Enhancing Private Sector Contribution in GDP through E-Government and R&D in ASEAN Region: A Panel Data Analysis

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Abstract: Private sector is very important for a country as it contributes to the economy and GDP of a country to a greater extent. E-government is actually the use of latest technologies in the services provided by the government and other information management systems. Research and development is the process applied before introducing a new product or starting a new business. This study analyzes the influence of e-government adoption and R&D process on private sector contribution of GDP in ASEAN countries. Two control variables i.e. literacy rate and per capita income have also been used. The past studies have been discussed in literature review section. For analysis purpose, data about the concerned variables has been collected from ASEAN countries for 27 years. After application of several tests and methods i.e. IPS unit root test, Pedroni cointegration test and FMOLS coefficient estimation test, the two major hypotheses of this study are accepted along with the impact of a control variable, literacy rate. However, the impact of other control variable i.e. per capita income is rejected. This study has various implications in theoretical, practical and policy making context in order to increase the performance and GDP contribution by private sector.

Keywords: Private Sector Contribution; Gross Domestic Product; E-Government; Research and Development; ASEAN

INTRODUCTION

The organizations or companies that are run by the people for profit gaining purposes without any influence of government are included in the private sector. On the other hand, the companies and organizations that are operated by government are included in government sector. Private sector organizations have a greater number of employees as compared to the public sector and all of them work for increasing revenues and profits. The countries which are having free economy have larger private sector. On the other hand, Anzoategui, Comin, Gertler, and Martinez [6] suggested that the countries having greater state control have larger public sector. Thus, the countries having greater private sector are supposed to have greater contribution in GDP of that country. Still there are many factors on which the contribution of GDP depends.

Rank ⇕	Country ⇕	Population in millions ⇕	GDP Nominal millions of USD ⇕	GDP Nominal per capita USD ⇕	GDP (PPP) millions of USD ⇕	GDP (PPP) per capita USD ⇕
1	Indonesia	260,581	940,953	3,362	3,256,730	12,422
2	Thailand	68,147	390,592	5,742	1,246,640	17,731
3	Philippines	103,701	311,687	3,002	873,966	8,224
4	Malaysia	31,973	302,748	9,501	922,894	28,612
5	Singapore	5,607	296,642	52,888	508,449	90,249
6	Vietnam	92,700	205,860	2,088	645,333	6,895
7	Myanmar	54,363	68,277	1,212	342,205	6,501
8	Cambodia	15,626	19,476	1,144	64,365	4,020
9	Laos	6,492	13,761	1,787	44,880	6,149
10	Brunei	417	10,458	30,993	35,817	83,513

Figure 1: GDP values of various ASEAN Countries

Figure 1 shows the different GDP values in various ASEAN countries. Research and development R&D consist of several activities performed before introducing a new product in market by a company. It may be considered as the first step in the introduction of new and innovative product in the market. According to Bonga and Nyoni [8] and Bronzini and Piselli [10], the basic purpose of R&D activities is to make sure that the company is introducing the right product at right time and in the right way. Several manufacturing companies such as pharmaceuticals, soft ware companies etc. take much more time on R&D as compared to other companies Carlson [12]. Companies mostly have separate departments of research and development whose main goal may not be to increase the profits of a company immediately but to contribute towards the long-term contribution to profit of that country.

E-government refers to the adoption of various innovative and technological practices while providing services to the citizens of that country Venkatesh, Thong, Chan, & Hu [38]. The main goal of this concept is to increase the transparency and accountability of government departments Sriyakul & Jermsittiparsert [37]. In addition to that, it also increases the efficiency and effectiveness of various services performed by government (Boonratmaitree, Yodsurang, Thongrawd, & Jermsittiparsert [9]. Schnoll [35] illustrates that fact that it also improves the relationships between people and government of a particular company leading towards the growth and development of government as well as the economy of the country.

