

The Role of Financial Development in Innovation: Panel Data Analysis of Asian Economies

Rasha Almalik ¹, Rozina Shaheen ²

^{1,2} Effat University, Jeddah, Saudi Arabia

Abstract

In this study author has attempted to investigate the effect of development of financial system on innovation score in selected Asian Economies. Two dimensions of the financial system have been studied in this research. These include development of financial intermediaries, measured by private sector credit as percentage of gross domestic product and development of financial markets, measured by market capitalization as percentage of gross domestic product. Annual data of 29 economies has been collected from year 2011-2022. In addition to the main independent variables, six control variables have been included namely control over corruption, gross domestic product, inflation rate, internet usage, trade balance and covid. Multiple regression analysis has been employed to achieve the research objectives. Empirical analysis reveals that private sector credit affects innovation positively while financial markets development affects innovation negatively. This leads to conclusion that during boom periods of stock markets, only bigger and stable firms enjoy benefits while small unlisted firms pursuing innovative projects get benefit from development of financial intermediaries. Control over corruption, GDP, inflation rate and trade balance are also significant and positive, which is in accordance with expected signs. However, internet usage has appeared insignificant. Covid variable also is not statistically significant. This suggests that, businesses may not have encountered significant challenges in innovative projects during the covid period relative to non-covid periods. On the basis of empirical analysis, it is recommended that government should strengthen financial institutions to enhance capacity of innovation and policy makers should make policies favoring international trade to facilitate innovation-based projects in the countries.

Keywords: Financial System, Gross Domestic Product, Innovation, Trade Balance.

1. Introduction

According to diffusion theory of innovation, everyone gets the benefit of innovation in society. However, early adopters lead the community in getting benefit. Others follow early adopters in enjoying the benefits of society. According to diffusion theory, benefits of innovation transfer to each and every individual but not at once rather diffuse in the society at slow pace. Thus, according to this diffusion theory of innovation, studying innovation is very important.

Schumpeter's theory of economic development [1] argues that the financial system is important for contributing to innovation, which positively influences economic growth. However, according to theory of comparative advantage, an innovation-based economy needs more funds from financial markets and institutions and thus financial system development in a country is likely to enhance the capacity and use of innovation in

the countries. Mankind has inherited characteristics of innovation. Keeping in view the importance of innovation and role of funds channelization by financial institutions, contribution of financial development in enhancing the capacity and use of innovation is at the heart of debate in this research paper.

Asia is the largest and the most populous continent in the world with a significant margin. Around 60 percent of the world's population lives in Asia. Asia has remained home to earlier human civilizations and has, thus, gone through various transformations. It is rich in resources like gas, petroleum, and other metals, however, according to Asian Development bank's report of 2023, around 155.2 million people in developing Asia lived in extreme poverty. This lack of capitalization of natural resources, which Asia has been blessed with, can partly be attributed to the corruption, and can partly be attributed to the lack of bringing

incremental as well as social innovation. Keeping these facts about Asia in mind, 29 Asian economies have been selected as sample economies to study the role of financial development in enhancing the innovative capacity of Asian Economies.

Availability and use of financial resources improve innovative capacity. Measuring the impact of development of financial institutions and financial markets on innovation is the main objective of this study. As innovation also transfers from country to other countries, therefore spillover effect in the field of technology is very likely. Connectedness of a country with the rest of the world will facilitate this transfer of innovation among various nations. Trade balance as percentage of gross domestic product can capture the connectedness of a country with the rest of the world. Therefore, trade balance has also been used as control variable in this study. New Growth theory given by Noble laureate Paul Romer posits that growth depends upon personal needs and wants. Holders of public offices in Asian economies are likely to pursue private profits and fulfil their personal needs and wants. Therefore, control over corruption in Asian economies has also been investigated in this study. Necessity is the mother of invention. Covid-19 brought new challenges for human beings and stopped many activities in the world. Technology also helps to bring innovation to the country as it creates new avenues and new markets for doing innovative business. Therefore, the effect of internet usage and covid-19 on innovation has also been studied in this research.

