Growth and Convergence: How could Governments Make Valid Expenditures to PromoteInnovation?

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Abstract. Economic growth had seen slowing growth rate in some developing economies mainly due to the limitations of convergence and catching-up effect, despite this theory having once provided the theoretical basis for the rapid growth of developing economies at their early stage. Due to the impacts of the global pandemic, this cease in growth is likely to occur more rapidly. Based on the endogenous theory of growth, this study conducted a deeper analysis from the aspect of government and its intervention, by dividing government expenditure into three categories that effect the environment and incentives for innovation to occur within an economy without taking direct investment into account. The variables via each category could be matched with an economic indicator that is either directly reflecting upon the government's expenditure or is largely dependent on the government's intervention. After conducting statistical data analysis on the raw data collected from the National Bureau of Statistics and the World Bank, the linear correlation constructed within the model could be tested with the significance coefficient of each variable. The output of this study put forward the endogenous theory of growth. Despite not being able to generate accurate anticipations, the general pattern of growth could be predicted with suggestions for the government to adjust their expenditure policies and plans in accordance with the economy's status and the growth of that economy can be oriented in theory.

Keywords: Innovation, Endogenous Growth Theory, Government intervention, Convergence, Economic growth.

1. Introduction

1.1 Research Background and Motivation

After COVID-19 and energy crisis-related global affairs had taken place and impacted all major economies in the world in recent years, the economic growth rate in some influential economies are seeming to cease with an urgent need for the development of technology to counter certain problems. The slowing growth rate in real output is most common and concerning for developing economies since the rapid economic production growths within developing economies seemed to reach their peaks, the maintenance of this growth has been coming across gradually increasing difficulties. Along with the influences of economically devastating events such as the COVID-19 pandemic, it is likely that those developing economies could reach their peaks in growth rate earlier than the predicted time and cease at a level lower than the anticipated threshold. The thesis of this essay derived from the concerns in reality, the investigation looking for a solution would be adopted in the field of innovation. In microeconomics analysis for firms' willingness and abilities to innovate within a market, the innovation levels of firms are dependent on the size of them. In economic terms, scale effect exists in markets. However, macroeconomic empirical study pointed out the disparate mechanisms of innovation growth between firms' competition and interplay of economies. Reflecting upon productive efficiency, industrial productions across the globe had discovered that economies with different starting points have the tendency to approach to the approximate same level of per capita production. In Baumol, W. J's 1986 paper, he investigated the converging pattern of per unit production among 6 economies with different initial per unit gross domestic product(GDP)[1]. Economies which started at a lower starting point would gradually converge to more developed economies in the duration of a century, given that the coefficient of initial income is negative in the regression of convergence[2]. This is known to be β-convergence, in this model the growth rate of GDP per unit is negatively correlated with the initial starting point β. For economies submitting to

this theory in empirical studies, China would be a representative among them considering its GDP from 2000 to 2020 had increased by more than 10 times. In comparison to the GDP growing pattern of more developed economies with higher starting points in GDP such as the United States or euro area, the convergence of Chinese economy is observable. Occurrence of this convergence mostly attribute to technological spillover and the flow of skilled labor in proceeding globalization and international trading. The effect of this spillover is finite, thus potential problem of ceasing in rapid growth is inevitable when an economy had been absorbing knowledge from the world and came closer to the boundary of human knowledge. Research and development(R&D) can put forward this boundary, despite not being able to maintain the same rapid growth as if the economy was still on its learning stage from other economies. In order to seek for a maintained development in the economy, R&D is the specific sector for the government to focus on. By paying a short term opportunity cost either through direct investment into a field of technology or reformation of general policies, the environment would be made more suitable for the growth of innovation. R&D does not only produce the innovation output within a certain industry, but the spillover effect would serve for the whole economy during the adoption process. As a subsequent side effect the knowledge foundation in the population would be improved due to the diffusion of innovation, cultivating more skilled labor force to compensate the need of labor in arising technology industries, gaining the access for future technological development. How the government could use their resources more efficiently to achieve the intended outcome would need to be studied.