E-government adoption and research and development may increase the GDP contribution of private sector of a country but unfortunately in ASEAN countries, e-government has not yet received enough attention and research and development procedures are not that much refined due to which private sectors are not showing enough contribution towards the GDP contribution Sá, Rocha, & Cota [34]. Other than ASEAN countries, other underdeveloped and developed countries are also facing the same problem of less GDP contribution by private sector. If this problem remains as it is for a longer span of time it will have drastic consequences on the GDP of those countries. Therefore, it is really important to give attention towards e-government and R&D procedures in order to increase the private share towards GDP of that country Chen, Kim, Otte, Wiseman, & Zdzienicka [13]

There are many researches in which the concepts of e-government and R&D have been discussed but their impact on GDP contribution of private sector of a country has not been yet studied Kurfalı, Arifoğlu, Tokdemir, & Paçin [21]. So, a research paper by Park and Kim [26] has recommended studying the impact of e-government adoption and R&D in this regard. The main purposes of this research are as follows:

- To analyze the significant impact of e-government adoption on private sector contribution in GDP of ASEAN countries
- To analyze the significant impact of R&D on private sector contribution in GDP of ASEAN countries

In ASEAN countries, the private sector is having a great significance because of the free economic conditions in those countries Chiang, Tao, & Wong [14]. In order to study the determinants to increase the GDP contribution by private sector, this research has been conducted. The significance of this study is that it will provide enough information and literature about e-government and R&D concepts and their impact on GDP contribution of private sector. Güler, Mukul, and Büyüközkan [19] supports the idea that it will also assist the private sector to adopt get benefit from e-government and improve R&D procedures to increase its GDP contribution. In addition, it will also assist the government in order to devise policies favorable for e-government adoption and R&D by private sector so that its GDP share can be increased.

Theory of Economic Development
Theory of economic development is a very important theory introduced by John Schumpeter. According to this theory, the development can be increased by introduction of latest technology and innovative practices in any organization Schumpeter [36]. In the initial phase, all the activities of an organization are taking place in a regular and repetitive manner, which can be called as circular flow just like the flow of blood. This flow creates the situation called as equilibrium. This equilibrium can be disturbed by introducing various activities and practices related to latest technologies and innovations. These technological adoptions by an organization in its activities results in increase in productivity of that organization. This productivity ultimately increases the growth and development of the organization Ranis and Fei [33]. As this study is related to the increase in contribution of GDP because of the use of e-government and research and development methods adoption, therefore this theory can be related this particular concept and can be used in this research.

Impact of E-Government on Private Sector Contribution in GDP
E-government is actually the use of information and other various communication technologies while providing services to the people of that country in order to increase transparency and effectiveness of these services in the country. The question is that how e-government can increase the GDP contribution of private sector of a company. We studied in the past research of Buffat [11] about the concept in which government and private sectors make a partnership for some common cause. In our case the partnership of public and private sector for the adoption of e-government services has been studied. These studies have cleared that private and public sectors can partner with each other for an initiative of government and work on that together DiMasi, Grabowski, & Hansen, [15]; Gang [17]. Various features of this partnership are found in literature. Private sector can invest and provide some services to the government and government sector may provide services to the citizens with the help of private sector Al-Hujran, Al-Debei, Chatfield, & Migdadi [2]. In case of e-government, government can make partnership agreement with private firms which are providing the IT services or information and communication technology services to the people. Anthopoulos, Reddick, Giannakidou, and Mavridis [5] suggest that government can use these services in their program of e-government and provide transparent services to the public. In this way, both the government and private sector is being benefitted from this partnership. In other words, private sector or specific tech related firms can provide their services to the government and earn revenues and profits which will ultimately increase their share of GDP in the total GDP of the country Howell [20]; McPake & Hanson [23]. This will not only be beneficial for the public of that country but will also lead towards the overall economic growth of the country. Another way in which e-government can impact private sector is that private organizations can get various facilities from e-government such as registration of companies and taxation affairs etc. and they may also get information about several aspects related to government through e-government. Meersman and Nazemzadeh [24] explained the same fact in other words in such a way that private organizations can get benefit from e-government process in its various governmental affairs resulting in the enhancement of performance and thus enhancement in the GDP contribution by the private sector. From the above discussion we can conclude that e-government can increase the GDP contribution of private sector of a country. We can make the following hypothesis:

H 1: E-Government has significant impact on GDP Contribution of Private Sector of ASEAN countries

