

# Tourism and Capital Formation in Highly Innovative Regional Countries: Evidence from Feasible Generalized Least Squares Method

Enn-Lun Yong

**Abstract**—The objective of this paper is to investigate the nexus between capital formation and tourism demand in some European countries. Particularly, the study aims to determine empirically the degree of elasticity of tourism demand in response to the changes of capital formation. The demand elasticity in terms tourism requires further clarification due to insufficient exploration in the literature. Due to the absence of cross-national evidence on this issue, the paper involves the application of Feasible Generalized Least Squares (FGLS) in panel data framework for this purpose. By imposing the assumption of highly innovative and developed status, a group of European countries with highly innovative index clarified by the Global Innovation Index are chosen as sample for the study. The result shows robust findings in which the sensitivity of estimation is checked as well as the correction for bias estimates is implemented with the Seemingly Uncorrelated Regression (SUR) method. The conclusion is in favor to the null hypothesis specified in this paper where tourism demand is inelastic to the changes of capital formation in this group of innovative and developed countries.

**Index Terms**—Capital formation, elasticity, innovation, tourism.

## I. INTRODUCTION

The tourism demand has been investigated in terms of the degree of elasticity with respect to different factors. A well-known factor for the study of elasticity is the income elasticity, while there are also elasticity factors such as price, exchange rate, transportation cost, and marketing [1]. Nonetheless, there are still potential factors deserved for further investigation in the area of tourism demand that without any empirical prove yet. For instance, are the changes in tourism demand elastic to the changes of capital investment to the tourism sectors, when innovation is taken into consideration?

The objective of this paper is therefore to explore the responsiveness of tourism demand to the change in capital investment. By applying the panel data econometrics to some European countries with highly innovative ranking, the result in this paper confirm the unique characteristics of the heritage properties across the highly innovative countries by the evidence that significant fixed effects over time are found, while there is no fixed time evidence among these countries.

Furthermore, costs for travelling are also confirmed to

have imposed negative effect to the tourism demand in these countries, which have been indicated by both price level and exchange rate. Having controlled these factors, the main issue is examined separately. Firstly, the capital investment is found to be very significant to tourism demand. Secondly, the Wald test cannot reject the null hypothesis that the demand for tourism to these countries is inelastic to capital investment. Moreover, the result is robust with suitable correction in the coefficient variance such as the Seemingly Uncorrelated Regression (SUR) method and the re-estimations with different control variables.

The paper has five sections, including the background of capital formation and innovation, the mathematical expression and econometric methods, the result and discussion, and finally the conclusion.

## II. CAPITAL FORMATION AND INNOVATION

First of all, the significance of this issue can be explained in a broader context where sustainable economic growth is the priority. Capital investment is not only a source of development for an industry, while it also the building block for a good image which is important to the economy. For example, Rosentraub and Joo [2] explain that capital investment to tourism sector is able to make a slow-grow city to gain national and international impression due to the development of tourism amenities. Furthermore, the investment in amenities may help retaining human capital for the betterment of economy, but whether it is an attraction to new workers is unsure. According to the study by Fortanier and van Wijk [3], they prove the significant role of foreign capital investment in the tourism sector. The capital investment not only creates new job opportunities in highly unemployment area, but these foreign capitals also involve knowledge development and diffusion through attracting skilled workers and training programs. They explain that the foreign entities are found to have such advantage than the local entities. Nevertheless, although capital investment is crucial on the one hand, it still needs to explore how capital investment will influence tourism demand, especially when the element of innovation plays the role on the other hand.

The diffusion of knowledge and technology over the past decades has explicitly rendered the tourism sector to incorporate various innovative concepts for attracting both local and international tourists. Mostly, tourism innovation is driven by the need of enhancing the quality of tourism products for tourists, which often involve the need of capital investment. This often involves the adoption of technology

Manuscript received April 10, 2013; revised June 27, 2013.

