

# Executive Summary

## Productivity and Performance of Thai Industry Report 2022



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# Executive Summary

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The Ministry of Industry's Industrial Economic Office (OIE) has commissioned the Fiscal Policy Research Institute Foundation (FisPRI) to conduct a comprehensive data survey and produce a report on the industrial performance for the year 2022, in order to facilitate the tracking of industrial economic developments. This data will serve as valuable information to support governmental policy formulation, measures, and planning, as well as private sector business operations. The project for the fiscal year 2023 aims to collect firm-level data from over 2,500 enterprises. This data will be analyzed to develop comprehensive Total Factor Productivity (TFP) indicators and study overall TFP Growth (TFPG) at the national level, industry level, and firm levels. The findings from this analysis will be used in the production and performance reports for the year 2022, as well as in significant policy recommendations. Furthermore, an analysis of leading industry players (Best Practice) and an examination of those facing challenges (Worst Practice) will be conducted to derive essential insights into the characteristics of high-performing benchmark groups and areas requiring improvement or vigilance.

In the realm of industrial analysis and operational performance assessment, we embark upon a journey to explore the concept of "Value Added" (VA). Value Added, within the economic context, signifies the economic value that accrues from the introduction of production factors into the production or service process, culminating in the creation of finished products or the completion of services. To unveil the origins of growth or the rate of increment in value added, we employ the Growth Accounting Model, a fundamental analytical accounting framework.

This model serves as our compass, guiding us in the pursuit of identifying the sources of economic growth, or the rate of increase in value added, stemming from critical primary production factors: labor and capital. Furthermore, it leads us to the assessment of Total Factor Productivity Growth (TFPG), a pivotal metric that encapsulates the expansion of overall production efficiency.

Thus, TFPG becomes a key indicator of the expansion of Value Added derived from various contributing factors. These factors encompass the quality of production inputs, both in terms of labor and capital. Additionally, they encompass the capabilities in various management domains, financial risk management, technological advancements, market conditions, and a myriad of external influences that may impact the generation of value added and the conduct of business operations.

In addition, an analysis of the key distinguishing characteristics of enterprises in the best practice group and the worst practice group compared to other groups can enhance our understanding of the success factors for enterprises in this particular group. It can also serve as a guideline for the development of enterprises in other groups, as well as for identifying future risk factors. The study results are elaborated as follows.

## Survey Result and Industry Structure

The field survey sampling in 2023 is designed to cover a TSIC manufacturing classification (21 2-digit industries segments)<sup>1</sup>, size of enterprises (small, medium, and large), and region (Bangkok and vicinities, Central, Western, Eastern, Northeastern, Southern, and Northern). Researchers acquire samples from a firm database collected by the Departments of Industrial works, an agency under the Ministry of Industry. The data from the Department of Business Development and the National Statistical Office are used in this study. Researchers limit samples to an active business firm that submit a financial statement in 2022. Finally, the sample size is 3,083 firms which cover 73.3% of the total sale of manufacturing firms from an industry census.

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<sup>1</sup>2-digit TSIC industries includes TSIC: 10 Manufacture of food products, TSIC: 11 Manufacture of beverages, TSIC: 12 Manufacture of tobacco products, TSIC: 13 Manufacture of textiles, TSIC: 14 Manufacture of wearing apparel, TSIC: 15 Manufacture of leather and related products, TSIC: 17 Manufacture of paper and paper products, TSIC: 19 Manufacture of coke and refined petroleum products, TSIC: 20 Manufacture of chemicals and chemical products, TSIC: 21 Manufacture of basic pharmaceutical products and pharmaceutical preparations, TSIC: 22 Manufacture of rubber and plastics products, TSIC: 23 Manufacture of other non-metallic mineral products, TSIC: 24 Manufacture of basic metals, TSIC: 25 Manufacture of fabricated metal products, except machinery and equipment, TSIC: 26 Manufacture of computer, electronic and optical products, TSIC: 27 Manufacture of electrical equipment, TSIC: 28 Manufacture of machinery and equipment, not elsewhere classified, TSIC: 29 Manufacture of motor vehicles, trailers and semi-trailers, TSIC: 30 Manufacture of other transport equipment, TSIC: 31 Manufacture of furniture, and TSIC: 32 Other manufacturing

The three highest firm numbers by manufacturing sectors in sample size are TSIC 10 Manufacture of food production, TSIC 22 Manufacture of rubber and plastic products, and TSIC 23 Manufacture of other non-metallic mineral products with samples contributed at 800, 359, and 283 respectively. On the size of the enterprise, the large enterprise shares the biggest portion with 1,414 samples (45.86%). Follow by the medium size at 800 samples (25.95%). The small enterprise shares the least portion with 869 samples (28.19%). The top three region contributions are Bangkok and vicinities with the highest contributor at 1,711 samples (55.50%). Follow by Eastern with 553 samples (17.94%) and the Northeastern region at 238 samples (7.72%)

**Table 1 : Field survey sample's structure**

**(a) The sample size is classified by TSIC and Enterprise Size**

| TSIC  |                       | Sale by Firm<br>Population<br>(%) | Size of Enterprise (samples) |       |     |       |     |       |       |       |
|-------|-----------------------|-----------------------------------|------------------------------|-------|-----|-------|-----|-------|-------|-------|
|       |                       |                                   | L                            | %     | M   | %     | S   | %     | Sum   | %     |
| 10    | Food                  | 88.7                              | 360                          | 11.68 | 182 | 5.90  | 258 | 8.37  | 800   | 25.9  |
| 11    | Beverage              | 83.5                              | 42                           | 1.36  | 9   | 0.29  | 31  | 1.01  | 82    | 2.7   |
| 12    | Tobacco               | 88.3                              | 4                            | 0.13  | 3   | 0.10  | 1   | 0.03  | 8     | 0.3   |
| 13    | Textiles              | 45.3                              | 31                           | 1.01  | 22  | 0.71  | 23  | 0.75  | 76    | 2.5   |
| 14    | Apparel               | 29.5                              | 26                           | 0.84  | 32  | 1.04  | 33  | 1.07  | 91    | 3.0   |
| 15    | Leather               | 69.7                              | 24                           | 0.78  | 29  | 0.94  | 29  | 0.94  | 82    | 2.7   |
| 17    | Paper                 | 78.9                              | 53                           | 1.72  | 37  | 1.20  | 31  | 1.01  | 121   | 3.9   |
| 19    | Petroleum             | 82.5                              | 20                           | 0.65  | 8   | 0.26  | 7   | 0.23  | 35    | 1.1   |
| 20    | Chemical              | 93.2                              | 133                          | 4.31  | 73  | 2.37  | 58  | 1.88  | 264   | 8.6   |
| 21    | Pharmacy              | 77.7                              | 22                           | 0.71  | 22  | 0.71  | 9   | 0.29  | 53    | 1.7   |
| 22    | Rubber and<br>Plastic | 65.1                              | 172                          | 5.58  | 89  | 2.89  | 98  | 3.18  | 359   | 11.6  |
| 23    | Non-Metallic          | 90.1                              | 86                           | 2.79  | 72  | 2.34  | 125 | 4.05  | 283   | 9.2   |
| 24    | Basic Metal           | 69.8                              | 57                           | 1.85  | 14  | 0.45  | 16  | 0.52  | 87    | 2.8   |
| 25    | Fab Metal             | 52.5                              | 51                           | 1.65  | 40  | 1.30  | 16  | 0.52  | 107   | 3.5   |
| 26    | Electronic            | 50.3                              | 66                           | 2.14  | 8   | 0.26  | 5   | 0.16  | 79    | 2.6   |
| 27    | Elec Appl.            | 65.6                              | 67                           | 2.17  | 36  | 1.17  | 16  | 0.52  | 119   | 3.9   |
| 28    | Machinery             | 54.0                              | 38                           | 1.23  | 21  | 0.68  | 13  | 0.42  | 72    | 2.3   |
| 29    | Automotive            | 61.8                              | 89                           | 2.89  | 37  | 1.20  | 27  | 0.88  | 153   | 5.0   |
| 30    | Other<br>Transport    | 99.1                              | 17                           | 0.55  | 9   | 0.29  | 9   | 0.29  | 35    | 1.1   |
| 31    | Furniture             | 50.6                              | 22                           | 0.71  | 28  | 0.91  | 33  | 1.07  | 83    | 2.7   |
| 32    | Other product         | 67.8                              | 34                           | 1.10  | 29  | 0.94  | 31  | 1.01  | 94    | 3.0   |
| Total |                       | 73.3                              | 1,414                        | 45.86 | 800 | 25.95 | 869 | 28.19 | 3,083 | 100.0 |

**(b) The sample size classified by Area and Region**

| Area                   | Amount       | Portion (%) |
|------------------------|--------------|-------------|
| Bangkok and vicinities | 1,711        | 55.50       |
| Eastern                | 553          | 17.94       |
| Northeastern           | 238          | 7.72        |
| Central                | 181          | 5.87        |
| Southern               | 161          | 5.22        |
| Northern               | 131          | 4.25        |
| Western                | 108          | 3.50        |
| <b>Total</b>           | <b>3,083</b> | <b>100</b>  |

Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

## Result of Productivity and Performance Analysis

### 1. Total Factor Productivity of Manufacturing Sector

In 2023, the overall performance of the manufacturing industry witnessed a significant increase in value added, expanding by 8.31%. This growth was primarily driven by an increase in working hours and capital inputs, which expanded by 5.10% and 0.37% respectively. Additionally, the Total Factor Productivity (TFP) of businesses reflected an expansion of 2.83%, largely due to external factors. Notably, market conditions improved, with a market expansion of 8.47%, coupled with recovery in both domestic and international sales. Furthermore, the quality of capital inputs saw an increase of 0.54%, attributed to a higher proportion of new machinery and an uptick in the use of automated and semi-automated machines. Conversely, the quality of labor inputs marginally declined by 0.03%, as the proportion of skilled and professional workers decreased, despite increased training efforts. Other quality-related factors contracted by 6.15%, mainly due to rising costs, which led to a decrease in value creation and liquidity, alongside a reduced ratio of capital inputs relative to labor and a slowdown in investment in research and development. However, businesses showed adaptability and development, reflected in increased adoption of Original Design Manufacturing (ODM) and Original Brand Manufacturing (OBM) models, greater use of E-Commerce, and a reduction in entrepreneurs' debt risk. Overall, these internal and external qualitative changes resulted in a 3.35% increase in the productive capacity of capital inputs, while labor productivity saw a decline of 0.52%.

