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Dampak Teknologi Disruptif dalam Sektor Manufaktur Indonesia

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CSIS-ADB Study - Supporting Technological Transformation: Measuring The Impact of Disruptive Technology to The Indonesian Economy

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ADB
Asian Development Bank

Industrial Revolution Timeline

End of 18th century

First mechanical loom - 1784

Beginning of 20th century

First production line, slaughter- houses in Cincinnati - 1870

Beginning of the seventies

First programmable logic controller (PLC) Modicon 084 - 1969

Today

Ubiquitous connectivity of people, machines and real time data

Industry Revolution 4.0
Cyber-physical systems

Industry Revolution 3.0
Use of electronics and IT to further automate the production

Industry Revolution 2.0
Introduction of mass production based on the division of labor

Industry Revolution 1.0
Introduction of mechanical production facilities using water and steam power

Key Technology of IR 4.0

Artificial Intelligence (AI)

Technology to process information, think and make automated decision

Internet of Things (IoT)

The internet interconnection of computing devices embedded in everyday objects

Advanced Robotics

Robotics technology supplemented by Artificial Intelligence or IoT

Wearables / Augmented Reality / Virtual Reality

The use of technology to enhance the functionality of everyday-worn-item

3D Printing

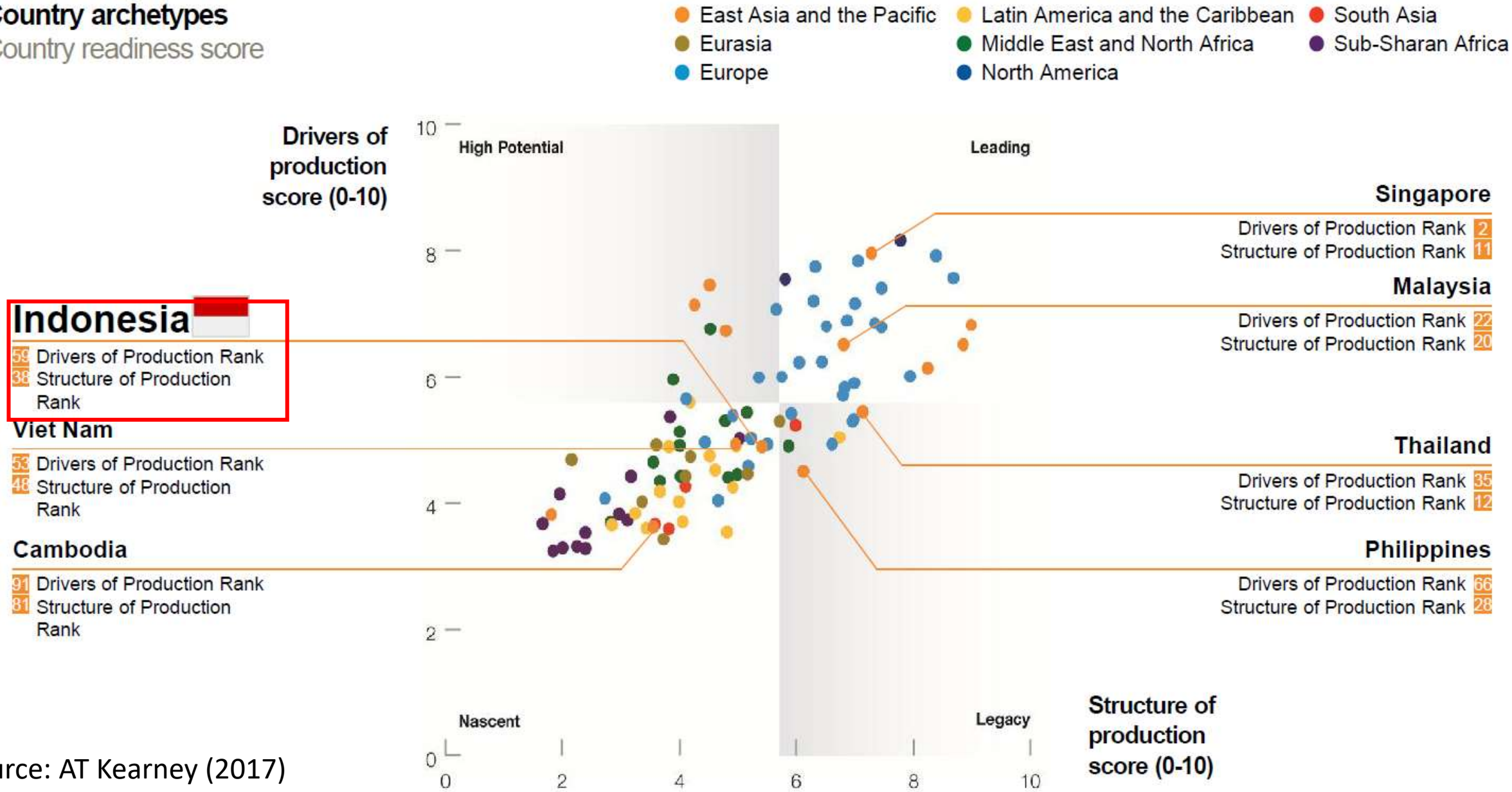
The internet interconnection of computing devices embedded in everyday objects

Source: AT Kearney (2017)

