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Judicial Efficiency and Corporate Innovation: Moderating Role of Governance

Muhammad Salman Shahzad[a*], Dr. Hamid Ullah[b], Dr. Amir Hussain[c]

[a]Scholar, Islamia College Peshawar. [b]Assistant Professor, Islamia College Peshawar. Assistant Professor, Institute of Management Studies, University of Peshawar.

[*]**Email:** Ims.hamid@gmail.com

***Abstract*:** This research examined that how well the judicial system works and its effect corporate innovation which measured through investments in research and development activities (R&D). The study also tests the moderating role governance in this relationship. The study used judicial data acquired from the World Bank's Doing Business database for the sample period from 2008 to 2019 whereas other variable data collected from the companies published reports. Correlation and Panel data analysis were employed for the analysis purpose. The regression results show that there exists a positive and significant effect of the Judiciary efficiency on firm's innovation. Moreover, the governance is also found to have a significant and positive moderating effect. These results support that efficient judicial systems boost corporate innovation by reducing uncertainties and creating a better environment for R&D. Additionally, strong governance further enhances the significant impact of judicial efficiency on corporate innovation, suggesting that good governance practice complement the judicial system in enhancing corporate innovation.

Keywords: Judicial Efficiency, Corporate Innovation, R&D Investments, Governance, Legal Systems and Economic Development.

1. Introduction

The effectiveness of justice system may have a huge impact on the capacity to engage in innovative practices. In the theory, a skilled legal system that resolves intellectual property disputes quickly and predictably can stimulate to various companies create innovations from the beginning by reducing uncertainty and anticipated legal costs. The inefficiencies found in patent litigation are largely due to a lack of specialized knowledge among judges in the patent law and technology. De Jong et al. (2008) propose that economy and institutional characteristics of a country can differently impact firms' capital structure decisions based on their specific attributes. For instance, the strength or weakness of judicial systems will influence the capital structure choices of small versus, high level of corporations with varying levels of physical assets, and the companies with different degrees of cash flow volatility. This differentiation provides a clearer understanding of the 'structural impact' of judicial system on debt ratio, as discussed by Jappelli et al. (2005) and Fabbri and Padula (2004).

In the book of, Bessant and Tidd (2007) describe organizational innovation as changing an existing structure through the introduction of new elements. This often results in efficient revisions to the firm's business model, product line, or operating procedures. Aghion et al. (2005) suggests that the divergent impact in the market on competitive level on innovation are not overall restricted; rather, their all impact rely on how increased competition influence market competitiveness and firms able to earn profit from effective innovations. The importance of a well-functioning legal system for fostering innovation is widely acknowledged, the aim of firm's governance in

shaping this dynamic is less explored. In contrast, Arrow (1962) highlighted that increased competition could actually promote innovation by rendering markets more open to competition, motivating both established and emerging firms to engage in innovative endeavors. Although the importance of governance in moderating the link between judicial performance and entrepreneurial innovation has been widely recognized in theory, but there is still a limited empirical research avalible in this domain. Thus findings of the research would help policymakers who aim to create legal and regulatory structures that promote corporate innovation. The objectives of this study are to fill this gap by examining the influence of judicial efficiency on corporate innovation and also to examine the moderating role of corporate governance in the case of emerging markets.

2. Literature Review

2.1 Legal Origin Theory

Djankov and Shleifer (2003) propose a theory of legal origins. This theory suggests that countries with effective legal systems often related to common law traditions, tend to experience higher economic development. On the other hand, La Porta and Silanes (1997) extended the theory of legal origins to corporate governance. It emphasizes how legal traditions influence organizational decision-making and behavior. Djankov and Shleifer (2003) build a strong relationship between an effective legal system and economic progress. This foundational research sets the basis for examining how judicial performance influences organizational scope. La Porta and Silanes (1997) immerse in the effects of two legal systems on organizational decision-making. The study examines whether companies with more effective legal systems engage in higher levels of innovation and risk-taking.

2.2 Judicial Efficiency

The judicial system plays an important role in this matter, not just in protecting what society believes is right, but also in deciding how well the economy does (Falavigna et al., 2019; Ippoliti & Vatiero, 2014). In fact, a good judicial system promote advancement in financial markets (Bae, K.H & Goyal, 2009; Fabbri, 2010, Qian & Strahan, 2007), entrepreneurship (Falavigna et al., 2019; Ippoliti, Melcarne, & Ramello, 2015), and firm growth (Beck, Demirguc-Kunt, & Maksimovic, 2006; Laeven & Woodruff, 2007). Efficient judicial system play important role in multiple terms for instance a well-functioning judicial system provides a secure environment for entrepreneurs by allowing them to address violations of law. Secondly, the performance of courts can affect entrepreneurship activities at a financial level (Galanter, 1974). A significant portion of this literature deliberates on the fundamental balance between judicial independence and judicial accountability (Djankov et al., 2002). Hence, it is imperative for a judicial system to not only maintain impartiality but also demonstrate accuracy and efficiency.

