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Digital Transformation in Indonesia's Labour Market: Gainers and Losers

*Maria Monica Wihardja, Abror Tegar Pradana, Putu Sanjiwacika Wibisana, Arya Swarnata, and Aufa Doarest**

This aerial picture shows vehicles on roads leading out of downtown Jakarta on January 2024. (Photo by BAY ISMOYO AFP).

* *Maria Monica Wihardja is Economist and Visiting Fellow at ISEAS – Yusof Ishak Institute and Adjunct Assistant Professor at National University of Singapore; Abror Tegar Pradana is Consultant at the World Bank Group's Social Protection and Jobs Global Practice; Putu Sanjiwacika Wibisana is Consultant at the World Bank Group's Urban Global Practice; Arya Swarnata is Master's candidate in International and Development Economics at Australia National University and Australian Award Recipient 2022; and Aufa Doarest is Private Sector Specialist at the World Bank Group's Finance, Competitiveness and Innovation.*

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EXECUTIVE SUMMARY

- Digital transformation in Indonesia, driven by the declining cost of digital technology and massive investment in the digital sector, has changed the nature of jobs. Since 2002, the digital task content of jobs has been rapidly increasing, while routine and manual task contents of jobs have been rapidly decreasing.

- There are at least three channels through which digital transformation can widen wage disparity: First, digital technological change tends to be skill-intensive, increasing skill premium – measured as the wage ratio between skilled and unskilled workers – as demand for skill increases; second, digital technological change displaces jobs with high content of routine tasks through automation, such as factory work and sales work; and third, new investment projects in various digital sectors favour higher skilled and better educated workers.

- Evidence from Indonesia shows that workers with higher skills and better education, including white-collar professionals, gain more from digital transformation compared to those with lower or middle-level skills and education, such as blue-collar manual labourers and sales and clerical workers.

- To accelerate Indonesia's digital transformation, it is important to complement the investment liberalisation in the sector with policies to improve educational outcomes and facilitate learning, make market policies adaptable to the changing nature of work, and improve access to and quality of internet connections.

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INTRODUCTION

Developing countries in Southeast Asia such as Indonesia, often view digital transformation as a universal solution for their economic and social problems. Some examples include the use of electronic wallets and payments by the unbanked and underbanked population obviating the need to open a bank account, and opening businesses on e-commerce platforms without physical offices. These countries also pin high hopes on emerging technologies like blockchain, artificial intelligence, and machine learning to make businesses and workers more productive.[1]

As of 2022, the digital economy already accounts for a significant share of the GDPs of these countries; in the Philippines, it accounts for 9.4 percent of GDP, Thailand 13 percent, Indonesia 5 percent, and Laos 3 percent. In more developed Southeast Asian countries, this share is much higher, with Malaysia at 25.5 percent and Singapore at 17.3. percent, albeit these are still relatively low compared to China's 41.5 percent. Others have set higher targets on the share of their digital economy to the GDP, for example, 10-15 percent for Indonesia by 2030 and 10 percent for Laos by 2040.

Despite promises of more inclusivity and better productivity, there is not much evidence showing how different kinds of workers in developing Southeast Asian countries have been impacted by the digital transformation in the last ten years.

In this essay, we focus on three key issues to understand better how digital transformation has impacted different types of workers in Indonesia, and how it may widen wage inequality. First is the widening skill premium due to increased internet penetration and higher demand for skills relevant to the digital era. Second is the hollowing out of routine, middle-skilled jobs, due to lower costs of technology and structural transformation of the economy. Third is the impact of new investment projects in various digital sectors favouring higher skilled and more educated workers.

We begin by looking at how the nature of jobs in Indonesia has changed and how investment and employment in three digital sub-sectors have evolved. Then, we look at the three key issues mentioned above. We conclude with some policy recommendations.