Country readiness

Country archetypes

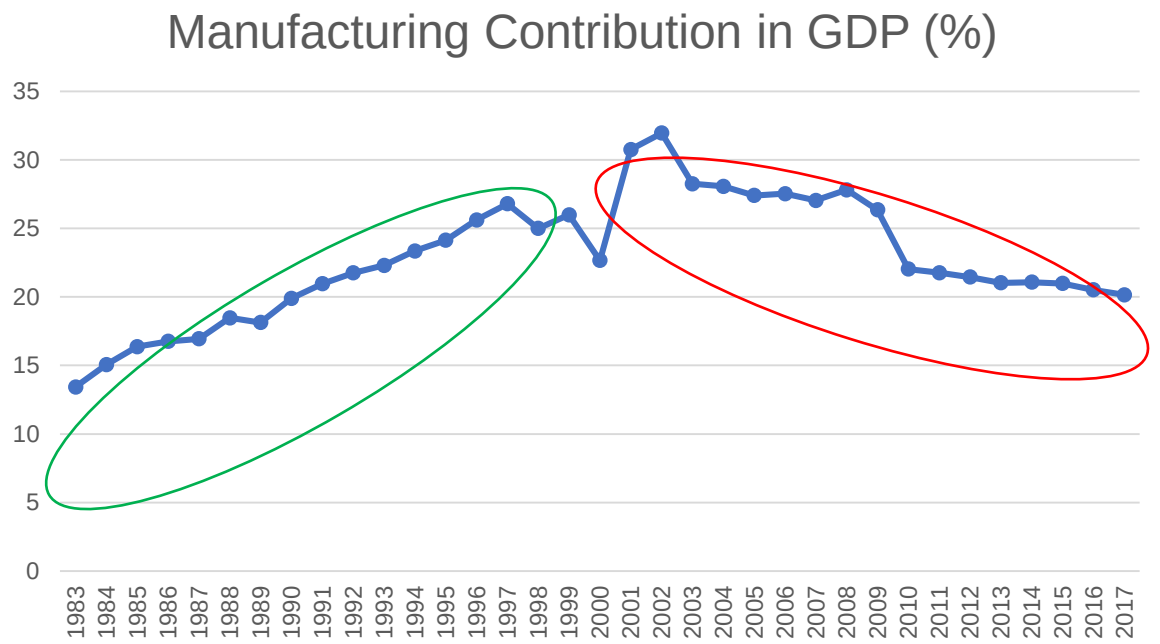
Country readiness score

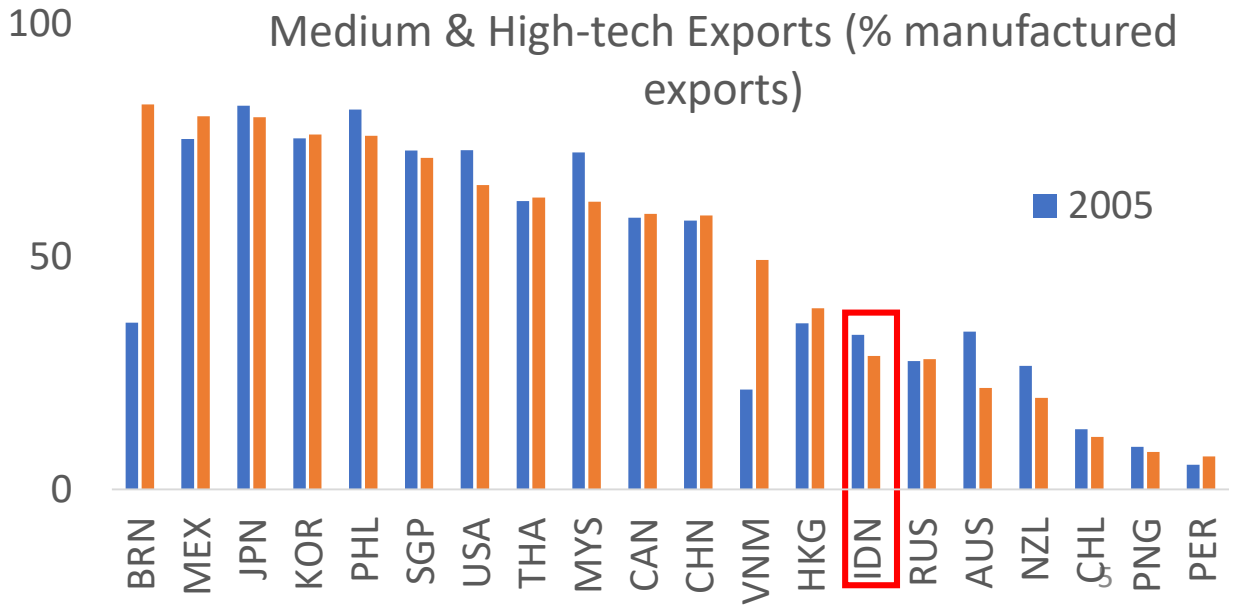


Source: AT Kearney (2017)

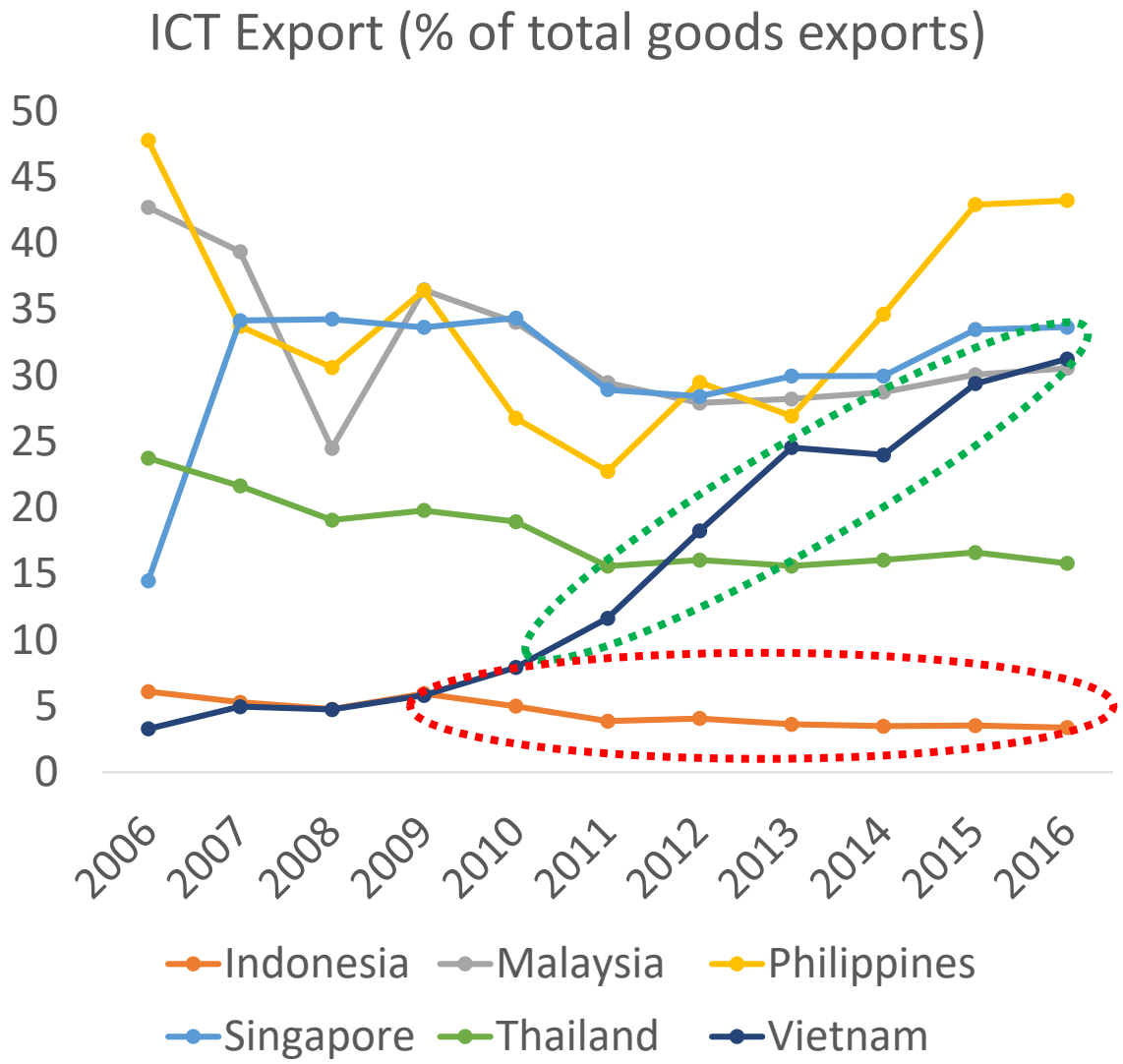
Manufacturing Sector: Sail or Sink?

