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GRADUATION THESIS

HOW DOES COMPETITIVENESS INDEX PROMOTE FOREIGN DIRECT INVESTMENT AT THE PROVINCIAL LEVEL IN VIETNAM? A NON-PARAMETRIC APPROACH

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Introduction

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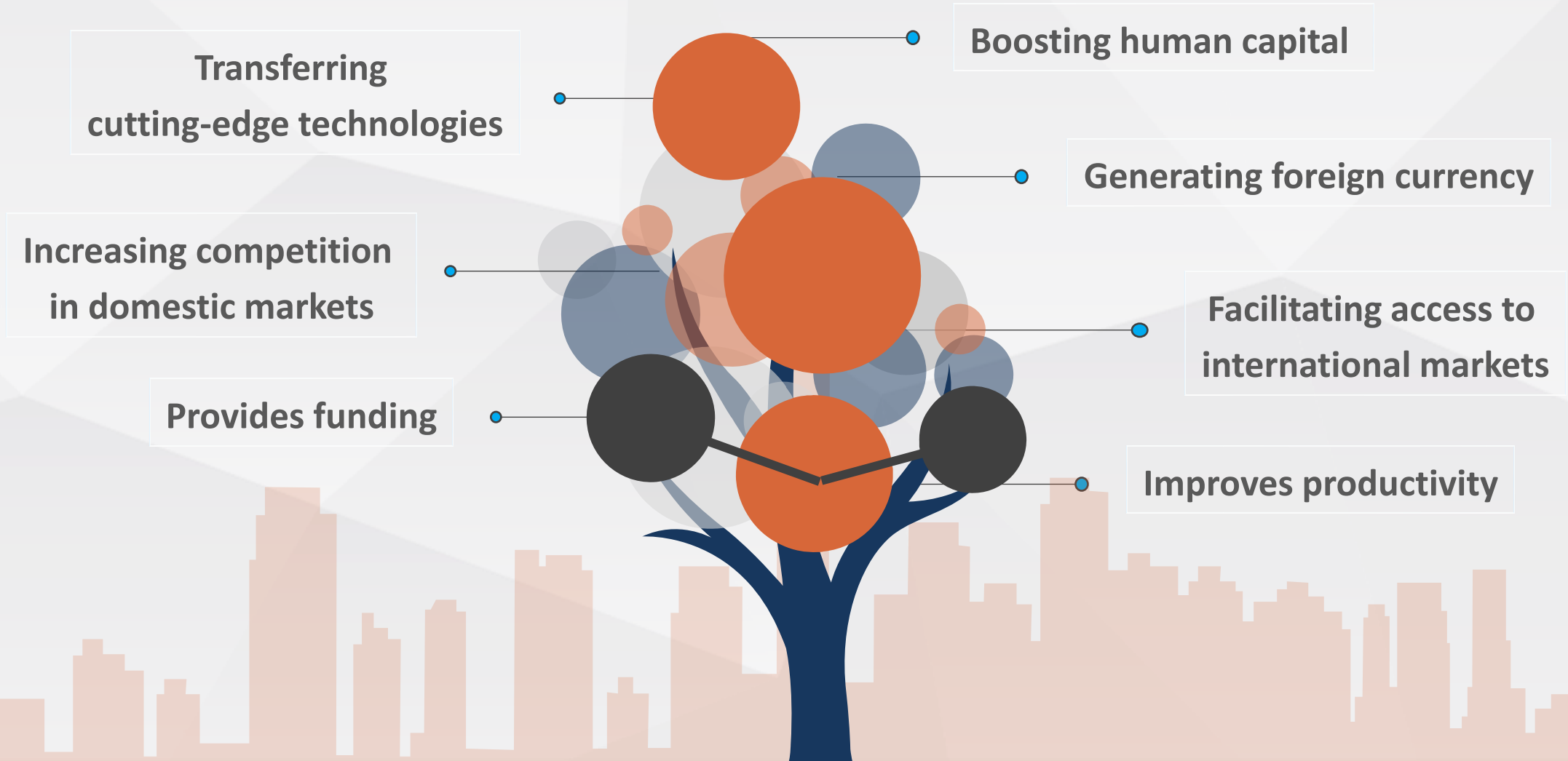
1.1. Topic Background

❖ Importance of FDI Attractiveness

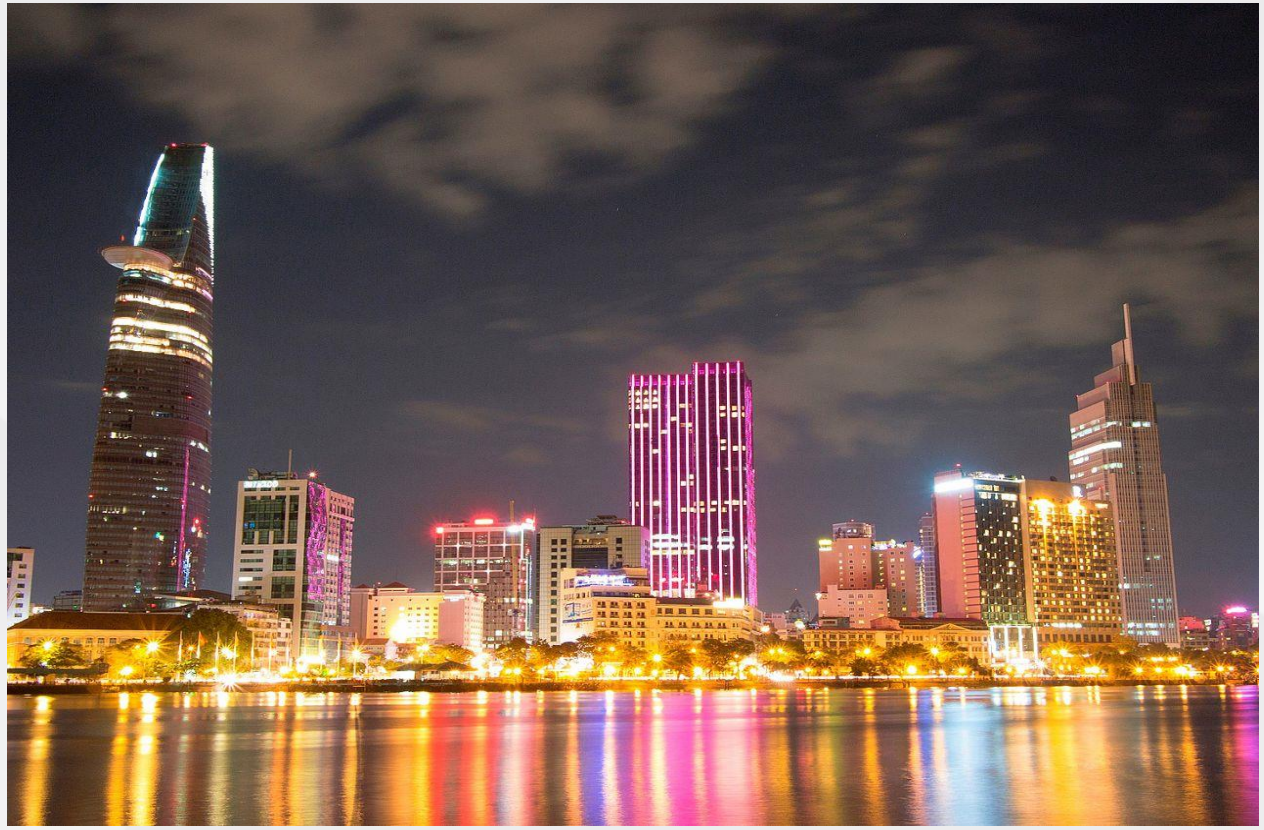


1.1. Topic Background

❖ Vietnam's favorable attributes in attracting FDI

In 1986, Vietnam initiated a set of reforms called “Doi Moi”

Paved the way for a sustained and significant inflow of FDI into Vietnam



1.1. Topic Background

❖ Vietnam's favorable attributes in attracting FDI

A stable environment
A dynamic economy
A rapid consumption market

Comprehensive and Progressive Agreement for Trans-Pacific Partnership

The EVFTA Agreement

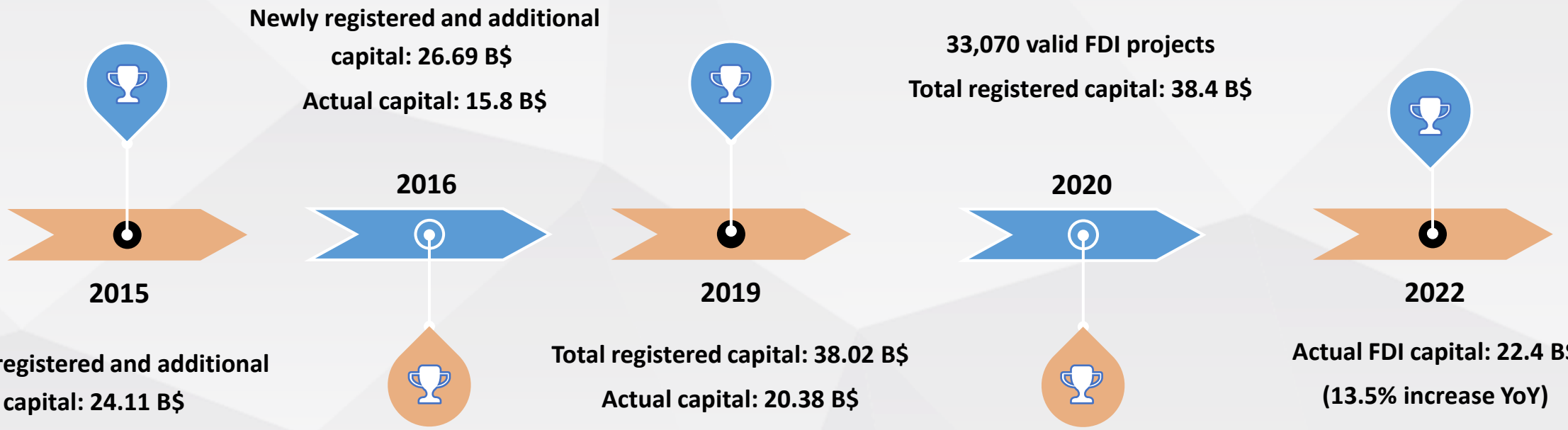
Lengthy coastline
Deep-water seaports

Administrative procedures
Investment incentives

Youthful labor force
Abundant population

1.1. Topic Background

❖ Achievements Of Vietnam In Recent Years



1.1. Topic Background

❖ **Practical Problem**

Investors' choosing mergers and acquisitions (M&A) rather than greenfield investments

Severely unequal distribution of FDI among provinces

Table 1.1. Foreign investment in Vietnam by Provinces (Accumulated until 2022)

