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Benchmarking a country for efficiency improvement: a DEA-based approach

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Abstract

The purpose of this study is to determine the critical factors of environment which influence the overall performance of Micro-Small-Medium Enterprises (MSMEs). This may be conjectured that the entry and exit from small and medium industries in any country are determined by the overall environmental mapping which is explicitly reflected through several parameters such as personality of entrepreneurs and operating environment of entrepreneurs. Accordingly, revisiting these two parameters can lead a country towards sustainable development. To develop a country's efficiency in terms of its SME development, it is essential to formulate an effective policy framework. For this, it is essential to visualize the overall situation in a comparative way. Benchmarking a similar country can lead towards effective policy formulation considering that the countries belong to the same category. The present study has developed an efficiency score for each country in terms of interaction variable. This score not only makes a country fit in a position of total entrepreneurship development but also with the help of benchmarking technique, the particular country can choose another efficient country to follow. This is also very much effective in the time of policymaking. In this research, three outputs have been taken to capture the overall entrepreneurial situation and in case of input only relevant variables have been taken into consideration.

Keywords: Entrepreneurial efficiency, DEA, Micro-Small-Medium Enterprises, Benchmarking, India, Developing country

Introduction

While formulating policy, the government was trying to address the fundamental issues of how to assess and improve the entrepreneurial situation in a country. The ultimate aim was to eradicate poverty and increase employment through entrepreneurial development. The SMEs play a great role in generating employment, promotion of innovation, and creation of competition and a healthy economy (Bannock, 1981). Promoting the MSME sector in developing countries will create more employment opportunities, give more equitable distribution of income, and will ensure increased productivity with better technology (Steel & Webster, 1991). Development and sustainability of MSME is heterogeneous across countries. A natural presumption is that the external environment plays a decisive role in shaping the entrepreneurial development of a country. However, when we look at entrepreneurial development among rich and poor countries, the picture gets less clear. Many poor countries with less infrastructural facilities are much ahead of

others in terms of entrepreneurial development. So, it is not obvious that the answer is just external environment; it is how efficiently a country manages this environment. In this context, entrepreneurial efficiency of SMEs is the most important concept.

As entrepreneurship is multi-dimensional, therefore, a crucial part of the economists' task is to find significant input as well as output that reflects the true picture of entrepreneurial situation of a country. Entrepreneurial development is influenced by the comprehension of the factors that allow some countries to achieve higher rates of growth. Making improvements in these factors can play a transformative role in promoting growth and development of entrepreneurship. One of the factors in a broader sense is environmental factor. The World Bank ranks 189 economies in 10 areas of business regulation, including starting a business and ease of doing business. But this ranking has failed to capture the total entrepreneurial condition of a country. This method measures all countries on similar parameters. But the characteristics of different countries are not similar where the degree of development is not the same. To capture the overall entrepreneurial scenario of a country, it is essential to consider only the relevant variables of that country. It is also pertinent to determine all the factors that reveal the true picture of entrepreneurial development. According to Munizu (2010), the performance of the small business sector is affected by two main factors namely external and internal environmental factors. Another dynamics of entrepreneurial development which comes under internal factor is the personality of entrepreneurs. These two factors namely entrepreneurial personality and entrepreneurial environment constantly interact with each other. A better understanding of this complex mechanism can help to identify the loophole within the entrepreneurial ecosystem.

The GEDI (Global Entrepreneurship Development Institute) measures both the quality of entrepreneurship and the extent and depth of the supportive entrepreneurial ecosystem. GEDI identified 14 important variables (pillars) that regulate levels of entrepreneurship. It is of common belief that both highly motivated individuals and a supporting institutional environment for entrepreneurship are required for the entrepreneurial scenario of a country to flourish. On the other hand, nascent entrepreneurship rate, new business development, and sustainability are the true reflection of entrepreneurial development as all of these represent the stages of entrepreneurial life circle with relative importance in the entrepreneurial process. Global Entrepreneurship Monitor estimates new firm birth rates, new business development rate, and business discontinuation rate. Against this background, it has become pertinent to measure the extent of relative efficiency of each country and to explore the areas for bringing an improvement in their efficiency. This study employs the data envelopment analysis (DEA) approach to measure the entrepreneurial efficiency of a country. Application of data envelopment analysis methods allowed us to find the country's efficient frontier in terms of SME development by usage of multiple inputs and output of the country. The DEA model allows relative efficiency measures. The measurement of relative efficiency where there are multiple possible incommensurate inputs and outputs was tackled by Farrell. Farrell and Fieldhouse focused on the construction of a

hypothetical efficient unit, as a weighted average of efficient units, to act as a comparator for an inefficient unit.

$$\text{efficiency of unit } j = \frac{u_1 y_1 + u_2 y_{2j} + \ldots}{v_1 x_{1j} + v_2 x_{2j} + \ldots}$$

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}}$$

where, u_1 = the weight given to output i

y_{1j} = amount of output 1 from unit j

v_1 = weight given to input 1

x_{1j} = amount of input 1 *to* j

The Government of different countries has undertaken several initiatives and instituted policy measures to foster entrepreneurship in the country. The main concern of government and policymakers are to get rid of the bottleneck of entrepreneurial development and to get answers on how to accelerate it. Positioning a country in terms of efficiency and comparing that country with more efficient countries can lead policymakers towards effective policymaking that increase the performance of the SME sector.

