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Entrepreneurial capability (EC) environment in ASEAN-05 emerging economies

An empirical approach

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Abstract

Purpose – The entrepreneurial capability (EC) environment refers to the general social and economic settings of a given local/regional entrepreneurship environment. The primary purpose of this study is to uncover key indicators of the EC milieu and test these components empirically within the context of the Association of South East Asian Nations (ASEAN)-5 economies to elucidate the current state of their EC environments, at the regional and national levels. To this end, the aim of this study is twofold. First, this work endeavors to explicate the determinants of EC, with aims of elucidating its association to commercial opportunities in (ASEAN)-5 economies, namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Next, this study applies the developed theory, including the identified determinants of EC to empirically test the efficiency and imperative coefficients of variables that have an impact on perceived entrepreneurial capabilities within a given environment.

Design/methodology/approach – This research applies two frontier models, namely, the consistent estimation of fixed-effects and linear transformation stochastic frontier models, to assess the coefficients of significant EC variables for the panel sample. Data corresponding to the assessed variables were retrieved from the databases of the Global Entrepreneurship Monitor (GEM) – 2016 and the World Competitiveness Yearbook (WCY) – 2016, for the period, 2010-2016.

Findings – The attained results suggest that factors corresponding to the variables "Entrepreneurship as a good career choice" and "perceived opportunities" have played a significantly positive role on the EC environment of ASEAN 05, although findings suggest both factors may still be improved upon. Conversely, the "fear of failure rate" factor was shown to have exerted a negative impact on the efficiency of the EC environment of ASEAN 05. Other important variables – such as intellectual property rights, university education and knowledge transfer rate – were shown to generate a positive impact on the EC environment of these economies.

Originality/value – This study makes an important contribution to the entrepreneurship literature and can stimulate policymakers to rethink the EC settings of ASEAN-05 in their pursuit of an innovation-driven region.

Keywords Stochastic frontier analysis, ASEAN-05, Entrepreneurial capability, Panel study

Paper type Research paper

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1. Introduction

Recent studies have contributed to the development of the theoretical concept of entrepreneurship capabilities (EC; Cantu-Ortiz *et al.*, 2017; Tofighi *et al.*, 2017). To this end, a great number of researchers have focused on potential linkages between EC at the micro environment level and economic development, generally from the perspective of individual university students (Miranda *et al.*, 2017). Most of these cases have explored entrepreneurial intention rather than factors affecting perceived capabilities of entrepreneurship (Siegel and Wright, 2015). Within this context, EC is used to describe the extent to which entrepreneurs are using their skills and knowledge to identify, categorize and exploit entrepreneurial opportunities within the university–industry–government complex (Nazaryeva, 2015; Šebjan *et al.*, 2016; Nyström, 2008). Such a topic has been the main focal point of the associated literature, namely, identifying the existing relationships between EC factors and entrepreneurial growth in the university–industry–government domain (Afzal *et al.*, 2017; Antonioli *et al.*, 2016).

Conversely, the determinants of EC at the cross-country or regional block levels remain a largely understudied area of research (Šebjan *et al.*, 2016). Indeed, an evident gap exists in the literature with respect to EC factors at the regional and cross-country levels, with only a limited number of countries assessed in past research of this kind (D'este *et al.*, 2009). Thus, the present study seeks to address this gap in the literature by examining EC at the aforementioned levels with respect to the five countries in the ASEAN region. While integrated in pursuit of a common economic policy to become an innovation-driven region in the future, these countries are historically quite distinctive in relation to their cultural influences, population size and income per capita (Scippacercola and D'Ambra, 2014).

The general EC environment of the university–industry–government domain has changed dramatically since the inception of the Bayh–Dole Act in the USA in 1980 (Nyström, 2008). Undoubtedly, this act has served to largely support university technology transfer, patenting and licensing processes in the USA, thus stimulating the growth of the overall entrepreneurship capabilities of the country. However, little attention has been paid to researching the key attributes of EC and of the start-up dimension (Hallam *et al.*, 2017). Recently, many governments across the world, and in particular ASEAN-05 Governments, have emphasized the EC environment in their economic development missions (Rashed *et al.*, 2015). Currently, a vast majority of entrepreneurship researchers assert that theoretical and empirical research on EC is needed to improve the consistency and relevance of future studies on this topic (Bergmann *et al.*, 2014). In the current study, the use of global entrepreneurship monitoring data has helped us to better elucidate the relationship between EC and its determinants. To this end, the currently presented research had two main objectives. First, the current work aimed to investigate the relevance of a number of factors emphasized in the literature as inducing the capacity of entrepreneurs to identify and exploit commercial opportunities within the context of ASEAN-5 countries. Second, the presented work aimed at identifying the most significant variables in this framework in relation to the EC of ASEAN-5 countries via empirical analyses undertaken using two models, namely, the consistent estimation of fixed-effects stochastic transformation frontier model (Chen *et al.*, 2014), and the log transformation frontier model. As it pertains to its practical implications, the findings of this work can serve as a guide for policymakers of the ASEAN region; as sustainable economic growth is highly linked to entrepreneurship, economic policies should aim to promote optimal EC environments by addressing the significant factors currently impacting the EC environments of individual countries, as well as those impacting the region as a whole. Ultimately, such policies will aid in strengthening university–industry–

government linkages and facilitate the creation of new employment opportunities for the next generation of entrepreneurs.

