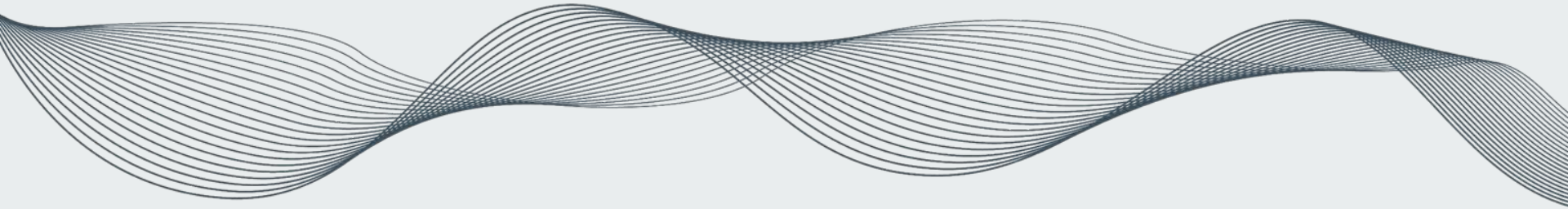
Estimating Productivity and Identifying the Frontier

Malaysia Productivity **Nexus**



TOC

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'

2. Identification of frontier firms and non-frontier firms at the sectoral level

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

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

The underlying productivity drivers

Source: New Zealand Productivity Commission (April, 2020)

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

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) construct 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.

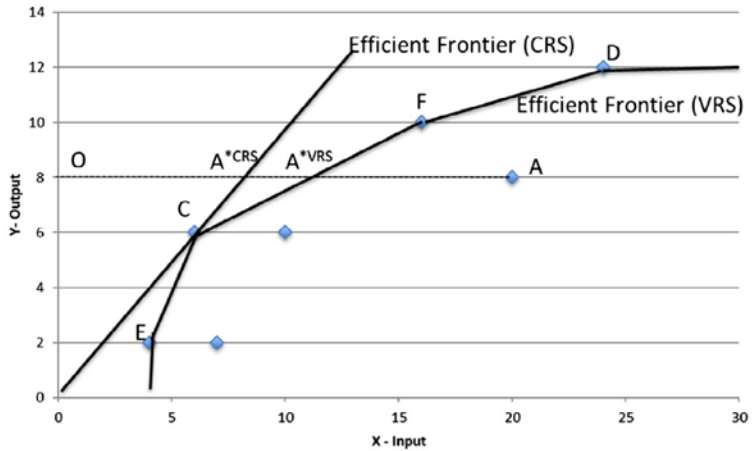


Figure 1: Hypothetical illustration of an efficient frontier

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

OECD MultiProd Project

Micro-aggregated data study on productivity patterns across countries and over time

MFP

OUTPUT	INPUT
Gross output Revenue	**Capital and Investment** Total investment across all asset classes
Value Added Revenues - cost of sales	**Labour** Employment in headcounts and; Labour costs

*The choice of simpler input measures has been driven by the aim of collecting comparable statistics across firms while achieving the broadest possible coverage.

MFP

OUTPUT	INPUT
Value Added Revenues - cost of sales	**Capital and Investment** Total investment across all asset classes
	Labour Employment in headcounts and; Labour costs

Total assets
Inventories, development property, plant equipment, investment properties, intangible assets, receivables and etc.

Total equity
Shareholder equities and non-controlling interest

Labour input
Proxied by staff costs (excluding executive director remunerations)

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.

BURSA MALAYSIA

MAIN Market

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

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

21

Electrical & Electronics

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&0 GREENTECH

Tech Equipments: 11

VSTECS
TRIVE
PENTA
NOTION
MMSVENTURES
MI
JCY
ITRONIC
FSBM
EDARAN
ELSOFT

Figure 3: Bursa Malaysia Main Market Indices

Findings

Preliminary

Firm-level efficiency score

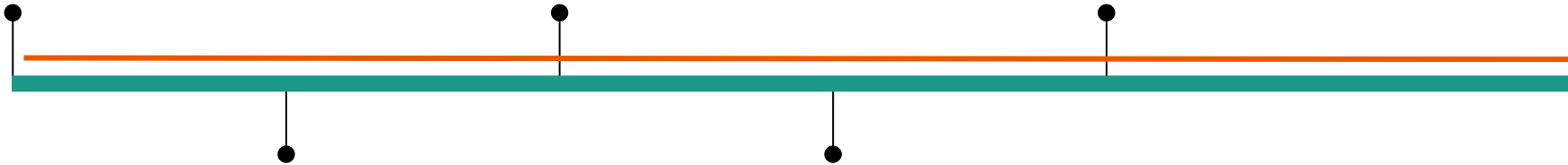
Firms' level efficiency scores for Electrical & Electronics Nexus over the period of 2017-2019