CHANGING NATURE OF JOBS

One indicator of how the nature of jobs in Indonesia is changing is the task content of jobs. A job can be characterised by the skills required to carry out the main activity (cognitive vs. manual) and by the nature of those tasks (routine vs. discretionary/non-routine processes). Five categories have been identified in the literature on the task content of jobs:

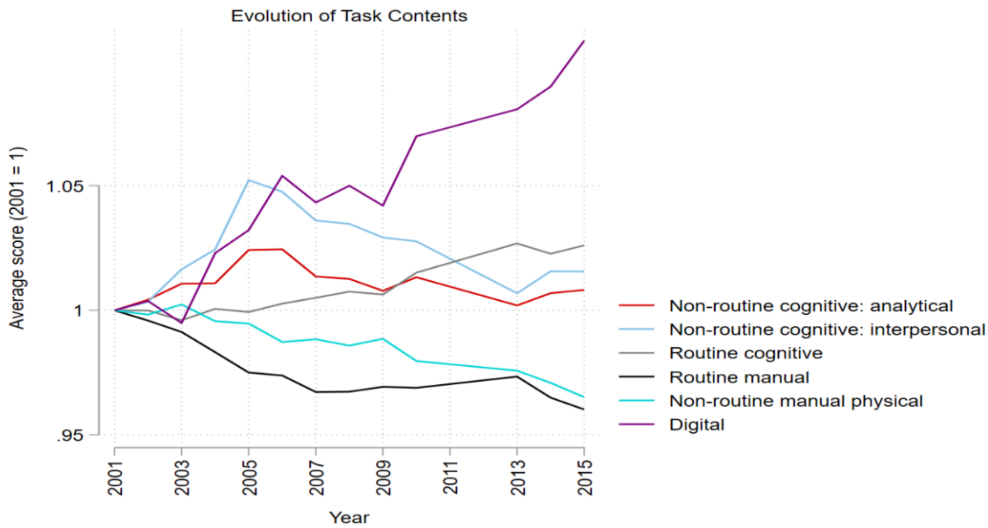
1. Non-routine cognitive and analytical tasks require the person carrying out the task to analyse and process abstract information and actively use it to solve complex problems.
2. Non-routine cognitive and interpersonal tasks require the person carrying out the task to manage people and relationships.

3. Routine cognitive tasks require the person carrying out the task to perform repetitive mental tasks with a higher degree of accuracy without the use of their discretion.
4. Routine manual tasks require the person carrying out the task to perform repetitive motions.
5. Non-routine manual tasks require the person carrying out the task to exercise judgement and physical dexterity.

Wihardja and Cunningham (2021) have added a sixth category, namely (6) digital tasks which require the person to carry out such tasks by working with computers and electronics.

In general, jobs in Indonesia still involve a lot of manual work. But from 2001 to 2015, a big decrease in manual tasks took place alongside a significant increase in tasks that require digital skills (Figure 1).

Figure 1: Evolution of task content of jobs in Indonesia, 2001-2015



Source: ONET 5.0; Sakernas 2001–10, 2013–15; authors' calculations
Note: The methodology to calculate task contents can be found in Box 5.2 in Wihardja and Cunningham, 2021

The changing nature of jobs in Indonesia is also marked by changing occupational shares, although not as evidently so. The share of sales workers (mid-skilled occupations) decreased from 2001 to 2019, while the share of managerial, professional, and technical workers (high-skilled occupations) increased (Table 1).[2] The shares of clerical workers; production, transport equipment workers, and labourers; and service workers remained relatively stable. As will be shown later, these changes are partly driven by the declining cost of digital technology as proxied by the price of hard disc drives, and changes in the economic structure.

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Table 1. Share Occupation (%), 2001, 2006 and 2019

Occupation (ranked by higher to lower wages)	2001	2006	2019
Managerial, professional, and technical workers	6.79	7.79	12.86
Clerical workers	8.36	8.24	8.32
Production, transport equipment workers, and labourers	44.48	43.26	43.14
Sales workers	31.69	30.75	26.96
Service workers	8.68	9.96	8.72

Source: Sakernas 2001, 2006 and 2019, authors' calculations
Note: The agriculture sector is excluded from the calculations.

Investment and Employment in the Digital Sector

The digital transformation of the economy is driven in part by private investments. To understand how digital investment has evolved, we use highly disaggregated investment data across Indonesia's economic sectors from 2010 to 2016. This data is sourced from Indonesia's Ministry of Investment. We also use the United Nations Statistics Division (UNSD) and the Organization for Economic Co-operation and Development (OECD) definitions of a digital sector, as shown in Annex Table 1.