Impact of R&D on Private Sector Contribution in GDP
R&D involves various processes and activities that are carried out in order to introduce a new and innovative product by a company into the market Nowak & Dahal [25]. R&D can be considered as the most basic step of introducing a new product in the market as the product is produced on the basis of information derived from R&D actions. The main purpose of R&D activities is that the product is made in such a way and is

introduced in such a way that it increases the revenues and profits of the company that has performed these activities. Alam [3] discussed that most of the private companies having good reputation and standard in the market usually have separate R&D departments of their own having certain employees that are specialized for performing certain activities related to R&D. This department has great importance for all the organizations and companies as it the backbone of each product produced or service provided by that organization Rahman & Siddiqui [32]; Wendt et al. [39]. As the main purpose of R&D activities is to increase the revenues and profits of a company, we can say that it results in the increase in the contribution of GDP of the country by that particular company. Yan, Chien, Hong, and Yang [40] suggested that as the countries having free economy have greater number of private organizations and firms resulting in greater private sector, R&D in the private sector may increase the GDP contribution by the private sector, which ultimately increases the GDP of the whole country and leads towards the growth and development of economy of that particular country. In this way, R&D can be beneficial not only for the private companies but also for the overall economic growth of that country Abu-Shanab [1]. From the above discussion we can conclude that better R&D processes in private sector can increase the GDP share of private sector in the total GDP of the country. We can make the following hypothesis:

H 2: Research and Development has significant impact on Private Sector GDP Contribution in ASEAN Countries.

METHOD

Data

In order to conduct this research, data was collected from the 10 countries that are included in ASEAN countries. The data collected in this regard consisted of 27 years. The variables about which data was collected include independent variables, dependant variables and control variables. The independent variables of this study include e-government and R&D with private sector contribution in GDP as a dependent variable. In addition to these variables, control variables such as per capita income and literacy rate were also included in the data gathering process. All this data was collected from different resources including E-government Development Index, World Development Indicators, which is provided by the United Nations as well as World Bank.

Model Specification

In this study, I will employ the time series data of the concerned variables in order to see various relationships between them. To be more accurate, the relationship between private sector contribution in GDP growth with e-government adoption as well as R&D will be checked by the analysis of collected data, in the presence of control variables literacy rate and per capita income. Private sector contribution of GDP growth (GDP) is the dependant variable in this study and is measured in the units of GDP per capita. E-government adoption (EGOV) is an independent variable in this study and is measured by percentage of people adopting e-government. In the same way, R&D (R&D) is another independent variable of this study and can be measured in the form of industry expenditure on R&D department. Moving towards the control variables, literacy rate (LIT) is a control variable of this study and has been measured by percentage of literate people in the country. The last variable, per capita income (PCI) is also a control variable of out study and can be measured by dividing national income by population size. In all these measurement terms, the author has discussed various impacts and relationships in regard of the variables. Using all these variables, the following equation is given as,

$$GDP_{it} = \alpha + \beta_1 EGOV_{it} + \beta_2 RAD_{it} + \beta_3 LIT_{it} + \beta_4 PCI_{it} + \varepsilon_{it} \quad (1)$$

Where, GDP is private sector contribution of GDP, EGOV is e-government adoption, R&D is research and development, LIT is literacy rate, PCI is per capita income, α is a constant, i represents cross sectional data, t represents time series data and ε_{it} is a term that represents the error.

Estimation Procedure

In order to analyze the collected data for the purpose of research, various tests are applied on it in order to obtain required results as well as to accept or reject the hypothesis produced in literature review section. This is done in order to produce some specific results related to the research. The tests used for this purpose include unit root test, panel cointegration test and coefficient estimation test. The purposes and equations of these tests are discussed here.

