Economics and Finance in Indonesia
Vol. 64 No. 1, June 2018 : 59–72
p-ISSN 0126-155X; e-ISSN 2442-9260

Does Manufacturing Sophistication Lead to Higher Demand for Vocational Workers? Evidence from Indonesia

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Abstract

Indonesia post-crisis manufacturing growth has been dominated by technologically sophisticated industry. Hypothetically, this development would increase the demand for skilled and more specialized workers like vocational school graduates. However, statistical evidences show that manufacturing sophistication stimulated by integration with the Global Production Network increase demand for vocational as well as general high school graduates. Moreover, higher demand does not necessarily result in sustainable career prospect, as many vocational graduates still have limited opportunity to improve their skills while climbing the seniority ladder possibly caused by shifting Global Value Chain from export-oriented toward domestic market-oriented that affect the industry's technological complexity.
Keywords: labor economics; vocational education; skill content; global production network; global value chain; industrial development.

Abstrak

Setelah krisis finansial 1998, pertumbuhan sektor manufaktur Indonesia didominasi oleh industri berteknologi mutakhir, misalnya industri mesin dan perlengkapannya. Secara teoritis, perkembangan ini akan meningkatkan permintaan terhadap tenaga kerja berkeahlian khusus, seperti lulusan sekolah menengah kejuruan. Bukti-bukti statistik menunjukkan bahwa permintaan tenaga kerja dengan pendidikan menengah kejuruan maupun menengah umum memang meningkat. Namun, peningkatan ini tidak selalu diikuti dengan prospek karir yang menunjang. Tenaga kerja dengan pendidikan menengah kejuruan memiliki kesempatan yang terbatas untuk meningkatkan keahlian mereka ketika menjejaki tangga karir senioritas. Hal ini mungkin disebabkan oleh pergeseran pada posisi mata rantai nilai global Indonesia dari mata rantai yang berorientasi ekspor menjadi pasar domestik, dan perubahan ini berdampak pada karakteristik teknologi yang digunakan.
Kata kunci: *ekonomi ketenagakerjaan; pendidikan vokasi; spesifikasi keahlian; mata rantai produksi global; mata rantai nilai global; pembangunan industri*

JEL classifications: J23; J24; L60; O33; O53

1. Introduction

After the 1998 financial crisis, Indonesia manufacturing sector has experienced a shift in its development path from export-oriented, labor-intensive (garment, textile, and footwear) and resources-intensive (plywood processing) industries (see Thee 2012, pp.156) to technologically more sophisticated industries, such as automotive, electronics, and machineries industries[1]. This shift affects employment pattern in the manufacturing sector. While

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[1] According to OECD (2011), these industries is classified under the categories medium-high technology and high-technology industries.

in the past manufacturing sector employed mainly unskilled workers with junior high school or lower educational background, today it employs workers with higher educational background, mainly high school graduates[2].

Hypothetically, the rise of technologically sophisticated industries, i.e. the medium-high tech and high-tech industries, would lead to higher demand for not only workers with higher level of education, but also workers with more specialized skills. Unlike labor-intensive or resources-intensive industries that use less specialized technologies in their production process, medium-high tech, and high-tech industries use more specialized technologies and machineries. Bringing such technologies to developing countries require workers with specialized skills, specifically workers with vocational education background (UNIDO 2015, pp. 92).

This paper aims to answer this question by focusing on the effect of medium-high tech and high-tech industrial development in Indonesia between the periods of 2001 and 2012. During this period, Indonesia medium-high tech and high-tech industries experienced rapid development, and this development offers an opportunity to assess the effect of industrial development on human capital, specifically workers with vocational high school (SMK) background compared to workers with general high school (SMA) background.[3] Although both workers have similar level of education, there is significant difference in their skill content, in which the former is educated in specific skills that prepare them for production-related jobs in manufacturing sector.

Unlike other research that examined the role of vocational education in developing countries at the level of individual workers, such as Newhouse & Suryadarma (2011); Malamud & Pop-Eleches (2010); Chen (2009); El-Hamidi (2006); and Moenjak & Worswick (2003), our discussion is more closely related to Krueger & Kumar (2004a,b) that discuss the relation be-tween technological development in manufacturing sector with vocational education.

Besides discussion on vocational education, this paper contributes to the discussion on Indonesia industrialization in post-crisis era, specifically the rise of medium-high tech and high-tech indus-tries. While most papers in this category focus solely on one category of manufacturing industry at a time, mostly in the automotive sector, such as Wicaksono & Priyadi (2016), Natsuda, Otsuka, & Thoburn (2015), Irawati (2012), and Sato (2011), this paper discusses multiple types of manufacturing industries which consist of (a) machineries and equipment; (b) electrical equipment and apparatus; (c) office, accounting and data-processing machinery; and (d) radio, television and communication equipment and apparatus manufacturing.

Our discussion also provide different nuance on the current state of Indonesia industrialization, in which there is a widespread fear of de-industrialization in the mainstream due to declining share of manufacturing output to total GDP as well as its share in export.[4]

This paper is organized as follows. Section 2 will briefly survey the existing literatures on vocational education. Section 3 provides brief explanation on the data set and statistical classifications used. Section 4 presents analysis on the current condition of Indonesia medium-high and high-tech industries. Section 5 analyzes the demand for SMK graduates

[2]This shift is partly caused by rigid labor regulations. For further explanation see Thee (2012, pp.163–164) and JETRO (2004, pp.3).

[3]In *Bahasa Indonesia*, SMK is the abbreviation for *Sekolah Menengah Kejuruan*, and SMA is for *Sekolah Menengah Atas*. This paper uses SMK and SMA to respectively refer to vocational high school and general high school, including in cited works where similar types of education institutions are present.

[4]Readers interested in de-industrialization may refer to Tadjoeddin, Auwalin, & Chowdhury (2016), Aswicahyono, Hill, & Narjoko (2013), and Mansur (2008).

in the industries. Section 6 concludes.