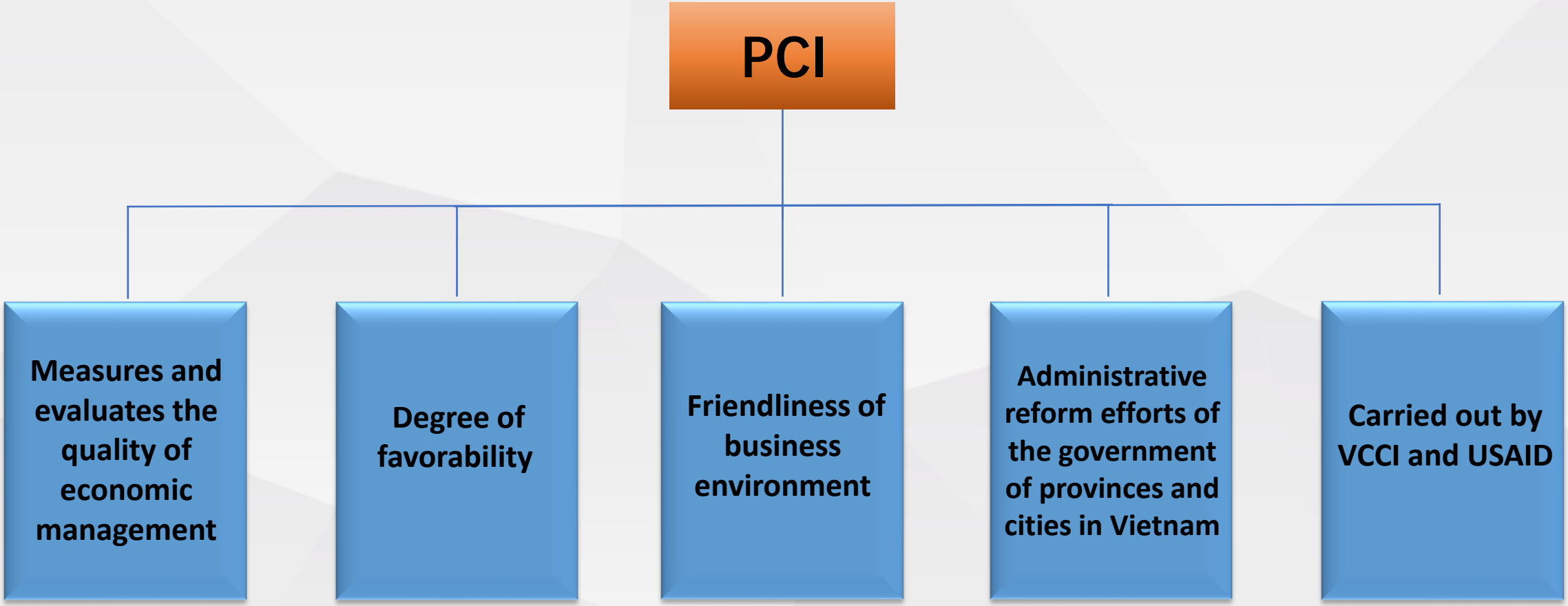
No	Provinces	FDI by cases	FDI by capital (Million USD)
1	Ho Chi Minh City	11,272	55,828.96
2	Binh Duong	4,074	39,633.40
3	Ha Noi	7,019	38,743.15
4	Dong Nai	1,818	34,992.05
5	Ba Ria Vung Tau	533	33,304.09
6	Hai Phong	982	25,274.13
7	Bac Ninh	1,819	23,170.76
8	Thanh Hoa	174	14,798.91
9	Long An	1,293	12,912.83
10	Ha Tinh	80	12,014.24
11	Thai Nguyen	197	10,448.39
12	Quang Ninh	159	10,172.66
13	Bac Giang	595	9,382.47
14	Tay Ninh	363	9,155.05
15	Hai Duong	507	9,148.14
16	Vinh Phuc	502	6,742.20
17	Hung Yen	533	6,620.40
18	Quang Nam	224	6,336.69
19	Da Nang	927	6,138.81
20	Ha Nam	374	5,327.52
21	Kien Giang	63	4,810.15
22	Bac Lieu	15	4,490.06
23	Khanh Hoa	119	4,395.09
24	Thua Thien Hue	130	4,239.03
25	Binh Phuoc	413	3,971.80
26	Binh Thuan	158	3,838.76
27	Nam Định	130	3,713.29
28	Tra Vinh	38	3,188.03
29	Phu Tho	217	3,099.49
30	Tien Giang	138	2,799.66
31	Quảng Trị	25	2,523.91
32	Nghe An	125	2,481.57

No	Provinces	FDI by cases	FDI by capital (Million USD)
33	Can Tho	86	2,222.86
34	Quang Ngai	63	2,124.71
35	Phu Yen	51	2,034.81
36	Ninh Thuan	56	1,735.14
37	Thai Binh	112	1,664.43
38	Ninh Binh	94	1,602.84
39	Ben Tre	65	1,585.02
40	Binh Dinh	99	1,203.46
41	Quang Binh	24	1,116.28
42	Vinh Long	71	1,007.16
43	Hoa Binh	51	720.14
44	Hau Giang	30	686.09
45	Dak Lak	27	642.12
46	Lao Cai	32	582.63
47	Lam Dong	102	514.62
48	Yen Bai	35	456.85
49	Soc Trang	16	340.61
50	An Giang	31	317.31
51	Dak Nong	20	311.87
52	Kon Tum	9	245.36
53	Lang Son	42	240.36
54	Dong Thap	21	231.58
55	Tuyen Quang	18	208.82
56	Ca Mau	11	157.83
57	Son La	10	135.73
58	Gia Lai	8	92.09
59	Cao Bang	16	30.63
60	Bac Kan	4	7.9
61	Ha Giang	6	4.15
62	Dien Bien	1	3
63	Lai Chau	1	1.5
Total		**36,278**	**438692.29**

The unequal distribution of FDI across industries, sectors, and regions can negatively impact the country's overall economic sustainability.

1.1. Topic Background

❖ Provincial Competitiveness Index (PCI) in Vietnam



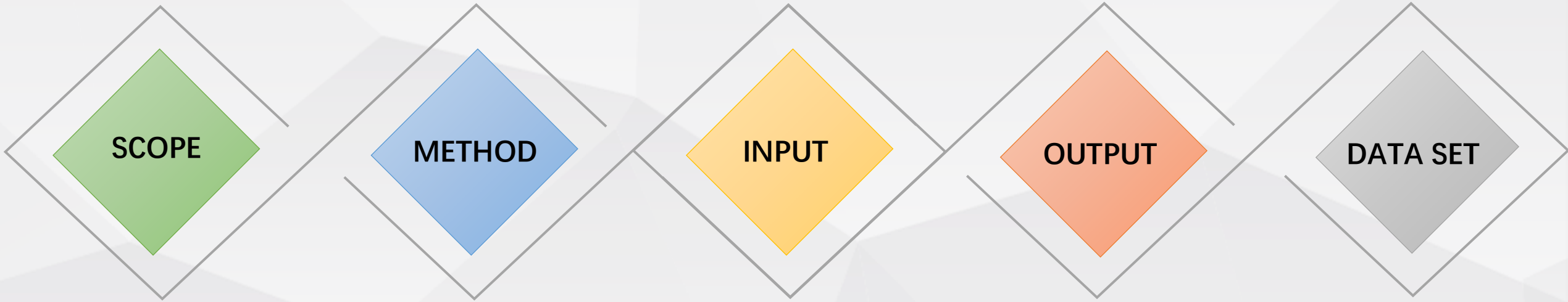
1.2. Research Questions and Objectives

1	Is the PCI an appropriate set of competitive indexes to assess the effectiveness of Vietnamese provinces in attracting FDI?	Grey Delphi	To formulate a set of Competitive Index to assess the effectiveness of Vietnamese provinces in attracting FDI
2	Are Vietnam's provinces effectively using resources to attract FDI?	DEA Super SBM	To analyze and evaluate Vietnam provinces' effectiveness in using resources to attract FDI.
3	Over the years, how has there been a change in optimizing the resources of Vietnamese provinces?	DEA Malmquist	To see the change in optimizing the resources of Vietnamese provinces over the years (2017-2021)

1.3. Methodology and Data Overview

Integrated method model:
- Grey Delphi
- DEA–Super SBM
- DEA–Malmquist

- FDI capital
- FDI by case



63 provinces in Vietnam from 2017-2021

10 Competitiveness Indexes

- General Statistics Office of Vietnam (GSO)
- Vietnam Chamber of Commerce and Industry (VCCI)

02
Literature Review

2.1. Literature Review on Competitiveness Index
2.2. Literature Review on Methods
2.3. Summary

2.1. Literature Review on Competitiveness Index

- ✓ Competitiveness is the "set of institutions, policies, and factors" that affect a country's productivity and determine its prosperity level (World Economic Forum, 2016)

- ✓ The World Bank developed the concept of Global Investment Competitiveness (GIC) to measure a country's ability to attract and retain FDI. (World Bank Group, 2020)

2.1. Literature Review on Competitiveness Index

16 potential inputs

- Entry costs
- Time Costs and Regulatory Compliance
- Labor training
- Innovation factor
- Land access and security
- Policy bias
- Legal institution
- Integration into global economy
- Transparency
- Proactivity of provincial leadership
- Education
- Socio-demographic
- Informal charges
- Business support service
- Financial market
- Urban-environmental

2.2. Literature Review on Methods: Delphi Method

The Delphi method (Olaf Helmer and Norman Dalkey, 1950s) is a forecasting technique that involves multiple rounds of questionnaires from a group of experts

Olaf (Ole) Helmer Tokheim

Norman Dalkey

2.2. Literature Review on Methods: Delphi Method

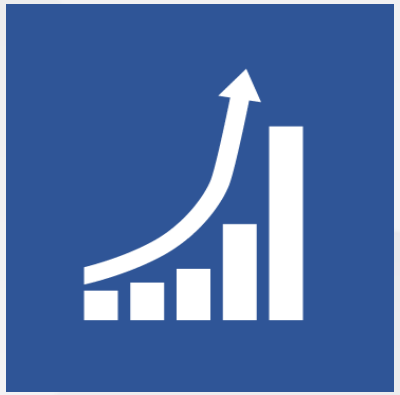
Strengths

- The method helps set preferences for accepting FDI.
- A platform for individual and collective judgments to determine subsequent actions for the topic.

Weaknesses

- The Delphi method requires experts to modify their opinions to match mean value of all expert opinions, resulting in a loss of individual expertise.
- The Delphi method does not consider the uncertainty and imprecision of data.

2.2. Literature Review on Methods: Grey Delphi Method

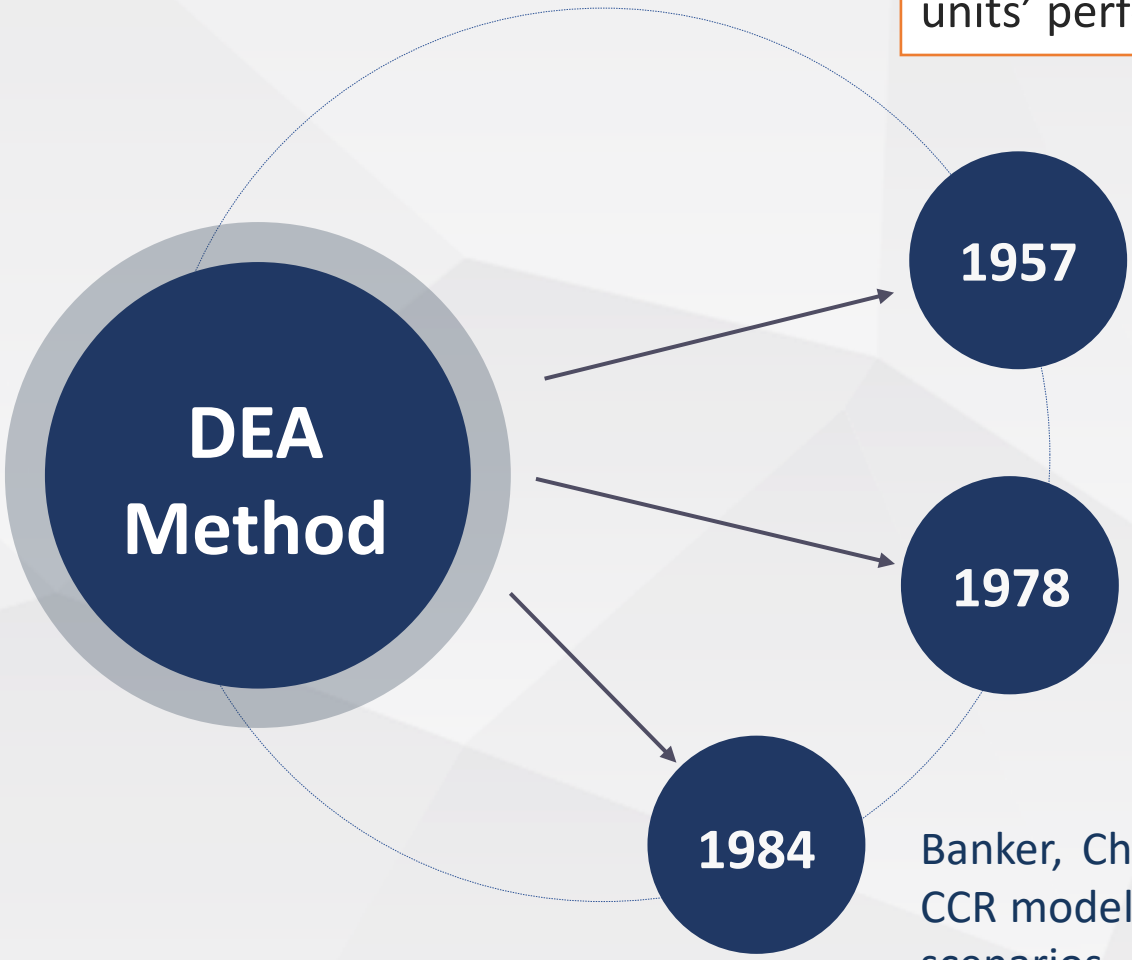


- Grey System Theory is a methodology that deals with data sets that are incomplete or have missing information.