1.2 Literature Review

The study of modern economic growth theory started with the development of Keynesian economics in which the independent studies from keynesian's scholars Roy.F Harrod(1939) and Evsey Domar(1946)had combined to form the Harrod-Domar model [3]. This model as the precursor of growth theory had pointed out the substituting correlation between government budgetary surpluses and domestic savings; also acknowledged capital accumulation as the key factor pushing forwards sustained economic growth [4]. Economic growth theory started at the early stage without primarily valuing the significance of innovation or technology until the study of Robert Solow(1956) and Trevor Swan(1956) constructed the Solow-Swan model which deemed exogenous factors such as knowledge or technology as the central factor to sustained long-term economic growth [5], this had led to the development of exogenous growth theory. The idea of exogenous growth theory is theoretically appropriate for the interpretation of an economy, yet if the key determining variable is considered to be exogenous which means immeasurable with endogenous economic factors the model itself would not be able to anticipate the trend of economic growth to a specific extent without the measurements of the economy's own factors of production. That limitation had weaken the validity and viability of growth theory, since exogenous factors do not directly refer to typical economic measurements. Interpretation of the factors causing innovation to improve could work as the solution to this fallacy, and further use endogenous factors for analysis. The AK model as the earlier precursor of endogenous growth theory was built by Paul M Romer in his 1986 paper Increasing Returns and Long-Run Growth[6]. It had removed exogenous factors from the previous models and used total factor productivity(TFP) A and capital K to explain the growth in total production Y with the factor of labour being eliminated by assuming the elasticity of capital to be unitary elastic. In this model, the existence of technology or innovation is not explicitly shown from its variables used for the exterior expression, instead technology related factors work as the determinant of variable A which derives from other variables. Total factor productivity is a ratio between aggregate output and aggregate input; it measures the productive efficiency of production, which its improvements are largely dependent on technological progresses. Despite being affected by technology and innovation, the level of innovation of an economy is not directly involved in the calculation of TFP. For early endogenous growth models like the AK model, the significance of measuring innovation is reflected upon its outcome for the calculation of real output rather than the mechanism and factors determining innovation itself. By referring to the interaction between endogenous factors how innovation is

determined could be interpreted without referring to the "manna of heaven" in which scholars used to adopt this phrase in their analysis(Mark Roberts and Mark Setterfield in the chapter 3 of the book Economic Growth: New Directions in Theory) [7], despite having disparities from theories to reality and the result could be varied across regions. A more efficient and economically viable pathway is to investigate how those factors could be controlled and modified by a manually manipulated institution of command rather than leaving it to the "invisible hand".

1.3 Research context and frameworks

Based on the theoretical foundation and real world background, the research would be a continuation of previous innovation and growth theory in concerns of the problems in terms of growth rate in reality. Granted that the majority of innovation is initially the result of market competition, government intervention would make the outcome of studies or innovations diffuse into the society more easily, with the benefit of creating their spillovers and externalities, hence making the most utility out of a technological breakthrough. In the real economies, the effects of specific policies would need to be based largely on the economy itself. The features of an economy could be articulated using both quantitative measure and qualitative measure, including quantifiable variables and abstract concepts. However, due to the existence of obscure variables like social attitude, behavior and opportunities, empirical studies exclusive to a specific economy cannot be replaced by full theoretical anticipation. The purpose of this study is essentially analyzing a specific part of one of those obscure variables which would be introduced in detail in the methodology part. By setting an influential economy in the world as an empirical study objective the outcome model would be firstly specific to the objective, yet could be generalize by removing some of the variables or adjusting constants for other studies.