2. Literature Review

Generally, scholarly works on vocational education in developing countries focus on labor market outcomes at an individual worker level in comparison with general education, and their results are mixed. Newhouse & Suryadarma (2011) and Chen (2009) in Indonesia, and Malamud & Pop-Eleches (2010) in Romania, for example, found no significant difference in labor market out-comes between SMK and SMA graduates. Contrastingly, El-Hamidi (2006) in Egypt, and Moenjak & Worswick (2003) in Thailand, found positive results for SMK graduates.

Although this approach is useful to examine the benefits of investing in vocational education for individuals,[5] it does not address the question regarding skill content requirement to stimulate technological development in developing countries. This question was addressed by Krueger & Kumar (2004a,b). Using European and the United States case they built a model of endogenous technological adoption by firms and education decisions by households and argue that education policy which favors vocational education over general education may contribute to slower technological adoption, because vocational education that emphasis task-specific skills in its curricula do not teach enough conceptual or cognitive skills as in general education. In other words, workers technological adaptability is determined by their general cognitive or 'intellectual' skills.[6]

Krueger and Kumar's argument is confirmed by Hanushek et al. (2017). Using data from *International Adult Literacy Survey*, they found workers with SMK background face disadvantages in employment at later age over their SMA counterparts. Their disadvantage occurs in their early 40s and exacerbate overtime due to lack of adaptability with rapid technological change. To solve this problem, policymakers need to consider the potential trade-off in skills development, specifically between teaching task-specific and general cognitive skills, in designing vocational education and training program.

Nonetheless, Hanushek et al. (2017) findings relies on data from developed countries. Unfortunately, there is no similar analysis exist for developing countries, where the application of cutting-edge technology on the bulk of the economy remain limited. Consequently, the magnitude of trade-off between task-specific and general cognitive skills as well as the relation between skill content and technological development are still not completely understood.

The global production networks (GPN) and global value chain (GVC) frameworks provides a way to assess the relation between skill content and technological development in developing countries. Ernst and Kim (2002) argue that GPN can act as cross-borders carrier of knowledge that transfers technical and managerial knowledge from flagship companies that are generally located in technologically developed countries to a network of overseas suppliers, mostly located in developing countries due to their cost advantage. Technological development occurs when over-seas suppliers successfully upgrade its capabilities, and the upgrading process is a continuous process as suppliers could move up the value chain by upgrading their capabilities further.

Technological development at supplier level depend on the industry's technological characteristics. Gereffi (1994) provides a framework to understand such characteristics by dividing industries into producer-driven and buyer-driven value chain.

[5] This approach is also used to justify the government policy in combating youth unemployment through vocational education. See Newhouse & Suryadarma (2011); and El-Hamidi (2006) for further explanation.

[6] The idea of workers' intellectual skills is comprehensively discussed by Kazuo Koike. See Koike (2002,2005) and Koike & Inoki (1990) for further explanation.

Producer-driven value chain is associated with "difficult technology" and typically characterized with medium-high and high-tech industries, such as automotive, electronics, and telecommunication. Contrastingly, buyer-driven value chain is associated with "easy technology" in labor-intensive industries like textiles, foot-wear, furniture, and agroindustry.

Generally, producers in developing countries join buyer-driven value chain because of their low level of technological development. Improvement in level of technology occurs when producers shift from buyer-driver to producer-driven value chain, such as shown by the experience of East and Southeast Asia countries.[7] To shift successfully, the producers need to upgrade their workers' skill content to meet the new technological requirement that require more specialized skills.

3. Method and Data

This research uses OECD (2011) classification of technology intensive manufacturing. According to this classification, manufacturing industries' level of technological intensity is determined by their direct and indirect R&D intensity relative to value-added and gross production statistics. They can be divided into four categories:

- High-technology Industries
  (e.g. aircraft and spacecraft; pharmaceuticals; office, accounting and computing machinery; radio, TV and communications equipment; medical, precision and optical instruments)
- Medium-high technology industries
  (e.g. electrical machinery and apparatus; motor vehicles, trailers and semi-trailers; railroad equipment and transport equipment; machinery and equipment; chemicals excluding pharmaceuticals)
- Medium-low technology industries
  (e.g. building and repairing of ships and boats; rubber and plastics products; coke, refined petroleum products and nuclear fuel; other non-metallic mineral products; basic metals and fabricated metal products)
- Low-technology industries
  (e.g. wood, pulp, paper, paper products, printing and publishing; food products, beverages and tobacco; textiles, textile products, leather and footwear).

Based on the classification above, our analysis focuses on medium-high (electrical machinery and apparatus; and machinery and equipment) and high-tech industries (office, accounting and computing machinery; and radio, TV and communications equipment and apparatus).

In analyzing the demand for workers with SMK background in these industries, this research uses the *National Labor Force Survey* (*Sakernas*), which is collected, organized and disseminated by the Central Agency on Statistics (BPS), for the periods between 2001 and 2012.[8] In analyzing this data, we combine descriptive statistics and cross-tabulation to exploit the richness of BPS micro data and clarify characteristics that are not revealed in official publications such as real wage per man-hour, share of workers that received certified training, and length of services. We also use the same approach in analyzing SMA graduates.

Besides workers' characteristics, this research examines the GVC and GPN positions of Indonesia medium-high and high-tech industries. We use the

[7] See Kuroiwa & Toh (2008) and Kawakami & Sturgeon (2011) for further discussion regarding GPN and GVC upgrading in East and Southeast Asia.

[8] In 2010, the BPS changed the industrial classification from KBLI 2005 (ISIC Rev. 3) to KBLI 2009 (ISIC Rev. 4). This change affect the data definition used in this research. We did some adjustment on 2010–2012 data by converting 2010–2012 data classification back to KBLI 2005. See Appendix I for further details.

Medium and Large Enterprises Industrial Statistics published by the BPS and international trade data from the United Nations International Trade Statistics Database (UN COMTRADE)[9].

