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THE EFFECTS OF INNOVATION ON THE ECONOMIC GROWTH OF CHINA

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ABSTRACT

The Chinese economy is well decorated and unarguably outstanding in its endeavors.For almost four decades now, it has been experiencing rapid growth rates, transforming the nation into ginormous economic power in the world. Arguably, the 1978 reform initiative retrospectively meant a shift from an extensive agriculture-based economy to an innovative, and industrialized manufacturing hub. Thus, this paper seeks to give a clear- cut analysis by applying the multiple time series regression on the nexus between innovation and the economic growth in China during the period (2000-2020). In order to provide a sound research, the study is interested in answering the following questions, what role does innovation have in the Chinese economy,? To what extent does "innovate-implement initiative" determine the Chinese economic development ? Answering the above questions tis relevantly deal in understand ing the effects of innovation to the economic development of China and why innovation is significant to the nation's future

KEYWORDS: ***economic growth, innovation , research and development, China.***

INTRODUCTION

Innovation in China has been vital since the initiation of the reform act in 1978, with almost four decades of unwavering growth rates averaging at least 10% annually. Although, the Chinese economic transformation might sound more apparent than real it has phenomenally turned out to be a world standard demonstration of knowledge based economy. Much of the growth has resulted from labor intensive manufacturing and high exports, managing to lift more than 850 million Chinese from extreme poverty.

Kline and Rosenberg (1986) and Ahmad, Mallick and Schroeder (2012), innovation processes take diverse forms depending on the product and external factors. From a research perspective, Rothwell (1994) emphasizes how innovation processes have transformed over time, due to shifts in the industry. The submission is that in the initial era of innovation processes, novelties were built through technology- push. This clarified that enterprises postulated that focusing on R&D resulted in fruitful outcomes of new products and the market became the hub of new know- how. Research on science of innovation concludes that more studies have been evidenced from 1970- 1980. In this period, it also was clear that a constant balance or nexus between technology- push and market- pull was significant in creating effective processes.

In 2018 the number of domestic patterns in China increased to 1.56 million which was by the highest in the world. However, due to high exportation the economy is vulnerable to exogenous shocks and has led the researchers and policy makers to invest more in research and development so always stay competitive in the global economy maintaining constant growth rates through extensive knowledge based reforms or policies.

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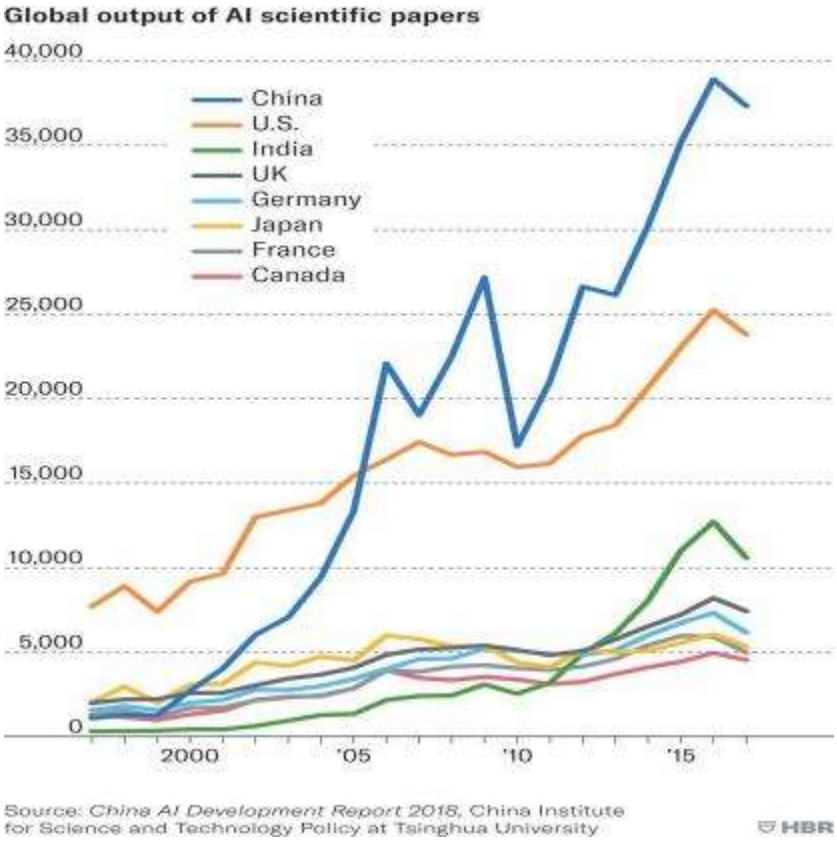
Figure 1. 1 Artificial Intelligence Dominance