This definition can be further broken down into three sectors: manufacturing, trade, and services based on their main economic activities. Examples of industries in the digital manufacturing sector are consumer electronics, electronic components and computers. Examples of industries in the digital trade sector are wholesale and retail sales of consumer electronics, electronic components and computers including those via mail order or internet order. Examples of industries in the digital service sector are computer programming and data processing activities. The complete list of industries in each digital sub-sector can be found in Annex Table 1.

Digital investment has been growing rapidly in Indonesia, even if it still accounts for a relatively small share of all investments. The share of new investment projects in the digital sector relative to the non-digital sector significantly increased in 2013 and since then, has hovered at around five percent of the total new investment projects. The digital service sector dominates new digital investment projects, accounting for 50 percent of total new digital investment projects between 2010 and 2016.

In the same period, the number of new investment projects in the digital manufacturing sector grew more slowly than the number for digital trade and digital services. While the number of new digital manufacturing investment projects almost doubled (from 57 to 93) between 2010 and 2016, the number of digital services investment projects increased four-fold (67 to 246)

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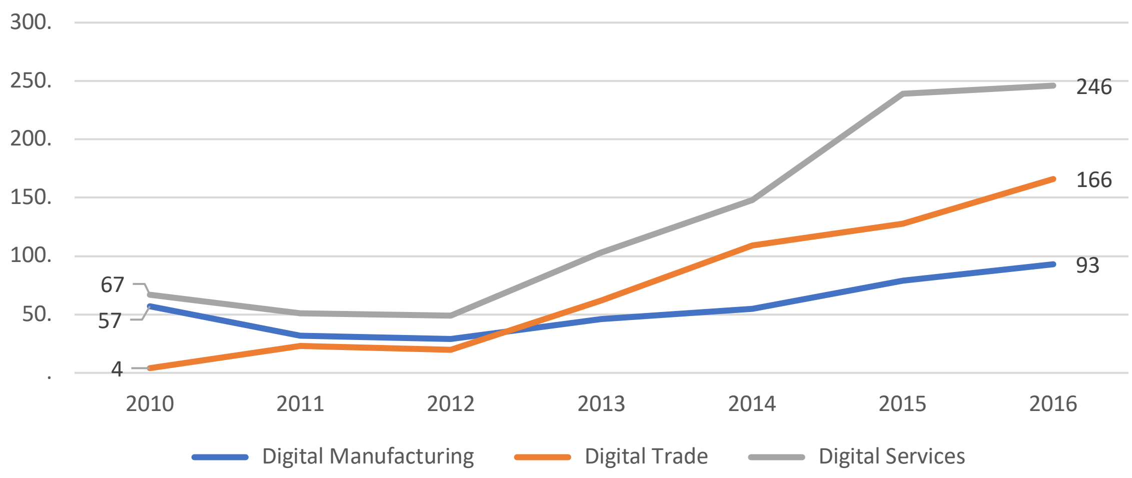
and the number of digital trade investment projects increased forty-fold, albeit that it started from a low base (4 to 166) (Figure 2).

Figure 2: Total Number of New Investment Projects by Digital Sub-Sectors, 2010-2016



Source: Authors' calculations based on investment data from the Ministry of Investment. Retrieved 2020.

However, increases in digital investment are not proportionately followed by increases in employment in the digital sector. Between 2011 and 2016, the share of employment in the digital sector hardly changed, hovering around 1.2 percent of total employment. This shows that the digital sector is less labour intensive than the non-digital sector. Within the digital sector, the employment share of digital services remained stable at 45 percent, the employment share of digital manufacturing declined from 15 percent in 2011 to 9 percent in 2016, and the employment share of digital trade increased from 39 percent in 2011 to 45 percent in 2016.

Workers in the digital sector usually get paid more than those in the non-digital sectors (Figure 3). In 2016, people working in digital manufacturing were earning the most, followed by those in digital services, while those in digital trade were earning the least. Although wages in both digital and non-digital sectors grew at a similar pace, there are differences in wage growth rates within the digital sector itself, with wage growth in digital manufacturing growing the fastest.