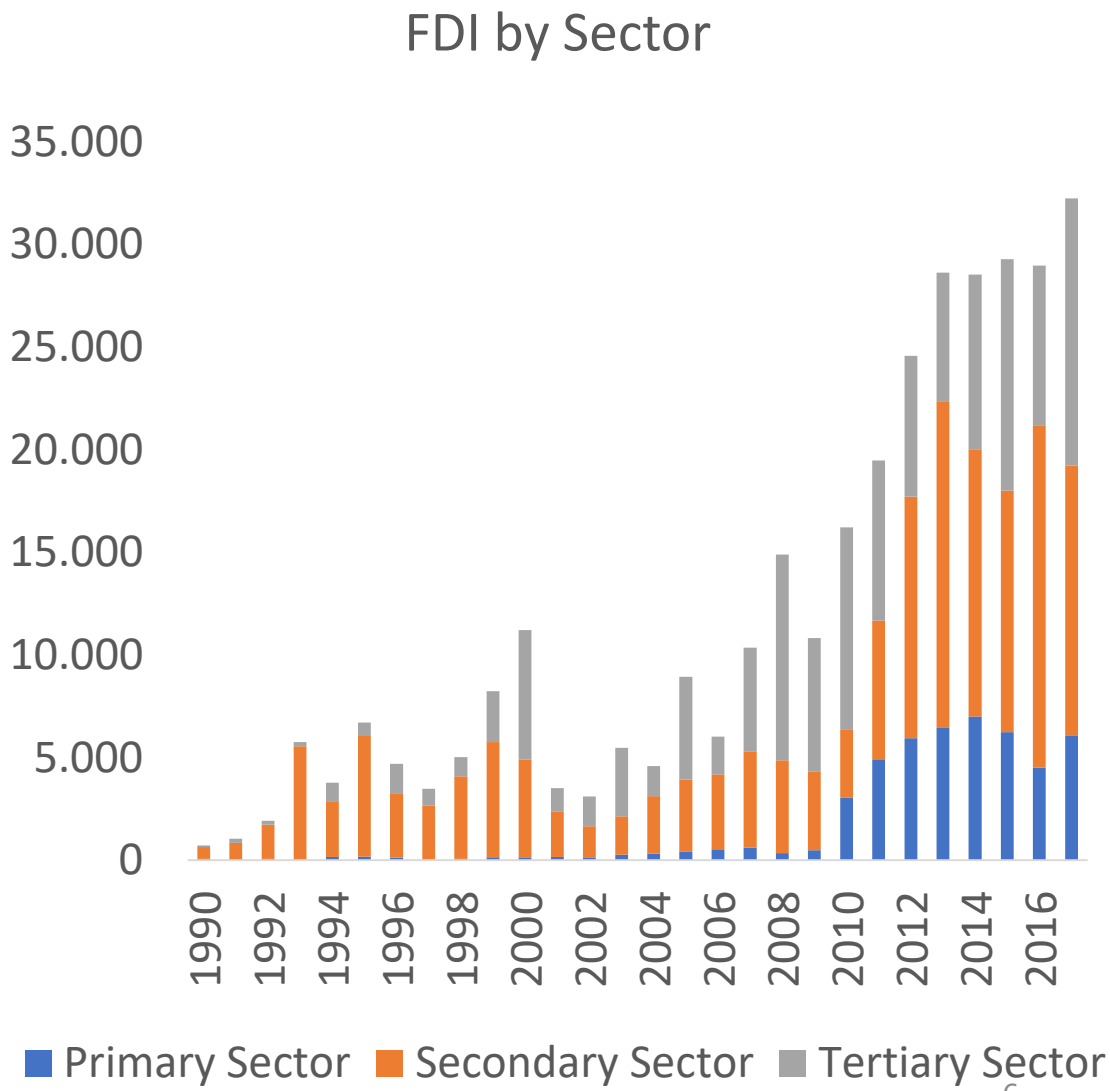
- Indonesia aims to revitalize its manufacturing sector
  - Premature deindustrialization (?)
  - Low-tech product = low value-added
  - Lagged behind our peers in the region
- Technology and digitalization are key drivers
  - Industry 4.0 as new source of growth (?)
  - Many literatures and reports already discussed the “potential” part
- Government’s effort
  - Making Indonesia 4.0: roadmap and aspiration
- Gap:
  - What is the state of technological adoption in Indonesia’s manufacturing sector?





……Indonesia's ICT-related goods trade is among the lowest in the region while FDI in secondary sector still flowing