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

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

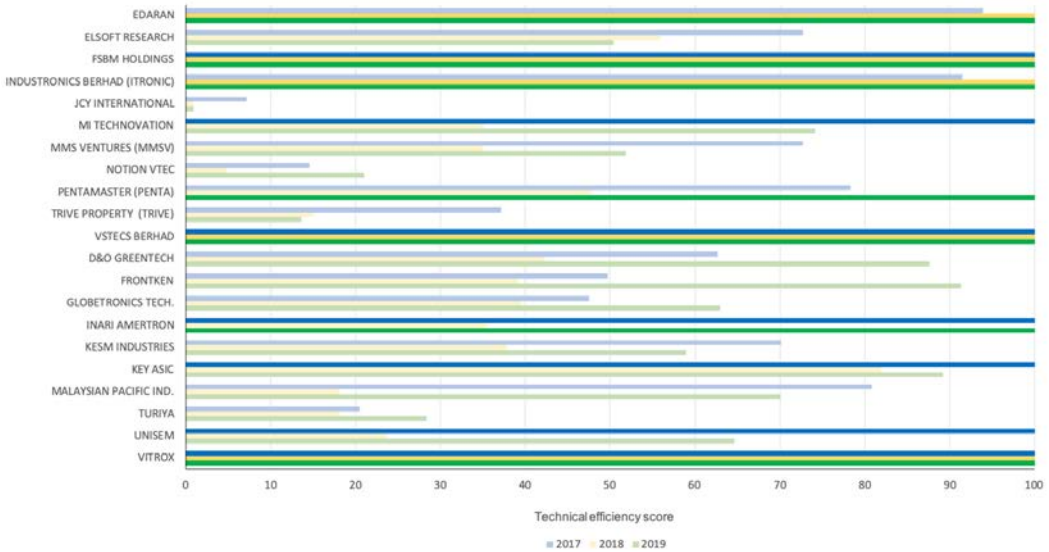


Figure 4: Electrical and Electronics Nexus technical efficiency and frontier firms

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

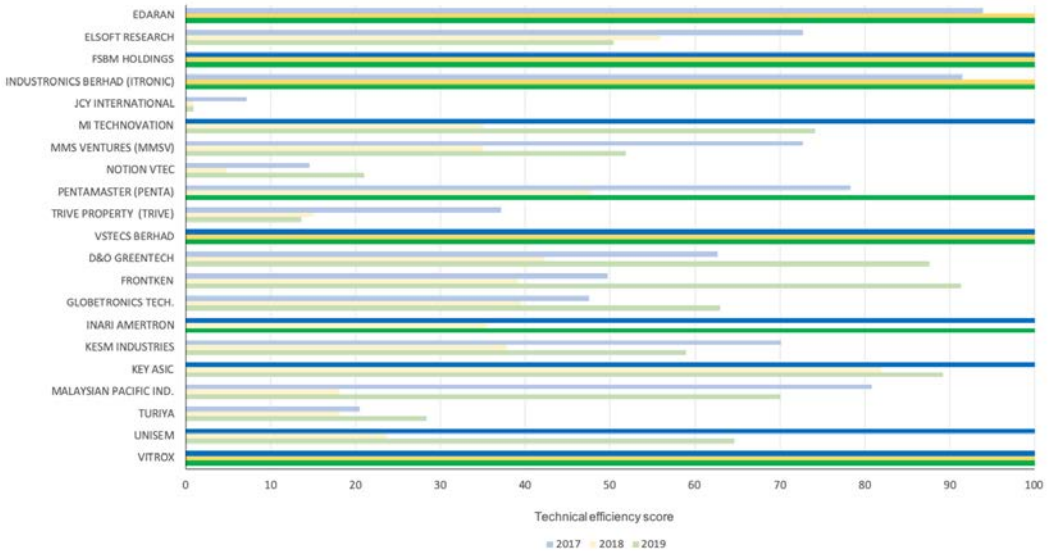


Figure 4: Electrical and Electronics Nexus technical efficiency and frontier firms

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.

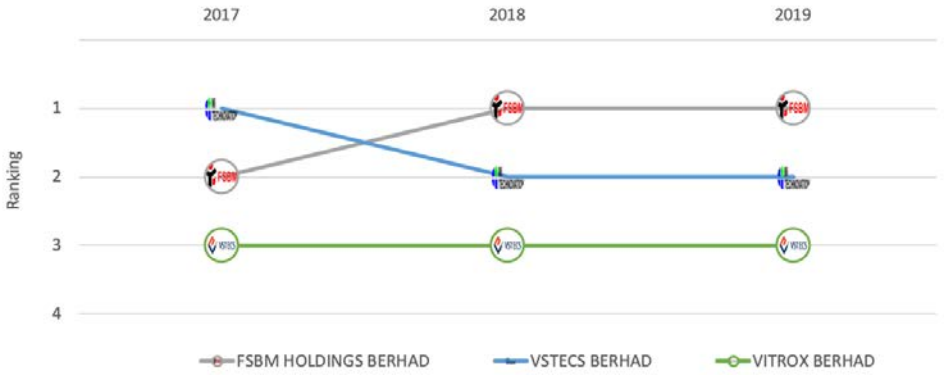


Figure 5: Electrical & Electronics Nexus frontier firms ranking

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.