To understand the true picture behind the performance of SME, it is imperative to explore all the controlling parameters of SME development. Different scholars have worked on this area and many of them found out the parameters within the external environment and their relative importance. Researchers in most of the cases used only one dimension of entrepreneurship and that is actually analyzed. But any empirical study trying to measure the "total" spectrum of entrepreneurship needs to think about the extensive range of indicators in order to portray the actual picture of entrepreneurship. Within this category, most of the researchers concentrated on one or two major parameters and discussed briefly about their impact on the overall business situation.

Another group of researchers believes in the micro view and identifies the factors that are controlled by entrepreneurs. This thought indicates that the potential entrepreneur has the ability to direct or adjust the outcome of each major influence. Entrepreneurial Trait School of Thought is one of the major thought under this category. This thought indicates the essential traits and characteristics of business owners for business startup and business development. According to this thought, a motivated and skilled individual can reshape the dimension of the business.

Basically, a country's entrepreneurial scenario can be seen from two different angles: one is entrepreneur's internal ability and another is external operating environment of business. On the basis of that philosophy, another group of scholars and researchers consider that entrepreneurial success is mainly managed by individual attributes and the surrounding environment" (Stam, 2010, 141). To assess the actual entrepreneurial position of a country, it is needed to consider both the dimensions.

Different researchers used different technique to understand the condition of entrepreneurship like the self-employment rate which has been used to compare entrepreneurship across countries, e.g., Acs, Audretsch, and Evans (1994), Blanchflower (2000),

Blanchflower (2004), Le (1999), OECD (1998), OECD (2000), and Parker and Robson (2004). A different group of indicators which are often used in the literature is entry and exit rates into and out of self-employment as used in, e.g., Evans and Leighton (1989), Fairlie (1999), Lin, Picot, and Compton (2000), and OECD (2000).

Finally, Audretsch and Thurik (2001), Bartelsman, Scarpetta, and Schivardi (2003), OECD (1997), and Parker (2004) use the relative share of economic activity (GDP or employment) accounted for by small firms as an indicator of entrepreneurship.

From an economic perspective, efficiency—in terms of input usage or output production—is related to the coefficient of resource utilization and is more scientific. The link between economic theory and efficiency measures based on distance functions now seems more evident. Without an adequate level of efficiency, a country cannot reach the desired level of development.

There is a plethora of research measuring the efficiency of the SMEs of different countries. Most of the research is based on developed countries. Reverte and Guzman (2010) have measured the relative efficiency of 1939 Spanish SMEs using DEA as a measuring tool. In the literature, there are also studies calculating the efficiency of SMEs in Turkey with DEA. Bayraktar, Demirbag, Koh, Tatoglu, and Zaim (2009) have compared the supply chain management application efficiencies of Turkish and Bulgarian SMEs via DEA. In the study of supply chain management, Günay (2015) has measured the efficiency of 10 food companies processed in BIST SME market with the use of the BCC model of input-oriented DEA. Akin (2010) has measured the relative efficiencies of 115 small enterprises conducting activities in the Western Mediterranean Region of Turkey with DEA. Most of the research focused on firm-level analysis. Some examples include Pitt and Lee (1981) on weaving firms in Indonesia; Little, Mazumdar, and Page (1987) on five industrial sectors in India; and Cortes (1987) on metalworking and food processing firms in Colombia. Determining entrepreneurial efficiency as a whole is missing in previous literatures. Very little studies have worked on country-based entrepreneurial efficiency that compares countries on the basis of their efficiency in consuming the resources and producing the outputs. Without proper combination of available input factor, a country will be off of the production possibilities frontier. A sufficient number of research now exists on distance functions (Cooper, Seiford, & Zhu, 2011), but positioning a country in terms of efficiency score, understanding the efficiency differences at a country level, and identifying an appropriate benchmark for each county, to the best of our knowledge, are empirically untested.

The present study is an effort to evaluate any county on the basis of efficiency scores. The present research is aimed to address the following issues in the study:

a. To develop a model to examine the nature of the relationship between the interaction variables with the stages of entrepreneurial process, namely, nascent entrepreneurship rate, business growth rate, and sustainability of the business where the country consists of developing and developed nations as also one of the variables.
b. To ascertain the level of importance of the interaction variables in the context of the relationships between the set of interaction variables and different stages of entrepreneurship development and also the significance of the country in each case.

c. To ascertain countries' degree of efficiency in terms of efficiency score and develop the framework for comparing that country with more efficient countries of similar type.
d. Identify the area of concern of a country for efficiency development that can lead towards effective policymaking.

Methodology

Source of data

The research is of a dynamic and multiregional structure and was conducted on the target sample based on the longitudinal study of GEDI report 2012–2016 (Global Entrepreneurship Development Institute report).

The cause of emergence of GEDI Index is to offer a more realistic and scientific measure of entrepreneurship based on the multidimensional facade of entrepreneurship. It is considered as one of the prime bases for policy analysis and outreach.

