



Estimating Productivity and Identifying the Frontier

Malaysia Productivity Nexus



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Background

Analysis of productivity at **industry** and **sectoral-level** is often **too broad** to be a practical basis for policy and strategy formulations.

It is therefore essential to understand how **firm-level (enterprise) productivity** patterns **evolve** by taking into account the **heterogeneity** between firms.

Benchmarking and **identification of frontier firms** would provide better insights in devising effective policies to boost productivity at the sectoral level.

Micro-level performance

Comparing firms' productivity within the same industry provides several **benefits**. Firms in different sectors can have **different** levels and growth rates of productivity for **reasons** unrelated to firm performance.

Variation in
labour and
capital intensity

Different pace of
technological
change

Degree of product
differentiation and
competition



Objectives

1

Preliminary evaluation of **firm level** efficiency and productivity based on the nine 'Productivity Nexus'

3

Analysis of productivity growth and organizational slack (**x-inefficiency**)

2

Identification of **frontier firms** and **non-frontier** firms at the sectoral level

4

Recommendation on **benchmarking framework** for enterprise level productivity assessment

Concept and context

Productivity reflects **how efficiently** a combination of **inputs** is used to produce **output**.

Higher productivity **doesn't** necessarily mean higher profitability. **Nor** do higher profits necessarily mean higher productivity.

Multi-Factor Productivity (MFP)



MFP reflects how efficiently a **combination** of **inputs** is used to produce output.

The term MFP is also known as Total Factor Productivity (TFP).

It is often thought of as a **proxy** for **broad technological advances** that increase the output from a composite of inputs.

Source: Conway, 2016

These advances can include **new technology** associated with new types of **equipment**, improvements in **management and production processes**, increased **scale** and improved worker **skills**.



Frontier Firms

Definitional variants and approaches

OECD defines frontier firms as those in the **top 10% of the productivity distribution** – either globally (global frontier) or among domestic firms (domestic frontier).

Multi-Factor-Productivity (MFP) measure is based on Solow residual model using **ORBIS** database covering firms under two-digit-industry classification*.

* International Standard Industrial Classification (ISIC)

COUNTRY LEVEL STUDIES

1

Distribution and ranking

Top 10 or top 100 ranked firms in each industries as a basis for measuring productivity frontier

2

Localize databases and sectoral classifications

New Zealand: Longitudinal Business Database (NZ Statistics)
Netherlands: Business Registry Dataset, Non-Financial Datasets, Polisbus Dataset (Central Bureau of Statistics)

3

Variations in specification and methodology used

Index number, parametric and non-parametric approach
Output and input definition
Variable weightage

Methodology

A three-step approach

Phase One

Quantitative Analysis of Firm-level Microdata

Identification of frontier and non-frontier firm for **benchmarking** purposes

Allows for various **decompositions** of productivity level and growth

Identify the nature of misallocation (**slacks**) at the firm-level

The underlying productivity drivers



Source: New Zealand Productivity Commission (April, 2020)

Phase Two

Qualitative and inquiry evidence based case studies

Exploration of the **underlying causes** of growth, innovation and productivity change

Phase Three

Workshops and Engagements

Policy recommendations through Enterprise Productivity Programme

Frontier Analysis

Firm-level productivity performance

| Data Envelopment Analysis (DEA) constructs a frontier as the ratio of the weighted sum of outputs to a weighted sum of inputs to enable comparisons on efficiency and productivity performance.

| DEA uses a ratio of total factor productivity to measure performance by attributing a virtual optimal weight to each production entity's input and output.

| The optimal weights are arrived at by means of a Linear Programming (LP) model.

| The efficient frontier is a function that indicates the maximum attainable level of output corresponding to a given composite inputs.

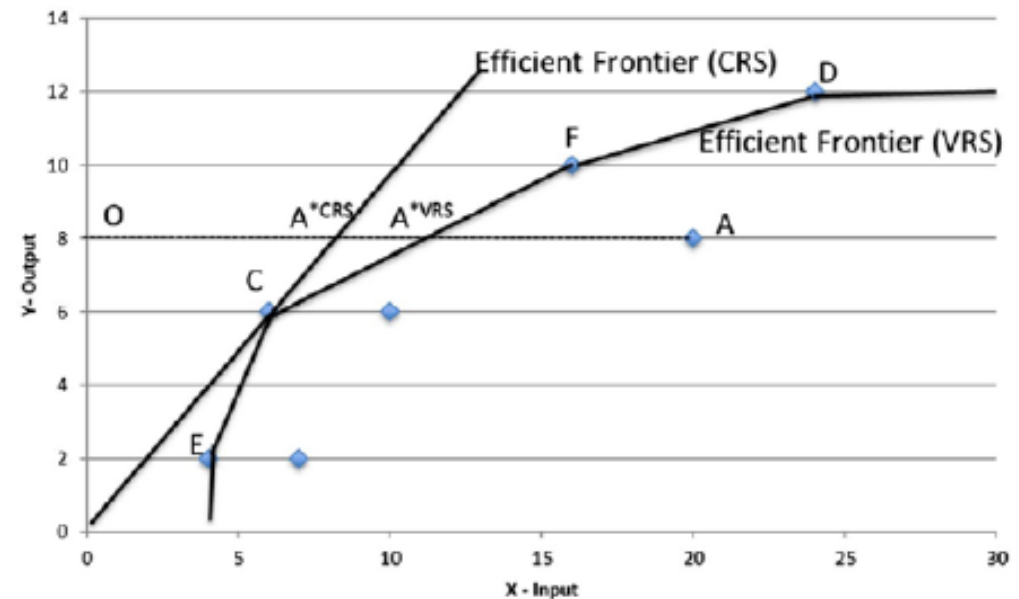


Figure 1: Hypothetical illustration of an efficient frontier



Frontier Analysis

Firm-level productivity performance

Efficiency score

Frontier methods represent performance by an efficiency **score**, calculated as the firm's **distance** to the best practice industry frontier.

Comparative analysis

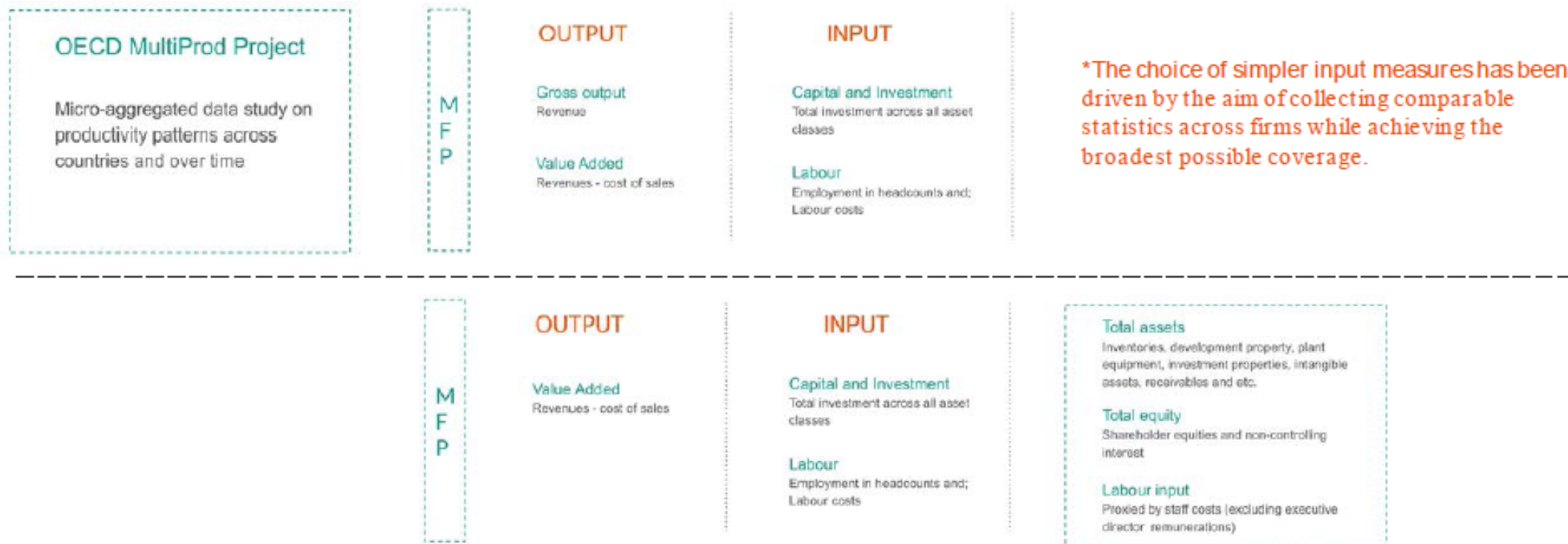
The general use of DEA is to determine, **compare** and **evaluate** efficiency of multiple production entities **against** the **best** observed **performance**.

Slack adjustment & Peers

A firm that is **not on the frontier** is rated to be **inefficient** and has the **potential to improve** its performance by realigning its resources according to its **benchmark** peers.

Frontier Analysis

General specifications and parameters



Data

Source and compilation

The study relies on **annual financial reports** of **public listed (main market)** companies under **Bursa Malaysia**. Specific sectors under the Productivity Nexus are the key domain for measuring firms' productivity over the period of 2017 to 2019.



