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Endogeneity Quagmire Empirical Evidence from Telecommunication Industry of Pakistan

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Purpose: The current research aims to analyze the particular quagmire of endogeneity by considering panel data with the renowned challenge of limited periods.

Design/Methodology/Approach: This study employed panel data generalized method of moments (GMM) approach.

Findings: Results show a presence of a significant and a negative relationship between operational risk and management performance and returns, thereby emphasizing the importance of operational risk management for enhanced performance in light of the theory of performance frontiers introduced by Schmenner and Swink in 1998.

Implications/Originality/Value: The results suggest that the focus on operational risk management should be revitalized if the firms seeks an improved performance and a sustainable competitive advantage.

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Introduction

The role of risk management has garnered significant attention of the years and often becomes the subject of the spotlight following corporate failures and crashes. Researchers and experts have followed a reductionist approach and broken down "Risk" into several categories. Of these categories, Operational Risk has remained one of the most underrated risks and received well-deserved attention by the Basel Committee in the 1996 reforms.

Myriad researches have attempted to explore the impact of operational risk on a firm. These include Mseddi and Abid, (2004), etc. Among the service industries used in similar research, available literature that seeks to examine the criticality of operational risk on novel industries such as Telecommunications is extremely scarce. Telecommunications, being a complex area can have a plethora of operational failures manifesting in the form of service level agreements

(SLAs), regulatory penalties by authorities, employee risks (retention, motivation, frauds, training, etc), processes risks, and so on. Operational Risk Management offers a potential solution for addressing the requirement for a centralized approach for the management of all such risks. Examining the applicability of this idea in an emerging industry would be ideal in this regard as novel and emerging industries are highly regulated, flexible, and offer transparent interpretations when juxtaposed with matured industries.

Another crucial factor is that rationalist researchers have focused on the explanation of the phenomenon of operational risk, while empiricists divert their efforts in analyzing the phenomenon through empirical testing. From an empirical point of view, the effectiveness of the research is contingent upon the underlying assumptions and how well the research models incorporate the ad-infinity variables which differ within and across the samples. From a rationalist's point of view, these variables or changes can be broadly understood as endogeneity that has impacted tremendous research and their interpretations. Addressing the issue of endogeneity in a complex area of Operational Risk becomes imperative in this context of Telecoms. Telecoms undertake long-haul projects with a life span extending up to 40 years, according to which the "Risk Avoidance" option is often ruled out. Williams et al, (1998) classified management of operational risk as pivotal for telecoms due to this assumption.

This research follows a holistic view of examining the phenomenon of operational risk in telecommunication organizations with minimum subjectivity in empirical testing. The purpose of this paper is double faceted. First, to explore whether operational risk influenced a telecommunication organization. Second, to thoroughly justify the appropriateness of an econometric model that adequately applies in the Telecommunication Industry of Pakistan with each company being significantly different from the other in different aspects (Endogeneity). Pakistan Telecom Industry is one of the fastest-growing industries in South Asia with nearly 100 million cellular users employing almost 1.36 million people.

Operational risk has been examined in detail by researchers, however, one easily observes the proclivity of the application of this concept to the financial sector. The paper contributes to the existing literature by presenting the application of operational risk to Telecoms. The paper also addresses the recommendation of inclusion of an inter-temporal choice of model as highlighted by Basak and Buffa (2015). Other contributory aspects include Additional dimensions of the volatility of earnings and earnings cover is encouraged for future research and segregation of performance metrics (returns) for internal management and shareholders.

The remainder of the paper is presented as follows: Section 2 explains the problems associated with endogeneity in panel data, Section 3 proposes the methodology to deal with the issue of endogeneity in context of telecoms, Section 4 presents the empirical analysis of the study followed by conclusions and discussions on the findings of the paper.

Dealing with Endogeneity

The term endogeneity is often quoted in analyzing results from regression models and refers to a state where explanatory variables correlate with the error term or whether two error terms show a correlation whenever we deal with structural equation modeling. The problem with endogeneity is that it can result in inconsistent estimates i.e. estimates do not represent true values as the sample size is increased, which can lead to potential wrong inferences along with misleading conclusions and incorrect theoretical interpretations. In the presence of endogeneity bias, according to Ketokivi and McIntosh (2017), researchers may not even get the right coefficient signs for their studies.