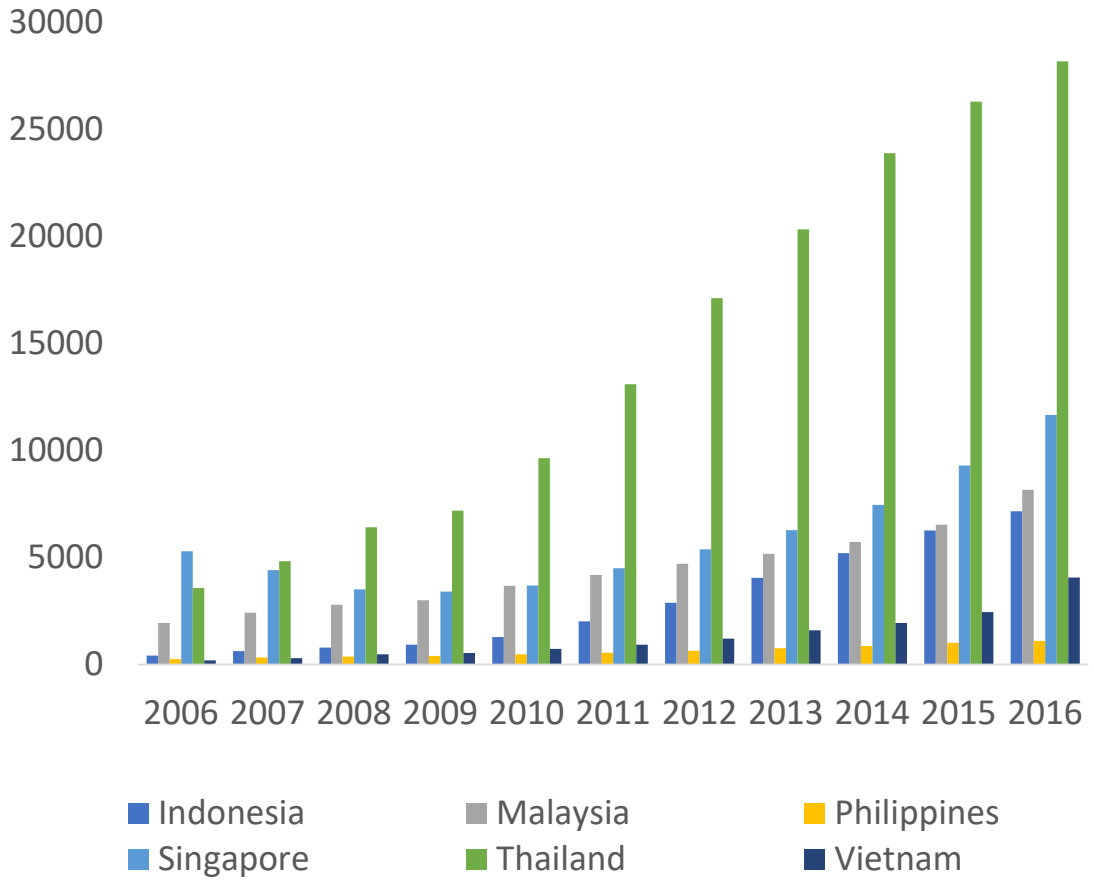


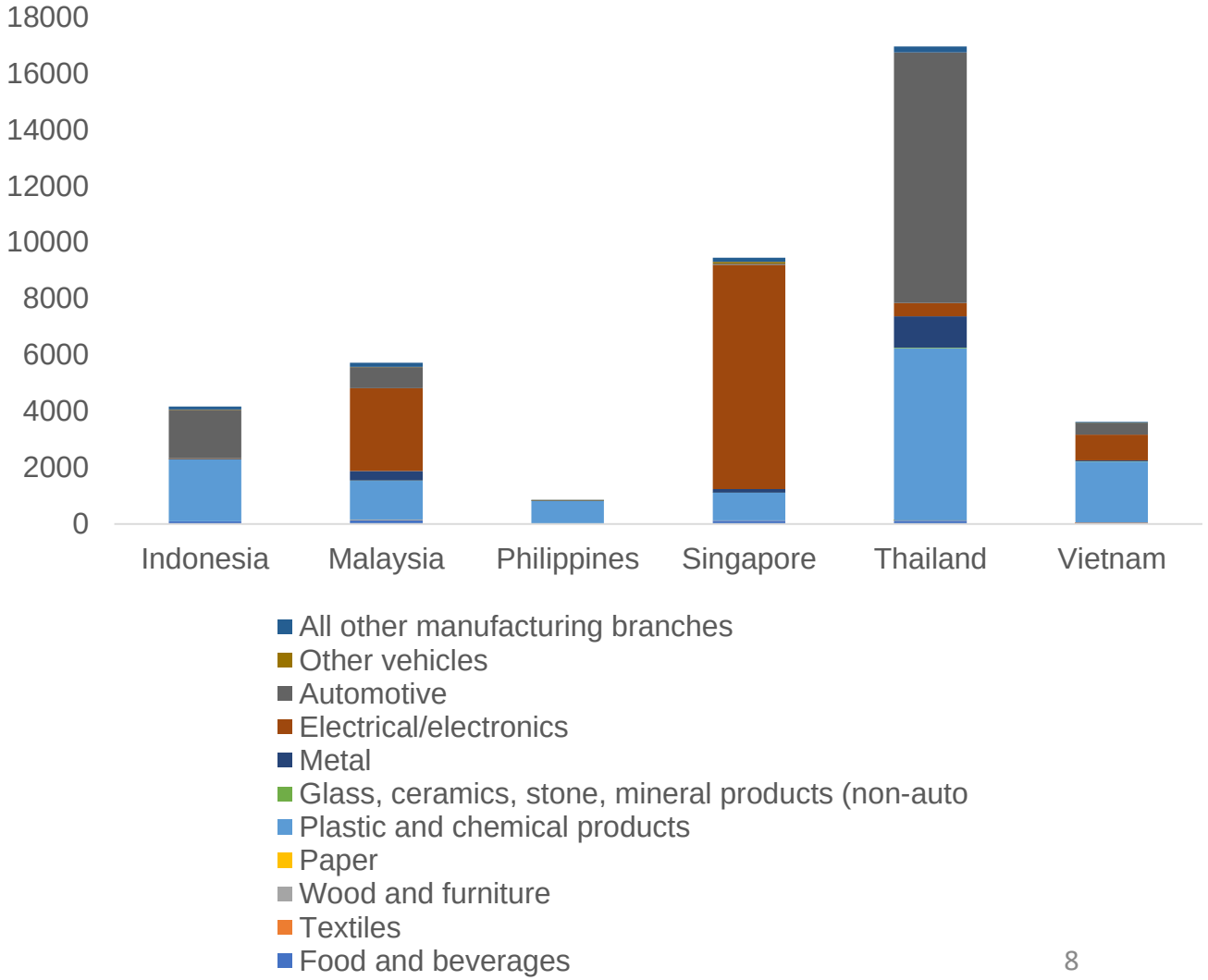


	Using technology licensed from foreign companies	Having their Web site	Using e-mail to interact with clients/suppliers	New product/service	Process innovation	R&D Spending
Food	7.5	15.4	13.9	**31.9**	28.6	0.9
Textiles	25.6	21.9	35.3	14.6	19.1	0.3
Garments	16.3	19.1	23	19	19	0.4
Chemicals & Chemical Products	24	41.2	**53.7**	9.2	15	**13.9**
Rubber & Plastics Products	**39.8**	6.8	12.7	3.3	**40.1**	0.8
Non-Metallic Mineral Products	4.7	6.3	42.4	6.2	6.6	0.8
Other Manufacturing	30.9	22.7	31.7	5.3	7.4	3

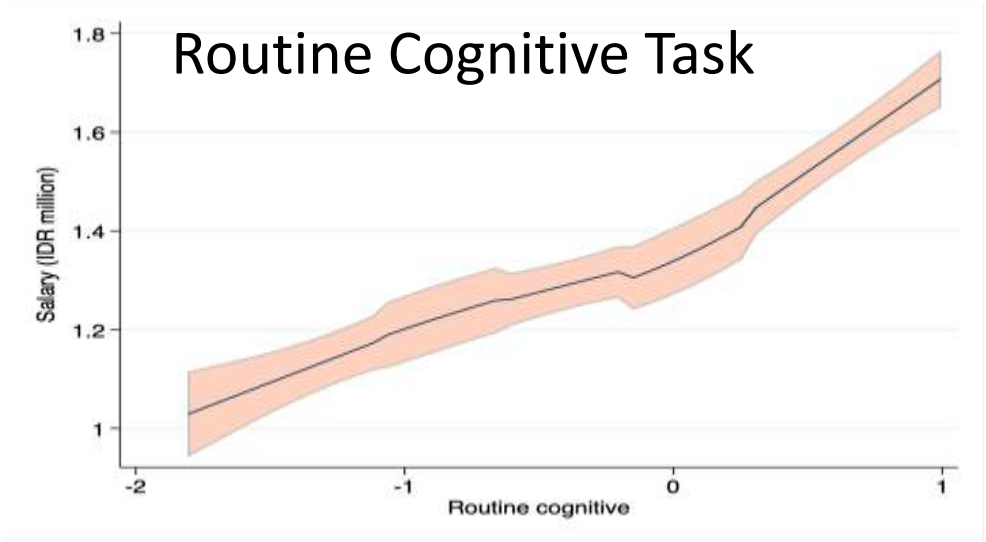
Source: WBES (2015)

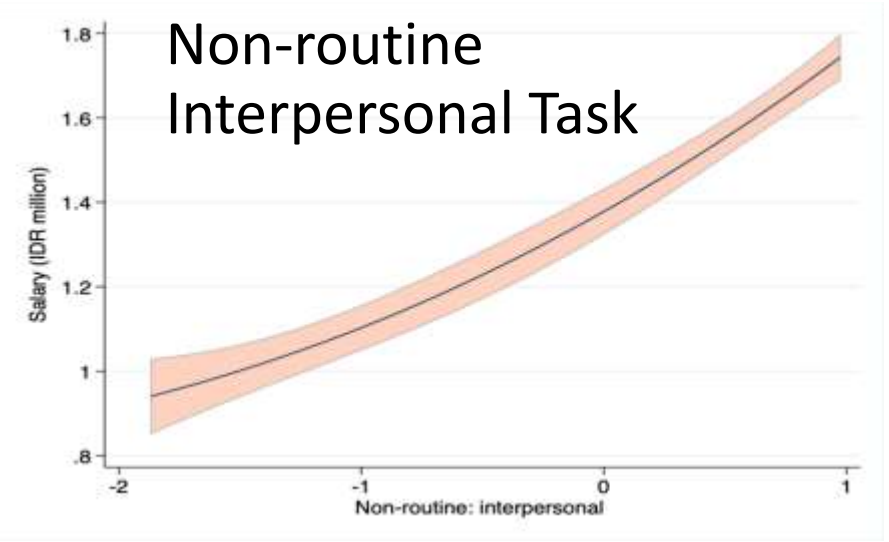
…the stock of industrial robots in Indonesia is still below Thailand and Singapore although it grew 16 times from 2006 to 2016. Mostly in plastic & chemical and automotive sector