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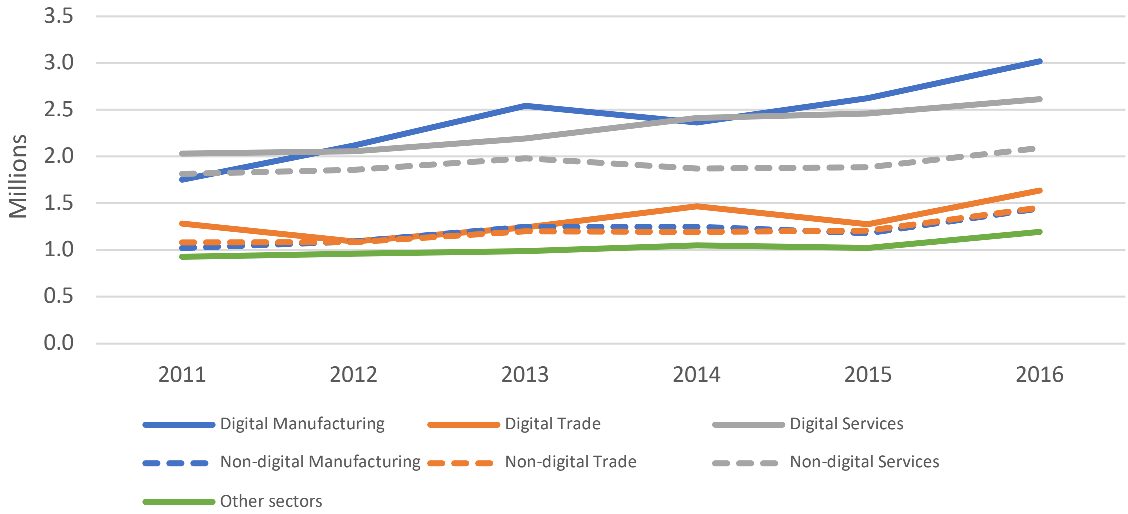
Figure 3: Real wage across sectors, 2011-2016 (million Rupiah 2010)



Source: Authors' calculations based on Sakernas 2011–16

In the next three sections, we will discuss the channels through which digital transformation can widen wage inequality.

WIDENING SKILL PREMIUM

Recent evidence from Indonesia indicates that as internet penetration increases, the wage gap between skilled and unskilled workers – known as the skill premium – has also grown. This means skilled workers are earning relatively more compared to unskilled workers. Using data from 2005 (post arrival of the internet) to 2019 (before COVID-19), Jacoby et al. (2021) show that the incremental benefits of internet penetration are greater for more educated workers, further widening the skill premium between less and more educated workers in Indonesia (Table 2). These effects survive intact after controlling for contemporaneous local trends/other lurking/confounding variables such as GDP, urbanisation, a district's average expenditure per capita, and the sectoral composition of jobs. These effects did not pre-date the arrival of the internet.

The last column in Table 2 shows that a one-percentage point increase in internet penetration increases the wage return to education for workers with college/university degree or higher by 0.6 percentage point but only by a 0.1-percentage point increase for workers with lower secondary school education and a 0.3-percentage point increase for workers with higher secondary school.

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Table 2: Internet penetration has exacerbated the skill premium

	Wage return to education w.r.t. <6 years of schooling	Additional average return of 1 percentage point increase in internet penetration
Primary school	18.5%	0.0%
Lower secondary school	32.8%	0.1%
Higher secondary school	49.7%	0.3%
College/University Degree or higher	79.4%	0.6%

Source: Jacoby et al (2021)

The same study, which uses 2005 to 2015 firm census data from medium and large manufacturing companies, confirms this widening wage gap due to increasing skill premium. Non-production workers (a proxy for more educated workers) earn more than production workers (a proxy for less-educated workers), and an increase in internet penetration increases this wage gap. This additional wage return of the internet on non-production workers does not pre-date the introduction of the internet (1990–2004).

At this point, however, little is known about how to attenuate the impacts of skill-biased technological change. Building on this work, Wihardja et al (forthcoming, 2024) explore channels that could attenuate the impact of internet penetration in widening the wage gap. There are indications that having certified training might help reduce the widening wage gap caused by the move towards digital adoption. Although we cannot distinguish between training in digital skills and training in other skills, this estimate provides a lower-bound estimate of the impact of certified training in attenuating the impact of internet penetration in widening the wage gap.