2. Entrepreneurship capabilities working framework

While other frameworks exist to explicate the factors related to EC, such as the resource-based framework and the entrepreneurial intention framework (Giuri *et al.*, 2014), the current study follows the entrepreneurship perceived capability-based framework. Resource- and capability-based frameworks aim to explicate two distinct attributes that shape the overall capability of an entrepreneur; the resource-based opinion emphasizes the supply of and access to resources, while the capability-based framework has the skill and agency of entrepreneurs as its focal point (Audu *et al.*, 2013). While only very few studies have adopted the capability-based framework, many researchers have suggested that the capability-based framework is a better indicator of factors that spur innovation and global business start-ups (Bergmann *et al.*, 2014).

The selected framework, namely, the entrepreneurial perceived capability-based framework, takes the supply of resources into account while emphasizing capabilities, while providing consideration to the dimension of entrepreneurship that concerns the seeking of opportunities to formulate start-ups via entrepreneur skill and knowledge (Siegel and Wright, 2015). Explicitly, the entrepreneurial perceived capability-based framework is divided into three capabilities that ease organizational spin-offs; e.g. opening new paths of action, balancing organizational and commercial interests and integrating new resources (Afzal *et al.*, 2017). Opening new paths of action, in which the entrepreneur seeks to explore new business ideas within the entrepreneurship ecosystem, designates the first capability. For example, patenting and licensing of new technology developed in a university may reveal a new path of action toward entrepreneurship. This capability is mostly dependent on the status of the university education system, the knowledge transfer rate (KT) between university and industry and finally, the strength of a country's intellectual property rights (IPR) law (Woo *et al.*, 2015). The capability to balance organizational and commercial interests, in turn, concerns the legitimization of both organizational and commercial activities. For instance, an entrepreneurship incubation facility may facilitate this balance by fostering spin-offs. Finally, the capability to integrate new resources is dependent upon the entrepreneur's personal networking, as well as the entrepreneurship opportunities available within the national environment. Moreover, past research has indicated that the extent to which potential entrepreneurs will look for new opportunities is associated with personal beliefs regarding entrepreneurship as a good career choice in a given national economy. The presence of a positive attitude toward entrepreneurship will certainly push forward the entrepreneurial capabilities to capitalize on networks and resources globally (Light and Dana, 2013). Thus, in this study, we have taken the aforementioned variables and the entrepreneurship perceived capability-based framework into account for our empirical analysis.

3. Selection of countries

The ASEAN was formed in 1967 by Indonesia, Malaysia, Philippines, Singapore and Thailand to promote intergovernmental cooperation and facilitate economic, educational, military, political and cultural integration among the member countries and Asian nations. Subsequently, the membership of the organization has been expanded by the inclusion of Brunei, Cambodia, Laos, Myanmar and Vietnam. The major aim of ASEAN is the acceleration of economic growth in the region. To this end, in 2015, the combined nominal GDP of the organization was more than US$2,432 billion[1]; indeed, after China, Japan,

France, Germany and the USA, ASEAN would be the sixth largest economy in the world if it were a country.[1] Holding a variety of common attributes amongst them, ASEAN-5 countries (the founder nations of ASEAN) endeavor to uplift from efficiency-based to technology-driven economies (Afzal and Lawrey, 2014). These attributes are indistinguishably acknowledged from economic and social perspectives. For instance, the ASEAN Free Trade Area (AFTA) has been in operation since 1992 in an effort to decrease intra-regional tariff charges. Moreover, with the exception of the Philippines, the governmental education expenditure of ASEAN-5 countries lies close to 20 per cent of their total expenditure (ASEAN Secretariat, 2014). Likewise, with the exception of Indonesia, the primary export of ASEAN-5 countries is that of high-tech products (Capannelli, 2014), with the large majority of such exports consisting of integrated circuits (ICs) and computer data storage units (Simoes *et al.*, 2016) certainly indicating the strong technological advancement of ASEAN-5. Indeed, the ASEAN Economic Community (AEC) is heading toward technology-driven production advantages as it endeavors to establish an economic region with a high level of competition. To accomplish this, wider economic policies must entail a competition policy structured on an advanced innovation system that takes into account the growth of the EC environment.