Panel Unit Root Test

Panel unit root tests are the tests that are used to confirm the stochastic properties as well the order of various variables used in this study. There are two types of unit root tests i.e. Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS). In the past many time series approaches were used for the same purpose, but they were not that much successful. To overcome this, new panel unit root tests are introduced i.e. LLC and IPS. There are two basic and important advantages of these unit root tests elaborated by Pedroni [27]. Firstly, these tests solve the problems related to the size and power of individual time series approaches more effectively. As this study involves the data collected from many different countries, therefore this varied collection of data provides a good variation that is beneficial for the use of panel unit root tests. This is due to the fact that more variation results in the greater power and accuracy of results of unit root tests. Secondly, these tests mostly result in standard normal distribution of the data. On the other hand, the old and conventional panel unit root tests provide nonstandard distribution of the data which is not in the favor of accurate and good results. These tests are actually the extensions of Dickey-Fuller unit root tests that are used for time series approach. LLC test is performed based on the null hypothesis of the variables of the study that consist of unit root placed against the alternative of no unit root in time series data. Moreover, LLC test provides a homogeneous autoregressive process in case of cross section data. On the other hand, IPS test provides heterogeneous autoregressive process in case of cross section data. In this study, IPS test has been used. The general equation for both these unit root tests is given as follows:

$$\Delta y_{i,t} = a_i + \rho y_{i,t} - 1 + \sum_{J=1}^{pi} a_J \Delta y_{i,t-J} + \varepsilon_{i,t} \ (2)$$

Panel Co-integration Test

Just as IPS unit root test, Pedroni test of panel cointegration also provides heterogeneous autoregressive process in case of cross-sectional data. As a result of this heterogeneity, it becomes difficult to take common cointegration of vectors in the panel data. According to Pedroni, two different cointegration approaches or techniques can be applied for checking the cointegration of variables. The within dimension consists of four test statistics; panel v statistic, panel rho statistic, panel PP statistic (nonparametric) and panel ADF statistic (parametric) discussed in detail by Pedroni [28]. On the other hand, "between dimension" technique of cointegration consists of just three test statistics. These include group rho statistic, group PP statistic (nonparametric) and group ADF statistic (parametric). Other than Pedroni, another cointegration test is also used named as Kao test. Both Pedroni and Kao tests are based on Engle-Granger (1987) two-step (residual-based) cointegration tests. But due to more comprehensive nature author will use Pedroni's cointegration test in this study. The following general equation is used for this purpose:

$$y_{i,t} = \alpha_i + \delta_{i,t} + \beta_1 X_{1,i,t} + \beta_2 X_{2,i,t} + \cdots + \beta_n X_{n,i,t} + \varepsilon_{i,t} \ (3)$$

Where αi shows country-specific effects, δit represents deterministic time trend, and $\varepsilon i,t$ denotes estimated residuals.

Coefficient Estimation Test

Coefficient estimation tests consist of two tests i.e. FMOLS and DOLS. FMOLS is basically used as a non-parametric technique in order to deal with serial correlation. On the other hand, DOLS is a parametric technique using lads and leads to deal with the same problem. FMOLS, introduced by Pedroni can be used to study the association between different variables of this study. Pedroni [29] suggested that it can also be effectively used to confirm the bond between variables studied in panel cointegration tests. OLS in this regard does not provide correct and reliable results. The issue of serial correlation can also be overcome by using FMOLS in both within and between dimension. The general equation for FMOLS is as follows:

$$\hat{\beta}_{FM} = \left(\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)^2\right)^{-1}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)GDP_{i,t} - T\hat{\delta}_{su}\right)(4)$$

Here $GDP_{i,t}$ is the transformed variable of private sector contribution of GDP.

Granger Casualty Test

Cointegration tests show that there is possibility that some casual relationships may exist between different variables of this study. Therefore, Dumitrescu and Hurlin Granger casualty test will be performed in order to identify those casual relationships with the help of following equation:

$$x_t = \sum_{i=1}^{\infty} a_i \, x(t-i) + c_1 + \mu_{1(t)} \ (5)$$
$$x_t = \sum_{i=1}^{\infty} a_i \, x(t-i) + \sum_{j=1}^{\infty} b_j \, y(t-j) + c_2 + \mu_{2(t)} \ (6)$$

RESULT

Results of Unit Root Test

To check the stationary or non-stationary state of the variables, I conducted unit root test for the collected data Pedroni [30]. In this regard, I used IPS unit root test, the results of which are shown in the table 1. According to table 1, it can be clearly seen that the null hypothesis of this test in the level section of the series data cannot be rejected. So for level data, it can be concluded that all the data of the variables is stationary as a result of application of IPS unit root test, that can also be used for heterogeneous panel data, to see whether unit root is present or not. So, the level series of the data is stationary. After testing level series, IPS was also applied for first difference series. In first difference series, it can be seen that the hypothesis of unit root test for all the values is rejected at one percent and five percent significance levels both. It can be said that the first difference series of data is integrated of order one. Overall it can be concluded that the "null hypothesis" cannot be rejected for level series and is non-stationary. On the other hand, the "null hypothesis" has been rejected for the first difference series of the data and is in stationary state.