**Figure 1 : The Value-Added Growth in Manufacturing Sector and Its Components in 2022**

| Year | Value Added | VA Contributed by |         |      |                     |                      |
|------|-------------|-------------------|---------|------|---------------------|----------------------|
|      |             | Labor             | Capital | TFPG | TFPG Contributed by |                      |
|      |             |                   |         |      | Labor Productivity  | Capital Productivity |
| 2022 | 8.30        | 5.10              | 0.37    | 2.83 | -0.52               | 3.35                 |
| 2021 | 9.34        | 0.31              | 2.15    | 6.88 | 5.16                | 1.72                 |

| Year | TFPG | TFPG Contributed by |               |               |               |
|------|------|---------------------|---------------|---------------|---------------|
|      |      | Labor Quality       | Labor Quality | Labor Quality | Labor Quality |
| 2022 | 2.83 | -0.03               | 0.54          | -6.15         | 8.47          |
| 2021 | 6.88 | 0.33                | 0.08          | -0.24         | 6.71          |

| Market Condition    |                                       |       |       |                                      |       |       |
|---------------------|---------------------------------------|-------|-------|--------------------------------------|-------|-------|
|                     |                                       | 2022  | 2021  |                                      |       |       |
| ▪ Sales growth (%)  |                                       | 13.04 | 10.32 |                                      |       |       |
| ▪ Export growth (%) |                                       | 9.76  | 14.92 |                                      |       |       |
| Input Quality       | ▪ Skill Labor share (%)               | 76.08 | 76.14 | ▪ Capital per Labor (mil.THB/person) | 1.65  | 1.68  |
|                     | ▪ Trained Labor share (%)             | 23.81 | 19.22 | ▪ Costs to Sales ratio (%)           | 77.10 | 76.47 |
|                     | ▪ Labor Age (year)                    | 36.91 | 36.36 | ▪ VA to Sales ratio (%)              | 22.85 | 23.74 |
|                     | ▪ New Machinery & Equipment share (%) | 11.90 | 11.14 | ▪ E-Commerce share (%)               | 1.75  | 1.36  |
|                     | ▪ Automation share (%)                | 29.61 | 27.95 | ▪ ODM & OBM share (%)                | 26.43 | 25.41 |
| Technology          | ▪ R&D to sales ratio (%)              | 0.08  | 0.11  | ▪ Current ratio (time)               | 1.76  | 1.93  |
|                     |                                       |       |       | ▪ Debts ratio (time)                 | 0.44  | 0.45  |
|                     |                                       |       |       | ▪ D/E ratio (time)                   | 0.52  | 0.54  |
| Management          |                                       |       |       |                                      |       |       |

**Quality Factors of TFP Determinants**

Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

## 2. Industry Status by Value Added and Total Factor Productivity

To evaluate the status of enterprises in the manufacturing sector, we used value-added growth and TFP growth as our splitting criteria and our results divided the industry into 4 stages as follows:

- **Good:** The expansion of value added and TFP indicates that entrepreneurs are capable of enhancing output and improving business performance. This also encompasses the development of production capabilities and the refinement of quality-oriented factors.

- **Poor:** The contraction of value added and TFP signifies a decline in entrepreneurs' output and operational results. This trend also indicates a diminished capability in production and a deterioration in qualitative factors
- **Uptrend:** Value-added contracts, yet TFP continues to expand, indicating a decrease in entrepreneurs' output and profitability. However, there is an onset of enhancements in production capabilities and improvements in qualitative factors.
- **Downtrend:** The expansion of value-added indicates that entrepreneurs are generating higher outputs and business results. However, the contraction of TFP suggests a declining proficiency in production capabilities and a deterioration in quality-related factors.

When considering the growth of value added and TFP Growth, classified by the growth status of these two indicators among different groups of enterprises, it was evident that the majority of enterprises were able to continuously recover and maintain a favorable position. There was an increase in value added and production capabilities. However, sectors experiencing a contraction in value added included textiles, paper, rubber, plastics, non-metallic minerals, and machinery. Conversely, sectors like tobacco production, chemicals, basic metals, fabricated metals, electronics, electrical appliances, and furniture were in a less favorable position, suffering from decreased value added and reduced production capabilities.

**Table 2 : Classification of Industry by Value-Added Growth and TFP Growth in 2022**

|  |   |
|--|---|
| <p><b>Uptrend: Falling Value-Added, but Expanding TFP</b></p> <p style="text-align: center;">-</p>   | <p><b>Good: Expanding Value-Added and TFP</b></p> <ul style="list-style-type: none"> <li>• Size: Large, Medium, and Small</li> <li>• Region: Bangkok and vicinities, Central, North, Northeast, East, and West</li> <li>• Sector: Food, Beverage, Textile, Leather, Petroleum, Pharmaceutical, Automotive, Other Transport Equipment, and Other Products</li> </ul> |
| <p><b>Poor: Shrinking Value-Added and TFP</b></p> <ul style="list-style-type: none"> <li>• Sector: Tobacco, Chemical, Basic Metal, Fabricated Metal, Electronics, Electrical, and Furniture</li> </ul> | <p><b>Downtrend: Growing Value-Added, but Declining TFP</b></p> <ul style="list-style-type: none"> <li>• Region: South</li> <li>• Sector: Apparel, Paper, Rubber, Plastic, Non-metallic, and Machinery</li> </ul>   |

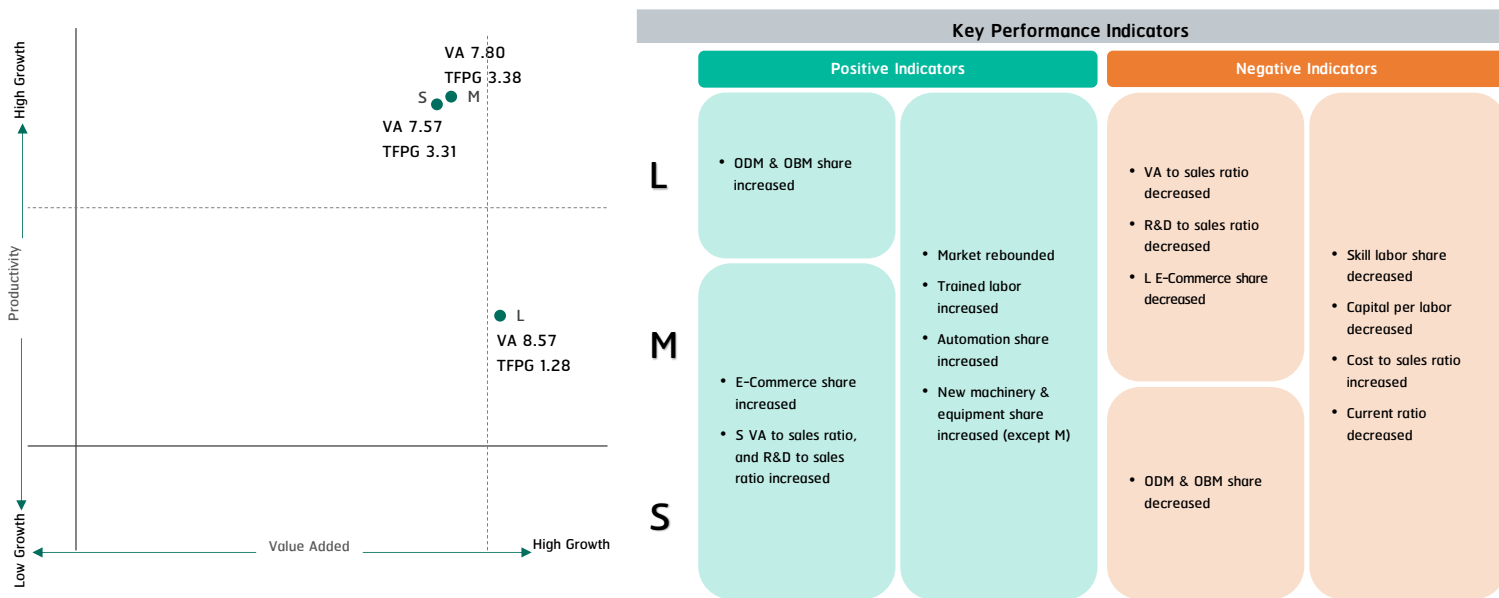
Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

**1) Evaluate by Size Classification:** In 2022, enterprises of all sizes continued to experience an increase in their value added and TFP growth. A significant source of this value added was attributed to the volume of labor input. Large enterprises showed a higher expansion in value-added compared to Small and Medium-sized Enterprises (SMEs), while SMEs themselves demonstrated better recovery and a higher rate of TFP growth. Key factors supporting the TFP Growth across all enterprises sizes included the recovery of markets, especially international ones, and the improved quality of capital inputs marked by an increase in automated machinery and equipment. This was complemented by intensified efforts in labor training and development. Additionally, large enterprises had increasingly adopted Original Design Manufacturing (ODM) and Original Brand Manufacturing (OBM) models. In the SME sector, there had been a notable rise in the proportion of E-Commerce activities. Meanwhile, medium-sized businesses had experienced a reduction in debt burdens, and small enterprises have not only increased their value creation but also invested more in research and development.