On the basis of the ASEAN Economic Community Blueprint, for ASEAN to achieve sustainable regional economic growth, the AEC must endeavor to reduce gaps among ASEAN countries in terms of economic growth. Undeniably, increased regional entrepreneurial activity would largely contribute to such a goal. As a viable strategy for sustainable economic growth, the AEC should, thus, promote the adoption of the entrepreneurship capability-based model as a framework for entrepreneurship growth, taking into account the identified factors affecting the EC environment at the national and regional levels.

4. Theoretical background

According to the Schumpeter (1942) entrepreneurship theory, within a given period, an entrepreneur has a new opportunity to attempt an innovation using his or her skill and knowledge. If the entrepreneur succeeds, the innovation will create a more productive version of the product or process than previous versions. Specifically, the production of the intermediate good in use will go from last period's value A_{t-1} up to $A_t = gA_{t-1}$, where $g > 1$. If the entrepreneur fails, then there will be no innovation at t, and the intermediate product will be the same one that was used in t–1; thus, $A_t = A_{t-1}$. To innovate, the entrepreneur must conduct research, a costly activity that uses the final good as its only input. While the success of the undertaken research is uncertain, as it may fail to generate any innovation, generally speaking, the more the entrepreneur spends on research, the more likely it is that he or she will be able to innovate. Specifically, the probability μ_t that an innovation occurs in any period t depends positively on the amount R_t of the final good spent on research, according to the innovation function $\mu_t = \Omega(R/A^*)$, where $A_t^* = \Upsilon A_{t-1}$ is the productivity of the new intermediate product that will result if the research succeeds. The reason the probability of innovation depends inversely on A_t^* is that as technology advances, it becomes more complex and, thus, harder to improve upon. Thus, it is not the absolute amount of research expenditure R_t that ultimately decides the success of the research, but the productivity-adjusted expenditure R_t/A_t^*, which we denote by n_t. Here, n_t consists of factors that improve the productivity of innovation from the entrepreneur's perspective. In this paper, we have classified these as factors affecting the environment that enhance entrepreneurs' capabilities, productivity and efficiency.

5. Brief literature review

Various studies have been carried out with respect to aspects of entrepreneurship capabilities. These studies encompassed a variety of approaches adapted to exam entrepreneurship from diverse perspectives. For instance, some works have examined the territorial aspects of entrepreneurship (Wright, 2005), compared entrepreneurs in different geographical contexts (Klofsten and Jones-Evans, 2000) or even assessed entrepreneurship models based on a number of associated variables (Clarysse *et al.*, 2011).

For instance, Tofighi *et al.* (2017) adopted a dynamic approach to study the academic entrepreneurial environment of Iran, using the non-probability version of cross impact analysis (CIA). The authors concluded that while the academic entrepreneurial ecosystem is flourishing in Iran, some improvements must be made to further nurture the academic entrepreneurship environment. In other work, Rashed *et al.* (2015) applied the structural equation model (SEM) in two steps to develop a mathematical model of entrepreneurship. This study, which had as a focal point the impact of transformational leadership behavior, revealed transformational leadership quality as having enormous influence over entrepreneurial practice. The population of this study included the student body of a public university in Iran. In turn, Hallam *et al.* (2017) carried out a multi-methodological study with respect to the Translational Research Advancement Network to Support, Fund, Organize, Roll Out and Motivate UT Innovations (UT TRANSFORM) project in the University of Texas. As part of a multi-phased investigation strategy, the awareness survey, carried out to measure attitudes and experiences with innovation and entrepreneurship across faculty, staff and students, revealed that a progressive entrepreneurial milieu is a primary driver of commercialization of university-based technology.

The capability-based entrepreneurial framework has been discussed and empirically analyzed with respect to two major perspectives: the institution-based perspective and from the standpoint of individual skill and knowledge. Notable EC analyses have been conducted in the context of cross-country or regional block settings. For instance, Šebjan *et al.* (2016) performed a cross country analysis of entrepreneurship intention in the Danube region. To the best of our knowledge, a macro level empirical analysis using the capability-based entrepreneurship framework has yet to be carried out. Further, very few studies have included application of econometric methods, particularly the stochastic frontier analysis (SFA), to dismantle the EC-based framework at the regional level (Ridha *et al.*, 2017). Therefore, the currently presented work seeks to address the above gaps by providing an empirical analysis of EC capabilities, using the capability-based entrepreneurship framework and SFA to elucidate the determinants of EC at the national and regional level for ASEAN-5 countries.