Table 1: Panel Unit Root Test

Variable	Level	First Difference
GDP	-1.38465 (0.1597)	-3.96843** (0.0023)
EGOV	-0.19273 (0.8456)	-4.62497* (0.0000)
R&D	-2.92745(0.2863)	-2.82645**(0.0027)
LIT	-1.62534 (0.4827)	-2.78346* (0.0002)
PCI	-2.04273 (0.7293)	-3.26743** (0.0154)

Results of Panel Cointegration Test

From the unit root, it has been observed that the data of all the variables is integrated in the same order one. Due to this integration, I will further test the data to check whether it is cointegrated or not. Another important purpose of this test is to see whether the variables of this study are in long run steady state or not Pedroni [31]. Panel cointegration tests are more reliable than the conventional conintegration test. These cointegration tests are carried out to find statistics and p-values and all the conclusions of this test are shown in the table. In this table it is clear that in "within dimension" approach; panel ADF statistic has rejected the null hypothesis with the significance of five percent. While, in "between dimension" approach, group rho statistic has rejected the "null hypothesis" with five percent and group ADF statistic has rejected the "null hypothesis" by one percent. So overall, three out of seven statistics have shown the rejection of null hypothesis by one and five percent significance levels. This shows that the variables of this study i.e. GDP, EGOV, R&D, LIT and PCI are in cointegration with each other. In addition, it is a well-known fact that nonparametric and non-parametric statistics are more important and reliable in cointegration tests. So, it can be concluded that all the variables are in cointegration with each other.

Table 2: Panel Cointegration Test

Dimension	Tests	Statistics	T-Value
Within Dimension	Panel v statistic	-0.06354	-0.83547
	Panel rho statistic	-0.95825**	-2.82647
	Panel PP statistic	-1.18364**	-2.28465
	Panel ADF statistic	-2.18465**	-3.18354
Between Dimension	Group rho statistic	-1.85236**	-2.73421
	Group PP statistic	-0.73437	-1.38751
	Group ADF statistic	-3.37464*	-3.62083

Note *, ** and *** denote rejection of no cointegration significant as 1, 5 and 10%

Results of Coefficient Estimation Test

From the panel cointegration test, it has been found that all the variables are in cointegration with each other. Now I will estimate the coefficients of all variables included in this study. In order to estimate the coefficients, I have used FMOLS technique both in the form of pooled and grouped versions. The results of

this test i.e. FMOLS are presented in the table. This table presents that the coefficients of e-government are 0.537 and 1.583 in pooled and grouped versions and both are significant to 1% and 5% confidence levels, which shows that e-government has significant impact on private contribution of GDP. Similarly, the coefficients of research and development are 1.374 and 1.746 for pooled and grouped versions respectively and they are 5% and 1% significant respectively. This shows that R&D has significant impact on private contribution of GDP. It can be concluded that both e-government and R&D have significant impacts on private contribution of GDP.

Table 3: Coefficient Estimation Test

Variables	Pooled	Grouped
EGOV	0.537*(2.634)	1.583**(2.527)
R&D	1.374**(2.276)	1.746*(2.864)
LIT	0.175 (0.032)	-0.173*(-2.032)
PCI	-1.597(2.163)	1.563*(2.165)
R-Squared Adj.	0.747	0.829

Note *, ** and *** represent that the variables at one, five and ten per cent significant,

Results of Granger Casualty Test
As the I had found the cointegration among the various variables through the use of panel cointegration test, so now I will apply the granger casualty test to spot the several casual relationships between different variables included in the study. The results of this granger test can be seen in the table. According to the results given in the table, casual relationships can be observed in the following variables; private sector contribution in GDP and e-government, e-government and private sector contribution in GDP, e-government and per capita income, research and development and private contribution in GDP, literacy rate and private sector contribution in GDP, literacy rate and research and development, per capita income and private sector contribution in GDP, per capita income and literacy rate. Results show that all the variables have casual relationships with each other. This test will also result in the conformation and verification of various hypotheses; I have made about dependent and independent variables as well as the control variables.