4. Current Development of Indonesia Medium-high and High-tech Industries

Although mainstream discussion on Indonesian manufacturing sector is dominated by fear of deindustrialization due to slower real manufacturing output growth vis-á-vis real GDP growth since 2005, Indonesia medium-high and high-tech industries had been growing much faster at 10.2% on average annually (see Figure 1). Because of its stunning growth performance, the industries real output share to GDP had increased from 5.6% in 2001 to 8.7% in 2013. At the same time, the industries output contribution to manufacturing grew by 13.7 percentage point to 33.9%.

This development was unexpected. Unlike industrialization before the 1998 financial crisis which was led by central government planning, the development of medium-high and high-tech industries occurred spontaneously. Between 2001 and 2005, when Indonesian economy was still re-covering from the aftermath of the crisis, these industries grew at double digit rate in the range of 10 to 20%. After that, the industries output growth experienced an unstable slow down due to subsequent financial crisis in the United States and sovereign debt crisis in the European Union.

Disaggregation on the data shows that the development of medium-high and high-tech industries is driven by the radio, television and communication equipment and apparatus (telecom) manu-facturing in early 2000s and by the electrical machinery and apparatus (electrical) manufacturing in late 2000s. In 2001–2004, telecom industry output tripled from 26 trillion to 77 trillion Rupiah. In 2005, however, this industry output fell drastically to 28 trillion Rupiah. After that, the output recovered slowly and reached 54 trillion Rupiah in 2011.

On the other hand, electrical manufacturing recorded a steady output growth. Between 2000 and 2011, this industry output increased by more than fivefold, from 17 trillion to 98 trillion Rupiah. Similarly, office, accounting and data-processing machinery (office and data-processing) manufacturing recorded phenomenal output growth from 27 billion to 950 billion Rupiah. Nevertheless, its output size is too small to be considered influential.

In contrast to electrical manufacturing, machinery and equipment (machinery) manufacturing suffered from output stagnation. As a result, this industry output share dropped from 46.3% in 2001 to 29% in 2011 and lost its leadership position to electrical manufacturing, of which the output share soared by 31.5 percentage point to 52.7% in 2011 (see Figure 2).[11]

Although the industries aggregate output had risen sharply in 2001–2011, the industries trade position has shifted from trade surplus to trade deficit (see Figure 3). Before 2007, Indonesia medium-high and high-tech industries were running small trade surplus that fluctuated in the range of USD1–4 billion.

[9] UN COMTRADE data is based on SITC Rev. 3. See Appendix II for explanation regarding adjustment between the SITC Rev. 3 and KBLI 2005 format.

[10] The growth rate for medium-high and high-tech industries includes figures from transportation industry (shipbuilding, land vehicles, and aircraft). Nevertheless, we decide to exclude them from this research. For GPN and GVC analysis on automotive industry, please see Wicaksono & Priyadi (2016).

[11] From this point, we will refer to machinery and equipment manufacturing as machinery; electrical machinery and equipment manufacturing as electrical; office, accounting and data-processing manufacturing as office and data-processing; and radio, television and communication equipment and apparatus manufacturing as telecom.

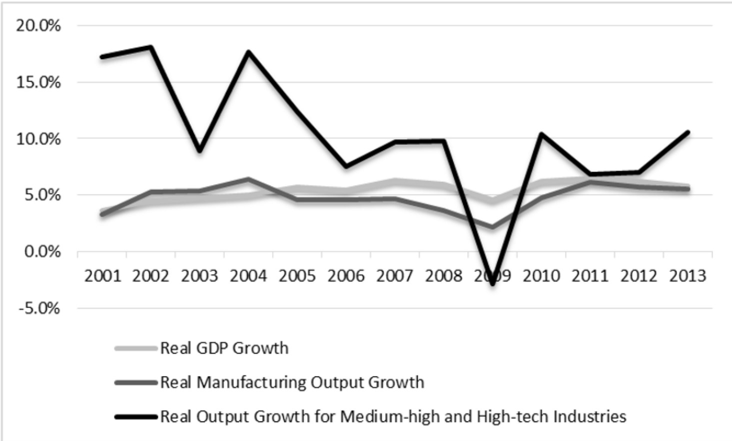

Figure 1: Real Growth Rate for GDP, Manufacturing Output, and Medium-high and High-tech Industries Output[10], 2001–2013
Source: Calculated from National Income of Indonesia, Statistics Indonesia (BPS)

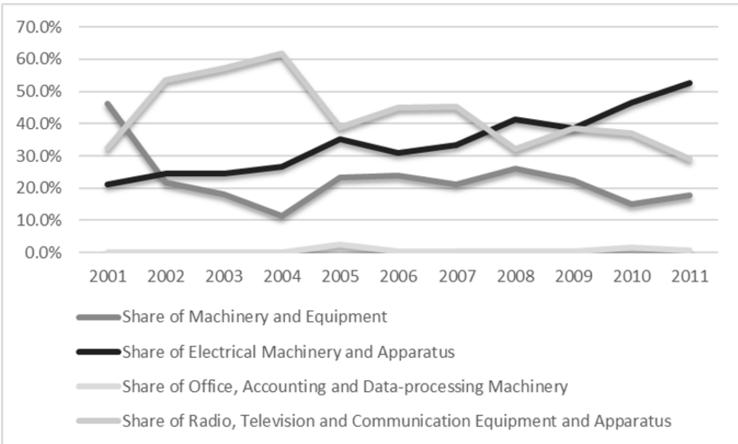

Figure 2: Output Share in Medium-high and High-tech Industries, 2001–2011
Source: Calculated from National Income of Indonesia, Statistics Indonesia (BPS)

Since 2004, the industries trade surplus had diminished and changed into trade deficit in 2007. After that, the deficit widened to its peak in 2012 at USD30 billion.

Interestingly, the industries widening trade deficit occurred simultaneously with sharp increase in total trade from USD15.3 billion in 2001 to USD62.1 billion in 2013. Steep growth in total trade suggest that the development of Indonesia's medium-high and high-tech industries is characterized by rapid improvement in GPN linkages. Furthermore, widening trade deficit that occurred after a period of trade surplus in early 2000s manifest a change in Indonesia's GVC position, from export market-oriented to domestic market-oriented. Technologically, the change in GVC characteristic might lead to the development of less sophisticated assembling technology that require less specialized workers.