GEDI identified 14 important variables (pillars) that regulate levels of entrepreneurship. All the pillars are calculated from the personal and institutional variables using the interaction variable method. Without assessing both, we do not get a perfect representation of the entrepreneurial ecosystem. All the 14 data of overall personality (interaction) are taken from the GEDI report 2012–2016.

This research also uses the data of GEM (Global Entrepreneurship Monitor) report, 2012–2016, which was conducted on the target sample based on the longitudinal study. The multinational GEM research project was planned on such a manner that it can provide a database to study the complex relationship between entrepreneurship and economic growth (Reynolds, Hay, and Camp, 1999) and smooth the progress path of entrepreneurship (Reynolds et al., 2005). Data of nascent entrepreneurship rate, new business ownership rate, and sustainability of business rate are taken from GEM (Global Entrepreneurship Monitor) report during the period 2012–2016.

Variables

GEDI identified 14 most important pillars emerge from the personal and institutional variables using the interaction variable method. These two ecosystem components coexist with mutual interaction.

The combined effect of both individual variables and institutional variables constitute interaction variables which are termed as the index of the entrepreneurial ecosystem. The three sub-indices namely, attitudes, abilities, and aspirations have four or five pillars each, in total 14 pillars to describe the entrepreneurial ecosystem of the country (Table 1).

Research design

At stage one, cluster analysis is performed on the basis of interaction variables to form two clusters which are homogeneous within each of the clusters and heterogeneous between them. Four classes are also formed named as class 1, class 2, class 3, and class 4, considering both type of nations (developed and developing) and two clusters mentioned earlier. At stage two, regression analysis was performed for each class with nascent entrepreneurship rate, new business, and sustainability rate as dependent variables

Table 1 Formation interaction pillars and their descriptions

Sub-index	Pillar	Description
Attitudes	Opportunity perception	Can the population recognize the opportunities to start a business and does the institutional environment support to act on those opportunities?
	Startup skills	Does the population acquire the skills necessary to start a business supported by the availability of tertiary education?
	Risk acceptance	Are individuals willing to take the risk of starting a business? Does the environment make them confident in this regard?
	Networking	Do entrepreneurs know each other and how geographically concentrated are their networks?
	Cultural support	Countries' point of view on entrepreneurship. Is it easy to choose entrepreneurship or does corruption make entrepreneurship difficult relative to other career paths?
Abilities	Opportunity startup	Are entrepreneurs motivated by opportunity rather than necessity and what is the role of government in this regard?
	Technology absorption	Size of the technology sector and readiness to absorb new technology.
	Quality of human resource	Extend of entrepreneurs' education, training about business, and ability to move freely in the labor market.
	Competition	Are entrepreneurs creating unique products and services and are able to enter the market with them?
Aspirations	Product innovation	Countries' ability to develop new products and integrate new technology.
	Process innovation	Do businesses use new technology and are able to access high-quality human capital in STEM fields?
	High growth	Intention of business to grow and whether they have the strategic capacity to achieve this growth.
	Internationalization	Do entrepreneurs want to enter global markets and is the economy complex enough to produce ideas that are valuable globally?
	Risk capital	Availability of capital from both individual and institutional investors.

on 14 interaction variables which are treated as independent variables. At stage three, DEA methods are applied to each class of the country to measure the relative efficiency of a specific country and to provide a more appropriate logical guideline for policymaking.

Result and discussions

Analysis: Stage I

Cluster analysis is performed on the basis of 14 identified parameters of attitudinal dimension of entrepreneurs to form two clusters with relatively homogeneous groups. The two homogeneously distributed groups have been obtained by cluster analysis based on five independent parameters. Justification of cluster formation has been made based on the differences of mean value of the two across all the values of identified parameters. The mean values of all perceptual parameters in cluster 2 have higher values than cluster 1 (Table 2).

Before that, a normality test for 14 parameters of interaction has been performed. Large significance values (> .05) of all the independent variables indicate that the observed distribution corresponds to the theoretical distribution. The value of significance indicates that all the independent parameters are normally distributed.

Table 2 Justification of formation of two clusters

Parameters	Interaction variables	Mean values of parameters in cluster 1	Mean values of parameters in cluster 2
P1	Opportunity perception	0.3838863	0.6592929
P2	Start-up skills	0.4243128	0.6076768
P3	Risk acceptance	0.3364455	0.7045455
P4	Networking	0.4036493	0.6832323
P5	Cultural support	0.3599052	0.7048485
P6	Opportunity start-up	0.3790995	0.7564646
P7	Technology absorption	0.2767299	0.6990909
P8	Human capital	0.3408057	0.7231313
P9	Competition	0.385782	0.6849495
P10	Product innovation	0.3641706	0.7551515
P11	Process innovation	0.2996209	0.679798
P12	High growth	0.3544076	0.6359596
P13	Internationalization	0.3616588	0.6963636
P14	Risk capital	0.297346	0.6833333

The results emerge from the developed models based on the two clusters which show that a significant level of differences in the personality parameters has established relationships among variables. Countries belonging to cluster I having potentially low scores in all attitudinal perspectives can only be successful in new venture creation through opportunity perceptions and networking whereas almost all attitudinal parameters of personality traits contribute significantly in developing nascent business in the countries belong to cluster II having potentially high scores in all attitudinal perspectives.