2. Methodology

2.1 Objectives and hypothesis

This study aims to investigate the level of innovation within an economy in relation to the level of government expenditure and how those expenditures are distributed in each sector. The idea of connecting innovation level with government spending formation initially derived from the neoclassical endogenous growth theory in which it interpreted long term economic growth in the business cycle with endogenous factors such as labour or capital. The other base theory is the innovation market triple helix model. The structure consist of three agents that constitute the market of innovation, with universities and firms acting as suppliers of labour(scholars) and monetary incentives respectively. The central role of the government reflects upon its functions as a regulator of innovation related activities by enacting patent&Intellectual property rights(IPR) laws and incentive policies(Etzkowitz and Leydesdorff,1995[7]). Regarding the government's functions and actions of providing policies that is not only limited to the structuring and maintenance of rules, but also monetary incentives and compatible mechanisms which both promote innovation. With the abilities mentioned above, the government's role could consists of functions of an advocate, the supplier of key resources and the institution that cultivates educated labour force besides its central function as a law reinforcing institution. As previous studies of innovation theory had analyzed, the level of innovation could be interpreted and explained with the quantity of factors of production within an economy, as well as behaviors of the three key agents in the innovation market. The level of innovation regarding more specific division and analysis of the components of government expenditure is to be discussed in this essay.

The study is based on several theoretical assumptions and produces hypothesis in terms of anticipation of the future growth of the economy. If anticipation based on this model is used to predict an economy's future, it must be adjusted with changing in factors according to the economy's condition. The validity in real world would also require empirical analysis, the impact of more factors would need to be taken into account since quantifiable variables are not sufficient to construct such a

model which simulate real world innovation market mechanism. Despite having endogenous growth theory making some immeasurable factors explanatory with measurable variables, the influences of opportunity, international affairs and omissions would inevitably make the model interpreting a three-sector economy deviated from reality. A theoretical model has a corresponding designated ideal economy in which those unpredictable changes and features would be ignored. Further more, government spending is not the only factor influencing innovation level, since the other factors can also make innovation attainable, free markets without any interventions could have different levels of innovation determined by their conditions.

Those factors are not to be studied in this paper, yet their existences would be represented as the minimal level of innovation without any extra government spending on the upside or any disasters or warfare on the downside. If regarding the government's interventions as a positive factor always elevating innovation level, the position of innovation level in a identical free market economy should be the minimum level. In the modeled regression equation below Y represents the total output of innovation which would be the sum of β0 , β1X1 and ui. β0 is the minimum level of innovation naturally occurring in an economy without intended promotion; ui represents the effects of omission and immeasurable unpredictable factors like opportunity or features specific to economies in real world, allowing this model to be more adoptable when making empirical adjustment.

$$Y=\beta_0+\beta_1X_1+ui \quad (1)$$

The aggregation of $\boldsymbol{\beta_0}$ and $\boldsymbol{ui}$ is the starting point of this linear graph intercepting Y-axis. Those quantifiable variables that are linearly correlated with Y is represented as $\boldsymbol{\beta_1X_1}$ in the general form. In further interpretation those variables would be assigned to separated representation in this general form.

2.2 Variable interpretation

By analyzing the effect of government expenditures in innovation regardless of direct investment the correlation between each sectors and innovation should be indicated with a relativity evaluation in general. A rank of utility of expenditure on innovation would be a real world indicator for policy makers to weigh their budget decisions if they attempt to elevate the gross domestic output of the economy in the long term.

In order to determine which part of government expenditure could be considered as innovation-promoting and examine whether the expenditures made by governments can effectively promote innovation if exclude direct investment would need to be evaluated from the aspect of welfare promotion, knowledge promotion and incentive promotion. With welfare promoting expenditure providing fundamental standard of living assurance, making talented scholars be able to innovate and bare the consequences of failure. Knowledge promotion attributes to the construction of the material foundation that is necessary for innovation, education spending would be the typical expenditure that fits in the description and requirements provided. Lastly, incentive of innovation regarding government's action has to do with policies and laws in accordance to patent, IPR and trademarks. Nevertheless, those policies would not be taken into account of the linear correlation study between expenditure and innovation since they do not come with a quantifiable monetary cost that is suitable in scale, yet their impact despite being less predictable in comparison to spending would attribute the expression of the model by regarding them as part of a constant. To show the distinction between incentive promotion and direct investment, the incentive expenditure would be referred to government's general expenditure in R&D in which it consists of the universal subsidies, prizes and funding granted by the government with financial support targeted at a particular firm, project or university being excluded.

