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Testing Financial Ratio Growth Rates for Optimum Regressors Selection

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ABSTRACT

The present paper demonstrated that how the impact of "residual correlations" approach helps in selecting the parsimonious regression method. For this the data is tested against heteroskedasicity, Normality, autocorrelation and colinearity before considering for the OLS parameter estimation procedure. For confirming this use of financial ratios, viz. Employee cost per net profit, the operating expenses per net profit, and together several ratios were taken into consideration. The result clearly stated that bi-variate model indeed found better than higher variable regression equations
Keywords- OLS, Parsimonious regression equation

Introduction & Historical Literature

The OLS model is a non-parametric parameter estimation method and is not new in the academic literature especially in relation to its use in detecting information efficiency of financial data. But papers discussing "residual correlations" for parsimonious regression equation are few with regard to the ratio like employee cost per net profit (taken as endogenous variable). Hence, it will be interesting to highlight the use of OLS in demonstrating how the particular ratios remain sensitive in providing information regarding the movement of employee costs per net profit. (ECNP).

Literature Review

(Tasche, 2000) in this paper the author explained the use and superiority of mean absolute deviation and interquartile range in determining parameter estimation of explanatory variables. (Mahmoud, 2008) confirmed the use of financial ratios for insurance companies, and used fuzzy clustering approach for selecting the 25 financial ratios. (Abdel & Kabajeh, 2012) used the pooled regression technique and estimated the adjusted R squared and t-statistic and regression coefficient to confirm the relationship among the key financial ratios. (Yan, 2012) In this paper along with aggregate Dividend yield , some other prominent ratios are considered to predict stock prices, for this the paper, with the help of OLS and Robust least squre (RLS) the outlier effect was identified and thus a rolling monthly regression was used, the paper also established relationship between seasonality through time-predictability and cross-predictability.

One of the phenomenal work by (Lev & Sunder, 1979) describe how to replace income from denominator to a more non-negative variable like (ending to beginning shareholder equity) since as author claimed will never be negative. Regarding outlier, winsoring and trimming can work out to be the best.

When studying the weak form of efficiency , it is imperative to mention that "random walk" can obtain three forms, one without any heteroskedasiticity, unconditional heteroskedasiticity, and conditional heteroskedasiticity ((Jefferis & Smith, 2005) and thus a model like GARCH will be of immense use in this respect. The study explained in the article by explained how the goodwill amortization impact the value relevance component i.e. prediction of the stock prices movement. (Senthilnathan, n.d.).

Methodology

Source: the last 14 years annual Income statement and balance sheet of ACC Ltd was acquired from Capitaline database. Total 8 relevant ratios which were considered are as follows:

1. Employee cost/Reported Net profit (EC/RNP)
2. Raw Material/Reported Net profit (RM/RNP)
3. Power & Fuel cost/Reported Net Profit (PF/RNP)
4. Other Manufacturing expenses/Reported Net profit (OME/RNP)
5. Misc. expenses/ Reported Net Profit (ME/RNP)
6. Return on Investment : Reported Net Profit/Total Capital (ROI)
7. Current Ratio : Total Current Assets/ Total current liabilities (TC/TL)
8. Net Current Assets/ Total Shareholders fund (NCA/TSF)

These ratios growth rates were also calculated so that the data can become scale invariant and the issue of Autocorrelation (if any) can be handled to an extent.

Firstly, in order to check the feasibility of considering in the Endogenous and Exogenous space, the ratios were put into correlation matrix. And thus, the desired ratios were put into Endogenous and Exogenous categories for further tests. The data was converted to a time-series format in Gretl and four important tests along with OLS parameter estimation with HAC criteria on the Growth rates.

The Heteroskedasiticity test, the Normality tests, the Autocorrelation test at lag 1 and The Volatility Inflation factor test.

The analysis of study continued with stress on selection of right variables for regression equations (mainly three regression equation were studied), regression parameters with p-value, SE of regression and R squared and Adjusted R squared. And finally, the residual correlation analysis for deciding about the optimal regressor based parsimonious regression equation.

Creation of Regression equations:

MODEL 1

$$y_{EC/RNPt} = \beta_1 + \beta_2 x_{OME/RNP} + \beta_3 x_{CR} + \beta_4 y_{NFA/TSF} + u_t \quad \text{eq. 1}$$

Further a second multivariate equation was desired, for which, the second largest regressor with Employee cost/ RNP growth rates was found to be Selling and Admn cost/ RNP growth rates at 0.9786. This exogenous variable also had weak negative correlation.