Enn-Lun Yong is with the School of Science and Technology, Universiti Malaysia, Kota Kinabalu, Sabah, CO 88400 Malaysia (e-mail: ennlynuyong@gmail.com).

for various purposes. Novelli *et al.* [4], for instance, discuss the network development concept in Small and Medium Enterprise (SME) as cost-effective way of being competitive in tourism sector. Moreover, successful innovation adoption is a subject matter of experience, which needs empirical investigation to prove. A study by Stamboulis and Skayannis [5] distinguish between endowment tourism and experience tourism, which involves different way of innovation. Endowment tourism involves change and improvement to reduce cost, while experience tourism is typical to conduct new inventions. In addition, the tourism innovation may also involve cross border and bordering knowledge diffusion. Waidenfeld [6] explains why this should be given more attention by scholars, managers as well as policy makers. The tourism sector is elaborated as a source of innovation, while the borders and bordering nature will enhance the diffusion of tourism innovation, including knowledge transfer in regional level and product innovation in sectoral level. Similarly, findings also indicate there is interdependency between internationalization and innovation with respect to the tourism sector [7]. Upon internationalization, they point to the need to explore the issue regarding how such innovation will influence the performance and competitiveness of tourism. A thorough exploration on defining the concept of innovation may be lacking for this purpose. Nevertheless, some categorization has been made for innovation in tourism, including the aspects of product or service, process, managerial, management, and institution [8]-[10]. These categories of innovation are related to cost reduction, while also require certain level of capital investment. In a nutshell, tourism demand depends on capital investment and this dependency is subject to the degree of innovation a firm, sector or country involving in tourism business. However, there is no exploration to this issue, especially when it relates to the degree of elasticity of demand.

### III. THE STUDY AND METHODOLOGY

Empirical investigation on tourism demand has been investigated with various models and methods in different locations as elaborated in two reviews covering the findings for more than two decades [11], [12]. However, the search for innovation in certain clustering countries and its different effects on tourism demand has not thoroughly explored. Most studies with panel data application is to country-specific investigation rather than tourism issue from some clustering countries [13]-[17]. Most of these studies focus in highly innovative countries such as Switzerland, Spain, Austria, and so forth in the European region, but a cross-national investigation for this region has not yet investigated. One crucial factor for exploring countries across Europe stems from certain tourism characteristics shared among them, such as the heritage of traditional culture. Borg *et al.* [18] prove the significance of tourism heritage cities in Europe as one tourism attraction for many visitors, while the number of tourists and excursionists has been expanding. It is believed that these European countries have their own unique characteristic within these heritage

properties. This has particular advantage to suit the taste of tourists who are highly selective in their consumption patterns and heritage sites as indicated in previous studies [19]. Moreover, these heritage properties are also found to be influenced by the capital investment in the sense that the process of capital accumulation in these advanced societies had led to revaluation and commodification, such as the creation of heritage as tangible asset which leads to changes in the consumer retail activities [20]. In order to investigate the tourism demand responsiveness to capital investment across these highly innovative European countries which are unique in terms of heritage properties, this paper applies the Feasible Generalized Least Squares (FGLS) method in the panel data framework, which has been indicated to be able to capture the effect of group level shock in which serial correlation occurred between individuals at different times [21].

The study involves the review of empirical investigations including a few review papers which provide essential information about findings in the past few decades as above-mentioned. Accordingly, the study specifies a hypothesis; tourism demand in those highly innovative and developed countries should be significantly inelastic in response to the capital formation the countries invest in the tourism sector over time.

The following model describes the possibility of this hypothesis using a simple mathematic manipulation to the change of tourism demand over time. The model shows that the change should be determined by the extent of capital formation to the industry as well as the costs of travelling measured by both the foreign exchange rate and price index. Most importantly, the growth factor of capital investment ( $\theta$ ) has important meaning which directly explains the hypothesis.

$$\frac{dV}{dt} = K^q Z \quad (1)$$

$$dV = K^q Z dt \quad (2)$$

$$\int dV = \int K^q Z dt \quad (3)$$

$$V = K^q Z t + C \quad (4)$$

$$\log V = q \log K + \log Z + \log T + \log C \quad (5)$$

$$\log V_t = q \log K_t + \log Z_t + \log C \quad (6)$$

$$\log V_{t,i} = q \log K_{t,i} + \beta \log Z_{t,i} + \alpha_{t,i} + \epsilon_{t,i} \quad (7)$$

where

$V$  = Visitor export from the home countries, measured by expenditure in each country by international tourists for both business and leisure trips.

$K$  = Capital investment in the tourism sector, measured by expenditure by all sectors in the travel and tourism industry, including investment spending such as visitor accommodation, passenger transportation equipment, restaurant, and leisure facilities.

$Z$  = A set of variables (including price index and exchange

rate per USD)

$T$  = Time trend variable

$q$  = A parameter of growth factor of capital investment of tourism sector.

$C$  = A constant which is rewritten as  $\alpha$  in (7).

$i$  = An indicator of the country.

