Role of Digital Education to Help Long-Term Growth Recover Under Covid-19

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Introduction

At the university where I am teaching, professors are now giving classes in rooms where there are no students, though the windows and doors are kept open to create good air quality. They are giving their lessons via their personal computers. I have not met many students during the spring and fall semesters in person: I have met them only through my PC. This is a striking change from our normal teaching styles at school. Digital technology will change the style of education substantially. This change in how to develop human capital will result in big productivity differentials.

Importance of Digital Networks

Digital networks will result in huge productivity increases. The government and private sectors in Japan are lagging behind in digitalization, as shown in *Chart 1* where Japan is ranked 30th among OECD countries. This is a chance to improve productivity and social customs in order to boost efficiency. The private sector has to meet the needs of customers, but competition among businesses will push digitalization in a speedy manner. The government sectors, however, including local governments, are only making gradual progress compared to private businesses. The education sector is another area where digitalization can be incorporated.

Incentive mechanisms must be put in for the public sector to improve its digital-based work environment. One way would be to reduce budget allocations if some ministries are slow to introduce digital-based public administration.

Ways to Finance Digital Networks

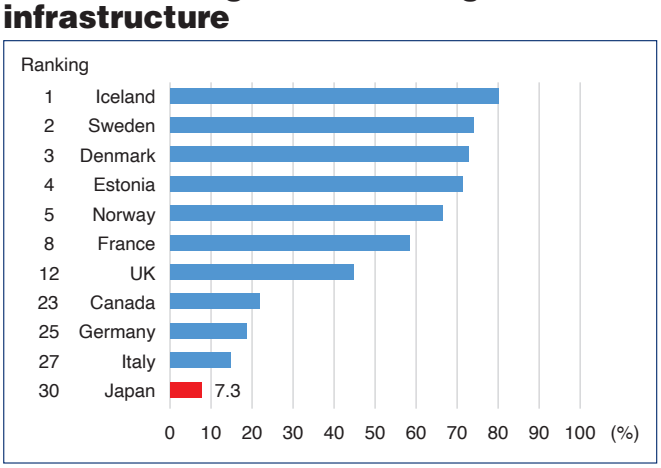
To construct a nationwide digital infrastructure network will cost a huge amount of money. Since Covid-19, many local governments have had to spend huge sums on the health sector and to support small and medium-sized enterprises (SMEs). They have little room to spend on digital infrastructure investments.

Broadband India, for example, would like to expand its network not only to cities but also to rural areas. Digital networks will bring new residential areas and new business to regions. But if digital infrastructure relies only on user charges, not enough money will be collected to expand networks all over the country, and heavy use of digital infrastructure will be restricted to urban areas, leaving rural regions behind.

Investment in digital infrastructure will lead to more people living in the region in question. New businesses will come to the region, and new shopping malls and restaurants will start to operate.

CHART 1

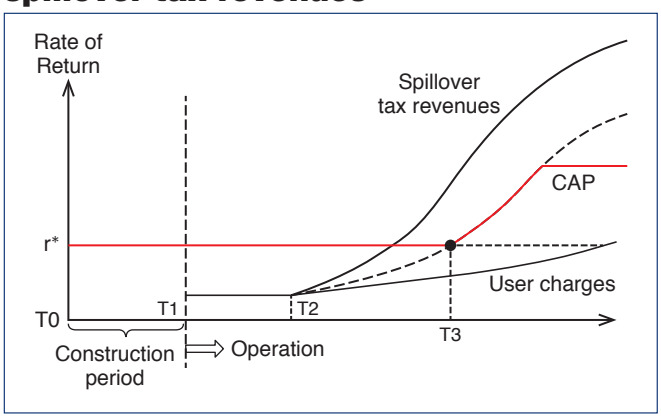
Utilization of government digital infrastructure



Source: Selecting future 2.0, Cabinet Ministry, 2020, chairperson: Yuri Okina

CHART 2

Floating government bonds reflecting spillover tax revenues



Source: Compiled by the authors

Various tax revenues (corporate tax, income tax, sales tax and property tax) will increase, as shown in *Chart 2*. If part of the spillover tax revenues were returned to the operators of digital infrastructure and investors in it, the rate of return will be much larger than relying only on user charges ("Impact of infrastructure on tax revenue: Case study of high speed train in Japan" by Naoyuki Yoshino and Umid Abidhadjaev, *Journal of Infrastructure, Policy and Development*, Vol. 1, Issue 2, 2017).