Prime market for listing of established companies

Regulatory benchmark

Compliance with relevant rules and guidelines prescribed by Securities Commission and Bursa Malaysia

Market benchmark

Non-prescriptive dimension which is purely market driven



Identifiable core business

- Majority ownership and management control of an identifiable core business which is the principal source of operating revenue or after-tax profit



Good management

- Effectively managed by capable people with the requisite experience and qualification
- Management continuity well in place



Healthy financial position

- Positive cash flow from operating activities
- Adequate working capital (for at least 12 months after listing)



Risk management

- Internal control and risk management systems are in place in view of the company's business and growth plans



Business prospects

- Involvement in growth industry
- Established brand or market visibility
- Inroads made against competitors
- Core business that is well positioned to reap returns



Commitment to compliance

- Sufficient systems, procedures, policies, controls and resources in place to ensure continuous compliance with the relevant rules and regulations



Responsible directors

- Directors are fully aware of and understand their fiduciary obligations



Good corporate governance

- Strong corporate governance policies and practices
- Founders, promoters, directors and management team have a good track record in corporate governance



No conflicts of interest

- Satisfactory resolution of any conflicts of interest situations



Does not undermine public interests

- Determination that the listing of an applicant does not undermine public interests

Source: *Going Public - A Practical Guide to Listing on Bursa Malaysia (2020)*

Data

Source and compilation

| Bursa Malaysia Mainboard listing: 977 companies

| Divided into 13 sectoral indices covering 38 + 4 subsectors in line with the internationally recognised standard (i.e. ICB and GICS)

| **Mapping** of Bursa sectoral listings with the 9 Productivity Nexus

	Sector	Subsector
1.	Construction	
2.	Consumer products and services	Agricultural product Automotive Food/beverages Household goods Personal goods Retailers Travel, leisure and hospitality
3.	Energy	Energy infrastructure, equipment and services Oil and gas producers Other energy resources
4.	Financial services	Banking Insurance Other financials
5.	Healthcare	Healthcare equipment and services Healthcare providers Pharmaceuticals

	Sector	Subsector
6.	Property	
7.	Industrial products and services	Auto parts Building materials Chemicals Diversified industries Industrial engineering Industrial materials, components and equipment Industrial services Metals Packaging materials Wood and wood products
8.	Real estate investment trusts	
9.	Technology	Digital services Semiconductors Software Technology equipment

	Sector	Subsector
10.	Transportation and logistics	Transportation and logistic services Transportation equipment
11.	Telecommunications and media	Media Telecommunications equipment Telecommunications service providers
12.	Utilities	Electricity Gas, water and multi-utilities
13.	Plantation	

Notes:
Industry Classification Benchmark (ICB)
Global Industry Classification Standards (GICS)

Table 1: Bursa Malaysia sector and subsector classifications

Data

Source and compilation



Figure 2: Malaysia Productivity Nexus

| Variation in **definitional classification** of sectoral level used.

| **Overlapping subsectors** under different sector classifications.

| **Unavailability** of employees headcounts microdata at firm level or number of persons engaged.

| **Newly listed** on Bursa Malaysia mainboard or being delisted

Data

Source and compilation



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Market Capitalization

FTSE Bursa Malaysia KLCI index: 0
 FTSE Bursa Malaysia Mid 70 index: 6
 FTSE Bursa Malaysia Small Cap Index: 15

Foreign-based

Holding companies incorporated abroad: 4

Semiconductors: 10

VITROX
 UNISEM
 TURIYA
 M'SIA PACIFIC IND.
 KEYASIC

KESM
 INARI
 GLOBETRONICS
 FRONTKEN
 D&O GREENTECH

Tech Equipments: 11

VSTECS
 TRIVE
 PENTA
 NOTION
 MMS VENTURES

MI
 JCY
 ITRONIC
 FSBM
 EDARAN
 ELISOFT



Figure 3: Bursa Malaysia Main Market Indices



Findings

Preliminary

Firm-level efficiency score

Firms' level efficiency scores for Electrical & Electronics Nexus over the period of 2017-2019

Relative efficiency ranking

Ranking of frontier and non-frontier firms for Productivity Nexus

Productivity trend

Sources of productivity growth and its decomposition

Frontier and non-frontier firms

Identification of efficient frontier firms for benchmarking and listing of non-frontier firms

Peers and relative targets

Peers for the non-frontier firms and potential improvement targets



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Findings

Electrical & Electronics Nexus

Electrical & Electronics Nexus 2017



7

out of 21 firms were on the efficient frontier

Electrical & Electronics Nexus 2018



5

out of 21 firms were on the efficient frontier

Electrical & Electronics Nexus 2019



7

out of 21 firms were on the efficient frontier

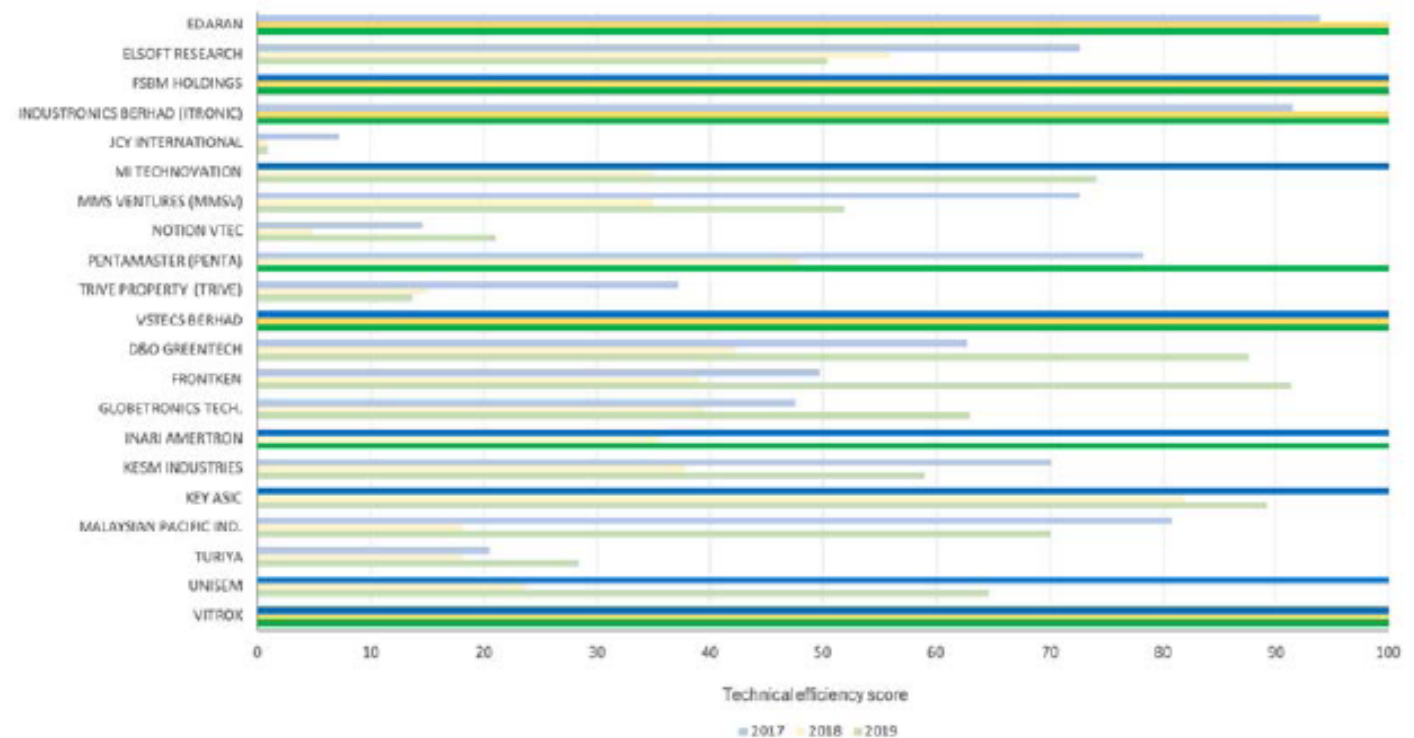


Figure 4: Electrical and Electronics Nexus technical efficiency and frontier firms

Findings

Electrical & Electronics Nexus

Over the period of 2017-2019, 3 firms had consistently recorded as the efficiency frontier for the **Electrical & Electronics Nexus**.