6. Data and variable selection

This study considers one dependent variable and several independent variables. Empirical analysis of initial-stage entrepreneurship is often based on the Global Entrepreneurship Monitor (GEM) research database. In addition to GEM-2016 data, data gathered obtained from the World Competitiveness Yearbook (WCY) 2016 research database are also used in the present study. The only dependent variable of the current study entails the perceived capabilities of the entrepreneur (PerCa[2]). To this end, Venkataraman (1997) argues that entrepreneurs should possess the necessary skills and knowledge for the development of a new venture; according to Shane (2000), entrepreneurial skill is attained via acquisition of technological embodied knowledge. The fear of failure (FefRa[3]) variable has a powerful impact (generally negative) upon entrepreneurial venture creation and may hold back entrepreneurs from exhibiting their potential (Arenius and Minniti, 2005; Politis and

Gabrielsson, 2009). This study also considers the state of entrepreneurship as a good career choice (EnGC[4]), a factor that is supported by several studies as an important explanatory variable (Davidsson, 1995; Krueger, 1993; Autio *et al.*, 2001). Another independent variable is perceived opportunity (PO[5]). This variable takes into account the economic, cultural and social conditions perceived as favorable to create a new product or service and enables a prediction of the productive chances of the firm (Druilhe and Garnsey, 2004; Penrose, 1959). As transformation of knowledge paves the path for innovation and consequently, entrepreneurial activities developed through the innovation process (Afzal, 2013; Etzkowitz *et al.*, 2000), knowledge transfer (KT[6]) is considered another independent variable in this study. Thomas and Carl (2001) argue that property rights help protect knowledge, and consequently aid in sustaining knowledge-based practice; as such, this study also considers IPR[7] as an independent variable. The standard of education provided by its universities directly influences the entrepreneurial activities in a given country. Therefore, another independent variable, namely, University Education of Entrepreneurs (UE) [8], is introduced to include a measurement of the educational levels of entrepreneurs. This activity also aids in the promotion of a competitive economy by fostering entrepreneurship at the tertiary level, thus contributing to the development of new generations of "young" entrepreneurs (Lockett and Wright, 2005; Siegel *et al.*, 2003).

7. Empirical methodology

7.1 Conceptual idea

SFA models were initially introduced by Aigner, Lovell, and Schmidt (1977) and Meeusen and Van den Broeck (1977). Since their inception, SFA models have become one of the most popular sub-disciplines of econometrics as they enable analyses of efficiency, productivity, cause of inefficiency and coefficients of interest in a parametric manner, as opposed to non-parametric models such as data envelopment analysis (DEA). For an introduction to SFA models, see Kumbhakar and Lovell (2003).

Pitt and Lee (1981) and Schmidt and Sickles (1984) were the first researchers to use SFA with random effects and time invariant inefficiency in the context of fixed effects panel models. However, these models are not used in the current study; as argued by Greene (2005), the handling of the effect in the models proposed by Pitt and Lee (1981) and Schmidt and Sickles (1984) neglects the possibility of other non-efficiency related to time-variant heterogeneity, which could affect estimations of efficiency, thus yielding biased results. Second, the assumptions of time-invariant inefficiencies have been demonstrated as inappropriate for extended time-series or, in other words, panel models as they imply that inefficiency cannot change over time (Kumbhakar, 1990; Battese and Coelli, 1992). Thus, a possible linear- and quadratic-time trend in efficiency is included in the model used in this research. This study has applied two SFA models to analyze the fit of data. First, a consistent estimation of fixed-effects was carried out via the stochastic frontier model proposed by Chen *et al.* (2014), using the stochastic frontier total factor efficiency (SFTFE) command to remove any quadratic time trend in efficiency. Next, the log transformation frontier model, which uses the frontier command proposed by Battese and Coelli (1992), was applied to the data to achieve a possible linear SFA model using a log transformation of variables. Further, the within transformation method was used to remove potential issues caused by the incidental parameter problem (Wong *et al.*, 2007).

The fixed-effects stochastic frontier model assumes that unpredictable variables in a country may impact or bias the outcome variable. This method circumvents the possibility of bias by removing time invariant factors to assess the net effect of the predictors on the dependent variable (Belotti and Ilardi, 2015). Moreover, the new STATA command,

"SFTFE", analyses the consistent estimation of the fixed-effects by enabling estimation of the fixed-effects SF models via three alternative estimators (Belotti and Ilardi, 2015; Chen *et al.*, 2014). Here, first-difference data transformation is treated to eliminate the fixed-effects, attaining consistency for both fixed-n (cross-section) and fixed-T (time) asymptotics. In addition, SFTFE allows for estimations of models that control inefficiency, running a first-order autoregressive process in parallel to estimations of variances in inefficiency as a function of exogenous covariates (Constantin and Iyer, 2011).

