Statistical analysis

Name:

Institution:

Findings and Analysis

Global financial crisis affected operations of various companies which led to tosses and business failure. Therefore, there is need to establish the extent of the impact of financial crisis on business profitability using the case of Tesco. . Seven variables, sales, Gross profit (GP) %, Operating profit, Return on Investment (ROI), and Return on assets (ROA), Net income and long term liabilities - were used for the analysis of the effects of global financial crisis on profitability of companies using the case study of Tesco. In these variables sales is taken as dependent variable and the influence of these independent variables on sales was determined. For checking the influence of independent variables on dependent variable, Ordinary least squares (OLS) was used and it required working on some assumption. In the ordinary least square the assumptions of regression analysis were checked by using some statistical tools, In case of any violation of assumption multiple linear regression the corresponding remedy will be used. Some of the tools which were used to make a good statistical model for the prediction of sales in the time period 2005 to 2014 are listed below (Brooks, 2014).

Regression analysis is used to test how much the influence of independent variable has on dependent variables (Wooldridge, 2012). In this scenario, dependent variables are influenced by independent variables of study plus the residual effect actors other than independent variables (Terrell & Fomby, 2006).

R square for checking how good the fitted model is, and also adjusted R square. According to Terrell & Fomby (2010) they are both used for evaluation of good model but adjusted R square only increase when there is significant variable in a model while R square can increase in either way. Any model having 0.5 or more R square is considered as good statistical model.

Autocorrelation occurs there is correlation among the residuals of same series. For this durbin Watson test was used. Any model falling in the range of 1.5-2.5 were not to be considered as an auto correlated model (Winkelmann, 2008).

Furthermore, Multicollinearity happens when there is a correlation between the independent variables and this makes the interpretation of model impossible as variables are correlated. Individual effect of each variable cannot be described. VIF (variance inflation factor) was used for conducting the checks. Terrell & Fomby(2010) defined for multicollinearity is whenever VIF is less than 10 there will no correlation among the independent variables and partial effect of each predictor can be described well (Griffiths et al., 2008).

Hetroscadsticity is when residuals does not have constant variation.This is another assumption of regression model that model must not be suffered from hetrosdascticity. So we are going to use White test for checking whether they are hetrosdastic or homosdastic.

F- statistics is used for the overall significance of model.

Correlation matrix is used which tells the correlation of variables with each other. Any variable having correlation 0.5 or more is considered as good correlation among the variable

Now we are going to analyze the normality of dependent variable. We are going to use E-views for the purpose of statistical analysis:

Data Sources

Data taken from the yearly development source of Tesco.

Results

Dependent variable needs to be normalized for proceeding for regression:

: Dependent variable is normal

: Dependent variables is non normal.

Empirical Distribution Test for SALES
Hypothesis: Normal
Date: 09/14/15 Time: 14:36
Sample: 2005 2014
Included observations: 10

Method	Value	Adj. Value	Probability
Kolmogorov (D)	0.162732	0.539793	0.9327
Anderson-Darling (A2)	0.391850	0.391850	0.8568

For regression analysis dependent variable must be normal. For normality purpose Kolmogrov and Anderson- Darling non parametric tests which are distribution free test were used. P- values of above two test are greater than the desired level of significance (0.05). Therefore, null hypothesis of normality cannot be rejected.

For proceeding further the nature of dependent variable in the form graphs was checked

Correlation among the variables

Table 1

	SALES	GP__	LONG_TERM_LIABILITIES	NET_INCOME	OPERATING_PROFIT	ROA	ROI
SALES	1	-0.339684847	0.900372765	0.016215403	0.576484594	-0.725187882	-0.652125816
GP__	-0.339684847	1	-0.256273612	0.879660117	0.546800092	0.828674168	0.855654188
LONG_TERM_LIABILITIES	0.900372765	-0.256273612	1	0.060637469	0.568615097	-0.706764628	-0.638643432
NET_INCOME	0.016215403	0.879660117	0.060637469	1	0.821980195	0.644272004	0.715542377
OPERATING_PROFIT	0.576484594	0.546800092	0.568615097	0.821980195	1	0.11033391	0.207796017
ROA	-0.725187882	0.828674168	-0.70676462	0.644272004	0.110333912	1	0.993086493
ROI	-0.652125816	0.855654188	-0.638643432	0.715542377	0.207796017	0.993086493	1