Analysis: Stage II

The personality perspectives may also vary among developed and developing nations, and to capture the influence of the nature of the country, as well as personality parameters, four classes have been developed (class III). Personality traits are used as the basis of the formation of the four classes/groups, considering both type of nations (developed and developing) and both clusters (Table 3).

Analysis: Stage III

The regression analysis has been performed directly, considering nascent entrepreneurship rate, new business development, and sustainability as dependent variables and the attitudinal parameters as independent variables separately for each class. The regression

Table 3 Formations of four different classes/groups

Class	Nation type	Cluster
Class 1	Developed [1]	Cluster I
Class 2	Developed [1]	Cluster II
Class 3	Developing (Akin, 2010)	Cluster I
Class 4	Developing (Akin, 2010)	Cluster II

outputs are measured in terms of the level of significance and also estimate the extent of differences in the context of relationship and emerging significant parameters of four different classes (Table 4 and Table 7)

Analysis: Stage IV

The DEA method is applied to countries within a class because DEA creates an efficient frontier consisting of the set of most efficient performers. Any DMU (decision-making units) inside the efficient frontier may use DEA for benchmarking. The efficient frontier consisting of the best observations is specified so that the efficiencies of all DMUs are calculated by the distance from this frontier.

A DMU that is not efficient and is inside the frontier can choose efficient DMUs on the frontier, as role models. All the DMUs within the frontier belong to the same category or more or less the same operating condition.

DEA does not presume any definite functional form linking inputs and outputs, thus avoiding problems of model misspecification, and this method consider multiple inputs and multiple outputs to construct relative efficiency of each DMU. It calculates the efficiency of a DMU with respect to other DMUs with common factors. It offers optimal weights for each factor.

In our case, countries are the decision-making units and we use an output-oriented model as the central focus is to analyze the possibility of increasing the output with constant input level.

In our analysis, the VRS method is used to determine the efficiency of a country, but to measure scale efficiency, the VRS method and CRS method have been compared. The difference between the two efficiency scores for a particular country indicates the scale inefficiency of a particular country. Five years' average data have been taken for each DMU and for each variable.

Conclusion and implication

The outcome of this section has several implications for researchers and policymakers. First of all, the findings of this study support the importance of the role of effective interaction of personal and institutional variables in entrepreneurial ecosystems. These findings also suggest an integrated approach which can minimize the negative influence

Table 4 Measures of extent of differences in the relationships among the variables

Class	Nascent significant parameters	R^2 value	New business significant parameters	R^2 value	Sustainability significant parameters	R^2 value
1	–	–	Technology and quality of human resource	0.40	Technology and quality of human resource	0.37
2	Quality of human resource	.58	Start-up skill and risk capital	0.45	Opportunity perception, networking, technology, cultural support, and product innovation	0.53
3	Opportunity perceptions, networking and risk capital	.14	Start-up skill and quality of human resource	0.24	–	–
4	Networking	0.93	Start-up skill	0.92	–	–

and maximize the positive ones to develop a competent entrepreneurial situation in terms of nascent entrepreneurship rate, new business development rate, and sustainability.

In the nascent stage, future entrepreneurs are actively involved in setting up a business and they are highly motivated by the opportunity perception, i.e., they are looking for new opportunities to start a business. In the business development stage, entrepreneurs manage their ongoing business. Opportunity perception again could be the important one to scale up its existing one or invest in the new business having potential in the future. It indicates that the size of the market/potentiality of the market can motivate a person towards startups, but this market potentiality can be utilized by the organization with their potential human resources to beat the competition. Risk capital also plays a significant role here because the availability of risk finance, particularly equity rather than debt, is an essential precondition for fulfilling entrepreneurial aspirations that are beyond an individual entrepreneur's personal financial resources.

Market opportunity remains the dominating factor even in the stage of sustainability, and the outcome is quite justified as the success of the business venture depends mostly on the business growth in the existing market as well as the creation of the new potential area of business. Networking emerges as one of the positive influential factors at this stage because it enhances the spectrum of understanding of the entrepreneurs regarding business environment, new technology, process invention, latent market demand, and also new challenges of the business. Market competition is also becoming an influencing factor for the development of the business as the entrepreneurs look for process and product innovation as well as find new markets with their existing products for their sustenance. As a result, they go for product or market uniqueness that can save them from profit sharing. On the other hand, negative attributes are those which are hindering the total entrepreneurial development. Process innovation which is reflected by using new technology and making expenditure towards R&D also hold negative relation with nascent entrepreneurship rate and sustainability. That can be explicated by the crunch of financial resources and improper training which may lead further fund shortage. In the business development stage, when the entrepreneur began to take things more seriously and increases his investment, they always undergo with fear for competition and failure. It has also been noticed that the increased quality of human resource holds back an entrepreneur to start a new business. This further reflects the cultural bottleneck of society where entrepreneurship is seen as a secondary choice. When countries' entrepreneurs are more internationalized, the new entrepreneur registration rate decreases because of incompetency fear, and also at a later stage, mainly big companies take the full advantage of export-oriented profit. Also, exporting more without inventory management and creating a global image without proper technology up-gradation seems to lead a firm towards an unstable condition. It is now a matter of question that how Gross Domestic Expenditure on Research and Development (GERD) help small entrepreneurs. For this, process innovation is also considered as a negative influential factor at sustainable stage. The government can play a pivotal role to overcome the financial crisis and technical incompetence, and it is the time to redesign the entrepreneur ecosystem which is mainly controlled by the government. When we consider the group-wise approach, the two clusters which show a significant level of differences in the personality interaction parameters have established relationships among