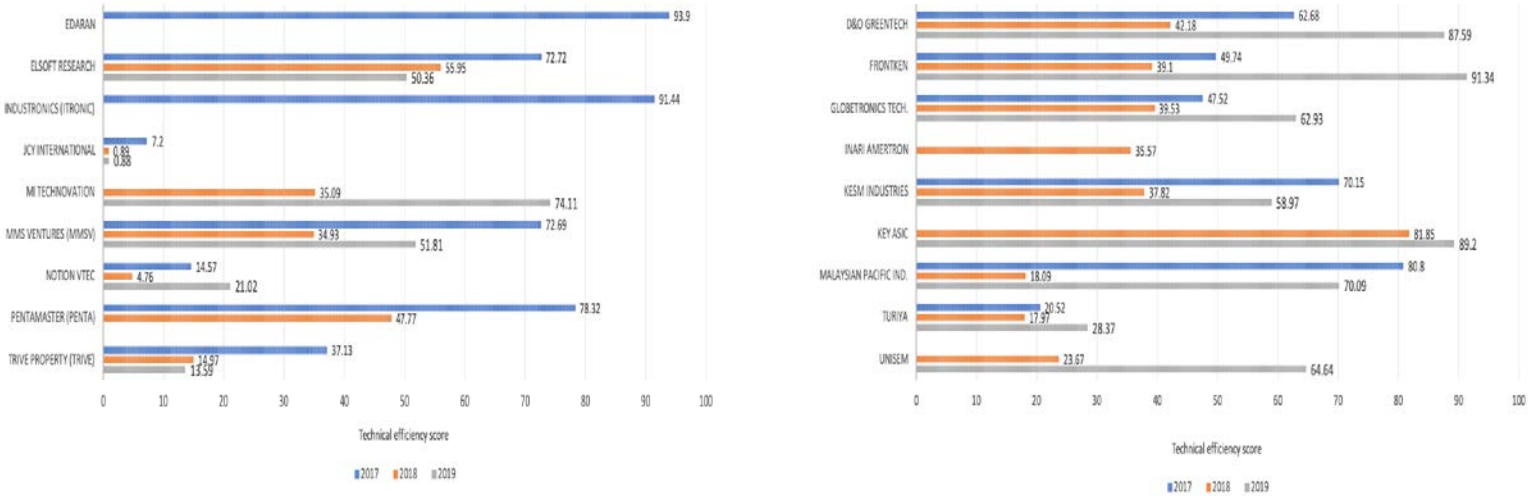


Figure 6: Electrical & Electronics Nexus technical inefficiency of the non-frontier firms

Findings

Electrical & Electronics Nexus

| 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.

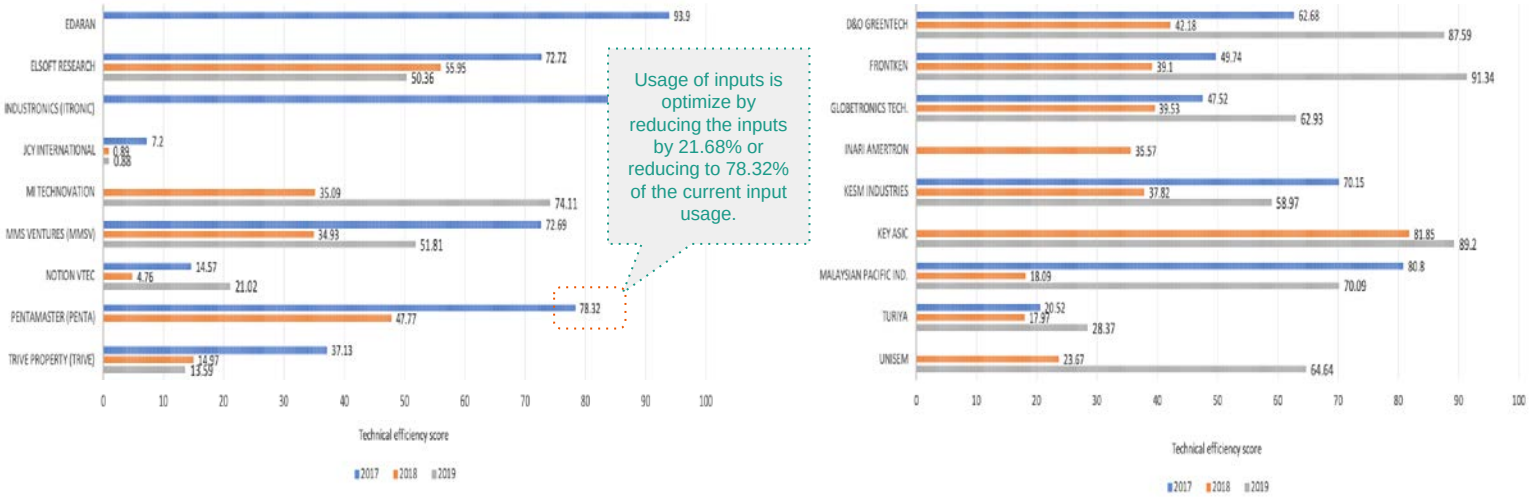


Figure 6: Electrical & Electronics Nexus technical inefficiency of the non-frontier firms

Findings

Electrical & Electronics Nexus

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.