From the above figure one can notice the trends in scientific investments have become a necessity globally and thereby causing alarming increase in artificial intelligence (AI), as part of the research and development scheme. China maintains constancy as it has managed to catch up with its competitors taking the leading role in AI since 2005 and maintaining up until 2018.This will also be profound in illustrating why the Chinese ingenuity keeps on spiking and giving high comparative advantage in the world market.

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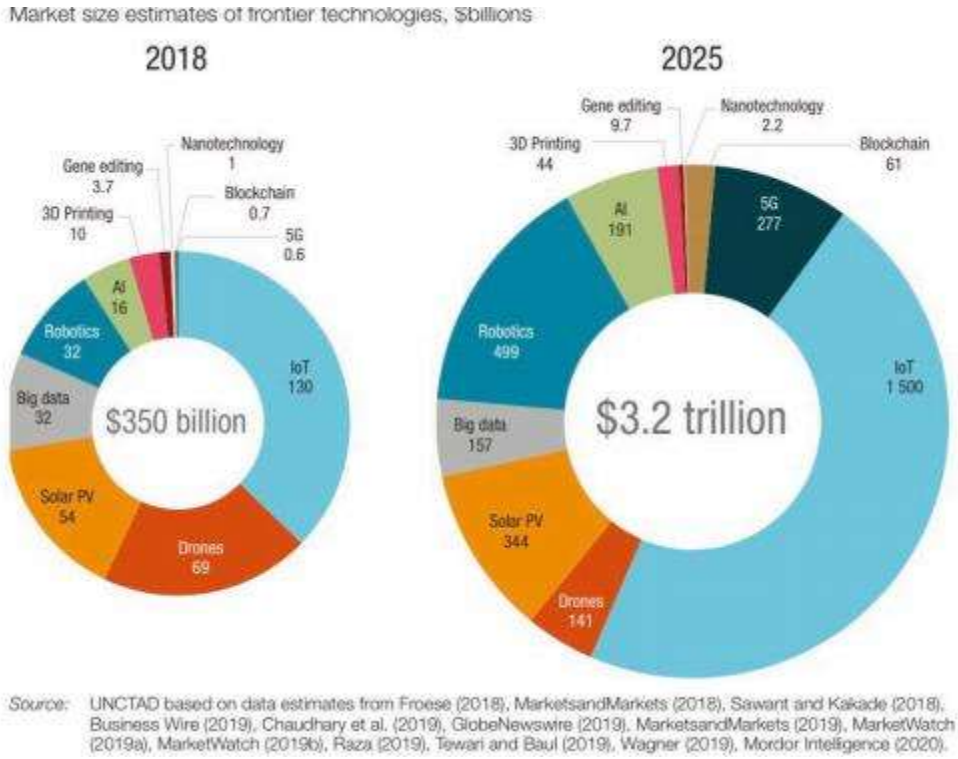
FIGURE 1.2 Frontier Technology on reform agenda.



Source: UNCTAD based on data estimates from Froese (2018), MarketsandMarkets (2018), Sawant and Kakade (2018), Business Wire (2019), Chaudhary et al. (2019), GlobeNewswire (2019), MarketsandMarkets (2019), MarketWatch (2019a), MarketWatch (2019b), Raza (2019), Tewari and Baul (2019), Wagner (2019), Mordor Intelligence (2020).

The above frontier technology in fig 1.2 is an illustration of a group of new technologies that is designed to maximize digitalization and connectivity functions thereby enabling them to integrate and increase their efficiency. These technologies are designed to produce increased productivity and assist in saving people's lives. Artificial intelligence for instance integrated with robotics can transform production and enterprise processes. This is also supported by 3D printing which allows faster and cheaper low volume production. Estimates are that by 2025 the technologies could grow to over $3.2 trillion.