2.4 Moderating Role of Governance

Wang and Qian (2023) proposed that strong governance principles play a vital role in strengthening the significant impact of effective legal systems on innovation. The results show that, when good governance practices are in place it act as a catalyst for companies to essentially allocate resources for research and development (R&D). The interplay between governance and legal efficiency has become fundamental in promoting and supporting enterprise innovation. This means that a well-regulated business environment not only benefits from an efficient legal system but also promote innovation in the company.

2.6 Other Variables

2.6.1 Firm Size, Debt Ratio Profitability and Research and Development)

Schumpeter (1951) hypothesized that the scale of operations is an important factor in determining a company's creativity. However, Audretsch (1988) produced inconsistent results. R&D investment in large industrial firms presents a negative relationship with firm size. While small & medium-sized listed companies show a positive relationship (Jabeen et al., 2019), Zhang and Zhong (2014) identified a positive connection among company size and corporate innovation investment.

Profitability has become another influential factor at the firm level (Crowley & Burke, 2018). Greater profits allow greater assets to be allocated to innovation operations (Mairesse & Mohnen, 2002), although some studies suggest that higher profit may not have a significant impact (Diéguez-Soto et al., 2016). Cai et al. (2013) found the increase in debt ratio especially stimulating investment in innovation in the chemical industry. While finding from developing industries suggests that high debt ratios hinder corporate innovation investment (Fu et al., 2016), the size of business ventures is often cited as a factor. Another effect (Blundell et al., 2010) is that longer-lived

companies tend to be more familiar with the corporate innovation landscape. This reduces innovation risk and promotes innovation efforts (Yuan & Yang, 2010). Despite opposing views (Shen & Zou, 2018), Cheng and Dai (2012) argue that the form and scope of state regulations vary from employer to employer. Including various types of property rights that affect the organization's innovative behavior. Notable exceptions include the studies of Meulbrook, Mitchell, Mulherin, Netter, and Poulsen (1990) as well as Mahoney, Sundarmurti, and Mahoney (1997). Their work delves into the effects of anti-takeover measures on long-term investment. It shows that companies' compliance with such requirements will reduce capital expenditures and R&D expenditures relative to sales.

2.7 Hypothesis Testing

2.7.1 Judicial Efficiency and Corporate Innovation

The primary aim of investing in R&D within businesses is largely to enhance innovation performance, ultimately bolstering the firm's competitiveness in the market and positively impacting its economic standing. Numerous scholars have identified the significant correlation among R&D expenditure and firm growth (e.g., Pieri et al., 2018). The current study examined judicial efficiency through two indicators: the duration (measured in days) from case filing to resolution (Case Duration) and the probability of a case being appealed by either party (Appeal Rate). Holding other factors constant, it is expected that an efficient judge would render decisions more promptly, spending less time on familiarizing themselves with precedents and comprehending the asserted patents' claims. In other words, a proficient judge tends to result in shorter case durations.

H1: There exists significant impact of judiciary efficiency on corporate innovation.

H2: The governance significantly moderates the relationship of judiciary efficiency and corporate innovation.

3. Research Methodology

This part of the study outlines the different methods available to the researcher, and defined the framework for conducting the research. It focuses on a quantitative approach to guide the study.

3.1 Research Approach

The approach to the research plays a key influence on forming the research methodology by helping identify underlying assumptions in the research process. The approach taken in conducting the research is influenced by the assumptions formed from the chosen philosophy (Flick, 2011). This study follows an positivist's approach, where quantitative data collected from various World Bank database and firm annual reports.

3.2 Research Model

The research model includes corporate innovation as the dependent variable and judicial efficiency is the independent variable. The main objective of research is to examined the impact of the judicial efficiency on corporate's creation and moderating role corporate governance.

The empirical model can be specified as follows:

$$CI_{it}=\beta_0+\beta_1 JE_{it}+\beta_2 CG_{it}+\beta_3(JE_{it}\times CG_{it})+\beta_4 FS_{it}+\beta_5 P_{it}+\beta_6 DR_{it}+\beta_7 FA_{it}+\epsilon_{it}$$

Where:

β_0 represent the constant term.

CI_{it} represent corporate innovation for firm *i* at time *t*

JE_{it} represent judicial efficiency for firm *i* at time *t*

CG_{it}represent corporate governance for firm *i* at time *t*

And the remaining variables which are FS_{it} , P_{it} and FA_{it} are regulated variables for firm *i* at time *t*.

ϵ_{it} is the error term.

This model able to examine both the direct influence of judicial efficiency on corporate innovation and the mediating impact of company's management on this connection.