Recognizing that other models may exist, which are equally plausible on logical grounds, is considered excellent academic practice in most cases. When developing hypotheses and models, researchers should rely on solid theoretical justifications to guide them in the right direction. According to Wawro (2002), the estimators which are calculated using 2SLS/3SLS approach will be consistent, however, these estimates will be inefficient as compared to the GMM model.

GMM approach eliminates endogeneity by "internally transforming the data"- Internal transformation refers to a statistical technique in which a variable's prior value is removed from its current value (Roodman, 2009). It is therefore possible to lower the number of observations while simultaneously increasing the efficiency of the GMM model through this procedure (internal transformation) (Wooldridge, 2012). Hence GMM approach is one of the best techniques for elevating endogeneity.

Data and Methodology

This study examines the relationship between operational risk and a firm's financial performance.

Table (3.1) Variables description and sources

Variable	Description	Units	Source
AU	Asset Utilization	Ratio	Financial Statements
ROA	Return on Assets	Ratio	Financial Statements
ROE	Return on Equity	Ratio	Financial Statements
RE	Reserves to Equity Ratio	Ratio	Financial Statements
ER	Efficiency Ratio	Ratio	Financial Statements
DOL	Degree of operating leverage	Ratio	Financial Statement

For measuring a firm's performance, we used return on assets, since the majority of the companies in the Pakistan telecommunications industry are from the private sector, the current research has relied on the classical measures of organizational performance i.e. Return on Equity, Return on Assets, and Asset Utilization. Return on Equity is preferred for measuring the efficiency of management and an entity's financial performance. Gatsi et al., (2016) argue that ROE is the most critical indicator for measuring financial performance as well as growth potential. The use of asset utilization proxy is in accordance with the research carried out by Wang (2010). The efficiency ratio, which may be determined by dividing operating expenditures by gross earnings, can be used as a proxy for operational risk. The population of this study consists of 16 companies from the telecommunication sector. The selection of the companies is based on telecom licenses issued by Pakistan Telecommunication Authority. The sample period ranged from 201-2017.

Econometric Model

$$AU_{it} = \alpha_0 + \beta_1 RE_{it} + \beta_2 DOL_{it} + \beta_3 ER_{it} + \varepsilon_{it} \dots\dots\dots 3.1$$

$$ROA_{it} = \alpha_0 + \beta_1 RE_{it} + \beta_2 DOL_{it} + \beta_3 ER_{it} + \varepsilon_{it} \dots\dots\dots 3.2$$

$$ROE_{it} = \alpha_0 + \beta_1 RE_{it} + \beta_2 DOL_{it} + \beta_3 ER_{it} + \varepsilon_{it} \dots\dots\dots 3.3$$

Where i represent a firm or a company ($i=1...14$) and t represents period ($t=2012....2017$), equation 1-3 is a general specification allowing for dynamic operational risk effects, and also a stochastic error term which is represented by (ε) .

Generalized Method of Moments

The Linear Dynamic Panel Model was utilized in this investigation (Arellano and Bond, 1991). The model incorporates the impacts of unobserved panel-level effects, which can be either fixed or random in distribution. This technique has been developed particularly for cases in which cross-sections are greater than the periods (Arellano and Bond, 1991).

In this model, there are also a number of analyses that may be used, such as homoscedasticity, cross-sectional, Linear Factor Models, and the Sargan test of over-identifying restrictions. GMM delivers more reliable judgments because it employs approaches that specifically target orthogonality criteria that were present in both the lagged variable and the error term (Arellano & Bond, 1991; Arellano & Bover, 1995). Even more robust and trustworthy measurements may be obtained using GMM, which handles autocorrelation, heteroscedasticity, and endogeneity problems (Blundell and Bond, 1998; Windmeijer, 2005). The following regression equation is an example:

$$y_{it} - y_{it-1} = (\alpha - 1)y_{it-1} + X_{it}\beta + n_{it} + y_t + \varepsilon_{it} \quad (3.4)$$

Where y is the logarithm of financial performance, X presents the range of descriptive variables other than insulated financial performance, η is an unnoticed industry specific effect, γ is a time-specific effect, ε is the error term, and the subscript “ i ” and “ t ” is organization and period, respectively. Equation (1.1) can be rewritten as:

$$y_{it} = \alpha y_{it-1} + X'_{it}\beta + n_i + y_t + \varepsilon_{it} \quad (3.5)$$