2. Literature Review

Academicians have made multiple attempts to explain innovation on the basis of development of financial system. Innovation creates new job opportunities, reduces transaction cost and contributes significantly to making human life easy. Authors who have written distinct work on the relationship between innovation and economic growth include [2], [3] and [4]. [2] documented that innovation leads to creativity in the business operation and thus leads towards economic growth.

Keeping in view the importance and beneficial role of innovation as source of economic development, many authors have tried to find out the

determinants of innovation at firm level as well as country level. Some authors have argued that innovation is positively associated with extent of money spent on Research and development in the organizations while others have submitted that innovation is positively associated with innovation friendly infrastructure in the countries ([5] and [6]). Academicians started realizing the role of financial intermediaries and financial markets after remarkable work done by [7], who assigned significant role to financial sector in creating innovation.

Modern day theories argue that entrepreneurs need easy access to funds for their startups. Individual investors are very hesitant to lend their money directly to entrepreneurs. Thus, financial intermediaries play their role between lenders and firms working on innovative ideas [8]. Financial intermediaries play a significant role between borrowers and lenders by creating liquidity, transforming risk, reducing transaction costs and producing information [9]. Thus, individuals who cannot collect or process information delegate monitoring responsibility to financial intermediaries. Ultimately, higher development of financial system in a country is more likely to enhance capacity and use of innovation in that country. Financial development can help to reduce financial constraints, which decrease innovation activities in any country [10].

Though many authors have studied the role of access to finance in materializing the Innovative ideas into real products, many authors believe that innovation activities in a country are also enhanced by connectedness of a country with the rest of the world. [11] has argued that trade liberalization policies in a country play a significant role in the promotion of innovation activities. [12] explored data of 29 OECD countries over a period of 40 years and found that trade affects innovation significantly. This finding is also supported by the significant work of [13]. When firms lack access to finance, they get demotivated to invest in technology and ultimately lack innovation-based setups [14]. Direct investors face problems in collecting information about innovative projects not only at the time of financing but also face hurdles after projects are launched [15]. Financial institutions have relatively better access to

information and better capacity to screen information. Therefore, investors lend their money to entrepreneurs working on innovative ideas through financial intermediaries by delegating them monitoring and screening authority. Thus, development of financial system in any country is likely to be positively associated with capacity and use of innovation in any country. Although a wide range of studies document how development of financial system leads to economic growth in any society.

However, there are very few studies which talk about channel through which causality runs from financial system to economic growth. In this research study, the author has attempted to empirically investigate the channel of innovation-based ventures. However, it is believed that development of financial system may not be fruitful in bringing innovation in a country, if overall governance environment or economic environment in a country do not facilitate innovation.

Table 1: Major Studies on Innovation

Author(s)	Study Period	Methodology	Findings
[16]	2002-2014	Generalized multilevel mixed model	Limits to innovation is different in different knowledge intense sectors
[12]	1980-2019	GMM	Trade, innovation quality and financial development promote innovation activities.
[14]	Survey data of 399 Chinese firms	Hierarchal linear modeling	Financial problems in enterprises lead to demotivation to pursue innovative projects.

[17]	2011-2018	Panel data	Development of financial institutions leads to innovation.
[18]	1990-2017	ARDL	Financial development promotes green innovation.

This study is unique in nature because it also investigates the effect of GDP, inflation, control over corruption and trade balance on innovation.

3. Hypotheses Development

Keeping in view the theoretical justification, the following hypotheses are developed for testing purpose. Testing of these hypotheses helps us to achieve the research objectives of this study. Hypotheses in alternative form are as below.

H1: Development of financial markets improves the innovation of sample economies.

H2: Private sector credit ratio improves the innovation of a country.

H3: Control over corruption enhances the capacity and use of innovation in the sample economies.

H4: Gross domestic product has significant effect on innovation in a country.

