Innovative Digital Public-Private Partnerships from Pandemic Response to Resilient Recovery: Linking Emerging Frontier Technologies with Sustainable Development

Sheng Wu,

United Nations University,

Operating Unit on Policy-Driven Electronic Governance,

Email:wus@unu.edu

Abstract

Since the onset of the Covid-19 pandemic, innovative Digital Public-Private Partnerships (DPPPs) against the backdrop of the 4th Industrial Revolution have emerged. Pilot activities unleashing the capacity of digital Tech Giants preluded an intelligent pandemic response, led by the World Health Organization and national governments. These DPPPs were scaled up to address more development challenges, such as Misinformation and Disinformation, Climate Change in the United Nations system and the development arena. This brief outlines the architecture of the new DPPPs and recommends policy considerations to sustain them and maximize their benefit. The Cobb–Douglas Production Function is derived to demonstrate how they can increase the aggregate development output.

Public-Private Partnerships (PPPs) are long-term agreements between the government and a private partner whereby the private partner delivers and funds public services using a capital asset. (OECD, 2014) PPPs have been leveraged to tackle development challenges by providing public services of infrastructure assets and social assets. (ESCAP, 2007; ADB, 2008) One classic case of PPPs for global development is that they played a significant role in eliminating Malaria to achieve the Millennium Development Goals (MDGs) in the 2000s. (WHO, 2006)

Since the onset of the Covid-19 pandemic, innovative Digital Public-Private Partnerships (DPPPs), against the backdrop of the 4th Industrial Revolution, have emerged in combating the virus. World Health Organization(WHO) and many national governments launched pilot programs that unleash the capacity of Digital Tech Giants worldwide, such as Microsoft, Google, Amazon, Facebook, etc., for innovative interventions for the pandemic response. (Goodkind, 2020) Frontier digital technologies, such as Artificial Intelligence, Big Data analytics, Virtual Reality, etc., immediately function as powerful interventions and barriers between the three essential elements of the intelligent era, namely 'data', 'algorithm,' and 'computing power' had been broken down by the new DPPPs in an emergency response context.

These new Digital PPPs enabled actions such as flighting Infodemics, using AI for disease surveillance, and data-driven decision-making at WHO and in many countries, and were scaled up globally. (IEEE Computer Society, 2021)

This brief outlines the architecture of the DPPPs initiated during the Covid-19 pandemic response by identifying the essential elements and their flow through key makers. The Cobb–Douglas Production Function is derived to demonstrate how linking the capacity from the private technology companies can improve the overall development investment return and increase the aggregate development output. Policy considerations are proposed for the new Digital PPPs to sustain beyond the pandemic and maximize their benefit for sustainable development.

Innovative DPPPs and their Architecture

The huge volume of resources required to meet the SDGs requires building diverse partnerships, including PPPs. (Jomo, 2016) However, finalized before the year 2016, when the concept of the 4th Industrial Revolution was first-time raised (Schwab, 2017), the SDGs agenda's innovation on PPPs had been limited on the financial side: resource mobilization tools are mainly aimed at aligning the national budget, development aid, banking flows, and philanthropies to bridge the financial gap. (WB, 2019) The tremendous technological resources brought by the 4th Industrial Revolution are missing from the PPPs for development discourse.

7 days after the WHO declared the Covid-19 outbreak as a Public Health Emergency of International Concern (PHEIC) on 30 January 2020, an early proof-of-concept story on media entitled 'Prominent role for AI emerges in virus fight' by the WHO professionals in digital health and innovation triggered worldwide attention towards frontier technologies' potential in the

pandemic response. (Mariano Jr&Wu, 2020)The key role of technology in COVID-19 battle was further elaborated in their article 'Technology has opened a window of opportunity'. (Mariano Jr&Wu, 2020) Afterward, a series of collaborations between the WHO and Tech Giants, including Microsoft, Google, Amazon, Facebook, etc., were piloted to address the challenge of early warning of the outbreak, pandemic surveillance, and public information for disease control and prevention. Different from the conventional PPPs, these projects focused on leveraging the advantages of frontier technologies from the private sector, including AI, big data analysis and VR, etc., rather than a financial donation. The same mode of the new partnerships was adopted by many countries, which has been encouraged by WHO as good practice of digital health. (See box 1 for examples of these projects)

Box 1 Examples of the new PPPs project

WHO partnered with Avanade and Microsoft to Fight Infection with Information

COVID-19 has highlighted the urgent need for swift action to address data challenges. WHO partnered with Avanade and Microsoft to create the world's first comprehensive, end-to-end data solution for global health: The World Health Data Hub. The Hub aims to reduce fragmentation, streamline processes, identify and resolve gaps and inequalities, and ensure data is accessible, findable, and usable for all stakeholders. (WHO, 2021)