variables. Countries belonging to cluster I have potentially low scores in all personality interaction perspectives whereas almost all personality interaction parameters of personality traits contribute significantly in developing business in the countries belonging to cluster II having potentially high scores in all personality interaction perspectives. The result explains the contributions of personality parameters along with the best possible institutional variable to develop entrepreneurship.

The result depicts a significant level of differences in the different segments of the study. In developed countries with high attitudinal perspectives, technology and quality of human resource has shown an insignificant relationship, but in developed countries with low attitudinal dimension (class I), these two variables have played a very significant role in developing entrepreneurship. In the developing nations with high values of attitudinal dimensions (class I), opportunity perception, networking, technology, cultural support, and product innovation and quality of human resource are the major contributors in entrepreneurial development whereas in developing nations having high score in attitudinal perspectives (class III), opportunity perceptions, networking and risk capital, start-up skill, and quality of human resource have become dominating factors in entrepreneurial development. In the case of developing countries, high attitudinal dimension, networking, and start-up skill are the significant factors for entrepreneurship. The results indicate a significant level of differences in the contributing factors for entrepreneurial development across the segments.

During recent years, several researches have been done for the SME development of a country. To develop a country in terms of its SME development, it is essential to formulate an effective policy framework. For this, it is essential to visualize the overall situation in a comparison mode. Benchmarking a similar country can lead towards effective policy formulation considering other constraints. In the last part of the present study, the efficiency score for each country in terms of interaction variable has been developed. This score not only makes a country fit in a position of total entrepreneurship development but also with the help of benchmarking technique, the particular country can choose another efficient country to follow. This is also very much effective in the time of policymaking. In this research, three outputs have been taken to capture the overall entrepreneurial situation and in case of input only relevant variables have been taken into consideration. Tables 5, 6, 7, and 8 shows the efficiency score of each country within the same class. The class is made considering the level of development and intensity of variables. In the abovementioned tables, some countries emerged as super-efficient, efficient, and inefficient according to our analysis.

To interpret the findings in more detail, let us take India, which falls under class III, which means a developing country with low mean values of all perceptual interaction parameters. India's efficiency score (VRS) is 30.74% which strongly identified this country as an inefficient country in terms of SME development. The VRS score (30.74) is better than the CRS score (22.86) due to the scale inefficiency. To find out the best-performing countries, we use super-efficiency scores.

In class III, seven countries emerged as super-efficient which are Ethiopia, Ghana, Uganda, Zambia, Pakistan, Indonesia, Thailand, and Vietnam. Along with these, five more countries can be termed as efficient countries like Barbados, Malawi, Libya, Indonesia, and Burkina Faso.

Table 5 Country-wise efficiency score of class I countries

	DMU	Score	Benchmarks	Score	Benchmarks
Class I	41.00	0.50	7 (0.27), 18 (0.73)	0.46	18 (0.86)
	42.00	0.48	7 (0.25), 17 (0.27), 18 (0.48)	0.44	17 (0.44), 18 (0.39)
	43.00	0.46	7 (0.24), 17 (0.27), 18 (0.49)	0.42	17 (0.44), 18 (0.39)
	44.00	0.45	7 (0.12), 17 (0.13), 18 (0.75)	0.41	8 (0.02), 13 (0.30), 18 (0.46)
	45.00	0.64	8 (0.03), 13 (0.40, 17 (0.20), 18 (0.37)	0.64	13 (0.48), 17 (0.15), 18 (0.38)
	46.00	0.30	7 (0.00), 17 (0.16), 18 (0.83)	0.30	8 (0.28), 18 (0.42)
	47.00	1.37	8.00	0.82	17 (0.20), 18 (0.28), 19 (0.08)
	48.00	Big	1.00	1.02	3.00
	49.00	Big	0.00	0.45	18 (1.50)
	51.00	0.88	12 (0.62), 13 (0.09), 18 (0.29)	0.80	13 (0.28), 18 (0.95)
	52.00	0.80	12 (0.39), 13 (0.12), 18 (0.49)	0.75	13 (0.24), 18 (0.90)
	53.00	1.20	2.00	0.88	13 (0.31), 18 (1.06)
	54.00	1.08	3.00	1.06	7.00
	55.00	0.44	7 (0.22), 17 (0.02), 18 (0.54), 19 (0.23)	0.42	13 (0.02), 18 (0.56), 19 (0.33)
	56.00	0.46	7 (0.42), 18 (0.58)	0.40	17 (0.04), 18 (0.73)
	58.00	Big	0.00	0.48	17 (0.22), 18 (0.98), 19 (0.03)
	60.00	1.07	6.00	1.07	6.00
	64.00	4.15	11.00	4.15	16.00
	74.00	1.05	1.00	1.02	3.00
	89.00	0.76	7 (0.39), 18 (0.61)	0.48	13 (0.14), 18 (0.38)
	95.00	1.17	0.00	0.84	8 (0.18), 18 (1.64)