Generally speaking, a stochastic frontier model has two components: one component is assumed to have a strictly nonnegative distribution, while the other component has a symmetric distribution. In econometrics, the nonnegative element is often designated as the inefficiency term, while the factor associated with the symmetric distribution is termed idiosyncratic error. Xtfrontier enables two different parameterizations of the inefficiency term: a time-invariant model and parameterization of time effects (Battese and Coelli, 1992). In the time-invariant model, the inefficiency term is presumed to have a truncated-normal distribution. In the parameterization of time effects proposed by Battese and Coelli (1992), the inefficiency term is modelled as a truncated-normal random variable elevated by a specific function of time. In both models, the idiosyncratic error term has a normal distribution. The lone panel-specific effect is the random inefficiency term in this case.

Aiming to explicate the factors that affect entrepreneurial capabilities, we formulated the functional form of two SFA models, namely, the consistent fixed effect estimator and the log linear time decaying model (based on the simple SFA panel model idea), to identify variations in inefficiency over time for our sample countries.

7.2 Functional derivation

The particulars of the functional roles of the stochastic frontier models used in the current study are best clarified via their application. Suppose that a country has an external environment function of f (Z_{it}, β). In an optimal case without error or inefficiency, at time t, the i^{th} country would support fully entrepreneurial capabilities:

$$Q_{it} = f(Z_{it}, \beta)$$

A central element of stochastic frontier analysis is that it assumes that each country theoretically produces or supports at a level below its maximum capacity owing to a degree of inefficiency impacting the associated processes. Explicitly:

$$Q_{it} = f\left(Z_{it,}\beta\right)\Upsilon_{it}$$

where Υ_{it} is the level of efficiency for a country i at time t; Υ_{it}, has an interval (0; 1).

If $\Upsilon_{it} = 1$.

Then the country provides an optimal support system to develop the EC environment by investing in university education and in technological development from university to industry, factors that are embodied in the EC environmental function (Z_{it}, β). Conversely, when $\Upsilon_{it} < 1$, the country does not make the most of factors Z_{it}, denominated as university education and technological development from university to industry, as embodied in the function f (Z_{it}, β).

Here, the outcome of EC performance is assumed to be strictly positive ($Q_{it} > 0$), while the degree of technical efficiency is expected to be strictly positive (that is, $\Upsilon_{it} > 0$). This is believed to be an expected condition of the EC environment function. Further, the outcome of the EC environment is also considered subject to random shocks, implying that

$$Q_{it} = f(Z_{it,}\beta)\Upsilon_{it}\exp(V_{it})$$

To achieve linear transformation, the natural log is taken for both sides:

$$\ln(Q_{it}) = \ln\{f(Z_{it,}\beta)\} + \ln(\Upsilon_{it}) + V_{it}$$

Assuming that there are a J number of input factors that affect EC performance, and that the environmental function is linear in its log form, defining the following equation, $\mu_{it} = \ln(\Upsilon^{it})$, thus yields

$$\ln(\boldsymbol{Q_{it}}) = \boldsymbol{\beta}_0 + \sum_{\mathbf{k}=1}^{\mathbf{j}} \boldsymbol{\beta_k} \ln(\boldsymbol{Z_{kit}}) + \boldsymbol{V_{it}} - \boldsymbol{\mu_{it}} \quad (1)$$

Here, μ_{it} is deducted from $\ln(Q_{it})$, restricting $\mu_{it} \geq 0$, which implies that $0 < \Upsilon_{\mathrm{it}} \leq 1$, as specified above.

As such, the model used in the current study actually fits the following form:

$$\boldsymbol{Y}_{\mathbf{it}} = \boldsymbol{\beta}_0 + \sum_{\mathbf{k}=1}^{\mathbf{j}} \boldsymbol{\beta}_{\mathbf{k}} \mathbf{ln}(\boldsymbol{X_{kit}}) + \boldsymbol{V}_{\mathbf{it}} - \boldsymbol{s\mu_{it}} \quad (2)$$

Thus, in the context of the discussion above, $Y_{it} = \ln(Q_{it})$ and $X_{kit} = \ln(Z_{kit})$, which looks like a general form of a production function.

Equation (2) is a variant of a panel-data model, in which V_{it} is the idiosyncratic error and μ_{it} is a time-varying panel-level effect. Generally speaking, most of the literature on this type of model has focused on deriving estimators for different specifications of the μ_{it} term.

