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Could Other Comprehensive Income Contribute to Foreign Exchange Risk Management Discourse?

Asuku Habib Usman[1], Adabenege Onipe Yahaya[2] & Terzungwe Nyor[2]

[1]*Graduate Student, Department of Accounting and Management, Nigerian Defence Academy, Kaduna, Nigeria, asukuusman@gmail.com*
[2]*Ph.D., Department of Accounting and Management, Nigerian Defence Academy, Kaduna, Nigeria, yoadabenege@nda.edu.ng; tnyor@nda.edu.ng*

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Abstract: *The unprecedented impact of the Covid-19 pandemic on businesses globally has spurred a rethink about risk mitigation and financial performance. Cross-border transactions based on global currencies and not securely hedged suffered setbacks at the onset of the pandemic as the US Dollar's value depreciated. This study looks at Foreign Exchange Risk Management from the Portfolio Theory approach with the objective of determining its effect on financial performance and improving the discourse. Modification of the traditional research approach was made to include both aspects of the risk management strategy of banks in focus. The variable of Other Comprehensive Income was introduced to the model for regression analysis. It was determined that Foreign Exchange Risk Management had a significant positive effect on financial performance. Other Comprehensive Income improved the modified model, is ascertained to be a substantive inclusion to the discourse and, is recommended in practice and research.*

Keywords: *Foreign Exchange Risk Management, Portfolio Theory, Other Comprehensive Income, Financial Performance, Diversification*

JEL Classification: *G32, F31, M41*

1. INTRODUCTION

Businesses face substantial risk in the current global economic environment. This premise has been intensified by the onset of the Covid-19 pandemic which stymied global economic activity and impacted businesses in unfamiliar ways. The global currency, the U.S. Dollar, experienced a downfall in value and plausibly created shortfalls in the financial position of businesses that had not adequately hedged against foreign exchange risk especially in instances of transnational transactions. The pandemic has prompted a need for greater insight to the risk management practices adopted by businesses. The conventional practices for mitigating foreign exchange risk are financial hedging (derivatives – forwards, options, and swaps) and, operational hedging (investing in foreign operations and geographical dispersion).

Foreign Exchange Risk Management research adopts both traditional proxies perspectives to make determinations. Studies by Mugi (2015) and,,Nzioka and Maseki (2017) conclude that Foreign Exchange Risk Management has a positive significant effect on the financial performance of firms in focus. Others like Limo (2014) have conclusions that diverge with conflicting results. This could be attributed to the modelling approaches of the studies in focus. Most prior studies focus on either financial or operational hedging perspectives in their models which may not provide a complete outlook of the foreign exchange risk management practices typically utilized.

Considering the results of previous work, this study relies on an approach hinged on the Portfolio Theory as postulated and validated by Johnson (1960) and Stein (1961), and seeks to incorporate all facets of foreign exchange risk management utilized by the firms in focus. Listed deposit money banks in Nigeria form the study group for this study considering the lack of purchasing power parity of the Nigerian currency (Naira) and the relevance of the banking sub-sector as it would be one with significant foreign exchange risk exposure. The selection of banks as the study group informs the decision to measure operational hedging in terms of Asset Diversification and Income Diversification as stated by Laeven and Levine (2006) which would provide more specific information about the hedging practices of the banks.

This paper seeks to ascertain the effect of foreign exchange risk management on financial performance and, determine what International Financial Reporting Standards No. 9 (Accounting for Derivatives) could offer to the discourse by introducing Other Comprehensive Income to the model considering it contains the changes in the fair value of derivatives utilized for hedging purposes and changes in the translation reserve. The study by Saymeh, Alkhazaleh and Musallam (2019) finds that Other Comprehensive Income has a positive significant effect on financial performance.

The theoretical, conceptual and methodological revisions in this study may provide a more unqualified view of the effect of Foreign Exchange Risk Management on financial performance and proffer insight for management with regard to their risk appetite and financial position. Against this premise, the following study hypotheses are postulated to be tested.