- Grey System Theory is particularly useful when dealing with data sets that are limited in size or scope or when there are gaps in the data.

2.2. Literature Review on Methods: DEA Method

The DEA method is widely utilized for evaluating decision-making units' performance (DMUs)



DEA can be traced back to Farrell's

Input and output weighting are the main drawback of Farrell's efficiency. Charnes, Cooper, and Rhodes (CCR) addressed this issue and introduced an improved technique

Banker, Charnes, and Cooper (BCC) expanded upon the CCR model by determining variable returns to scale (VRS) scenarios, enabling a more thorough examination of DMU efficiency

Table 2.1. List of related studies

No.	Papers	Inputs	Outputs	Methods	Sample and Region
1	(Suyanto, Salim and Bloch, 2009)	Spillovers from FDI	Productivity growth	Generalized Malmquist	Indonesian chemical and pharmaceutical firms
2	(Lei et al., 2013)	Material capital Human Capital Energy degree of openness	FDI performance index FDI potential index	CCR model, Malmquist	Chinese provinces
3	(Thanh Tung, 2014)	Provincial Competitive Index (2012 version)	FDI and domestic investment	DEA Malmquist, bootstrapping	63 provinces of Vietnam
4	(Noyan Aydin, 2014)	Gross domestic product, population, and global competitiveness index	FDI	FDEA	12 transition economies for 2011
5	(Wang and Le, 2019)	FDI, exchange rate, CSR spending	Gross domestic product; GDP per capita	GM (1,1) model, DEA Malmquist, Super SBM	20 developing countries
6	(Zhang et al., 2019)	FDI	The efficiency of government expenditure on environmental protection	The output-oriented DEA scale return model	China
7	(Liu et al., 2022)	Land, capital, natural resources, labor	Air pollution, Water pollution, Solid Waste pollution, CO_2 Emissions, the added value of industrial output	Super SBM model	China
8	(Le and Dang, 2022)	Labor force, gross regional product, and the PCI	FDI by capital (cumulative) and FDI by cases (cumulative)	IFTS, SMA DEA window	42 of Vietnam's 63 provinces
9	(Starčević et al., 2022)	FDI, RER, Inflation rate	GDP, RER, employment rate, import, export, inflation rate	DEA, PCA, IMF SWARA method, CRADIS method	Bosnia, Herzegovina, and Serbia
10	(Polloni-Silva et al., 2022)	Population density, GDP per capita, industry share of GDP, service's share of GDP, education level, productivity, infrastructure	Intensity of FDI	Traditional panel data econometrics, DEA	All municipalities of the State of São Paulo, Brazil

2.2. Literature Review on Methods: Super SBM model

1. The Super-SBM model will be applied to investigate the slacks of inputs-outputs of this case study

2. Slack refers to the potential improvement in the input and output variables for the inefficiency units compared to the benchmark objective

3. In performance evaluation, the frontier is held constant for DMUs with efficiency value $\theta < 1$

4. Varies from the SBM model in that for a DMU with an efficiency value of $\theta = 1$

5. Can measure and compare the efficiency of DMUs by allowing a DMU's efficiency value to exceed 1

2.2. Literature Review on Methods: DEA Malmquist model

The Malmquist Index (MI) can evaluate the relative growth in productivity between two time periods (Färe, Grosskopf, and Roos, 1998).

Pontus Roos

Shawna Grosskopf

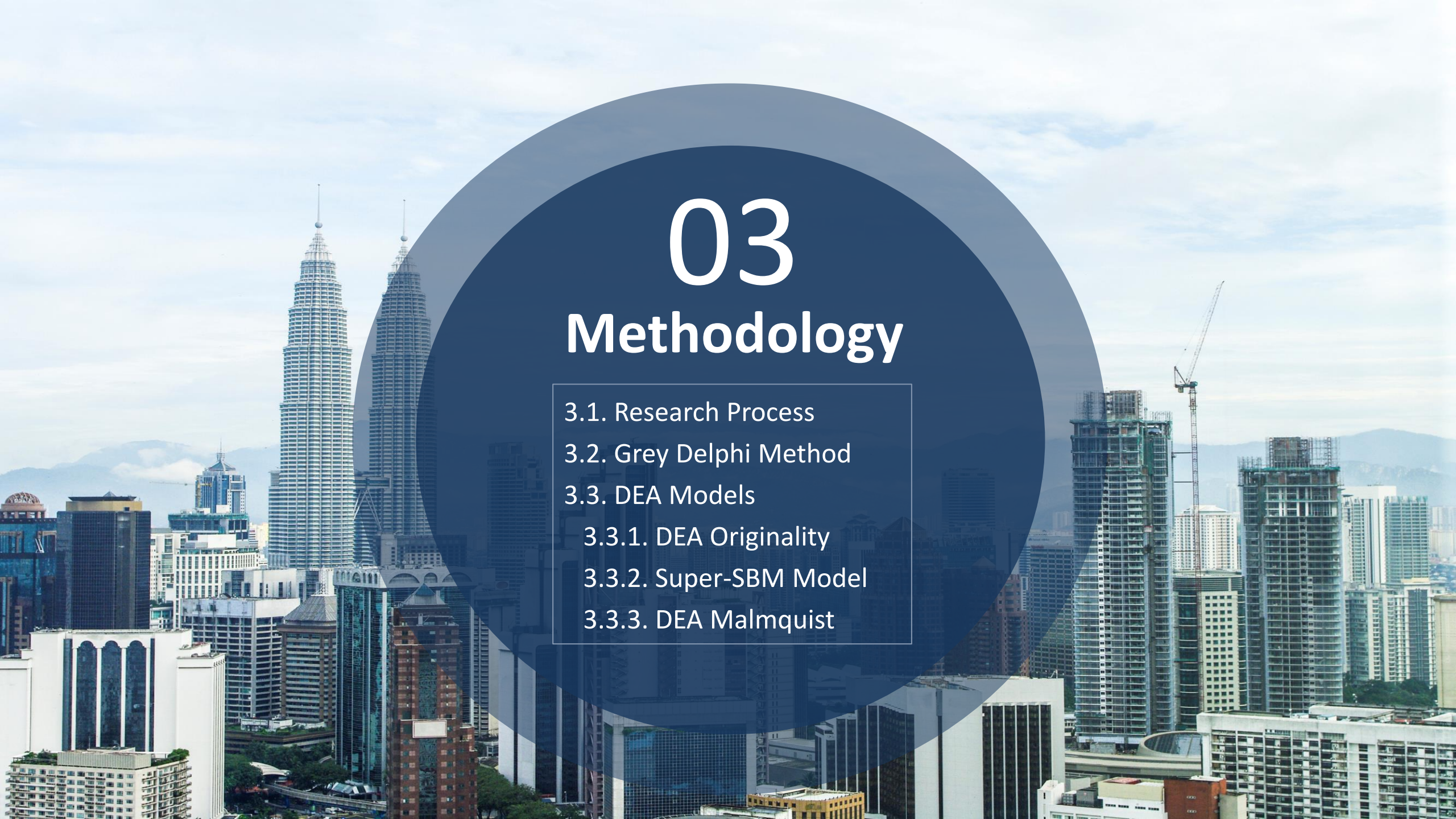
Rolf Färe

2.3. Summary

03 DEA Malmquist is utilized to calculate the efficiency changes for 2017–2021.

02 Super-SBM offers a detailed comparison and recommendation between inefficient and efficient DMUs based on scores, rankings, and slack indicators.