Despite improvement at aggregative level, there is significant difference in the magnitude of improvement in GPN linkages at sub-industry level. According to table 1, the improvement in GPN linkages was stronger in medium-high tech industries than in high-tech industries. Between 2001 and 2013,

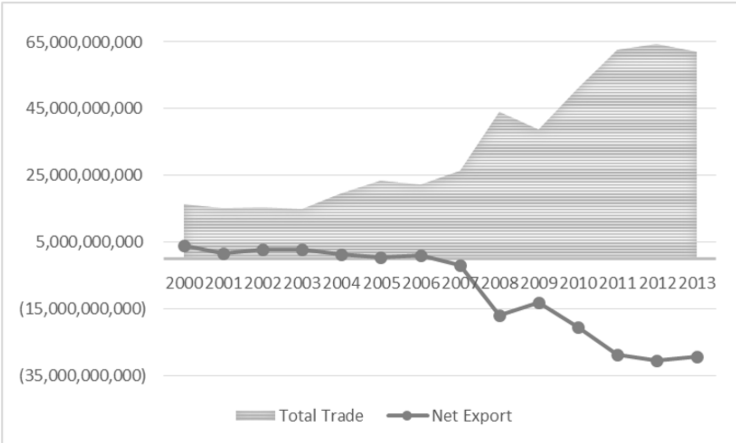

Figure 3: Total Trade and Net Export for Medium-high and High-tech Industries, 2001–2013 (in million USD)
Source: Calculated from UN COMTRADE

Table 1: Trade Performance for Medium-high and High-tech Sub-industries, 2001 and 2013 (in million USD)

		Machinery and Equipment (Machinery)	**Electrical Machinery and Apparatus (Electrical)**	**Office, Accounting, and Data-processing Machinery (Office and Data-processing)**	**Radio, Television, and Communication Equipment and Apparatus (Telecom)**
Export	2001	504	2,633	2,063	3,353
	2013	2,859	7,619	1,986	3,993
	% Change	467.3%	189.4%	-3.7%	19.1%
Import	2001	3,847	1,632	414	902
	2013	20,221	14,555	3,471	7,395
	% Change	425.6%	791.9%	738.4%	719.8%
Trade Surplus/ (Deficit)	2001	(3,343)	1,001	1,649	2,451
	2013	(17,362)	(6,936)	(1,485)	(3,402)
	% Change	419.4%	-792.9%	-190.1%	-238.8%
Total Trade	2001	4,351	4,265	2,477	4,255
	2013	23,08	22,174	5,457	11,388
	% Change	430.5%	419.9%	120.3%	167.6%

Source: Calculated from UN COMTRADE

machinery and electrical manufacturing recorded more than 400 per cent growth in the value of total trade to USD23 billion to the former and USD22 billion for the later. At the same time, total trade for sub-industries in high-tech category only increased by 167.6% (telecom) and 120.3% (office and data-processing).

The difference in the magnitude of improvement in GPN linkages at sub-industry level was caused by difference in export performance. Between 2001 and 2013, electrical machinery and apparatus industry export grew by 189.4% to USD7.6 billion in export value. Meanwhile, machinery and equipment industry recorded stronger export growth by 467% to USD2.8 billion. In contrast, Radio, television and communication equipment and apparatus industry ex-port only grew by 19.1% to USD3.9 billion. Even worse, office, accounting and data-procession machinery industry experienced a slight decrease of 3.7% in export value.

5. Demand for SMK Graduates in Medium-high and High-tech Industries

In the past decade, Indonesia's medium-high and high-tech industries experienced an improvement in GPN linkages and a change in GVC characteristic from export market-oriented toward domestic market-oriented. Theoretically, this development would create two competing forces. On one hand, improvement in GPN linkages would lead to higher demand for SMK graduates. On the other hand, change in the industries' GVC characteristic toward domestic market orientation, which is associated with less sophisticated assembling technology, would wind down the gain in demand for SMK graduates and lead to higher demand for workers with more general knowledge but less specialized skills, i.e. SMA graduates.

Figure 4 provides evidences for the simultaneous effects of an improvement in the industries' GPN linkages and a change in their GPN characteristics toward domestic market orientation on the demand for SMK graduates. Following the industries' GPN and GVC timeline, we found that the number of SMK graduates increased after 2008, from approximately 105,000 workers in 2008 to more than 154,000 workers in 2012. Before that, the numbers of SMK educated workers in the industries' workforce were relatively stable in the range of 120–130,000 workers, except for 2002 at 83,725 workers. At the same time, the numbers of SMA graduates also grew from approximately 136,000 workers to more than 163,000 workers. Unlike the previous period when the ebb and flow of the SMA graduates employment trend in the industries appeared independently from its SMK counterparts, the increasing trend after 2008 moved in unison with the trend for SMK graduates.

Even though in aggregate the demand for SMK graduates in medium-high and high-tech industries' increased after 2008, the demands at sub-industry level varied in accordance with the mag-nitude of improvement in GPN linkages. For example, the number of SMK graduates in machinery manufacturing, where GPN recorded vigorous improvement as indicated by total trade as well as export performance, grew from approximately 17,500 workers in 2001 to around 39,200 workers in 2012. Similarly, the numbers of SMK graduates in electrical manufacturing increased more than double to 56,342 workers. In contrast, the numbers of SMK graduates in telecom manufacturing, where improvement in GPN linkages were weak, fell by a third to 56,000 workers in 2012 (see Figure 5).

Office and data-processing manufacturing was an exception. Although the industry's GPN performance was weak, the demand for SMK graduates increased rapidly from only 766 workers in 2001 to 2,564 workers in 2012, albeit at high volatility gauge in which the industry could lose more than 70 per cent of its SMK workforce in just one year.[12] This irregularity might be caused by low level of industrial development that is still at its infancy. As a result, Office and data-processing manufacturing's demand for SMK graduates would increase regardless of the performance of its GPN linkages.

