THE LONG-RUN RELATIONSHIP BETWEEN R&D EXPENDITURE AND WEALTH OF ASEAN-5

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ABSTRACT
The rapid pace of industrial transformation into knowledge-based economy model worldwide has prompted ASEAN countries to respond by strengthening their research and development investment in the past decade. The objective of the study is to examine whether this new economic paradigm improves the general wealth of the people in these countries. To achieve this goal, long-run relationship between R&D expenditure and the gross national income of five major ASEAN countries from 2001 to 2010 are analyzed. The econometric evidence of this study suggests the presence of long-run cointegration relationship between these two variables. Findings indicate that higher research and development activity has a positive effect on the wealth for the countries under study.

KEY WORDS
Research and Development Expenditure, Gross National Income.

1. INTRODUCTION
Knowledge is a crucial factor, along with other conventional factor of productions such as land, labour and tools, in determining the wealth of a nation. This is because in the knowledge-economy paradigm, the leverage of information and communication technologies and output obtained via research and development activities can promise a higher payoff over time. Recognizing this, ASEAN countries have intensified its research and development investment in the past decade.

The payoff from research and development investment is debatable. According to Thurow (1999)[1], the average private rate of return from research and development expenditure was 24% while the social rates of return of research and development spending was about 66% at the time of study. This results shows that research and development could be beneficial as it promises positive social spillovers. Nevertheless, some argued that returns from research and development spending could be hard to realize if the innovations or inventions are not embedded in the economic activities.

With that in mind, the objective of this paper is to assess the long-run relationship among R&D investment and the gross national income of five major ASEAN countries, namely, Indonesia, Singapore, Malaysia, Philippine and Thailand.

2. LITERATURE REVIEW
Porter (1990) [2] contended that a nation’s prosperity is created and this prosperity can only be achieved if the industries in the country concern are capable of gaining competitive advantages via innovations. On the other hand, innovations can be encouraged by means of research and development activities. The economy landscape of Indonesia, Malaysia, Philippine and Thailand’s economy were predominated by the agricultural activities while Singapore’s economy was impelled by the manufacturing sector. However, prosperity was hard to achieve despite the availability of huge cheap labour pool and capital in these countries if compared to the advanced industrial nations. With that, ASEAN countries have gradually increased their national expenditure on research and development activities. This measure was essential to facilitate better productivity and employment creations. Subsequently, the wealth or the gross national income of the people can be improved.

Thus far, not many studies were done to assess the returns of R&D investment in ASEAN countries. In fact, the social-economic benefits of R&D could be hard to measure as they vary across industries and field. Hence, the economic implications of the R&D investments could be hard to determine (Salter and Martin, 2001)[3]. At the firm level, some studies documented that firms with higher investment in R&D performed better in terms of growth opportunities and future returns (Ho et al. 2006 and Chan et al., 2007) [4][5]. On the other hand, Doukas and Switzer (1992) [6] found that R&D spending has no significant impact on firms’ subsequent returns.

At the macro level, Pavitt (1980) [7] posited that, the long-run economic growth of a country can only be achieved by improving the innovative capacity of the nation. Such innovative capacity could be achieved by providing sufficient funding to support researches as well...
as fostering a stronger university-industrial collaboration in developing new products and technologies and commercializing these innovations later. Apart from that, in promoting an innovative knowledge economy, a tax policy which encourages private research and development investment is helpful.

Most countries agree that investment in R&D is a pro-active strategy to uplift poorer nations to achieve a higher standard of living. A good example would be Singapore. Singapore has achieved a high standard of living status due to its pro-active foreign investment strategies in the field of R&D, innovation and ICT technologies (Tiits (2007) [8]. Geroski and Walters (1995) [9] also found that UK’s R&D activity is correlated with the country’s economy dynamics. A more recent study conducted by Sterlacchini and Venturini (2009) [10] on knowledge economy in European Union documented that the research and development intensity and the percentage of adults with tertiary educations in the region has positive impact on the per capita GDP growth in EU. All in all, the findings between the relationship of research and development spending and return are inconclusive; hence, this paper intends to complements the literatures by examining the impact of R&D expenditure on GNI per capita (proxy of wealth) in the ASEAN context.

3. METHODOLOGY

This study uses annual data of gross national income and research and development expenditure of 5 ASEAN countries from year 2001 to year 2010. The ASEAN-5 are Indonesia, Malaysia, Philippines, Thailand and Singapore. Data on gross national income (GNI), research and development expenditure (RD) are obtained from IMD, UNESCO and World Bank database. All data are logarithmic transformed before applied.

To examine whether a long-run relationship exist between the national research and development spending and the gross national income per capita, the panel unit root tests and panel cointegration tests are adopted in this study.

i. Panel unit root tests

Both Im et al (2003) [11] and Manddala and Wu (1999) [12] panel unit root tests were examined in this study. The commonly adopted panel unit root test of Im et al. (2003) [11] considers the following hypothesis:

\[ H_0: \rho_i < 0, \text{ for some } i. \]  

(1)

The ADF-type t-statistics of Im et al. (2003) [11] is given as:

\[ \bar{t} = \frac{1}{N} \sum_{i=1}^{N} \bar{t}_i, \]  

(2)

where \( \bar{t}_i \) is the individual ADF t-statistics for the unit root test.