01 Input indicators that best match the characteristics of FDI evaluation will be well considered.



03
Methodology

3.1. Research Process

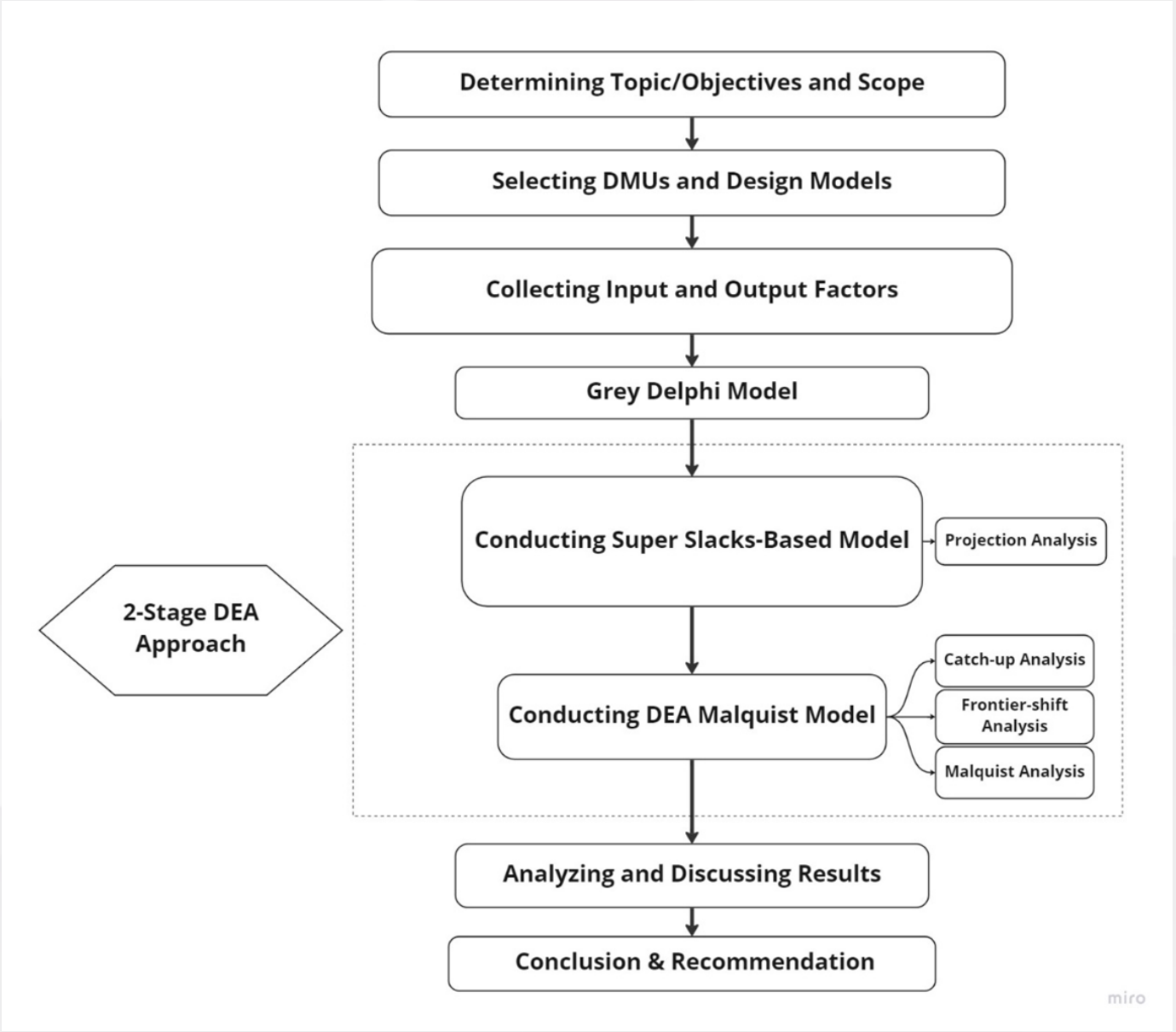


Figure 3.1. The research process

3.2. Grey Delphi Method

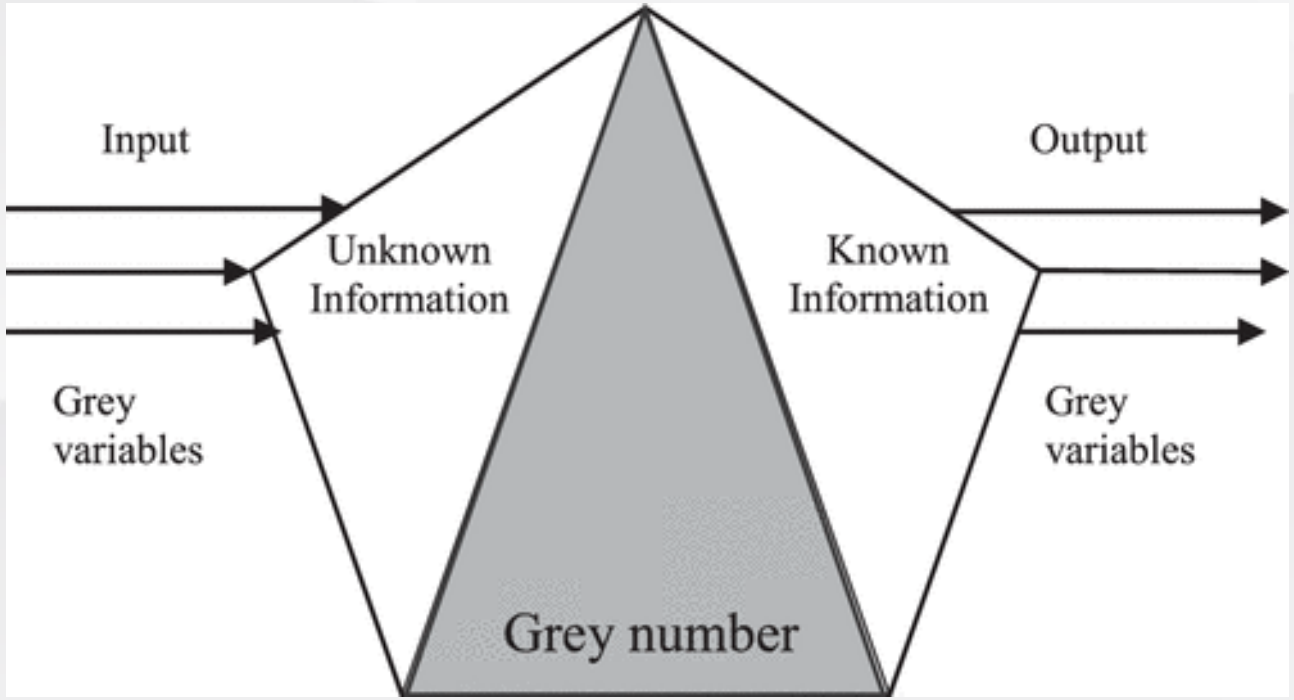
The Delphi method synthesize the opinion of experts on a particular issue to reach a consensus.

The conventional Delphi method has drawbacks:

- the need for multiple iterations to reach an agreement,
- subjectivity and bias among experts.

$\Rightarrow$ To deal with this uncertainty, this study employs the grey systems theory

The grey systems theory (Liu and Lin, 2006) categorizes information into fully known, grey, and unknown.



3.2. Grey Delphi Method

Step 1. Identification of competitive index factors (CIFs) of FDI

Step 2. Response collection from experts

Step 3. Overall evaluation using the grey number.

$$\otimes G_i = \frac{\left(G_i^1 + \otimes G_i^2 + \cdots + \otimes G_i^h + \cdots + \otimes G_i^p\right)}{p}$$

- where $\otimes G_i$ is the overall evaluation of CIF's importance and $\otimes G_i^h$ denotes the hth expert's evaluation of CIF$_i$ of FDI adoption.

Step 4. Whitening of the grey number

The grey number having the interval $\otimes G = [G^L, G^R] = [G' \in G \,|G^L \leq G' \leq G^R|]$ Moreover, their equivalent whitenization value is $\otimes G^{\sim}$. The whitenization of grey numbers is obtained through:

$$\otimes G^{\sim} = \alpha . G^L + (1 - \alpha) . G^R, \alpha = [0,1] \qquad (1.2)$$

Step 5. Setting threshold limit and CIFs selection

3.3
Data Envelopment Analysis Model
(DEA Model)

3.3.1. DEA Originality: Performance Evaluation and Tradeoffs

1. An essential aspect of any business operation.

   Identify areas for improvement and increase efficiency

2. Single-measure analysis is commonly used in performance evaluation.

3. Each business operation has specific performance measures or metrics, which may involve tradeoffs, interactions, or substitutions.

3.3.1. DEA Originality: Data Envelopment Analysis (DEA)

According to Cooper et al. (2011):

- DEA is a relatively new “data-oriented” approach for evaluating the performance of a set of peer entities called Decision Making Units (DMUs) which convert multiple inputs into multiple outputs.
- The definition of a DMU is generic and flexible.
- Recent years have seen a great variety of applications of DEA for use in evaluating the performances of many different contexts.
- Because it requires few assumptions, DEA has also opened possibilities for use in cases difficult to other methods because of the complex nature of the relations between the multiple inputs and outputs.

3.3.1. DEA Originality: An Example of DEA

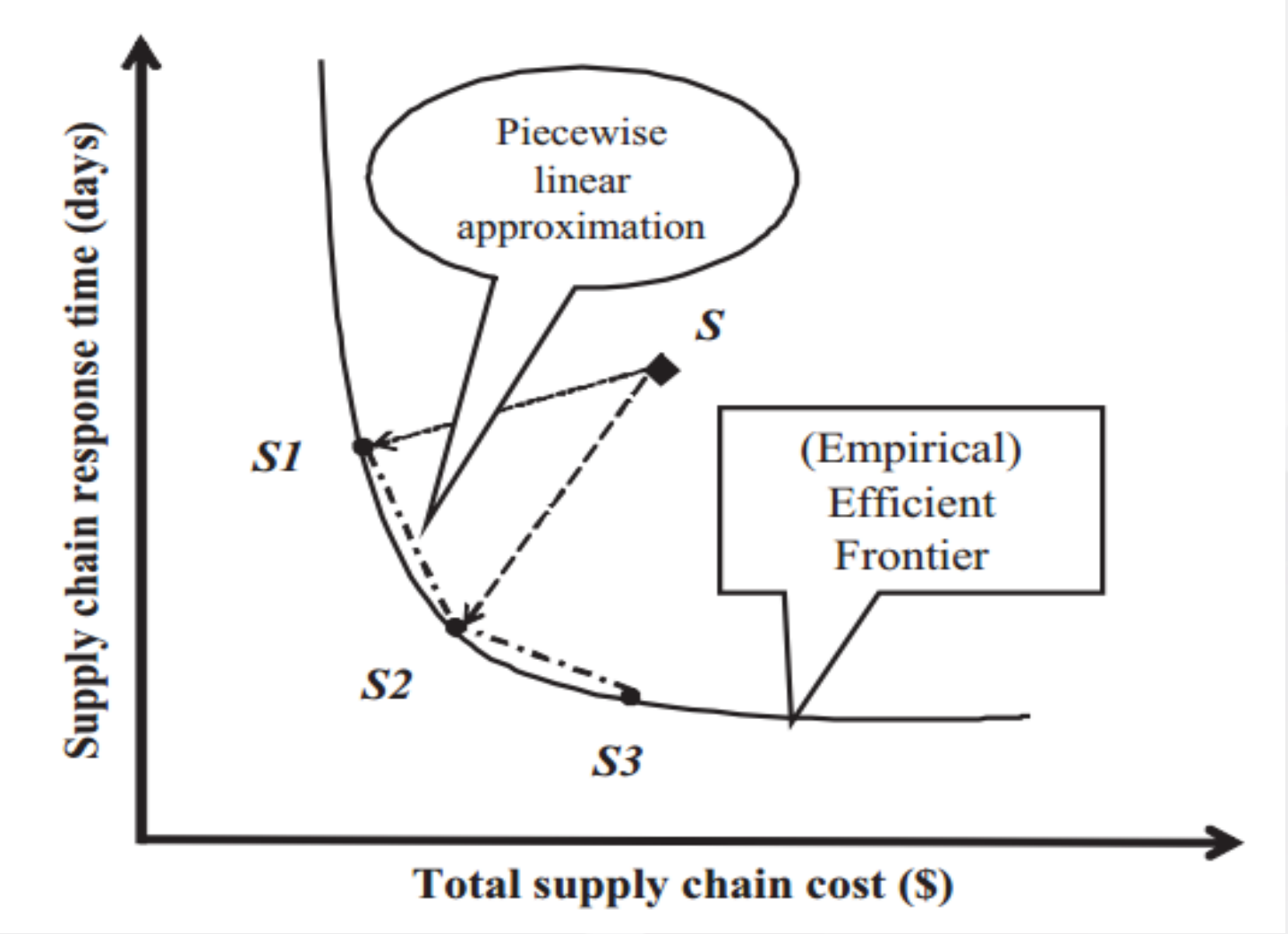


Figure 3.2. (Example) Best efficient frontier of supply chain operations

3.3.2. DEA Super-SBM Model

- The Super-SBM model calculates the efficiency of a DMU by comparing it to the nearest point on the frontier, excluding itself.
- The Super-SBM model was introduced by Tone (2001) to separate and rank these efficient DMUs. If $\rho*=1$, then the DMU (x_{k0},y_{k0}) is efficient, the Super-SBM model can be described as follows:

$$min\delta = \frac{\frac{1}{m}\sum_{i=1}^{m} \bar{x_i}/x_{ik}}{\frac{1}{g}\sum_{i=1}^{g} \bar{y_i}/y_{ik}}$$

Subject to:

- $\bar{x} \geq \sum_{j=1,j\neq k}^{n} \lambda_j \, x_j;$
- $\bar{y} \leq \sum_{j=1,j\neq k}^{n} \lambda_j \, y_j;$
- $\bar{x} \geq x_k, 0 \leq \bar{y} \leq y_k, \lambda \geq 0.$

3.3.3. DEA Malmquist

The change in total factor productivity from period *t* to period *t* + 1 is calculated as the following Equation (5):

$$MPI_t^{t+1} = \sqrt{\frac{\rho_0^t(x^{t+1}, y^{t+1})}{\rho_0^t(x^t, y^t)} \times \frac{\rho_0^{t+1}(x^{t+1}, y^{t+1})}{\rho_0^{t+1}(x^t, y^t)}}$$

- $MPI_t^{t+1} > 1$ indicates positive DMU performance growth,
- $MPI_t^{t+1} = 1$ indicates the performance has no change,
- $MPI_t^{t+1} < 1$ indicates negative growth.

The MPI index can be decomposed into the product of two components:

$$MPI(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{\rho_0^{t+1}(x^{t+1}, y^{t+1})}{\rho_0^t(x^t, y^t)} \sqrt{\frac{\rho_0^t(x^{t+1}, y^{t+1})}{\rho_0^{t+1}(x^t, y^t)} \times \frac{\rho_0^t(x^t, y^t)}{\rho_0^{t+1}(x^t, y^t)}}$$

= Catch-up (CU) × Frontier shift (FS)

04

Results and Discussion

4.1. Results of Grey Delphi

4.2. Data Collection

4.3. Efficiency Analysis

4.4. Malmquist Productivity Changes

4.5. Discussion

4.1. Results of Grey Delphi

Table A1. Table of experts

No	Gender	Age	Education	Position	Seniority
1	Male	Under 25	Bachelor	Scholar	Less than 5 years
2	Male	From 40 to 60 years old	Professor	Policy Maker	From 10 to 20 years
3	Female	From 25 to 40 years old	Master graduate	Scholar	From 5 to 10 years
4	Male	From 25 to 40 years old	Master graduate	Managers	From 5 to 10 years
5	Female	From 25 to 40 years old	Master graduate	Scholar	Less than 5 years
6	Male	From 25 to 40 years old	Doctor	Scholar	From 10 to 20 years
7	Female	From 25 to 40 years old	Master graduate	Policy Maker	From 5 to 10 years
8	Female	From 25 to 40 years old	Professor	Managers	From 5 to 10 years
9	Female	From 25 to 40 years old	Doctor	Policy Maker	From 10 to 20 years
10	Male	From 40 to 60 years old	Professor	Policy Maker	From 10 to 20 years
11	Female	Under 25	Master graduate	Managers	Less than 5 years

- There is no set standard for sample size of a panel but it is generally agreed that the more members will increase the reliability of judgments.
- Minimum number range from 10 - 18 per area of expertise (Okoli & Pawlowski, 2004).
- A small group of experts who are knowledgeable in the problem can still provide valuable insights and feedback.
- This can help to reduce the time and cost required for the analysis.