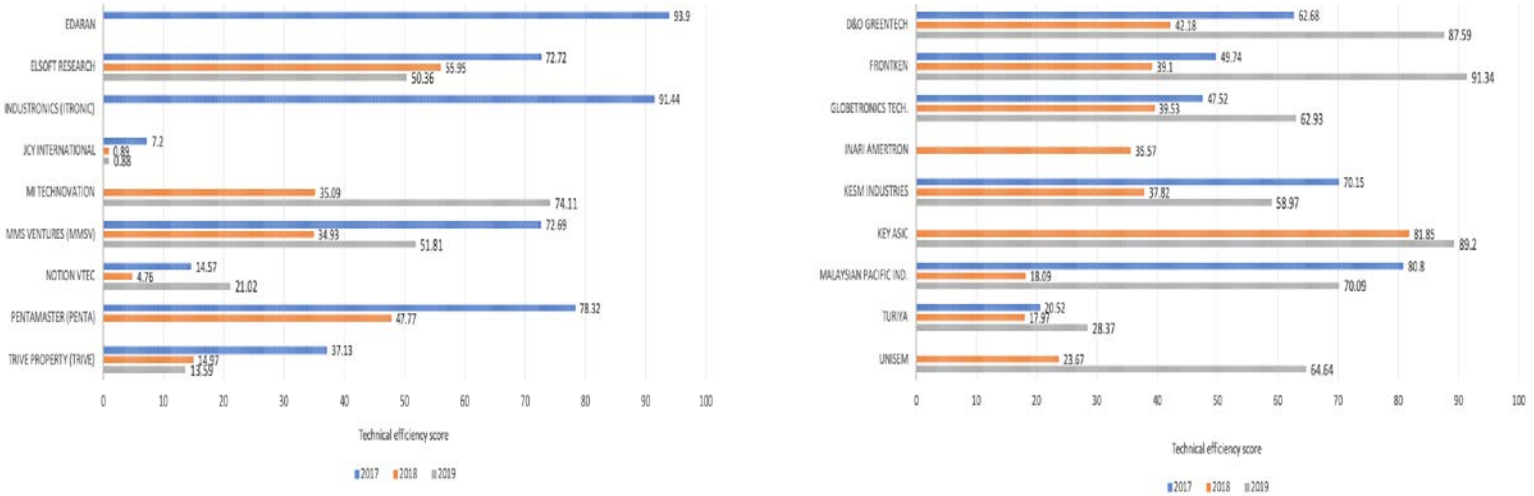


Figure 6: Electrical & Electronics Nexus technical inefficiency of the non-frontier firms

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

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	ViTrox
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	ViTrox
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)

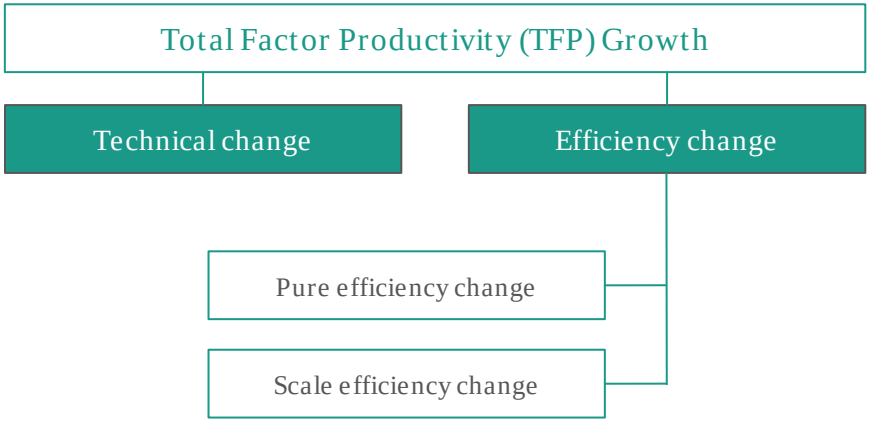
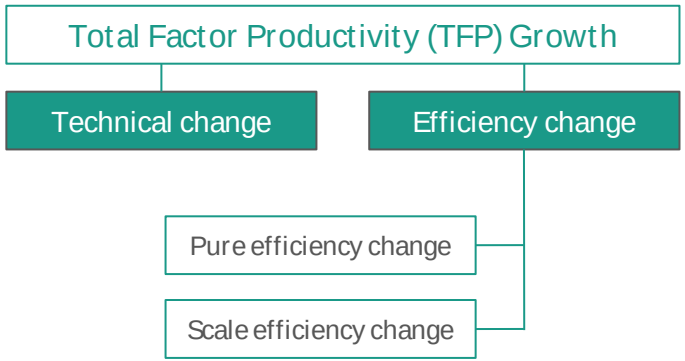