H_1: Foreign Exchange Risk Management has no significant effect on financial performance

H_2: Foreign Exchange Risk Management with Other Comprehensive Income has no substantive effect on financial performance

2. METHODOLOGY

The data for this study is drawn from the published annual reports of 7 listed deposit money banks of 15 as at December 2017 in Nigeria from 2012 to 2017 considering the year of IFRS adoption by the banking sector in Nigeria (2012) and the availability of data requisite for this study. The banks in focus presented their financial hedging tools in the categories of Derivative Assets and Derivative Liabilities which will be represented by Da and Dl respectively in this study. With regard to operational hedging, data was deduced from the annual reports of the banks for Asset diversification and Income Diversification denoted by Ad and Ind respectively. Assuming a linear relationship between Financial Performance and Foreign exchange Risk Management like prior studies like Limo (2014) and Kiptisya (2017), this study depicts the relationship in terms of the selected variables as follows.

Model 1: $R.O.A._{i,t} = \beta_0 + \beta_1 Da_{it} + ß_2 Dl_{it} + \beta_3 Ad_{it} + \beta_4 Ind_{itt} + e_{it}$

Model 2: $R.O.A._{i,t} = \beta_0 + \beta_1 Da_{it} + ß_2 Dl_{it} + \beta_3 Ad_{it} + \beta_4 Ind_{it} + \beta_5 Oci_{itt} + e_{it}$

Where ROA is Return on Assets (Financial Performance), Da is Derivative Assets, Dl is Derivative Liabilities, Ad is Asset Diversification, Ind is Income Diversification, Oci is Other Comprehensive Income, β_0 is the intercept, β_1, β_2, β_3, the regression coefficients and e the error term.

The requisite normality checks are executed on the data and subsequent diagnostic and post estimation tests are utilized as well to ensure validity of the estimation results. The regression results for the model are assessed independently and then compared to each other to determine which has greater explanatory power with regard to financial performance. The first model is compared with previous studies in terms of variability with regard to the Sums of Squares of the regression results to ascertain if this study's model is a better fit for the data utilized. The comparison of both models in the study attempts to establish evidence for the inclusion of Other Comprehensive Income in the Foreign Exchange Risk Management assessment approach in research and practice.

3. RESULTS

Data (See Appendix A) for this study was subjected to normality checks and was determined to be normally distributed; density plots, results for Shapiro-Wilk's, kurtosis and skewness tests are presented in Appendix B. Results for the Variance Inflation Factor are presented as follows.

Table 1
Variancee Inflation Factor

Da	*Dl*	*Ad*	*Ind*	*Oci*
2.206611	1.793352	1.433433	1.307310	1.694815

Note: All values determined are significantly less than 5

Table 1 shows the results of the Variance Inflation Factor where all values determined are significantly lower than 5 and thus indicative that there is no multicollinearity amongst the variables in the model. This is suggestive of the potential for a viable model for the study.

Table 2
Regression results for Roa on Da, Dl, Ad and Ind.

Estimate	*Standard Error*	*t-value*	*Pr (>|t|)*	
Da	- 0.00117089	0.00043775	- 2.6748	0.011829 *
Dl	0.00148458	0.00048806	3.0418	0.004756 **
Ad	0.00353239	0.01080096	0.3270	0.745833
Ind	0.00323443	0.00625289	0.5173	0.608639

Total Sum of Squares = 0.0022724 . Residual Sum of Squares = 0.0016578 , R-squared = 0.27046 , Adjusted R-squared = 0.035121 , p-value = 0.039141

Note: Table shows results for the fixed effects model as it was determined to be most appropriate over the random and ols regression. No heteroskedasticity or serial correlation. (See results in Appendix B).

Table 3
Regression results for Roa on Da, Dl, Ad, Ind and Oci.

	Estimate	*Standard Error*	*z-value*	*Pr (>|t|)*
(Intercept)	0.02134375	0.02797091	0.7631	0.445422
Da	- 0.00148250	0.00057164	- 2.5934	0.009502**
Dl	0.00198547	0.00062781	3.1625	0.001564 **
Ad	0.00099190	0.01338042	0.0741	0.940906
Ind	0.00854736	0.00747495	1.1435	0.252844
Oci	0.00349903	0.00301809	1.1594	0.246313

Total Sum of Squares = 0.005037, Residual Sum of Squares = 0.0035753, R-squared = 0.29019, Adjusted R-squared = 0.19161, p-value = 0.011638

Note: Table shows results for the random effects model as it was determined to be most appropriate over the fixed and ols regression. No heteroskedasticity or serial correlation. (See results in Appendix B).

The first hypothesis of this study is examined using the results in Table 2. It states that Foreign Exchange Risk Management hasno significant effect on financial performance. From Table 2 it is ascertained that the p-value is 0.039141 (significant at 5% level) which provides sufficient evidence against the null hypothesis and it is therefore rejected.