H5: Inflation affects the innovation in a country significantly

H6: Access to internet increases the innovation-based activities of sample economies.

H7: Trade balance has positive effect on innovation of sample economies.

H8: Covid has significant effect on innovation score of sample economies.

4. Data and Model specifications

The primary objective of this research is to empirically investigate how development of financial markets and development of banking sector have contributed to the success and capacity of innovation in the sample economies.

5. Data Sample

To achieve this objective, panel data of 29 countries has been collected. The panel consists of 29 selected economies and period ranges from 2011 to 2022. Data of independent variables has been collected from world development indicators

(published by World Bank) while data of innovation has been obtained from Global Innovation index, developed jointly by World Intellectual property organization (WIPO) and Cornell University. Thus, this is balanced panel data.

6. Model Specifications

Keeping in view the specification requirements of econometrics, the following eight regression equations have been specified.

$$\text{Innoit} = \beta_0 + \beta_1 * \text{FMDit} + \beta_2 * \text{PSCit} + \beta_3 * \text{COCit} + \beta_4 * \text{GDP} + \beta_5 * \text{I.Rit} + \beta_6 * \text{IUit} + \beta_7 * \text{NXit} + \mu\text{it}$$

(1)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{FMDit} + \beta_2 * \text{PSCit} + \beta_3 * \text{COCit} + \beta_4 * \text{GDPit} + \beta_5 * \text{NXit} + \mu\text{it}$$

(2)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{FMDit} + \beta_2 * \text{COCit} + \beta_3 * \text{GDPit} + \mu\text{it}$$

(3)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{PSCit} + \beta_2 * \text{COCit} + \beta_3 * \text{GDPit} + \mu\text{it}$$

(4)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{FMDit} + \beta_2 * \text{PSCit} + \beta_3 * \text{COCit} + \beta_4 * \text{GDP} + \beta_5 * \text{I.Rit} + \beta_6 * \text{IUit} + \beta_7 * \text{NXit} + \beta_8 * \text{Covidt} + \mu\text{it}$$

(5)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{FMDit} + \beta_2 * \text{PSCit} + \beta_3 * \text{COCit} + \beta_4 * \text{GDPit} + \beta_5 * \text{NXit} + \beta_6 * \text{Covidt} + \mu\text{it}$$

(6)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{FMDit} + \beta_2 * \text{COCit} + \beta_3 * \text{GDPt} + \beta_4 * \text{Covidt} + \mu\text{it}$$

(7)

$$\text{Innoit} = \beta_0 + \beta_1 * \text{PSCit} + \beta_2 * \text{COCit} + \beta_3 * \text{GDPit} + \beta_4 * \text{Covidt} + \mu\text{it}$$

(8)

Names of variables, their symbols, description, and source have been explained in Table 2.

Table 2: Description of Variables

Variable	Symbo	Description	Source
Innovation	INNO	Innovation is measured by intellectual scoring on the basis of global innovation index	World property organization
Financial Development Proxies			
Financial market development	FMD	financial market development measured by market	World Bank

		capitalization as percentage of GDP	
Private sector credit	PSC	is private sector credit extended by banking sector in \$ as percentage of GDP	World Bank
Control Variables			
Gross domestic product	GDP	Gross Domestic Product	World Bank
Control over corruption	COC	control over corruption measured by Estimate	World Bank
Net exports (trade balance)	NX	net exports measured by difference of exports and imports, scaled by GDP	World Bank
Inflation rate	IR	Inflation rate measured by percentage change in the consumer price index	World Bank
Internet usage	IU	internet usage, measured by number of internet users as percentage of total population	World Bank
Covid	Covid	Dummy variable which takes the value 1 in	Author

		years 2020 and 2021 while 0 otherwise	
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To measure the impact of independent variables on dependent variable, regression analysis has been selected. Regression analysis is a statistical technique to measure the magnitude, direction as well as significance of variables. In the absence of control variables, regression is likely to attribute some variance in innovation to development of financial markets, while it would be coming from other explanatory variables.