Table 4: Granger Casualty Test

	GDP	EGOV	R&D	LIT	PCI
GDP	-	0.1835*	0.6394	0.7264	0.8633
EGOV	0.7263**	-	0.3678	0.1844	0.0173*
R&D	0.8643*	0.2835	-	0.2592	0.1992
LIT	0.8263*	0.0263	0.2883*	-	0.7352
PCI	0.1634**	0.6284	0.0243	0.2747*	-

Note * and **mean significant relationship significant at 1 & 5%, respectively

DISCUSSION

The basic aim of this research was to determine the impacts of two independent variables e-government on the dependent variable i.e. private sector contribution in GDP growth of a country in the presence of two control variables i.e. literacy rate and per capita income. The first hypothesis of this study was that e-government has significant impact on private sector contribution of GDP in ASEAN region. By applying various techniques and approaches, this hypothesis was tested effectively and finally was accepted as a result. A past study of Banerjee and Chau [7] has shown the same result in regard of e-government impact on private sector contribution in GDP. E-government involves the use of technology which ultimately increases the performance of private sectors resulting in the increase in their GDP contribution. Next hypothesis of this study was that research and development have significant impact on private sector contribution in GDP in ASEAN regions. After testing, this hypothesis was also accepted. Research and development increases the performance of an organization which results in the increase in private sector contribution in GDP. Another research by Ehrlich and Holdren [16] has also shown the same result. Literacy rate was used as a control variable and its impact has been accepted as significant by several tests, which has

also been shown by another researcher, Griliches [18]. Literacy increases the employment and performance of the private sectors resulting in increase in private sector contribution in GDP. The last variable, per capita income is a control variable used in this study, but its significant impact on private sector contribution in GDP has been rejected by several tests. The same result has also been shown in earlier study of Landefeld and Grimm [22].

CONCLUSION

Private sector is very crucial for the economic growth and development of a country as it it covers the major portion of economy of the country. E-government involves the use of practices of latest technology and innovative practices in various services and information management systems by government to increase their transparency and efficiency. Research and development is a very important aspect applied before the introduction of a new product or service. The actual purpose of this study was to check the impact of e-government and research and development on private sector contribution in GDP in the presence of control variables such as literacy rate and per capita income. Data was collected about these variables from 10 ASEAN countries for 27 years from various sources such as World Bank. Several tests were used to evaluate this data. These tests include panel unit root test, cointegration test, coefficient estimation test and Granger casualty test. As a result of these tests, the hypotheses of significant impact of e-government and research and development on private sector contribution in GDP were accepted. In addition, the significant impact of literacy rate was accepted but the significant impact of per capita income was rejected. In short, we can conclude that e-government and R&D have significant impact on private sector contribution in GDP.

This study has several theoretical, practical and policy making benefits. This study will provide a complete literature and information about the important concepts of e-government and R&D and their impacts on private sector contribution in GDP. In addition to that, this study will also provide assistance to the private industry of ASEAN countries to use e-government and R&D effectively in order to increase private sector contribution in GDP. Other than that, this study may also provide assistance to the government in making various policies favorable for e-government adoption and R&D. Governments of various ASEAN countries may also provide funds to the private sector to improve e-government and R&D projects.

There are various limitations of this study. Firstly, the sample data size is less than appropriate and it can be increased by the future researchers in their researches. In addition, this study is only specific to ASEAN countries, but the future researchers can also use other European counties and other regions of the world too. This study has involved tests like unit root test, panel cointegration test, coefficient estimation test and Granger casualty test etc. In future researches, other tests may be used for the same purpose i.e. panel data analysis. In the last, this study only consists of variables such as e-government, R&D, private sector contribution of GDP. In future, other variables and their impacts can also be studied.

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