3.3 Type of Study

This study employs a quantitative approach, using numerical data to examine how judicial efficiency influences corporate innovation. Additionally, it explores the mediating impact of governance on this connection. Data for the analysis was sourced from multiple platforms, including the World Bank's Doing Business index and companies' annual reports spanning the years 2008 to 2019. Statistical techniques such as correlation and panel data regression were applied to evaluate the connections between the variables.

3.4 Sample of the Study

The sample time period of judicial data from 2008 to 2019 were acquired from World Bank's Doing Business database. The substitutes encompass the following: (a) the duration, measured in days, from the initiation of a judicial case to the execution of the courts final decision. To evaluate judicial efficiency, we use the reciprocal of this duration, denoted as TID. (b) expenses related to litigation; (including legal fees compulsory full service fee and estimated attorney's fees) expressed as a percentage of the claim amount, which is represented by the symbol COC and, (c) The number of actions that must be taken to release a case from diapers provided for the enforcement of a court decision, represented by PNUM. Firms' level data collected from the non-financial sector of 312 firms representing all sectors except financial sector which is entirely different in its financial makeup.

3.5 Variables Symbols and Measurement

Table 1: Variable description

Variables	Symbol	Measurement	References
Judicial Efficiency	JE1	Sub-Index from the Economic Freedom	Hamid, Hussain and Haq(2017)
		Initiated cases/disposed off	
	JIE2	Pending cases by district Population	
	JIE3	Time taken by court to conclude cases	
	JIE4		
Firm Size	FSIZE	Record the nature of the entire agreement.	Hamid, Hussain and Haq(2017)
Debt ratio	DE	Ratio of long term liabilities to total liabilities	Hamid, Hussain and Haq(2017)
Perf	ROA	Return to total assets ratio	Khlifi and Zouari(2022)
Corporate Innovation	cinv1	R&D expenditures to total sales	Xu and Sim(2018)
	cinvo2	R&D expenditures to total assets	Xu and Sim(2018)

4. Results and Discussions

4.1 Descriptive Statistics

Table 2 presents descriptive statistics for the variables used in this study. It includes number of observations (N), mean and standard deviation. Minimum and maximum values.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
cinv1	7524	.045	.141	0	.991
cinvo2	7524	.048	.141	0	.998
cg1	7524	-1.083	.081	-1.233	-.941
cg2	7524	-1.04	.079	-1.19	-.91
JE1	7524	3.537	.29	3.11	4.11
JIE2	7524	1.454	.885	0	6.361
JIE3	7524	.177	.244	.003	.9
JIE4	7524	1.015	1.382	0	3.03
Latf	7524	.373	.321	0	2.901
Mb	7524	4.774	5.207	0	19.973
Lev	7524	.449	.272	0	.9
Size	7524	6.212	.915	0	8.885
Mcap	7524	21.733	10.037	7.466	41.415

cinv1 and cinvo2: Both variables, have a mean close to 0.045 and 0.048 respectively, with standard deviations of 0.141. The values range from 0 to approximately 0.991 and 0.998.

cg1 and cg2: These variables, have negative means of -1.083 and -1.04 respectively. Their standard deviations are 0.081 and 0.079, with values ranging from -1.233 to -0.941 and -1.19 to -0.91.
JE1: JE1 mean vale is 3.537 and a standard deviation of 0.29. Range of values is from 3.11 to 4.11.
JIE2, JIE3, and JIE4: These variables show considerable variability. JIE2 has a mean of 1.454 with a standard deviation of 0.885, ranging from 0 to 6.361. JIE3 has a mean of 0.177 with a standard deviation of 0.244, ranging from 0.003 to 0.9. JIE4 has a mean of 1.015 and a higher standard deviation of 1.382, with values ranging from 0 to 3.03.
Latf: This variable has a mean of 0.373 and a standard deviation of 0.321, with values ranging from 0 to 2.901.
Mb: This variable has a relatively high mean of 4.774 and a standard deviation of 5.207, indicating substantial variability with values ranging from 0 to 19.973.
Lev: This variable has a mean of 0.449 and a standard deviation of 0.272, with values ranging from 0 to 0.9.
Size: This variable has a mean of 6.212 and a standard deviation of 0.915, with values ranging from 0 to 8.885.
Mcap: This variable has the highest mean of 21.733 and a standard deviation of 10.037, with values ranging from 7.466 to 41.415.
These analyses indicate that the variables exhibit varying levels of central tendency and dispersion. Variables such as `Mb` and `Mcap` show higher variability, while variables such as `cg1` and `cg2` exhibit lower variability. These statistics provide a basic understanding of the distribution and variability of data, essential for further analysis.