Maintenance and repair costs can be covered by total revenues (=user charges and spillover tax returns). By creating digital infrastructure, even though governments share their spillover tax revenues with operators and investors, they will gain net revenues since the spillover tax revenues are additional revenues.

Digital infrastructure bonds are another way to finance a digital network. As shown in *Chart 2*, the interest rate on bonds should be set at the same rate (r*) as ordinary government bonds until the spillover tax returns in addition to user charges exceed r* (=the rate of interest on ordinary government bonds) at period T3. In *Chart 2*, 50% of total spillover tax revenues are assumed to be returned to infrastructure operators and investors. In other words, the government and private sectors should share spillover taxes half and half ("Inducing private finance to water supply and inland water transport using spillover tax revenues" by Naoyuki Yoshino, *Innovation for Water Infrastructure Development in the Mekong Region, Chapter 3,* OECD, 2020).

Governments can set a "cap" on the digital infrastructure bonds. The spillover tax returns above the cap would be kept as government reserves to compensate for the construction costs (period T0 and T1), maintenance costs and other costs. Extra spillover tax revenues above the cap can be kept as reserves to prepare for natural disasters such as typhoons or earthquakes. These bonds will give incentives to digital infrastructure companies to develop regions in order to increase spillover tax returns which they can receive as revenues. These returns will also be a means of keeping user prices as low as possible, which could in turn expand the number of broadband users.

Digitalization in Education

Covid-19 forced schools to close. Many schools started online education without their students being physically present at the school. In order to ensure efficiency and fairness, digital education should be provided over the Internet or mobile devices so that all students can have access to the lessons without attending school.

A national online education service could be provided for all levels of students from primary school to university level. Even adult education can be provided. *Table 1* shows an example of an online lecture program. P stands for primary school, J stands for junior high school and H stands for high school. 1 is the first grade and 3 shows the third grade. The time of the online lesson is provided under the subject, such as mathematics or history. The best teachers

TABLE 1

Online lessons program

	Mathematics	History	·····
P1-1 P1-2 ⋮	Wed. 1000-1040 Mon. 0900-0940 ⋮	Fri. 0200-0240 Tue. 1050-1200 ⋮	·····
J1-1 ⋮ J3-20	Thu. 0900-0950 ⋮ Tue. 1300-1350	Wed. 1100-1150 ⋮ Mon. 1400-1450	·····
H1-1 ⋮ H3-45	Mon. 0800-0850 ⋮ Fri. 0900-0950	Tue. 0900-0950 ⋮ Thu. 1300-1350	·····

Source: Compiled by the authors

in the country can provide online education in various subjects and their lessons can be accessed by students at any time. Lessons in difficult subjects could be watched repeatedly at home.

Local teachers could complement the online lectures provided by top teachers by watching to see if their students in class have understood them well or not, and providing supplementary information. The online lessons could be taken at home if the school is closed. This is one way in which digital technology can change the way students are taught.

Adult education can also be easily introduced online. Various training courses, such as customer relations in the retail sector, can be provided online. Such courses could be provided in two ways – by the Ministry of Education and by private broadcasters. The ministry would be able to provide a wide variety of courses to fit with the curriculum as compulsory subjects, while private broadcasting companies could set up their own courses using their own materials and unique methods.

Digitalization Can Promote Sales of SMEs

SMEs hire fewer recruits each year compared to large companies, and it is difficult for them to set up their own education and training courses for their employees. Digital education programs on various subjects would be able to help improve the skills of employees at SMEs.

Online sales have been increasing since the Covid-19 outbreak, and many people have started to order goods through the Internet. Digitalization will help SMEs whose sales networks were poor compared to large businesses to sell their products. Farmers can sell their vegetables and meat by taking orders through the Internet. New start-up businesses can take orders from customers online, and if their products are high quality and reasonably priced customers will order them repeatedly. Their sales can be expanded overseas by use of digital technology if payment systems across countries are well established.

Infrastructure & Education

Digital education can be provided not only in cities but also in rural areas and remote islands. It has often been observed that urban areas have more teachers of high quality than rural regions, while remote islands cannot provide top-level education in many subjects. But digital education will change traditional concepts of education. Wherever students live, top-level lessons in all the subjects can be provided to them through mobile devices. As long as students have the desire to learn, teachers in remote places can provide them with the answers. The Ministry of Education can help set up online courses taught by top teachers in all subjects.