China is a major producer of some of these technologies, for example, 5G, drones and solar PV. Finance companies have also used the technology in making important decisions and risk aversion.

Different schools of thinking have provided theories on regional economies and expounding how regional development incorporates economic, social, institutional, and cultural characteristics that produce different capacities that increase and drive regional development. Space may influence transactions between companies in three unique ways: (i) lower scale of transaction and generally of an economic nature when only done over short distances and this prevent economies of scale; (ii) uneven transactions and becoming more complex to sustain over longer distances than regular and expected transactions; (iii) diverse modes of transaction (for instance, face-to-face encounters in opposition to electronic transactions) and leading to different results in terms of spatial costs, Scott (1998).

Schumpeter's Triad was preceded by seven types of innovation processes, with the first five being divided into linear models (science-push/technology-push and demand pull/need-pull), interactive models (coupling model Mowery, Rosenberg, 1979) and incorporated one (Rothwell, Zegveld, 1985). Myers and Marquis (1969) supported the 1960-s "technology push" view of market-relevant aspects (second generation).They reasoned that innovations resulting from R&D activities were aimed towards the pleasure of customer needs (market pull approach).

The Development of marketing function in enterprises shed new light on the innovation process. When markets become mature, customers are as good source of new ideas as technical staff in R&D departments.

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2. THE NEXUS BETWEEN INNOVATION AND GROWTH

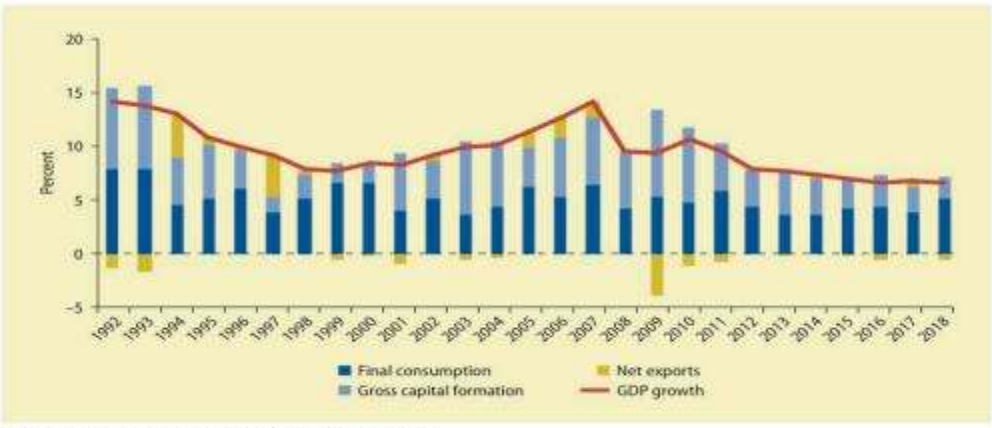
The relationship between innovation and growth has been a subject of great concern among economist. To start with, according to knowledge based models goods are non rival, thus their usage or introduction in a different manner or method does not in an way affect results, this therefore gives room to the idea of innovative catch up whereby reform involves invention, innovation and imitation allowing one idea to produce different output depending on the level of inventive capability. According to Innovative China Drive for new Growth, China R&D reached 2. 18% compared to OECD average of 2.4%, which signified how important structural innovation would impact economical reforms and thereby boost the growth of the economy. However, the results were not an overnight event therefore required patience and dedication.

The increasing function of innovation in China has pulled the attention of scholars both inside and outside the country. Examples also include many recent studies. Wei and Liu (2006) found positive impacts of R&D behavior on productivity performance at the firm level. Their finding is consistent with interpretation at the sector level by Wu (2006, 2009) who argued that R&D contribution to productivity growth in manufacturing is statistically significant. Several authors also provided evidence using cross-regional data (Kuo and Yang, 2008). While others focused on firms within a certain region (Hu and Jefferson 2004). More so, this study analyzes the existing literature in several ways.

Research also submits that, there is a positive nexus between innovation productivity increase or growth and the economic enterprise performance. Thus in short the argument is that R&D investments by enterprises will most likely increase product innovations and thereby improving the whole economic performance as well as competence, (Bogliacino and Pianta 2009).More so, increased competition in the world market, motivates manufacturing companies to invest in innovation as to constantly maintain their product values in a forever changing global market. The addition in value results from a series of product, process and intellectual innovation, (Hoonspoon and Ruenroom 2012).