$t$  = An indicator of the time period

Equations (1) and (2) indicate that the change of tourism demand ( $V$ ) over time depends on tourism capital formation ( $K$ ) driven by a growth factor ( $\theta$ ). Moreover, equations (3) and (4) show an additional term ( $C$ ) that has to be taken into consideration. The intercept or constant ( $C$ ) consists of essential information as it will show factors that may vary across the units of analysis but constant over time. This term is expected to be positive since it reflects the average tourism demand when tourism capital investment ( $K$ ) or the set of control variables ( $Z$ ) is zero. Equations (5) and (6) are written in logarithm form in order to ease interpretation as well as to obtain the demand elasticity in response to the capital investment ( $\theta$ ). The term ( $\theta$ ) is simplified by assuming to be constant over time and contains two integrated meanings. Firstly, it would mean the degree of demand responsiveness to the extent of capital investment in the tourism sector in the home countries. Secondly, the term also means the growing factor of capital investment in the tourism industry. These specifications stems from one assumption leading to the hypothesis.

The ability to export tourism products depends on the degree of capital formation a country has invested into this industry. Thus, it should influence the volume of tourism demand and supply. Highly innovative and developed countries are assumed to have well-equipped tourism industry as a result of their substantial capital formation since decades ago, while the capital investment thereto is more on expansion and maintenance purposes and therefore the demand for tourism products should be less responsive to the change in capital investment in the recent decades. Thus, the parameter ( $\theta$ ) is expected to be less than one and it also implies the inelastic demand to capital investment changes.

Equation (7) subsumes the meaning of differences across time ( $t$ ) and countries ( $i$ ) attached to each term in the equation. The study takes into consideration both the period and cross-section heteroscedasticity effects and therefore different weights will be assigned to the observations in the estimation. Meanwhile, it concerns also the robustness of estimation on the coefficient standard errors as well as the covariance. Such specification is accomplishable via the Feasible Generalized Least Squares estimation method. The method involves the correction for both period heteroscedasticity and cross-section heteroscedasticity by using the cross-section Seemingly Uncorrelated Regression (SUR) and period Seemingly Uncorrelated Regression (SUR) estimation techniques. In order to test the hypothesis that tourism demand has inelastic response to capital investment,

estimations are implemented on (8) to (11). Each of the equations is added with different control variables in order to check for the sensitivity of the estimate ( $\theta$ ) of demand elasticity to capital investment change.

$$\log V_{t,i} = q \log K_{t,i} + a_{t,i} + e_{t,i} \quad (8)$$

$$\log V_{t,i} = q \log K_{t,i} + b \log Z_{t,i}^E + a_{t,i} + e_{t,i} \quad (9)$$

$$\log V_{t,i} = q \log K_{t,i} + b \log Z_{t,i}^P + a_{t,i} + e_{t,i} \quad (10)$$

$$\log V_{t,i} = q \log K_{t,i} + b_1 \log Z_{t,i}^E + a_{t,i} + b_2 \log Z_{t,i}^P + e_{t,i} \quad (11)$$

where

$E$  = Exchange rate is measured as currency per USD

$P$  = Price index

Equation (9) is estimated with exchange rate ( $E$ ), equation (10) is estimated with price index ( $P$ ), and equation (11) is estimated with both exchange rate ( $E$ ) and price index ( $P$ ). Based on these regressions, three aspects are concerned with respect to the null hypothesis. Firstly, suppose ( $\beta$ ) is larger than one and positive, it means that tourism demand is elastic to capital investment, while ( $\beta$ ) less than one and positive would imply that the null hypothesis will not be rejected. Secondly, it is to find out if these developed and highly innovative samples are significant in terms of the cross-section fixed effect subsumed in the estimate of constant ( $\theta$ ). It is expected to be significantly positive since high income and innovation capability should distinguish these countries with unique tourism attraction. The fixed effect constant which is significant means the attractiveness of built tourism not attributed to the change of capital investment. Finally, the control variables of price index ( $P$ ) and foreign exchange rate ( $E$ ) are examined to assess the cost associated with the tourism sectors. High price level is expected to have adverse effect to tourism export. Nevertheless, the effect of changing exchange rate is unexpected due to the undetermined and inconsistent behavior as shown in most European countries. These variables are expected to influence both tourism demand and tourism capital investment since both imply the costs accrued to this industry.