Figure 7: Decomposition of TFP growth

Findings

Electrical & Electronics Nexus

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



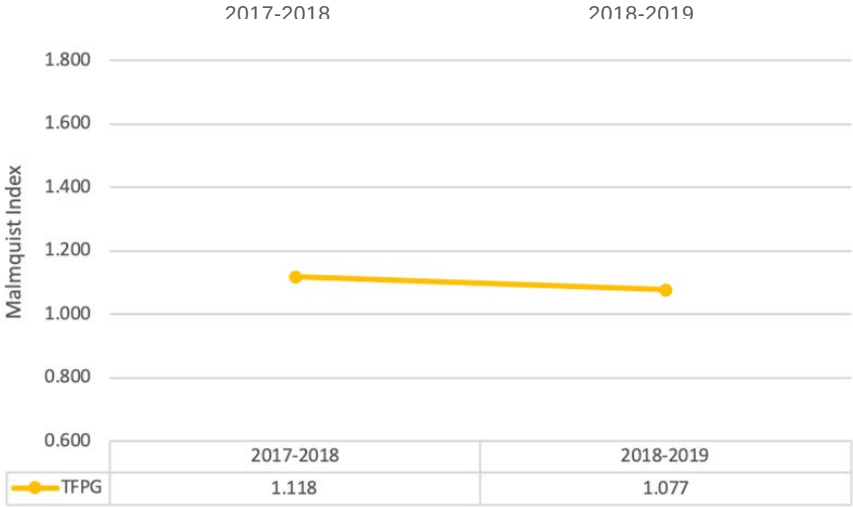


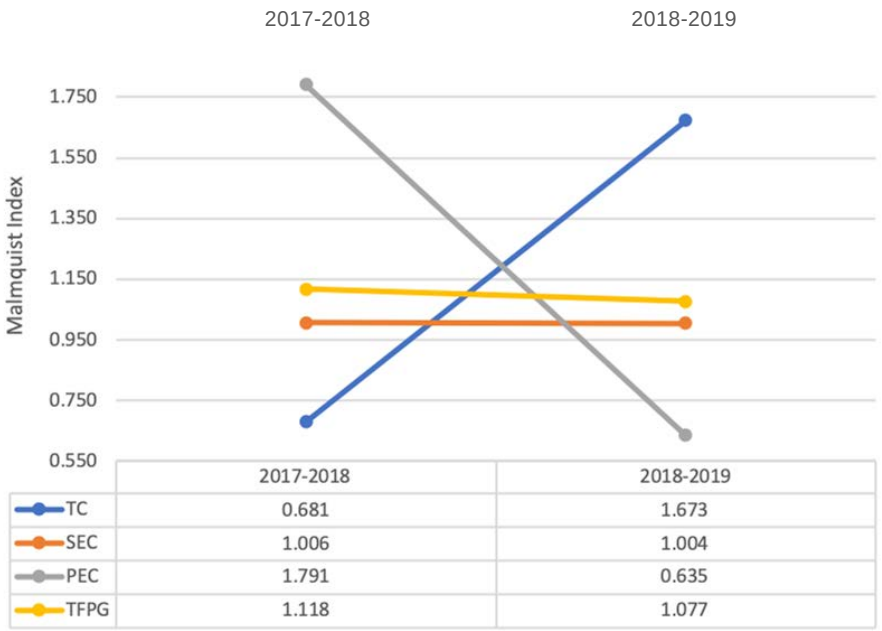
Figure 8: Tourism Nexus productivity trend

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.