This table shows the correlation of the variables with itself as well as with other variables. It is basically a correlation matrix retrieved from the Eviews software, and it helped to observe the relationship of the variables with itself and other variables. Not only it reports the relationship of variables, it extends its horizon to also give information about the direction as well as the magnitude of a relation. Range of correlation is from 0 to 1 where 0 reports no relation and 1 reports a 100% relation between the variables. The table has five variables. These variables are Sales, Gross profit, Long term liabilities, Net income,

Operating profit, Return on Assets and Return on Investment. A variable always have a best and strong relation with itself. Therefore, a variable will have a correlation value of 1 with itself. This can be seen above in the right diagonal of the table which contains 1 in all those cells. Sales has a relation of about 34% with Gross profit, 90% with Long term liabilities, 1% with the net income, about 57% with the operating profit, 72% with the Return on Assets and 65% with the Return on Investment.

Gross profit margin has a really weak association of about 33% with sales, about 26% with the long term liabilities, 88% with net income, 55% with operating profit, 83% with Return on Assets and carries a relation of about 85% with Return on Investment. The variable of Long term liabilities has a strong relation of about 90% with sales, 25% with the Gross profit, only 6% with the net income, 57% with the operating profit, around 71% with the Return on Assets and 64% with Return on Investment of the company. For the variable of Net income, it has a very weak bonding of around 1% with the sales, 88% with the gross profit, contains a relation of only 6% with long term liabilities, 82% with the operating profit, relation of 64% with the Return on Assets and an association of almost 65% with Return on Investment (Griffiths et al, 2008). Considering the variable of operating profit, it contains a relation of about 57% with the sales, 55% with gross profit margin, a bonding of about 56% with the long term liabilities, 82% bonding with the net income, a correspondence of only 11% with the Return on Assets and a weak association of 20% with the variable of Return on Investment. The variable of Return on Assets has a decent relation of about 72% with sales, 83% with gross profit, 70% with the long term liabilities, 64% with the net income, 11% with the operating profit and a really strong association of bonding 99% with the Return on Investment. Moving to the last variable of the correlation matrix, it is established that the variable of Return on Investment has a relation of about 65% with the sales, a bonding of 85% with the gross profit, 64% with the long term liabilities, 71% with the net income, 21% with operating profit and a very strong relation of 99% with the Return on Assets (Brooks, 2014).

Results of Regression line

: Coefficients are insignificant

: Coefficients are significant

: Intercept is insignificant

: Intercept is significant

Dependent Variable: SALES
Method: Least Squares

Date: 09/14/15 Time: 16:53
Sample: 2005 2014
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP__	-6879.489	2287.097	-3.007956	0.0573
LONG_TERM_LIABILITIES	-0.159822	0.553645	-0.288672	0.7916
NET_INCOME	-13.50268	6.090111	-2.217148	0.1133
OPERATING_PROFIT	27.62652	4.590932	6.017628	0.0092
ROA	2314.245	4064.537	0.569375	0.6089
ROI	-1453.949	2139.023	-0.679726	0.5454
C	50966.64	13543.86	3.763079	0.0328

R-squared	0.996948	Mean dependent var	52834.90
Adjusted R-squared	0.990844	S.D. dependent var	11321.35
S.E. of regression	1083.319	Akaike info criterion	17.00947
Sum squared resid	3520743.	Schwarz criterion	17.22128
Log likelihood	-78.04737	Hannan-Quinn criter.	16.77712
F-statistic	163.3228	Durbin-Watson stat	2.026298
Prob(F-statistic)	0.000735		

The above regression analysis is done by regressing all the variables required in a study. Firstly the long term liabilities, Return on assets and return on investment are highly insignificant variables as their p values are higher than the desired level of significance 0.10 which means they are not helpful in predicting sales from 2005 to 2014. On the basis of p value of intercept term intercept term is significant here although the fitted model is quite good as it has R square and adjusted R square 0.99 and 0.99 respectively. P value of F statistic is quite lower than the level of significance which means over all model is significant. Hence the model is not suffering from autocorrelation because durbin Watson value is 2.02 which is lying in the thumb rule of no auto correlation (Brooks, 2014).