The data for visitor export ( $V$ ) and tourism capital formation ( $K$ ) are obtained from the World Travel and Tourism Council (WTTC) for the 1988-2011 periods. The exchange rate ( $E$ ) measured using the implied Purchasing Power Parity conversion rate is obtained from the International Monetary Fund (IMF) and price index measured by the consumer price index is obtained from the World Development Indicators (WDI) of the World Bank. The sample of countries is chosen to fit the assumption of highly innovative and developed countries. Thus, the Global Innovation Index is referred to identify the countries with

innovation index scored at 5.0 and above. In addition, it is further restricted to European countries only since it has the advantageous due to the concentration in one geographical area. As a result, 14 European countries are selected for this study, including Switzerland, Sweden, Finland, United Kingdom, Netherlands, Denmark, Ireland, Luxembourg, Norway, Germany, Iceland, Belgium, Austria, and France.

#### IV. RESULTS

The estimation results of (8) to (11), which are written as four models with different specification in terms of variables (Table I and Table II). Model 1 and 2 are estimated with balanced panel data in the FGLS framework with cross-section fixed effect. Due to unbalanced panel data, model 3 and 4 are estimated with unbalanced panel data in the FGLS framework with cross-section fixed effect. All models are assigned weight for the cross-sectional dimension, while coefficient variances are corrected with SUR method. First of all, the results confirm to the expectation that there is unique characteristic in each country and these unique characteristics are constant over time. This is shown by the significant redundant fixed effect test at 1% critical level in all models, which rejects the null hypothesis that there is no hetero effect across these countries in terms of tourism demand at different times. This paper attributes this effect to the heritage properties which are unique across the countries clustering in the regions. The control variables including the price index and foreign exchange rate are found to be significant at 1% critical level across the models. These results imply that the costs of travelling do matter and have negative impacts to the tourism demands in Europe. The capital investment coefficient in each model is statistically significant at 1% critical level. Thus, tourism demand to Europe is found to be very significant to capital investment changes, which means the capital formation does important add-on to the quality of tourism sector. Nevertheless, the null hypothesis that tourism demand is inelastic in response to capital formation cannot be rejected, which is shown by the coefficient value that is less than one in each model. The implication is that capital investment does influence tourism demand, but the change is very small. Fig. 1 shows one of the plots of sufficient goodness-of-fit of the fitted and actual estimates of the models, which is summarized by the residual series that is stationary around the zero line.

Parisi *et al.* [22] show that while R & D spending will make more new products, fixed capital formation has priority in triggering process innovation which makes higher productivity that raises tourists' satisfaction. Similarly, the raising productivity in the tourism products is proved be driven by the change in the physical capital, which can be even more effective when combined with human capital, innovation, and competitive environment [23]. While tourism demand is sensitive to new ideas, innovation has played exactly the role for raising the demand for tourism to Europe. Since the countries in the sample are all highly innovative, the additional capital formation for further innovative development will have minor impact on the tourism demand to Europe.

TABLE I: ESTIMATION WITH EXCHANGE RATE

Dependent Variables: Visitor export		
<b>Independent Variables:</b>		
Intercept ( <i>C</i> )	Coef.: 1.4912*** (S.E.: 0.0149)	Coef.: 1.7936*** (S.E.: 0.0369)
Log [Tourism Capital Formation ( <i>K</i> )]	Coef.: 0.1095*** (S.E.: 0.0090)	Coef.: 0.1135*** (S.E.: 0.0087)
Log [Exchange Rate per USD ( <i>E</i> )]	-	Coef.: -0.4101*** (S.E.: 0.0467)
<b>Redundant Fixed Effect Test</b>		
<b>Log Likelihood stat. (Prob.)</b>	2646.9501*** (Prob.: 0.0000)	1739.1838*** (Prob.: 0.0000)
<b>Residual Normality Test</b>		
<b>Jarque-Bera stat. (Prob.)</b>	0.6592 (Prob.: 0.7192)	1.1993 (Prob.: 0.5490)
<b>Closeness of Fit</b>		
<b>R<sup>2</sup></b>	0.9925	0.9911
<b>Adjusted R<sup>2</sup></b>	0.9922	0.9907

Note: Coef. indicates coefficient value. S.E. is standard error. \*, \* and \*\*\* indicate 10%, 5% and 1% significance level, respectively. All variables are in logarithm form.