Therefore, six control variables have been used in this study namely control over corruption, net exports, GDP, inflation rate and internet usage. To check the whether the relationship between financial markets development and innovation is different in covid period than non-covid period, dummy variable has been introduced, which takes the value of 1 for years 2020 and 2021 for all sample countries and 0 otherwise.

7. Results and Analysis

Primary objective of this study is to investigate the impact of financial system development on innovation in Asian Economies. To achieve research objectives, 8 hypotheses were developed at the end of literature review. In this section, Table 3 reports the descriptive statistics, Table 4 shows correlation matrix, Table 5 contains regression results of model 1,2,3 and 4. Table 6 reports results of models 5,6,7 and 8. Models 5,6,7,8 include dummy variable Covid, which takes the value 1 in years 2020 and 2021 while 0 otherwise. Table 7 reports the diagnostics of model No. 5, which includes all the independent variables in the equation.

Table 3: Descriptive Statistics

	INN	FDM	PSC	CO	GDP	IR	IU	NX
Mean	38.17	107.40	84.25	0.07	3.17	5.45	66.51	56.95
Median	36.20	53.06	69.89	0.14	3.41	2.91	71.39	39.03
Maximum	63.50	1777.23	263.59	2.17	13.38	154.76	100.00	221.61

Minimum	16.70	0.08	13.70	-1.23	-21.40	-3.75	4.50	10.35
Std. Dev.	10.13	229.46	49.66	0.82	4.02	12.96	24.80	48.43
Skewness	0.54	5.00	1.41	0.83	-1.44	7.72	-0.59	1.74
Kurtosis	2.45	29.25	5.17	2.96	8.03	75.18	2.36	5.31

8. Interpretation of descriptive statistics of panel data

This table shows the descriptive statistics of balanced panel of 29 sample economies over 12 years from 2011-2022. Average value of innovation score of 29 countries is 38.17 over sample period. Among sample economies, Singapore achieved highest score calculated on capacity and success of innovation in years 2012. On the basis of Global innovation index, Algeria achieved minimum score of 16.70. These values indicate that Singapore is leading the other sample economies in the field of innovation while Algeria is lagging behind all other sample economies in the field of innovation.

Standard deviation of financial markets development is 229, which is very high. In a variable having high standard deviation, mean cannot be considered as accurate measure of central position. This is also evident from range of financial markets development which is almost 1777. Median value of 53 is relatively better measure of central position of financial markets development. Half of the sample economies have market capitalization more than 53 % while remaining half of sample economies have market capitalization less than 53 percent of GDP. However, this variable is not normally distributed because skewness value is 5 and kurtosis value is also above acceptable range of 3.

Strong control over corruption has been recorded for Singapore in year 2018 as it obtained estimate of 2.17, which is highest value for any sample economy from 2011 to 2022. South Asian economies have not obtained positive estimates for control over corruption because Bangladesh, India, Indonesia and Iran have all negative values of control over corruption. Eastern Asian states show impressive estimated score of control over

corruption as Japan and Singapore have positive values of control over corruption. Middle eastern states have shown mixed performance as far control over corruptions is concerned.

Bahrain has obtained negative values for some years; however, Saudi Arabia is relatively better. Algeria did not show promising results. Mean value of access to technology, measured by percentage of population using internet shows that around 66 percent of population of sample economies had access to internet over sample period of 2011-2022. However, this variable is also heavily dispersed with maximum value of 100 percent (Qatar 2021) and minimum value of below 5% (Bangladesh in 2011). Like innovation, financial markets development and control over corruption, internet usage is also away from normal distribution. Ratio of trade balance of panel of 29 economies shows that on average, difference of exports and imports scaled by GDP remained 56 percent over sample period. Hongkong had trade balance of 221% of gross domestic product in 2013, which shows their strong connectedness with the world. On the other hand, Bangladesh reported trade balance of just 10% of GDP in year 2021, which is lowest value in the sample. Lower p value of JB suggests that net exports variable is also not normal. Last variable is private sector credit as proxy of financial development. 29 countries have private sector credit, on average, 90 percent of their GDP.