Social media giants agree package of measures with UK Government to tackle vaccine disinformation

Google, Twitter, Facebook endorsed the principle that no company should be profiting from COVID-19 vaccine mis/disinformation and commit to swifter responses to flagged content. The platforms will step up work with public health bodies to promote factual and reliable messages. (Gov.UK, 2020)

The new Digital Public-Private Partnership (DPPPs) is a novel type of partnership that germinated in the Covid-19 pandemic response practice. It is a mechanism for public organizations, including development agencies and governments to utilize the technological resources and expertise of the private sector to create revolutionary solutions for development challenges. where the public is facing a lack of technological resources for more efficient and effective services, a partnership with the private sector, in particular, tech companies with frontier technology advantages, can help reshape the interventions.

In the intelligent era opened by the 4th Industrial Revolution, the three essential elements of productivity, namely 'data', 'algorithm,' and 'computing power', are unevenly distributed in the public and private sectors. While both sectors have their own advantageous condition to progress toward the intelligent future with unlimited computing power in the cloud, ubiquitous sensors, and smart algorithms, both have their own disadvantages and constraints. Nevertheless, the private sector is often considered more entrepreneurial and more efficient in incorporating new technologies into its operations to boost efficiency and productivity. (West & Lu, 2009; Balka, Heslin & Risse-Tenk, 2022) The new DPPPs can enable the flow of these elements between the two sectors so that the advantageous condition and capacity can join forces. The architecture of the new DPPPs is illustrated in Figure 1 with major components as follows:

- Key Actors: in the pandemic context, the WHO and a few country governments piloted new DPPPs with some Tech Giants. While the DPPPs are scaling up globally, all actors for SGDs are becoming relevant. For example, the UN secretariat (fight misinformation and disinformation)(UN, 2020), UNFCCC (Climate Change)(UNFCC, 2022), and White House (working with IBM to make supercomputing resources available for potential treatments for coronavirus). (Gil, 2020)
- Essential resources, elements, and flow: the DPPPs enable new flows of essential elements of productivity for the intelligent age, namely 'data', 'algorithm', and 'computing power' between the private sector and the public sector, rather than only financing.
- Interactions: In conventional PPPs, the public sector intervenes with the private sector by regulating industry development, and the private sector supplies products and services. (WB, 2022) with the DPPPs, the private sector can support the regulator to adapt to the pace of advancement of frontier technologies for standard-setting; the public sector can empower the private sector to contribute to public service in a more active and creative way.
- Policy environment: the DPPPs emerged under a series of international and national policies and organizational regulations in an emergency context, for example, *Art.8(2) of the European Convention on Human Rights concerning privacy*, Recital 4, Art. 9(2)(i), Recitals 52 and 54 GDPR of The European Union General Data Protection Regulation(GDRP), OCDCP 630/2020, WHO regulation on pro bono

activities during Covid-19 emergency response, WHO regulation on PPPs during Covid-19 emergency response, just to name a few among hundreds of Covid-19 related laws and regulations. (Covid-19 Law Lab, 2022) While these laws and regulations expire in post-pandemic time, sustaining and developing the DPPPs requires new policies and regulations enablers.

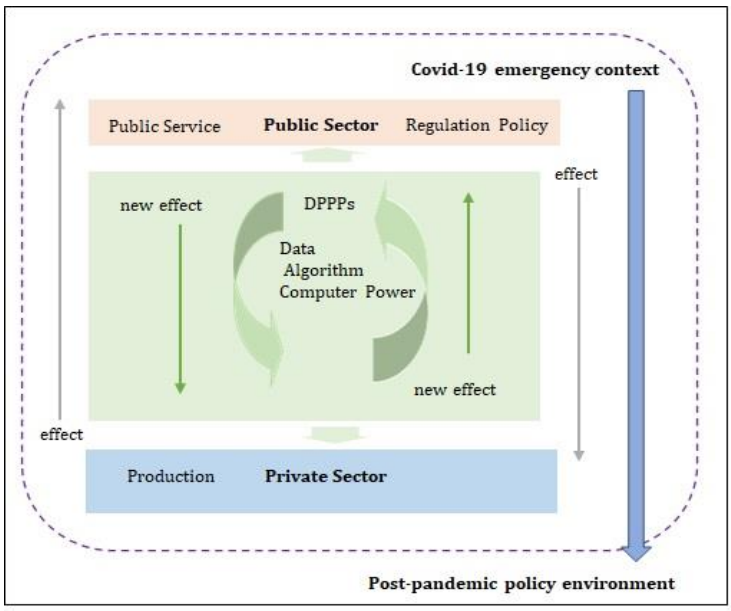

Figure 1. Architecture of DPPPs

Source: author

Cobb–Douglas Production Function and the Rationale for DPPPs

The Cobb–Douglas production function is a particular functional form of the production function used to represent the technological relationship between the amounts of two or more inputs and the amount of output that can be produced by those inputs:(Solow, 1975)

$$Y = AK^{\alpha}L^{1-\alpha} \quad (1)$$

Where Y is the aggregate output, and A is the technical capacity, while K and L denote capital and labor.