4.2 Governance Index

4.2.1 Bartlett's test of sphericity

In the below table the results indicated a chi-Square value of 41876.845 with 15 degrees of freedom and a p-value of 0.000. The significant value is less than 0.005 or ($p<0.005$) which shows that the variables are independent to each other. Consequently, the data is appropriate for factor analysis.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.900
Bartlett's Test of Sphericity	Approx. Chi-Square	41876.845
	Df	15
	Sig.	.000

As mentioned in the above table the value of KMO is .900 that shows excellent result which means that the value is in Meritorious range which means that the sample size is adequate and the data is appropriate for factor analysis.

Table 4: Communalities

	Initial	Extraction
Voice and Accountability, Estimate	1.000	.761
Political Stability and Absence of Violence/Terrorism, Estimate	1.000	.687
Government Effectiveness, Estimate	1.000	.915
Regulatory Quality, Estimate	1.000	.878
Rule of Law, Estimate	1.000	.954
Control of Corruption, Estimate	1.000	.910

Extraction Method: Principal Component Analysis.

The communalities of every variable, both initially and after extraction, are given in Table 4. The initial communalities for all variables are 1.000, indicating that each variable is fully considered in the analysis. The

extraction communalities represent the proportion of each variable's variance that is explained by the extracted factors, as determined by Principal Component Analysis (PCA).

- **Voice and Accountability, Estimate**: The extraction communality is 0.761, suggesting that 76.1% of the variance in this variable is accounted for by the extracted factors.
- **Political Stability and Absence of Violence/Terrorism, Estimate**: The extraction communality is 0.687, indicating that 68.7% of the variance is explained by the factors.
- **Government Effectiveness, Estimate**: The extraction communality is 0.915, showing that 91.5% of the variance is accounted for by the factors.
- **Regulatory Quality, Estimate**: The extraction communality is 0.878, indicating that 87.8% of the variance is explained by the factors.
- **Rule of Law, Estimate**: The extraction communality is 0.954, suggesting that 95.4% of the variance is explained by the factors.
- **Control of Corruption, Estimate**: The extraction communality is 0.910, indicating that 91.0% of the variance is explained by the factors.

These high communalities indicate that the variables are well represented by the extracted factors, confirming the adequacy of the PCA for this dataset.

Table 5: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.105	85.079	85.079	5.105	85.079	85.079
2	.386	6.441	91.520			
3	.287	4.789	96.309			
4	.121	2.012	98.321			
5	.051	.849	99.170			
6	.050	.830	100.000			

Extraction Method: Principal Component Analysis.

The table 5 includes the initial eigenvalues and the extraction sums of squared loadings for each principal component. The components are listed in descending order of the amount of variance they explain. The first principal component has an eigenvalue of 5.105, which means it explains 85.079% of the total variance in the data. This high percentage indicates that the first component captures the majority of the variability in the dataset. The second principal component explains an additional 6.441% of the total variance, bringing the cumulative variance explained to 91.520%. While this component explains much less variance than the first, it still contributes to the overall understanding of the data structure. The third principal component explains 4.789% of the variance, increasing the cumulative variance explained to 96.309%. This component captures a small, but still relevant, portion of the variance. The fourth principal component explains 2.012% of the variance, making the cumulative variance explained 98.321%. This component has a relatively minor contribution to the overall variance. The fifth principal component explains 0.849% of the variance, with a cumulative total of 99.170%. The variance explained by this component is minimal. The sixth and final principal component explains 0.830% of the variance, bringing the total cumulative variance explained to 100%. This component has the smallest contribution to the total variance. Only the first component has an extraction sum of squared loadings equal to its initial eigenvalue (5.105), indicating that the majority of the variance is captured by the first principal component.

The PCA results reveal that the first principal component is highly dominant, explaining 85.079% of the total variance. The second and third components explain additional variance but to a much lesser extent. The remaining components contribute minimally to the overall variance. This suggests that the data can be effectively summarized and interpreted using primarily the first principal component, with the second and third components providing supplementary insights.

Table 7: Component Matrix

	Component 1
Rule of Law, Estimate	.977

Government Effectiveness, Estimate	.957
Control of Corruption, Estimate	.954
Regulatory Quality, Estimate	.937
Voice and Accountability, Estimate	.872
Political Stability and Absence of Violence/Terrorism, Estimate	.829

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

This component captures the significant variance among the indicators, as evidenced by the high loadings on each variable. The loadings are as follows: Rule of Law (0.977), Government Effectiveness (0.957), Control of Corruption (0.954), Regulatory Quality (0.937), Voice and Accountability (0.872), and Political Stability and Absence of Violence/Terrorism (0.829). These high loadings indicate a robust relationship between the extracted component and the governance indicators, suggesting that the component effectively represents an overarching measure of governance quality. This finding implies that improvements in this component are likely to be associated with simultaneous improvements in rule of law, effectiveness of government corruption control Quality of control Voice and responsibility and political stability. The extracted component can thus be interpreted as a comprehensive governance quality index, reflecting the integrated performance across multiple governance dimensions. This interpretation aligns with the theoretical expectations that good governance practices are interrelated and tend to improve collectively.