TABLE II: ESTIMATION WITH PRICE AND EXCHANGE RATE

Independent Variables: Visitor export		
<b>Independent variables:</b>		
Intercept ( <i>C</i> )	Coef.: 4.8458*** (S.E.: 0.2745)	Coef.: 4.8126*** (S.E.: 0.2709)
Log [Tourism Capital Formation ( <i>K</i> )]	Coef.: 0.0939*** (S.E.: 0.0198)	Coef.: 0.0964*** (S.E.: 0.0202)
Log [Exchange Rate per USD ( <i>E</i> )]	-	Coef.: 0.0892 (S.E.: 0.0846)
Log [Price Index ( <i>P</i> )]	Coef.: -0.7396*** (S.E.: 0.0591)	Coef.: -0.7481*** (S.E.: 0.0614)
<b>Redundant Fixed Effect Test</b>		
<b>Log Likelihood stat. (Prob.)</b>	186.3573*** (Prob.: 0.0000)	192.3712*** (Prob.: 0.0000)
<b>Residual Normality Test</b>		
<b>Jarque-Bera stat. (Prob.)</b>	3.9220 (Prob.: 0.1407)	4.2160 (Prob.: 0.1215)
<b>Closeness of Fit</b>		
<b>R<sup>2</sup></b>	0.8986	0.9014
<b>Adjusted R<sup>2</sup></b>	0.8938	0.8964

Note: Coef. indicates coefficient value. S.E. is standard error. \*, \* and \*\*\* indicate 10%, 5% and 1% significance level, respectively. All variables are in logarithm form.

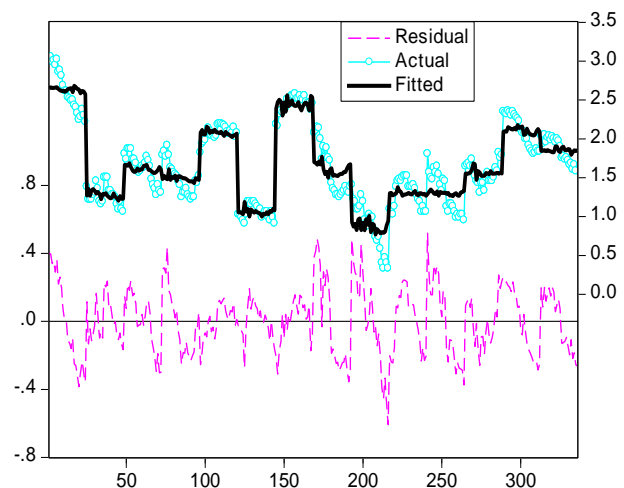


Fig. 1. Actual and fitted residuals plot.

## V. CONCLUSION

This paper has introduced the null hypothesis that tourism demand is inelastic in response to capital investment in highly innovative and developed countries. The hypothesis is observed with the effects of tourism heritage properties built across some European countries, which are fixed over time but differed across these countries. The estimation proves that the countries are unique in terms of these heritage properties and these properties are one important factor for the growing tourists to Europe. Costs of travelling have been generally agreed as the burden to tourists, while this is self-evident but the result show that the inclusion of both variables in a model will not produce a better goodness-of-fit compared to only either variable is estimated in a model. The capital investment in the tourism sector across these countries is found to be significant, which confirmed to the literature that capital investment is important for quality purpose in those developed and innovative countries. Nonetheless, the estimates of capital formation across the models are very inelastic, which imply that the null hypothesis cannot be rejected. In other words, tourism demand is expected to have inelastic response to capital investment in the highly innovative and developed countries. The process of estimations and tests are implemented with the application of Feasible Generalized Least Squares (FGLS) in a panel framework that developed from a simple mathematical model built to describe the null hypothesis. In order to ensure the robustness of the estimations, corrections are implemented using the Seemingly Uncorrelated Regression (SUR) methods on the coefficient variances.

## REFERENCES

- [1] G. I. Crouch, "A meta-analysis of tourism demand," *Ann. Tourism Res.*, vol. 22, no. 1, pp. 103-118, 1995.
- [2] M. S. Rosentraub and M. Joo, "Tourism and economic development: which investments produce gains for regions?" *Tourism Manage.*, vol. 30, no. 5, pp. 759-770, Oct. 2009.
- [3] F. Fortanier and J. V. Wijk, "Sustainable tourism industry development in sub-Saharan Africa: Consequences of foreign hotels for local employment," *Int. Bus. Rev.*, vol. 19, no. 2, pp. 191-205, Apr. 2010.
- [4] M. Novelli, B. Schmitz, and T. Spencer, "Networks, clusters and innovation in tourism: a UK experience," *Tourism Manage.*, vol. 27, no. 6, pp. 1141-1152, Dec. 2006.
- [5] Y. Stamboulis and P. Skayannis, "Innovation strategies and technology for experience-based tourism," *Tourism Manage.*, vol. 24, no. 1, pp. 35-43, Feb. 2003.
- [6] A. Waidenfeld, "Tourism and cross border regional innovation systems," *Ann. Tourism Res.*, vol. 42, pp. 191-213, July 2013.
- [7] A. M. Williams and G. Shaw, "Internationalization and innovation in tourism," *Ann. Tourism Res.*, vol. 38, no. 1, pp. 27-51, Jan. 2011.
- [8] A.-M. Hjalager, "Innovation patterns in sustainable tourism—an analytical typology," *Tourism Manage.*, vol. 18, no. 1, pp. 35-41, Feb. 1997.