After identifying the key concepts of this study on the basis and narrowing the range of inclusion, each of those measurement taken into consideration are registered with a corresponding data provided by national statistic bureaus. The output of innovation as an independent variable can be measured by the amount of regional patent applications in an economy. The dependent variables regarding those categories of government expenditure have data representations individually. Welfare promotion

expenditure was disparate from transfer payments with the latter one having more exclusivity in nature. Transfers only serve for a limited percentage and range of an economy's population which does not make it representative. Life expectancy and gross domestic products have validity indicating the standard of living in an economy despite not directly referring to the government's expenditure pattern which promoted them; in comparison to human development index they are more specific to welfare, since education is measured as an individual variable instead of combining in the measure of welfare. The idea of knowledge expenditure is identical to government education expenditure in real term, while literacy rate is also an indicator, but exists as a result of this spending in a linear relationship. After all three objective variables of this study being assigned to a specific economic indicator the model could be constructed as the regression equation given below:

$$Y= \beta_0+\beta_1 E+\beta_2 W+\beta_3 I+ui^* \quad (2)$$

The major improvement on the previous expression is the detailing in independent variables after the three components of government's budget in innovation are assigned to data. E stands for education expenditure; W stands for welfare condition and I stands for incentives. $\boldsymbol{\beta}$ is the general expression of the regression coefficient in describing each linear relationship. The only additional adjustment is added on $\boldsymbol{u_i}$ by including the effects of policies and laws regardless of spending. However, the specific numerical value for $\boldsymbol{u_i}$ is not going to be included in further data analysis due to their features as qualitative measurements. In the original hypothesis, this regression model should be linear in terms of the relation between the independent variable and each dependent variable. Analysis of this regression model and regression coefficients would prove the validity for each variable and the real relationship for some of the variables if not being linear.

Table.1 Descriptive data analysis display of economic indicators

Variable	N	mean	p50	S.D	min	max
Patent application	47	289339	189536	325281	72079	1.394e+06
GDP in Trillion $	47	12.49	12.65	3.273	6.087	20.14
Education spending (% of GDP)	47	4.809	4.976	0.559	3.522	5.563
Life expectancy in year	47	78.53	78.60	2.059	74.41	82.06
R&D spending (% of GDP)	47	2.259	2.136	0.377	1.714	2.833

The measures of expenditure mentioned in this section had corresponding data set collected in table.1. The overall sample space includes the 19 years variation of the 5 measurements in 3 different regions, taken up a total amount of 47 individual data piece. For descriptive data analysis the table had used 5 main benchmarks showing the distribution of different measures of expenditure across regions. The measure of standard deviation, minimum and maximum value are demonstrated to describe the location and spread of those data, with the mean value and fifty percentile median value indicating the skewness of data.

2.3 Data collection

The data of those variables was collected from a wide sample range based on the principle of selecting representative and influential economies in the world. When doing this selection, the idea of representative economy is the key to this study. An economic theory that is largely derived from empirical research, observation and summary is suitable for the practical applications of this study and data selection. The main focus of this study is on developing economies which had the potential resources and abilities to exceed developed economies in terms of aggregated gross output, yet had come to the point of slowing down submitting to convergence. The study object included both developing and developed economy with the later one being a contrast. Instead of regarding the regional economic units as countries or nations for the occurrences of those data, economy including countries and economic unions is a more preferable domain for this study. The purpose for this

clarification is to remove those conceptual limitations from political and historical terminologies, whilst focusing on the real formation based on the functioning of those most influential economies.