Table 8: Matrix of Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) cinv1	1.000							
(2) cinvo2	0.594	1.000						
(3) cg1	0.064	0.019	1.000					
(4) cg2	0.094	0.018	0.996	1.000				
(5) JE1	0.018	0.006	0.023	0.025	1.000			
(6) JIE2	-0.014	-0.019	0.011	0.011	-0.021	1.000		
(7) JIE3	-0.061	-0.083	0.007	0.005	-0.006	0.004	1.000	
(8) JIE4	-0.043	-0.025	0.144	0.112	-0.035	0.010	0.002	1.000

The relationship between cinv1 exists strong positive correlation with cinvo2 with the value of (0.594), this shows that as cinv1 increases, cinvo2 tends to increase as well. While there are weak correlations with other variables: cinv1 has negligible correlations with cg1 (0.064), cg2 (0.094), JE1 (0.018), JIE2 (-0.014), JIE3 (-0.061), and JIE4 (-0.043), suggesting minimal linear relationships with these variables.

There exists strong positive correlation of cinvo2 with cinv1 (0.594). On the other hands there exist weak correlations with the remaining variables which are: cinvo2 that shows negligible correlations with cg1 (0.019), cg2 (0.018), JE1 (0.006), JIE2 (-0.019), JIE3 (-0.083), and JIE4 (-0.025) respectively.

The relationship between cg1 with cg2 (0.996) very strong positively correlated. This indicates an almost perfect linear relationship, suggesting these variables are nearly identical in their variations. While weak correlations with other variables: cg1 has negligible correlations with cinv1 (0.064), cinvo2 (0.019), JE1 (0.023), JIE2 (0.011), JIE3 (0.007), and JIE4 (0.144) respectively. The relationship between cg2 with cg1 (0.996) very strong positive correlation. Again, this indicates an almost perfect linear relationship. And weak correlations with other variables cg2 shows negligible correlations with cinv1 (0.094), cinvo2 (0.018), JE1 (0.025), JIE2 (0.011), JIE3 (0.005), and JIE4 (0.112) respectively. The variable JE1 weak correlations with all other variables. JE1 has very weak correlations with cinv1 (0.018), cinvo2 (0.006), cg1 (0.023), cg2 (0.025), JIE2 (-0.021), JIE3 (-0.006), and JIE4 (-

0.035), indicating minimal linear relationships. There also exist of JIE2 weak correlations with all other variables. JIE2 shows very weak correlations with cinv1 (-0.014), cinvo2 (-0.019), cg1 (0.011), cg2 (0.011), JE1 (-0.021), JIE3 (0.004), and JIE4 (0.010), suggesting minimal linear relationships. The relationship of JIE3 weak correlations with all other variables. JIE3 has very weak correlations with cinv1 (-0.061), cinvo2 (-0.083), cg1 (0.007), cg2 (0.005), JE1 (-0.006), JIE2 (0.004), and JIE4 (0.002) respectively. The relationship of JIE4 weak correlations with all other variables: JIE4 shows very weak correlations with cinv1 (-0.043), cinvo2 (-0.025), cg1 (0.144), cg2 (0.112), JE1 (-0.035), JIE2 (0.010), and JIE3 (0.002) respectively.

4.4 Results of main Regression Model

In the below table the value of F-test is 14.922 which means that the current model is fit for study. Likewise the value of R-square is 0.10 means 10% of changed in dependent variable is clarified by independent variables.

4th column in table 8 shows "t values". The value from -2 and +2 in the t value indicates the goodness of variable.

5th column shows probability value. With the significance level set at 5%, corresponding to the 95% of confidence interval. If the p value is exceeds 5%, it indicates that variable does not significantly effect on the dependent variable.

JE1 has a positive and highly significant effect on corporate innovation. For each unit increase in JE1, corporate innovation increases by 0.008 units. This indicates that improvements in judiciary efficiency are connected with greater levels of corporate innovation. The t value of JE1 is 14.6 that is greater than 2 show significance of JE1. Similarly, the p value of JE1 is 0.000 that shows significance with dependent variable. It means that with an efficient judicial system the companies will holds to maintain its innovation greatly.

The second variable shows the inverse relation between JIE2 and cinv1. The coefficient value JIE2 has a negative and significant effect on corporate innovation. For each unit increase in JIE2, corporate innovation decreases by 0.004 units. The t value of JIE2 is -2.85 that is negative and greater than -2 which show significance of JIE2. Similarly, the p value of JIE2 also shows insignificance with dependent variable with value of 0.004.This suggests that higher inefficiency in the judiciary negatively impacts corporate innovation.