HOLLOWING OUT OF ROUTINE, MIDDLE-SKILLED JOBS

Digital technological change is not always labour augmenting, i.e., helping workers increase their productivity, but sometimes it can be labour replacing, i.e., cutting jobs. However, low-skilled jobs that need personalised care or services such as masseuses, may not be easily replaced by technology, but routine jobs will be. These jobs are likely to be middle-skilled jobs; this will, in turn, create job polarisation or hollow out middle-skilled occupations including (door-to-door) sales workers and clerical workers.

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More affordable technology as proxied by the price of computer memory (hard disc drive)[3] has been turbocharging digital transformation globally, but this has benefited high-skilled workers while adversely affecting middle-skilled workers, especially clerical and sales workers, not only in developed countries but also in developing countries like Indonesia (Wihardja et al, forthcoming 2024). There are also other factors such as the supply and demand of different types of skills in the labour market resulting from educational improvement and structural changes that adversely affect middle-skilled workers (Annex Table 2). Premature deindustrialisation in the early 2000s in Indonesia, for example, has increased the demand for low-end skills and high-end skills but hollowed out mid-level skills due to the decline in manufacturing employment.

EFFECTS OF DIGITAL INVESTMENT ON WAGES AND EMPLOYMENT

A new investment project in the digital manufacturing sector, such as in new manufactures of consumer electronics, computers and electronic components, differentially impacts wages of workers, disproportionately benefiting workers at the top of the wage distribution. A new investment project in the digital manufacturing sector decreases wages for workers in the lower quantiles (bottom 60 percentiles of the wage distribution), while increasing wages for those in the upper quantiles (upper 40 percentiles of the wage distribution) (Figure 4). This presumably occurs through automation and other skill-intensive technological change as shown below. In contrast, new investment projects in digital trade and digital services have no significant incremental impact on wages across the wage distribution.

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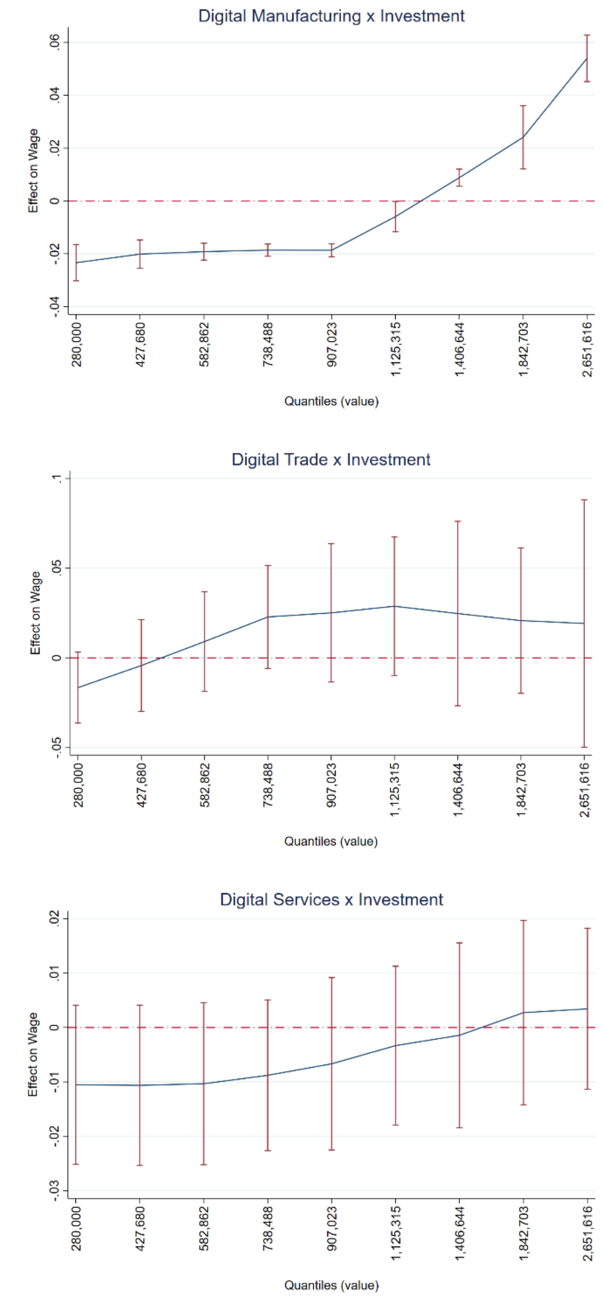
Figure 4: Marginal Impact of New Investment Projects on Wage



Sources: Wihardja et al (forthcoming, 2023).
Data from Sakernas 2010-2016; investment data from Ministry of Investment.
Note: Bars show 95% confidence interval.