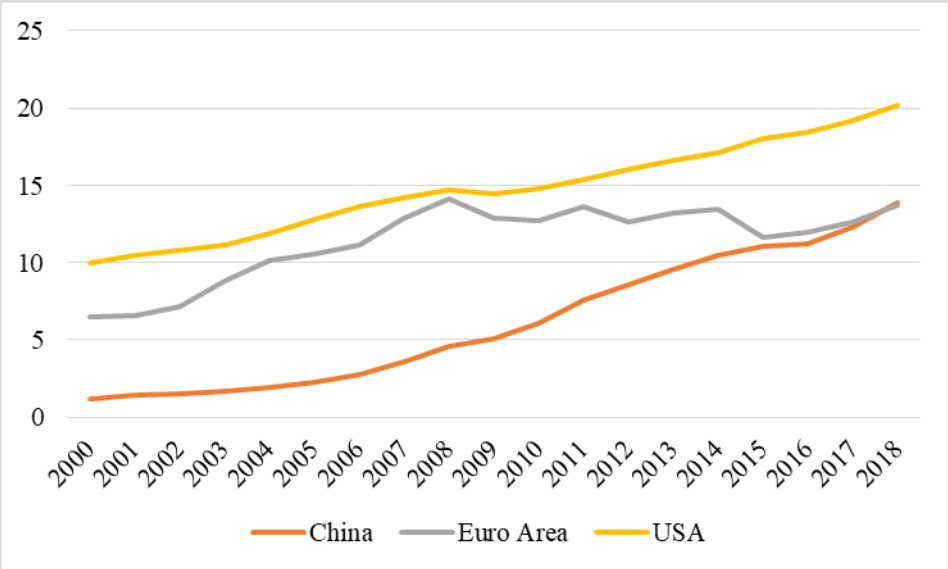

Figure.1 The GDP of three economies from 2000 to 2018 (Unit:trillion $)

Source: World Bank national accounts data, and OECD National Accounts data files.

Figure1 had represented the collected data from the three regions chosen within the 19-year duration. Despite having a sustained growth leading to a double in the US economy's GDP, it is clear to see that the GDP gap between China's economy and the USA economy had dwindled over this period[9]. By using the European economy for comparison, the theory of convergence would be represented with a greater significance in graph. As shown, over the 19-year period the GDP level of China had not only converged towards, but also exceeded the GDP of level in European economy. A deficit of this measure in realistic term would be the impacts of economic failures, recessions and financial crisis were not equally influential among economies. Arguably for growth theory economic recessions were already taken into account, like the modeled business cycle had made the assumption of constant economic recessions and booms in advance. However, without empirical measures and precisely running over the potentially important variables, those assumptions based on logic would lose their validity in reality. The result of their theoretical model could usually point at the correct direction or even anticipate potential obstacles on the way of economic development, yet the inability of predicting to which extent the obstacles would last or to whom would these obstacles impede the most had limited their adoption to theories only. Similar concerns and questionings in detail would make the general deficits in models hardly being recognized as an omission in most case, since governments would not even attempt to make any accurate forecast fully based on models. This had explained why in reality convergence might be more radical (compared to European economy), or more implicit(compared to the US economy) regarding the economy used for comparison.

For further interpretation measuring innovation investment and related spending, data set of those variables during the 19-year period from 2000 to 2018 is listed for the two developed economies selected as sample: the USA and euro area. While for the study object China which is considered to be a developing economy following the convergence pattern, the range of data selection is narrowed down to a 9 year period from 2010 to 2018. By excluding data from some of the earlier years, the converging pattern during the later stage with decreasing growth rate can be emphasized. This exclusion is made also out of the consideration for the data set itself. Since the GDP level of China had been varying greatly overall from 2000 to 2018, excluding a part of this data set could reduce the omissions and errors due to over spreading distribution.

3. Results and Discussion

3.1 Data analysis

After running the data through correlation analysis program, a table consists of the output of the analysis had been produced as given below. It shows the correlation analysis of the collected data for each variable by gathering their significance in relation to the study object.