- [9] K. Weiermair, "Product improvement of innovation: what is the key to success in tourism?" in *Innovation and Growth in Tourism*, OECD, Ed. Paris: OECD, 2006, pp. 53-69.
- [10] A. M. Hjalager, "A review of innovation research in tourism," *Tourism Manage.*, vol. 31, no. 1, pp. 1-12, Feb. 2010.
- [11] C. Lim, "Review of international tourism demand models," *Ann. Tourism Res.*, vol. 24, no. 4, pp. 835-849, Oct. 1997.
- [12] H. Song and G. Li, "Tourism demand modeling and forecasting—a review of recent research," *Tourism Manage.*, vol. 29, no. 2, pp. 203-220, Apr. 2008.
- [13] B. Rey, R. L. Myro, and A. Galera, "Effect of low-cost airlines on tourism in Spain. A dynamic panel data model," *J. Air Transp. Manage.*, vol. 17, no. 3, pp. 163-167, May 2011.
- [14] T. G. Muñoz and L. F. M. Martín, "Tourism in the Balearic Islands: a dynamic model for international demand using panel data," *Tourism Manage.*, vol. 28, no. 5, pp. 1224-1235, Oct. 2007.
- [15] M. Falk, "A dynamic panel data analysis of snow depth and winter tourism," *Tourism Manage.*, vol. 31, no. 6, pp. 912-924, Dec. 2010.
- [16] C. Massidda and I. Etzo, "The determinants of Italian domestic tourism: a panel data analysis," *Tourism Manage.*, vol. 33, no. 3, pp. 603-610, June 2012.
- [17] S. Banfi, M. Filippini, and L. C. Hunt, "Fuel tourism in border regions: the case of Switzerland," *Energ. Econ.*, vol. 27, no. 5, pp. 689-707, Sept. 2005.
- [18] J. V. D. Borg, P. Costa, and G. Gotti, "Tourism in European heritage cities," *Ann. Tourism Res.*, vol. 23, no. 2, pp. 306-321, 1996.
- [19] G. Richards, "Production and consumption of European cultural tourism," *Ann. Tourism Res.*, vol. 23, no. 2, pp. 261-283, 1996.
- [20] K. Meethan, "Consuming (in) the civilized city," *Ann. Tourism Res.*, vol. 23, no. 2, pp. 322-340, 1996.
- [21] C. B. Hansen, "Generalized least squares inference in panel and multilevel models with serial correlation and fixed effects," *J. Econometrics*, vol. 140, no. 2, pp. 670-694, Oct. 2007.
- [22] M. L. Parisi, F. Schiantarelli, and A. Sembenelli, "Productivity, innovation, and R & D: micro evidence from Italy," *Eur. Econ. Rev.*, vol. 50, no. 8, pp. 2037-2061, Nov. 2006.
- [23] A. Blake, M. T. Sinclair, and J. A. C. Soria, "Tourism productivity: evidence from the United Kingdom," *Ann. Tourism Res.*, vol. 33, no. 4, pp. 1099-2066.



**Yong Enn Lun** comes from the Sabah state of Malaysia and born in the 1983. Yong has attained the Bachelor of Economics with Honours in financial economics in 2008 from Universiti Malaysia Sabah, a state university located in the Sabah state of East Malaysia. Yong has also attained the Master of Economics in 2010 from Universiti Kebangsaan Malaysia, the national university of Malaysia located in the Selangor state of West Malaysia. Yong's major field of study in the master degree is econometrics. He is a lecturer in the School of Science and Technology of University Malaysia Sabah since August 2011. He involves in the teaching of mostly economic related subjects, including microeconomics, macroeconomics and econometrics. His current research interest is the study that focuses on the insight related to role of innovation in economic development, with the application of econometric methods. Particularly, he is interested in searching for the best integration of economic theory, mathematical economics, and econometric methods that lead to the most reliable and valid conclusion of the topic under investigation