However, range of almost 250 shows that sample economies are heterogeneous on the basis of private sector credit. Like other variables, this is also not normally distributed. Sample economies have shown varying growth over sample period. On average, sample economies grew at rate of 3.17 per annum with maximum of above 13 percent growth in a year with lowest growth of negative 21.40 growth. The inflation rate, measured by first difference of consumer price index shows that sample economies, on average experienced 5.45 inflation per annum. As inflation variable has huge dispersion with maximum value of 154.76 percent and lowest value of -3.75 percent, therefore, mean of inflation rate is also not a good measure of central position and median value of 2.91 percent is better measure of average inflation rate in the sample economies.

Table 4: Correlation Matrix

	INNO	FDM	PSC	COC	GDP	IR	IU	NX
INNO	1.00							
FDM	0.39	1.00						
PSC	0.70	0.56	1.00					
COC	0.76	0.44	0.55	1.0				
GDP	0.06	-0.09	-0.18	-0.02	1.00			
IR	-0.23	-0.05	-0.12	-0.31	-0.27	1.0		
IU	0.43	0.22	0.41	0.53	-0.29	-0.06	1.0	
NX	0.61	0.57	0.50	0.69	0.05	-0.17	0.4	1.0

9. Interpretation of Correlation matrix

Correlation measures the relationship between two variables. Its value varies between -1 and +1. The correlation table reported above indicates that our dependent variable Innovation based score is positively correlated with all our independent variables except inflation rate, which is in accordance with theory. The correlation coefficient between innovation and private sector credit is 0.70, which is a strong positive correlation. It indicates that financial development and innovation score move in same direction as thus, they are strongly associated with each other. Innovation has weak positive correlation with development of financial markets as correlation coefficient is 0.39. Innovation also has a strong positive correlation with control over corruption. It means countries where corruption is not controlled, innovative activities cannot be practiced at large scale. Strong positive correlation of Innovation has been found with net exports, which is also supported by theory of international trade. The more open an economy will be, the stronger the probability of accepting innovation transferring from other countries.

10. Regression Results

Results of regression equations have been written in the table below. Panel 1 shows results of regression equations without dummy variable of covid while panel 2 shows results after inclusion of covid variable.

Table 5: Regression Results

Dependent Variable (Innovation)									
IVs	Model 1		Model 2		Model 3		Model 4		
	Coeff	S.Es	Coeff	S.Es	Coeff	S.Es	Coeff	S.Es	
Intercept	27.375	1.003	27.750	0.631	36.483	0.211	28.612	0.526	
FMD	-0.0061***	0.001	-0.0061***	0.001	0.0041***	0.001			
PSC	0.0999***	0.009	0.0998***	0.008			0.0965***	0.005	
COC	6.2204***	0.344	6.0782***	0.182	9.0709***	0.159	6.5057***	0.297	
GDP	0.3826***	0.076	0.3511***	0.061	0.2157***	0.067	0.2707***	0.047	
IR	0.0283**	0.013							
IU	0.0022	0.022							
NX	0.0215***	0.005	0.0225***	0.005					
Adj. R ²	0.728		0.728		0.592		0.71		
N	348		348		348		348		

Model 5 is the main model of this study which includes all the 8 independent variables. Thus, all the hypotheses are tested using results of model 5. In this model, financial markets development and private sector credit variable, which are proxies of financial development, are significant at 1% level of significance.