- FSBM
- VSTECs
- VITROX

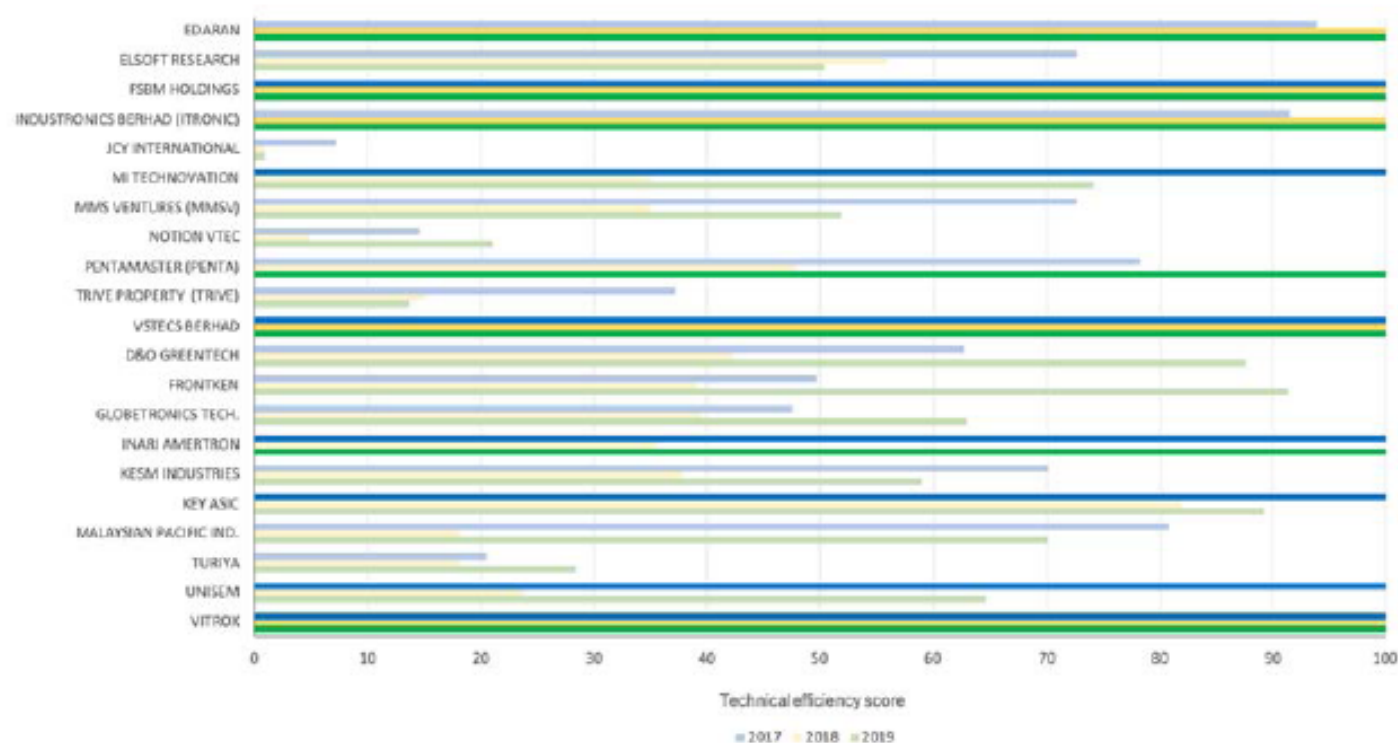


Figure 4: Electrical and Electronics Nexus technical efficiency and frontier firms

Findings

Electrical & Electronics Nexus

| Over the period of 2017-2019, **FSBM** and **VSTECs** had consistently ranked 1st and 2nd in technical efficiency performance relative to other firms on the frontier for **Electrical & Electronics Nexus**.

| **Edaran Berhad** joined the bandwagon of the top rank in recent years while **Mi Technovation** which had consistently on the frontier, improved the rank to 3rd in year 2019.



Figure 5: Electrical & Electronics Nexus frontier firms ranking

Findings

Electrical & Electronics Nexus

The existence of persistent **technical inefficiencies** over time offers an **opportunity** for the non-frontier firms to reduce inputs usage to achieve the same level of outputs.

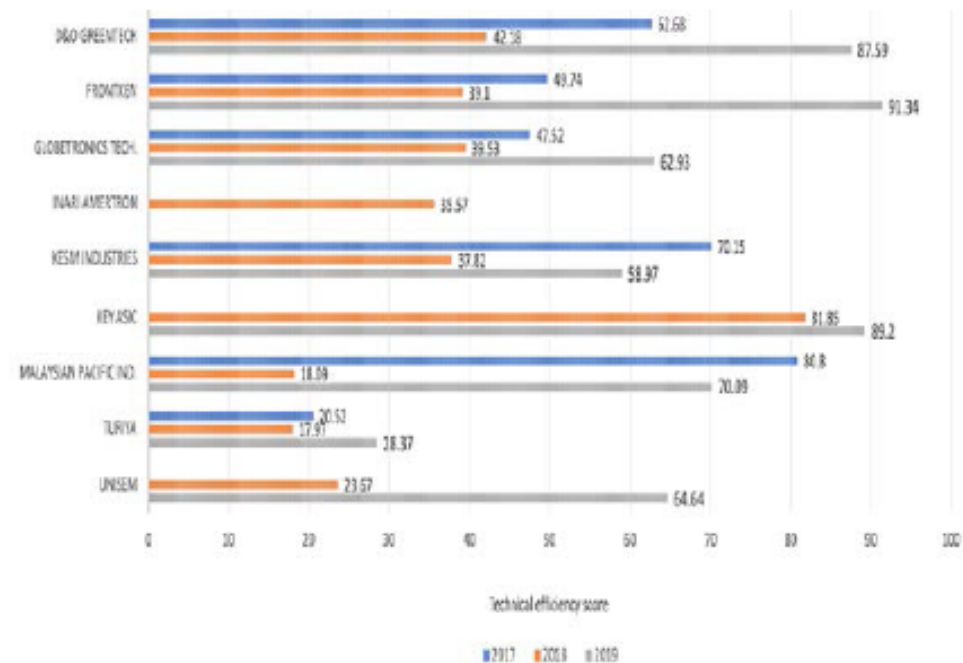
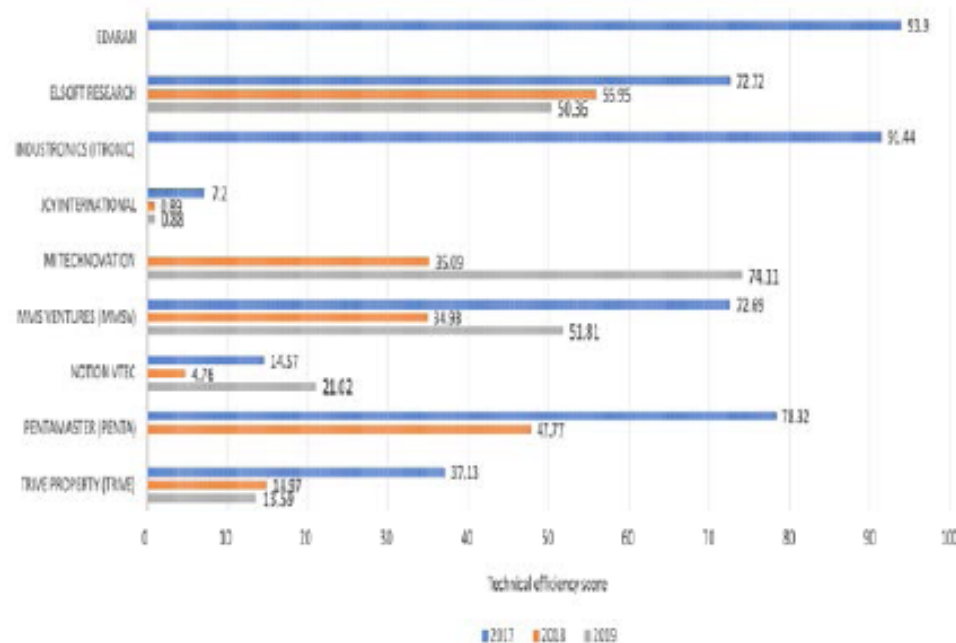


Figure 6: Electrical & Electronics Nexus technical inefficiency of the non-frontier firms

Findings

Electrical & Electronics Nexus

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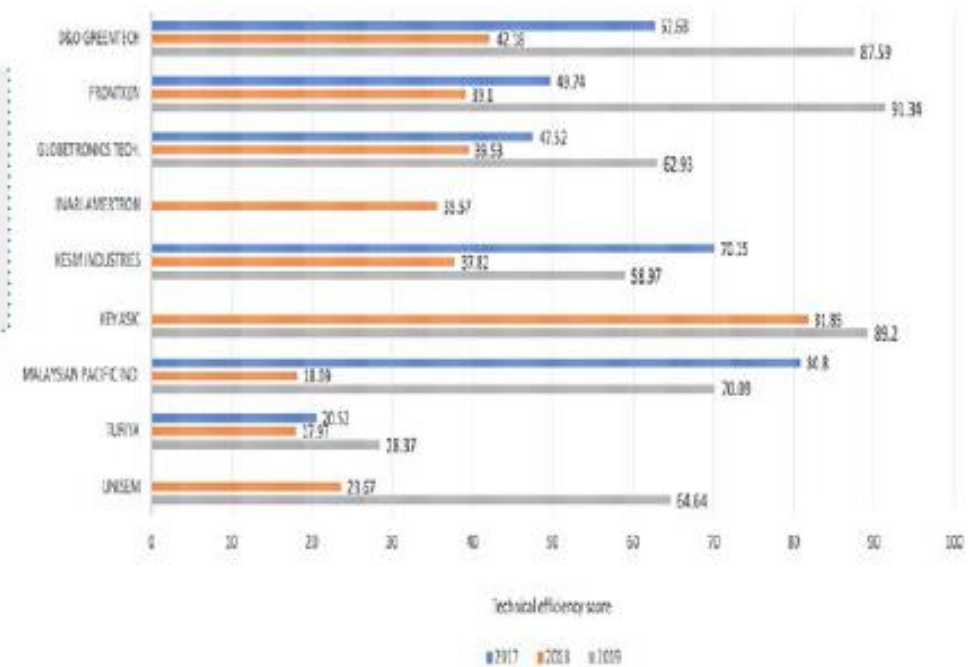
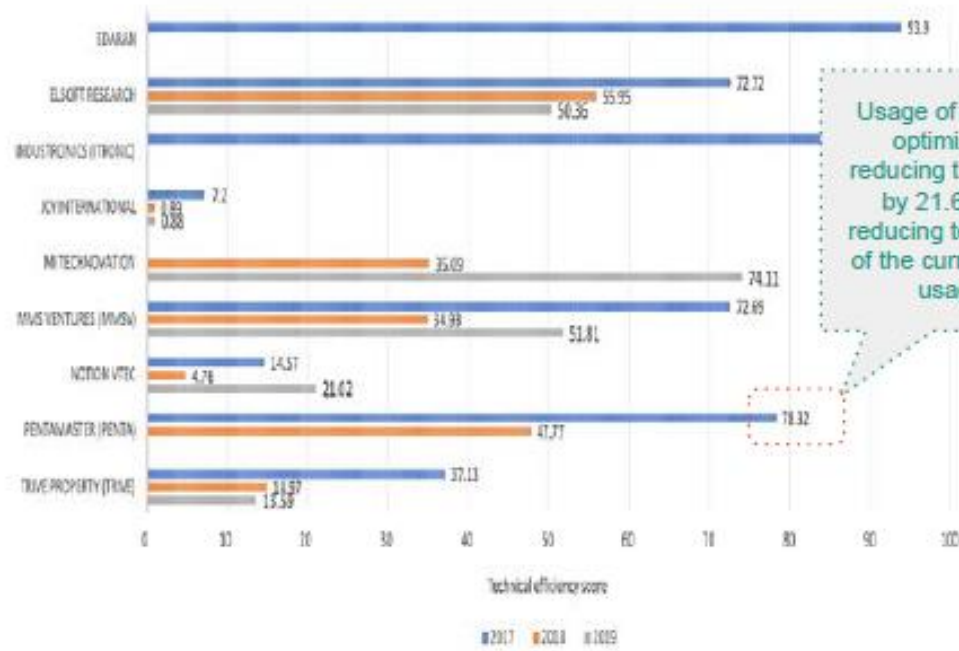