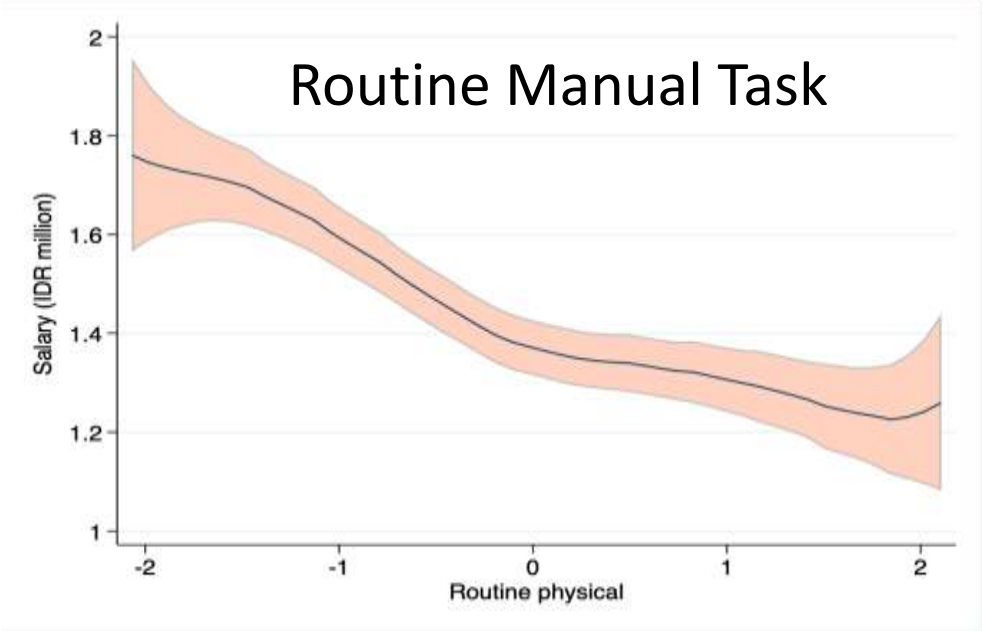


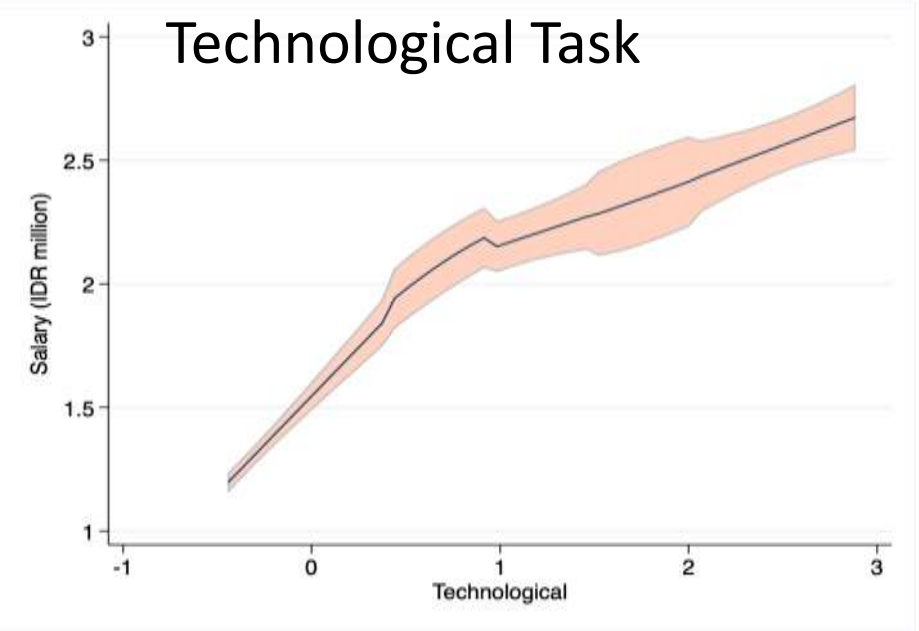


Source: International Federation of Robotics









Evidence from Indonesia: IFLS Data

Source: Wicaksono and Mangunsong (2019)

Firm-Level Analysis

- This chapter uses secondary data from *Statistik Industri* (SI) and analyzes the link between technology and firm productivity using input material data
  - This approach is reasonable in senses that intermediate inputs are one of the essential channels of technology diffusion across countries (Romer, 1990, Grossman & Helpman, 1991 and Aghion & Howitt, 1992)
- Technology, as we mentioned in this part, is not necessarily a disruptive technology. We approach this by using UNIDO classification **to define high-tech input and non-high-tech input**
- Use 2006 to 2015 sample period to capture the most recent development of technology in manufacturing

- There are three datasets used in this study:
  - First, SI data which comprises of annual Indonesian medium-sized and large manufacturing firms survey with at least 20 employees). It includes industry codes, a unique plant code, number of employees, value-added, imports, and export values. Industry codes are defined up to the five-digit International Standard Industrial Classification (ISIC) level.
  - Second, Input Data Set of SI *(unpublished)* which provides firm-level information on the inputs used by each plant
  - Finally, the Wholesale Price Index (WPI) to deflate the nominal value-added using the four-digit level WPI published by BPS. For the input data, we use two-digit level WPI.

Firm-Level Analysis

To examine the effect of high-tech input to productivity, we start by estimating a standard Cobb-Douglas production function

$$Y = A\, K_{it}^{\beta_1} L_{it}^{\beta_2}$$

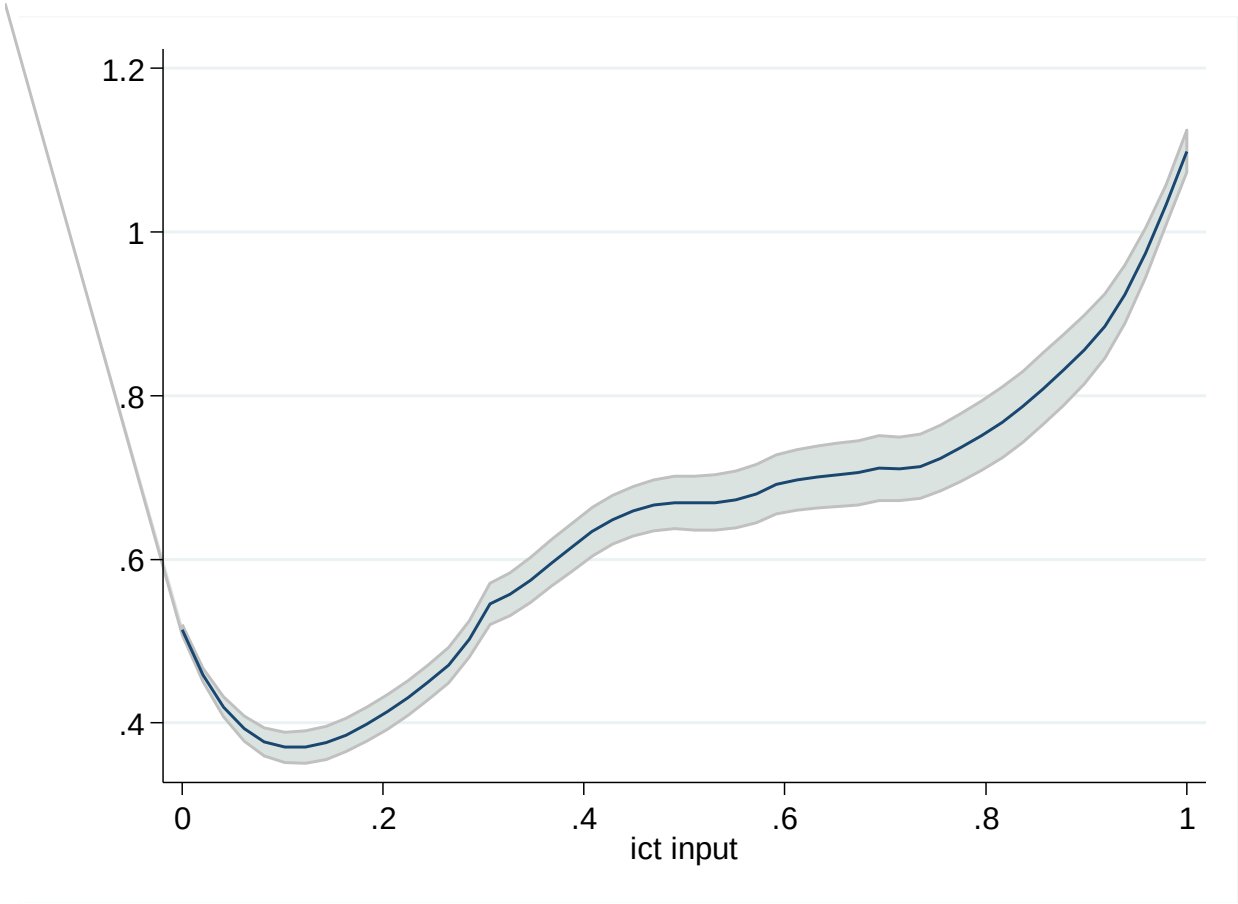
Where Y is the output of firm *i* in year *y, L* is labor and K is capital stock. We define *A* as follows