Table.2 Significance ranking of variables

Patent application	Patent~n	Year	Lifeex~r	RDexpe~P	Govern~g	GDPinT~S
	1					
Year	0.461***	1				
Life expectancy	-0.600***	0.163	1			
RD expenditure	-0.0170	0.150	-0.0520	1		
Education spending	-0.780***	-0.327**	0.645***	0.383***	1	
GDP in Trillion $	0.00200	0.541***	0.331**	0.734***	0.372***	1

*: Regression coefficient significant under 10%
**: Regression coefficient significant under 5%
***: Regression coefficient significant under 1%

As demonstrated by the significance notations of the variables, the significance level for the regression coefficient for each variable and their influence on the dependent Y variable which is the innovation output are being interpreted. The independent variable education expenditure and GDP had shown the most relevance with the dependent variable (patent application), while for life expectancy and R&D expenditure the correlation is not that significant in linear regression. For the time variable "year", its significance level is high, which reflected upon the pattern of increasing in empirical data showing that patent application number had varied with time forming a positive correlation.

Table.3 Correlation analysis output of statistical measurements

Patent application	Coef.	Std. Err.	t	P>t	95% Conf.	Interval
Government education spending	-1.86e+05	87765.662	-2.12	0.041	-3/63e+05	-8191.531
GDP in Trillion US	70133.435	15039.648	4.66	0.000	39712.875	1.01e+05
Year	-5.01e+04	11997.384	-4.18	0.000	-7.44e+04	-2.58e+04
Life expectancy at birth in year	29531.171	55080.604	0.54	0.595	-8.19e+04	1.41e+05
RD expenditure of GDP	1.06e+06	2.77e+05	3.82	0.000	4.98e+05	1.62e+06
_ICountryre_2	-9.89e+05	3.16e+05	-3.13	0.003	-1.63e+06	-3.50e+05
_ICountryre_3	-1.74e+06	2.54e+05	-6.85	0.000	-2.25e+06	-1.23e+06
_cons	9.74e+07	2.20e+07	4.43	0.000	5.30e+07	1.42e+08

Table.3 above had given detailed results of statistical measurements and benchmarks of variables. The fifth column is a processed P value derived from the t value which is directly linked to the analysis of the regression coefficient $\boldsymbol{\beta}$. P value represents the probability for null hypothesis to be true, in other words, the chance for the regression coefficient $\boldsymbol{\beta}$ to be 0. P in the form of decimals shows the probability and thus could be converted into the format of percentage. When the value of P is below 10%(0.1) the chance for null hypothesis to be true can be acknowledged as a minor probability event in which in most studies the variable could be regarded as significant on the first level. When rejecting the null hypothesis, the alternative hypothesis previously set as the hypothesis of the study could be

accepted and proved true. In this case if a variable have a P value below certain threshold, the smaller it gets the stronger significance would sustain within the regression coefficient. For the variable life expectancy, its P value exceeded 59% which means that the null hypothesis should be accepted andits correlation with the dependent variable Y is not significant in this regression as the coefficient

$\boldsymbol{\beta}$ became 0 according to the null hypothesis.

Table.4 Multicollinearity test

Variable	VIF	1/VIF
Lifeexpect~r	41.28	0.024225
RDexpendit~P	34.94	0.028620
Year	13.87	0.072081
GDPinTrill~S	7.77	0.128655
Government~g	7.73	0.129309
Mean VIF	33.61	

In the multicollinearity test given in the table above, the variance inflation factor(VIF) is used to determine whether an independent variable can be explained or represented by another independent variable in linear regression. When VIF reaches above 10 the variable is in linear correlation with another independent variable and should be regarded as having Multicollinearity with that variable. For the factor life expectancy it had reached the highest VIF of 41.28 value via all independent variables, showing its relevance with them. Same issue happened to other variables as well. However, multicollinearity would not effect the result or accuracy of this study greatly, since this data analysis did not include data of control variables which means that the existence of multicollinearity would not occur to control variables. For most of the time, multicollinearity is a problem when there is a high rate of relevance between the control variable and other independent variables. Since control variables can be influenced to a great extent by the changes in independent variables when they are linearly correlated. As a result the control variables would not be controlled, and causing omissions in the interpretation of the study object Y variable.