And to remove the industry-specific effects, Equation (3.5) is taken as first differenced, like the following:

$$\Delta y_{it} = \alpha \Delta y_{it-1} + \Delta X_{it}\beta + \Delta y_t + \Delta \varepsilon_{it} \quad (3.6)$$

To utilize this tool it is essential to account for possible endogeneity of the descriptive variables, and secondly, the difficulty resulting from establishing the latest error term, $\Delta \varepsilon_{it} = (\varepsilon_{it} - \varepsilon_{it-1})$, that is in connection with the lagged dependent variable, $\Delta y_{it-1} = (y_{it-1} - y_{it-2})$.

The GMM dynamic panel information estimator produces the following moment conditions when the error term, is assumed to be unlinked and the descriptive variables, X , are assumed to be inadequately exogenous (that is, when the descriptive variables are orthogonal to the prospect realizations of the error term).

$$E[y_{it-s}\Delta \varepsilon_{it}] = 0 \text{ for all } s \geq 2, t = 3, \dots, T \quad (3.7)$$

$$E[X_{it-s}\Delta \varepsilon_{it}] = 0 \text{ for all } s \geq 2, t = 3, \dots, T \quad (3.8)$$

And so, the instruments for this differenced equation are descriptive variables that lagged at least twice. The GMM estimator depends upon above mentioned moment conditions is said to be different estimator (or difference GMM).

Empirical Analysis

Descriptive Statistics

Table 4.1 – Descriptive Statistics

Description	AU	DOL	ROA	ER	RE	ROE
Mean	0.539	-20.358	-0.012	2.629	0.198	0.131
Median	0.472	0.181	0.027	0.644	0.403	0.062
Maximum	1.296	15.717	0.423	150.220	3.910	3.271
Minimum	0.001	-1616.000	-1.057	-2.610	-7.024	-0.572
Std. Dev.	0.278	184.256	0.185	17.090	1.218	0.510
Skewness	0.435	-8.600	-3.088	8.528	-2.244	4.468
Kurtosis	2.790	74.976	17.504	74.164	18.896	26.168
Sum	41.480	-1567.576	-0.900	202.450	15.277	10.095
Sum Sq. Dev.	5.857	2580222.000	2.596	22195.920	112.687	19.752

For performance-related measures, The Return on Assets (ROA) of Telecommunications has a mean of -0.012, while the minimum and maximum are -1.057 and 0.423 percent respectively. Return on equity (ROE) has a mean value of 0.131 with minimum and maximum values of -0.572 and 3.271. Asset utilization has a mean value of 0.539. the minimum and maximum values are 0.001 and 1.296. With regards to operational risk, the mean efficiency ratio (ER) is 0.688 while the maximum and minimum value is 4.998 and -2.610 respectively. Reserves to Equity ratio have a mean of 0.198, while the maximum and minimum are 3.910 and -7.024 respectively. For testing multicollinearity, regression, and variance inflation test have been conducted. The tables below show the results of a simple regression of variables and variance inflation factor (VIF). Results of regression indicate the absence of multicollinearity. For VIF, a value greater than 10 is an indicator of multicollinearity of severe nature. Since the highest value given in the table below is 1.38, it can be reasonably concluded that multicollinearity is not a problem for the data used in the study.

Table 4.2 - Correlation Matrix

	AU	ROA	ROE	DOL	ER	RE
AU	1.000					
ROA	0.182	1.000				
ROE	-0.108	-0.091	1.000			
DOL	0.015	0.075	-0.079	1.000		
ER	-0.025	0.165	0.137	0.112	1.000	
RE	0.054	-0.389	-0.223	0.041	-0.510	1.000

Table – 4.3 Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
ER	1.38	0.722057
RE	1.37	0.730049
DOL	1.03	0.974529
Mean VIF	1.26	

Table-4.4 – Tests For Normality

Description	AU	DOL	ROA	ER	RE	ROE
Jarque-Bera	2.572	17569.800	797.303	17181.130	875.279	1978.238
Probability	0.276	0.000	0.000	0.000	0.000	0.000

Correlation values in table 4.2 are below the threshold of 0.9 which states that there no multicollinearity among the variable of the study. Table 4.3 shows VIFs of all values below 2, affirming that multicollinearity will not affect the coefficients and p-values.