The variable JIE3 also shows inverse and high relationship with cinv1. When there is a unit increase in judicial inefficiency the decrease in corporate innovations. The coefficient value of JIE3 is -0.033 which indicates negative and greater but impact on cinv1. For each unit increase in JIE3 results in a 0.033 unit decrease in corporate innovation reinforcing the idea that judicial inefficiency hinders the firm's innovation. The t value of JIE3 is -2.53 that is negative and greater than -2 which show significance of JIE3. Similarly, the p value of JIE3 also shows significance with dependent variable with value of 0.012.

The variable JIE4 also shows inverse relationship with that of dependent variable cinv1. When there is a unit increase in judicial inefficiency the decrease in corporate innovations. The coefficient value of JIE4 is -0.003 which shows negative and smaller but impact on cinv1. Each unit increase in JIE4 results in a 0.003 unit decrease in corporate innovation. The t value of JIE4 is -2.53 that is negative and greater than -2 which show significance of JIE4. Similarly, the p value of JIE4 also shows significance with dependent variable with value of 0.012.

The fifth variable which is latf the coefficient value is 0.004 that shows no significant effect of latf on corporate innovation. The increase of a unit increase in laft results 0.004 increases in corporate innovation. The t-value of latf is 0.62 which is less than 2 and the p-value is 0.537 which indicates insignificant.

The coefficient of variable mb is 0.001 and positive relation with corporate innovation. The increase in the market to book ratio there increase in 0.001 of the firm's innovation. The t value and p value 1.98 and 0.40 which indicates higher market valuation relative to book value is associated with greater innovation.

The variable lev has negative coefficient beta. The t value and p value -0.47 and 0.637 which shows that there is no effect of leverage on corporate innovation. Thus the results indicate leverage does not have a significant impact on corporate innovation in this model.

The next variable which is fsize the beta coefficient value is -0.01 that shows an inverse relation of size with corporate innovation. The increase in a unit if size there is decrease 0.01 in the corporate innovation. The t value and p value of size are -6.12 and 0.000, so the results indicate that firm size has a negative and highly significant effect on corporate innovation. Larger firms tend to innovate less, possibly due to bureaucratic inertia or resource allocation issues.

The last variable is the constant term the beta coefficient of constant term is positive 0.085. The t value and p-value of constant term 4.82 and 0.000. The result indicates significant and the constant term representing the baseline level of corporate innovation when all other variables are zero.

Table 9: Corporate Innovation and Judiciary Efficiency

cinv1	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
JE1	.008	.000	14.6	.000	-.003	.02	***
JIE2	-.004	.002	-2.85	.004	0	0	***
JIE3	-.033	.006	-5.57	0	-.045	-.022	***
JIE4	-.003	.001	-2.53	.012	-.005	-.001	**
Latf	.004	.006	0.62	.537	-.008	.016	
Mb	.001	.000	1.98	.04	0	.001	**
Lev	-.004	.007	-0.47	.637	-.018	.011	
Size	-.01	.002	-6.12	0	-.013	-.007	***
Constant	.084	.022	3.82	0	.041	.128	***

Mean dependent var	0.045	SD dependent var	0.141
R-squared	0.10	Number of obs	7523
F-test	14.922	Prob > F	0.000
Akaike crit. (AIC)	-8197.010	Bayesian crit. (BIC)	-8134.678

*** *p<.01*, ** *p<.05*, * *p<.1*

The robustness check regression model uses a different measure of corporate innovation (cinvo2) as the dependent variable to verify the consistency of the results. The model again examines the relationship between corporate innovation and judiciary efficiency, along with control variables. JE1 has a positive and highly significant effect on corporate innovation. . Each unit increase in JE1 is associated with a 0.004 unit increase in corporate innovation. This indicates that improvements in judiciary efficiency are associated with higher levels of corporate innovation. The t value of JE1 is 2.41 which is the higher value than 2 indicates the goodness of JE1. Similarly, the p value of JE1 is 0.04 which indicates the goodness with dependent variable. It means that with an efficient judicial system the companies will holds to maintain its innovation greatly.

JIE2 has a negative and highly significant effect on corporate innovation. Each unit increase in JIE2 is associated with a 0.006 unit decrease in corporate innovation. The value range of t of JIE2 is -2.60 which is higher than -2 indicates goodness of JIE1. Similarly, the p value of JIE2 is 0.009 that shows significance with dependent variable. It shows that greater the inefficiency in the judiciary negatively impacts corporate innovation.