Higher demand for SMK graduates in medium-high and high-tech industries is a positive development. Nonetheless, higher demand alone does not necessarily result in sustainable employment conditions. For instance, the increase in demand for SMK graduates might result in more workers working under one to two years outsourcing contract with minimal employment benefits. To examine such possibility, we add two variables in our analysis: earning potential as represented by real wage per man-hour

[12] The volatility might be caused by sampling problem in the *Sakernas* data. Nevertheless, this topic is not within the scope of this paper.

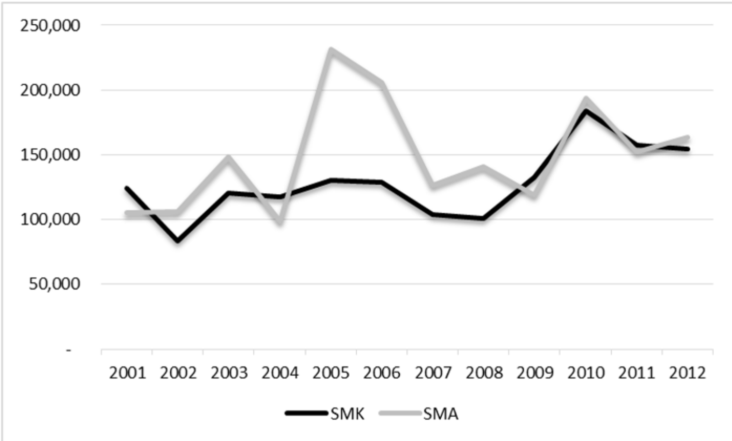

Figure 4: The Numbers of SMK and SMA Graduates in Medium-high and High-tech Industries, 2001–2012
Source: Calculated from Sakernas, BPS

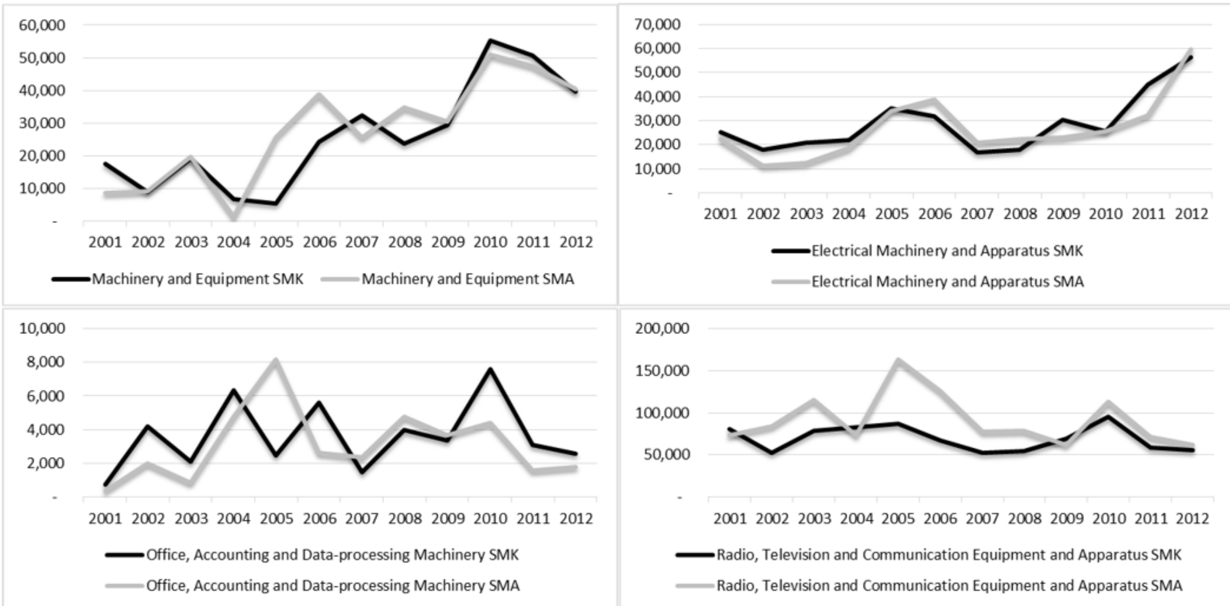

Figure 5: The Numbers of SMK and SMA Graduates at Sub-industry Level, 2001–2012
Source: Calculated from Sakernas, BPS

and career opportunities as measured by length of services and opportunity to acquire vocational training on-the-job.

We found that earning potential for SMK graduates, as reflected by growth in real wage per man-hour, is not related with the progression in GPN linkages. For example, real wage per man-hour in machinery manufacturing only grew on average by 2.7% per year between 2001 and 2012, lower than the average for medium-high and high-tech industries at 3.2%. Meanwhile, SMK graduates in telecom manufacturing increased by an average of 4% per annum (see Table 2).

Likewise, SMA graduates' earning potential is not related with the GPN performance. In electrical manufacturing, the average real wage per man-hour

Table 2: Real Wage per Man-hour and Its Average Annual Growth Rate for SMK and SMA Graduates in Medium-high and High-tech Industries, 2001–2012

		2001	2012	Average Annual Growth Rate	Standard Deviation
Machinery and Equipment (Machinery)	SMK	8,005	9,395	2.7%	0.15
	SMA	5,912	7,622	3.6%	0.16
Electrical Machinery and Apparatus (Electrical)	SMK	8,011	9,12	5.7%	0.29
	SMA	11,661	8,732	-1.0%	0.17
Office, Accounting and Data-processing Machinery (Office and data-processing)	SMK	7,097	9,337	9.5%	0.41
	SMA	6,759	6,722	24.3%	1.03
Radio, Television and Communication Equipment and Apparatus (Telecom)	SMK	8,214	9,643	4.0%	0.21
	SMA	8,106	10,57	3.4%	0.13
Medium-high and High-tech	SMK	8,092	9,367	3.2%	0.19
	SMA	8,707	8,935	0.9%	0.11

Source: Calculated from Sakernas, BPS

decreased by 1 per cent per annum. In contrast, SMA graduates in telecom manufacturing enjoyed an average of 3.4% annual growth rate, significantly higher than the average growth rate for medium-high and high-tech industries at 0.9% per annum (see Table 2 too).