This section details the findings of the application of panel data models Fixed Effect, Random Effect, and GMM. Since our relevant model for the research is GMM, results of the Fixed Effect and Random Effect models are presented for the sake of comparison.

Table 4.7: Comparison of Results - Fixed and Radom effect Regression Vs GMM One-Step & Two-Step as Performance as Dependent Variable

Variables	Fixed Effect	Random Effect	Generalized Method of Moments	
			One Step Results	Two-Step Results
Asset Utilization (AU) is the dependent variable				
AU L1	-	-	0.363* (0.162)	0.364* (0.057)
DOL	0.002 (0.004)	0.002 (0.004)	-0.003* (0.004)	-0.002* (0.002)
ER	0.007 (0.017)	0.007 (0.016)	0.002* (0.020)	-0.011** (0.011)
RE	-0.004 (0.017)	-0.003 (0.017)	-0.004** (0.012)	-0.010 (0.007)
Return On Assets (ROA) is the dependent variable				
ROA L1	-	-	-0.124* (0.047)	-0.135* (0.009)
DOL	0.002 (0.004)	0.003 (0.004)	0.001 (0.003)	-0.001 (0.001)
ER	-0.014 (0.018)	-0.011 (0.017)	-0.047 (0.029)	-0.050* (0.004)
RE	-0.080* (0.017)	-0.074* (0.017)	-0.088* (0.004)	-0.091* (0.002)
Return On Equity (ROE) is the dependent variable				
ROE L1			0.376* (0.166)	0.373* (0.010)
DOL	-0.030** (0.014)	-0.017 (0.055)	-0.009 (0.011)	-0.008* (0.004)
ER	0.100*** (0.058)	0.047 (0.053)	0.278 (0.225)	-0.278* (0.031)
RE	-0.067 (0.060)	-0.079 (0.055)	0.053 (0.138)	-0.052* (0.016)

*, **, *** represents significant at 1%, 5% and 10% respectively and standard errors are in parenthesis

Our main methodology in this research study is the generalized method of moments (GMM) as the number of cross-sections (14 firms) is greater than the period (5 years) shows better results. Results are further augmented by applying 1 & 2 step results of GMM, for return on assets, GMM step-1 shows a significant relationship of performance with all three proxies of operational risk, however, GMM step-2 shows an insignificant relationship for reserves to equity ratio in contrast to GMM step-1. GMM step 2 results are better for Return on Assets and Return on equity as compared to step-1. A common aspect of the results of both aspects is the presence of an insignificant relationship of Degree of operating leverage and performance measure (ROA). For return on equity, results under GMM step-2 are comparatively better. ROE shows significant relationships with operational risk under GMM step 2 and shows no such significant relationships for GMM step 1.

The efficacy of results of GMM Step-2 is further augmented by the deployment of Under identification and Over Identification tests as given in Tables 4.10 and 4.11. Under identification test results, insignificant P-values show that the number of instrumental variables used in GMM Step-2, are not less than endogenous variables in the data suggesting absence of under identification. Results of Over Identification tests in Table 4.11 also show insignificant P-values i.e. Instruments are valid instruments. Over Identification test shows whether the instruments correlate with the error term. It considers both included and excluded variables and also accounts for collinearity. Both tests are widely used for analyzing the application of GMM.

According to Wooldridge (2001), GMM is well suited for obtaining efficient estimates that account for Heteroscedasticity and serial correlation. Table 4.9 shows presence of heteroscedasticity thereby fulfilling the recommendation of Wooldridge (2001). A basic Rule of Thumb is suggested by Arellano and Bond (1998) is that dynamic panel model should be initially estimated by pooled OLS and approaches like Fixed Effect. If the Difference GMM (Step 1) estimate obtained is close to or below the estimate of Fixed Effect, this indicates presence of downward bias due to weak instrumentation and results of system GMM (Step 2) will yield efficient estimates as compared to any other models.

From the point of view of accounting and finance, a possible challenge is the use of ROA and ROE values used in the research. Since both measures, rely on common returns, this might indicate the presence of a similarity to some extent. In order to account for this, Kruskal Wallis Test has been used. The test has been used to determine whether the impact of the three variables AU, ROA and ROE is the same. Higher value of H-stat as compared to Chi-Sq indicates the rejection of the null hypothesis that the three samples are the same.