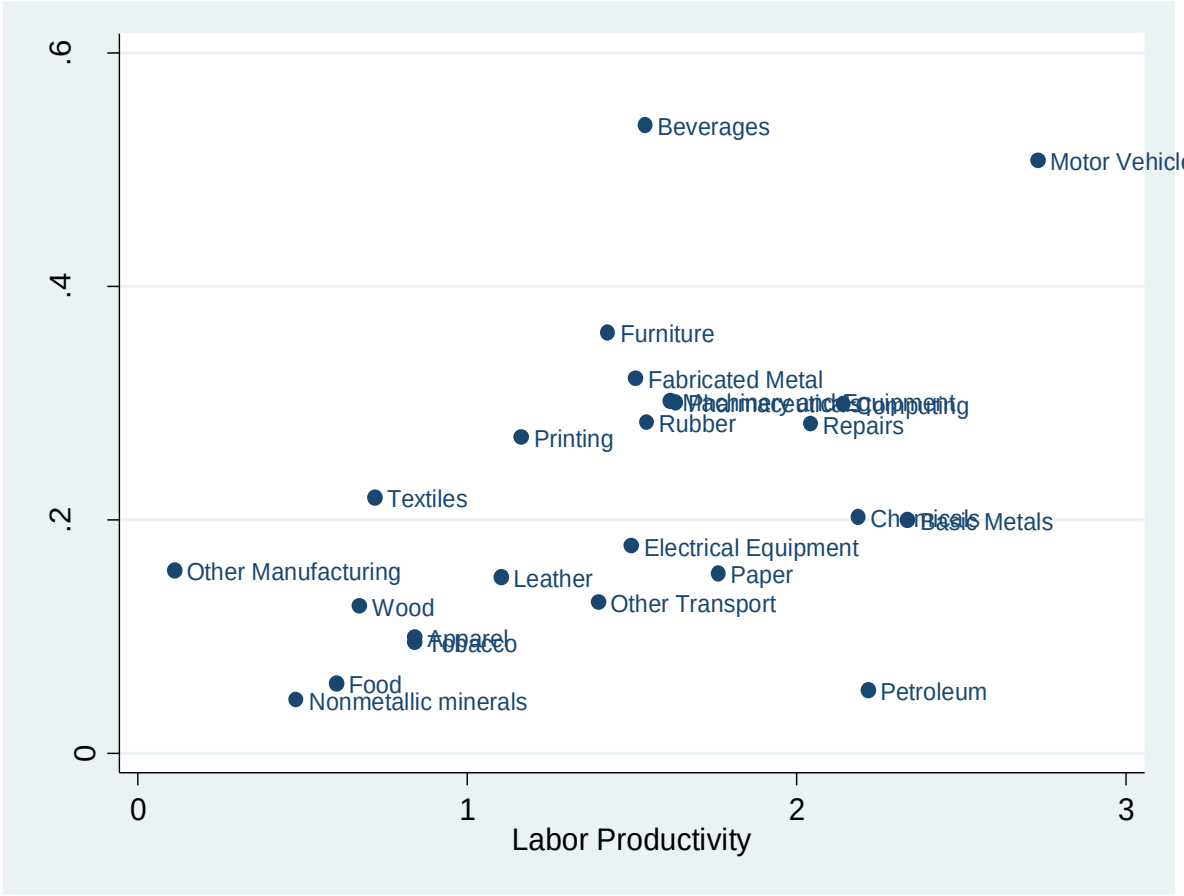
$$A = f(ownership, market\ orientation, technological\ intensity)$$

Finally, we estimate the labor productivity equation below

$$lnVA/L_{it} = \beta_1 + \beta_2 lnK/L_{it} + \beta_3 \ln TI_{it} + \beta_4 FDI + \beta_5 export + u_{it}$$

Productivity and High-tech Input Share





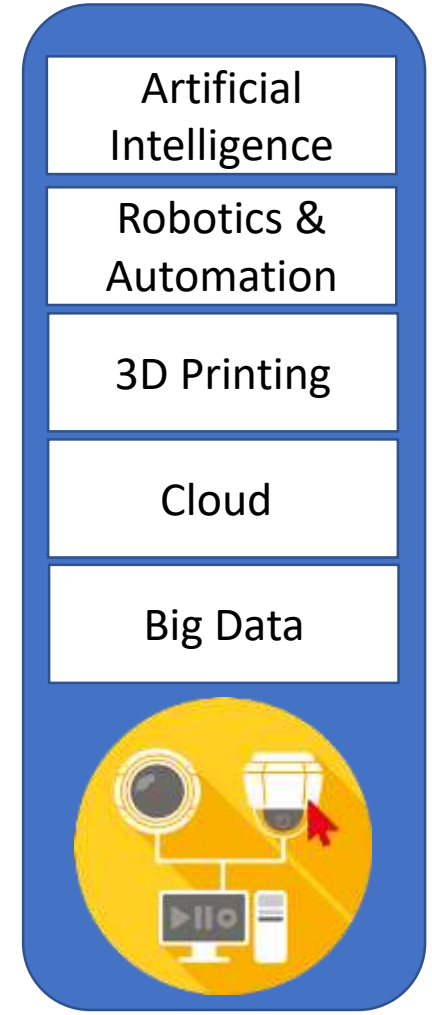
Estimation Result

	Productivity (VA/L)	
lninputtech	0.0150***	
	7.84	
inputtechshare		0.014
		1.01
K/L	0.0602***	0.0603***
	20.77	20.82
export	0.284***	0.282***
	42.29	42.07
fdi	0.174***	0.176***
	5.36	5.4
export & fdi	-0.253***	-0.251***
	(-9.43)	(-9.37)
constant	-0.335***	-0.323***
	(-5.59)	(-5.40)
Observations	125322	125322
R-squared	0.027	0.027

Sector	Elasticity
Tobacco	0.154***
Leather	0.044***
Fabricated Metal	0.041***
Rubber	0.033***
Furniture	0.031***
Motor Vehicles	0.03***
Food	0.029***
Other Manufacturing	0.029***
Apparel	0.025***
Nonmetallic minerals	-0.03***
Electrical Equipment	-0.043***
Basic Metals	0.025
Machinery and Equipment	0.021
Other Transport	0.019
Paper	0.008
Chemicals	0.001
Beverages	0.001
Wood	0.001
Computing	-0.001
Pharmaceuticals	-0.007
Textiles	-0.009
Printing	-0.01
Repairs	-0.024
Petroleum	-0.048

