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INNOVATION AND ECONOMIC GROWTH CASE STUDY CHINA AFTER THE WTO

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ABSTRACT

Based on the definition of the economic development given by many economists, the economic development is affected by several economic indicators essentially by the degree of innovation, the research and development activities also by the foreign direct investment and by the human capital education level.

Therefore, the aim of this study was to analyses the link between the innovation and economic growth in the Chinese economy. To verify this link, we adopt a certain strategy, by using a single country analysis based on multiple regression models. In order to estimate the innovation degree, we have used various variables as a proxy such as the number of patents, the number of trademarks and the research and development expenditures. The results of this study, provide a positive linkage between the two indicators, the economic growth, and innovation degree.

Keywords: Economic growth, China, WTO

JEL Classification: O31, O30, O47, O52

1. INTRODUCTION

In today's world, the investment in Research and development became inevitable and that to be a part of the global world system and improve the competition power. Therefore, research and development became a key driver of the country's economic growth process. Therefore, many different studies whether theoretical or empirical relevant to research and development role in economic growth agree on the significant contribution of the research and development in the economy of some countries around the world (Romer, 1990; Lucas, 1988).

Thus, the extraordinary performance of the economic growth of china's economy among the last 20 years had generated an increasing in the number of studies related to it in order to explain this performance especially when we compared to other countries China presents a successful example in enhancing the economic growth and that's why we chose China as our case study for

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this framework.

The aim of this research was to analyses the link between the innovation and economic growth in the Chinese economy. To estimate the change degree, we have used various variables as a proxy such as the number of patents, the number of trademarks and the research and development expenditures. The structure of this paper is as follows: in Section 3 we will present the different literature review, the4thSection saved for explaining the data and the methodology. Section 5, it's for the empirical analyses, section 6 for analyzing the empirical output obtained and Section 7, discussion for these latter's and finally a general conclusion.

2. LITERATURE REVIEW

The relationship between economic growth and innovation became an attractive subject for many academic researchers whether to analyses the level or degree of development for the countries or to figures the direct or indirect effects of innovation on economic growth.

For the academic and theoretical studies, Solow (1956) and Romer (1986), they both analyzed the relation between innovation and economic growth, each one of them from his perspectives and point of view. For Solow (1956) model, the economic growth is exogenous and explained by two variables capital and labor. Also, he conducted that the economic growth affected as well by the evolution of the innovation degree. On the other hand, The Romer (1986) theory which is considered that economic growth is characterized by endogenously, and also affected by the entrepreneurship by modeling the innovation system or process.

However, for the empirical studies which they discussed the relationship between economic development and innovation degree, like the study of Ulku (2004), the author has investigated the link between the economic growth and research and development expenditures which reflect the innovation degree. The author analyzed this relationship for almost 30 countries divided into two groups countries that blown to OCED countries and countries that not. Following the steps of Romer (1986), the author tested the hypothesis that the research and development activity boosts the level of innovation and the latter' s as well leads to increases the level of the economic growth. As a result, the author's study has confirmed the previous hypothesis mostly for the developed and emerging countries.

As well as for, Cuma BOZKURT in 2015, in this study, the author investigated the relationship between research and development expenditure and economic growth. The author found an evidence of the unidirectional effect of research and development on economic growth. This impact is strongly significant and has positive worth.

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Also, we have the study realized by Westmore, 2013, which was aimed to examine the determinants of research and development expenditures and patents and the link between innovation and economic growth. The result of this investigation provided evidence of the influence of incentives of intellectual property rights that support and encourage innovation activities in private sector.

Another research, Taban and Şengür 2013 analyzed the relationship between R&D and economic growth in Turkey using a cointegration models. The authors concluded that research and development expenditures influence the economic growth positively in the long run.

Likewise, this study of Sadraoui and Zina 2009, examined the dynamic relationship between research and development and economic growth by using the GMM model in 23 countries. As a result, the authors found a positive and significant impact of research and development on the economic development of those countries.

Finally, another study realized by Pece, Simona, Salisteanu 2015 was interested in analyzing the link economic growth and the innovation capacity of an economy using CEE countries, data; the results has provided evidence of a positive impact of innovation on the economic development of the choosing countries.