3.2 Discussion

From the results of the data analysis conducted in the last section, the overall validity of the original hypothesis is proved and the study itself would have significance in related study for growth theory. This research followed a logic chain from proposing hypothesis to analyzing variables and then looking for specific economic indicators corresponding with the variables. According to the result of analysis, some of the data or indicator should be rejected and replaced by more related data. However, the failure in terms of validity or correlation occurring to an single economic indicator should not be sufficient enough to deny the whole variable. The component of government spending which attributed to the part of welfare promotion is invariably a measurements of the fundamental status of an economy from a government's perspective. On a larger scale of economic status it is included in the part of ***ui*** working as a control variable or for granted environment for innovation since it is barely measurable. Life expectancy would largely depend on the economy itself rather than the expenditure choice made by the government, which means that it does not represent government spending on welfare or improvement of standard of living. Arguably, it could be used as a control variable which reflects upon the status of an economy. Nevertheless, in that case multicollinearity would not be negligible, and as the testing result had shown that life expectancy has a great VIF value, its linear correlation with other variables is significant thus cannot be used as an control.

Frenkel's 2003 paper "Barriers and Constraints in the Development of Regional Industrial Innovation" addresses the factors that affect the level of innovation in an economy, and more specifically, the factors that limit the level of innovation[10]. It had included a wide range of sample up to 17 possible limitations not only limited to government's policies, but also consumers and producers within the market. However, it is still based on government's interference towards the economy. Instead of giving suggestions of policies or focusing on anticipation he analyzed the impact

of policies on the free market of that specific economy and the responses made by other agents in the market. This choice of analyzing and focusing on a case study had enabled his study to be more detailed and reflective in comparison to the study in this essay, since the aim of this study is to construct a generally effective model which could be used as a reference for government's intervention regarding the economy's status. The linear regression model used in the research had omitted the value of u_i and thus errors cannot be avoided if variable u_i is at an abnormal level. This model is invalid when attempting to make accurate anticipations if without further data analysis specific to case study, yet it is able to orient a rough direction and indicate suitable policies. In theory the modeled factors should have consistency in terms of the magnitude of their influences on an universal level, yet to make the anticipation closer to reality the modelling process must be domestic to each economy which investigated.

4. Conclusion

This study had deconstructed the components of government spending with related aspects of innovation promotion given that government intervention is the active way to elevate the level of innovation within an economy. Each component is granted with a representative economic indicator that can be measured by collectable data in real world economies. The construction of a linear regression model that consists all the variables needed for interpretation had built upon the existing endogenous growth theory and expanded on a specific economic agent. The theoretical contribution of modeling provides ideas for the analysis of economic growth and also guidance for further studies on this topic, despite that in statistical data analysis there are omissions and newly found invalid indicator that is not sufficient to represent a variable. Space of improvements mainly exists for the mathematical analysis of factors effecting innovation level and economic growth. A fully theory-based modelling would omit the existences of frequent economic failure and bubbles that could greatly distort the anticipated path of an economy, making that anticipation ineffective. While for studies using real economies as objectives, the existences of those failures are reflected upon economic indicators despite not being directly pointed out. In fact, the sample space is made exclusive to reflect upon a real world issue of ceasing in growth for developing economies. Having the model based upon case studies using representative economies of different level of development had enhanced its ability of anticipation following the pattern of growth, and by including the theory of convergence in consideration a concern of the negative effects of convergence could be evaluated. In this scenario, negative effects refer to the situation when a developing economy had approached or even reached the level of economic growth of a developed economy. For the governments, if they wish to sustain this growth rate without making futile expenditures, then start to analyze how to make a valid investment in innovation based on the objective limitations of the economy itself would be the solution to this issue. With further studies investigating each component of expenditure or variables effecting innovation level to a deeper extent, the future development pattern could be largely predictable or even alterable for governments, which means that the maximization of utility and efficiency could be made viable regardless of the limitation of time in theoretical analysis. In reality, the progressions in innovation and growth theory can boost the growth when the economy is reaching its peak or dwindle the recession when it is overcoming a trough.

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