Survey Background

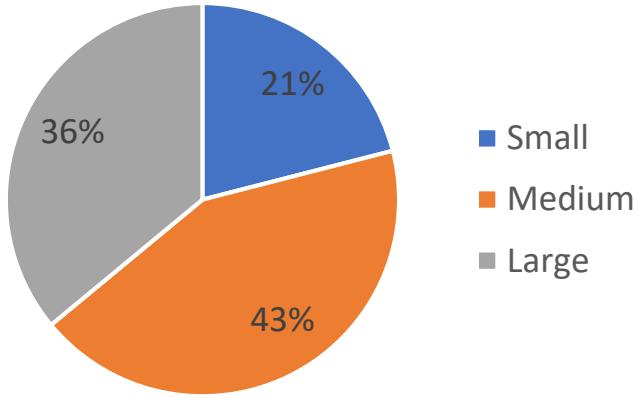
- Our data set consists of a firm-level survey of 502 firms
  - Located in four provinces, DKI Jakarta, Banten, Jawa Barat and Jawa Timur
- The survey was conducted in all locations between December 2018 and February 2019 through series of face-to-face interviews
- The questionnaire divided into five parts which are
  - Company's characteristic (ownership, export, import)
  - Research and development activity (budget, activities)
  - Technological adoption (benefit and constraint, ICT adoption)
  - Industry 4.0 technology (awareness, utilization, impact)
  - Employment (structure, wages)
- Six sectors – food & beverages, garment, footwear, electronics, automotive and rubber & plastics – were selected based on employment and output proportion in the economy
  - In addition, the selection also considers Making Indonesia 4.0 masterplan focus sector. The survey uses sector, region and size (employment) for stratification strategy using 2015 *Statistik Industri* as sampling frame



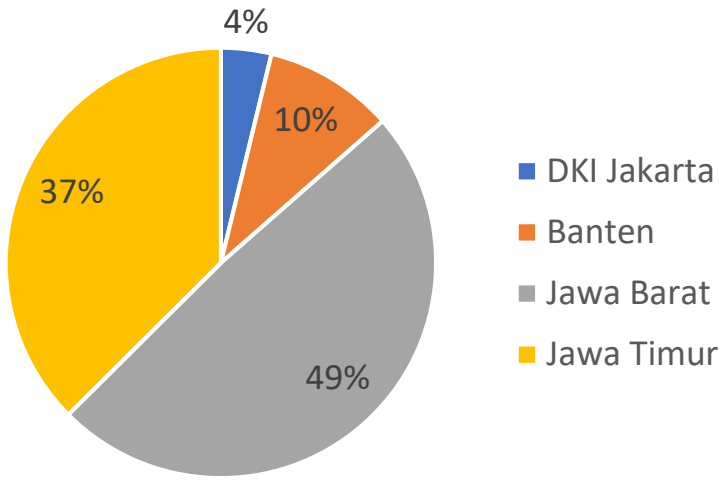
Profile

- 502 companies
- Four provinces
- 6 sectors
- 21% exporter
- 27% importer
- 88% domestic-private firm
- 57% SMEs