Figure 6: Electrical & Electronics Nexus technical inefficiency of the non-frontier firms

Findings

Electrical & Electronics Nexus

The overall technical efficiency score for the non-frontier firms averaged at 57.10, 33.13, and 54.64 for the year 2017, 2018 and 2019, respectively.

On average, non-frontier firms were using more than doubled the required amount of inputs to produce the given output level.

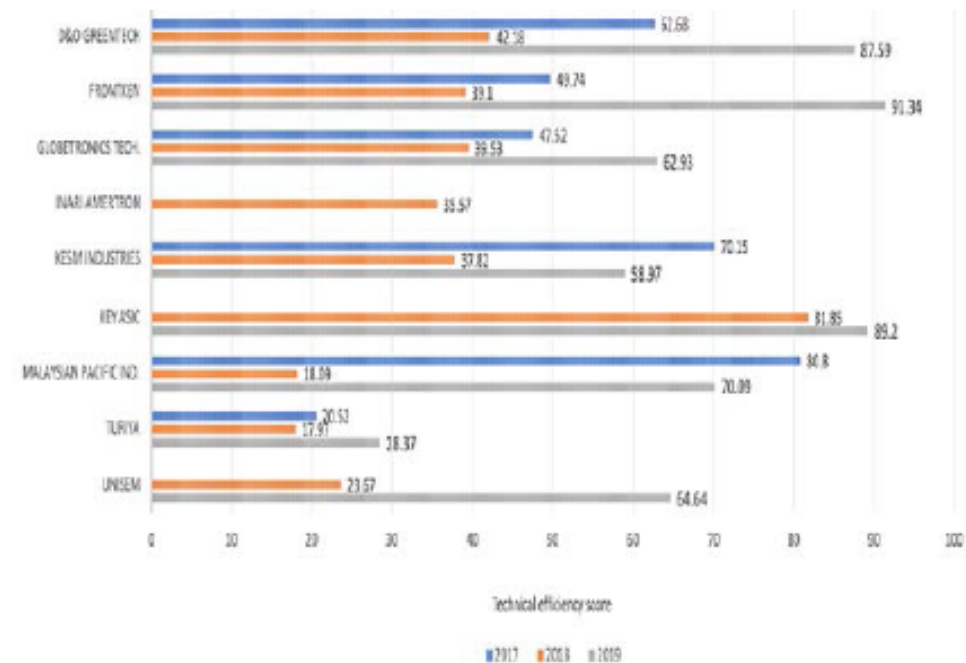
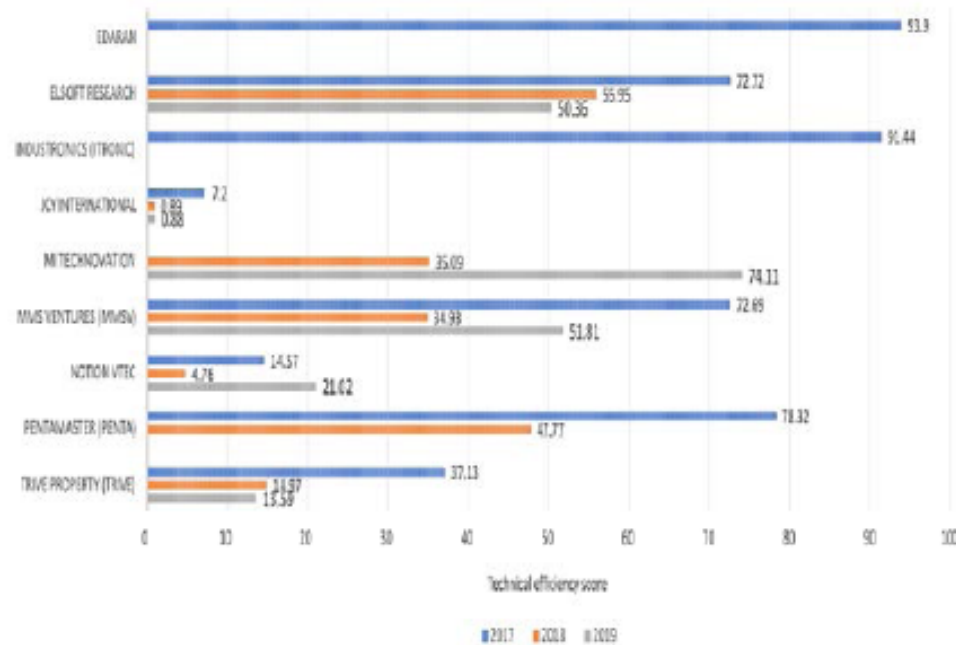


Figure 6: Electrical & Electronics Nexus technical inefficiency of the non-frontier firms

Findings

Tourism Nexus

| On average, non-frontier firms were using **more than doubled** the required amount of inputs to produce the given output level.

Non-optimal usage of inputs

Waste of resources



OVERPRODUCTION

- Producing sooner or in greater quantity than what is required by the process that follows



WAITING

- A worker who waits
- An idle machine that should be operating



TRANSPORT

- Moving parts and products unnecessarily because of excessive distance between workstations



INEFFICIENT OPERATIONS

- Unnecessary or non optimal operations



INVENTORY

- Having more inventory than what is required in a pull system



MOTION

- Workers straining or making unnecessary movements



NON-QUALITY

- Correction, inspection, rework and scrap



POOR DESIGN

- A poorly designed product that takes more time to produce than originally planned
- A product containing materials that are not adapted to the client's needs




Source: Productivity Matters - Benchmarking your company to up your game (2016)

Findings

Electrical & Electronics Nexus

| Relative importance of peers as a benchmark and role model for non-frontier firms are based on the calculated **lambda** values.

| Greater value of lambda indicates a better benchmark and role model frontier peers relative to others based on **operating scale**.

	Non-frontier firms	 FSBM	 VSTECs	 ViTrex [®]
1.	Elsoft Research	(0.80)	(0.04)	(0.07)
2.	JCY International	(1.00)	(0.00)	(0.00)
3.	MI Technovation	(0.00)	(0.27)	(0.34)
4.	MMS Ventures	(0.64)	(0.00)	(0.04)
5.	Notion VTEC	(0.00)	(0.02)	(0.09)
6.	Trive Property	(0.99)	(0.00)	(0.00)
7.	D&O Greentech	(0.00)	(0.00)	(0.00)
8.	FRONTKEN	(0.00)	(0.00)	(0.04)
9.	Globetronics	(0.00)	(0.00)	(0.16)

	Non-frontier firms	 FSBM	 VSTECs	 ViTrex [®]
10.	KESM Industries	(0.00)	(0.00)	(0.08)
11.	Key Asic	(0.78)	(0.01)	(0.03)
12.	Malaysia Pacific Industries	(0.00)	(0.00)	(0.00)
13.	Turiya	(0.92)	(0.06)	(0.02)
14.	UNISEM	(0.00)	(0.00)	(0.00)

Notes:

Figures in parentheses are Lambda values

Table 2: Electrical and Electronics Nexus non-frontier firms' peers (2019)

Findings

Tourism Nexus

Malmquist productivity index indicates total factor productivity change (TFP) from one period to another.