The second hypothesis of the study is appraised using the results in table 3. The hypothesis states that Foreign Exchange Risk Management with Other Comprehensive Income has no substantive effect on financial performance. The results in Table 3 show that the p-value for the regression is 0.011638 (significant at 5% level) which offers adequate evidence against the null hypothesis and it is this rejected.

4. DISCUSSION

The results obtained from regressing Return on assets on Foreign Exchange Risk Management provide sufficient evidence to ascertain that the financial and operational hedging tools of derivative assets, Derivative Liabilities, Asset Diversification and Income Diversification have a positive significant effect on the financial performance of the banks in focus. This determination is in congruence with studies like Gideon (2013), Limo (2014), Mugi (2015) and Nzioka and Maseki (2017). The results also show that the model that included Other Comprehensive Income has a significant effect on the financial performance of the banks in focus in the study.

It is pertinent to note that the models in this study offered significantly lower variability (Total sum of Squares) than those of previous studies. In particular, it is observed that the models produced significantly lower Residual Sum of Squares values which is indicative of the models' appropriateness to fit the data for the study in comparison to those used in prior studies. Conversely, the study results show a lower R-squared value than other studies which may be attributable to the small dataset utilized for the analysis.

Upon comparison of the models in the study, it is observed that results from the model with Other Comprehensive Income had a higher R-squared value than the model without it.This implies that a greater part of the financial performance of the banks in focus in the study could be explained by the model with Other Comprehensive Income. Taking the Adjusted r-squared values of both results into cognisance, it is also determined that the model with Other Comprehensive income produced a significantly greater value than the model without it which is indicative of the improvement to the model that is provided by its inclusion and offers a measure of reliability to the improved R-squared value as well.. In addition, the p-value from the results with Other Comprehensive Income is also improved in comparison to the results for the model without it.

5. CONCLUSION

This paper examines the effect of Foreign exchange Risk Management on financial performance by varying the traditional proxies used in similar studies. Both financial and operational hedging perspectives were utilized in this study which is a shift from work done in other studies. This shift was catalysed by the Portfolio Theory which provides the framework for the combination of both Foreign Exchange Risk Management approaches for research and practice. The determination through the results obtained in this study is that Foreign Exchange Risk Management, utilizing both financial and operational approaches, has a significant positive effect on financial performance. It is also determined that the use of the proxies for both approaches in the models used were a better fit for research in this regard. Finally, it was ascertained that the inclusion of Other Comprehensive Income improved the model and thus provides a better assessment of the effect of Foreign Exchange Risk Management on financial performance.

Against this backdrop, it is recommended that management at banks consider utilizing the model developed in this study with the inclusion of Other Comprehensive Income to offer a holistic overview of the effect of their foreign exchange risk management strategies on their financial position with a view to optimization. With regard to further study, it is recommended that Other Comprehensive income be included in traditional models for foreign exchange risk management research to validate its effectiveness as determined in this study.