The DPPPs bring the private sector (P) into the production that was once dominated by the government sector (G). Y is the sum of Yg and Yp.

(α and β are share parameters)

$$Y = Y_g + Y_p = A_g K_g^{\alpha} L_g^{1-\alpha} + A_p K_p^{\beta} L_p^{1-\beta} \quad (2)$$

Plugging in c, which denotes capital efficiency:

$$Y = Y_g + Y_p = A_g (c_g K_g)^{\alpha} L_g^{1-\alpha} + A_p (c_p K_p)^{\beta} L_p^{1-\beta} \quad (3)$$

The marginal revenue product of capital (MRPK) of the government sector and the private sector are:

$$\mathrm{MRPK}_g = \alpha c_g^{\alpha} A_g (L_g / K_g)^{1-\alpha} \quad (4)$$

$$\mathrm{MRPK}_p = \beta c_p^{\beta} A_p (L_p / K_p)^{1-\beta} \quad (5)$$

In the scope of frontier technologies, the private sector has been recognized with a comparative advantage in innovation and higher capital efficiency (Gerrard, 2001, West & Lu, 2009; Balka, Heslin & Risse-Tenk, 2022), therefore:

$\alpha > \beta$,

$\mathrm{MRPK}_g < \mathrm{MRPK}_p$

$$\alpha c_g^{\alpha} A_g (L_g / K_g)^{1-\alpha} < \beta c_p^{\beta} A_p (L_p / K_p)^{1-\beta} \quad (6)$$

$$\Delta Y = A_g L_g^{1-\alpha}\left[(c_g K_g + c_p \Delta K)^{\alpha} - c_s^{\alpha} K_g^{\alpha}\right] - A_p L_p^{1-\beta}\left[c_s^{\beta} K_p^{\beta} - (c_p K_p - c_p \Delta K)^{\beta}\right] > 0 \quad (7)$$

Using DPPPs, introducing capital in the private sector K*p* into the government-dominated area, the aggregate output Y will increase. When (4) =(5),

$$\alpha c_g^{\alpha} A_g (L_g/K_g)^{1-\alpha} = \beta c_p^{\beta} A_p (L_p/K_p)^{1-\beta} \quad (8)$$

The aggregate output Y yields its maximum, and the transition reaches an equilibrium of maximum profit. This derivation reveals that introducing resources by DPPPs from the private sector can improve aggregate output. It provides economic evidence for advocating sustaining the DPPPs beyond the pandemic response context and developing it for the post-pandemic resilient recovery.

Policy Recommendations and Conclusions

Based on the above analysis, policy recommendations concerning DPPPs are proposed as follows:

Firstly, *policy advocacy*: the success of pilot DPPPs during the Covid-19 pandemic and the Cobb–Douglas production function derivation provides evidence that DPPPs can benefit development and reshape the solution to global challenges. It is necessary to explore further this innovative partnership and to enrich its architecture and system.

Secondly, *policy-making:* DPPPs are not about conventional financing but mean a flow of technological power. Its scope goes beyond the PPPs' major field of infrastructure and can support the progress of all SDGs. Therefore, the actors, including the leading parties of DPPPs need to expand beyond national government and development banks: a full spectrum of development agencies needs to be included in the landscape, and the private sector should take on a new role, since through

DPPPs, the effect between the two sectors become mutual and creative.

Thirdly, *policy implementation*: The blank of policy tools to empower governments and development agencies to design and manage DPPPs needs to be filled. The policy toolkit should contain and combine two categories of instruments: the first category of instruments had already been employed by government and development banks, for example, the Framework for Disclosure in Public-Private Partnership Projects, Fiscal Risk Assessment Model, PPP Contractual Provisions, Country PPP Readiness Diagnostic Tool, etc., (WB, 2014,); the second category of instruments should contain principles, norm, and standards specific to frontier technologies. Furthermore, a governance system and methods need to be established based on the two sides.

Moving from pandemic response to resilient recovery, a tipping point comes for developing an innovative partnership to harness the power of emerging frontier technologies for Sustainable Development. This brief captures innovative DPPPs piloted in the pandemic response context, gives a definition, and outlines their architecture. It demonstrates economic evidence for advocating this innovative partnership and proposes policy recommendations for sustaining the DPPPs beyond the pandemic and maximizing their benefit for sustainable development.