Any movement of productivity over time can be decomposed into two parts:

- 1 **Movement of the frontier** due to changes in technological capabilities of the firm (technical change)
- 2 **Movement of the firm towards (or far from) the frontier** (technical efficiency)

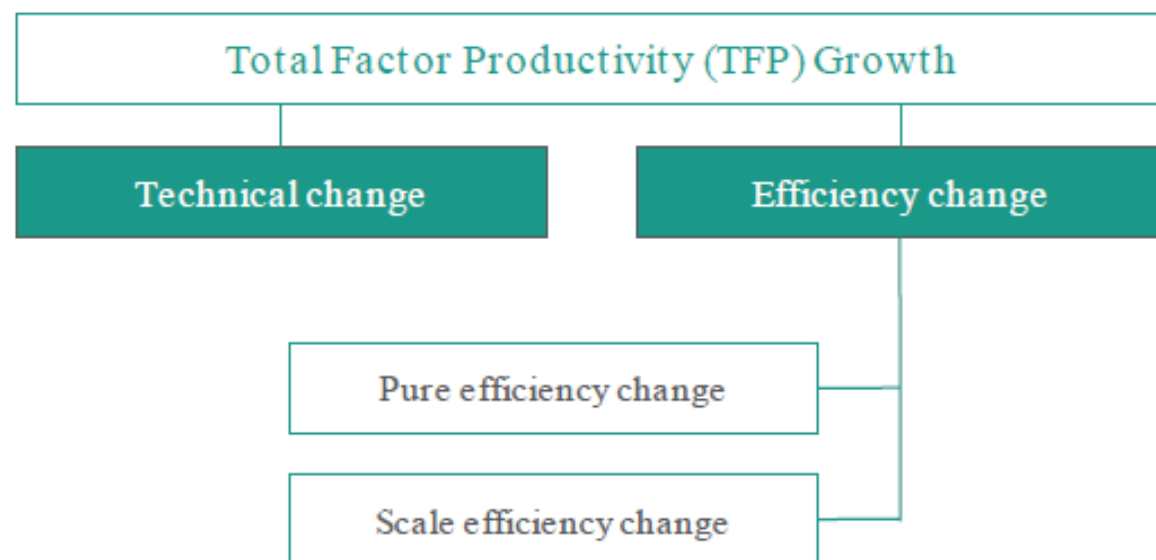


Figure 7: Decomposition of TFP growth

Findings

Electrical & Electronics Nexus

| The overall Electrical & Electronics Nexus saw a **slower** TFP growth over the period of 2017-2019.

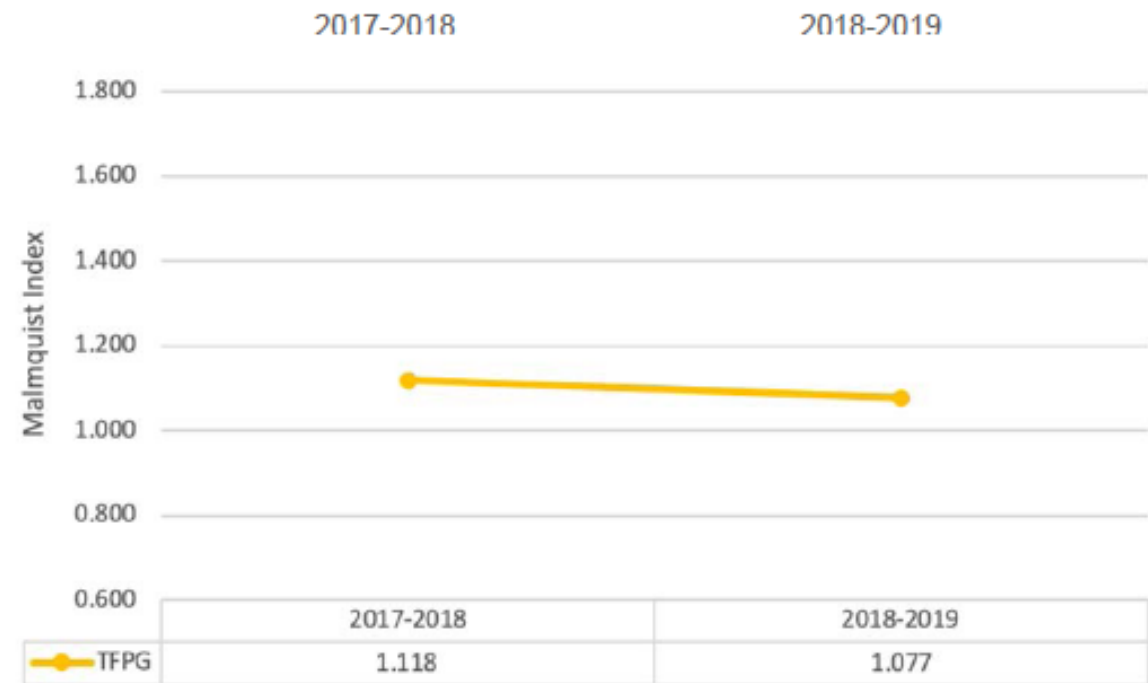
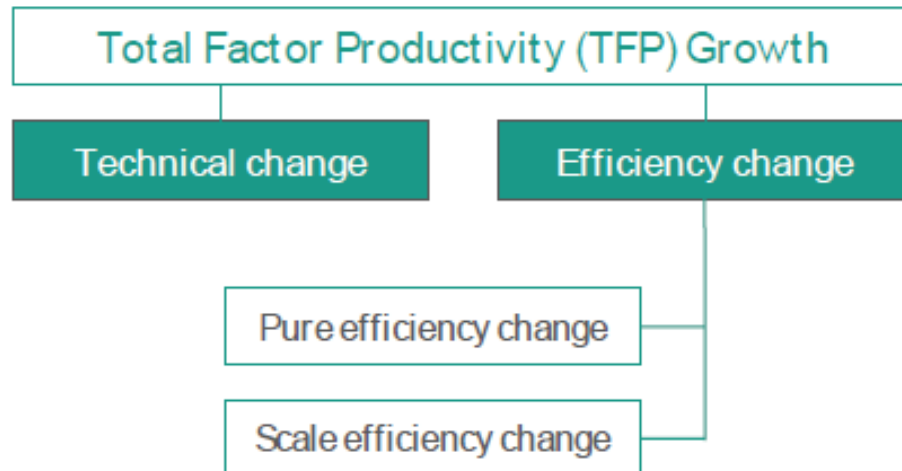


Figure 8: Tourism Nexus productivity trend

Findings

Electrical & Electronics Nexus

| The slower growth in TFP was mainly contributed by the decline in pure efficiency and the slower growth in the scale effects.

| The positive TFP growth recorded for the Electrical & Electronics Nexus in the recent year was mainly contributed by the significant improvement in the technological change.