For significant risk factors negatively impacting the TFP Growth of businesses of various sizes, the primary ones included a decline in the quality of the labor force due to a reduced proportion of skilled labor, a slowdown in investments leading to a decreased ratio of capital utilization per worker, increased costs, and heightened financial risks due to reduced liquidity. Large and medium-sized enterprises had seen a reduction in value addition. Furthermore, large businesses had experienced a decrease in the proportion of E-Commerce and investments in research and development. Additionally, both large and small enterprises face increased debt burdens. This included SMEs (Small and Medium-sized Enterprises), which had also seen a decrease in production in the ODM and OBM.



Figure 2 : Results of Productivity and Performance by Size in 2022



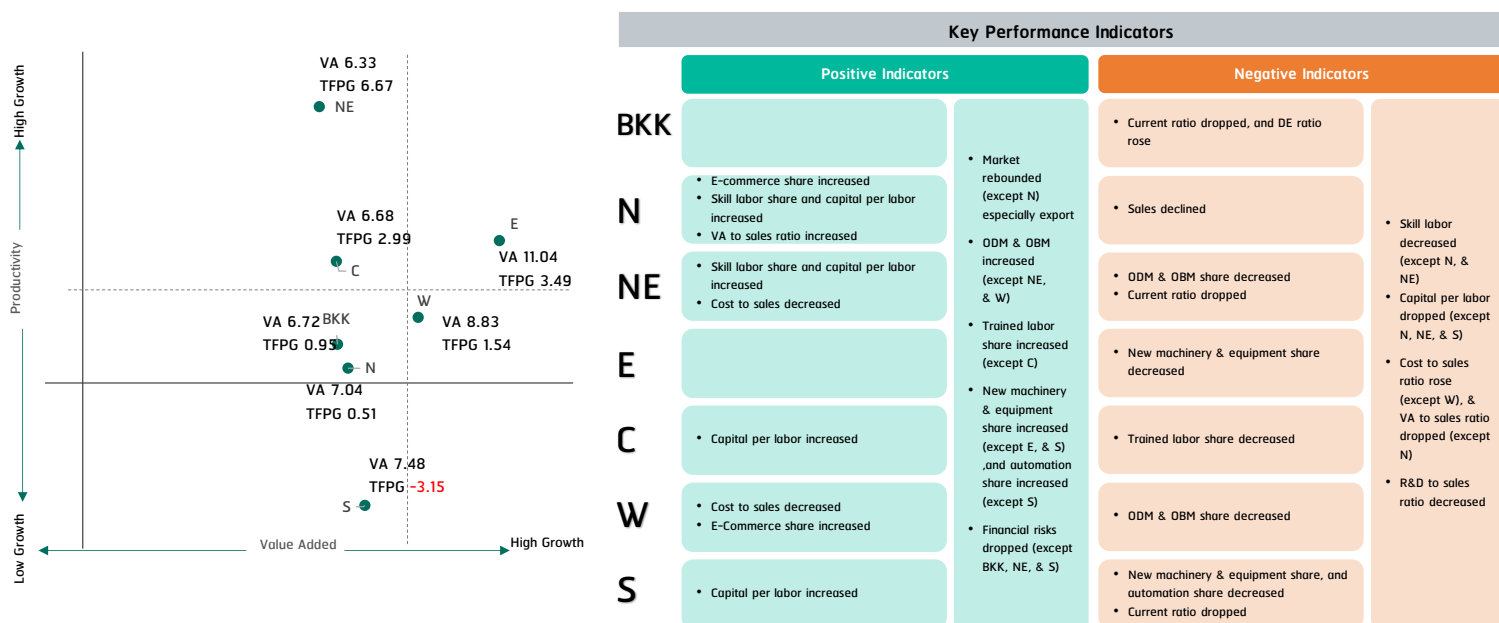
Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

**2) Classification by region:** In most regions, the value added had significantly increased, with nearly every region experiencing expansion in TFP, except for the Southern region. The Eastern region witnessed the most substantial expansion in value added, and the Northeastern region experienced the greatest growth in TFP. Nearly all regions saw labor quantity as the primary factor influencing the expansion of value added. However, for the Northeastern region, TFP was a significant factor. Key factors supporting TFP Growth in each region included a recovering market, especially the foreign markets, along with a general improvement in the quality of capital factors. This was complemented by increased training of the workforce, advancements in ODM and OBM, reduced financial risks with increased liquidity, and a decrease in debt accumulation. Furthermore, the Northern, Northeastern, and Southern regions increased their capital-to-labor ratio. The Northern and Western regions saw a rise in the proportion of E-Commerce. Additionally, the Northern region adjusted to enhance its capacity to generate more value added, while the Western region experienced a reduction in costs per sales.

For the key risk factors that adversely affected TFP Growth across all regions, the predominant issue was that entrepreneurs in each region generally experienced a decrease in the proportion of skilled labor, utilized less capital per worker, faced rising costs, and saw a reduction in value creation. Moreover, investment in research and development also slowed down. Additionally, enterprises in the Bangkok area, Northeastern, and Southern regions

experienced a decrease in liquidity. Specifically, the South faced a decline in the quality of capital inputs, while the East saw a reduction in the proportion of new machinery. Furthermore, the Northern region witnessed a contraction in sales growth.