Other Tests

Table 4.8: Ramsey reset test

	Model 1	Model 2	Model 3
Description	Ramsey RESET test AU	Ramsey RESET test ROA	Ramsey RESET test ROE
Ho	Model Has No Omitted Variables	Model Has No Omitted Variables	Model Has No Omitted Variables
F(3,70)	106.67	8.54	47.13
Prob > F	0.00000	0.00010	0.00000
Results:	Model Is Truly Specified	Model Is Truly Specified	Model Is Truly Specified

Table 4.9 : Breusch-Pagan / Cook-Weisberg test for Heteroskedasticity

Description	Model 1	Model 2	Model 3
	Fitted values of AU	Fitted values of ROA	Fitted values of ROE
Ho	Constant Variance	Constant Variance	Constant Variance
Chi-Sq	0.27	1.14	19.69
Prob> Chi-Sq	0.6061	0.2847	0

Table 4.10 : Under Identification Test

Hansen J Test Value	Model 1- With AU As Dependent Variable	Model 2- With ROA As Dependent Variable	Model 3- With ROE As Dependent Variable
Chi-Square	253.259	312.7749	331.5414
P-Value	0.0001	0.0034	0.0033

Table 4.11 : Over Identification Test

Sargan Test Value	Model 1- With AU As Dependent Variable	Model 2- With ROA As Dependent Variable	Model 3- With ROE As Dependent Variable
Chi-Square	7.771043	9.239353	9.72132
P-Value	0.5574	0.4155	0.3735

Table 4.12 : Kruskal Wallis Tests (N-1) (5) D.O.F

Chi-Square Value	11.071
H-Stat Value	97.92

The findings are supported by the existing literature according to which improvement in capacity management primarily drives cost operational efficiency consequentially reducing the firm's operational risk thereby enhancing asset utilization (Kuhn et al., 2012). The research supports the existing literature, in the sense that a negative relationship exists between operational risk and firm performance. Other studies that found the same result include the studies of Soyemi et al., 2014; Tamimi et al., 2015; and Maytham et al., 2013. In contrast with the existing literature, the present study did not find any relationship between the degree of operating leverage and return on assets. With regards to the impact of operational risk on performance is best reflected in the results of Return on equity. All three proxies of operational risk have resulted in significant relationships with return on equity in accordance with the results in the literature. A big departure from the results of the existing literature is the comparison of the strength of the significant relationships, the present study has found. Although the direction of the relationships is in accordance with the previous literature, the strength of the relationships is not. After comparison with the works of previous researchers, the possible reasons for the deviation of results are:

The sector undertaken for the study could be a very significant reason for deviation of the results from existing literature. For instance, while measuring the impact of operational risk the researches of Gill et al., (2014) comprised of Manufacturing companies only. Gadzo et al., (2019), Shamsuddin et al., (2018) and Muriithi and Waweru, (2017) included only commercial banks, Chen et al., (2015)'s research of operational risk and its implications on performance was based on the insurance industry. The current research included Telecommunication companies belonging to the service sector of Pakistan.

Conclusion

The research was aimed to explore the influence of "Risk", more specifically "Operational risk" on organizational financial performance. After clarifying what risk and risk management is, the research continues with the discussion of the implications of risks inherent in business due to the course of its operations i.e. operational risk in different industrial sectors. Operational risk is explained in light of concepts given by The Basel Committee and the British Bankers Association.

Results indicate that the financial performance of the telecommunication organization is significantly influenced by operational risk. The direction of the relationship is negative, suggesting an increased operational risk deteriorates financial performance.

Though the research was able to identify significant relationships of operational risk with a firm's financial performance, it can also be used as the basis for future studies that aim to explore the corresponding impact of operational risk on other dimensions of telecommunication industries. As explained earlier, operational losses can have many serious consequences for

telecommunication companies. Apart from catastrophic examples, many other examples such as loss of key management personnel, frauds, system breakdowns, inappropriate processes, legal fines, etc. are prevalent in the telecommunication sector of Pakistan. Operational failure of telecommunication companies can have serious consequences for other companies belonging to different sectors that rely on telecoms for the quick flow of information and connectivity.

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