Figure 1.2 below shows that China has been gradually transforming in its innovation capacity, topping high among low and medium income countries. According to NBOSD, China's innovation (R&D), accounted for 20% of the world total. As mentioned earlier this has given China an extensive comparative advantage thereby increasing its competency in the global economy. Despite the decrease in GDP rates, China is still ahead of many countries in the global community.

Figure 1.3 Composition of GDP growth in China, 1992-2018



Source: Calculations based on National Bureau of Statistics data.

3. MODELING THE RELATIONSHIP BETWEEN R&D, INNOVATION AND GROWTH

Different economic theories have been established since the 90's in a bid to analyze and explain the nature of the connection between innovation and growth resulting to the creation of knowledge- based growth models. The empirical literature defines two main categories of the growth models which are, the first generation method (accumulation based theory, Romer (1990) and Aghion and Howitt (1992)), and the second generation (innovation based theory Jones (1995) and Segerstorm (1998).I however find the

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multiple time series regression analysis and correlation coefficient relevant and most appropriate method in my research work. The significance of these approaches is to clearly navigate how resources result into to growth under the influence of innovative strategy and as a result measure whether the correlation is positive or negative.

The research paper considered the three variables in the subject matter and tried to analyze the multi-variety data or parameters that shape the relationship between innovation and growth. Multiple regression analysis is a statistical tool that is used to predict and forecast the outcome of a response variable. In my research it must be noted that the data collected is mainly from the World Bank Data Base, Statistica[1] Communiqué of National Economy and Social Development, National Bureau of Statistics of China, www. stats. gov. cnand all copyrights are observed.

Multiple regression methodology: Variables under study are Innovation, R&D and GDP.

$$(1)\quad Yit = \beta\,0 + \beta 1X1it + \beta 2X_{2it} + \epsilon$$

$$(2)\quad GDP_{it} = \beta_{\,0} + \beta 1In_{it} + \beta 2R\&D_{it} + \epsilon$$

when OLS is applied we proceed to get the following formula (3)

$$(3)\quad GDP_{it} = \beta_0^{\,2} + \beta_1^{\,2}\, In_{it} + \beta 2^{\,2}\, R\&D_{it} + \epsilon$$

equation 3 are estimated values of the initial equation to minimize the sum of the residual square

Whereby Yi represents the dependent variable GDP_{it} of China and is the one under study of influence from R&D and innovation. Whereas, β0 is the GDP- intercept at zero and can be referred to ceteris paribas, as other independent variables such as infrastructure, government expenditure, enrollment ratio are put at constant.

X1it and X2it are the independent variables, Innovation and R&D being analyzed respectively and their changes or implementation affects the GDP performance.

β 1X1 1 represent In_{it} the regression coefficient that will measure a unit in change in innovation due different shocks- the change in the country's GDP.

B2 X2 represent $R\&D_{it}$ the coefficient value that measures a unit in change in R&D changes-the change of GDP when innovation capacity changes as well.

ϵ will represent the residual of the analysis and will mainly symbolize the models error in simulation and it represent the parameters at a specific point in time.

4. RESULTS OF THE SIMULATION

NB: The results are based on authors own calculation.

Table:1
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
GDP	20	98.70	2442.60	844.6550	706.74679	499491.023
R & D	20	100280. 10	378000000.00	21177480.4300	84056715.44952	7065531412160778.000
Innovation	20	100.00	450.00	184.9850	77.21368	5961.952
Valid N (listwise)	20					

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Table: 2
Correlations

		GDP	R & D	Innovation
Pearson Correlation	GDP	1.000	.557	.914
	R & D	.557	1.000	.826
	Innovation	.914	.826	1.000
Sig. (1-tailed)	GDP	.	.005	.000
	R & D	.005	.	.000
	Innovation	.000	.000	.
N	GDP	20	20	20
	R & D	20	20	20
	Innovation	20	20	20

Table :**3**

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9092719.339	2	4546359.669	194.382	.000[b]
	Residual	397610.098	17	23388.829		
	Total	9490329.437	19			

a. Dependent Variable: GDP
b. Predictors: (Constant), Innovation, R & D

Table 4

Coefficient Correlations[a]