**Figure 3 : Results of Productivity and Performance of Industry by Region in 2022**

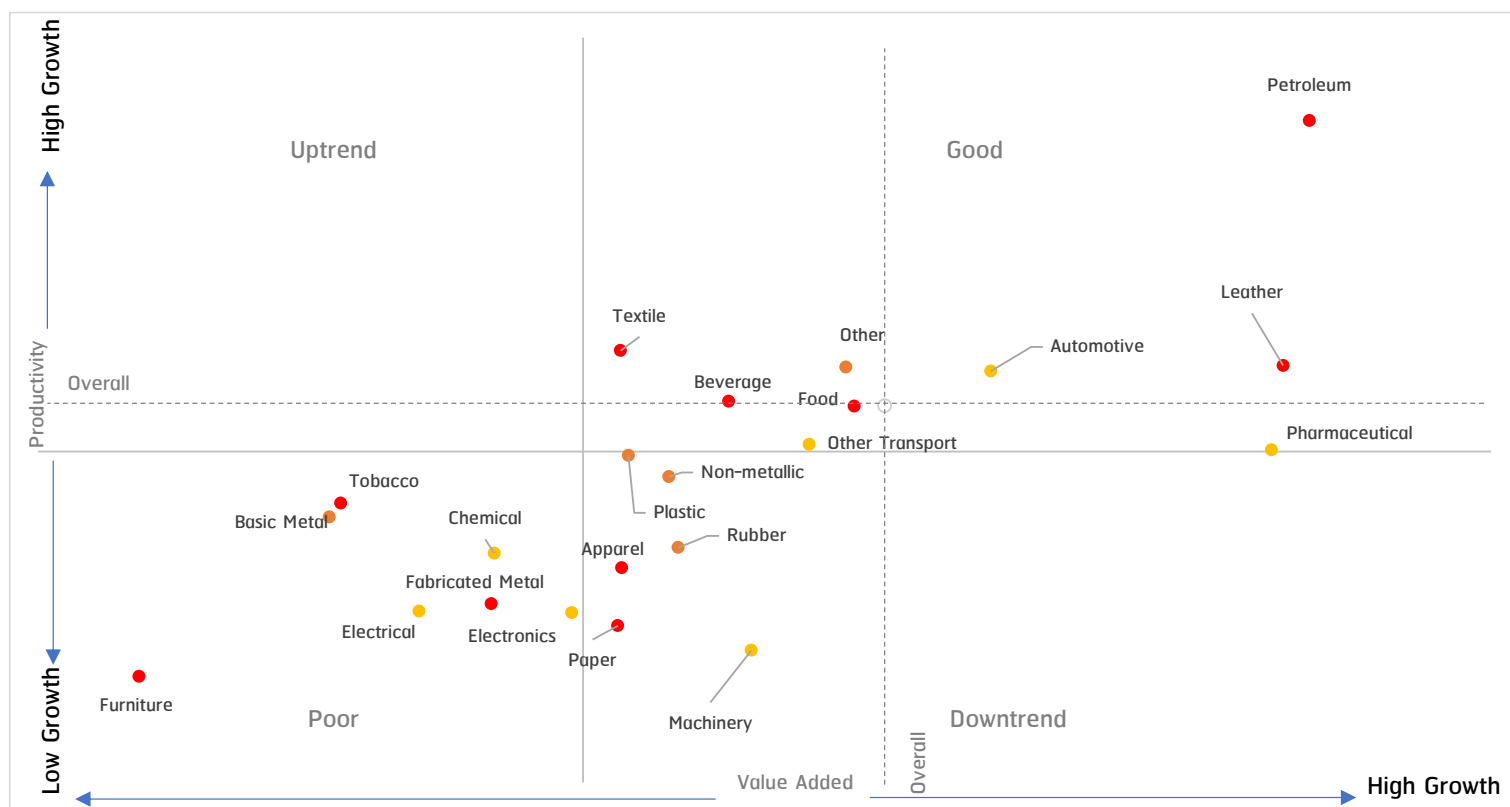


Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

**3) Classification by Sector:** In 2022, the manufacturing sector was able to continuously recover and was in a good state, with increased value added and production capabilities. However, industries that experienced a contraction in value added included textiles, paper, rubber, plastics, non-metallic minerals, and machinery, which were trending negatively. This also included sectors like tobacco, chemicals, basic metals, fabricated metals, electronics, electrical, and furniture, which were in a poor state with declining production capabilities. The primary factor contributing to the expansion of value added in most manufacturing sectors was labor, except for sectors like beverages, textiles, petroleum, automotive, and other products where TFP Growth was a significant factor. The change in TFP in most well-performing manufacturing sectors was mainly driven by external factors, specifically market conditions, except for the beverage. Conversely, the poorly performing and negatively trending manufacturing sectors were primarily influenced by other qualitative factors as important components of their TFPG. Nevertheless, changes in both internal and external factors, especially market conditions, also led to an increase in the productivity of production factors, particularly capital productivity, except in sectors like non-metallic mineral,

machinery, and other products, where labor productivity decreased, except in sectors like food, beverages, textiles, leather products, petroleum, automotive, and other transport equipment.

Figure 4 : Results of Productivity and Performance of Industry by Sector in 2022



Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

Note:

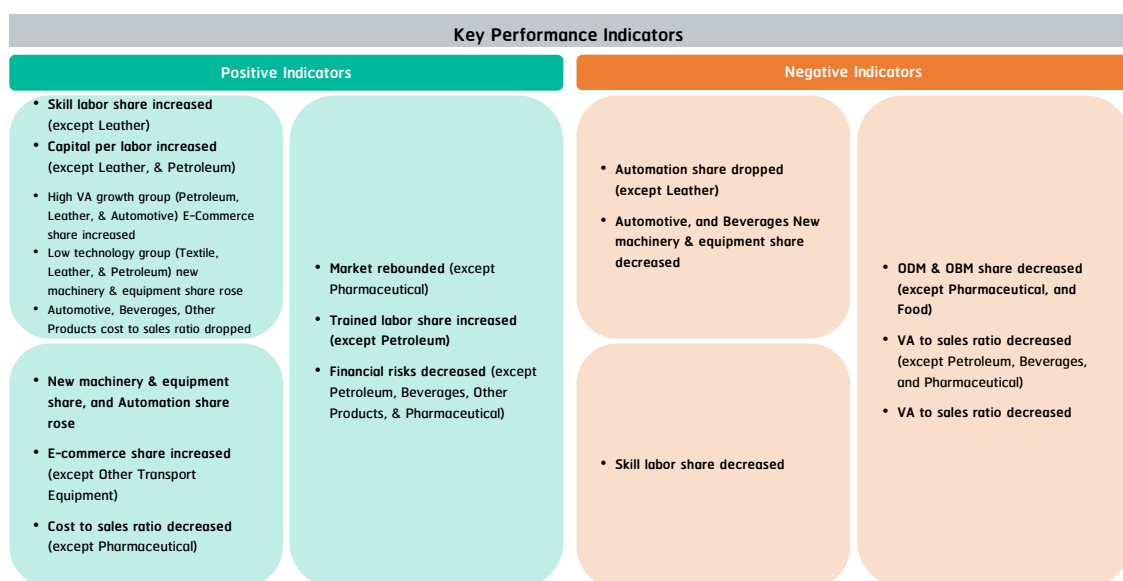
- 1) Yellow signify industries with medium to high technological levels, orange denote industries characterized by medium technological standards, and red represent industries with low technological capabilities.
- 2) The classification of technology levels is based on the criteria set by UNIDO for segmenting technology levels in various manufacturing sectors. This categorization has considered the intensity of research and development (R&D) investments relative to the value of production, as well as the proportion of R&D investment in relation to the value added.

Based on value-added and TPF analysis, we can demonstrate the industry sector's situation in 3 groups as shown below.

**3.1) Good Stage:** Sectors within this group had exhibited enhanced value and Total Factor Productivity (TFP) expansion. Predominantly, these sectors were characterized by low technological levels yet demonstrated a robust recovery. This composition included;

|                | VA    | TFPG  |
|----------------|-------|-------|
| Petroleum      | 52.19 | 37.86 |
| Leather        | 19.21 | 5.55  |
| Automotive     | 11.26 | 4.84  |
| Other Products | 7.29  | 5.12  |
| Beverages      | 4.02  | 3.06  |
| Textile        | 1.01  | 5.81  |

|                           | VA    | TFPG |
|---------------------------|-------|------|
| Pharmaceutical            | 18.99 | 0.26 |
| Food                      | 7.43  | 2.67 |
| Other Transport Equipment | 6.23  | 0.46 |



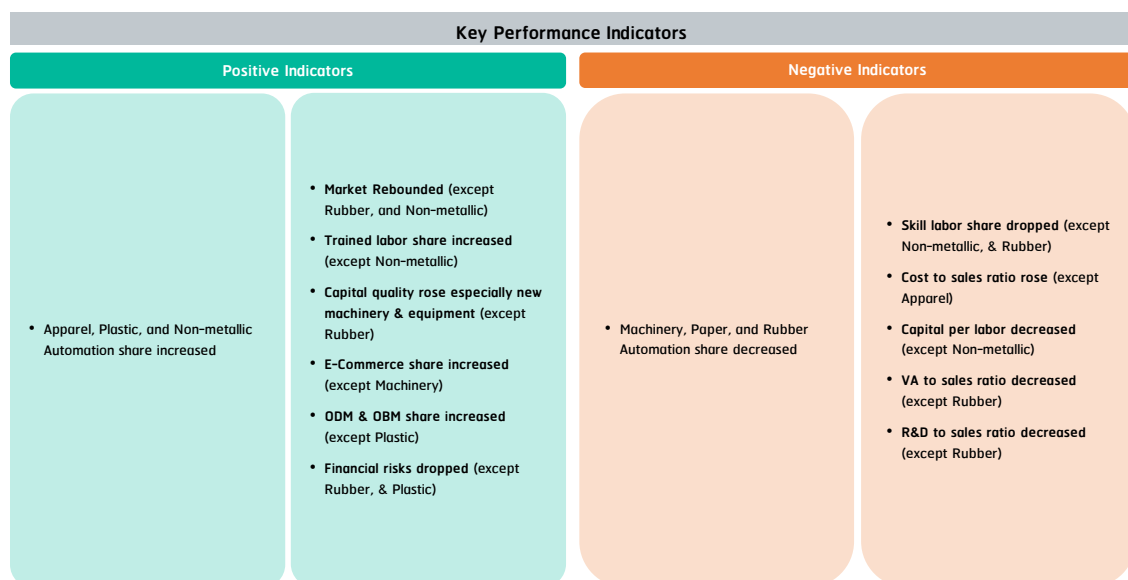
➤ The sectors in manufacturing that experienced greater TFP expansion than the overall industry included petroleum, leather, automotive, other products, beverages, and textiles. Key factors supporting TFP growth encompassed a recovering market, generally improved labor quality (except in leather and petroleum), increased skilled labor proportion and workforce training, and more capital utilization per labor (excluding leather and petroleum), along with decreased debt levels (except for petroleum). Additionally, sectors with significant value added expansion were petroleum, leather, and automotive, which saw increased E-Commerce usage. Automotive, leather, and textiles experienced greater liquidity. High and medium-technology groups saw cost reductions, while the low-technology group witnessed an increase in new machinery proportion. However, notable risks negatively impacting TFP growth included a reduction in the proportion of automated machinery (except in leather and other products), a decrease in production in ODM and OBM, and a diminished

capacity for value addition (except in petroleum and beverages), along with a slowdown in research and development.