Using 44 countries' data from the United Nations, *Table 2* shows that secondary school education and university education together

TABLE 2

Infrastructure investment & education

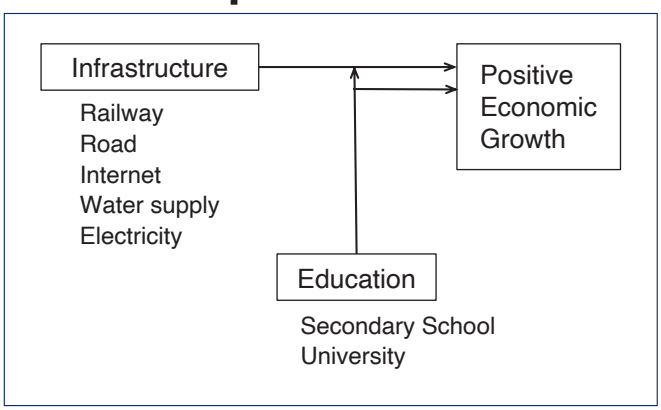
Dependent variable: log difference GDP per capita in 1991-2010			
Regression number	REG.1	REG.2	REG.3
Variables	Coef.	Coef.	Coef.
InY_1991	-0.06	-0.14	-0.14
	(-0.54)	(-1.35)	(-1.38)
ln (n+g+d)	-3.09	-5.75	-4.36
	(-0.59)	(-1.23)	(-0.77)
ln (Kg)	0.23	0.34	0.53
	(1.17)	(2.00)	(3.30)
ln (Sec)			0.00
			(0.46)
ln (Kg) x ln (Sec)	0.20		
	(1.59)		
ln (Uni)			0.21
			(2.07)
ln (Kg) x ln (Uni)		0.24	
		(2.76)	
Constant	-0.28	0.56	0.48
	(-0.33)	(0.69)	(0.57)
Number of observations	44.00	44.00	44.00
R-squared	0.21	0.30	0.30
F-statistic	2.62	4.14	3.29

Note: "Kg" stands for infrastructure, "Sec" stands for secondary school education and "Uni" stands for university education. "ln(Kg)xln(Sec)" and "ln(kg)xln(Sec)" show infrastructure combined with secondary school education and university education will enhance much more impact in regional growth.

Source: Naoyuki Yoshino and Umid Abidhadjaev (2016)

CHART 3

Economic impact of infrastructure



Source: Compiled by the authors

with infrastructure investment can create a statistically significant economic impact on a region ("Explicit and Implicit Analysis of Infrastructure Investment: Theoretical Framework and Empirical Evidence" by Naoyuki Yoshino and Umid Abidhadjaev, *American Journal of Economics*, 6 (4), 2016). Secondary school education will give basic skills to everybody, while university education will provide higher skills for professionals. *Table 2* gives an econometric estimate of the relation between education and infrastructure investment.

Digital education which can be provided not only in cities but also in rural regions will increase the productivity of people in those regions together with infrastructure investments.

Chart 3 demonstrates the importance of digital infrastructure in addition to secondary school and university education pushing up economic growth.

Human Capital Development: Estimates of Impact

The following estimation reports the impact on productivity in various regions in Japan of a 10% increase of human capital development, such as by digital education ("Changes in Economic Effect of Infrastructure and Financing Methods" by Masaki Nakahigashi and Naoyuki Yoshino, *Public Policy Review*, Vol. 12, No. 1, 2016). *Table 3* summarizes this impact on production in primary industries (=agriculture, fishery sector), secondary industries (=manufacturing) and tertiary industries (=services sector). The estimation is based on Nakahigashi-Yoshino where a trans-log production function was used at regional levels in Japan.

TABLE 3

Impact of 10% increase of human capital on GDP in regions in Japan

(trillion yen, Real GDP, base year 2005)

Region in Japan	Primary Industry	Secondary Industry	Tertiary Industry
Hokkaido	0.03	0.21	0.81
Tohoku	0.05	0.50	1.16
Northern Kanto	0.04	1.10	1.20
Southern Kanto	0.03	2.60	7.17
Hokuriku	0.01	0.44	0.75
Tokai	0.03	1.62	2.32
Kinki	0.02	1.65	3.44
Chugoku	0.02	0.61	1.05
Shikoku	0.02	0.24	0.54
Northern Kyushu	0.02	0.49	1.26
Southern Kyushu	0.03	0.23	0.59

Source: Compiled by the authors based on Masaki Nakahigashi and Naoyuki Yoshino (2016)

Conclusion

This article explains the importance of digital technology to promote sales by SMEs and quality education. Faced with Covid-19, there is little fiscal room to increase spending on digital infrastructure. Floating infrastructure bonds which return spillover tax revenues for infrastructure operators and infrastructure investors will be one way of bring private sector finance into infrastructure investment. JS

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