MODEL 2

$$y_{EC/RNPt} = \beta_1 + \beta_2 x_{S\&A/RNP} + \beta_3 x_{CR} + \beta_4 y_{NFA/TSF} + u_t \quad \text{eq. 2}$$

Third equation will consider multicolinearity issue which exists between S&A/RNP growth rates and OME/RNP growth rates respectively.

MODEL 3

$$y_{EC/RNPt} = \beta_1 + \beta_2 x_{OME/RNP} + \beta_3 x_{S\&A/RNP} + \beta_4 x_{CR} + \beta_5 y_{NFA/TSF} + u_t \quad \text{eq. 3}$$

Comparative Analysis and Interpretation

In order to arrange the right endogenous and exogenous variables a careful observation of variables compatibility in relation to correlations was considered. It is worth to mention that as far as EC/RNP growth rates with OME/RNP growth rates is concerned the correlation was found maximum. It was at 98.88% but to go further in selecting next two exogenous variables, TC/TL I.e. Current ratio growth rates and NCF/RNP growth rates were found having minimum correlation with OME/RNP growth rates. However, the endogenous variable OME/RNP growth rates were at -0.1277 and 0.1044 with current ratio growth rates and NCA/ TSF growth rates respectively. The repressors Employee cost/ RNP growth rates were at 0.0598 with current ratio growth rates and -0.1759 with NCA/ TSF growth rates.

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Further to the selection of Endogenous and Exogenous variables entering into regression equation, the VIF result further confirm that Model 1 and Model 2 seems to provide a reasonably low VIF component confirming that colinearity is looked into seriously, also, with regard to inclusion of two highly correlated regressors in Model 3, indeed, the VIF was way ahead for them from the acceptable limit assuring a Multicolinearity issue.

See Table 3 above, the impact of the unexplained variation was comparatively very low and was proved insignificant by the regression model. However, p-value of Model 2 is giving better result.

For the first regressor, the impact on regressand i.e. EC/RNP growth rate was more significant in Model 1 for obvious reasons of better management of colinearity. Comparing this, S&A/RNP growth rates were more significant with regressand at 0.9631 at Model 2. However, quite surprisingly, in the Model 3, OME/RNP growth rate also witnessed a good relationship with the regressand. Hence, it confirms that both OME/RNP growth rates and S&A /RNP growth rates performed better than Current ratio growth rates and NCA/TSF growth rates in the OLS setup.

In Table 4, both Model 1 and Model 3 passed the three tests of Normality of residuals, Heteroskedasiticity of Residual variances and Autocorrelation. However, Model 2 suffered from slightly higher Autocorrelation in the growth rates.

Seeing initially Table 5 the SE of regression was minimum for Model1, the Squared remained same for Model 1 and Model 3. Adjusted R squared declined in all the three models confirming that lagged values of regressors are not better in explaining the movements of EC/RNP growth rates.

Residual Analysis

Comparing the three models, it is worth appreciating that it is always good to observe that comparing Model 1 (with no heteroskedasiticity, no autocorrelation and normality of residuals) with Model 2 (high autocorrelation) and Model 3 (with multicolinearity problem) behaved differently. As can be witnessed see Figure 1 and Table 6 above, while Model 2 (with high autocorrelation) apparently showing very high variance in the residual movement across years. Model 3 (with Multicolinearity problem) and Model 2 seems almost moved alike. Residual correlation among Model 1 and Model 3 was also highest at 0.9977, while for Model 1&2 combination it was at 0.5333 and for Model 2&3 combination it was at 0.5877 respectively.

So it is worth concluding that compare to factor of Multicolinearity, an aspect of autocorrelation dominated in the regression volatility. Out of Models, certainly Model 1 keep fewer variables compare to the Model 3, so it may be relevant to consider Model 1 for serving the purpose of parsimonious regression model.

The Analytical Outcome

Ignoring the Multicolinearity issues for a while, since it has not disrupted with referring to the Regression correlation, it is well understood, that the impact of Autocorrelation in this case with Annual Financial ratios with growth rates have been more severe. Comparing, the residual correlations, certainly Model 1 and Model 3 almost identically performed, and hence Model 1 can be selected for simple reason of containing less no of regressors claiming the parsimonious nature of regression model

Empirical Scope

This study demand more robust analysis since the OLS estimation are unbiased linear estimation of parameters but are not efficient until the sample size is not increased to significantly levels. Secondly, the financial ratios as seen here suffer heavily from Aggregation and hence disaggregated financial information can provide better judgement of the validity of this model. The model needs to be tested against fairly large no of companies in the similar industry and across countries for its empirical validity.