A new investment project in the digital manufacturing sector reduces employment in the sector by 0.5 percent. The negative impact on employment of a new investment project in the digital manufacturing sector is most pronounced among female workers; less-educated youths and older workers; and blue-collar (both low- and high-skilled) workers (Figure 5). Blue-collar, low-skilled workers include plant and machine operators and assemblers, while blue-collar, high-skilled workers include electrical installers and repairers. Meanwhile, highly educated

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youth and white-collar workers benefit the most from a new digital manufacturing investment project.

A new investment project in digital trade, such as wholesale and retail sales of computers, electronic and telecommunication equipment via mail or internet order, reduces employment by 4.1 percent. The negative employment impact of a new investment project in digital trade is most pronounced among female workers; less-educated older workers; and white-collar, low-skilled workers (often associated with clerical and sales workers) (Figure 5). Meanwhile, highly educated older workers and high-skilled, blue-collar workers (such as specialised traders of electrical and electronic equipment) benefit the most from such an investment project.

A new investment project in digital services, such as software publishing, computer programming activities and satellite telecommunication activities, only increases employment of highly educated older workers (Figure 5).

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Figure 5: Marginal Impact of New Investment Projects on Employment, by Worker Group, 2010-2016

Sources: Sakernas 2010-2016; authors' calculations
Note: Bars show 95% confidence interval.

All of the abovementioned findings show that less-educated workers and workers with high routine task content – whether in blue- or white-collar jobs – are more vulnerable and easily replaced at the onset of digital technological change. There are, however, cases where high-skilled, blue-collar workers with higher non-routine task contents such as electrical installers and repairers in the digital manufacturing sector may also be adversely affected, especially by automation.

Although traditionally disadvantaged workers, including females, rural workers, lower educated, and older workers, run higher risks of being left behind; they are also the ones who potentially benefits the most if they were more equipped with digital skills and had higher digital task content in their jobs. In fact, increasing digital task content of job among these workers could significantly boost their incomes.

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CONCLUSION

To address the digital divide arising from digital transformation, we recommend that policies to accelerate Indonesia's digital transformation and liberalise its digital investment are accompanied by complementary policies on education, labour, and internet infrastructure (Table 3).

Table 3: Complementary Policies to Ensure an Inclusive Digital Transformation in Indonesia

Policy	Actions
Education, including technical and vocational education and training	Improve educational outcomes (enrolment and quality) and facilitate (lifelong) learning.
Active labour market	Constantly review and adjust labour market policies to fit with the changing nature of jobs and business models.
Internet infrastructure	Improve access to and quality of internet connections and reduce internet prices to facilitate digital learning.

Source: Authors' analysis

Our analyses, however, do not take into account the effects of new and emerging digital technologies post-2019 such as generative AI. Contrary to our analysis, a study by Felten et al (2023) and Hui et al (2023) shows that generative AI exposes mostly highly educated, highly paid, and white-collar workers including in online freelancing world to job losses. Hence, different digital technologies may have different impacts on the labour market. Our policy recommendations shed light on the findings in this essay while considering that digital technologies will continuously evolve.

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ANNEXES

Annex Table 1: Industry code-based definition of digital sector

UNSD ICT Sector

Manufacturing:

2610: Manufacture of electronic components and boards
2620: Manufacture of computers and peripheral equipment
2630: Manufacture of communication equipment
2640: Manufacture of consumer electronics
2680: Manufacture of magnetic and optical media

Trade:

4651: Wholesale of computers, computer peripheral equipment, and software
4652: Wholesale of electronic and telecommunications equipment and parts
4741: Retail sale of computers, peripheral units, software, and telecommunication equipment in specialised stores
4791: Retail sale via mail order houses or via internet

Services:

581: Publishing of books, periodicals, and other publishing activities
5820: Software publishing
591: Motion picture, video and television program activities
592: Sound recording and music publishing activities
60: Broadcasting and programming activities
6110: Wired telecommunications activities
6120: Wireless telecommunications activities
6130: Satellite telecommunications activities
6190: Other telecommunications activities
6201: Computer programming activities
6202: Computer consultancy and computer facilities management activities
6209: Other information technology and computer service activities
6311: Data processing, hosting and related activities
6312: Web portals
639: Other information service activities
9511: Repair of computers and peripheral equipment
9512: Repair of communication equipment

Note: Blue denotes additional definition based on OECD (2021).