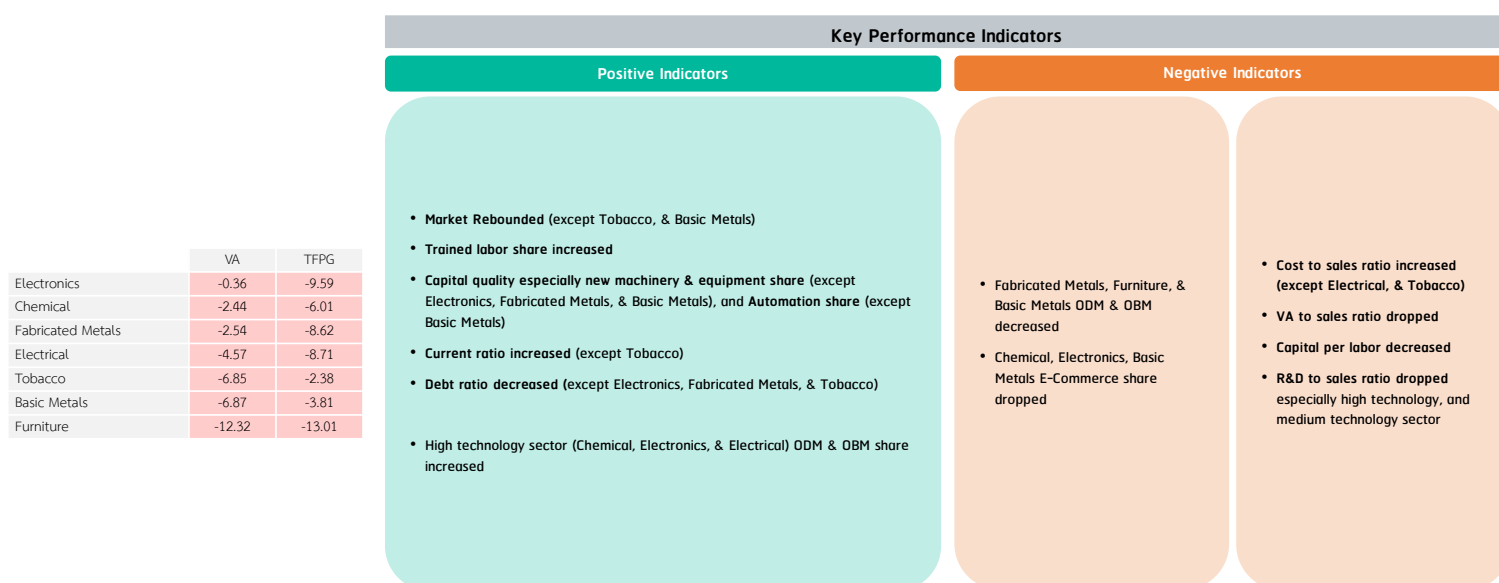
- **The sectors that exhibited less expansion in TFP than the overall manufacturing industry included pharmaceuticals, food, and other transport equipment.** Key factors that supported the growth of TFP were market recovery (excluding pharmaceuticals), enhanced quality of capital due to both a higher proportion of new machinery and automated machinery, increased labor training, and a shift towards ODM and OBM, coupled with greater use of E-Commerce (excluding other transport equipment). Additionally, there was a reduction in costs and financial risks (excluding pharmaceuticals). Conversely, significant risk factors negatively impacting TFPG included a decline in labor quality due to a lower proportion of skilled labor, a decreased ratio of capital to labor, and a reduction in value addition (excluding pharmaceuticals), along with a decline in research and development activities.

- 3.2) Downtrend Stage:** In this group, the sectors still experienced an expansion in their value-added, but TFP contracted. **These sectors included machinery, rubber, non-metallic minerals, plastics, apparel, and paper.** Key risk factors negatively impacting TFP growth were the rising costs (excluding apparel), a decrease in the capital-to-labor ratio (excluding non-metallic minerals), and a decline in value added creation (excluding rubber), along with reduced investment in research and development (excluding rubber). Additionally, the proportion of skilled labor decreased in the machinery, apparel, paper, and plastics sectors. Meanwhile, the share of automated machinery also declined in the machinery, paper, and rubber sectors. Significant factors supporting TFPG included improved market conditions (excluding rubber), increased labor training (excluding non-metallic minerals), enhanced capital quality, especially in the proportion of new machinery (excluding rubber), increased use of E-Commerce (excluding machinery), and a rise in ODM and OBM production (excluding plastics), along with better financial risk management (excluding rubber)

|              | VA   | TFPG   |
|--------------|------|--------|
| Machinery    | 4.47 | -11.91 |
| Rubber       | 2.61 | -5.94  |
| Non-metallic | 2.40 | -1.48  |
| Plastic      | 1.26 | -0.26  |
| Apparel      | 1.08 | -6.98  |
| Paper        | 1.03 | -10.12 |



**3.3) Poor Stage:** In this group, the sectors still had value added and TFP contracted. **These included electronics, chemicals, fabricated metals, electrical, tobacco, basic metals, and furniture.** Key risk factors negatively impacting TFP Growth included increased costs (except for electronics and tobacco), a reduction in the use of capital per labor, and a decrease in value addition. Additionally, investment in research and development decreased (except for tobacco and furniture), especially in high and medium technology sectors. Furthermore, production in ODM and OBM declined in the fabricated metals, furniture, and basic metals sectors. Simultaneously, the proportion of E-Commerce reduced in the chemical, electronics, and basic metals sectors. However, significant factors supporting TFPG were the improvement in market conditions (except for tobacco), increased labor training, and enhanced quality of capital inputs, particularly in the proportion of new machinery (except for electronics, fabricated metals, and basic metals) and the proportion of automated machinery (except for basic metals). There was also a decreased risk of debt accumulation (except for electronics and tobacco) and improved liquidity (except for tobacco).



An overview of the industrial sector and its major manufacturing branches revealed that, despite possessing production capabilities (TFPG), there had been a decline, primarily due to various qualitative factors. Notably, increased costs and a decrease in value addition had been prominent, coupled with a decline in labor quality. This trend persisted even though the economy showed signs of recovery and there was a continuous improvement in the quality of capital factors. Industries experiencing positive growth in TFPG, such as the petroleum, other products, and textile sectors, had seen significant enhancements in the quality of production factors. On the other hand, sectors with negative TFPG, including electronics, chemicals, fabricated metals, electrical, tobacco, basic metals, and furniture, had faced critical challenges in cost management and value creation, as detailed in Table 3.

**Table 3 : The Growth Accounting of the Manufacturing Industry by Sector in 2022**

**(a) Value Added and its Components** (Unit : %)

| Growth Accounting (%) |               | 2022        |                   |         |       |                    |             | 2021              |         |       |                      |                    |                      |
|-----------------------|---------------|-------------|-------------------|---------|-------|--------------------|-------------|-------------------|---------|-------|----------------------|--------------------|----------------------|
|                       |               | Value Added | VA Contributed by |         |       |                    | Value Added | VA Contributed by |         |       |                      |                    |                      |
|                       |               |             | Labor             | Capital | TFPG  | TFPG               |             | Labor             | Capital | TFPG  | TFPG                 |                    |                      |
|                       |               |             |                   |         |       | Labor Productivity |             |                   |         |       | Capital Productivity | Labor Productivity | Capital Productivity |
| TSIC                  | Sector        |             |                   |         |       |                    |             |                   |         |       |                      |                    |                      |
| Over all              | Manufacturing | 8.30        | 5.10              | 0.37    | 2.83  | -0.52              | 3.35        | 9.34              | 0.31    | 2.15  | 6.88                 | 5.16               | 1.72                 |
| 10                    | Food          | 7.43        | 3.88              | 0.88    | 2.67  | 0.85               | 1.82        | 7.46              | 0.08    | 0.20  | 7.18                 | 5.11               | 2.07                 |
| 11                    | Beverage      | 4.02        | -0.65             | 1.61    | 3.06  | 2.54               | 0.52        | 0.02              | 1.56    | -2.48 | 0.94                 | -1.56              | 2.50                 |
| 12                    | Tobacco       | -6.85       | 4.27              | -8.74   | -2.38 | -5.85              | 3.47        | -3.54             | -5.20   | 0.49  | 1.17                 | 2.96               | -1.79                |
| 13                    | Textile       | 1.01        | -4.90             | 0.10    | 5.81  | 5.53               | 0.28        | -5.87             | -3.76   | -1.47 | -0.64                | -0.31              | -0.33                |
| 14                    | Apparel       | 1.08        | 8.54              | -0.48   | -6.98 | -7.66              | 0.68        | -14.16            | -7.82   | -0.45 | -5.89                | -3.30              | -2.59                |