3. DATA AND METHODOLOGY

a. Data

The primary objective of this paper is to analyses the connection between economic growth, innovation, foreign direct investments, high education, labor force and the level of exports. The data source is world bank, The World Intellectual Property Organization (WIPO) and The Organization for Economic Co- operation and Development (OECD), by taking into consideration the period 2001-2014. The variable that used as a proxy for innovation was the level of research and development expenditures. The variables used in the current study, can be observed in the below table:

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Table 1	
variables	**Definition**
GDP	Log of GDP
Number of patents	Annual number of patients
Number of trademarks	Annual number of trademarks
Research and development expenditures	The share of the investigation and development costs in total
FDI	Log of the foreign direct investment
population with tertiary education	The percentage of population with higher education in the total active population
Unemployment rate	Unemployment rate
Exports	Log of exports
Source: Author's calculations	

b. Methodology

The purpose of this paper is to examine the following hypothesis: is the economic growth rate of China is affected by the innovation capacity. In our framework, we will use the multiple regression models to estimate the previous hypothesis.

Thus, the following regression is used to examine the relation or the link between the economic growth and the variables that we mentioned in in the above section, u7u7 which can be observed below:

$$\mathbf{GDP = c + \alpha * Patents + \beta * Trademarks + \gamma * R\&D + \varepsilon t} \quad \textbf{(1)}$$

$$\boldsymbol{GDP = c + \alpha * FDI + \varepsilon t} \quad \textbf{(2)}$$

$$\boldsymbol{GDP = c + \alpha * Exports + \beta * \text{Population with tertiary education} + \varepsilon t} \quad \textbf{(3)}$$

4. Empirical analysis

Before reviewing the results of the estimation, it is necessary first to verify a fundamental and essential condition of our model. Which is the stationarity of the time series that we choose to work with it. The rule is that the time series called not stationary when it is auto correlated continually. In another word, its value at every period depends strongly on the previous one.

The Augmented Dickey-Fuller Test (ADF) is one of the unit root tests for stationarity especially

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when the unit roots can cause unpredictable results in your time series analysis.

Table 2. Results of the ADF test of Dickey-Fuller

variables	T statistics	critical value (5%)
ΔGDP	-3.888	-3.600
Δ Patent	-5.548	-3.600
Δ trademarks	-3.430	-3.600
Δ R&D	-4.072	-3.600
ΔFDI	-4.131	-3.600
ΔTeducat	-3.496	-3.600
ΔExport	-4.542	-3.600

Source: Our calculations based on output Stata 12

5. RESULTS

a. Estimation result

After testing the ADF Dickey-Fuller test, we moved to the model estimation by integrating each variable with his appropriate order in the estimation, the empirical output that we have it from testing the following hypothesis of the effect of the economic indicators that we explained in the previous section on the economic growth for the Chinese economy is presented in the tables below.

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Table 3: Regression results for the connection between economic growth and its determinants			
Variable	Model (1)	Model (2)	Model (3)
Number of patents	**0.0000114 (5.99) *** **		
Number of trademarks	**0.0095927 (2.88) ** **		
R&D Expenditures	**0.017574 (14.53) *** **		
FDI		**0.209778 (3.65) *** **	
Tertiary education rate			**0.0356998 (1.55) * **
Exports			**1.037375 (13.08) *** **
Employment			
Adj.R^2	[1]	**0.5712**	**0.9664**
Prob > F	[2]	**0.0045**	**0.0001**
Source: Authors' calculations, ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively			

b. Post-estimation

i. Normality test for the residuals

Before interpreting the previous results, we must before verify some hypothesis that allows us to use the last result as a final regression; those hypotheses are the normality distribution. For a small, simple number observation <50, if the Absolut Z-score for either Skewness and Kurtosis are less than 1.96 which correspond with α level = 0.05, then we rejected the null hypotheses and concluded that the distribution of the sample is non-normal.