Model			Innovation	R & D
1	Correlations	Innovation	1.000	-.826
		R & D	- 826	1 000
	Covariance	Innovation	.649	-4.922E-7
		R & D	-4.922E-7	5.476E- 13

a. Dependent Variable: GDP

Table 5

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1(Constant)	- 1461.661	140.588		- 10.397	.000		
R & D	-5.232E-6	.000	-.622	-7.070	.000	.318	3. 143
Innovation	13.067	.806	1.428	16.220	.000	.318	3. 143

a. Dependent Variable: GDP

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Table 6

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	R & D	Innovation
1	1	2. 189	1.000	.01	.02	.01
	2	.787	1.668	.02	.29	.00
	3	.025	9.433	.97	.69	.99

a. Dependent Variable: GDP

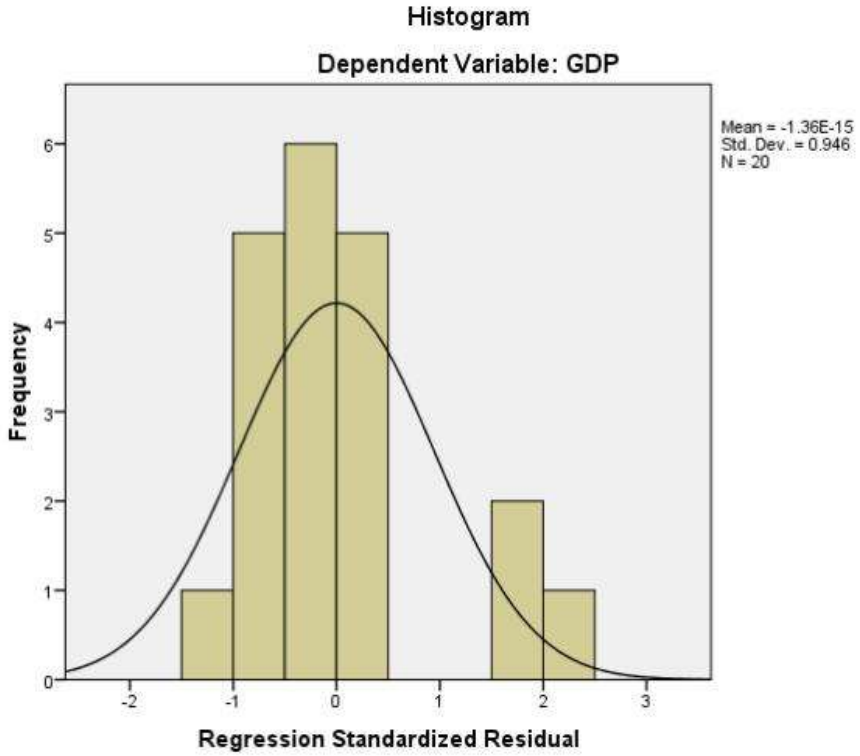
Table7

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	- 155.5313	2440.6216	844.6550	691.78333	20
Residual	-177. 19182	363.99493	.00000	144.66115	20
Std. Predicted Value	-1.446	2.307	.000	1.000	20
Std. Residual	- 1. 159	2.380	.000	.946	20

a. Dependent Variable: GDP

Table 8



Source based on author's calculation

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Table9

Descriptive Statistics

	Mean	Std. Deviation	N
GDP	844.6550	706.74679	20
R & D	21177480.4300	84056715.44952	20
Innovation	184.9850	77.21368	20

Table10

Regression

Equation	Observation	Parms	RMSE	R-sq	F	P
GDP billions	21	2	14644.59	0.886	73.79846	0.0000
GDP billions	Coefficient.	Std. Err.	t	P>t	[95% Conf.	Interval]
Innovation	0.075888	.4125975	0.18	0.856	-.7876884	.9394646
R&D	27730.48	2434.972	11.39	0	22634.02	32826.93

Table 11

Model Summary[b]