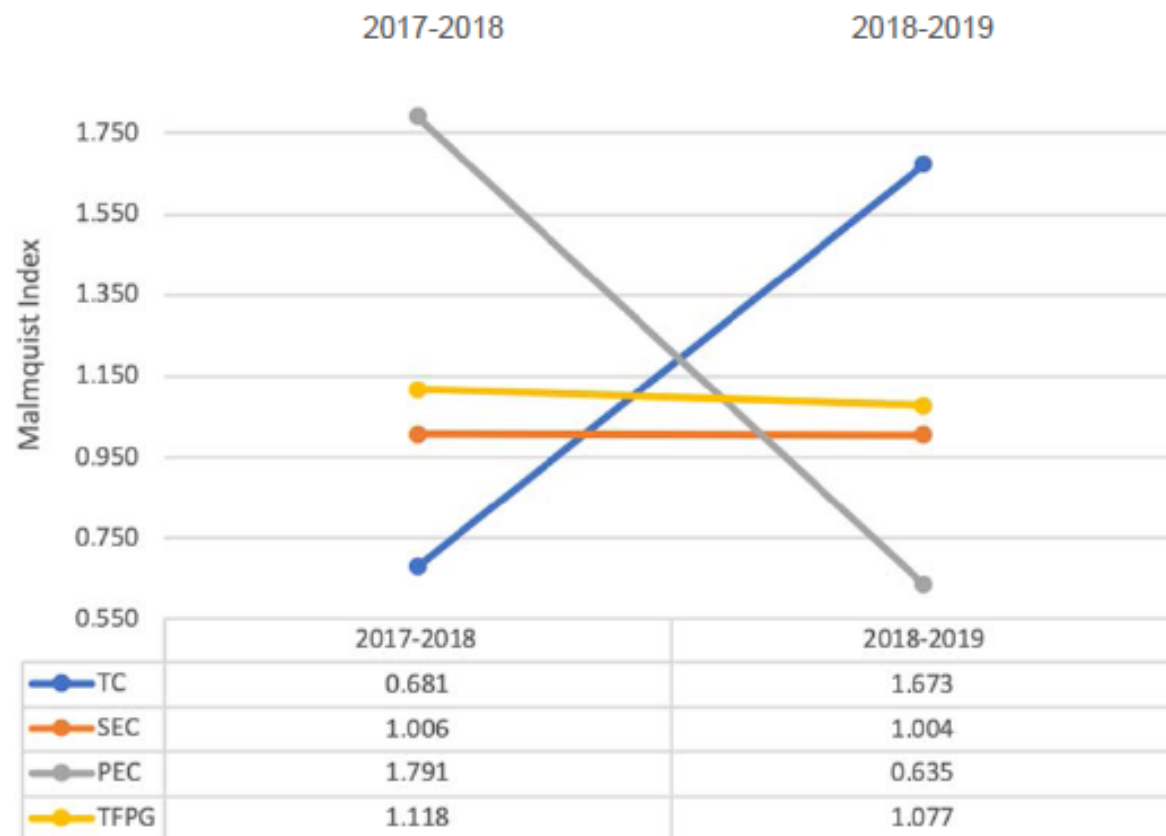


Figure 9: Electrical and Electronics Nexus productivity trend

Findings

Electrical & Electronics Nexus

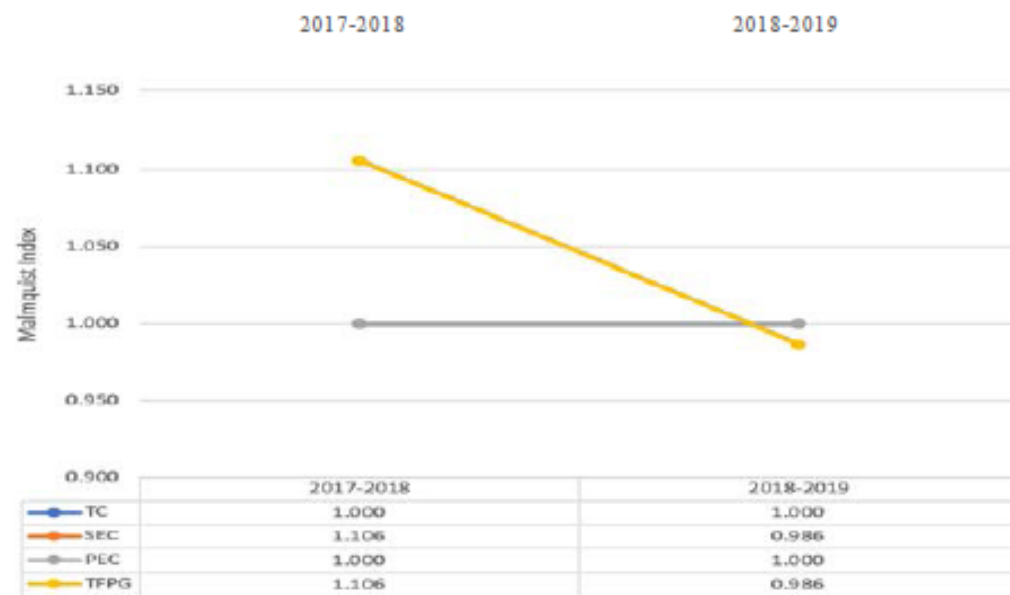


Figure 10 (a): E&E Nexus productivity trend for frontier firms

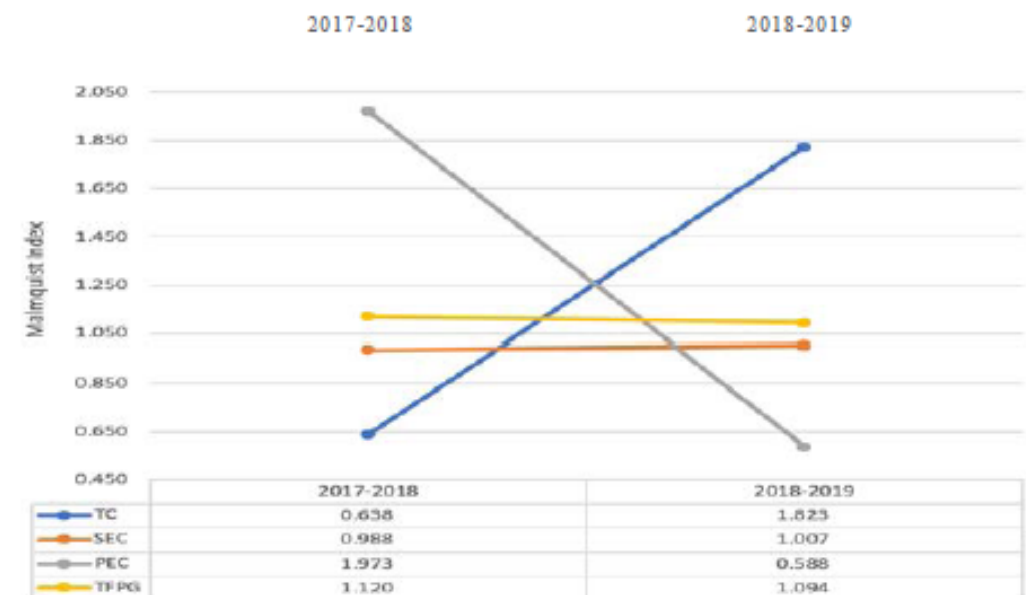


Figure 10 (b): E&E Nexus productivity trend for non-frontier firms

Findings

Electrical & Electronics Nexus

| On average, the **non-frontier** firms' productivity trends were **catching up** relative to the frontier firms although at a slower rate than year 2017-2018.

| The **technological change** contributed significantly to the growth of TFP among the **non-frontier** firms despite the declining trend in pure efficiency.

| The non-frontier firms' average for **pure efficiency trend declined** over the period of 2018-2019 while the frontier firms' average pure efficiency was stagnant.

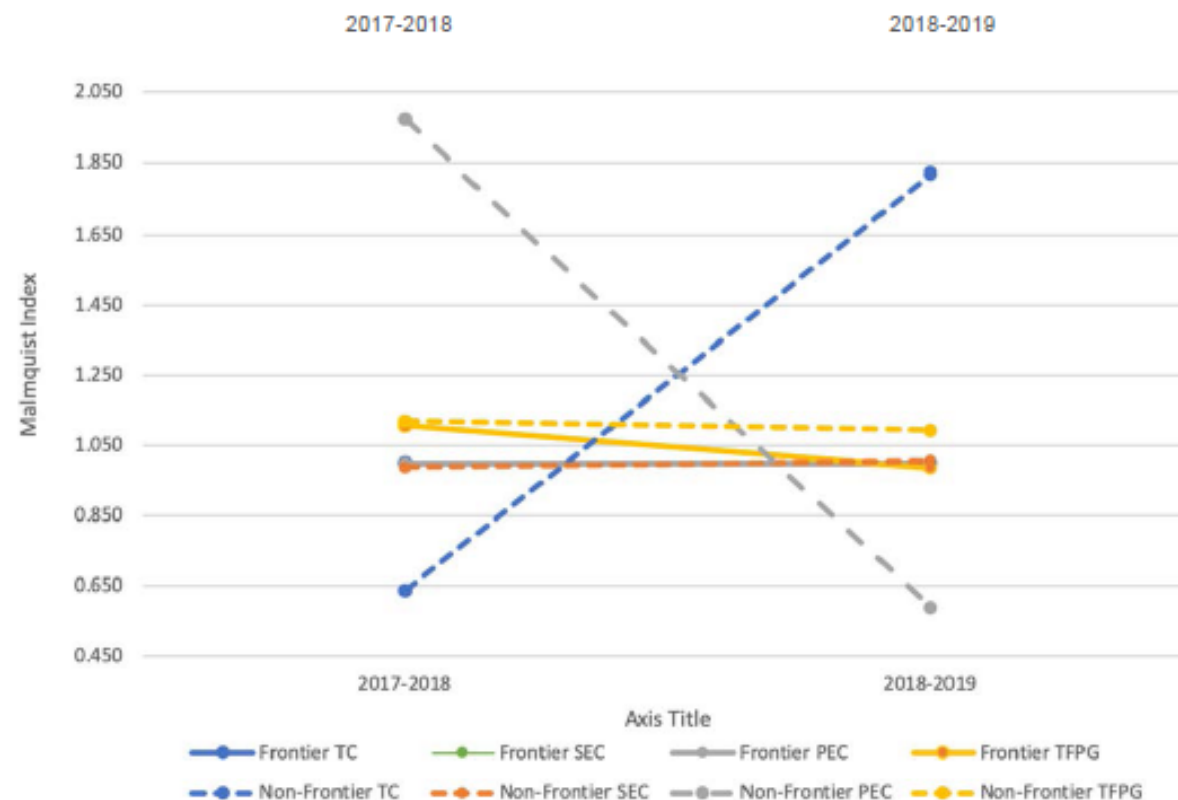


Figure 11: E&E Nexus productivity trend - frontier vs. non-frontier firms

Summary & Conclusion



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Tourism



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Electrical & Electronics

Tourism Nexus 2017



8

out of 25 firms were on
the efficient frontier

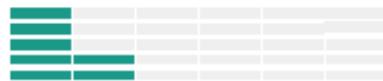
Tourism Nexus 2018



6

out of 25 firms were on
the efficient frontier

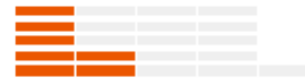
Tourism Nexus 2019



7

out of 25 firms were on
the efficient frontier

Electrical & Electronics Nexus 2017



7

out of 21 firms were on
the efficient frontier

Electrical & Electronics Nexus 2018



5

out of 21 firms were on
the efficient frontier

Electrical & Electronics Nexus 2019



7

out of 21 firms were on
the efficient frontier

Summary

& Conclusion

| Consistently on the frontier from 2017-2019 and ranked 1st and 2nd in their respective Productivity Nexus

| Highest frequencies for best role model frontier peers according to the operating scale.