On the other hand, the Maddala and Wu (1999) [12] approach combined the p-values of the individual ADF t-statistics to obtain:

\[ x^2 = -2 \sum_{i=1}^{N} \log(\pi_i), \]  

(3)

where \( x^2 \) is a chi-squared test statistic with 2N degree of freedom and \( \pi_i \) is the p-value of the ADF t-statistics for cross-section unit \( i \).

ii. Panel Cointegration Tests

Two types of panel cointegration test were used in this study. The first type is the Johansen Fisher panel cointegration test. Both the likelihood ratio trace statistics and the maximum eigenvalue statistics are used to determine the presence of cointegration vectors in time series study (Johansen, 1988) [13]. The trace statistics and maximum eigenvalue statistics are shown in equation (4) and (5) respectively.

\[ \hat{\lambda}_{\text{trace}}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \]  

(4)

\[ \hat{\lambda}_{\text{max}}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \]  

(5)

The second test used in this study was the Pedroni (1997, 1999)’s [14][15]Panel ADF-type. Referring to equation (6), if \( \hat{\varepsilon}_{\text{it}} \) is stationery, then, there is a cointegration between the y and x’s variables. The unit root property of \( \hat{\varepsilon}_{\text{it}} \) can be determined using equation (7). The null hypothesis for Pedroni’s tests is no cointegration. The alternative hypothesis for the within-group estimation is \( H_0: \rho_i = \rho < 0, \text{ for all } i \), while for the between-group estimation, the alternative hypothesis is \( H_0: \rho_i < 0, \text{ for all } i \).

Engle and Granger residuals-based static cointegration regression:

\[ y_{it} = \alpha_i + \beta_i t + \beta_{1i} x_{1it} + \ldots + \beta_{Mi} x_{Mit} + \varepsilon_{it}. \]  

(6)

where \( y \) is the dependent variable, whereas \( x \)’s are a set of independent variables.

\[ \Delta \hat{\varepsilon}_{it} = \alpha_i + \rho \hat{\varepsilon}_{it-1} + \sum_{j=1}^{p} \theta_j \Delta \hat{\varepsilon}_{i,t-j} \mu_{it} \]  

for \( i = 1, \ldots, N \) and \( t = 1, \ldots, T, \)  

(7)

where \( \hat{\varepsilon}_{\text{it}} \) is estimated from Equation (6).

4. EMPIRICAL RESULTS

The results of panel unit root tests of Im et al. (2003) [11] and Manddala and Wu (1999) [12] are summarized in Table 1. It can be observed from Table 1 that all the variables under study are not stationary at level (at 5% significance level). However, both LRD and LGNI become stationary after first differencing. Therefore, it
can be concluded these variables are consistently integrated of order 1\(^1\).

Table 1: Results of Panel Unit Root Tests

| Variable | Test Statistics |  
|----------|----------------|---|
|          | IPS            | MW (ADF) |
| A: Level | -0.523 [0.301] | 10.540 [0.395] |
| LGNI     | -0.198 [0.422] | 13.388 [0.203] |
| LRD      | -0.198 [0.422] | 13.388 [0.203] |
| B: First Difference | -2.029 [0.021] | 23.189 [0.010] |
| ΔLGNI    | -2.349 [0.009] | 26.941 [0.003] |

Notes: LGNI and LRD represent the logarithms of gross national income and research and development expenditure respectively. The first differenced variable is given by a symbol \(Δ\) in front of the variable name. The values in brackets are the \(p\)-values of the test statistics.

Since the variables are integrated of the first order, there is a possibility that they are cointegrated in the long-run. As such, the cointegration tests of Pedroni (1997, 1999, and 2001) [14][15][16] and Johansen Fisher panel cointegration (1988) [13] were performed and the results are shown in Table 2.

Table 2: Panel Cointegration Results

A: Pedroni Residual Cointegration Test

| Panel cointegration statistic (within dimension) |  
|-------------------------------------------------|---|
| Panel v-statistic                              | 43.359 (0.000) |
| Panel rho statistic                            | 1.259 (0.884) |
| Panel PP statistic                             | -1.105 (0.135) |
| Panel ADF statistic                            | -1.781 (0.037) |

Group mean panel cointegration statistics (between dimension)

| Group rho statistic | 2.0749 (0.981) |
| Group PP statistic  | -1.64 (0.050)  |
| Group ADF statistic | -4.103 (0.000) |

B: Johansen Fisher Panel Cointegration Test

| Number of CE (At most 1) |  
|--------------------------|---|
| Fisher stat (trace and max-eigen test): | 23.97 (0.008) |

Notes: The values in brackets are the \(p\)-values of the test statistics. The number of lag truncations used is 1.

Panel cointegration results using Pedroni Residual Cointegration Test in Panel A and the Johanson Fisher Panel Cointegration Test in Panel B show some evidences of cointegration between gross national income and the research and development expenditure. These evidences have provided support to the innovation theories and concept of knowledge economy that technological advancement, scientific knowledge and human capital development via research and development promotes higher productivity in modern economies and this creates a positive impact on the wealth of the nation (Scmookler, 1966; Porter, 1990, and Jorgenson, Ho and Stiroh, 2006) [17][2][18].

5. CONCLUSION

This study examines whether research and development spending in ASEAN-5 enhances the wealth proxy by the gross national income of these counties in the long-run. Empirical evidence suggests that there is long-run cointegration relationship between these two variables. Therefore, to increase the living standard of the people, a pro-research and development investment government policy should be encouraged. Moving towards a knowledge-economy model could be the right move for ASEAN-5 in terms of eradicating poverty and keeping up with their advanced counterparts.

REFERENCES