In both models used in this study, namely, the consistent fixed-effect estimator and the time-varying decay specification, the central efficiency change is demonstrated by equation (3):

$$\boldsymbol{\mu}_{\mathbf{it}} = \mathbf{exp}\{-\eta(\mathbf{t} - \boldsymbol{T}_{\mathbf{i}})\}\boldsymbol{\mu_i} \quad (3)$$

where Ti is the last period in the ith panel, and η is the decay parameter, which is independently and identically distributed.

Theoretically speaking, when $\eta > 0$, the degree of inefficiency decreases over time; when $\eta < 0$, the degree of inefficiency increases over time.

8. Results and discussion

Generally speaking, before using the maximum likelihood procedure, the OLS results in Table I need to be verified. To this end, the negative sign of the skewness (−54.3475) of the residual indicates that the correct residuals of the sample characteristic prevailed for application of the maximum likelihood method in the consistent estimation of fixed-effects stochastic frontier model. This also indicates the variability of the attained results (Rashidghalam *et al.*, 2016). Both Tables I and II present statistical analyses of internal and external factors that affect the entrepreneurial perceived capabilities environment in ASEAN-05 economies. Here, the dependent variable PerCa is explained by a set of independent variables in both models.

With the exception of FefRa, the above analyses yielded positive variable coefficients for all factors, revealing that factors such as the presence of entrepreneurial role models,

previous entrepreneurial experience, as well as the perception of social support factors and government policy, such as IPR, play a positive role on EC, but are not being sufficiently cultivated to provide adequate support for the growth of the EC environment of ASEAN-05 economies. Such a conclusion is clearly supported by looking at the IPR variable results of both models, which have yielded positive yet statistically insignificant IPR variables. Likewise, the negative coefficient of the fear of failure variable in both models implies that within the context of ASEAN-5 economies, EC performance and fear of failure hold an inverse relationship. As entrepreneurs feel increasingly burdened by a fear of failure, the less likely they are to apply their skills and knowledge in seeking new ventures in the economy. This constitutes an important finding for policymakers of ASEAN-05, indicating further considerations should be given to the state of the EC supporting environment with respect to this variable.

The impact of the PO on output is positive and significant in both models, as seen in Tables I and II. The attained results in Table I show that the factors affecting the EC environment, such as EnGC, have a positive and significant impact on the production frontier. While Model 1 (Table I) indicated positive but not significant values for KT and UE, the Model 2 (Table II) yielded both positive and significant outcomes of the same variables on EC performance and resilience of the frontier. Such a finding implies that universities in ASEAN-05 are concentrating on promoting EC capability-based outcomes such as technology transfer, new patents, commercialization of scientific invention and licensing facilities. This is very vital for entrepreneurial capability development as these constitute key external factors that immensely affect the outcome of EC activity and improve the efficiency frontier at the national level.

If we compare our findings with recent EC literature on ASEAN-05, we can find evidence to support our empirical results. A study of the relationship between the work environment

Table I.
Consistent estimation of fixed-effects stochastic frontier model results

Dependent variable PerCa	Coefficients	Standard error	z	P > |z|	[95 per cent conf. interval]	
FefRa	− 0.1525173	0.1572386	−0.97	0.332	− 0.4606993	0.1556647
PO	0.5306167	0.1220725	4.35	0.000	0.2913589	0.7698745
EnGC	0.4269469	0.1425154	3.00	0.003	0.1476218	0.7062719
KT	1.428881	0.8792445	1.63	0.104	− 0.2944063	3.152169
IPR	0.5739623	1.031765	0.56	0.578	−2.596184	1.44826
UE	0.7390088	0.7335291	1.01	0.314	− 0.6986819	2.1767

Source: Author calculation

Table II.
Log transformation frontier model results

Dependent variable PerCa_log	Coefficients	Standard error	z	P > |z|	[95 per cent conf. interval]	
FefRa_log	0.271308	0.0760363	3.57	0.000	0.1222805	0.4203373
PO_log	−0.4017503	0.122001	−3.29	0.001	−0.6408679	−0.1626328
EnGC_log	0.9734191	0.1095154	8.89	0.000	0.7587729	1.188065
KT_log	0.1073086	0.0840422	1.28	0.002	0.2720284	0.0574111
IPR_log	0.0101934	0.0991004	0.10	0.918	−0.1840397	0.2044265
UE_log	0.3676244	0.1079669	3.10	0.001	0.5792356	0.1560131
_cons	3.325477	8.465878	0.39	0.694	−13.26734	19.91829

Source: Author calculation

of individual researchers and their engagement with entrepreneurship activity in Thailand shows that commercialization of academic entrepreneurs' research outputs plays an important role in social changes (Sooampon and Igel, 2014). In that study, entrepreneurial capability is defined as experience in transforming scientific expertise into a commercial product or service to be sold in the market. While university–industry–government linkages are not favorable in Thailand, public universities encourage entrepreneurial activities (Intarakumnerd and Schiller, 2009).