Our evidences show that SMK and SMA graduates made significant gains in term of career prospect. The numbers of senior workers in both categories, as measured by the numbers of SMK and SMA graduates who work for more than three years in the same company between 2008 and 2012, had increased in all sub-industries, except in office and data-processing manufacturing. The largest gain occurred in electrical manufacturing, in which the numbers of senior SMK and SMA graduates increased from around 9,400 to 31,000 workers for the former and from approximately 11,500 to 22,000 workers for the later. Meanwhile, the numbers of such workers were falling in office and data-processing manufacturing. Even worse, this industry had not employed senior SMA graduates anymore since 2011 (see Figure 6).

Although SMK and SMA Graduates' career prospects made significant gains in term of workplace seniority, these gains were not followed by skill upgrading opportunity. As shown in Figure 7, the numbers of SMK and SMA graduates that receive certified training at sub-industry level between 2007 and 2012 fell significantly, except for SMK graduates in electrical manufacturing as well as telecom manufacturing. This evidence suggest that their career improvement occurs in precarious condition, in which a sudden technological change would disrupt their career achievement.

One possible explanation for this condition is the shift in medium-high and high-tech industries' GVC position from export-oriented toward domestic market-oriented value chain. Domestic market-oriented value chain is strongly associated with less sophisticated technologies such as assembling technology. As a result, firms in medium-high and high-tech industries have minimum incentive to provide greater training opportunities for their workers.

6. Conclusion and Some Remaining Problem

This paper examines the effects of medium-high and high-tech industries development on the demand for workers with more specialized skills and education, specifically vocational school graduates, and their employment condition in term of earning potential and their career prospect.

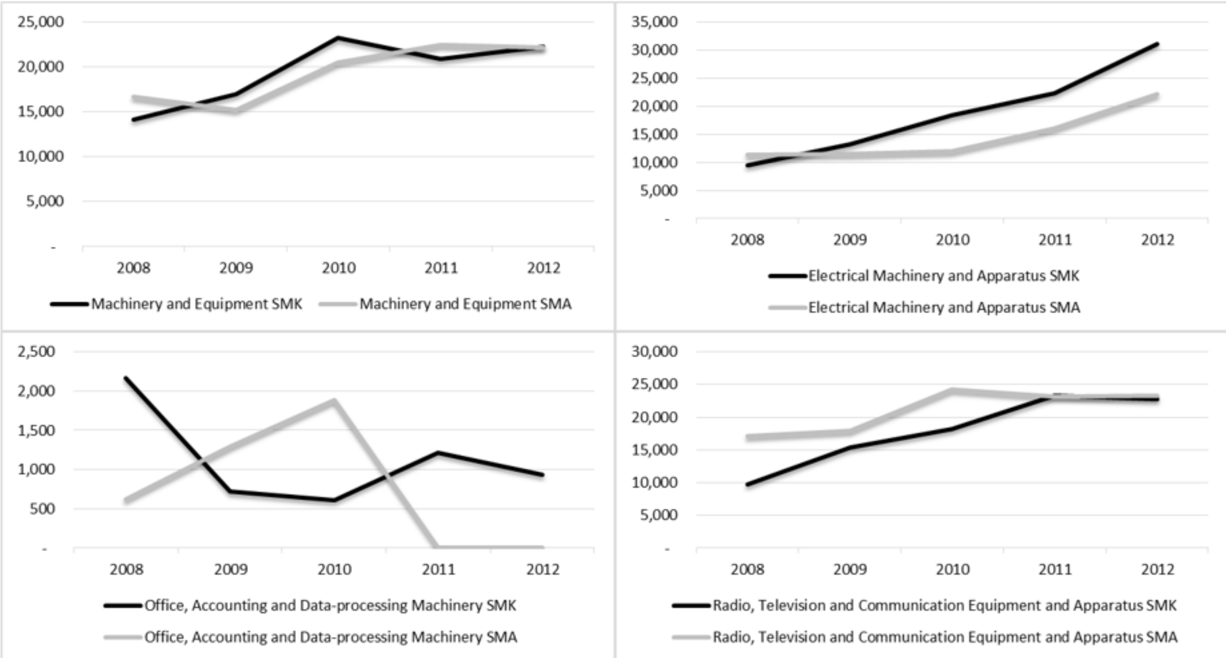

Figure 6: The Numbers of SMK and SMA Graduates who Work for More than 3 Years in the same Company in Medium-high and High-tech Industries at Sub-industry Level, 2008–2012
Source: Calculated from Sakernas, BPS