[1] Because of multicollinearity between the three variables (patent, trademark, and R&D) we introduce each one alone, therefore, result of adj.R^2 and Prob>F will be:

	Model1a Patent	model1b Trademark	model1b R&D
Adj.R^2	0.7654	0.4306	0.9462
Prob > F	0.0001	0.0149	0.0001

[2] Look at 1st note

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in the tables below we presenting the result of the normality test:

table 4. Skewness/Kurtosis tests for Normality

Variable	adj chi2(2)	Prob>chi2
residu(Model1a)	3.07	0.2157
residu(model1b)	0.62	0.732
residu(model1c)	2.21	0.3319
residu(model2)	1.44	0.4859
residu(model3)	1.92	0.3828

Source: Our calculations based on output Stata 12

Therefore, since all the P. Values are higher than α =0.05, then we retain the null hypothesis and consider the sample as coming from normal distribution

ii. heteroscedasticity test

We used the Breusch-Pagan test to verify the presence of heteroskedasticity problem; the test problem is as follows:

- H0: homoscedasticity
- H1: heteroskedasticity

If the probability associated with the test is less than α, the hypothesis of homoscedasticity (H0) is rejected. On the other hand, if the probability is greater than α, the null hypothesis is verified and we can assume the homoscedasticity of the residuals. With α = 5% = threshold of significance.

According to the table 4, The results of the heteroskedasticity test show that all the probabilities are all greater than 0.05. So, we reject the hypothesis H1 of heteroscedasticity and assume the homoscedasticity of the residues.

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Table 5: Results of the heteroskedasticity test (Breusch-Pagan)		
Model	Chi2(1)	P.value
Model1a	0	0.9992
model1b	1.85	1.739
model1c	0.09	0.765
model2	0.04	0.8367
model3	0.25	0.6164
Source: Our calculations based on output Stata 12		

6. DISCUSSION

The results indicated that the economic growth is influenced by many factors, in the 1st place and mostly by the innovations degree which is proxied by the number of patents, the level of research and development expenditures and number of trademarks, and in the 2nd secondly by the foreign direct investments, exports and education level of the population.

The results highlighted a positive impact of innovation on the evolution of economic growth, which can be observed through the positive impact of research and development expenditures variable on the economic growth since we supposed that the previous variable is used as one of the proxies of innovation. Also, we can describe the link between innovation and economic growth through the significant and positive impact on Number of patents and trademarks on economic growth.

Furthermore, the findings support a healthy and active relationship between Foreign direct investment, exports, and economic growth. Therefore, we have concluded that foreign direct investments have an essential role in the economic growth of China even through the knowledge transfer or/ and the enhancing of technological processes.

Also, the results indicated that education level, especially the tertiary education, have an active and substantial impact on economic growth and through her, we can explain the improvement of the innovation capacity of the country

We finalize by concluding that the results obtained support the endogenous growth model, because the output of the model carries out an active link between economic growth and innovation.

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7. GENERAL CONCLUSION

The innovation, R&D expenditures and the investments in technology are significant and essential factors for guaranty a high level of competitiveness and continually progress, and which through them a country can maintain sustainable growth. Therefore, to bond and ensure the improvement of the public and private sectors, and as well to enhance the standard of living, the country should get a high level of education, boosting the investment in research as well a creation of a new brand-new product which she should be accompanied by facilitating the road for investors to get into the market.

We choose to work on the period from 2001 to 2014 due to the serval's reasons. First, because of the high change in the international bonds between China and the developed world especially it is observed since 2001 when China entrance to the WTO. Secondly, in 2002 the rapid cut of the trade barriers which has reinforced and enhanced the development of foreign investments and more importation of technology into China. Likewise, as a result, the basics channels of international technology transfer became more significant and more efficient, also which will be eventually accompanied with evolution if exports to China because of the linkage with rest of the world.

This framework has led to deduct that the concluded results support the endogenous model, because the output of the empirical estimation confirms an active link between economic growth and innovation. This can be explained through the Research and development expenditure evolution also can be explained by the amelioration of the number of patents and trademarks. Therefore, we concluded that the research and development costs increase the number of patents and the trademarks which enhance the level of innovations and the latter lead to permanent growth

Also, this framework confirmed the importance of the educational attainment population on the economic growth; each country has a high number of population with tertiary education will lead to more research and development which will boost the expenditure of these latter's then will generate more innovation.

Likewise, the foreign direct investment has a positive and significant impact on the economic growth, especially this type of investment is a source of technology transfer and innovation.

Finally, through this analysis we provide that the Research and development has an essential role in economic growth and one of the most important indicators to study the country economic growth and degree of development and openness.