The variable JIE3 also shows inverse and high relationship with cinvo2. When there is a unit increase in judicial inefficiency the decrease in corporate innovations. The coefficient value of JIE3 is -0.044 which shows negative and greater but impact on cinvo2. For each unit increase in JIE3 results in a 0.044 unit decrease in corporate innovation reinforcing the idea that judicial inefficiency hinders the firm's innovation. The t value of JIE3 is -8.64 that is greater than -2 which show significance of JIE3. Similarly, the p value of JIE3 also shows significance with dependent variable with value of 0.000.

The variable JIE4 also shows inverse relationship with that of dependent variable cinvo2. When there is a unit increase in judicial inefficiency the decrease in corporate innovations. The coefficient value of JIE4 is -0.002 which shows negative and smaller but impact on cinvo2. Each unit increase in JIE4 results in a 0.002 unit decrease in corporate innovation. The t value of JIE4 is -2.03 which is higher than -2 which indicates the goodness of JIE4. Similarly, the p value of JIE4 also shows significance with dependent variable with value of 0.041.

The fifth variable which is latf the coefficient value is 0.012 which means that Latf has a marginally significant positive effect on corporate innovation in the robustness check, indicating potential positive influence when other variables are controlled. The t-value of latf is 1.82 which is less than 2 and the p-value is 0.073 which indicates insignificant.

The next variable which is mb the beta coefficient value is 0 which means that mb has no effect on corporate innovation in the robustness check. The t-value of mb is -0.10 which is less than -2 and the p-value is 0.917 which indicates insignificant.

The variable lev has negative coefficient beta. The increase of a unit of lev results 0.026 decrease in cinvo2. The t value -3.31 which is greater than -2 shows significant result and p value is 0.001 which shows that there is significant effect of leverage on corporate innovation. Thus the results indicate that leverage has a significant negative effect on corporate innovation. Higher leverage is associated with lower innovation, possibly due to

financial constraints or risk aversion.

The next variable which is fsize the beta coefficient value is -0.018 that shows an inverse relation of size with corporate innovation. The increase in a unit of size there is decrease 0.018 in the corporate innovation. The t value and p value of size are -9.55 and 0.000, so the results indicate that firm size has a negative and highly significant effect on corporate innovation. Larger firms innovate less, consistent with findings from the main model.

The last variable is the constant term the beta coefficient of constant term is positive 0.169. The t value and p-value of constant term 6.91 and 0.000. The result indicates the constant term is positive and significant, indicating the baseline level of corporate innovation when all other variables are zero.

Table 10: Corporate Innovation and Judiciary Efficiency(Robustness Check)

cinvo2	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
JE1	.004	.002	2.41	.04	-.01	.013	**
JIE2	-.006	.003	-2.60	.009	0	0	***
JIE3	-.044	.005	-8.64	0	-.054	-.034	***
JIE4	-.002	.001	-2.03	.041	-.002	.002	**
Latf	.012	.007	1.80	.073	-.001	.026	*
Mb	0	0	-0.10	.917	-.001	.001	
Lev	-.026	.008	-3.31	.001	-.042	-.011	***
Size	-.018	.002	-9.55	0	-.021	-.014	***
Constant	.169	.025	6.91	0	.121	.217	***

Mean dependent var	0.048	SD dependent var	0.141
R-squared	0.25	Number of obs	7523
F-test	24.536	Prob > F	0.000
Akaike crit. (AIC)	-8313.853	Bayesian crit. (BIC)	-8251.522

*** *p<.01*, ** *p<.05*, * *p<.1*

The above table shows how judicial efficiency and corporate governance together affect corporate innovation (cinv1).

The interaction between JE1 (a measure of judicial efficiency) and corporate governance (CG) has a positive coefficient, meaning they seem to have a positive relationship with corporate innovation. However, this result is not statistically significant since the p-value is high (0.384) and the confidence interval includes zero.

The relationship between JIE2 (a measure of judicial inefficiency) and CG is positive and highly significant. This means that when judicial inefficiency increases, effective corporate governance greatly enhances corporate innovation.

The interaction term JIE3_CG is also positive and highly significant. This suggests that higher judicial inefficiency, when paired with strong corporate governance, significantly boosts corporate innovation.

Similarly, the interaction between JIE4 and CG is positive and significant. This indicates that this measure of judicial inefficiency, when balanced with effective corporate governance, positively affects corporate innovation.

The coefficient for Latf is positive but not statistically significant, so it doesn't have a meaningful impact on corporate innovation. Mb has a positive coefficient, indicating a slightly significant positive effect on corporate innovation. Leverage (Lev) has a negative coefficient but is not significant, so it doesn't meaningfully affect corporate innovation. Firm size has a significant negative effect on corporate innovation, meaning larger firms tend to invest less in R&D relative to their size. The constant term is significant, indicating a basic level of corporate innovation when all other variables are zero. As a result the interaction terms show that when there is judicial inefficiency, strong corporate governance greatly improves corporate innovation. The control variables have mixed results, with firm size negatively affecting corporate innovation. The model explains a moderate amount of the variation in corporate innovation and is overall statistically significant.