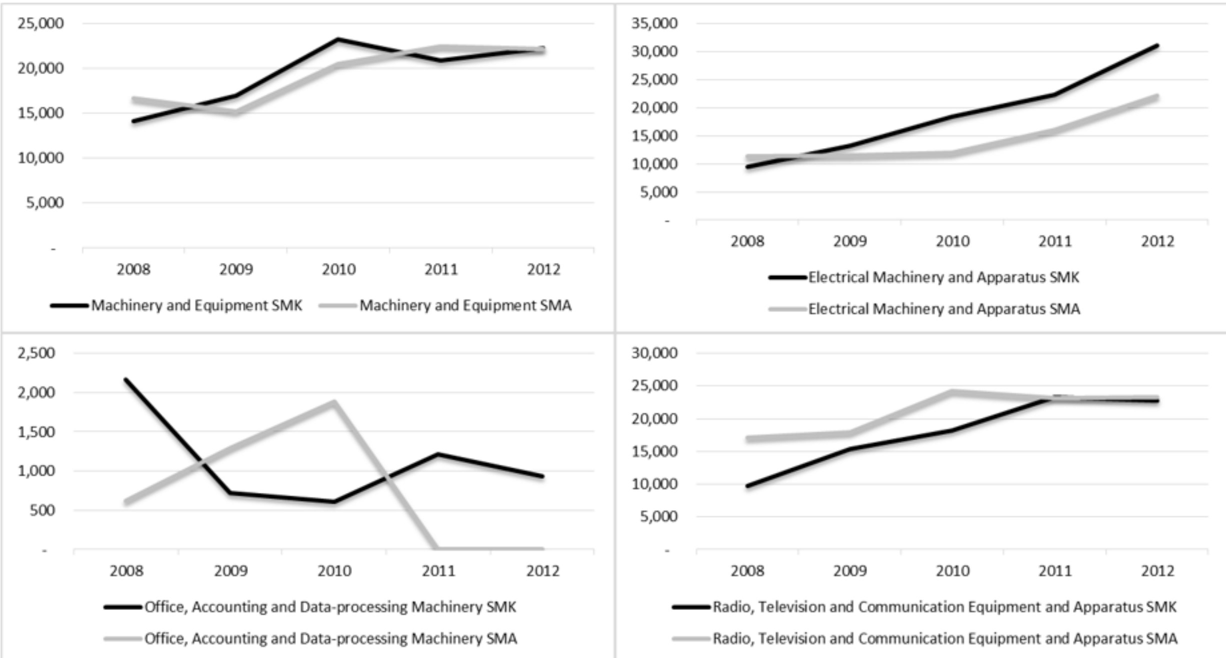

Figure 7: The Numbers of SMK and SMA Graduates that Receive Certified Training in Medium-high and High-tech Industries at Sub-industry Level, 2007–2012
Source: Calculated from Sakernas, BPS

Over the last decade, Indonesia's medium-high and high-tech industries has experienced transformations in their GPN and GVC positions. All sub-industries in the industries have undergone rapid integration in GPN linkages. However, this integration is followed by a change in GVC position from export-oriented to domestic market-oriented value chain, which affect the industries technological characteristics. Moreover, the degree of improvement in GPN linkages is different across sub-industries. While medium-high industries record significant improvement in GPN integration, high-tech industries perform poorly.

The difference in performance between medium-high and high-tech industries affects their demand for workers with vocational education or SMK graduates. On one hand, medium-high industries show significant increases in the numbers of SMK graduates in their workforce. On the other hand, the number of SMK graduates in high-tech industries is largely unchanged. However, the increase in the numbers of SMK graduates in medium-high industries is followed by equal increase in the numbers of SMA graduates in the workforce, indicating the effect of change in GVC characteristics on demand for workers' skill contents.

Analyzing the sustainability of SMK graduates' employment condition, we found that improvement in GPN linkages does not affect their potential earning as well as their career prospect. Rather, their employment conditions vary across industries. Nevertheless, the finding on their career prospect is noteworthy. SMK graduates' progression in workplace seniority does not come hand-in-hand with greater opportunity to upgrade their skills through certified training. We suspect that it is caused by the change in GVC characteristics toward domestic market-oriented value chain that affect the type of technology adopted in the industry such as less sophisticated assembling technology.

Before ending this article, we would like to remind the readers that this article is just an overview on the current development in Indonesia medium-high and high-tech industries. Further research is required to clarify vocational skill formations in these industries.

References

[1] Aswicahyono, H., Hill, H., & Narjoko, D., 2013. Indonesian industrialization: A late-comer adjusting to crises, in A. Szirmai, W. Naude, & L. Alcorta (eds.), *Pathway to industrialization in the twenty first century: New challenges and emerging paradigms*, pp.193–222. Oxford University Press, Cambridge, United Kingdom.

[2] Chen, D., 2009. Vocational schooling, labor market outcomes, and college entry, *Policy Research Working Paper 4814*. Human Development Sector Department - East Asia and Pacific Region - The World Bank, Washington DC. http://documents.worldbank.org/curated/en/771881468049456978/Vocational-schooling-labor-market-outcomes-and-college-entry.

[3] El-Hamidi, F., 2006. General or vocational schooling? Evidence on school choice, returns, and 'sheepskin' effects from Egypt 1998. *Journal of Economic Policy Reform, 9*(2), pp.157–176. DOI: https://doi.org/10.1080/13841280600772861.

[4] Ernst, D., & Kim, L., 2002. Global production networks, knowledge diffusion, and local capability formation. *Research policy, 31*(8–9), pp.1417–1429. DOI: https://doi.org/10.1016/S0048-7333(02)00072-0.

[5] Gereffi, G., 1994. The organisation of buyer-driven global commodity chains: How US retailers shape overseas production network, in G. Gereffi & M. Korzeniewicz (Eds.), *Commodity chains and global capitalism*, pp.95–122. Praeger Publishers, Westport, Connecticut.

[6] Hanushek, E. A., Schwerdt, G., Woessmann, L., & Zhang, L. 2017. General education, vocational education, and labor-market outcomes over the lifecycle. *Journal of Human Resources, 52*(1), pp.48–87.

[7] Irawati, D., 2012. *Knowledge transfer in the automobile industry: Global-local production networks*. Routledge, London.

[8] JETRO, 2004. Important industry report: Electronics and Electronic appliances industry. *Draft Report*. Japan External Trade Organization (JETRO), Jakarta.

[9] Kawakami, M., & Sturgeon, T.J., 2011. *The dynamics of*

local learning in global value chains: Experiences from East Asia. Palgrave Macmillan, New York.

[10] Koike, K., 2002. Intellectual skills and competitive strength: is a radical change necessary?. *Journal of Education and Work, 15*(4), pp.391–408. DOI: https://doi.org/10.1080/1363908022000023542.

[11] Koike, K., 2005. *Shigoto no Keizaigaku [The economics of works in Japan], [3rd Ed.]*. Toyo Keizai Shinposha, Japan.

[12] Koike, K., & Inoki, T., 1990. *Skill formation in Japan and Southeast Asia*. University of Tokyo Press, Tokyo.

[13] Krueger, D., & Kumar, K.B., 2004a. Skill-specific rather than general education: A reason for US–Europe growth differences?. *Journal of Economic Growth, 9*(2), pp.167–207. DOI: https://doi.org/10.1023/B:JOEG.0000031426.09886.bd.