	2017-2018	2018-2019
TC	0.681	1.673
SEC	1.006	1.004
PEC	1.791	0.635
TFPG	1.118	1.077

Figure 9: Electrical and Electronics Nexus productivity trend

Findings

Electrical & Electronics Nexus

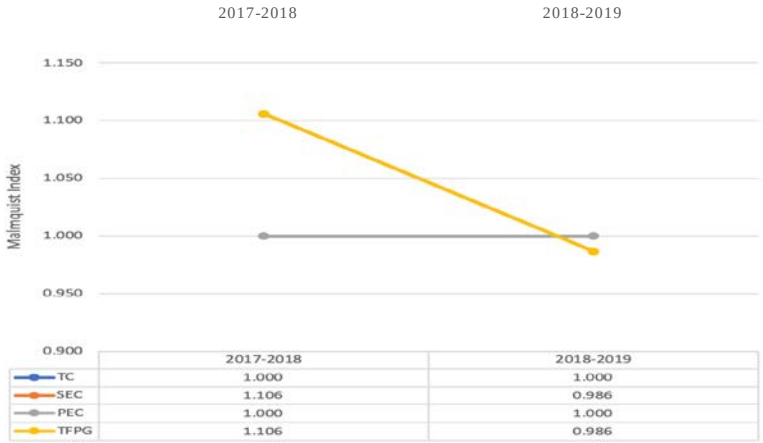


Figure 10 (a): E&E Nexus productivity trend for frontier firms

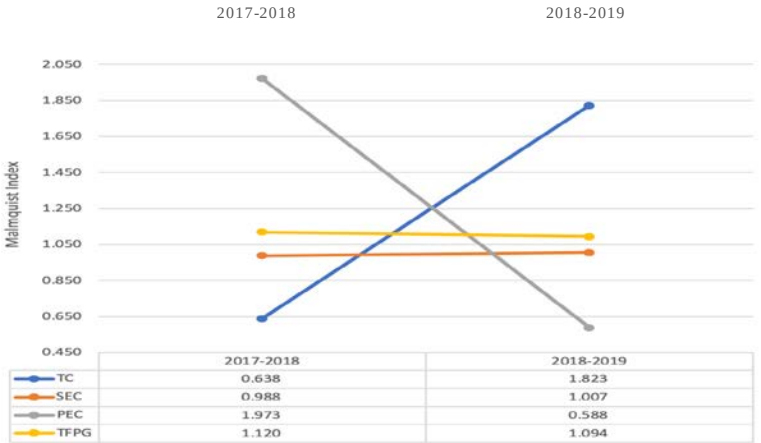


Figure 10 (b): E&E Nexus productivity trend for non-frontier firms

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.