| Growth Accounting (%) |                  | 2022        |                   |         |        |                    |                      | 2021        |                   |         |       |                    |                      |
|-----------------------|------------------|-------------|-------------------|---------|--------|--------------------|----------------------|-------------|-------------------|---------|-------|--------------------|----------------------|
|                       |                  | Value Added | VA Contributed by |         |        |                    |                      | Value Added | VA Contributed by |         |       |                    |                      |
|                       |                  |             | Labor             | Capital | TFPG   | TFPG               |                      |             | Labor             | Capital | TFPG  | TFPG               |                      |
|                       |                  |             |                   |         |        | Labor Productivity | Capital Productivity |             |                   |         |       | Labor Productivity | Capital Productivity |
| TSIC                  | Sector           |             |                   |         |        |                    |                      |             |                   |         |       |                    |                      |
| 15                    | Leather          | 19.21       | 8.96              | 4.70    | 5.55   | 5.45               | 0.10                 | 8.89        | -7.73             | 0.66    | 15.96 | 14.77              | 1.19                 |
| 17                    | Paper            | 1.03        | 13.68             | -2.53   | -10.12 | -13.15             | 3.03                 | 6.56        | -3.48             | 1.31    | 8.73  | 7.20               | 1.53                 |
| 19                    | Petroleum        | 52.19       | 10.06             | 4.27    | 37.86  | 7.86               | 30.00                | 25.41       | 0.79              | -3.10   | 27.72 | 3.97               | 23.75                |
| 20                    | Chemical         | -2.44       | 6.70              | -3.13   | -6.01  | -8.00              | 1.99                 | 8.40        | 5.53              | 0.19    | 2.68  | 0.34               | 2.34                 |
| 21                    | Pharma           | 18.99       | 15.93             | 2.80    | 0.26   | -3.41              | 3.67                 | -2.39       | 1.89              | -2.09   | -2.19 | -3.66              | 1.47                 |
| 22                    | Rubber           | 1.95        | 5.26              | -0.11   | -3.20  | -4.11              | 0.91                 | 9.07        | 0.39              | 2.02    | 6.66  | 5.61               | 1.05                 |
| 23                    | Non-metallic     | 2.40        | 2.27              | 1.61    | -1.48  | -1.09              | -0.39                | -0.59       | -2.25             | -2.83   | 4.49  | 1.92               | 2.57                 |
| 24                    | Basic Metal      | -6.87       | 1.24              | -4.30   | -3.81  | -4.54              | 0.73                 | 23.67       | -3.17             | 3.73    | 23.11 | 17.00              | 6.11                 |
| 25                    | Fabricated Metal | -2.54       | 8.90              | -2.82   | -8.62  | -10.24             | 1.62                 | 11.74       | -2.91             | -0.85   | 15.50 | 10.84              | 4.66                 |
| 26                    | Electronic       | -0.36       | 10.30             | -1.07   | -9.59  | -10.49             | 0.90                 | 12.45       | 5.97              | 5.93    | 0.55  | 0.50               | 0.05                 |
| 27                    | Electrical       | -4.57       | 6.70              | -2.56   | -8.71  | -9.52              | 0.81                 | 8.50        | 6.84              | 2.28    | -0.62 | -1.20              | 0.58                 |
| 28                    | Machinery        | 4.57        | 12.57             | 3.91    | -11.91 | -9.55              | -2.36                | 14.35       | -1.15             | 3.19    | 12.31 | 10.34              | 1.97                 |
| 29                    | Automotive       | 11.26       | 3.05              | 3.37    | 4.84   | 3.07               | 1.77                 | 14.52       | 9.80              | 7.68    | -2.96 | -1.74              | -1.22                |
| 30                    | Other Transport  | 6.23        | 3.22              | 2.55    | 0.46   | 0.34               | 0.12                 | 3.49        | 0.59              | 0.50    | 2.40  | 1.13               | 1.27                 |
| 31                    | Furniture        | -12.32      | 5.18              | -4.49   | -13.01 | -14.51             | 1.50                 | 8.68        | -5.73             | 2.95    | 11.46 | 12.12              | -0.66                |
| 32                    | Other            | 7.29        | -1.61             | 3.78    | 5.12   | 6.23               | -1.11                | 12.05       | 0.57              | -1.35   | 12.83 | 8.22               | 4.61                 |

## (b) TFPG and its Components

(Unit : %)

| Growth Accounting (%) |               | 2022   |                     |                 |                       |                  | 2021  |                     |                 |                       |                  |
|-----------------------|---------------|--------|---------------------|-----------------|-----------------------|------------------|-------|---------------------|-----------------|-----------------------|------------------|
|                       |               | TFPG   | TFPG Contributed by |                 |                       |                  | TFPG  | TFPG Contributed by |                 |                       |                  |
|                       |               |        | Labor Quality       | Capital Quality | Other Quality Factors | Market Condition |       | Labor Quality       | Capital Quality | Other Quality Factors | Market Condition |
|                       |               |        |                     |                 |                       |                  |       |                     |                 |                       |                  |
| Overall               | Manufacturing | 2.83   | -0.03               | 0.54            | -6.15                 | 8.47             | 6.88  | 0.33                | 0.08            | -0.24                 | 6.71             |
| 10                    | Food          | 2.67   | -0.53               | 1.07            | -12.25                | 14.38            | 7.18  | 0.13                | 0.03            | 3.17                  | 3.85             |
| 11                    | Beverage      | 3.06   | 0.39                | -0.59           | 3.13                  | 0.13             | 0.94  | -0.16               | 0.03            | 0.84                  | 0.23             |
| 12                    | Tobacco       | -2.38  | -0.01               | 0.13            | 0.32                  | -2.82            | 1.17  | -0.97               | -1.38           | 2.73                  | 0.79             |
| 13                    | Textile       | 5.81   | 3.90                | -0.41           | -7.43                 | 9.75             | -0.64 | 3.07                | -0.25           | -2.14                 | -1.32            |
| 14                    | Apparel       | -6.98  | -2.34               | 0.43            | -18.64                | 13.57            | -5.89 | 1.27                | -0.18           | -0.61                 | -6.37            |
| 15                    | Leather       | 5.55   | -5.08               | 1.10            | -8.43                 | 17.96            | 15.96 | 1.71                | -0.01           | 6.65                  | 7.61             |
| 17                    | Paper         | -10.12 | -1.23               | 0.59            | -14.39                | 4.91             | 8.73  | 0.68                | 0.33            | 1.68                  | 6.04             |
| 19                    | Petroleum     | 37.86  | 4.45                | 0.43            | 12.12                 | 20.86            | 27.72 | 0.25                | 0.26            | 1.27                  | 25.94            |
| 20                    | Chemical      | -6.01  | 0.57                | 2.49            | -18.09                | 9.02             | 2.68  | -0.77               | 0.11            | -6.64                 | 9.98             |
| 21                    | Pharma        | 0.26   | -1.18               | 1.72            | 1.31                  | -1.59            | -2.19 | 0.77                | 0.02            | -1.59                 | -1.39            |
| 22                    | Rubber        | -3.20  | -1.42               | 0.88            | 1.52                  | -4.18            | 6.66  | 0.34                | -0.11           | 0.20                  | 6.23             |
| 23                    | Non-metallic  | -1.48  | 1.12                | 1.45            | -7.38                 | 3.33             | 4.49  | -0.16               | -2.00           | 11.04                 | -4.39            |



| Growth Accounting (%) |                  | 2022   |                     |                 |                       |                  | 2021  |                     |                 |                       |                  |
|-----------------------|------------------|--------|---------------------|-----------------|-----------------------|------------------|-------|---------------------|-----------------|-----------------------|------------------|
|                       |                  | TFPG   | TFPG Contributed by |                 |                       |                  | TFPG  | TFPG Contributed by |                 |                       |                  |
|                       |                  |        | Labor Quality       | Capital Quality | Other Quality Factors | Market Condition |       | Labor Quality       | Capital Quality | Other Quality Factors | Market Condition |
| TSIC                  | Sector           |        |                     |                 |                       |                  |       |                     |                 |                       |                  |
| 24                    | Basic Metal      | -3.81  | 1.81                | -1.71           | -6.70                 | 2.79             | 23.11 | 0.95                | 0.85            | 3.10                  | 18.21            |
| 25                    | Fabricated Metal | -8.62  | 1.11                | 2.18            | -14.52                | 2.61             | 15.50 | 0.15                | -0.03           | 4.22                  | 11.16            |
| 26                    | Electronic       | -9.59  | 1.26                | -0.30           | -22.45                | 11.90            | 0.55  | -0.07               | 0.07            | -3.71                 | 4.26             |
| 27                    | Electrical       | -8.71  | -1.36               | 3.11            | -17.97                | 7.51             | -0.62 | -0.64               | 3.24            | -8.35                 | 5.13             |
| 28                    | Machinery        | -11.91 | -0.75               | 0.67            | -22.91                | 11.08            | 12.31 | 2.56                | 0.04            | 2.05                  | 7.66             |
| 29                    | Automotive       | 4.84   | 0.84                | -0.96           | -2.96                 | 7.92             | -2.96 | -0.68               | 0.26            | -6.58                 | 4.04             |
| 30                    | Other Transport  | 0.46   | -4.76               | 0.22            | -5.09                 | 10.09            | 2.40  | -0.52               | 0.01            | -16.68                | 19.59            |
| 31                    | Furniture        | -13.01 | -0.18               | 0.74            | -18.53                | 4.96             | 11.46 | 0.41                | 0.07            | 10.08                 | 0.90             |
| 32                    | Other            | 5.12   | 1.23                | 0.15            | -3.66                 | 7.40             | 12.83 | 1.82                | -0.03           | 2.98                  | 8.06             |

Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

## Analysis of Characteristics of Enterprises

The analysis of the characteristics of enterprises involve a comparative approach, segregating reference entrepreneurs into a 'Best Practice' group and a 'Worst Practice' group. The 'Best Practice' enterprises are those who demonstrated high productivity levels and significant growth. This selection is based on their TFP and the growth rate of their productivity (TFPG), averaging higher than half of the total sample group during 2021-2022. This group comprise 776 observations. In contrast, the 'Worst Practice' group include enterprises with TFP and TFPG averages lower than half of the entire sample, totaling 805 observations. Detailed statistical test results are also provided.