[14] Krueger, D., & Kumar, K.B., 2004. US–Europe differences in technology-driven growth: quantifying the role of education. *Journal of Monetary Economics, 51*(1), pp.161–190. DOI: https://doi.org/10.1016/j.jmoneco.2003.07.005.

[15] Kuroiwa, I., & Toh M.H. (eds.), 2008. *Production networks and industrial clusters: Integrating economies in Southeast Asia*. Institute of Southeast Asian Studies (ISEAS), Singapore.

[16] Malamud, O., & Pop-Eleches, C., 2010. General education versus vocational training: Evidence from an economy in transition. *The Review of Economics and Statistics, 92*(1), pp.43–60. DOI: https://doi.org/10.1162/rest.2009.11339.

[17] Mansur, A., 2008. Is Indonesia Undergoing A Process of De-industrialization?. *Master Thesis*. Graduate School of Development Studies - Institute of Social Studies, Netherlands. https://thesis.eur.nl/pub/6708/Ahmad%20Mansur%20ECD.pdf.

[18] Moenjak, T., & Worswick, C., 2003. Vocational education in Thailand: a study of choice and returns. *Economics of Education Review, 22*(1), pp.99–107. DOI: https://doi.org/10.1016/S0272-7757(01)00059-0.

[19] Natsuda, K., Otsuka, K., & Thoburn, J., 2015. Dawn of industrialisation? The Indonesian automotive industry. *Bulletin of Indonesian Economic Studies, 51*(1), pp.47–68. DOI: https://doi.org/10.1080/00074918.2015.1016567.

[20] Newhouse, D., & Suryadarma, D., 2011. The Value of vocational education: High school type and labor market outcomes in Indonesia. *The World Bank Economic Review, 25*(2), pp. 296–322. https://openknowledge.worldbank.org/handle/10986/13476. DOI:10.1093/wber/lhr010.

[21] OECD, 2011. *ISIC Rev. 3 technology intensity definition: Classification of manufacturing industries into categories based on R&D intensities*. Economic Analysis and Statistics Division - OECD Directorate for Science, Technology and Industry. https://www.oecd.org/sti/ind/48350231.pdf.

[22] Sato, Y., 2011. Local firms' capability development in captive value chains: Evidence from the Indonesian motorcycle industry, in M. Kawakami & T.J. Sturgeon (Eds.), *The dynamics of local learning in global value chains: Experiences from East Asia*, pp.100–135. Palgrave Macmillan, New York.

[23] Tadjoeddin, M.Z., Auwalin, I., & Chowdhury, A., 2016. Revitalizing Indonesia's manufacturing: The productivity conundrum. *Working Papers in Trade and Development 2016/20*. Arndt-Corden Department of Economics - Crawford School of Public Policy - ANU College of Asia and the Pacific, Australia. https://acde.crawford.anu.edu.au/sites/default/files/publication/acde_crawford_anu_edu_au/2016-11/2016-20_chowdhury_manufacturing_in_indonesia-productivity_23nov16.pdf.

[24] Thee, K.W., 2012. Indonesia's Industrial Policies and Development since Independence, in Thee K.W., *Indonesia's Economy since Independence*, pp.141–174. Institute of Southeast Asian Studies (ISEAS), Singapore.

[25] UNIDO, 2015. *Industrial development report 2016: the role of technology and innovation in inclusive and sustainable industrial development*. United Nations Industrial Development Organization (UNIDO), Vienna. https://www.unido.org/sites/default/files/2015-12/EBOOK_IDR2016_FULLREPORT_0.pdf.

[26] Wicaksono, P., & Priyadi, L., 2016. Decent work in global production network: lessons learnt from the Indonesian automotive sector. *Journal of Southeast Asian Economies (JSEAE), 33*(1), pp.95–110. DOI: 10.1353/ase.2016.0006.

Appendix

Table A1: Adjusting KBLI 2005 and KBLI 2009

KBLI 2005 (ISIC Rev. 3)		KBLI 2009 (ISIC Rev. 4)	
Code	Industry Name	Code	Industry Name
29	Manufacture of machinery and equipment, n.e.c.	252	Manufacture of weapons and ammunition
		275	Manufacture of domestic appliances
		2811	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
		2812	Manufacture of fluid power equipment
		2813	Manufacture of other pumps, compressors, taps and valves
		2814	Manufacture of bearings, gears, gearing, and driving elements
		2815	Manufacture of ovens, furnaces and furnace burners
		2816	Manufacture of lifting and handling equipment
		2819	Manufacture of other general-purpose machinery
		282	Manufacture of special-purpose machinery
		3312	Repair of machinery
30	Manufacture of office, accounting and computing machinery	2621	Manufacture and assembly of electronic computers
		2817	Manufacture of office machinery and equipment (except computers and peripheral equipment)
31	Manufacture of electrical machinery and apparatus, n.e.c.	271	Manufacture of electric motors, generators, transformers and electricity distribution and apparatus
		272	Manufacture of batteries and accumulators
		273	Manufacture of wiring and wiring devices
		274	Manufacture of electric lighting equipment
		279	Manufacture of other electrical equipment
32	Manufacture of radio, television and communication equipment and apparatus	261	Manufacture of electronic components and boards
		2622	Manufacture of computer peripheral equipment
		263	Manufacture of communication equipment
		264	Manufacture of consumer electronics

Table A2: Adjusting KBLI 2005 and SITC Rev. 3

KBLI 2005 (ISIC Rev. 3)		SITC Rev. 3	
Code	Industry Name	Code	Industry Name
29	Manufacture of machinery and equipment, n.e.c.	72	Machinery specialized for particular industries
		73	Metalworking machinery
		74	General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.
30	Manufacture of office, accounting and computing machinery	75	Office machines and automatic data-processing machines
31	Manufacture of electrical machinery and apparatus, n.e.c.	71	Power-generating machinery and equipment
		77	Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including non-electrical counterparts, n.e.s., of electrical household-type equipment)
32	Manufacture of radio, television and communication equipment and apparatus	76	Telecommunications and sound-recording and reproducing apparatus and equipment