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APPENDIX A

Dataset

Year	*roa*	*da*	*dl*	*ad*	*ind*	*oci*	*fermi*
2012	0.05379	0	0	0.925	0.363	9.6772	0
2013	0.0595	7.8614	0	0.665	0.342	9.6843	0
2014	0.0623	10.395	9.24	0.458	0.25	9.4116	10.9977
2015	0.0569	10.8913	9.3832	0.406	0.13	9.3796	5.393865
2016	0.0634	11.1925	10.4811	0.719	0.286	10.8847	24.12287
2017	0.064542	10.9656	9.7248	0.706	0.1	10.8169	7.528662
2012	0.098226	0	10.1222	0.646	0.1591	8.9492	0
2013	0.087968	0	10.1661	0.61	0.062	9.0907	0
2014	0.0751	0	10.1007	0.544	0.02	8.5985	0
2015	0.06474	8.1973	9.0975	0.536	0.02	8.9532	0.799443
2016	0.06867	9.2846	9.3276	0.343	0.03	9.1108	0.891145
2017	0.06939	9.1201	8.8697	0.4805	0.264	9.1328	10.26138
2012	0.04655	0	0	0.722	0.042	8.7244	0
2013	0.04777	8.2307	6.5892	0.668	0.054	9.5024	1.956319
2014	0.04909	8.7241	8.4038	0.475	0.266	9.4613	9.263425
2015	0.04615	0	0	0.475	0.12	9.5459	0
2016	0.0448	9.0181	8.9945	0.494	0.777	9.5358	31.13437
2017	0.03834	9.4532	9.4161	0.583	0.305	9.8113	15.82772
2012	0.07774	0	8.0934	0.9971	0.1495	9.5483	0
2013	0.07544	9.5139	7.4914	0.8877	0.2383	9.9622	15.07689
2014	0.07296	9.8152	8.9745	0.714	0.161	9.0781	10.1259
2015	0.05375	9.2574	8.5146	0.873	0.118	9.9095	8.119879
2016	0.05497	10.027	7.1461	0.75	0.169	10.4297	9.082137
2017	0.06284	9.8982	8.0899	0.809	0.089	10.195	5.765512
2012	0.045636	0	0	0.916	0.07	7	0
2013	0.050909	0	0	0.741	0.008	9.1581	0
2014	0.05678	10.2278	9.7834	0.324	0.104	9.4064	3.371711
2015	0.05857	9.9285	8.5843	0.397	0.103	9.2435	3.485108
2016	0.0595	10.9183	10.825	0.438	0.228	9.8219	11.80299
2017	0.05832	10.7575	10.3182	0.605	0.187	9.4067	12.55776
2012	0.08172	10.3502	7.3042	0.453	0.981	9.4582	33.59608
2013	0.09556	10.3537	8.366	0.409	0.951	10.1855	33.69126
2014	0.08131	10.6627	9.5801	0.372	0.973	10.8237	36.97371
2015	0.08335	10.4586	8.4253	0.559	0.003	10.6141	0.147772
2016	0.10627	10.3181	9.848	0.646	0.878	11.2301	57.63348
2017	0.09327	10.0797	9.9976	0.738	0.933	10.6334	69.38752
2012	0.04164	0	0	0.67	0.18	9.6402	0
2013	0.03697	0	0	0.811	0.45	10.0411	0
2014	0.03483	0	0	0.807	0.638	9.3609	0
2015	0.03327	9.2601	0	0.779	0.444	9.8853	0
2016	0.0347	9.4389	7.1139	0.648	0.315	9.2553	13.70613
2017	0.03156	9.1129	8.9877	0.597	0.462	9.8895	22.59027

APPENDIX B_1

Descriptive Statistics

da	dl	ad	ind
Min. : 0.000	Min. : 0.000	Min. :0.3240	Min. :0.0030
1st Qu.: 0.000	1st Qu.: 6.720	1st Qu.:0.4764	1st Qu.:0.1008
Median : 9.272	Median : 8.549	Median :0.6460	Median :0.1835
Mean : 6.993	Mean : 6.842	Mean :0.6285	Mean :0.2958
3rd Qu.:10.296	3rd Qu.: 9.539	3rd Qu.:0.7402	3rd Qu.:0.3578
Max. :11.193	Max. :10.825	Max. :0.9971	Max. :0.9810

oci
Min. : 7.000
1st Qu.: 9.246
Median : 9.541
Mean : 9.630
3rd Qu.: 9.949
Max. :11.230

roa
Min.:0.03156
1st Qu.:0.04686
Median :0.05903
Mean :0.06141
3rd Qu.:0.07457
Max. :0.10627

>shapiro.test(da)
data: da
W = 0.69546, p-value = 4.888e-08
>shapiro.test(dl)
Shapiro-Wilk normality test

data: dl
W = 0.72241, p-value = 1.409e-07

>shapiro.test(ad)
Shapiro-Wilk normality test
data: ad
W = 0.97728, p-value = 0.5587
>shapiro.test(ind)
Shapiro-Wilk normality test
data: ind

```
W = 0.80751, p-value = 6.426e-06
>shapiro.test(oci)
        Shapiro-Wilk normality test

data: oci
W = 0.93206, p-value = 0.01521

>shapiro.test(roa)
        Shapiro-Wilk normality test
data: roa
W = 0.96745, p-value = 0.2705

kurtosis(da)
[1] -1.227435

>kurtosis(dl)
[1] -0.7738233

>kurtosis(ad)
[1] -0.9311149

>kurtosis(ind)
[1] 0.3123708
>kurtosis(oci)
[1] 2.228367

>kurtosis(roa)
[1] -0.5988872

>skewness(da)
[1] -0.834094

>skewness(dl)
[1] -1.008926

>skewness(ad)
[1] 0.1194083

>skewness(ind)
[1] 1.24518

>skewness(oci)
[1] -0.5314073
```