### 1) Best Practice

For indicators of a sample group that significantly differed from others, it was the factors related to management and production costs, as well as labor potential. These were fundamental in facilitating business recovery in highly uncertain economic conditions. Labor factors played a crucial role in enhancing flexibility amidst increasingly challenging and complex business adjustments. The exemplary group exhibited higher average values in these two factors compared to the remaining entrepreneurs, detailed as follows.

- **Labor Quality:** Effective sample groups had demonstrated a greater development of the workforce's potential, which constituted a vital foundation for the evolution towards high-value industries.
- **Market Management:** Effective sample groups had achieved significant access and were extensively interconnected with international supply chains.
- **Production Management:** Successful entrepreneurs employed machinery and equipment to aid in their production and operational processes. This approach resulted in heightened precision and efficiency in their manufacturing activities. Additionally, it enabled the evolution towards business models increasingly influenced by digital technology. Moreover, these entrepreneurs created value and distinctiveness in their products and services, leading to enhanced business profitability.
- **Cost Management:** A good sample group had demonstrated an adeptness in cost management, effectively controlling expenses. Additionally, they were capable of significantly enhancing value. The management of costs and the generation of value added were key factors that reflected their competitive abilities and roles in the international value chain.

## 2) Worst Practice

For the sample groups with suboptimal status that significantly differed from others, key indicators were management factors related to production and costs, including labor potential. These elements remained fundamental in business contexts. Additionally, these groups with less favorable statuses had exhibited risks from international markets and the creation and utilization of investments in machinery and equipment. This also extended to research and development, which could have constituted short-term costs and expenses. The details were as follows.

- **Input Quality:** Groups with poor status had shown less development in their workforce potential. Additionally, these groups had invested more in machinery and equipment, which might have constituted additional costs and expenses, leading to a short-term decrease in profits.

- **Market Management:** The sample group with poor status had significant access to and connections with the international supply chain. This exposed them to greater impacts from volatility in foreign markets compared to other groups. As a result, they experienced negative effects on their business returns during periods when the global economy and financial markets slowed down.
- **Cost Management:** Sample groups with poor status had demonstrated an adeptness in managing costs ineffectively, while their ability to generate added value was limited.
- **Research and Development:** Groups with unfavorable status had once posed a significant challenge to research and development investments. This situation often resulted in increased costs and expenditures, subsequently leading to a short-term reduction in profit margins.

Table 4 : Indicator of Various of Enterprises in 2021-2022

## (a) Best Practice

| Variable  | Best Practice | Others    | t-Statistics |
|---|---------------|-----------|--------------|
| TFP (2016=100)  | 786.00        | -2,241.35 |              |
| TFPG (%)  | 330.73        | -3.43     |              |
| <b>Quality of Input Factors</b>   |               |           |              |
| Share of Skilled labors and Professionals (%)                                 | 47.87         | 43.37     | -3.8585***   |
| Share of labor with training (%)  | 49.18         | 46.15     | -1.8102*     |
| Share of Machinery and Equipment with age 5 years or less (%)                 | 21.80         | 24.15     | 1.5931       |
| Share of Machinery and Equipment with Automatic and Semi-Automatic System (%) | 18.97         | 22.14     | 2.0797**     |
| <b>Management</b>   |               |           |              |
| <b>Structure of Production and Sales</b>                                      |               |           |              |
| Share of Exports (%)  | 28.92         | 36.31     | 1.1705       |
| Share of E-Commerce Usage (%)   | 8.69          | 12.72     | 2.4538**     |
| Share of Imported Raw Materials (%)   | 20.50         | 29.76     | 1.4646       |
| Share of ODM and OBM (%)  | 70.53         | 65.03     | -2.3897**    |
| Fixed Assets per Labor (Millions of Baht/Person)                              | 11.98         | 4.44      | -3.6357***   |

| Variable                          | Best Practice | Others | t-Statistics |
|-----------------------------------|---------------|--------|--------------|
| <b>Costs</b>                      |               |        |              |
| Value added to Sales Ratio (%)    | 34.38         | 26.85  | -10.2035***  |
| สัดส่วนต้นทุนทั้งหมดต่อยอดขาย (%) | 92.86         | 94.73  | 2.4464**     |
| <b>Finance</b>                    |               |        |              |
| Current Ratio (Times)             | 20.02         | 10.70  | -1.6327      |
| Debt to Equity Ratio (Times)      | 1.01          | 3.83   | 1.3709       |
| <b>Innovation</b>                 |               |        |              |
| R&D Investment to Sales Ratio (%) | 0.05          | 0.06   | 0.3134       |

## (b) Worst Practice

| Variable  | Worst Practice | Others | t-Statistics |
|---|----------------|--------|--------------|
| TFP (2016=100)  | -7,303.54      | 577.56 |              |
| TFPG (%)  | -132.03        | 155.56 |              |
| <b>Quality of Input Factors</b>   |                |        |              |
| Share of Skilled labors and Professionals (%)                                 | 42.28          | 45.26  | 2.6139***    |
| Share of labor with training (%)  | 45.72          | 47.34  | 0.9802       |
| Share of Machinery and Equipment with age 5 years or less (%)                 | 25.51          | 22.87  | -1.7943*     |
| Share of Machinery and Equipment with Automatic and Semi-Automatic System (%) | 23.01          | 20.74  | -1.5110      |
| <b>Management</b>   |                |        |              |
| <b>Structure of Production and Sales</b>                                      |                |        |              |
| Share of Exports (%)  | 42.65          | 31.73  | -1.7173*     |
| Share of E-Commerce Usage (%)   | 12.72          | 11.30  | -0.8622      |
| Share of Imported Raw Materials (%)   | 21.40          | 29.80  | 1.3812       |
| Share of ODM and OBM (%)  | 64.98          | 66.86  | 0.8694       |
| Fixed Assets per Labor (Millions of Baht/Person)                              | 4.04           | 7.15   | 1.5186       |
| <b>Costs</b>  |                |        |              |
| Value added to Sales Ratio (%)  | 24.10          | 30.39  | 8.5774***    |
| สัดส่วนต้นทุนทั้งหมดต่อยอดขาย (%)   | 96.08          | 93.62  | -3.2671***   |
| <b>Finance</b>  |                |        |              |
| Current Ratio (Times)   | 7.20           | 15.11  | 1.3982       |
| Debt to Equity Ratio (Times)  | 1.84           | 3.58   | 0.8520       |

| Variable                          | Worst Practice | Others | t-Statistics |
|-----------------------------------|----------------|--------|--------------|
| <b>Innovation</b>                 |                |        |              |
| R&D Investment to Sales Ratio (%) | 0.07           | 0.05   | -1.7570*     |

Source: Compiled and calculated by FPRI based on 2022 FF9 survey data, OIE

Note: ‘\*\*\*’ ‘\*\*’ and ‘\*’ denotes indicator of both groups are significantly different at the confidence level of 99%, 95% and 90% respectively.

## Policy Recommendations

In 2022, the Thai economy showed signs of sustained recovery from the previous year, despite facing an early-year outbreak of the COVID-19 Omicron variant. The revival was underpinned by the government's economic recovery and stimulus policies. Additionally, the rebound in the economies of various countries contributed to the improved recovery of both global and Thai trade. Export conditions continued to grow robustly, and high agricultural produce prices led to increased incomes for manufacturing workers and farmers, thereby boosting domestic purchasing power. However, the Thai economy still faced risks from soaring global commodity and energy prices, leading to a significant uptrend in inflation. Moreover, central banks worldwide signaled interest rate hikes, adding volatility to the global financial markets.

Consequently, the formulation of policy recommendations was determined based on approaches grounded in the uncertain state of the industry sector, encompassing both domestic and international market trends. This involved a detailed analysis of 15 manufacturing sectors, categorized according to their respective statuses in the industry.