4.1. Results of Grey Delphi

Table 4.1. Linguistic scale and grey number

Linguistic Scale	Grey Number
No important (NI)	[0,0]
Low important (LI)	[0,1]
Medium important (MI)	[1,2]
High important (HI)	[2,3]
Very high important (VH)	[3,4]

Table 4.2. Results of the Grey Delphi method

CIFs	Overall Grey Weight		Crisp Weight	Decision	Decode
EC	2,3	3,3	2,8	Accept	CIF1
ED	0,8	1,6	1,2	Reject	
FIN	0,9	1,7	1,3	Reject	
LS	2,0	3,0	2,5	Accept	CIF2
TR	2,0	3,0	2,5	Accept	CIF3
IC	2,1	3,1	2,6	Accept	CIF4
GL	0,8	1,4	1,1	Reject	
LT	2,2	3,2	2,7	Accept	CIF5
PB	2,1	3,1	2,6	Accept	CIF6
IN	0,6	1,1	0,9	Reject	
PL	2,2	3,2	2,7	Accept	CIF7
SS	2,1	3,1	2,6	Accept	CIF8
UE	1,3	2,2	1,8	Reject	
LA	2,3	3,3	2,8	Accept	CIF9
SD	1,0	1,8	1,4	Reject	
LI	2,3	3,2	2,8	Accept	CIF10

4.2. Data Collection

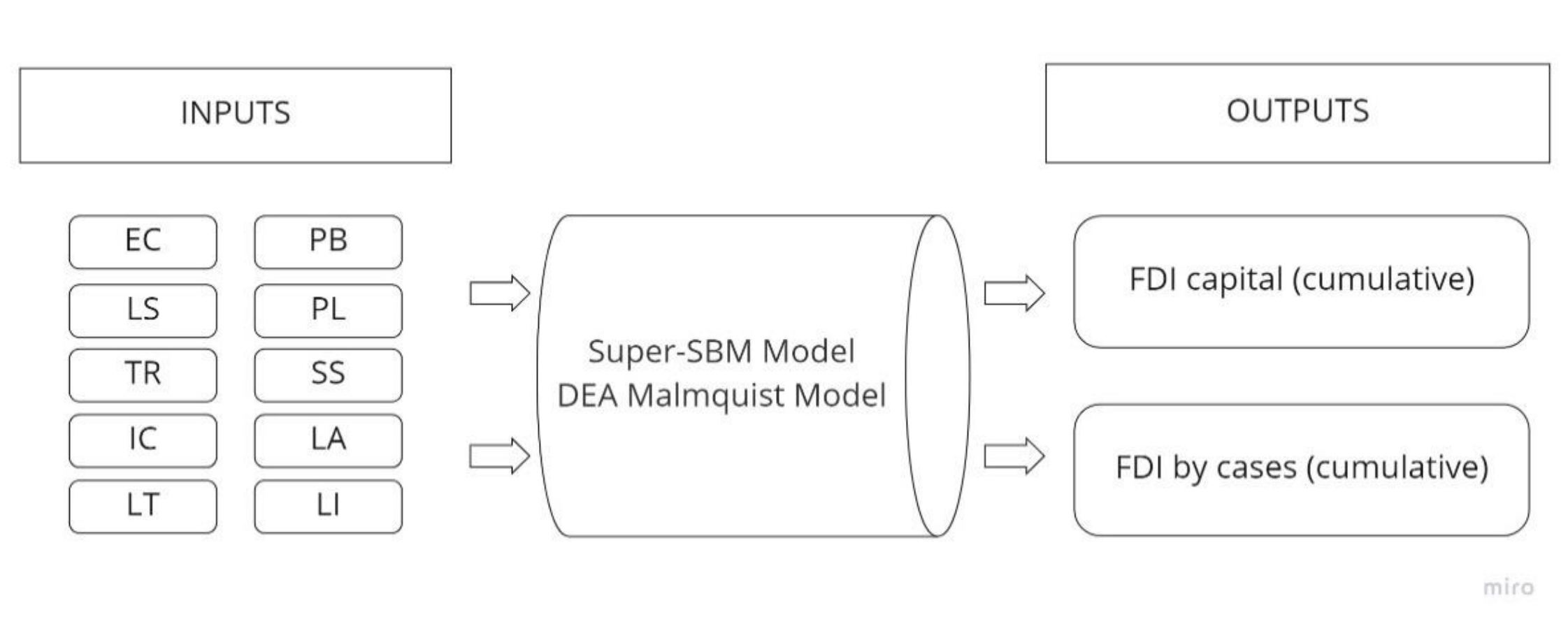


Figure 4.1. DEA structure for evaluation of FDI attractiveness in Vietnam

4.3. Efficiency Analysis

Table 4.3. FDI attractiveness efficiency scores and ranking of provinces (2017–2021).

Provinces	Efficiency Scores					Ranking				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
An Giang	0.0045	0.0044	0.0054	0.0055	0.0058	47	49	47	50	49
Bac Lieu	0.0016	0.0097	0.0115	0.0993	0.0967	58	45	43	21	21
Bac Giang	0.1003	0.1079	0.1259	0.1479	0.174	17	16	14	14	13
Bac Kan	0.0005	0.0005	0.0005	0.0004	0.0004	61	61	61	61	61
Bac Ninh	0.3662	0.3789	0.3581	0.401	0.4044	6	7	7	7	7
Ben Tre	0.018	0.021	0.0206	0.0308	0.0314	35	35	35	36	37
Binh Duong	0.6533	0.6742	0.703	0.6928	0.7224	3	3	2	3	3
Binh Dinh	0.015	0.0175	0.0161	0.0224	0.0228	37	37	37	38	40
Binh Phuoc	0.0495	0.0562	0.0614	0.0702	0.0799	29	27	27	27	24
Binh Thuan	0.0805	0.0763	0.0771	0.0805	0.079	23	23	24	24	25
Ba Ria Vung Tau	0.6118	0.6464	0.6426	0.6777	0.6363	5	4	5	4	5
Ca Mau	0.0017	0.0016	0.0031	0.0093	0.0032	57	58	54	46	56
Cao Bang	0.0043	0.0028	0.0021	0.0019	0.0019	49	55	57	58	58
Can Tho	0.0139	0.0147	0.0145	0.0151	0.0405	41	39	39	42	34
Da Nang	0.0945	0.1075	0.1089	0.1083	0.1127	21	17	17	19	19
Dak Lak	0.0044	0.0034	0.0033	0.0033	0.0124	48	52	51	53	44
Dak Nong	0.0025	0.0034	0.0032	0.0065	0.0064	54	51	52	48	48
Dien Bien	0.0001	0.0001	0.0001	0.0001	0.0001	63	62	63	63	63
Dong Nai	0.617	0.6259	0.6514	0.6686	0.6592	4	5	4	5	4
Dong Thap	0.0034	0.003	0.0031	0.0031	0.0043	52	54	53	54	54
Gia Lai	0.0007	0.0006	0.0007	0.0007	0.0007	60	60	60	59	59
Ha Giang	0.0013	0.001	0.0007	0.0006	0.0006	59	59	59	60	60
Ha Nam	0.0547	0.0628	0.0774	0.0878	0.0964	26	26	23	23	22
Ha Noi	0.6592	0.741	0.6942	0.7514	0.7347	2	2	3	2	2
Ha Tinh	0.2795	0.2651	0.2466	0.2519	0.2351	9	9	9	9	10
Hai Duong	0.1883	0.1717	0.1759	0.1967	0.1672	10	10	10	10	14
Hai Phong	0.3417	0.394	0.3838	0.4028	0.4479	7	6	6	6	6
Hau Giang	0.0179	0.0098	0.0107	0.0106	0.0137	36	44	45	44	43
Hoa Binh	0.014	0.0164	0.0152	0.016	0.0168	39	38	38	41	42
Hung Yen	0.0985	0.1015	0.1046	0.11	0.1209	18	19	18	18	16
Kien Giang	0.097	0.1022	0.0987	0.1083	0.1027	19	18	20	20	20
Kon Tum	0.002	0.0021	0.002	0.0021	0.0056	56	57	58	57	50
Khanh Hoa	0.0949	0.0924	0.0905	0.0898	0.0955	20	21	21	22	23
Lai Chau	0.0004	0.0001	0.0001	0.0001	0.0001	62	62	62	62	62
Lang Son	0.0059	0.0054	0.005	0.0052	0.0049	46	47	49	51	51
Lao Cai	0.0128	0.0123	0.0123	0.0122	0.0116	43	43	42	43	45
Lam Dong	0.0146	0.0123	0.0109	0.0106	0.0101	38	42	44	45	46
Long An	0.1416	0.1481	0.1523	0.1581	0.2425	12	12	12	12	9
Nam Dinh	0.0723	0.072	0.0691	0.0759	0.0722	24	24	26	26	27
Ninh Binh	0.029	0.0279	0.0293	0.0313	0.0343	33	34	34	35	36
Ninh Thuan	0.0295	0.0379	0.0353	0.0324	0.0365	32	32	32	34	35
Nghe An	0.0429	0.0415	0.0443	0.0487	0.0502	30	29	29	30	30
Phu Tho	0.0248	0.028	0.0331	0.0395	0.0491	34	33	33	33	31
Phu Yen	0.1171	0.0395	0.0429	0.0415	0.0422	15	31	30	32	32
Quang Binh	0.0135	0.0178	0.0164	0.0244	0.0256	42	36	36	37	39
Quang Nam	0.1242	0.128	0.1189	0.1223	0.1189	13	13	15	16	18
Quang Ninh	0.1188	0.1231	0.1167	0.1244	0.1422	14	15	16	15	15
Quang Ngai	0.0334	0.0397	0.0391	0.0416	0.0409	31	30	31	31	33
Quang Tri	0.0023	0.0022	0.0021	0.0025	0.0044	55	56	56	56	53
Soc Trang	0.0029	0.0052	0.0051	0.0063	0.0047	53	48	48	49	52
Son La	0.0036	0.0031	0.0029	0.0029	0.0029	51	53	55	55	57
Tay Ninh	0.1111	0.1241	0.1379	0.1553	0.1755	16	14	13	13	12
Tien Giang	0.0504	0.0483	0.0547	0.0591	0.0597	28	28	28	29	29
HCMC	1.5429	1.5914	1.6109	1.5499	1.5985	1	1	1	1	1
TT-Hue	0.0544	0.0785	0.0788	0.0794	0.0771	27	22	22	25	26
Tuyen Quang	0.0038	0.0041	0.0042	0.0047	0.0042	50	50	50	52	55
Thai Binh	0.014	0.0145	0.0145	0.0161	0.0275	39	40	40	39	38
Thai Nguyen	0.1629	0.1695	0.1683	0.1754	0.1798	11	11	11	11	11
Thanh Hoa	0.3166	0.3136	0.3041	0.3117	0.3033	8	8	8	8	8
Tra Vinh	0.0681	0.0715	0.0692	0.0691	0.0701	25	25	25	28	28
Vinh Long	0.0116	0.0126	0.0138	0.016	0.0175	44	41	41	40	41
Vinh Phuc	0.0889	0.0993	0.1027	0.1103	0.1202	22	20	19	17	17
Yen Bai	0.0104	0.0088	0.0082	0.0085	0.0092	45	46	46	47	47
Average	**0.1225**	**0.1269**	**0.1272**	**0.1335**	**0.1376**					