>skewness(roa)
[1] 0.4418044

vif(mymodel)
da dl ad indoci
2.206611 1.793352 1.433433 1.307310 1.694815

APPENDIX B_2
Inferential Statistics

Roa on Da, Dl, Ad, Ind
Pooling Model

Call:
plm(formula = y ~ x, data = Thesis_Data, model = "pooling")
Balanced Panel: n = 7, T = 6, N = 42
Residuals:
Min.1st Qu.Median 3rd Qu. Max.
-0.0376142 -0.0059289 0.0013899 0.0088254 0.0279101

Coefficients:
Estimate Std. Error t-value Pr(>|t|)

(Intercept)	0.03690820	0.01347498	2.7390	0.009424 **
xda	-0.00152821	0.00071169	-2.1473	0.038389 *
xdl	0.00364567	0.00079895	4.5631	5.392e-05 ***
xad	0.00668625	0.01574522	0.4247	0.673549
xind	0.02042119	0.00852582	2.3952	0.021786 *

—
Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.014747
Residual Sum of Squares: 0.0086212
R-Squared: 0.41541
Adj. R-Squared: 0.35221
F-statistic: 6.57299 on 4 and 37 DF, p-value: 0.00042224

summary(fixed)
Oneway (individual) effect Within Model

Call:
plm(formula = roa ~ da + dl + ad + ind, data = Thesis_Data, model = "within")

Balanced Panel: n = 7, T = 6, N = 42

Residuals:
Min.1st Qu.Median 3rd Qu. Max.

-1.1853e-02 -3.6047e-03 -2.3383e-05 3.6472e-03 1.4294e-02

Coefficients:

	Estimate	Std. Error	t-value	Pr(>|t|)
da	-0.00117089	0.00043775	-2.6748	0.011829 *
dl	0.00148458	0.00048806	3.0418	0.004756 **
ad	0.00353239	0.01080096	0.3270	0.745833
ind	0.00323443	0.00625289	0.5173	0.608639

—

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.0022724
Residual Sum of Squares: 0.0016578
R-Squared: 0.27046
Adj. R-Squared: 0.035121
F-statistic: 2.8731 on 4 and 31 DF, p-value: 0.039141

```
>random<- plm(roa ~ da + dl + ad + ind, data=Thesis_Data, model = "random")
>summary(random)
```

Oneway (individual) effect Random Effect Model
(Swamy-Arora's transformation)

Call:
plm(formula = roa ~ da + dl + ad + ind, data = Thesis_Data, model = "random")

Balanced Panel: n = 7, T = 6, N = 42

Effects:

	var	std.dev	share
idiosyncratic	5.348e-05	7.313e-03	0.828
individual	1.110e-05	3.332e-03	0.172
theta:	0.3327		

Residuals:

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.02800461	-0.00400575	0.00022281	0.00555747	0.02611051

Coefficients:

	Estimate	Std. Error	z-value	Pr(>|z|)
(Intercept)	0.04618053	0.01258628	3.6691	0.0002434 ***
da	-0.00139481	0.00062691	-2.2249	0.0260877 *
dl	0.00264011	0.00070906	3.7234	0.0001966 ***
ad	0.00438340	0.01465430	0.2991	0.7648480
ind	0.01407204	0.00808656	1.7402	0.0818281 .

—

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.0078271
Residual Sum of Squares: 0.005411

R-Squared: 0.30867
Adj. R-Squared: 0.23394
Chisq: 16.5204 on 4 DF, p-value: 0.0023948

Regression (Pooled OLS) with OCI

Call:
plm(formula = y ~ x, data = Thesis_Data, model = "pooling")
Balanced Panel: n = 7, T = 6, N = 42
Residuals:

Min.1st Qu.Median		3rd Qu.	Max.	
-0.03740140	-0.00639213	0.00078617	0.00927821	0.02364954

Coefficients:
Estimate Std. Error t-value Pr(>|t|)

(Intercept)	0.00173197	0.03601523	0.0481	0.96191
xda	-0.00186552	0.00077951	-2.3932	0.02204 *
xdl	0.00357707	0.00080043	4.4689	7.515e-05 ***
xad	0.00153075	0.01646691	0.0930	0.92645
xind	0.01646718	0.00930474	1.7698	0.08524 .
xoci	0.00440450	0.00418302	1.0529	0.29938