Tourism

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- Berjaya Sports Toto Berhad
- Berjaya Land Berhad
- Genting Berhad
- Magnum Berhad
- Pan Malaysia Holdings



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- FSBM
- VSTECS
- VITROX



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Tourism



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Summary & Conclusion

| Greater volatility in efficiency level over time for Electrical and Electronics Nexus relative to the Tourism Nexus

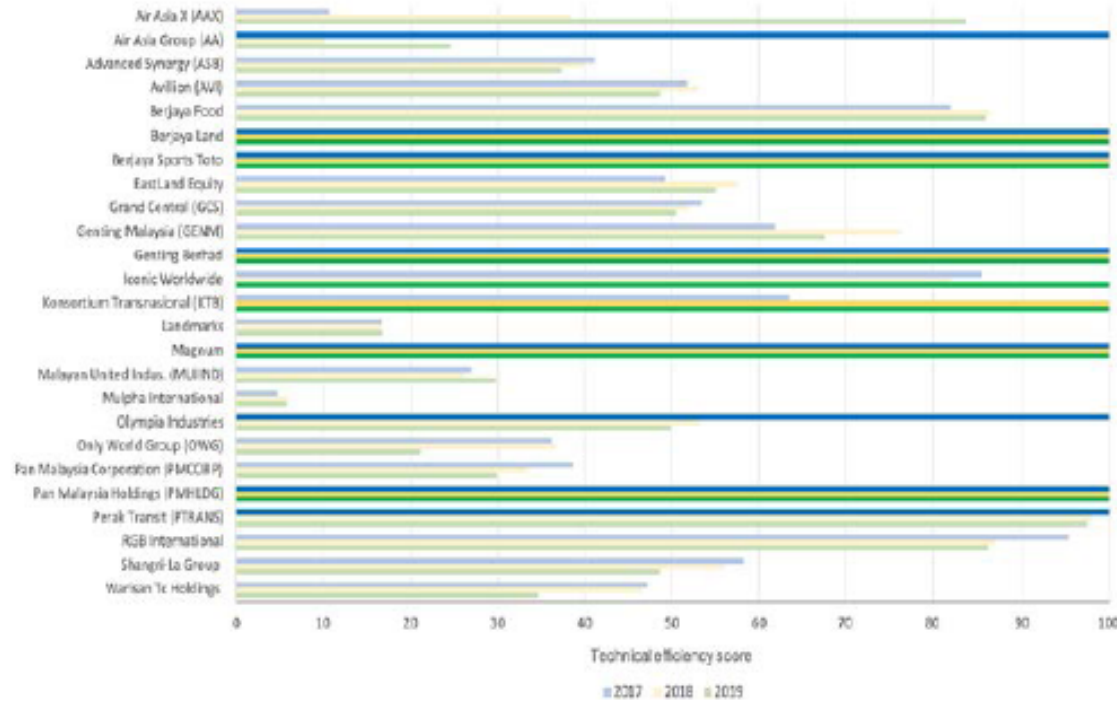


Figure 12 (a): Tourism Nexus technical efficiency and frontier firms

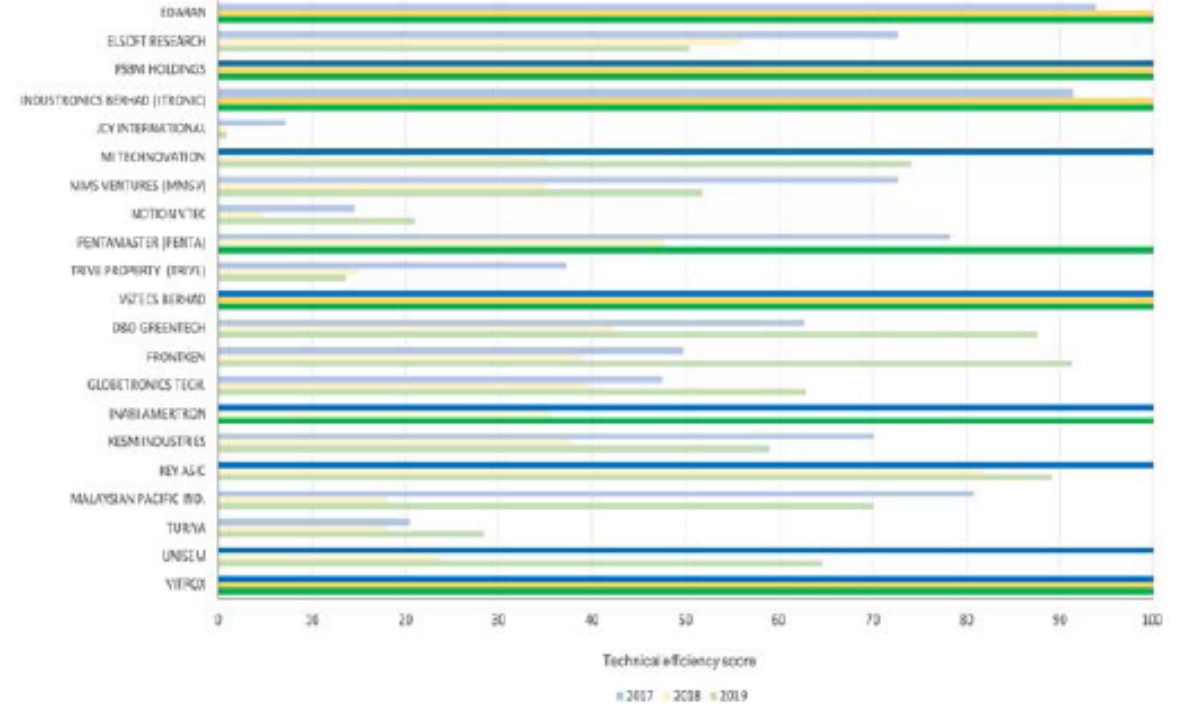


Figure 12 (b): E&E Nexus technical efficiency and frontier firms



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Tourism



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Summary & Conclusion

| Greater **volatility** in **efficiency level** over time for Electrical and Electronics Nexus relative to the Tourism Nexus