4.3. Efficiency Analysis

Provinces	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021	
	Efficiency Scores					Ranking					
Ho Chi Minh City	1.5429	1.5914	1.6109	1.5499	1.5985	1	1	1	1	1	Five provinces with the highest efficiency score
Ha Noi	0.6592	0.741	0.6942	0.7514	0.7347	2	2	3	2	2	
Binh Duong	0.6533	0.6742	0.703	0.6928	0.7224	3	3	2	3	3	
Dong Nai	0.617	0.6259	0.6514	0.6686	0.6592	4	5	4	5	4	
Ba Ria Vung Tau	0.6118	0.6464	0.6426	0.6777	0.6363	5	4	5	4	5	
Phu Yen	0.1171	0.0395	0.0429	0.0415	0.0422	15	31	30	32	32	Four provinces with the most fluctuations
Bac Lieu	0.0016	0.0097	0.0115	0.0993	0.0967	58	45	43	21	21	
Can Tho	0.0139	0.0147	0.0145	0.0151	0.0405	41	39	39	42	34	
Dak Lak	0.0044	0.0034	0.0033	0.0033	0.0124	48	52	51	53	44	
Ha Giang	0.0013	0.001	0.0007	0.0006	0.0006	59	59	59	60	60	Five provinces with the least efficiency score
Gia Lai	0.0007	0.0006	0.0007	0.0007	0.0007	60	60	60	59	59	
Bac Kan	0.0005	0.0005	0.0005	0.0004	0.0004	61	61	61	61	61	
Lai Chau	0.0004	0.0001	0.0001	0.0001	0.0001	62	62	62	62	62	
Dien Bien	0.0001	0.0001	0.0001	0.0001	0.0001	63	62	63	63	63	

The FDI efficiency of Vietnam's provinces in 2017–2021 was not high; most of the scores were less than 1, except for Ho Chi Minh City. The average efficiency score obtained throughout the years is merely 0.1225 to 0.1376

Figure 4.2. The list of six socio-economic regions of Vietnam

Table 4.4. FDI attractiveness efficiency trend of six socio-economic regions (2017–2021)

Key Economic Region	2017-2018	2018-2019	2019-2020	2020-2021	Average
Northern Midlands and Mountain	0.024	0.025	0.027	0.029	0.032
Red River Delta	0.184	0.198	0.193	0.21	0.215
North Central and Central Coast	0.092	0.089	0.087	0.089	0.088
Central Highlands	0.004	0.004	0.003	0.004	0.007
South East	0.597	0.619	0.634	0.635	0.645
Mekong River Delta	0.033	0.034	0.035	0.045	0.053

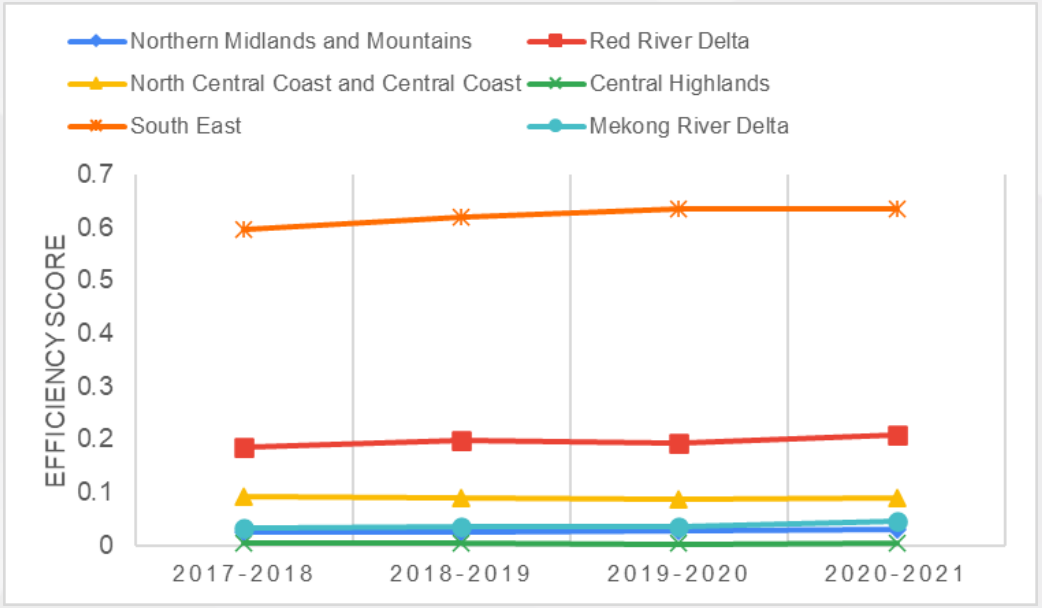


Chart 4.1. Trend of efficiency in each socio-economic region of Vietnam (2017–2021)

Table 4.5. Input-output projection rate (%) of provinces' FDI efficiency over years

Variables		2017	2018	2019	2020	2021	Average
Inputs	CIF1	−88.24	−87.19	−86.61	−87.48	−86.97	−87.30
	CIF2	−88.22	−88.66	−87.72	−86.81	−86.38	−87.56
	CIF3	−87.67	−87.15	−86.96	−86.76	−87.21	−87.15
	CIF4	−86.85	−86.91	−87.14	−86.46	−86.12	−86.69
	CIF5	−88.44	−87.88	−87.90	−86.57	−86.91	−87.54
	CIF6	−88.40	−86.90	−87.77	−86.42	−86.21	−87.14
	CIF7	−88.49	−87.73	−88.16	−87.06	−86.91	−87.67
	CIF8	−86.05	−85.73	−85.86	−86.06	−84.06	−85.55
	CIF9	−86.79	−86.60	−86.49	−85.92	−84.92	−86.15
	CIF10	−88.73	−88.60	−88.44	−87.11	−87.00	−87.98
Outputs	FDI by cases	323.37	335.11	350.36	486.52	501.29	399.33
	FDI by capital	20.6	20.17	22.63	19.31	19.38	20.42

4.4. Malmquist Productivity Changes

Table 4.6. Catch-up Index (2017–2021)

Catch-Up	2017–2018	2018–2019	2019–2020	2020–2021	Average
An Giang	0.9953	1.22	1.0257	1.0391	1.07
Bac Lieu	6.0015	1.1863	8.6488	0.9735	4.2025
Bac Giang	1.0752	1.1676	1.1741	1.1767	1.1484
Bac Kan	1.1417	0.8711	0.9275	0.9393	0.9699
Bac Ninh	1.0347	0.945	1.1197	1.0085	1.027
Ben Tre	1.1682	0.9832	1.493	1.0204	1.1662
Binh Duong	1.032	1.0428	0.9855	1.0427	1.0258
Binh Dinh	1.1674	0.9219	1.3905	1.0169	1.1242
Binh Phuoc	1.1351	1.0933	1.1428	1.1384	1.1274
Binh Thuan	0.9485	1.0103	1.0437	0.9811	0.9959
BRVT	1.0566	0.9941	1.0545	0.9389	1.011
Ca Mau	0.9394	1.9849	2.9946	0.3383	1.5643
Cao Bang	0.6606	0.7265	0.9327	0.9931	0.8282
Can Tho	1.0623	0.9839	1.0439	2.6792	1.4423
Da Nang	1.137	1.0128	0.995	1.0403	1.0463
Dak Lak	0.7655	0.9773	1.008	3.702	1.6132
Dak Nong	1.3774	0.9297	2.0389	0.9855	1.3329
Dien Bien	0.9079	0.8522	0.9434	0.9792	0.9207
Dong Nai	1.0143	1.0408	1.0265	0.9858	1.0168
Dong Thap	0.8857	1.0423	0.9984	1.3839	1.0776
Gia Lai	0.8466	1.0729	1.0827	0.9481	0.9875
Ha Giang	0.8028	0.6447	0.9564	0.9668	0.8427
Ha Nam	1.1481	1.2328	1.134	1.0979	1.1532
Ha Noi	1.1242	0.9368	1.0825	0.9777	1.0303
Ha Tinh	0.9486	0.9302	1.0214	0.9335	0.9584
Hai Duong	0.9115	1.0248	1.118	0.8502	0.9761
Hai Phong	1.153	0.9741	1.0494	1.112	1.0721
Hau Giang	0.5491	1.0918	0.987	1.2942	0.9805
Hoa Binh	1.1745	0.9275	1.0519	1.0487	1.0507
Hung Yen	1.0306	1.0308	1.0517	1.099	1.053
Kien Giang	1.0546	0.9655	1.0966	0.9485	1.0163
Kon Tum	1.0567	0.9389	1.035	2.7239	1.4386

Catch-Up	2017–2018	2018–2019	2019–2020	2020–2021	Average
Khanh Hoa	0.9732	0.9794	0.9923	1.0639	1.0022
Lai Chau	0.3007	0.8838	0.9229	1.0148	0.7805
Lang Son	0.9176	0.9172	1.0325	0.9499	0.9543
Lao Cai	0.9607	0.9998	0.9921	0.9496	0.9755
Lam Dong	0.8435	0.8811	0.9746	0.956	0.9138
Long An	1.046	1.0281	1.038	1.5341	1.1615
Nam Dinh	0.9955	0.9601	1.0986	0.9512	1.0014
Ninh Binh	0.9623	1.0487	1.0678	1.0982	1.0442
Ninh Thuan	1.2849	0.9308	0.9173	1.1262	1.0648
Nghe An	0.9671	1.0698	1.0991	1.0301	1.0415
Phu Tho	1.1308	1.182	1.1939	1.2413	1.187
Phu Yen	0.3374	1.086	0.9679	1.0155	0.8517
Quang Binh	1.3222	0.9195	1.4922	1.0461	1.195
Quang Nam	1.031	0.9291	1.0283	0.9726	0.9902
Quang Ninh	1.0367	0.9479	1.0662	1.1429	1.0484
Quang Ngai	1.1915	0.983	1.0661	0.9825	1.0558
Quang Tri	0.9447	0.955	1.1974	1.7526	1.2124
Soc Trang	1.812	0.9819	1.2364	0.7521	1.1956
Son La	0.8682	0.9122	1.0227	0.9774	0.9451
Tay Ninh	1.1171	1.1106	1.1267	1.1302	1.1211
Tien Giang	0.9565	1.1334	1.0798	1.0115	1.0453
HCMC	1.0314	1.0122	0.9621	1.0313	1.0093
TT-Hue	1.4437	1.0041	1.007	0.9719	1.1067
Tuyen Quang	1.0771	1.0162	1.1222	0.9034	1.0297
Thai Binh	1.0371	1.0012	1.114	1.7027	1.2137
Thai Nguyen	1.0401	0.9931	1.0421	1.025	1.0251
Thanh Hoa	0.9905	0.9698	1.0248	0.9733	0.9896
Tra Vinh	1.051	0.9681	0.9976	1.0147	1.0079
Vinh Long	1.0893	1.0901	1.161	1.092	1.1081
Vinh Phuc	1.1176	1.0339	1.0736	1.0904	1.0789
Yen Bai	0.8449	0.9264	1.0401	1.0803	0.973
Average	**1.0957**	**1.0097**	**1.2351**	**1.142**	**1.1206**

Table 4.7. Frontier-shift Index (2017–2021)

Frontier	2017–2018	2018–2019	2019–2020	2020–2021	Average
An Giang	1.0094	1.0223	0.9906	1.0271	1.0124
Bac Lieu	1.0127	1.0213	0.9914	1.024	1.0124
Bac Giang	1.0051	1.0223	0.9904	1.0215	1.0098
Bac Kan	1.0956	1.105	1.0516	1.0443	1.0741
Bac Ninh	1.002	1.0213	0.9926	1.0268	1.0107
Ben Tre	1.012	1.0199	0.9956	1.0257	1.0133
Binh Duong	1.0062	1.0223	0.9844	1.0285	1.0104
Binh Dinh	1.0087	1.0225	0.9897	1.0238	1.0112
Binh Phuoc	1.0056	1.0217	0.9849	1.0323	1.0111
Binh Thuan	1.01	1.0197	0.9878	1.0282	1.0114
BRVT	1.0046	1.0209	0.9887	1.0266	1.0102
Ca Mau	1.0529	1.0195	0.9852	1.0264	1.021
Cao Bang	1.0916	1.1	1.0471	1.045	1.0709
Can Tho	1.0067	1.0209	0.9906	1.0263	1.0111
Da Nang	1.0029	1.0221	0.9858	1.0255	1.0091
Dak Lak	1.0107	1.0207	0.9839	1.027	1.0106
Dak Nong	1.0067	1.0221	0.9885	1.023	1.0101
Dien Bien	1.0909	1.1018	1.0512	1.0478	1.0729
Dong Nai	1.0057	1.0193	0.9873	1.0267	1.0097
Dong Thap	1.0109	1.0211	0.9954	1.0226	1.0125
Gia Lai	1.0924	1.1015	1.0532	1.0469	1.0735
Ha Giang	1.0906	1.1003	1.0554	1.0471	1.0734
Ha Nam	1.0001	1.0211	0.9839	1.0222	1.0068
Ha Noi	1.0009	1.0196	0.9835	1.028	1.008
Ha Tinh	0.9989	1.0204	0.9839	1.0252	1.0071
Hai Duong	1.0079	1.0221	0.9806	1.0255	1.009
Hai Phong	1.0064	1.0218	0.9849	1.0268	1.0099
Hau Giang	1.0131	1.02	0.9974	1.0229	1.0133
Hoa Binh	1.0061	1.021	0.9845	1.0295	1.0103
Hung Yen	1.0059	1.0212	0.9939	1.0167	1.0094
Kien Giang	1.0106	1.0214	0.9919	1.0274	1.0128
Kon Tum	1.0071	1.0218	0.9856	1.026	1.0101