Table 6 Country-wise efficiency score of class II countries

	DMU	Score	Benchmarks	Score	Benchmarks
Class II	30	3.3395	2	1.6676	1
	37.00	1.21	2.00	1.02	0.00
	38.00	1.53	2.00	0.59	17 (0.37)
	39.00	0.90	1 (0.73), 2 (0.09), 3 (0.01), 5 (0.02), 9 (0.15)	0.55	1 (0.13), 15 (0.13), 17 (0.21)
	41.00	1.25	1.00	0.79	15 (0.37), 17 (0.07)
	42.00	1.07	0.00	0.53	14 (0.02), 16 (0.04), 17 (0.30)
	43.00	1.19	0.00	0.54	15 (0.07), 17 (0.26)
	46.00	1.39	0.00	1.31	1.00
	50.00	1.26	2.00	1.15	1.00
	57.00	1.00	0.00	0.85	14 (0.28), 17 (0.30)
	58.00	1.05	0.00	0.92	9 (0.11), 15 (0.50), 17 (0.03)
	62.00	1.64	0.00	0.90	15 (0.49), 17 (0.05)
	64.00	0.95	1 (0.21), 2 (0.41), 3 (0.22), 9 (0.09), 15 (0.04), 17 (0.04)	0.70	8 (0.09), 14 (0.07), 15 (0.20)
	66.00	1.09	0.00	1.09	3.00
	77.00	1.19	1.00	1.18	6.00
	84.00	2.93	0.00	2.78	2.00
	85.00	Big	1.00	1.47	9.00

Table 7 Country-wise efficiency score of class III countries

	DMU	Score	Benchmarks	Score	Benchmarks
Class III	1.00	0.22	20 (0.10), 21 (0.03), 22 (0.46), 26 (0.22), 40 (0.19)	0.21	20 (0.14), 21 (0.12), 22 (0.59)
	2.00	1.18	17.00	1.12	20.00
	3.00	0.62	20 (0.48), 21 (0.35), 42 (0.17)	0.46	20 (0.52), 21 (0.58)
	4.00	0.24	20 (0.25), 22 (0.10), 27 (0.06), 44 (0.59), 52 (0.01)	0.20	20 (0.33), 21 (0.01), 22 (0.92)
	5.00	0.22	20 (0.13), 21 (0.09), 22 (0.38), 44 (0.40)	0.20	20 (0.17), 21 (0.11), 22 (0.85)
	6.00	0.37	20 (0.14), 22 (0.38), 26 (0.48)	0.33	20 (0.27), 21 (0.06)
	7.00	0.92	20 (0.10), 27 (0.07), 52 (0.83)	0.51	20 (0.01), 21 (0.16), 22 (1.50)
	8.00	0.34	2 (0.01), 20 (0.06), 22 (0.93)	0.26	2 (0.01), 20 (0.13), 22 (0.59)
	9.00	0.24	21 (0.19), 22 (0.57), 26 (0.21), 40 (0.02)	0.23	20 (0.00), 21 (0.22), 22 (0.68)
	10.00	0.28	2 (0.05), 20 (0.38), 22 (0.57)	0.27	2 (0.05), 20 (0.40), 22 (0.50)
	11.00	0.32	22 (0.38), 27 (0.05), 44 (0.29), 52 (0.28)	0.28	21 (0.06), 22 (0.89), 52 (0.22)
	12.00	0.80	2 (0.20), 20 (0.47), 22 (0.33)	0.80	2 (0.20), 20 (0.47), 22 (0.32)
	13.00	0.22	20 (0.09), 21 (0.01), 22 (0.59), 26 (0.31), 40 (0.01)	0.19	20 (0.18), 21 (0.05), 22 (0.59)
	14.00	0.59	20 (0.24), 21 (0.53), 22 (0.10), 40 (0.13)	0.25	20 (0.16), 21 (0.24)
	15.00	0.34	22 (1.00)	0.17	2 (0.00), 20 (0.14), 22 (0.30)
	16.00	0.26	2 (0.05), 20 (0.10), 22 (0.85)	0.17	2 (0.04), 20 (0.21), 22 (0.39)
	18.00	0.34	22 (1.00)	0.13	2 (0.05), 20 (0.12), 22 (0.18)
	19.00	0.35	21 (0.10), 22 (0.90)	0.29	20 (0.05), 21 (0.07), 22 (0.70)
	20.00	0.78	27 (0.09), 44 (0.91)	0.43	20 (0.49), 22 (1.11)
	21.00	Big	28.00	Big	44.00
	22.00	Big	11.00	2.35	20.00
	23.00	13.23	40.00	9.41	41.00
	24.00	0.85	22 (1.00)	0.68	2 (0.01), 20 (0.02), 22 (0.77)
	25.00	0.53	20 (0.32), 21 (0.03), 22 (0.06), 27 (0.26), 52 (0.32)	0.39	20 (0.26), 21 (0.10), 22 (1.06)
	26.00	0.28	21 (0.04), 22 (0.80), 26 (0.16)	0.13	20 (0.16), 21 (0.02), 22 (0.27)
	27.00	Big	8.00	1.53	0.00
	28.00	Big	9.00	0.67	22 (1.77)
	29.00	0.30	2 (0.02), 20 (0.60), 22 (0.38)	0.24	2 (0.00), 20 (0.67), 22 (0.09)
	31.00	0.77	2 (0.41), 20 (0.04), 22 (0.56)	0.42	2 (0.06), 20 (0.40)
	32.00	0.24	2 (0.02), 20 (0.56), 22 (0.41)	0.18	20 (0.67)
	33.00	Big	0.00	2.67	0.00
	36.00	Big	0.00	0.44	20 (0.98), 22 (0.17)
	40.00	0.27	2 (0.16), 20 (0.31), 22 (0.53)	0.25	2 (0.14), 20 (0.36), 22 (0.38)
	59.00	0.52	22 (1.00)	0.24	2 (0.04), 20 (0.11), 22 (0.29)
	61.00	0.46	2 (0.18), 22 (0.82)	0.21	2 (0.08), 20 (0.23), 22 (0.09)
	63.00	0.33	2 (0.12), 20 (0.47), 22 (0.42)	0.24	20 (0.64)
	65.00	0.31	2 (0.09), 20 (0.05), 22 (0.86)	0.22	2 (0.06), 20 (0.16), 22 (0.45)
	67.00	0.85	20 (0.21), 21 (0.48), 22 (0.21), 26 (0.10)	0.85	20 (0.24), 21 (0.49), 22 (0.24)
	68.00	0.29	2 (0.04), 20 (0.17), 22 (0.79)	0.20	2 (0.03), 20 (0.28), 22 (0.33)
	69.00	1.37	4.00	0.70	20 (0.01), 21 (0.19), 22 (0.30)
	70.00	0.31	2 (0.03), 20 (0.45), 22 (0.52)	0.23	2 (0.02), 20 (0.54), 22 (0.13)
	71.00	1.26	1.00	0.45	20 (0.95), 21 (0.14)
	73.00	0.22	2 (0.04), 20 (0.01), 22 (0.95)	0.17	2 (0.04), 20 (0.09), 22 (0.59)
	75.00	1.45	6.00	0.84	20 (0.13), 21 (0.03), 22 (1.19)