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Annex Table 2: Drivers of Job Polarisation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Share managerial, professional, and technical workers		**Share clerical workers**		**Share production, transport equipment workers, and labourers**		**Share sales workers**		**Share service workers**	
log(cost per MB) t-1	-0.016***	-0.016***	0.007***	0.012***	0.000	-0.001	0.011***	0.006***	-0.003*	-0.002
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)
share completed primary education t-1	-0.025	-0.023	-0.180***	-0.200***	0.153**	0.157**	-0.072	-0.054	0.124***	0.120***
	(0.041)	(0.042)	(0.041)	(0.043)	(0.071)	(0.072)	(0.050)	(0.051)	(0.036)	(0.038)
share completed secondary education t-1	-0.106***	-0.102***	-0.012	-0.056	0.072	0.081	0.012	0.052	0.034	0.025
	(0.032)	(0.035)	(0.040)	(0.047)	(0.066)	(0.072)	(0.050)	(0.054)	(0.036)	(0.043)
share completed tertiary education t-1	0.191**	0.213*	0.099	-0.153	0.160	0.214	-0.336**	-0.108	-0.115	-0.166
	(0.086)	(0.111)	(0.076)	(0.128)	(0.138)	(0.188)	(0.135)	(0.172)	(0.100)	(0.136)
share workers manufacturing t-1	-0.035	-0.034	-0.147**	-0.166***	0.279***	0.282***	-0.311***	-0.294***	0.215***	0.211***
	(0.057)	(0.058)	(0.060)	(0.061)	(0.099)	(0.100)	(0.089)	(0.087)	(0.058)	(0.059)
share workers low VA services t-1	0.013	0.013	0.013	0.013	-0.080	-0.080	0.107*	0.107*	-0.054	-0.054
	(0.042)	(0.042)	(0.049)	(0.048)	(0.069)	(0.069)	(0.064)	(0.064)	(0.048)	(0.048)
share workers high VA services t-1	-0.065	-0.066	-0.219***	-0.209***	0.334**	0.332**	-0.147	-0.156	0.097	0.099
	(0.086)	(0.086)	(0.081)	(0.079)	(0.165)	(0.165)	(0.145)	(0.144)	(0.125)	(0.125)
share workers other industries t-1	0.180***	0.181***	-0.189**	-0.198***	0.127	0.129	-0.296***	-0.287***	0.178**	0.176**
	(0.057)	(0.058)	(0.076)	(0.076)	(0.119)	(0.118)	(0.093)	(0.093)	(0.070)	(0.071)
share urban population t-1	-0.077**	-0.075**	0.093***	0.072**	0.032	0.036	-0.011	0.008	-0.038	-0.042
	(0.035)	(0.035)	(0.035)	(0.031)	(0.053)	(0.052)	(0.041)	(0.040)	(0.044)	(0.043)
log(mean real expenditure per capita) t-1	-0.009	-0.009	0.014	0.006	-0.026*	-0.025*	0.005	0.012	0.017	0.015
	(0.008)	(0.008)	(0.009)	(0.009)	(0.015)	(0.015)	(0.014)	(0.015)	(0.012)	(0.012)
Observations	464	464	464	464	464	464	464	464	464	464
Adjusted R-square	0.874	0.874	0.769	0.776	0.779	0.778	0.741	0.744	0.685	0.685
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Robust standard errors in parentheses

* p<0.10 ** p<0.05 *** p<0.01

ENDNOTES

[1] This paper is excerpted from a technical paper prepared for a project on industrial policies commissioned and funded by Japan Economic Foundation (JEF) and Economic Research Institute for ASEAN and East Asia (ERIA), co-written by Maria Monica Wihardja, Abror Tegar Pradana, Putu Sanji Wibisana, Arya Swarnata, and Aufa Doarest. This technical paper will be published as ERIA Discussion Paper.

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[2] This analysis excludes the agriculture sector, whose employment decline is mostly driven by the country's structural transformation.
[3] Unit cost in MegaBytes

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