In Singapore, the economy is basically dependent on industry and service entrepreneurship. Singapore universities and government policies have been major contributors to knowledge generation and commercialization though entrepreneurship (Sohn and Kenney, 2007). To this end, the National University of Singapore has been playing a large role in economic development through its entrepreneurial activities (Wong *et al.*, 2007). Likewise, within three years of the initialization of the Entrepreneurial University project, Malaysia has seen a large increase in knowledge output, including a large increase in the total number of publications and patents of Malaysian origin. Indeed, in addition to the observed increase in the overall number of publications, an increase in the number of citations has also been observed for academic and technological publications originating from Malaysia (Wong and Goh, 2010; Razak and Saad, 2007). Also, Indonesia and the Philippines are slowly but surely catching up to their own frontiers. For instance, the Philippines is currently agreed to be transitioning from an efficiency-based to an innovation-based economy. However, for the Philippines to hasten their transition, the country must lend appropriate support to the nurturing of skilled entrepreneurs. For example, the main present contribution of the Philippines to its GDP is the manufacture of semiconductors, a technology that has high demand in Japan and Western European countries. However, to sustain and grow this market, the Philippines must concentrate efforts on developing and sustaining the national EC environment and its determinants (Afzal, 2013). Likewise, as an emerging market, Indonesia is considered to be one of the next-eleven or N-11 countries, a designation given to emerging markets that could potentially become some of the world's largest economies. To lead the way, Indonesia needs to shift their current production frontier to a new paradigm, which of course can only be made possible with the presence of a strong, skilled entrepreneurial workforce. Undoubtedly, some of the impeding factors currently hindering faster growth in entrepreneurial capacity for ASEAN-05 include the absence of proper government policies to uphold IPR laws, as well as a lack of regulation policies aimed at encouraging potential entrepreneurs to take risks and view EnGC. Given the above discussion, the results of the current study on ASEAN-05 can certainly help guide policymakers in enabling adequate EC environments at the national and regional levels. The overall results, disclosed in Tables I and II, seem to suggest that the efficiency estimates derived from the application of both stochastic frontier models are relatively robust to the distributional assumptions that we made, thus producing expected outcomes.

8.1 Cross-country efficiencies

A comparison of our findings with recent EC literature yields sufficient theoretical evidence to support our empirical results, in particular corroborating the importance of university education standards as well as knowledge transfer between the university–industry domain in the development of skilled entrepreneurs in the country. For example, applying the theory proposed by Aghion *et al.* (2005), let us assume there are two countries, namely, Malaysia

and Indonesia, with identical resource endowment – except that skilled entrepreneurs are scarcer in Indonesia as compared to that in Malaysia, which can be represented as follows:

$$H^I/_{L^I} < H/_L$$

where L and H stand for the amounts of unskilled and skilled entrepreneurs employed in the technology enhancing sector, respectively, while "I" and "M" represent Indonesia and Malaysia, respectively. Now, we assume that IPR law is not enforced in I and that there is no trade between "I" and "M", which also implies that intermediate producers in "M" cannot sell any goods, which need copyright protection, to "I". Thus, "M" can only collect copyright rents from domestic innovators. On the other hand, entrepreneurs in "I" can imitate new technologies invented in "M" at a small cost. This also discourages entrepreneurs of "I" from innovating on their own. At one point, both countries will end up using the same technologies, and thus, productivity will accordingly reach a steady state in that region (assuming a two-country case). Thus, there will be no incentive for innovators and entrepreneur to produce or improve upon a good or service in both countries.

Therefore, numerically speaking,

$$\frac{A_H}{A_L} = \frac{H}{L}$$

where A is the productivity parameter. Therefore, the development of appropriate government policies revolving around IPR law can play a crucial regional role as an incentive for entrepreneurs to innovate and remain competitive. The absence of such variables not only hinders the entrepreneurial process, it can also be said to play a large negative role in the creation and perpetuation of the observed cross-country efficiency differences. In summary, factors such as quality of tertiary education, KT and IPR laws can be said to be significant external factors capable of enhancing entrepreneurial capabilities, both at national and regional levels.