Table 6: Regression Results with Covid as I.V

Dependent Variable (Innovation) with Covid									
IVs	Model 5		Model 6		Model 7		Model 8		
	Coeff.	S.Es	Coeff	S.Es	Coeff	S.Es	Coeff.	S.Es	
Intercept	27.321	1.080	28.079	0.634	36.795	0.211	29.305	0.615	
FMD	-0.0061***	0.001	-0.0061***	0.001	0.0041***	0.001			
PSC	0.0989***	0.009	0.0990***	0.008			0.0904***	0.004	
COC	6.0919***	0.379	6.0433***	0.177	9.0414***	0.164	6.4935***	0.225	

GDP	0.3492***	0.082	0.3113***	0.0663	0.1781***	0.071	0.3369***	0.069	
IR	0.0271***	0.011							
IU	0.0095	0.025							
NX	0.0215***	0.005	0.0225***	0.005					
Covid	-1.4673	0.913	-1.357	0.543	-1.2449	0.27	-1.4648	0.553	
Adj. R ²	0.729		0.720		0.593		0.720		
N	348		348		348		348		

***, ** and * indicate significance at 1%, 5% and 10% level of significance

The positive coefficient of PSC (0.098) indicates that expansion in credit extended by commercial banks to private sector contributes positively to innovation of any country. However, when financial development is proxied by market capitalization as percentage of GDP, the sign is negative. The negative sign of financial markets development is due to the fact that investors do not prefer to invest in innovation-based ventures directly, instead they prefer to extend their funds to innovation-based projects through financial intermediaries. As investment in stock markets is always riskier than putting money in banks, therefore, investors do not trust innovative ideas and therefore, entrepreneurs following innovative businesses enjoy benefit by development of credit through financial institutions instead of directly going to market and offer equity. The independent variables of model 5 are same as that of model 1 except covid variable.

Coefficient of control over corruption is also positive and significant at even 1 percent level of significance showing positive contribution of corruption control to innovation score. This shows that if governments fail to control corruption in the country, entrepreneurs pursuing innovative business remain unable to materialize their ideas. A corruption free economy is very friendly for undertaking innovative businesses and ultimately increasing innovation score of countries.

Coefficient of GDP (0.349) is positive which shows that growing economies are more friendly for innovation-based businesses.

Higher inflation is associated with expansionary monetary policy when credit remains available to businessman at relatively less cost, therefore, coefficient of inflation is also positive. Coefficient of inflation rate is also significant at 1 percent level of significance. Coefficient of internet usage is insignificant in determining the innovation score of countries. This is possible in the presence of GDP as explanatory variable in the equation. The coefficient of net exports (0.021) is positive and significant. This supports the argument that higher connectedness of a country facilitates the transmission of tech-based projects from one country to others.

Covid created new types of challenges for business in general. However, when we test it empirically, our result shows that covid is insignificant. All the hypotheses of the study are accepted except hypothesis No. 6 and 8. The explanatory power and adjusted R square of models 1,2,3 and 4 are less than corresponding covid models 5,6,7 and 8. The presence of dummy variable covid in the model 8 has very sound theoretical support as almost all business faced challenges in their operations as well supply chain management during covid period. Therefore, models 5,6,7 and 8 are preferred over corresponding models 1,2,3 and 4. As effect of inflation and internet usage can be captured by GDP, therefore, inflation rate and internet usage were dropped in model 6 but value of adjusted R square decreased which showed that these two variables may not be irrelevant in determination of innovation-based scores of sample economies. To check for any specification error in model 6, models 7 and model 8 were run by employing only one proxy of financial development. As explanatory power of model 8 was higher than that of model 7, therefore, contribution of private sector credit in innovation is much higher than that of market capitalization ratio. Adjusted R square indicates that 72.98 percent of variance in innovation is explained by employed 8 explanatory variables of model 5. This value of coefficient of determination is higher than values of adjusted R square of model 6,7 and 8. Thus keeping in view the theory and explanatory

power, model 5 is preferred and diagnostics are run on model 5 and reported in the Table 7 below.