Table 7 Country-wise efficiency score of class III countries *(Continued)*

	DMU	Score	Benchmarks	Score	Benchmarks
	76.00	0.76	22 (0.07), 27 (0.34), 44 (0.56), 52 (0.04)	0.47	22 (1.39), 52 (0.03)
	78.00	0.32	2 (0.11), 20 (0.32), 22 (0.57)	0.26	2 (0.08), 20 (0.40), 22 (0.30)
	80.00	Big	0.00	0.71	20 (1.16), 22 (0.13)
	81.00	0.57	22 (0.18), 27 (0.13), 44 (0.21), 52 (0.49)	0.47	21 (0.03), 22 (0.98), 52 (0.30)
	82.00	0.25	2 (0.09), 20 (0.06), 22 (0.86)	0.18	2 (0.07), 20 (0.16), 22 (0.45)
	83.00	0.41	2 (0.02), 20 (0.13), 22 (0.84)	0.17	20 (0.33)
	86.00	0.57	21 (0.24), 22 (0.19), 26 (0.57)	0.24	20 (0.22), 21 (0.13)
	87.00	Big	7.00	1.10	4.00
	88.00	0.29	20 (0.38), 22 (0.48), 26 (0.14), 27 (0.00)	0.29	20 (0.40), 22 (0.65)
	90.00	0.29	20 (0.13), 22 (0.87)	0.11	2 (0.00), 20 (0.06), 22 (0.30)
	92.00	0.24	22 (1.00)	0.07	2 (0.01), 20 (0.01), 22 (0.28)
	94.00	0.76	22 (0.57), 27 (0.05), 52 (0.38)	0.70	21 (0.14), 22 (0.81), 52 (0.23)

Reference sets suggest an efficient country which acts as a role model for inefficient countries. For India, reference countries are found as Barbados, Botswana, and Ghana. However, the final decision of country to follow requires further sociological and geographical analysis. Only Asian countries are considered from this point of view to decide more suitable benchmark country for India.

According to the reference sets given in the Table 9, the most referenced countries are also Barbados, Botswana, and Ghana, but we consider Thailand, as it is Asian countries and they have more similar type of values, culture, and practices than other recommended countries. So, it can be concluded that within the same class, countries have more or less the same level of input but different level of output that determine efficiency. The varying output depends on the ability of a country to utilize its resources. This type of ability represents the entrepreneurial motive of a country that is also free from cultural bottleneck.