9. Conclusion and contribution

This study presented two SFA models to estimate the current state of factors that generate an impact upon the entrepreneurial perceived capabilities environment in ASEAN-05. Accurate estimations of variables that influence the efficiency of a given regional or national EC environment can help guide improvements to the entrepreneurial ecosystem by providing important feedback to policymakers regarding gaps and deficiencies hindering the growth of entrepreneurship. The attained results of the current work certainly support that entrepreneurial perceived capability variables such as perceived opportunities in the country, EnGC, fear of failure, IPR, KT and overall university education system have significant impact on the production frontier. Moreover, internal variables such as perceived opportunities in the country for the entrepreneur, and views on EnGC were shown to play a larger role in determining the quality of the EC environment in comparison to the degree of fear of failure on the part of the entrepreneur. On the other hand, external variables such as the KT between university and industry as well as the overall university educational system in the country were shown to positively impact the EC environment in ASEAN-05. Indeed, it would seem that these two factors constitute the most important variables to consider for future perfections of the production frontier. Chiefly, the methodology described in this work is appropriate for evaluations of efficiency and coefficients of determinants of EC environments.

Given the overall discussion and the strategic priority variables of the ASEAN-05 region, several policy implications can be pursued. Practically speaking, policies that may affect key determinants in the individual entrepreneurial decision-making process must consider the inclusion of strategies aimed at enhancing KT opportunities, improving standards of tertiary education and abating the "fear of failure" mindset of potential entrepreneurs.

Past EC studies have illustrated differences in entrepreneurial intentions from cross-cultural and cross-country perspectives. For example, Liñán and Chen (2009) and Šebjan *et al.* (2016) have focused their research on the EC differences in Taiwan and the Danube region in Spain, respectively. The currently presented study contributes to a reinstated definition of entrepreneurial capabilities, demonstrating how its factors shape the overall entrepreneurship process in ASEAN-05 via the use of the stable panel stochastic frontier analysis method. While many ASEAN entrepreneurship studies have been carried out to date, such as works by Ramli and Senin (2015), Ismail *et al.* (2015), Binti Hamidon *et al.* (2017) and Binti Othman and Othman (2017), among others, this is, to the best of our knowledge, the first instance were the aforementioned methodology is used to elucidate the factors affecting the entrepreneurial capabilities environment at regional and national levels. As a future step to further elucidate the socio-cultural factors that shape the EC environment in ASEAN-05, researchers may wish to attain findings from the micro-level individual university domain via specific surveys on young entrepreneurs.

Lack of sufficient time-series data and the application of non-parametric methods for comparisons comprise the fundamental limitation of this study. However, despite our limited data, the findings resulting from application of the proposed method already provide a useful interpretation of the efficiency frontier for evaluations of EC performance. Finally, the results of this work highlight that entrepreneurship is not only the result of a given individual's skill, knowledge and ability to seek new ventures, but also – to a large extent – a result of the state of the tertiary educational system, the KT and the establishment of government policies such IPR law with respect to the environment where the entrepreneur lives and works.

9.1 Practical implications of the study

Given the aforementioned discussion and taking into account the strategic priorities of the ASEAN region, several policy implications can be established. Policy intervention in the economic process should take into account both the overall conditions of the socioeconomic system as well as individual characteristics of entrepreneurs. Policy measures that may influence key determinants in the decision-making process of an individual starting an entrepreneurial career should be aimed at strengthening the perceived knowledge and skills needed for entrepreneurship, and at lowering individuals' fear of failure. Regarding the importance of perceived entrepreneurial knowledge and skills in the formation of entrepreneurial intentions, the nurturing of entrepreneurial skills at an early age constitutes a key step toward instilment of the entrepreneurial "spirit" and, hence, the development of a new generation of entrepreneurs. As an important strategy, the inclusion of different forms of formal as well as informal entrepreneurial education and training, such as the implementation of team projects in a real entrepreneurial environment, for example, should be considered at all educational levels. Moreover, the purpose of using GEM data is to provide insights and recommendations that will help researchers improve the application of GEM data in future research projects and identify needs for future research designs in GEM-related research.

Notes

1. Source: ASEAN Secretariat and IMF World Economic Outlook April 2016.
2. PerCa = Perceived capabilities of the entrepreneur (percentage of 18-64 population who believe they have the required skills and knowledge to start a business).
3. FefRa = Fear of failure (percentage of 18-64 population perceiving good opportunities to start a business who indicate that fear of failure would prevent them from setting up a business).
4. EnGC = Entrepreneurship as a good career choice (percentage of 18-64 population who agree with the statement that in their country, most people consider starting a business as a desirable career choice).
5. PO = Perceived opportunity (percentage of 18-64 population who see good opportunities to start a firm in the area where they live).
6. KT = Knowledge transfer (knowledge transfer is highly developed between companies and universities (Updated: MAY 2012, IMD WCY executive survey based on an index from 0 to 10).
7. IPR = Intellectual property rights (IPR are adequately enforced (Updated: MAY 2012, IMD WCY executive survey based on an index from 0 to 10).
8. UE = University education of entrepreneurs [university education meets the needs of a competitive economy (updated: MAY 2012, IMD WCY executive survey based on an index from 0 to 10)].

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