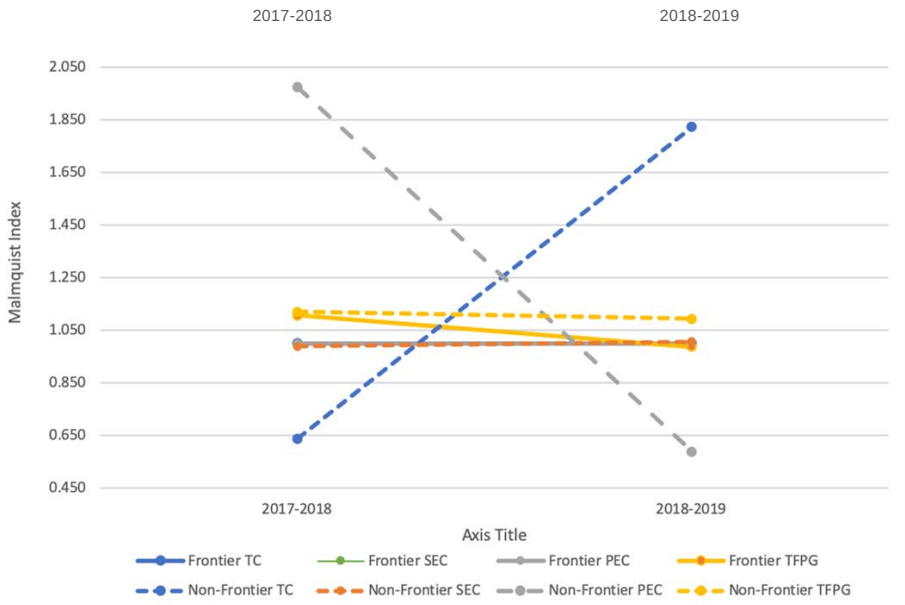


Figure 11: E&E Nexus productivity trend - frontier vs. non-frontier firms

Tourism

25

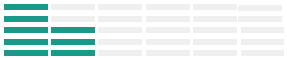
Electrical & Electronics

21

Summary

& Conclusion

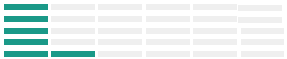
Tourism Nexus 2017



8

out of 25 firms were on the efficient frontier

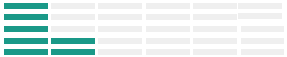
Tourism Nexus 2018



6

out of 25 firms were on the efficient frontier

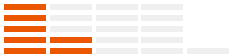
Tourism Nexus 2019



7

out of 25 firms were on the efficient frontier

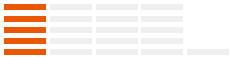
Electrical & Electronics Nexus 2017



7

out of 21 firms were on the efficient frontier

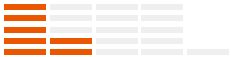
Electrical & Electronics Nexus 2018



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

25

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

Electrical & Electronics

21

- FSBM
- VSTECS
- VITROX

25

Tourism

21

Electrical & Electronics

Summary

& Conclusion

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

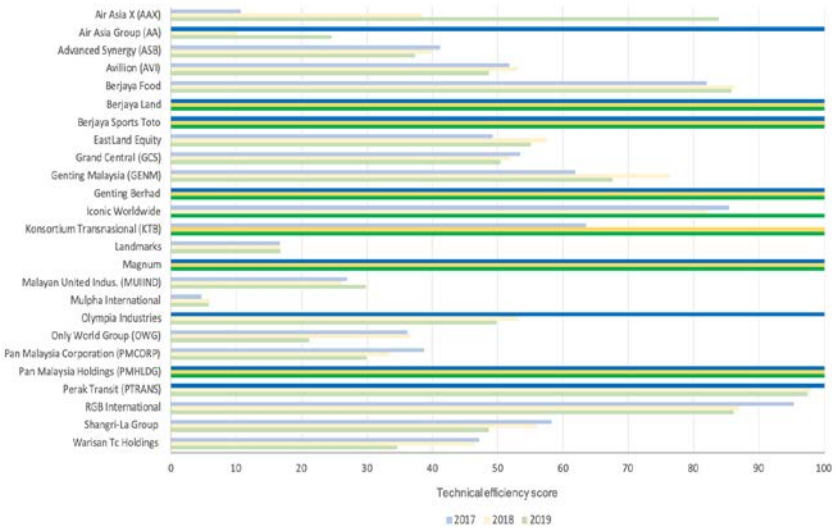


Figure 12 (a): Tourism Nexus technical efficiency and frontier firms

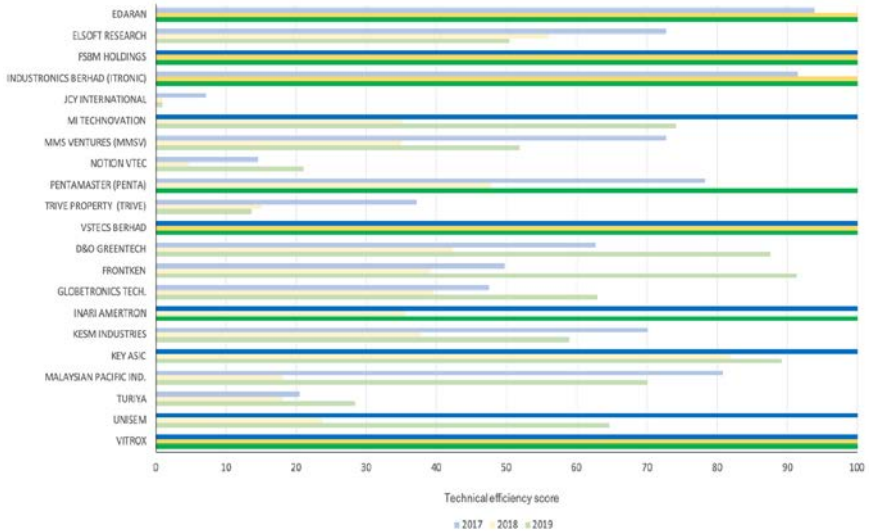