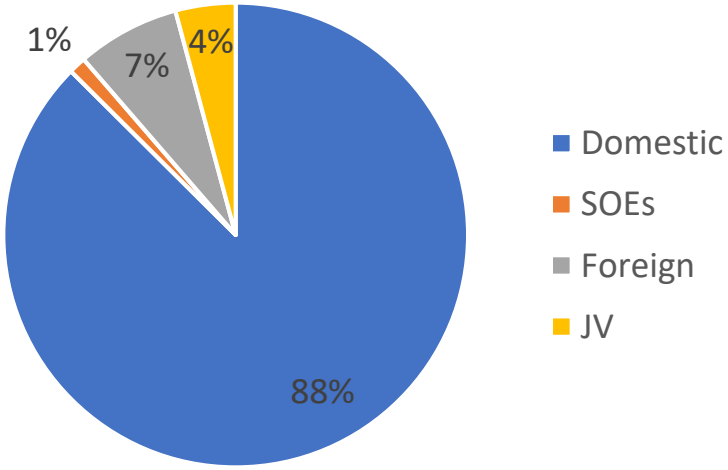
Firm Size



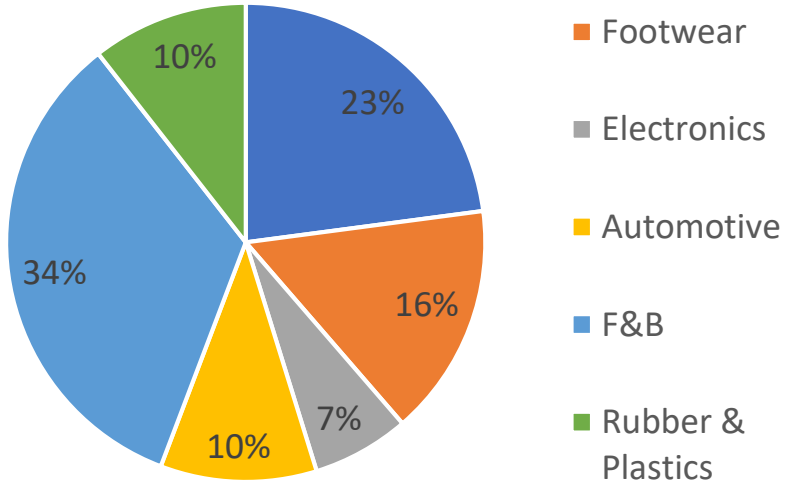
Firm Location



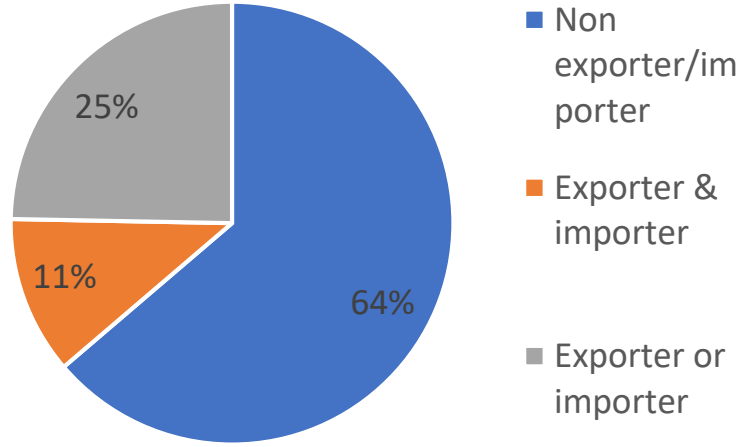
Ownership

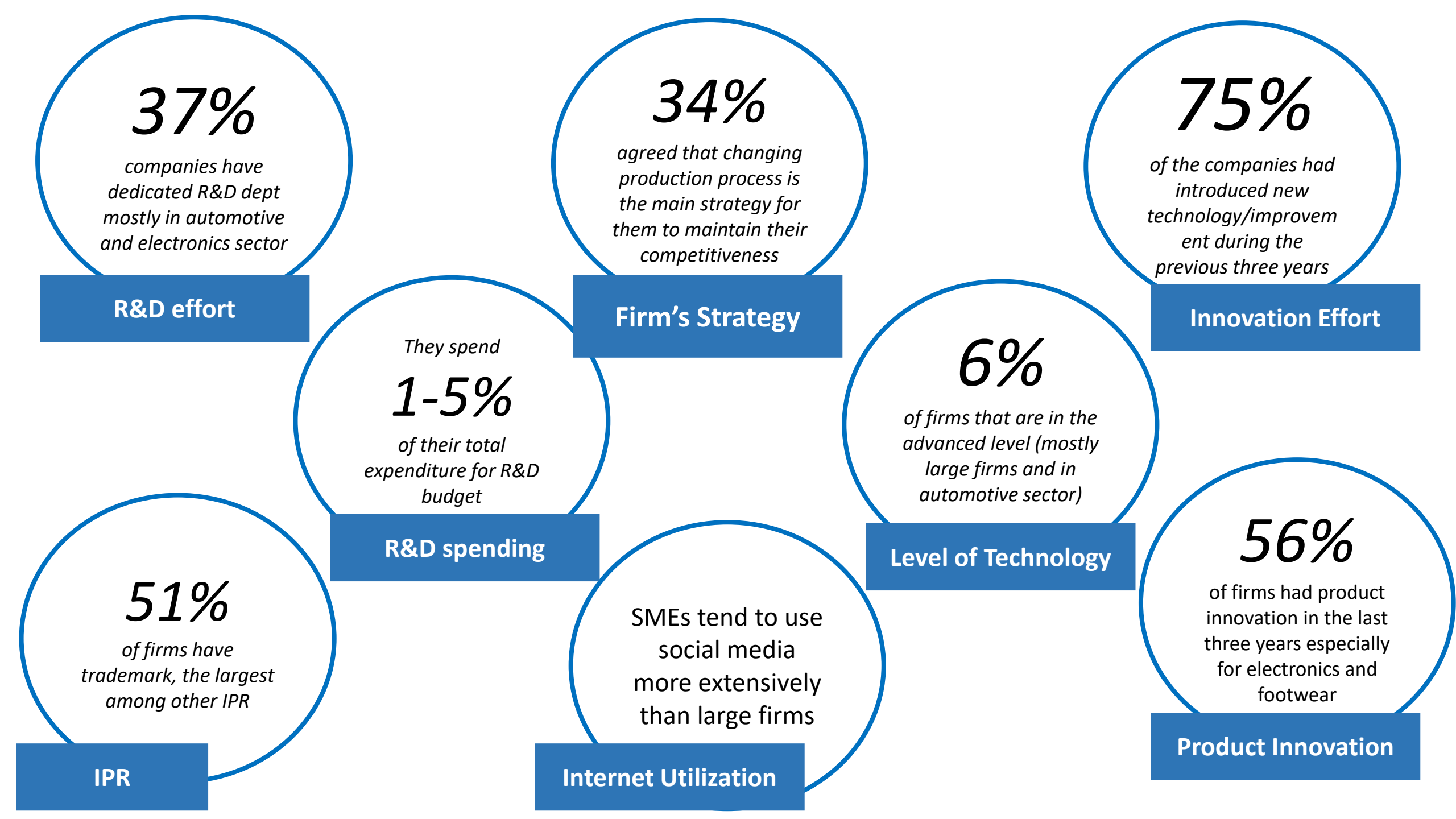


Sector



Trade




37%
companies have dedicated R&D dept mostly in automotive and electronics sector
R&D effort
34%
agreed that changing production process is the main strategy for them to maintain their competitiveness
Firm's Strategy
75%
of the companies had introduced new technology/improvement during the previous three years
Innovation Effort
They spend
1-5%
of their total expenditure for R&D budget
R&D spending
6%
of firms that are in the advanced level (mostly large firms and in automotive sector)
Level of Technology
56%
of firms had product innovation in the last three years especially for electronics and footwear
Product Innovation
51%
of firms have trademark, the largest among other IPR
IPR
SMEs tend to use social media more extensively than large firms
Internet Utilization

Awareness

68%

of firms are familiar with automation

Benefits

1. Productivity
2. Energy efficiency
3. Better planning and budgeting

R&D effort

Only 7%

of firms are aware about Making Indonesia 4.0

Utilization

27%

of the firms has utilized automation i.e. the highest among other Industry 4.0 technology

Obstacles

1. High financial need
2. Unclear financial feasibility
3. Lack of high-skilled workers

Information

60%

of firms obtain information about industry 4.0 in-house

Firm's Plan

>80%

of firms do not have plan to use these technologies anytime soon technologies

Assistance

20%

of firms expect protection and training from the government

Provide effective incentives	• Technological adoption creates information and knowledge externalities to other firms -> reasonable for the government to provide incentives e.g. to upgrade their r&d capacity • Firms that have dedicated research and development department are more innovative and more likely to adopt industry 4.0 technology
Narrowing skill gap	• The survey highlights that there is a concern about the shortage of skilled workers in the future • In the long-term, the government should focus on human capital and skill formation system while the short-term policy could be a more flexible high-skilled foreign worker to fill the skill gap • Experts are mostly foreigners since Indonesia still an importing technology country
Improve innovation environment and encourage competition	• The government should improve innovation culture by strengthening IPR and competition policy -> IPR is highly related to technological adoption • Firms are aware that innovation is the key to survive in the market competition although our survey also found that most firms ask for protection as the best assistance to face industry 4.0 • The government should be careful about the type of protection and avoiding cherry-picking winner policy.
Ensure infrastructure quality and facilitating industry 4.0 policy	• Internet access and electricity are the central enablers for industry 4.0 • The adoption of a flexible, clear, and adaptive policy to new technologies is as important as building a good hard infrastructure • Indonesia should also consider the international framework and actively contribute to global governance in digitalization and technology.
Better data for better policy making	• The study found difficulties in gathering relevant data on industry 4.0 related technology • Good quality and comprehensive of data on Industry 4.0 technology and the firm's innovation effort is an inevitable requirement for the government towards more sound policies esp. to track progress and bottleneck (e.g. European Manufacturing Survey in EU)

Policy Recommendation

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Thank You

The full results of the manufacturing survey are analysed in: Aswicahyono H, and Rafitrandi D.2019. Disruptive Technology in Manufacturing Sector. ADB Economic Working Paper Series. Forthcoming

Appendix 1

The technology classification is based on research and development (R&D) expenditure incurred in the production of manufactured goods. Manufacturing industries with a higher R&D intensity are considered high-technology industries. R&D intensity refers to the ratio of R&D expenditure to an output measure, usually gross value added. (Galindo-Rueda and Verger, 2016)

Medium-high and high technology *(high-tech)*

Division 20	Chemicals and chemical products
Division 21	Pharmaceuticals
Division 26	Computer, electronic and optical products
Division 27	Electrical equipment
Division 28	Machinery and equipment n.e.c.
Division 29	Motor vehicles, trailers and semi-trailers
Division 30	Other transport equipment except ships and boats
Division 22	Rubber and plastics products
Division 23	Other non-metallic mineral products
Division 24	Basic metals
Division 32	Other manufacturing except medical and dental instruments
Division 33	Repair and installation of machinery and equipment

Low technology *(low-tech)*

Division 10	Food products
Division 11	Beverages
Division 12	Tobacco products
Division 13	Textiles
Division 14	Wearing apparel
Division 15	Leather and related products
Division 16	Wood and products of wood and cork
Division 17	Paper and paper products
Division 18	Printing and reproduction of recorded media
Division 19	Coke and refined petroleum products
Division 25	Fabricated metal products except weapons and ammunition
Division 31	Furniture