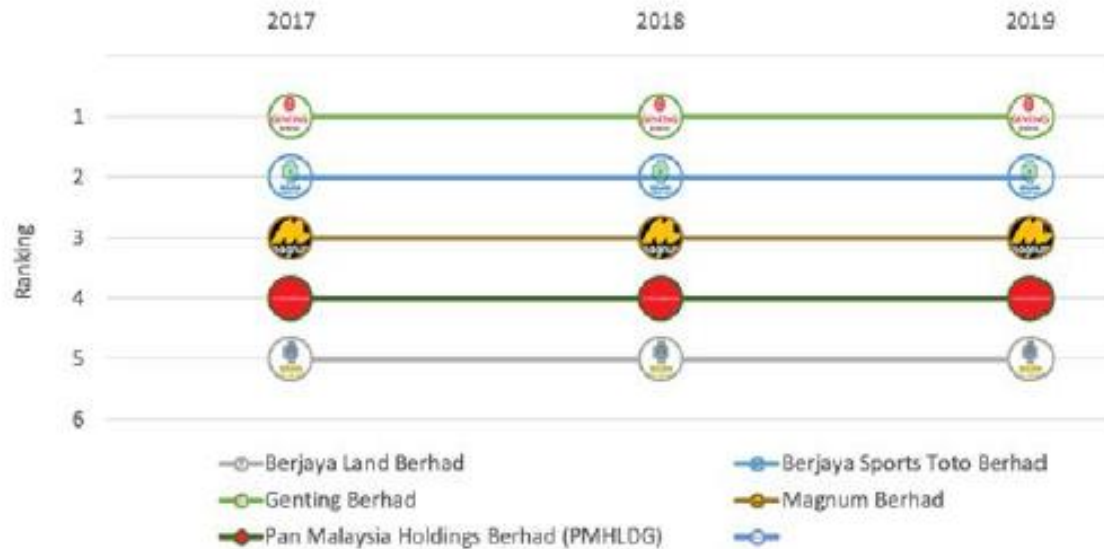


Figure 13 (a): Tourism Nexus frontier firms ranking

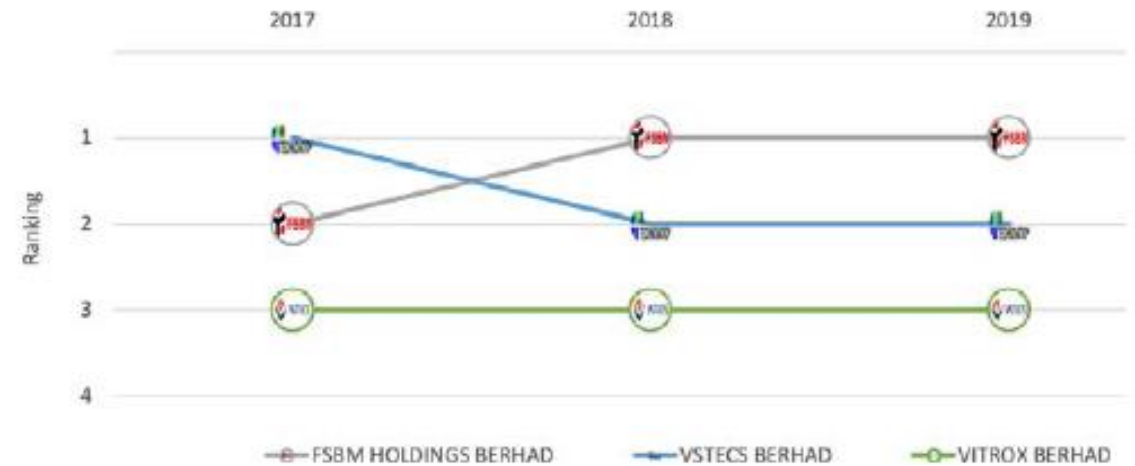


Figure 13 (b): Electrical & Electronics Nexus frontier firms ranking



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Tourism

Summary & Conclusion

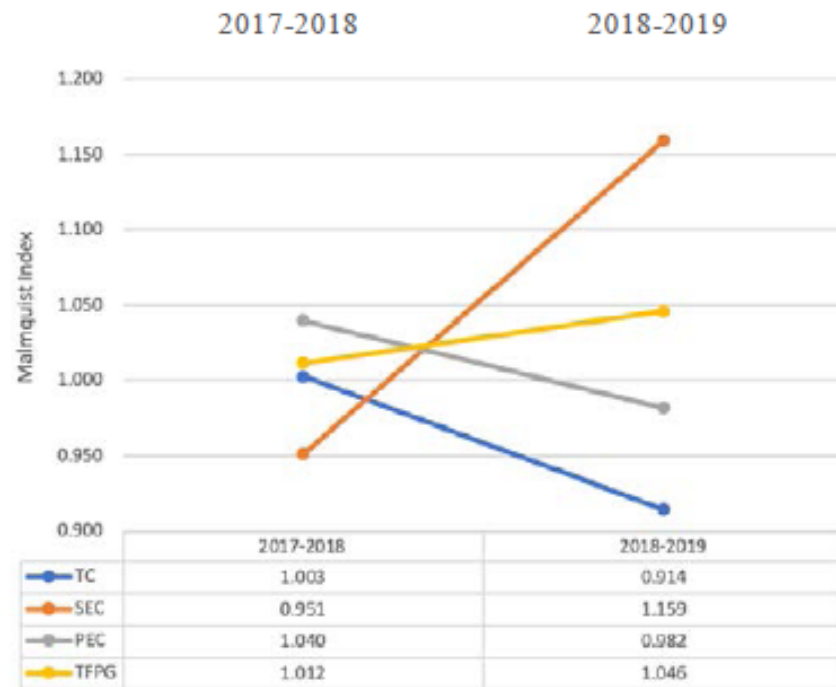


Figure 14 (a): Tourism Nexus productivity trend



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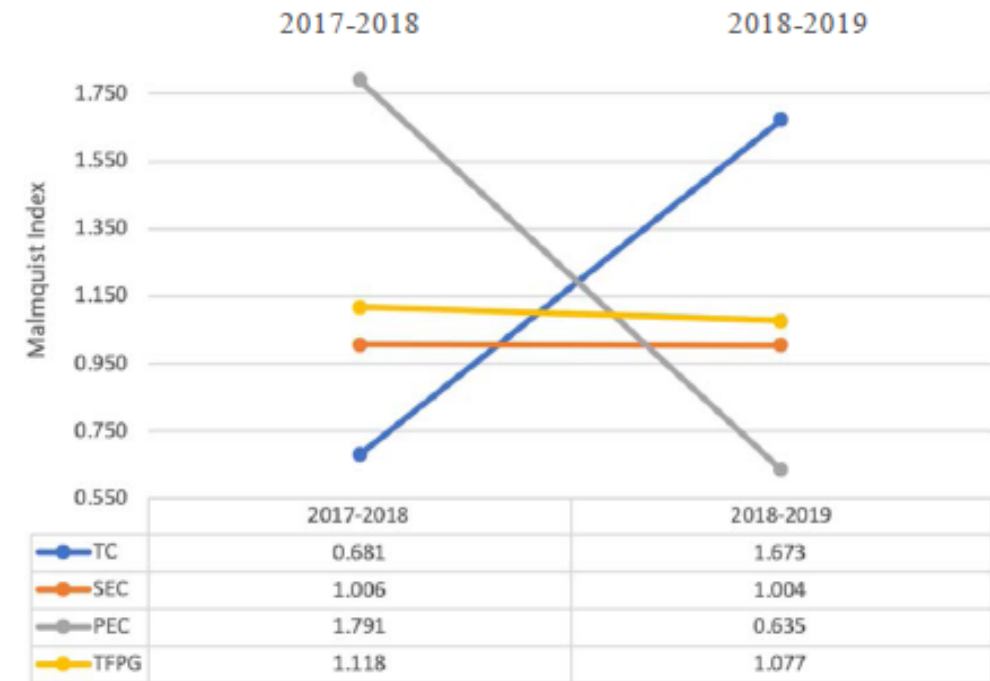


Figure 14 (b): Electrical and Electronics Nexus productivity trend

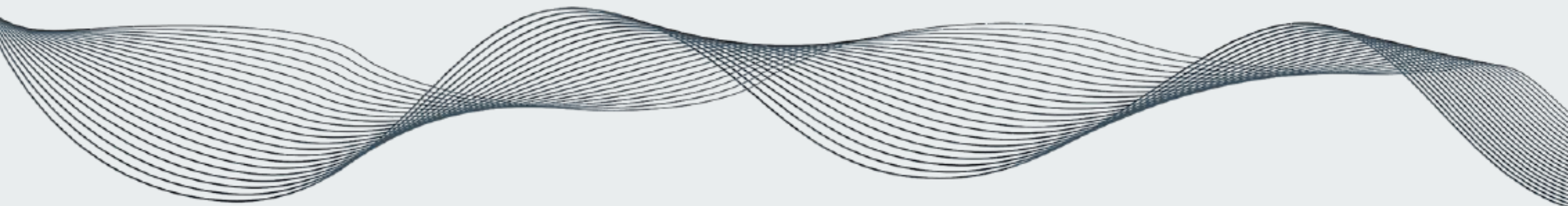


Thank you.

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International Islamic University Malaysia





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Summary & Conclusion

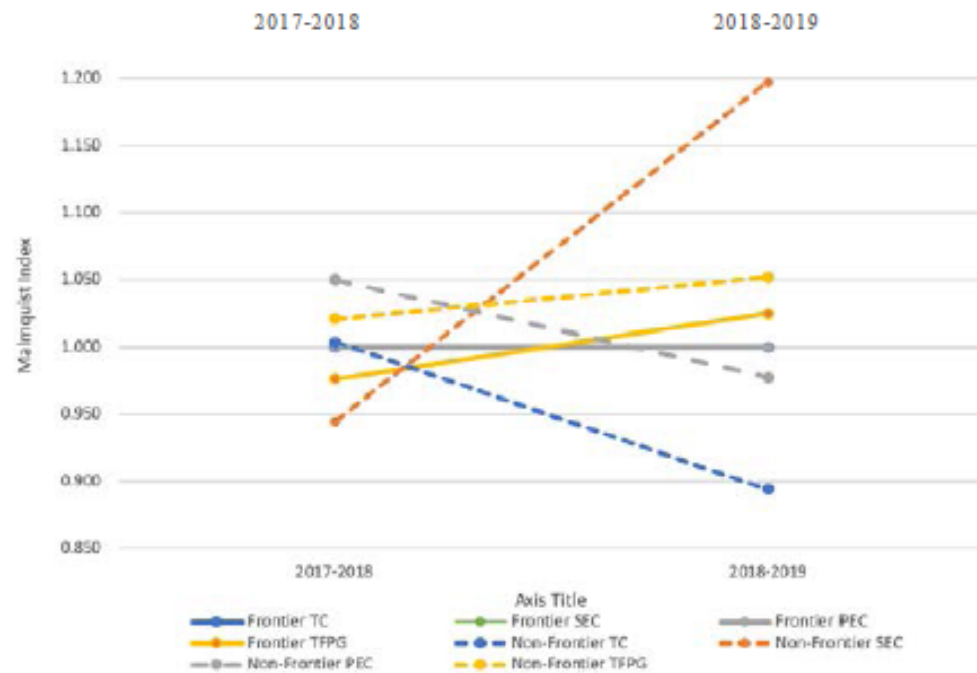


Figure 15 (a): Tourism Nexus productivity trend - frontier vs. non-frontier firms

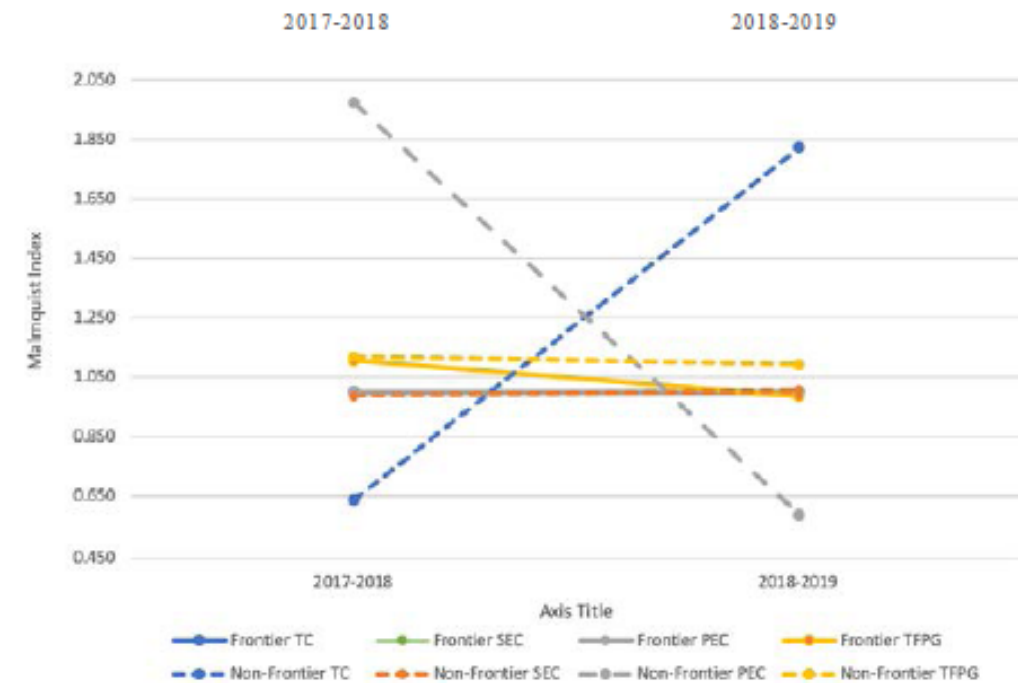


Figure 15 (b): E&E Nexus productivity trend - frontier vs. non-frontier firms



Summary

& Conclusion

Matters of concern

Slower positive trends
in TFP growth for the
Electrical and
Electronics Nexus

Deterioration of
average pure efficiency
trends for the non-
frontier firms under
both Nexus

The average input
usage patterns among
the non-frontier firms
were more than
doubled the required
level for both Nexus