**Table 5 : Policy recommendations for each manufacturing sector**

| (a) Good status: Positive value-added and positive TFP |   |
|--|---|
| Sector   | Recommendation  |
| Food   | <ul style="list-style-type: none"> <li>Invest in research and development to create new knowledge, reduce production costs, and control quality to meet market standards.</li> <li>Invest in training personnel to develop skills that match job requirements, enhancing production efficiency.</li> <li>Incorporate new technologies or innovations into the production process for modern, competitive products and innovative food designs.</li> </ul> |

| <b>(a) Good status: Positive value-added and positive TFP</b> |   |
|---|---|
| <b>Sector</b>   | <b>Recommendation</b>   |
|   | <ul style="list-style-type: none"> <li>• Entrepreneurs should plan raw material usage and reduce transportation costs due to the risks inherent in global economic instability and conflicts.</li> </ul>  |
| Beverages   | <ul style="list-style-type: none"> <li>• Entrepreneurs must adapt to enhance productivity in labor and machinery to better manage production costs.</li> <li>• They should prepare for developing personnel capable of utilizing new technologies and machinery to innovate and improve production.</li> <li>• Key product sector entrepreneurs need to elevate their products' value, align with government measures, or shift to more promising business ventures.</li> <li>• Health beverage industry players should continuously innovate and intensify marketing efforts to increase consumer awareness of health benefits and product knowledge.</li> </ul>   |
| Petroleum   | <ul style="list-style-type: none"> <li>• Entrepreneurs should enhance operational efficiency and control costs, particularly raw material and financial expenses, to improve business performance.</li> <li>• Improve oil refinery efficiency to reduce costs, increase refining margins, and enhance the industry's profitability.</li> <li>• Encourage entrepreneurs to develop personnel through focused activities that enhance existing skills, especially in critical areas like financial and accounting expertise for the energy sector.</li> <li>• Biofuel producers should boost production efficiency to lower costs and improve fuel quality, ensuring competitiveness and survival as biofuel subsidies phase out.</li> <li>• Businesses should innovate in products and services to grow sales, especially in slowing economies, by entering related industries like Electric Vehicles (EVs) and investing in technologies for carbon capture and storage.</li> <li>• Support the development of environmentally friendly petroleum products due to increasing global interest in sustainable petroleum options.</li> </ul> |
| Automotive, and Other transport equipment                     | <ul style="list-style-type: none"> <li>• The government should address fuel and energy pricing issues, key industrial production costs, by implementing short-term policies to reduce costs, allowing businesses to adapt gradually.</li> </ul>   |

| <b>(a) Good status: Positive value-added and positive TFP</b> |  |
|---|--|
| <b>Sector</b>   | <b>Recommendation</b>  |
|   | <ul style="list-style-type: none"> <li>• The government should establish clear, tiered wage policies to enable businesses to adjust in a volatile production cost environment, influenced by external global situations.</li> <li>• Businesses should develop management plans for emergency measures, especially in financial management, to handle production and raw material costs, preparing for uncertain scenarios impacting trade and future production factor costs.</li> <li>• Businesses should expand their production networks and trade partnerships, particularly regionally, to diversify raw material sourcing risks and explore markets with lower selling costs for improved profitability.</li> </ul>                  |
| Other Products  | <ul style="list-style-type: none"> <li>• The industry is urged to enhance training for workers, especially in the jewelry and gem production sector, where specific skills are crucial for quality control. In addition to training, the industry faces a labor shortage, necessitating measures to increase workforce numbers.</li> <li>• Promotion of modern capital investment, including advanced tools and machinery, is encouraged in the medical equipment manufacturing sector to boost its competitive edge.</li> <li>• The protracted Russia-Ukraine conflict impacts raw material costs and production efficiency in various industries. Businesses should plan to adapt quickly to these challenging circumstances.</li> </ul> |

| <b>(b) Downtrend: positive value-added but negative TFP</b> |   |
|---|---|
| <b>Sector</b>   | <b>Recommendation</b>   |
| Paper   | <ul style="list-style-type: none"> <li>• Developing a diverse range of paper products with enhanced durability and strength to meet the continuous demands of various industries, especially in consumer goods, health products, dietary supplements, and medical materials.</li> <li>• Promoting the use of agricultural waste in paper production, aligning with the circular economy concept of creating and recycling materials for innovative uses under the BCG model.</li> <li>• Elevating operational efficiency and supply chain integration through automation and data analytics, aiming for operational excellence and strengthening production and supply chain capabilities.</li> <li>• Adopting the ESG 4 Plus approach to drive environmentally friendly paper production and products, setting ambitious targets for net-zero</li> </ul> |

| <b>(b) Downtrend: positive value-added but negative TFP</b> |  |
|---|--|
| <b>Sector</b>   | <b>Recommendation</b>  |
|   | greenhouse gas emissions in line with Thailand's carbon neutrality and net-zero greenhouse gas emission goals.   |
| Rubber  | <ul style="list-style-type: none"> <li>• Entrepreneurs should explore expanding their production networks and trade partnerships, with a special focus on regional growth.</li> <li>• It's crucial for businesses to plan and assess the feasibility of applying suitable technology and machinery, in line with their business potential, while also developing the skills of their workforce to keep pace with these technologies.</li> <li>• Entrepreneurs should study and enhance their capabilities in research and development, aiming to produce future-ready products. This involves collaboration with technological and innovative entities.</li> </ul>                                       |
| Plastic   | <ul style="list-style-type: none"> <li>• Industrial entrepreneurs should increasingly study and plan for raw material and energy costs using various forward market trading tools. This includes investments in machinery and alternative energy usage.</li> <li>• Entrepreneurs should explore developing production methods and products that align with new international environmental standards, including state-promoted and policy-compliant products.</li> <li>• Producers must develop personnel expertise in future products, focusing on new production skills, particularly in environmentally friendly plastics made from sustainable materials and processes.</li> </ul>                   |
| Non-metallic Minerals                                       | <ul style="list-style-type: none"> <li>• Support the enhancement of production processes by investing in technology to create high-quality, environmentally friendly new products.</li> <li>• Encourage expansion into the CLMV countries due to their continuous growth and to explore new markets for customer base expansion.</li> <li>• Promote the development of more efficient production processes, including elevating the capabilities of entrepreneurs to apply knowledge for innovative product design and development.</li> <li>• Advocate for businesses to adopt clean or alternative energy in production processes, as it can help reduce fuel costs and energy consumption.</li> </ul> |

| <b>(c) Poor: Positive value-added and negative TFP</b> |  |
|--|--|
| <b>Sector</b>  | <b>Recommendation</b>  |
| Tobacco  | <ul style="list-style-type: none"> <li>• The government should continuously assist tobacco farmers in adapting to changes in tobacco planting quotas.</li> </ul> |



| <b>(c) Poor: Positive value-added and negative TFP</b> |  |
|--|--|
| <b>Sector</b>  | <b>Recommendation</b>  |
|  | <ul style="list-style-type: none"> <li>• The Tobacco Authority should expand new marketing channels, especially exports, and reduce over-reliance on the domestic market.</li> <li>• The Tobacco Authority and other operators must adapt to maintain profitability and survival, necessitating enhanced production efficiency and developing more profitable products.</li> <li>• Tax structure adjustments leading to higher prices for cheaper cigarettes have increased illegal, cheaper cigarette imports. Additionally, the rising popularity of e-cigarettes, still considered illegal, calls for improved regulation of illicit products.</li> </ul>   |
| Chemical   | <ul style="list-style-type: none"> <li>• The strategy encourages entrepreneurs to increase the proportion of environmentally friendly products by innovating in the production of chemical products using natural raw materials.</li> <li>• There's a focus on developing skilled personnel to meet the complex and high-value needs of the chemical industry, including enhancing necessary skills and updating educational curriculums to align with industry demands.</li> <li>• The expanding export markets plan includes expanding the target market for chemical industry exports, particularly to the CLMV group.</li> <li>• The ESG principles adoption Support is provided for integrating Environmental, Social, and Governance (ESG) principles in the chemical industry, aiming for carbon neutrality and reducing greenhouse gas emissions in Thailand.</li> <li>• The initiative seeks to connect the Thai chemical industry with the global value chain, enabling Thai entrepreneurs to access advanced technology and innovations and enter international markets.</li> </ul> |
| Basic Metals   | <ul style="list-style-type: none"> <li>• Entrepreneurs should enhance the quality of basic metal products to increase their value, meeting customer needs through customized products, supported by investment in research and development.</li> <li>• Business operators should expand trade partnerships, with government support in network creation, especially in the ASEAN region, which is experiencing growth in investment and production capacity.</li> <li>• Companies should begin assessing their carbon footprint in production processes to plan carbon emission reductions and adapt to the rising demand for eco-friendly products, in anticipation of potential Compulsory Border Adjustment Mechanism (CBAM) regulations.</li> </ul>  |

| <b>(c) Poor: Positive value-added and negative TFP</b> |  |
|--|--|
| <b>Sector</b>  | <b>Recommendation</b>  |
| Fabricated Metals                                      | <ul style="list-style-type: none"> <li>• Entrepreneurs should enhance the design, standard, and quality of metal packaging to meet customer demands for aesthetics and functionality.</li> <li>• Expansion into international markets, especially in the ASEAN region, including Indonesia and Vietnam, is advised for products like chains, wires, springs, screws, and screw nails, leveraging government support.</li> <li>• Environmental considerations should be a priority in all stages of the production process, aiming for cleaner and more eco-friendly methods.</li> <li>• Developing a supply chain management plan is essential to address the increasing uncertainties in business.</li> </ul> |
| Electronics  | <ul style="list-style-type: none"> <li>• Entrepreneurs should invest in modern machinery to improve efficiency and reduce energy costs, fostering the development of high-tech products.</li> <li>• They should also diversify their supply chain management to mitigate production risks by sourcing materials from various cost-effective suppliers.</li> <li>• Additionally, entrepreneurs should play a role in enhancing workforce productivity, leading to cost savings and increased research and development skills for innovative product creation.</li> </ul>  |
| Electrical   | <ul style="list-style-type: none"> <li>• Prioritizing workforce skill enhancement, particularly in advanced technologies, improves production quality and product value.</li> <li>• Increasing investments in research and development results in higher-tech products with greater market value.</li> <li>• Effective supply chain management, especially when dealing with material scarcity and sourcing from multiple suppliers, helps reduce raw material price fluctuations.</li> </ul>  |



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