Table 11: Interaction of Judiciary Efficiency and Inefficiency with Governance

cinv1	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig

JE1_CG	.003	.004	0.87	.384	-.01	.004	
JIE2_ CG	.034	.000	2.82	.005	0	0	***
JIE3_ CG	.031	.005	5.65	0	.02	.042	***
JIE4_ CG	.003	.001	2.43	.015	.001	.005	**
Latf	.004	.006	0.62	.536	-.008	.016	
Mb	.001	000	1.89	.059	0	.001	*
Lev	-.004	.007	-0.48	.631	-.018	.011	
Size	-.01	.002	-6.18	0	-.013	-.007	***
Constant	.103	.016	6.33	0	.071	.135	***

Mean dependent var	0.045	SD dependent var	0.141
R-squared	0.21	Number of obs	7523
F-test	14.904	Prob > F	0.000
Akaike crit. (AIC)	-8195.498	Bayesian crit. (BIC)	-8133.167

*** *p<.01, ** p<.05, * p<.1*

The R-squared value of 0.37 suggests that 37% of the variability in corporate innovation can be explained by the model. The F-test is highly significant (p<0.01), indicating that the model as a whole is statistically significant. The AIC and BIC values are provided for model comparison purposes, with lower values indicating a better fit. Judicial efficiency combined with strong corporate governance has a positive and major effect on corporate innovation (cinvo2). However, the confidence interval includes zero, suggesting some caution regarding the lower bound of the effect. As judicial inefficiency (JIE2) increases and is paired with strong corporate governance, there is a significant positive effect on corporate innovation. The confidence interval suggests a precise estimate of this effect. Higher levels of judicial inefficiency (JIE3), when combined with strong corporate governance, significantly enhance corporate innovation. This effect is highly significant, indicating a robust relationship. The interaction between JIE4 and corporate governance does not have major effect on corporate innovation, indicating that this measure of judicial inefficiency does not affect innovation outcomes.

Latf shows a marginally significant positive influence on firm innovation, suggesting that technological advancements in legal frameworks might slightly enhance innovation. Mb does not significantly affect corporate innovation, indicating that market-based factors may not directly influence innovation outcomes in this context. Leverage (debt levels) has a significant negative impact on corporate innovation. Higher debt levels are associated with reduced investment in innovation activities. The firm size indicates significant negative impact on firm's innovation. Larger firms tend to invest less in R&D relative to their size.

As the above given result shows that how well courts work and whether they're efficient or not affects innovation in companies, especially when combined with strong corporate rules. When courts aren't efficient but corporate rules are strong, innovation gets a big boost. This highlights how important it is for laws and corporate rules to work together to encourage new ideas in businesses.

Table 12: Interaction of Judiciary Efficiency and Inefficiency with Governance

cinvo2	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
JE1_CG	.007	.003	2.03	.042	-.014	0	**
JIE2_ CG	0.05	0	2.40	.016	0	0	**
JIE3_ CG	.04	.005	8.58	0	.031	.049	***
JIE4_ CG	.001	.001	0.17	.865	-.002	.002	
Latf	.013	.007	1.83	.068	-.001	.026	*
Mb	-.004	.004	-0.06	.953	-.001	.001	
Lev	-.026	.008	-3.30	.001	-.042	-.011	***
Size	-.018	.002	-9.66	0	-.022	-.014	***
Constant	.149	.017	8.70	0	.115	.182	***

Mean dependent var	0.048	SD dependent var	0.141
R-squared	0.37	Number of obs	7523

F-test	24.392	Prob > F	0.000
Akaike crit. (AIC)	-8315.788	Bayesian crit. (BIC)	-8253.456

*** $p<.01$, ** $p<.05$, * $p<.1$

5. Conclusion

Efficient judicial systems quickly and fairly resolve legal disputes, reducing uncertainties and risks related to R&D investments, which encourages companies to pursue innovation. This research examined that how well the judicial system works and its effect corporate innovation which measured through investments in research and development activities (R&D). The study also tests the moderating role governance in this relationship. The study used judicial data acquired from the World Bank's Doing Business database for the sample period from 2008 to 2019 whereas other variable data collected from the companies published reports. The study also showed that good governance strengthens the positive effects of judicial efficiency on innovation. Effective governance adds assurance and stability, creating a supportive environment for innovation. Policymakers are advised to improve judicial efficiency and governance frameworks to promote corporate innovation and drive economic growth.

5.1 Future Scope of the Study

i. The study has several limitations and other studies can improve these results by taking in to financial and non-financial firms as well.
ii. The results can be further improved by taking into account cross countries data.
iii. More time period data can be considered
iv. Covid-19 time period before and after can be considered for further analysis.

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