—
Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.014747
Residual Sum of Squares: 0.0083636
R-Squared: 0.43287
Adj. R-Squared: 0.35411
F-statistic: 5.49558 on 5 and 36 DF, p-value: 0.00073746
> fixed <- plm(roa ~ da + dl + ad + ind + oci, data=Thesis_Data, model= "within")

Call:
plm(formula = roa ~ da + dl + ad + ind + oci, data = Thesis_Data,
model = "within")

Balanced Panel: n = 7, T = 6, N = 42

Residuals:

Min.1st	Qu.	Median	3rd Qu.	Max.
-0.01177915	-0.00396236	0.00042321	0.00377289	0.01415757

Coefficients:
Estimate Std. Error t-value Pr(>|t|)

da	-0.00126475	0.00044245	-2.8585	0.007668 **
dl	0.00134462	0.00049964	2.6912	0.011526 *
ad	0.00220066	0.01079653	0.2038	0.839862
ind	0.00346489	0.00621871	0.5572	0.581544
oci	0.00278203	0.00237417	1.1718	0.250503

—

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.0022724
Residual Sum of Squares: 0.0015853
R-Squared: 0.30239
Adj. R-Squared: 0.046596
F-statistic: 2.60076 on 5 and 30 DF, p-value: 0.04545

Random
Call:
plm(formula = roa ~ da + dl + ad + ind + oci, data = Thesis_Data,
model = "random")

Balanced Panel: n = 7, T = 6, N = 42

Effects:
varstd.dev share
idiosyncratic 5.284e-05 7.269e-03 0.631
individual 3.093e-05 5.562e-03 0.369
theta: 0.5292

Residuals:

Min.1st Qu.Median		3rd	Qu. Max.	
-0.0213926	-0.0038579	-0.0014675	0.0041823	0.0212635

Coefficients:

	Estimate	Std. Error	z-value	Pr(>|z|)
(Intercept)	0.02134375	0.02797091	0.7631	0.445422
da	-0.00148250	0.00057164	-2.5934	0.009502 **
dl	0.00198547	0.00062781	3.1625	0.001564 **
ad	0.00099190	0.01338042	0.0741	0.940906
ind	0.00854736	0.00747495	1.1435	0.252844
oci	0.00349903	0.00301809	1.1594	0.246313

—
Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares: 0.005037
Residual Sum of Squares: 0.0035753
R-Squared: 0.29019
Adj. R-Squared: 0.19161
Chisq: 14.718 on 5 DF, p-value: 0.011638

APPENDIX B_3

Diagnostic and Post-estimation Tests

Hausman Test

data: roa ~ da + dl + ad + ind
chisq = 11.127, df = 4, p-value = 0.02517
alternative hypothesis: one model is inconsistent

>pFtest(fixed,pooling)
F test for individual effects

data: roa ~ da + dl + ad + ind
F = 21.702, df1 = 6, df2 = 31, p-value = 7.728e-10
alternative hypothesis: significant effects

>bptest(roa ~ da + dl + ad + ind, data=Thesis_Data, studentize = F)

Breusch-Pagan test

data: roa ~ da + dl + ad + ind
BP = 7.0649, df = 4, p-value = 0.1325
>pbgtest(fixed)
Breusch-Godfrey/Wooldridge test for serial correlation in panel models
data: roa ~ da + dl + ad + ind
chisq = 11.41, df = 6, p-value = 0.0765
alternative hypothesis: serial correlation in idiosyncratic errors

Hausman Test
data: roa ~ da + dl + ad + ind + oci
chisq = 6.2012, df = 5, p-value = 0.2871
alternative hypothesis: one model is inconsistent

Lagrange Multiplier Test - (Honda) for balanced panels
data: roa ~ da + dl + ad + ind + oci
normal = 4.9023, p-value = 4.735e-07
alternative hypothesis: significant effects

Breusch-Pagan test
data: roa ~ da + dl + ad + ind + oci
BP = 6.5453, df = 5, p-value = 0.2567

Breusch-Godfrey/Wooldridge test for serial correlation in panel models
data: roa ~ da + dl + ad + ind + oci
chisq = 11.693, df = 6, p-value = 0.06918
alternative hypothesis: serial correlation in idiosyncratic errors