Figure 12 (b): E&E Nexus technical efficiency and frontier firms

25

Tourism

21

Electrical & Electronics

Summary

& Conclusion

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

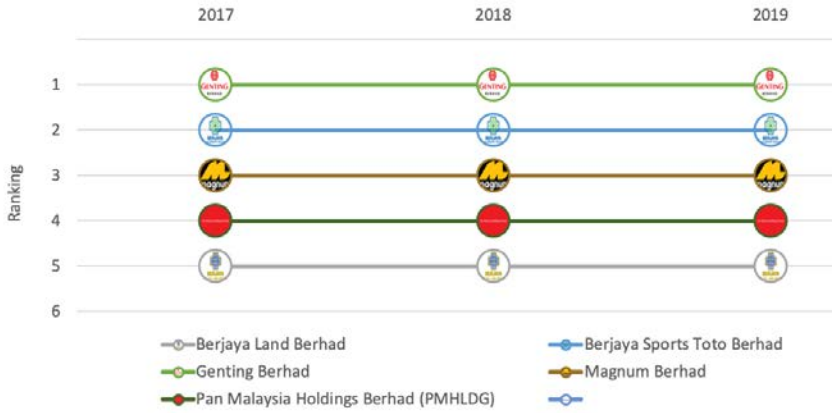


Figure 13 (a): Tourism Nexus frontier firms ranking

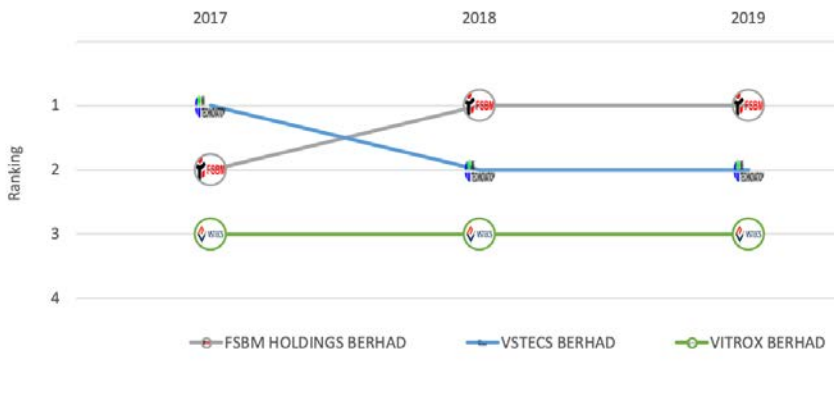


Figure 13 (b): Electrical & Electronics Nexus frontier firms ranking

25

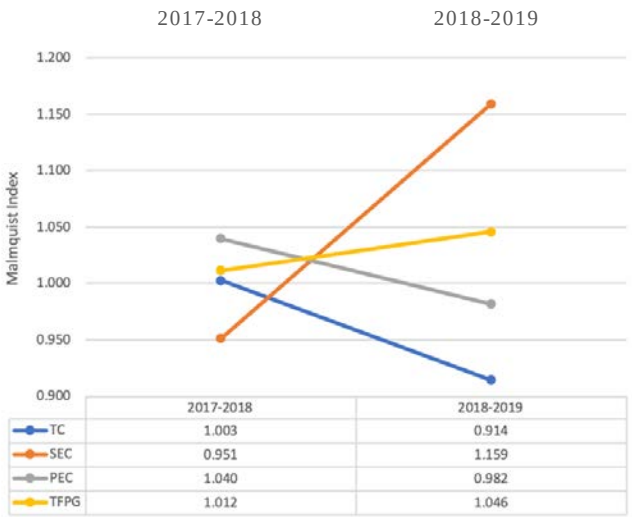
Tourism

21

Electrical & Electronics

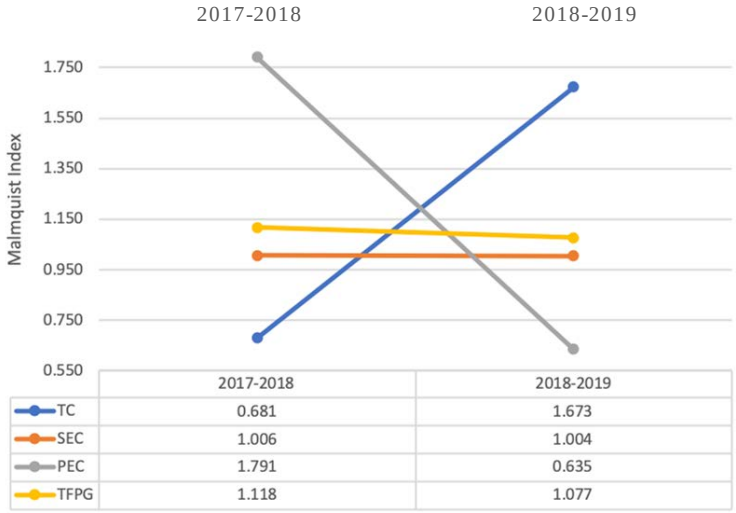
Summary

& Conclusion



	2017-2018	2018-2019
TC	1.003	0.914
SEC	0.951	1.159
PEC	1.040	0.982
TFPG	1.012	1.046

Figure 14 (a): Tourism Nexus productivity trend



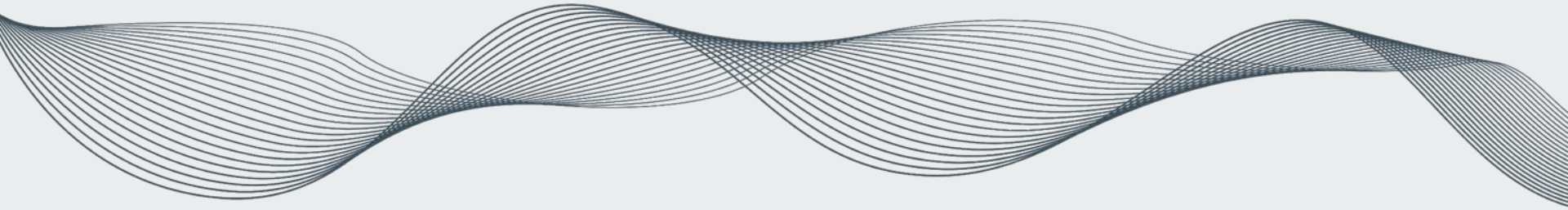
	2017-2018	2018-2019
TC	0.681	1.673
SEC	1.006	1.004
PEC	1.791	0.635
TFPG	1.118	1.077

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

Thank you.

Dr. Wan Rohaida Wan Husain
Assoc. Prof. Dr. Noorihsan Mohamad

International Islamic University Malaysia



25

Tourism

21

Electrical & Electronics

Summary

& Conclusion

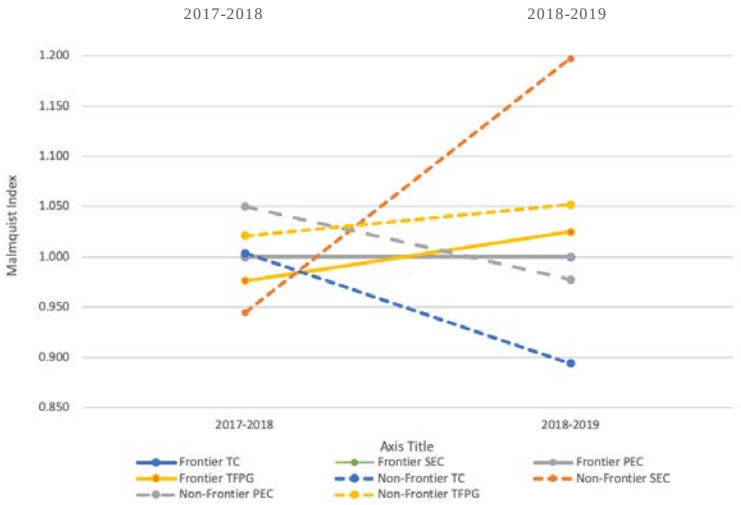


Figure 15 (a): Tourism Nexus productivity trend - frontier vs. non-frontier firms

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