There are some countries with an inconsistent classification which indicate the fluctuating nature of entrepreneurial development. That means there are some countries which cannot be categorized as developed or developing countries in this research. In a certain year, a certain country is categorized as a developing country and next year it falls under developed country. As this research considers a 5-year data, this transformation has occurred for some countries within this 5-year span of time. For this reason,

Table 8 Country-wise efficiency score of class IV countries

	DMU	Score	Benchmarks	Score	Benchmarks
Class IV	4.00	Big	2.00	1.07	0.00
	17.00	0.71	4 (0.79), 7 (0.21)	0.64	4 (0.71), 7 (0.19)
	31.00	0.70	4 (0.84), 7 (0.16)	0.47	4 (0.57), 7 (0.11)
	34.00	1.99	5.00	1.97	6.00
	35.00	0.69	1 (0.02), 4 (0.78), 7 (0.21)	0.69	4 (0.82), 7 (0.20)
	72.00	Big	0.00	0.67	4 (1.16)
	79.00	2.00	5.00	1.93	5.00
	91.00	0.98	1 (0.04), 4 (0.30), 7 (0.66)	0.97	4 (0.42), 7 (0.64)
	93.00	0.85	4 (0.56), 7 (0.44)	0.84	4 (0.55), 7 (0.44)

Table 9 Country code

Argentina	Barbados	Brazil	Chile	Colombia	Costa Rica	Ecuador	El Salvador	Mexico	Panama
1	2	3	4	5	6	7	8	9	10
Peru	Trinidad and Tobago	Uruguay	Algeria	Egypt	Iran	Israel	Tunisia	Angola	Botswana
11	12	13	14	15	16	17	18	19	20
Ethiopia	Ghana	Malawi	Namibia	Nigeria	South Africa	Uganda	Zambia	China	Japan
21	22	23	24	25	26	27	28	29	30
Korea	Malaysia	Pakistan	Singapore	Taiwan	Thailand	Austria	Belgium	Denmark	Estonia
31	32	33	34	35	36	37	38	39	40
Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Netherlands
41	42	43	44	45	46	47	48	49	50
Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	The UK	Bosnia and Herzegovina	Croatia
51	52	53	54	55	56	57	58	59	60
Macedonia	Norway	Russia	Switzerland	Turkey	The USA	Guatemala	Jamaica	Libya	India
61	62	63	64	65	66	67	68	69	70
Indonesia	Korea	Philippines	Czech Republic	Burkina Faso	Cameroon	Australia	Kazakhstan	Qatar	Vietnam
71	72	73	74	75	76	77	78	79	80
Bolivia	Puerto Rico	Suriname	Luxembourg	Canada	Morocco	Senegal	Lebanon	Bulgaria	Georgia
81	82	83	84	85	86	87	88	89	90
Hong Kong	Jordan	United Arab Emirates	Belize	Cyprus					
91	92	93	94	95					

Table 10 Evaluation table

Pillar	Required increase in pillar	Percentage of total new effort (%)
Startup skills	0.12	14
Networking	0.19	19
Cultural support	0.10	11
Technology absorption	0.25	28
Human capital	0.05	6
High growth	0.08	9
Risk capital	0.11	13

some of the countries fall under two different classes. DEA considers each country as a separate DMU within the same class, and for this reason, the total number of DMU is 103 which is more than the total number of countries, i.e., 94. This analysis validates DEA as a positioning tool and it reveals the true picture of the entrepreneurial efficiency of a country.

Policy implications

Based on the result of this research, every country that is operating at sub-optimal scale holds the benchmark relationship with an efficient country, operating at an optimal scale. It can be suggested to macroeconomic policymakers of inefficient countries to focus on the benchmark countries at the time of policy formulation. It can be concluded that following a country on the basis of the development of entrepreneurship should not be seen as a scientific solution. In the case of India, Thailand emerged as a benchmark country, considering sociological and geographical similarities. So, India should follow Thailand to increase its entrepreneurial efficiency. Now, it must be decided which area should be spotlighted. This part is well tackled by GEDI. They provide a comprehensive analysis of a country with its benchmark country and provide the percentage of total new effort, and the score indicates the degree of concern of the particular subparameter (Table 10).

In GEDIs' data explorer section (https://thegedi.org/tool/), when India is evaluated with Thailand with the motive of optimal resource allocation, the following result emerges:

- Technology absorption needs the most concern and required to give maximum new effort.
- The second priority area is networking.
- Other vital areas of concern are start-up skill, risk capital, cultural support, and high growth.

Future scope of the study

An extension of this study can be used for an in-depth analysis of the policy related to MSME. Comparing inefficient countries with efficient ones most of the time leads towards betterment. Now, the question is how to compare, with whom to compare, and what to compare. The present research provides the guideline of comparison and points out the more specific area of focus. An in-depth analysis of the policies of this area of a country with the benchmarked country can guide policymakers to think scientifically at the time of policymaking.

Abbreviations
DEA: Data envelopment analysis; DMU: Decision-making units; GEDI: Global Entrepreneurship Development Institute; GEM: Global Entrepreneurship Monitor; MSME: Micro-Small-Medium Enterprises

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Authors' contributions
SD and AK were the major contributors in writing the manuscript. The corresponding author, SD, presented the main idea and worked on the literature, data collection, and analysis of this study. AK worked on the findings, discussion, and conclusion of this study. All authors reviewed the manuscript. Both authors read and approved the final manuscript.

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