Frontier	2017–2018	2018–2019	2019–2020	2020–2021	Average
Khanh Hoa	1.0076	1.0203	0.9914	1.0213	1.0101
Lai Chau	1.0924	1.1032	1.0507	1.0499	1.0741
Lang Son	1.061	1.0216	0.9873	1.0241	1.0235
Lao Cai	1.0083	1.0224	0.9828	1.023	1.0091
Lam Dong	1.0923	1.1026	1.0272	1.0255	1.0619
Long An	1.01	1.0206	0.9933	1.0276	1.0129
Nam Dinh	1.0066	1.021	0.9865	1.022	1.009
Ninh Binh	1.0039	1.0215	0.9933	1.0156	1.0086
Ninh Thuan	1.0085	1.0209	0.9897	1.0181	1.0093
Nghe An	0.9993	1.0213	0.9847	1.0302	1.0089
Phu Tho	1.0056	1.0216	0.9901	1.0231	1.0101
Phu Yen	1.0084	1.0196	0.9868	1.0232	1.0095
Quang Binh	1.0055	1.0213	0.9798	1.0303	1.0092
Quang Nam	1.0068	1.0214	0.9903	1.0231	1.0104
Quang Ninh	1.0094	1.0213	0.9896	1.0256	1.0115
Quang Ngai	1.0018	1.0216	0.9857	1.0217	1.0077
Quang Tri	1.0832	1.1054	1.0161	1.0237	1.0571
Soc Trang	1.01	1.0218	0.9956	1.023	1.0126
Son La	1.0087	1.0211	0.9879	1.0287	1.0116
Tay Ninh	1.0082	1.0212	0.9949	1.0243	1.0121
Tien Giang	1.0088	1.0204	0.9868	1.0276	1.0109
HCMC	1.0189	1.0371	1.0284	1.0071	1.0229
TT-Hue	1.0041	1.0227	0.9908	1.0217	1.0098
Tuyen Quang	1.0085	1.0226	0.9887	1.0215	1.0103
Thai Binh	1.0081	1.0211	0.9882	1.0237	1.0103
Thai Nguyen	1.0076	1.0213	0.989	1.02	1.0095
Thanh Hoa	1.0023	1.0206	0.9817	1.0287	1.0083
Tra Vinh	1.0125	1.0207	0.9975	1.019	1.0124
Vinh Long	1.0088	1.0203	0.9914	1.029	1.0124
Vinh Phuc	1.0081	1.0205	0.9881	1.0202	1.0092
Yen Bai	1.0073	1.021	0.9878	1.0195	1.0089
Average	**1.0194**	**1.0317**	**0.9962**	**1.0264**	**1.0185**

Table 4.8. Malmquist productivity index (2017–2021)

Malmquist	2017–2018	2018–2019	2019–2020	2020–2021	Average
An Giang	1.0047	1.2472	1.0161	1.0672	1.0838
Bac Lieu	6.078	1.2116	8.5744	0.9969	4.2152
Bac Giang	1.0806	1.1936	1.1629	1.2021	1.1598
Bac Kan	1.2509	0.9625	0.9754	0.9809	1.0424
Bac Ninh	1.0368	0.9652	1.1115	1.0355	1.0372
Ben Tre	1.1822	1.0028	1.4864	1.0467	1.1795
Binh Duong	1.0384	1.066	0.9702	1.0725	1.0368
Binh Dinh	1.1776	0.9426	1.3762	1.0411	1.1344
Binh Phuoc	1.1414	1.117	1.1255	1.1751	1.1398
Binh Thuan	0.958	1.0302	1.0309	1.0088	1.007
BRVT	1.0615	1.0149	1.0427	0.9639	1.0207
Ca Mau	0.9891	2.0237	2.9504	0.3472	1.5776
Cao Bang	0.7211	0.7992	0.9766	1.0379	0.8837
Can Tho	1.0694	1.0044	1.0341	2.7496	1.4644
Da Nang	1.1403	1.0351	0.9809	1.0668	1.0558
Dak Lak	0.7738	0.9975	0.9917	3.8019	1.6412
Dak Nong	1.3867	0.9503	2.0156	1.0082	1.3402
Dien Bien	0.9905	0.939	0.9917	1.026	0.9868
Dong Nai	1.02	1.0609	1.0134	1.0121	1.0266
Dong Thap	0.8954	1.0643	0.9938	1.4152	1.0922
Gia Lai	0.9248	1.1817	1.1402	0.9925	1.0598
Ha Giang	0.8756	0.7094	1.0094	1.0123	0.9017
Ha Nam	1.1482	1.2588	1.1157	1.1222	1.1612
Ha Noi	1.1251	0.9551	1.0646	1.0051	1.0375
Ha Tinh	0.9475	0.9492	1.0049	0.957	0.9647
Hai Duong	0.9187	1.0474	1.0963	0.8719	0.9836
Hai Phong	1.1603	0.9953	1.0335	1.1417	1.0827
Hau Giang	0.5564	1.1137	0.9844	1.3238	0.9946
Hoa Binh	1.1817	0.947	1.0356	1.0797	1.061
Hung Yen	1.0366	1.0527	1.0453	1.1173	1.063
Kien Giang	1.0657	0.9862	1.0877	0.9745	1.0285
Kon Tum	1.0643	0.9593	1.0201	2.7946	1.4596

Malmquist	2017–2018	2018–2019	2019–2020	2020–2021	Average
Khanh Hoa	0.9806	0.9992	0.9837	1.0865	1.0125
Lai Chau	0.3285	0.9751	0.9697	1.0654	0.8347
Lang Son	0.9736	0.937	1.0193	0.9728	0.9757
Lao Cai	0.9687	1.0222	0.975	0.9715	0.9844
Lam Dong	0.9214	0.9715	1.0012	0.9804	0.9686
Long An	1.0564	1.0493	1.031	1.5765	1.1783
Nam Dinh	1.0021	0.9803	1.0837	0.9721	1.0096
Ninh Binh	0.966	1.0712	1.0607	1.1153	1.0533
Ninh Thuan	1.2958	0.9502	0.9079	1.1466	1.0751
Nghe An	0.9664	1.0925	1.0822	1.0612	1.0506
Phu Tho	1.1372	1.2075	1.1821	1.27	1.1992
Phu Yen	0.3402	1.1073	0.9551	1.0391	0.8604
Quang Binh	1.3295	0.9391	1.462	1.0779	1.2021
Quang Nam	1.038	0.9489	1.0184	0.995	1.0001
Quang Ninh	1.0464	0.968	1.0551	1.1722	1.0604
Quang Ngai	1.1936	1.0043	1.0509	1.0038	1.0631
Quang Tri	1.0233	1.0557	1.2167	1.7942	1.2724
Soc Trang	1.83	1.0034	1.2309	0.7694	1.2085
Son La	0.8758	0.9314	1.0103	1.0054	0.9557
Tay Ninh	1.1262	1.1341	1.1209	1.1576	1.1347
Tien Giang	0.9649	1.1565	1.0655	1.0394	1.0566
HCMC	1.0509	1.0498	0.9894	1.0387	1.0322
TT Hue	1.4497	1.0269	0.9978	0.9929	1.1168
Tuyen Quang	1.0863	1.0392	1.1095	0.9228	1.0395
Thai Binh	1.0455	1.0223	1.1009	1.743	1.2279
Thai Nguyen	1.048	1.0143	1.0306	1.0455	1.0346
Thanh Hoa	0.9927	0.9898	1.0061	1.0013	0.9975
Tra Vinh	1.0641	0.9881	0.9951	1.034	1.0203
Vinh Long	1.0989	1.1122	1.1509	1.1237	1.1214
Vinh Phuc	1.1266	1.0551	1.0608	1.1124	1.0887
Yen Bai	0.8511	0.9459	1.0274	1.1014	0.9815
Average	**1.114**	**1.0402**	**1.2287**	**1.172**	**1.1387**