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ANNEXURE

Model 1: OLS, using observations 2000-2013 (T = 14)
Dependent variable: EC_RNP
HAC standard errors, bandwidth 1 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.00633046	0.0246028	0.2573	0.80216	
OME_RNP	0.966579	0.0234522	41.2149	<0.00001	***
TC_TL	0.238705	0.109352	2.1829	0.05398	*
NCA_TSF	-0.00122122	0.000502208	-2.4317	0.03535	**

Mean dependent var	-0.195002	S.D. dependent var	0.691633
Sum squard resid	0.086839	S.E. of regression	0.093188
R-squared	0.986036	Adjusted R-squared	0.981846
F(3, 10)	1009.659	P-value(F)	1.04e-12
Log-likelihood	15.71414	Akaike criterion	-23.42827
Schwarz criterion	-20.87204	Hannan-Quinn	-23.66490
rho	0.155250	Durbin-Watson	1.621995

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square (2) = 3.65516
With p-value = 0.160803

LM test for autocorrelation up to order 1 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.247737
With p-value = P (F (1, 9) > 0.247737) = 0.630607

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 12.7119
With p-value = P (Chi-square(9) > 12.7119) = 0.176082

Variance Inflation Factors

Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

OME_RNP 1.033
TC_TL 1.049
NCA_TSF 1.043

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Properties of matrix X'X:

1-norm = 17128.128
Determinant = 502882.16
Reciprocal condition number = 1.7921497e-005

Model 2: OLS, using observations 2000-2013 (T = 14)
Dependent variable: EC_RNP
HAC standard errors, bandwidth 1 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0065311	0.0378522	0.1725	0.86645	
TC_TL	0.00595257	0.230877	0.0258	0.97994	
NCA_TSF	-0.000901252	0.000186146	-4.8416	0.00068	***
S_A_RNP	0.963097	0.042647	22.5830	<0.00001	***

Mean dependent var	-0.195002	S.D. dependent var	0.691633
Sum squared resid	0.250274	S.E. of regression	0.158200
R-squared	0.959754	Adjusted R-squared	0.947681
F(3, 10)	178.0981	P-value(F)	5.62e-09
Log-likelihood	8.304660	Akaike criterion	-8.609320
Schwarz criterion	-6.053090	Hannan-Quinn	-8.845945
rho	-0.403495	Durbin-Watson	2.784814

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 11.335
with p-value = P(Chi-square(9) > 11.335) = 0.253444

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 4.19011
with p-value = 0.123064

LM test for autocorrelation up to order 1 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 5.92175
with p-value = P(F(1,9) > 5.92175) = 0.0377674

Variance Inflation Factors

Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

TC_TL	1.035
NCA_TSF	1.048
S_A_RNP	1.027

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Properties of matrix X'X:

1-norm = 17137.352
Determinant = 492470.75
Reciprocal condition number = 1.8382672e-005

Model 3: OLS, using observations 2000-2013 (T = 14)
Dependent variable: EC_RNP
HAC standard errors, bandwidth 1 (Bartlett kernel)

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.0066186	0.0239258	0.2766	0.78831	
TC_TL	0.228624	0.121988	1.8741	0.09368	*
NCA_TSF	-0.00120286	0.000444736	-2.7047	0.02421	**
S_A_RNP	0.0452293	0.177425	0.2549	0.80451	
OME_RNP	0.922509	0.18915	4.8771	0.00087	***

Mean dependent var	-0.195002	S.D. dependent var	0.691633
Sum squared resid	0.086454	S.E. of regression	0.098010
R-squared	0.986098	Adjusted R-squared	0.979919
F(4, 9)	1128.300	P-value(F)	3.84e-12
Log-likelihood	15.74529	Akaike criterion	-21.49058
Schwarz criterion	-18.29530	Hannan-Quinn	-21.78636
rho	0.117959	Durbin-Watson	1.695464

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 8.45471
with p-value = P(Chi-square(8) > 8.45471) = 0.390358

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 3.25801
with p-value = 0.196124

LM test for autocorrelation up to order 1 -
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.139321
with p-value = P(F(1,8) > 0.139321) = 0.718654

Variance Inflation Factors

Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

TC_TL 1.140
NCA_TSF 1.058
S_A_RNP 33.631
OME_RNP 33.844

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Properties of matrix X'X:

1-norm = 17181.323
Determinant = 94799.67
Reciprocal condition number = 4.9780947e-006