However it was necessary to remove insignificant variables from the model. For this removed long term liabilities were removed and the results were as shown below:

: Coefficients are insignificant

: Coefficients are significant

Dependent Variable: SALES
Method: Least Squares

Date: 09/14/15 Time: 16:54
Sample: 2005 2014
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP__	-7209.668	1738.863	-4.146197	0.0143
NET_INCOME	-14.88825	3.291052	-4.523858	0.0106
OPERATING_PROFI T	28.44389	3.172807	8.964897	0.0009
ROA	2993.111	2910.579	1.028356	0.3619
ROI	-1532.566	1862.716	-0.822759	0.4569
C	48963.91	10212.58	4.794468	0.0087

R-squared	0.996863	Mean dependent var	52834.90
Adjusted R-squared	0.992942	S.D. dependent var	11321.35
S.E. of regression	951.1229	Akaike info criterion	16.83687
Sum squared resid	3618539.	Schwarz criterion	17.01842
Log likelihood	-78.18436	Hannan-Quinn criter.	16.63771
F-statistic	254.2324	Durbin-Watson stat	2.189348
Prob(F-statistic)	0.000043		

In the above output long term liabilities were removed from the model and the resultants is that return on assets (ROA) and return on investment (ROI) are insignificant, their p values are higher than level of significance 0.10 and still model is not suffering from auto correlation as the durbin Watson value is 2.1, it is lying in the rule of thumb of 1.5-2.5. Any durbin Watson value is lying in this specified bound is indication of no auto correlation in a particular statistical model.

: Coefficients are insignificant

: Coefficients are significant

Dependent Variable: SALES
Method: Least Squares
Date: 09/14/15 Time: 16:55
Sample: 2005 2014
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP__	-6319.725	1316.772	-4.799407	0.0049
NET_INCOME	-15.35135	3.136057	-4.895113	0.0045
OPERATING_PROFI	27.67320	2.931812	9.438940	0.0002

T				
ROA	673.5657	699.7161	0.962627	0.3799
C	45075.26	8755.733	5.148086	0.0036

R-squared	0.996332	Mean dependent var	52834.90
Adjusted R-squared	0.993398	S.D. dependent var	11321.35
S.E. of regression	919.8821	Akaike info criterion	16.79322
Sum squared resid	4230916.	Schwarz criterion	16.94451
Log likelihood	-78.96611	Hannan-Quinn criter.	16.62725
F-statistic	339.5616	Durbin-Watson stat	2.419996
Prob(F-statistic)	0.000003		

On the basis of previous E-views output return on investment is eliminated from the model because it had p value 0.45 which is clear indication of insignificant variable which means return on investment is not predictor of sales since 2005 to 2015. There's one more insignificant variable i.e. return on investment it has 0.37 p value therefore, (ROI) return on investment is insignificant. It must not be included in a model.

: Coefficients are insignificant

: Coefficients are significant

Dependent Variable: SALES
Method: Least Squares
Date: 09/14/15 Time: 16:56
Sample: 2005 2014
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP__	-5742.561	1165.162	-4.928554	0.0026
NET_INCOME	-12.70923	1.507759	-8.429216	0.0002
OPERATING_PROFI T	25.02730	1.013844	24.68556	0.0000
C	47045.91	8460.855	5.560420	0.0014

R-squared	0.995653	Mean dependent var	52834.90
Adjusted R-squared	0.993479	S.D. dependent var	11321.35
S.E. of regression	914.2422	Akaike info criterion	16.76324
Sum squared resid	5015032.	Schwarz criterion	16.88428
Log likelihood	-79.81621	Hannan-Quinn criter.	16.63047
F-statistic	458.0393	Durbin-Watson stat	2.281551
Prob(F-statistic)	0.000000		

Therefore, all the variables are significant i.e. their p values are lower than the level of significance including intercept term which means they are actual predictor of sales from 2005 to 2014.

