value	*df*
Restricted LogL	-10.42633	25
Unrestricted LogL	-10.39643	24

3.10. White Heteroskedasticity Test

Table 7 shows that the value of F-test is 1.812251 with a probability of 0.1672 which is greater than to alpha 0.05. Therefore the researchers decide to not rejecting the null hypothesis and conclude that the data is has a constant variance.

Table 7
White Heteroskedasticity test run on Eviews

Heteroskedasticity Test: White			
F-statistic	1.812251	Prob. F(20,10)	0.1672
Obs*R-squared	24.29658	Prob. Chi-Square(20)	0.2297
Scaled explained SS	24.84997	Prob. Chi-Square(20)	0.2072

3.11. Mathematical Model formulated using Matrices through Normal Estimation Equation

Using MATLAB, we obtain the following model that has significant linear association to consumer loan. Matrix theory was utilized by the researchers since it consist of more than one variable to conduct mathematical scheming in fitting multiple linear regression.

This formula represents the estimation using least square regression method

$$(X'X)\, b \;=\; X'Y$$

$$\begin{bmatrix} 0.0310 & 0.1091 & 0.0694 & 0.2172 & 0.2664 & 0.1551 \\ 0.1091 & 0.3883 & 0.2437 & 0.7675 & 0.8944 & 0.5420 \\ 0.0694 & 0.2437 & 0.1562 & 0.4846 & 0.6046 & 0.3479 \\ 0.2172 & 0.7675 & 0.4846 & 1.5274 & 1.8233 & 1.0815 \\ 0.2664 & 0.8944 & 0.6046 & 1.8233 & 4.4724 & 0.5328 \\ 0.1551 & 0.5420 & 0.3479 & 1.0815 & 0.5328 & 1.5680 \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \end{bmatrix} = \begin{bmatrix} 124.4909 \\ 457.3911 \\ 275.1856 \\ 890.7064 \\ 856.6249 \\ 579.7188 \end{bmatrix}$$

then using the relation $b = (X'X)^{-1}X'y$, the estimated regression coefficients are obtained as:

$$b_0 = -24.1410, b_1 = 2.3607, b_2 = 1.8711, b_3 = 2.3265, b_4 = -0.0365, b_5 = -0.0653$$

Consumer loan can be computed using the regression equation:

$$ln(ConLoan) = -24.1410 + 2.3607ln(ER) + 1.8711ln(UR) + 2.3265ln(GDPpC) - 0.0365IR - 0.0653INTERATES$$

where

ConLoan	= Total Consumer Loan
ER	= Exchange Rate (U.S. Dollar to Philippine Peso)
UR	= Unemployment Rate
GDPpC	= Gross Domestic Product per Capita
IR	= Inflation Rate
INTERATES	= Interest Rate

3.11.1. Test of the Individual Significance of the Regression and Test of Overall Significance of the Regression

Table 8 shows that the p-value associated with the t-statistic is less than 0.05. This indicates that following predictors has a significant linear association to consumer loan. For instance, for every unit change in the variable LOG(ER), the dependent variable LOG(CL) was predicted to increase by 2.360692 "ceteris paribus". It also shows that the value of F-test is 130.0712 with the probability of 0.0000000. This test statistic states the overall significance of the regression model. Since the computed p-value is less than to alpha at 0.05, we decide to reject the null hypothesis all of the regression coefficients are equal to zero which means the group of variables are jointly significant statistically including the whole regression model.

Table 8
Result of the Least Square test on the variables that is run on EViews

Dependent Variable: LOG(CL)
Method: Least Squares
Date: 08/17/15 Time: 17:59
Sample: 1983 2013

Included observations: 31

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	-24.14100	4.769274	-5.061776	0.0000
LOG(ER)	2.360692	0.316736	7.453178	0.0000
INTERATES	-0.065340	0.020205	-3.233897	0.0034
IR	-0.036498	0.013648	-2.674340	0.0130
LOG(UR)	1.871129	0.907063	2.062844	0.0497
LOG(GDP)	2.326543	0.503680	4.619089	0.0001
R-squared	0.962982	Mean dependent var		4.015837
Adjusted R-squared	0.955579	S.D. dependent var		1.789563
S.E. of regression	0.377174	Akaike info criterion		1.059763
Sum squared resid	3.556499	Schwarz criterion		1.337309
Log likelihood	-10.42633	Hannan-Quinn criter.		1.150236
F-statistic	130.0712	Durbin-Watson stat		1.876749
Prob(F-statistic)	0.000000			

According to computed value, an increase in exchange rate, unemplyment rate and gross domestic product have a positive effect in predicting the consumer loan. It means that the higher the exchange rate, unemployment rate and gross domestic product, the consumers are more encourage to commit on loans. However, an increase in interest rate and inflation rate have a negative effect in predicting the consumer loan in the Philippines. It means that the higher the interest rates and inflation rates the consumers are discourage to commit on loans.

4. CONCLUSION

Based on the result, the researcher has a sufficient evidence to conclude that Gross Domestic Product per Capita, Exchange Rate (U.S. Dollar to Philippine Peso), and Unemployment Rate is a predictor of Consumer Loan. The researchers come up with a model of is $ln(ConLoan) = -24.1409957283 + 2.36069212544 * ln(ER) + 1.87112905793 * ln(UR) + 2.3265430308 * ln(GDPpC) - 0.0653397103022 * INTERATES - 0.0364981226399 * IR.$ where Conloan is Consumer Loan, ER is exchange rate, GDPpC is gross domestic product per capita, and UR is unemployment rate. There were 96.29% of the variation of dependent variable that can explain by the independent variables.

According to result, an increase in exchange rate has a positive effect in predicting the consumer loan as well as the underemployment rate and the gross domestic product. However, an increase in interest rate and inflation rate have a negative effect in predicting the consumer loan in the Philippines.

5. RECOMMENDATION

Approximately, the consumer loan constitute 5% of the total Gross Domestic Product of the Philippine. Nevertheless, the rapid increase of consumer loan may affect the GDP of the country. Through this result, the researcher has a sufficient evidence to recommend that the government may allot attention to attention to monitor the Exchange rate, Unemplyment rate, Gross Domestic Product per Capita, Interest Rate, and Inflaton Rate. Also, the researchers recommend to search or use different independent variable such as money supply, remittaces, and lending rate to determine and understand the behavior of consumer loan. Moreover, the researcher suggests the different economic thories in making another research about consumer loan including theory of Bonds Market and Two Period Consumption

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