4.4. Comparative Analysis

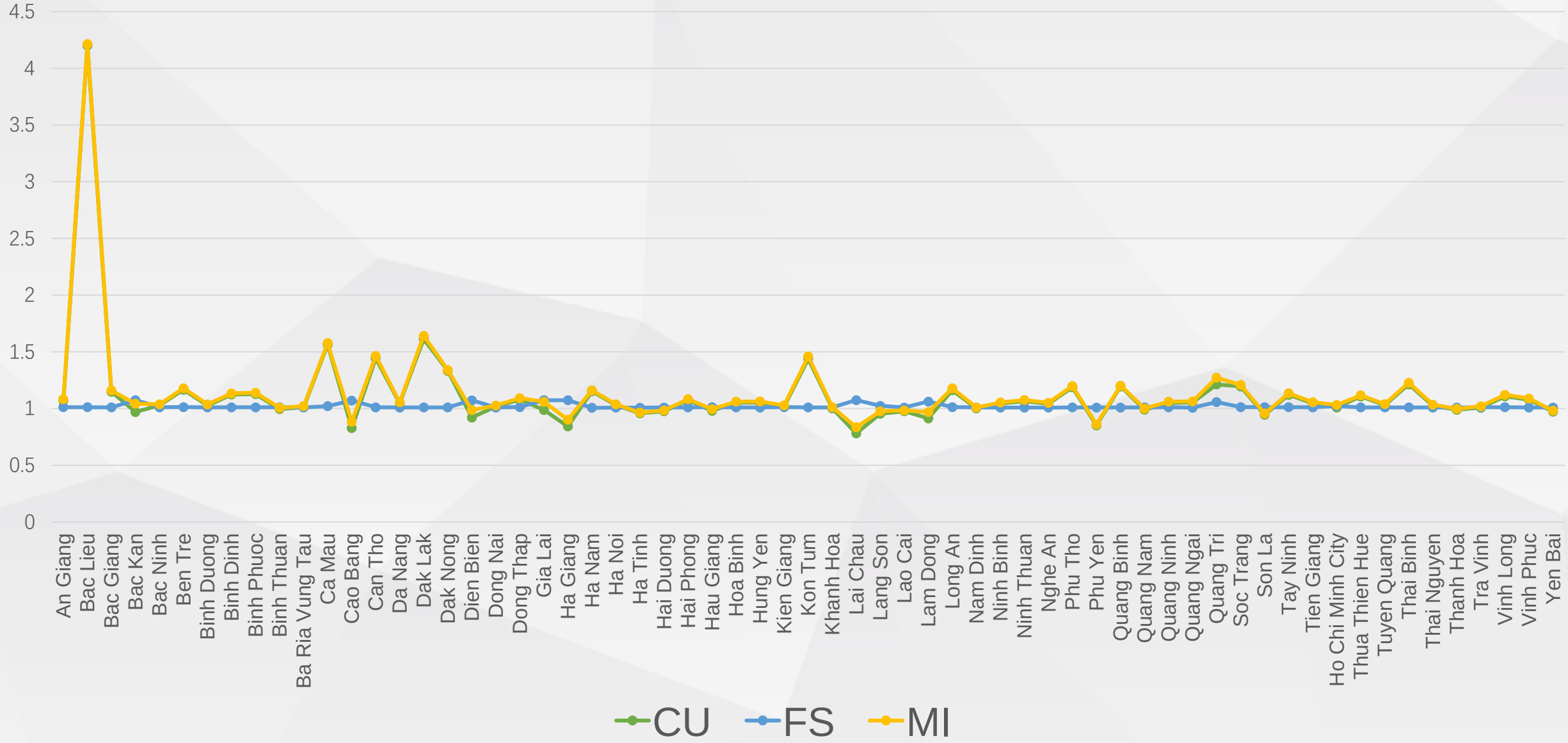
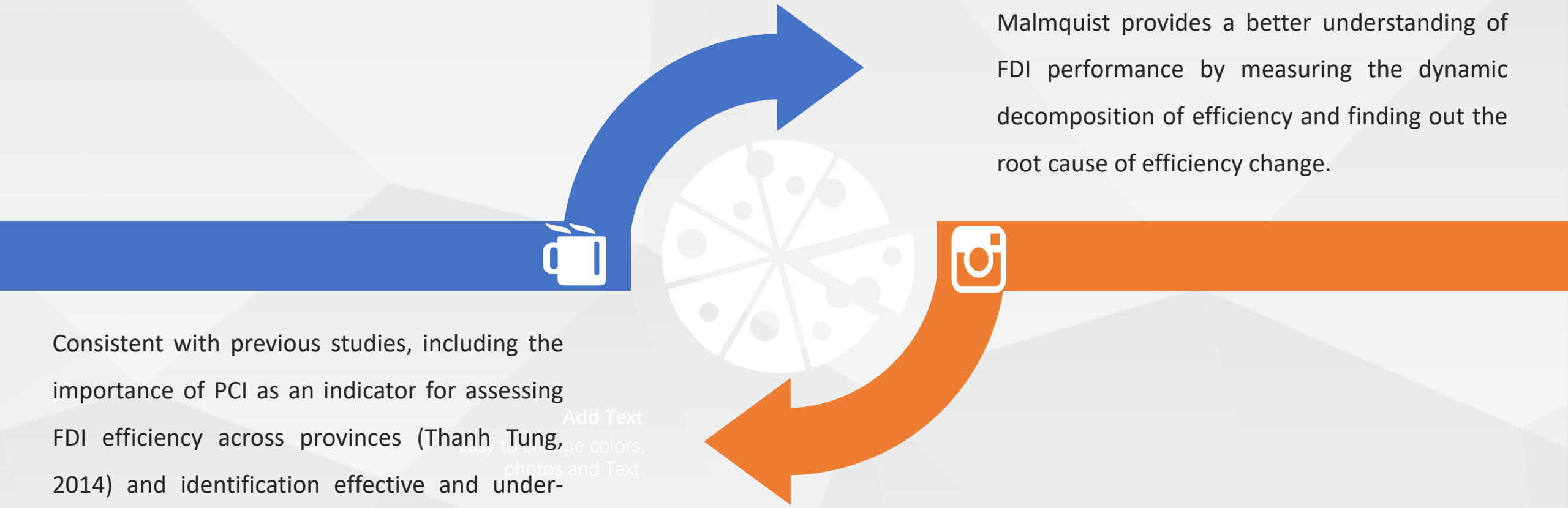


Chart 4.2. Comparison of catch-up (CU), frontier-shift (FS), and Malmquist index (MI)

4.5. Discussion

Combination of super-SBM model and Malmquist provides a better understanding of FDI performance by measuring the dynamic decomposition of efficiency and finding out the root cause of efficiency change.



Consistent with previous studies, including the importance of PCI as an indicator for assessing FDI efficiency across provinces (Thanh Tung, 2014) and identification effective and under-effective provinces in FDI investment. (Le and Dang, 2022)

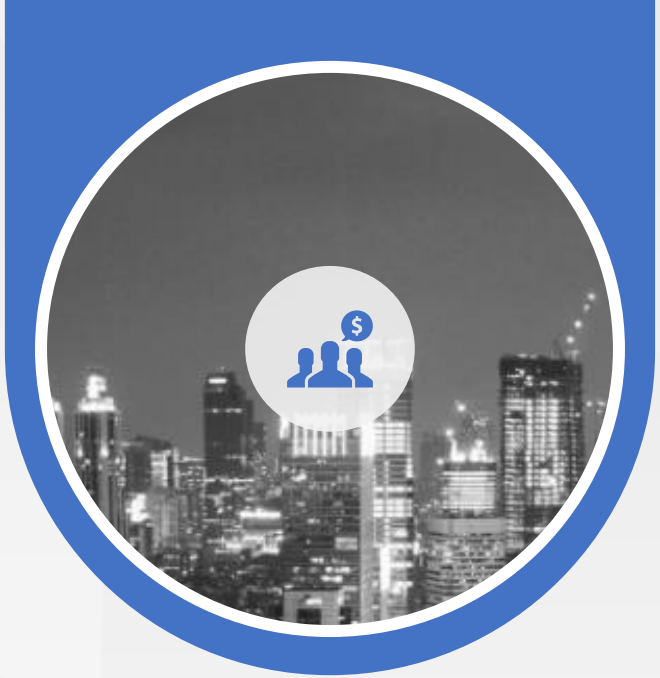
05
Conclusion

5.1. Conclusion

5.2. Implications

5.3. Limitations and Future Works

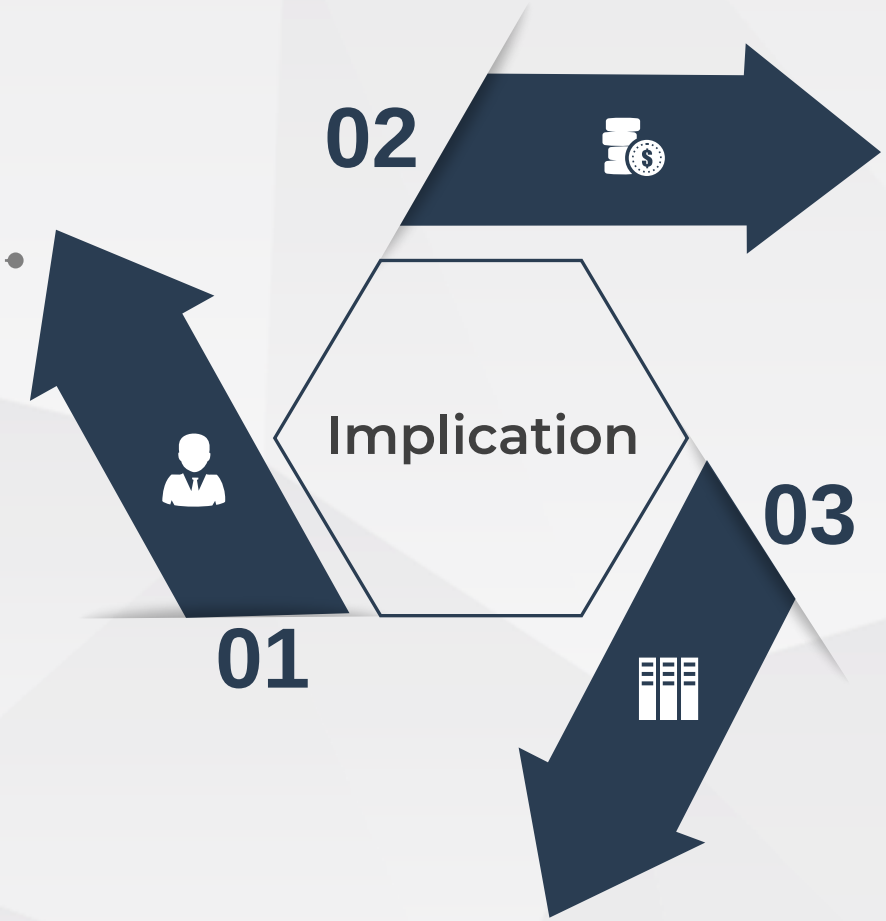
5.1. Conclusion



Conclusion

- The important of FDI
- Innovative integrated approach: Grey Delphi, DEA Super SBM, DEA Malmquist
- Provide insights into the efficiency and optimization level of FDI attraction in each province over time
- Aiding policymakers and investors in making informed decisions regarding FDI in Vietnam

5.2. Implications



For Investors

- ✓Providing insights into the FDI performance evaluation.
- ✓Learning from these successful models and identify potential investment opportunities in Vietnam.

For Policymakers

- ✓Conducting thorough due diligence.
- ✓Considering the infrastructure and human resource availability when selecting investment locations.
- ✓Paying attention to the province's policies where they intend to invest, especially the investment climate.

For Academic

- ✓Evaluating FDI performance at the sub-national level is essential to gain a more understanding of FDI's impact on local economies.
- ✓Examining the role of infrastructure and human capital in FDI performance evaluation.

5.3. Limitations and Future Works

Limitations.	Future Works.
Not fully consider the impact of COVID-19 on FDI performance.	Examining how the pandemic has affected the performance of FDI attractiveness.
Only considers limited indicators in evaluating FDI attractiveness.	Using additional indicators such as education, financial market, innovation, integration into the global economy, and socio-demographic and urban-environmental factors.
Only uses the DEA method for performance evaluation.	Integrate the DEA method with other techniques.
Only focuses on FDI attractiveness in Vietnam and does not compare it to other countries or regions.	Comparing FDI attractiveness across different countries or regions to identify differences in the factors that affect FDI performance.
Only focuses on the efficiency of FDI without considering its distributional effects.	Examining the distributional effects of FDI, including its impact on local communities, employment, and income distribution.

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How Does the Competitiveness Index Promote Foreign Direct Investment at the Provincial Level in Vietnam? An Integrated Grey Delphi–DEA Model Approach

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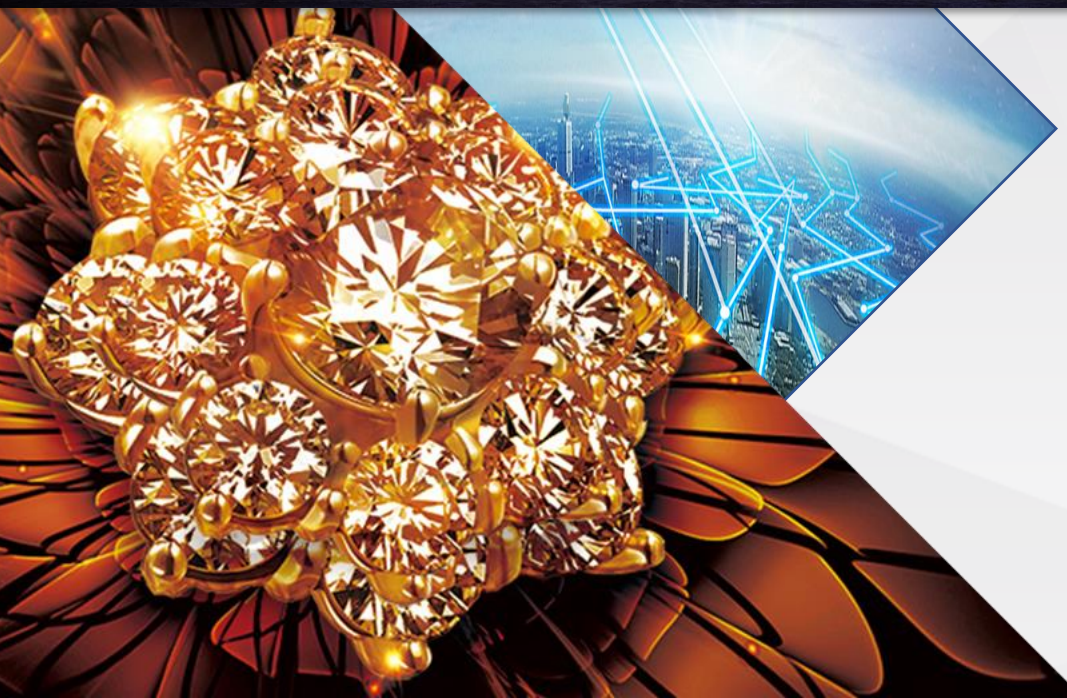

Thanks For Your Listening

Q&A Section