Any statistical model requires some assumptions to be fulfilled in order to make a statistical model. From the above analysis, fitted model is good indicated by high R square and adjusted R square and the model is free from autocorrelation too evident by durbin Watson value i.e. 2.28. Though there are some other assumptions which must be fulfilled for this regression analysis (Griffithset al. 2008).

Also, coefficient analysis was used for testing the multicollinearity. The results of correlation analysis show some variables are collinear to each other. In regression analysis we usually predict our dependent variables with the influence of independent variables and residuals. So any model suffering from multicollinearity (Co linearity among the independent variables) cannot be interpreted well. Variance inflation factor is going to be used to check the Co linearity among the independent variables.

Variace Inflation Factors
Date: 09/14/15 Time: 16:56
Sample: 2005 2014
Included observations: 10

Variable	Coefficient Variance	Centered VIF
GP__	1357601.	7.668116
NET_INCOME	2.273339	16.57298
OPERATING_PROFIT	1.027879	5.347682
C	71586065	NA

The above table has shown that Net income has high VIF which means it has high Co linearity with other variables as its VIF is 16.57 which is no ok for the interpretation of model. This means this variable must not be included in a model. Remaining two variables have VIF 7.6 and 5.3 respectively. These two variables have VIF less than 10 which means they are okay, they are not affected by multicollinearity (Griffithset al. 2008).

Dependent Variable: SALES
Method: Least Squares
Date: 09/14/15 Time: 16:57
Sample: 2005 2014
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP__	-14603.44	1667.331	-8.758575	0.0001
OPERATING_PROFIT	17.70945	1.737274	10.19382	0.0000

C	112822.5	10849.00	10.39934	0.0000

R-squared	0.944170	Mean dependent var	52834.90
Adjusted R-squared	0.928219	S.D. dependent var	11321.35
S.E. of regression	3033.216	Akaike info criterion	19.11596
Sum squared resid	64402783	Schwarz criterion	19.20673
Log likelihood	-92.57980	Hannan-Quinn criter.	19.01638
F-statistic	59.19055	Durbin-Watson stat	2.414388
Prob(F-statistic)	0.000041		

Net income is removed from the model to fulfill the assumption of no multicolllinearity among the model and the results are following:

Variance Inflation Factors
Date: 09/14/15 Time: 16:58
Sample: 2005 2014
Included observations: 10

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
GP__OPERATING_PROFIT	2779993.	176.7997	1.426514
C	3.018121	28.91793	1.426514
	1.18E+08	127.9302	NA

it is evident that there is no multicollinearity among the independent variables as all the VIF's are smaller than 10

There is another assumption of no hetroscadticity which means there must be constant variances of residuals so White test was used and the results are following:

H0: There is homoscedasticity.

H1: There is heteroscedasticity.

Heteroskedasticity Test: White

F-statistic	28.25728	Prob. F(5,4)	0.0032
Obs*R-squared	9.724682	Prob. Chi-Square(5)	0.0834
Scaled explained SS	4.113364	Prob. Chi-Square(5)	0.5332

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/14/15 Time: 18:22
Sample: 2005 2014
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.35E+08	1.43E+08	2.348100	0.0787
GP__^2	-3472828.	3375515.	-1.028829	0.3617
GP__*OPERATING_PRO FIT	25497.71	4970.759	5.129541	0.0068
GP__	-24391059	42975310	-0.567560	0.6007
OPERATING_PROFIT^2	-9.286566	2.626344	-3.535929	0.0241
OPERATING_PROFIT	-147378.4	31694.11	-4.650023	0.0097

R-squared	0.972468	Mean dependent var	6440278.
Adjusted R-squared	0.938053	S.D. dependent var	8919925.
S.E. of regression	2220087.	Akaike info criterion	32.34770
Sum squared resid	1.97E+13	Schwarz criterion	32.52925
Log likelihood	-155.7385	Hannan-Quinn criter.	32.14854
F-statistic	28.25728	Durbin-Watson stat	2.136499
Prob(F-statistic)	0.003225		

From the above analysis P value is lower than level of significance 0.10. Hence rejection of null hypothesis is concluded which means in this regression model residual variances are not constant

White consistent standard errors was used which gave Robust effect (they are considered as good)