Table 7: Regression Diagnostics

VIFs for Multicollinearity	Jarque Bera for normality	LR test for Heteroskedasticity	Durbin Watson for Autocorrelation
1.15 - 2.83	1.195 (0.55)	Likelihood ratio 217.8 (0.0)	0.220

11. Interpretation of Diagnostics

Regression assumes that no explanatory variable is a perfect linear function of another explanatory variable. In other words, regression equation should be free from the issue of multicollinearity. Multicollinearity is estimated by calculating variance inflation factors of all independent variables. Rule of thumb is that if VIFs are below 5, then multicollinearity is not severe. VIFs of all independent variables range between 1.15 and 2.83 as reported in table 7. These values of VIFs show that no explanatory variable is perfect linear function of any other explanatory variable and even imperfect multicollinearity is not severe in our model. As equation contains constant, therefore, centered VIFs have been used. Explanatory variables having higher values of VIFs (normally greater than 5) provide consistent results but are unreliable. Our results are reliable as equation is not suffering from severe multicollinearity.

Regression also assumes that error term should be normally distributed, though this is optional assumption of classical linear regression model. To investigate normality of residuals, Jarque Bera statistics has been reported in table No. 7. JB statistics is 1.195 with p value of 0.5500 in the parenthesis. The null hypothesis of JB is skewness is zero and excess kurtosis is also 0. As p value (0.5500) is above level of significance of 5%, therefore, null hypothesis of normal distribution is accepted.

Another assumption of classical linear regression model is homoscedastic residuals, which means that variance of the residuals should remain constant. To diagnose the issue of heteroscedasticity in residuals, the Log Likelihood ratio has been applied. The null hypothesis of LR

test of heteroscedasticity is that residuals are homoscedastic. LR ratio of 217.872 and corresponding P value (0.000) show that null hypothesis of homoscedasticity is rejected, and it is concluded that regression equation is suffering from this issue. As a remedy of heteroscedasticity, author has used heteroscedasticity consistent white standard errors in the regressions.

Another assumption of regression is that one value of residual should not depend upon its previous value. In other words, residuals should not suffer from issue of serial correlation or autocorrelation. Durbin Watson test has been used in this study. The value of DW ranges from 0 to 4. A value close to 0 indicates positive serial correlation while value close to 4 shows negative serial correlation. Durbin Watson stat (0.220) has been reported in table No. 7, in which results of all diagnostic tests have been reported. Overall, diagnostics reported in table 7 reveal that regression results are reliable as regression equations do not seem to be suffering from any severe issue.

12. Conclusions

In this study, author has attempted to explain innovation score of selected economies as function of various country level factors including development of financial system, control over corruption, gross domestic product, inflation rate, internet usage, trade balance. This research has focused on the role of development of financial intermediaries and financial markets in bringing innovation in the sample economies. The relationship between financial system development and innovation has been studied during normal periods and during covid period. After empirical investigation of data of 29 economies from 2011 to 2022, we conclude that the development of the financial sector, when measured by private sector credit affects innovation positively while same affects negatively when measured by market capitalization as percentage of GDP. This shows that entrepreneurs pursuing funds for innovation-based projects are benefitted by financial intermediaries only. This is in accordance with theory because investors select financial intermediaries because of their better skills in screening and monitoring. When financial markets develop, large size old firms which are listed on stock exchanges benefit.

However, innovation-based businesses are small and majority of them do not get listed on stock exchanges in initial years of life, therefore, they are affected negatively as funds move to large sized old firms instead of newly set up innovation-based ventures. In addition, institutional quality affects innovation score positively, which means that corruption free economies facilitate innovation-oriented projects and economic growth affects innovation positively like other businesses. Inflation rate also affects innovation positively which negates the uncertainty hypothesis that inflation creates uncertainty. This supports the hedging argument that during periods of higher inflations, investors seek innovative ideas to hedge their risk. Internet users as a percentage of population is insignificant. It means simply increasing the number of users is not helpful in enhancing innovation. Users need to be focused on specific direction towards innovation-based projects. Economic policies devised to liberalize trade help to increase innovations in the countries.

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