Acknowledgments

This document is a result of the project "INOV.EGOV-Digital Governance Innovation for Inclusive, Resilient and Sustainable Societies / NORTE-01-0145-FEDER-000087", supported by Norte Portugal Regional Operational Programme (NORTE 2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (EFDR).

S.W. is a scholar on Intelligent Health Leadership Theory and Practice, AliResearch's "Huoshui" Young Academics Project 2021, Alibaba Group.

References

Organization for Economic Co-operation and Development (OECD)., 2014, OECD Principles for good public governance of Public-Private Partnerships: the role of dedicated PPP units.

The Economic and Social Commission for Asia and the Pacific (ESCAP).,2007, https://www.unescap.org/resources/public-private-partnerships-infrastructure-development-primer.

Asian Development Bank (ADB).,2008, This Public-Private Partnership (PPP) Handbook. http://www.adb.org/documents/public-private-partnership-ppp-handbook.

WHO., 2006, Partnerships for malaria control: engaging the formal and informal private sectors. https://apps.who.int/iris/bitstream/handle/10665/43577/9241563346_eng.pdf?sequence=1&isAllowed=y.

Goodkind, N., 2020, The World Health Organization is leaning on big tech to navigate the COVID-19 pandemic. https://finance.yahoo.com/news/world-health-organization-leaning-big-163425983.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referre

IEEE Computer Society., 2021, How Tech Companies are Helping the World During the COVID-19 Crisis. https://www.computer.org/publications/tech-news/covid19-research/how-tech-companies-are-helping-the-world-during-the-covid-19-crisis.

Jomo, K. S., Chowdhury, A., Sharma, K., & Platz, D., 2016, Public-private partnerships and the 2030 Agenda for Sustainable Development: fit for purpose?. UNDESA working paper.

Schwab, K., 2017, The fourth industrial revolution. Currency.

World Bank(WB)., 2019, The 2019 Update the 2023 Sustainable Development Agenda and the World Bank Group: Closing the SDGs Financing Gap. https://thedocs.worldbank.org/en/doc/259801562965232326-0270022019.

Mariano Jr, Bernardo, Wu, S., 2020, Prominent role for AI emerges in virus fight. China Daily. https://www.chinadaily.com.cn/a/202002/07/WS5e3cb4c6a310128217275a42.html.

Mariano Jr, Bernardo, Wu, S., 2020, Technology has opened a window of opportunity. China Daily. https://www.chinadaily.com.cn/a/202003/27/WS5e7d5503a310128217282619.html.

WHO., 2021, Fighting infection with information. https://www.who.int/news-room/feature-stories/detail/fighting-infection-with-information.

Department for Digital, Culture, Media & Sport, Department of Health and Social Care, The Rt Hon Oliver Dowden CBE MP, The Rt Hon Matt Hancock MP., 2020, Social media giants agree on package of measures with UK Government to tackle vaccine disinformation. Gov. UK. https://www.gov.uk/government/news/social media-giants-agree-package-of-measures-with-uk.

Gerrard, M., 2001, Public-private partnerships. Finance and development, 38(3), 48-51.

West, D. M., & Lu, J., 2009, Comparing technology innovation in the private and public sectors. Governance Studies at Brookings. http://www188.pair.com/next1/Comparing%20tech%20innovation%20in%20public%20and%20private%20sectors.pdf.

Balka, Heslin, and Sina Risse-Tenk., 2022, Unlocking the potential of public-sector IT projects. McKinsey&Company. https://www.mckinsey.com/industries/public-and-social-sector/our-insights/unlocking-the-potential-of-public-sector-it-projects.

The Department of Global Communications, UN., 2020, 5 ways the UN is fighting 'infodemic' of misinformation. Covid-19 Response, UN. https://www.un.org/en/un-coronavirus-communications-team/five-ways-united-nations-fightin -misinformation Nations.

UNFCCC., 2022, Frontier Technology. UNFCC Blog. https://unfccc.int/blog/frontier-technology.

Gil, D., 2020. IBM helps bring supercomputers into the global fight against COVID-19. IBM and Coronavirus stories. IBM Newsroom. https://newsroom.ibm.com/IBM-helps-bring-supercomputers-into-the-global-fight-against-COVID-19.

WB., 2022, World Bank Guidance on PPP Legal Frameworks. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/099440006162228966/P17521204fa5900710ba160e9613aa44291.

Covid-19 Law Lab. , 2022, https://covidlawlab.org/.

Solow, R. M., 1957, Technical change and the aggregate production function. The review of Economics and Statistics, 312-320.

Delmon, J., 2014, Creating a Framework for Public-Private Partnership (PPP) Programs: A practical guide for decision-makers. https://documents1.worldbank.org/curated/en/153101468190188221/pdf/99114-WP-Box393188B-PUBLIC-PPP-guide-decision-makers.pdf.