Model	R	R Square	Adjusted R Square	d. Error of the Estimate	Durbin-Watson
1	.979[a]	.958	.953	152.93407	1.232

a. Predictors: (Constant), Innovation, R & D

b. Dependent Variable: GDP

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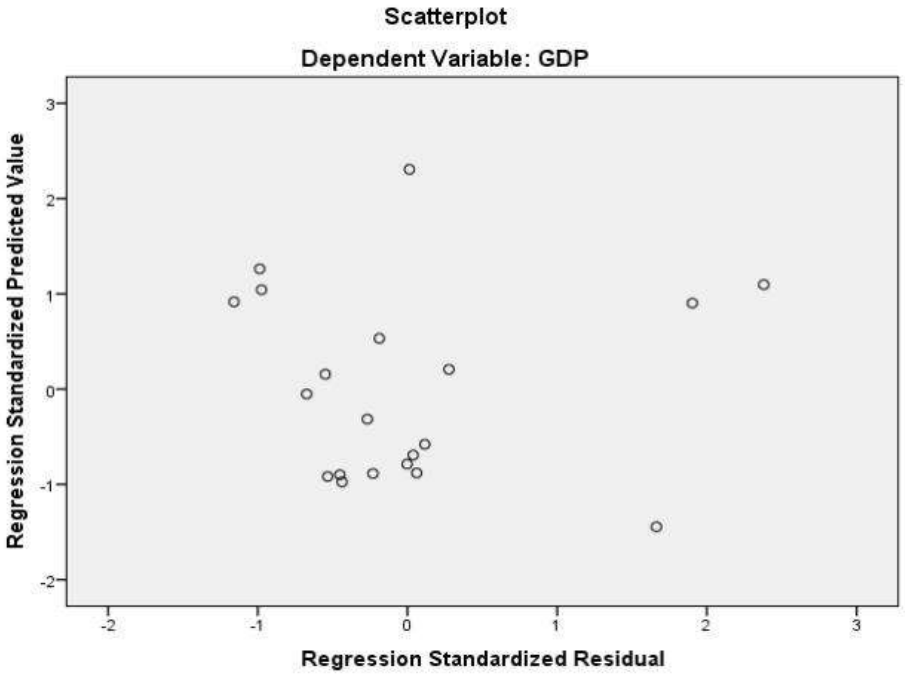
Table 12



DISCUSSION OF THE RESULTS

Preliminary analysis and data check

Extensive data was obtained from different journals and sources like OECD, World Bank, Statistical Communiqué of National Economy and Social Development, National Bureau of Statistics of China, www.stats.gov.cn and all copyrights are observed. The method was to verify whether a nexus between innovation and growth exist. Firstly the method made sure to avoid outliers .The data included for innovation, growth and R&D accounts effect from 2000-2020, a period of 20 years. As discussed above the method used three main variables which are Growth, R&D and Innovation.

Analysis of Data

The first step is to look at the assumptions, and we check the Correlation table first. The results show that there is a strong relationship between the dependent variable GDP with the two independent variables namely R&D and Innovation. The assumption comes from the fact that the data the Pearson correlation is showing that all the values are close to 1 with the GDP = 1, R&D = 0.557 and innovation =0.914. Therefore one can notice the relation is perfect and a change in the variables does affect the dependent variables

Second, on the coefficient table our VIF and tolerance clearly shows that we do not have multi Collinearity problem and that our data is statistically significant as they are below the value of 10 which is the standard number and any figure more than shows redundancy in the simulation. Standard deviation shows a moderate rectangular distribution and the two variables still prove that the results are statistically significant.

Weakness of the Method

Sometimes obtaining data manually can lead to errors and thereby resulting in biased information. The relationships between the dependent variable and the independent variables can be casual sometimes or have a unique relation that is always transient and thereby multiple simulations can result differently while using the same data.

CONCLUSION

The nexus between innovation and growth affects the economic performance and output. It can be argued that a shift to knowledge based economy increase the country's competency and accelerates the economic transformation. It is an urgent call for theglobal community to catch- up with the China Initiative for new Drivers of growth to remain competitive and increase production. Regional innovation has largely been influencing the research and development act in China . Moreover, much of the innovation has largely been through manufacturing enterprises embracing the idea of innovative productivity. Research shows that more and more patents are being open in China and maximum efforts have been put towards maintaining the high rates of growth and as well as taking a toll in competing in the global economy. Therefore, one can conclude that after substantive analysis, the more the innovation the greater the economic growth.

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