Results after using White consistent standard errors are given below:

Dependent Variable: SALES
Method: Least Squares
Date: 09/14/15 Time: 16:59
Sample: 2005 2014
Included observations: 10
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GP__ OPERATING_PROFI T	-14603.44	2396.251	-6.094288	0.0005
	17.70945	0.948193	18.67706	0.0000
C	112822.5	17839.79	6.324206	0.0004

R-squared	0.944170	Mean dependent var	52834.90

Adjusted R-squared	0.928219	S.D. dependent var	11321.35
S.E. of regression	3033.216	Akaike info criterion	19.11596
Sum squared resid	64402783	Schwarz criterion	19.20673
Log likelihood	-92.57980	Hannan-Quinn criter.	19.01638
F-statistic	59.19055	Durbin-Watson stat	2.414388
Prob(F-statistic)	0.000041	Wald F-statistic	179.1320
Prob(Wald F-statistic)	0.000001		

White consistent standard errors changes the standard errors and it is evident that standard error in the above output are changed in the comparison with the output of White test.

Now we can finalize our statistical model as:

Sales = C + GP + Operating profit

Sales = 112822.5 -14603.44GP + 17.70945operating profit

Interpretations of Model :

The above equation can be interpreted in a way that when there is no predictor of sales still the average value will be 112822.5. This can also be called as the mean value of the variable. Moreover, it can be seen that the variable of sales is negatively related with GP, and carries a positive association with operating profit. It means that sales will move in one direction and variable of GP will move in other one, while for the variable of operating profit, the relation is positive, and so it can be concluded that both the variables of sales and operating profit will move in the same direction. That means that with a one unit change in Gp, sales will decrease by 14603 units on average. Similarly, interpreting the relation of sales and operating profit, it can be seen that with a one unit change in operating profit, then on average there will be a 17.709 unit change in sales (Brooks, 2014). Both the variables of Gp and operating profit have been found to be significant. Significance means that these variables have a meaningful impact on the sales of the company. Significance of a variable is considered to be one of the vital things of the regression. If a variable is not significant, then it means that it offers no impact whatsoever on the dependant variable of the study. Change in the dependent variable with respect to independent variables will be on average because it is mean model it can only show average change.

Conclusion

By using multiple linear regression analysis tools it has been established that among Gross profit (GP) %, Operating profit , Return on Investment (ROI), and Return on assets (ROA), Net income and long term liabilities only two variables were helpful and fulfilling the requirements of regression analysis, these are

GP and operating profit. The variables were taken from companies that managed financial problems during the global financial crisis. It is concluded that gp and operating profit are only helpful in determining profitability of companies especially Tesco which means all other are not relevant to the profitability of companies during the global financial crisis (International, 2014).

References

Brooks, C. (2014). *Introductory econometrics for finance*. New York, N.Y: Cambridge University Press.

Griffiths, W. E., Hill, R. C., & Lim, G. C. (2008). *Using EViews: For principles of econometrics, third edition*. Danvers (Mass.: John Wiley & Sons.

Hill, C. W. L. (2014). *International business: Competing in the global marketplace*.New York, NY : McGraw Hill Education.

International Monetary Fund. (2009). *Global financial stability report: Responding to the financial crisis and measuring systemic risks*. Washington, D.C: International Monetary Fund.

International Monetary Fund. (2011). *Global financial stability report: Durable financial stability : getting there from here*. Washington, DC: International Monetary Fund.

International, M. F. (2014). *Global financial stability report: Oct-14*. Place of publication not identified: Intl Monetary Fund.

Sweo, R. E., & Pate, S. K. (2013). *International business: A practical approach*. Charleston, S.C: Made in the USA.

Terrell, D., & Fomby, T. B. (2006). *Econometric analysis of financial and economic time series: Part A*. Amsterdam: Elsevier JAI.

Terrell, D., & Fomby, T. B. (2010). *Econometric analysis of financial and economic time series*. Amsterdam: Elsevier JAI.

Winkelmann, R. (2008). *Econometric analysis of count data*. Berlin: Springer.

Wooldridge, J. M. (2012). *Econometric analysis of cross section and panel data*. Cambridge, Mass: MIT Press.