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Financing Models for Digital Ecosystems

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Data Governance Network

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Abstract

This paper explores various financing models for the digital ecosystem within the Indian setup. It uses the market/non-market failure distinction and applies it to different parts of the ecosystem, outlined in the Open Digital Ecosystems framework. It identifies which form of financing — public, private and philanthropic — is suitable for the relevant component of the digital world — data registries, exchanges, open stacks, marketplaces, co-creation platforms, and information access portals. Finally, it treats philanthropic financing as a special case of financing mechanisms available and analyses their pros and cons in the Indian digital ecosystem.

Table of Contents

1. Introduction **04**

2. Conceptual Framework **05**

2.1 ODE Framework 05

a. Data registeries 06

b. Data exchanges 06

c. Open stacks 06

d. End user solutions 06

2.2 Operating Principles to Choose Financing Models 07

2.2.1. Market failures 08

2.2.2. Non-market failures 09

3. Financing different layers of the ecosystem **11**

3.1 Data Registries 11

3.2 Data Exchanges 12

3.3 Open stacks 13

3.4 End User Solutions 14

3.5 Community 17

4. The Role of Philanthropic Capital **18**

5. Conclusion **20**

Appendix I: Relevant Financing models **21**

References **25**

1. Introduction

The last decade has witnessed a steep rise in both the use of technology, and frameworks of governance. With this, there is an overt commitment to achieving a free and fair digital economy.[1] Such a commitment has only grown stronger and been reinforced time and again.[2] Some economies have evolved more on this aspect than others. In India, an overlooked but important aspect of achieving such an end is the financing models in practice to develop various parts of the digital ecosystem.

Traditional understanding of financing does not directly apply to the digital economy. Financing models for digital goods,[3] digital platforms[4] and digital infrastructure[5] are shaped by our understanding of what is data. For instance, data, by and large, is non-excludable in nature but the infrastructure that stores and disseminates the data can be made excludable. Excludability can be 'adjusted' based on the kind of data, the entity in charge of building the system of storage, and protocols set for access. Such characteristics not only make the toolkit of financing of digital goods different from traditional goods, but also makes it trickier to design.

The objective of this paper is to use the conceptual toolkit of market and non-market failures to analyse the suitability of available financing models. Three caveats about this paper are important.

First, this paper is in no way or form, the final word on this subject. To the contrary, many aspects of a digital economy are still to be categorized within existing typologies and it is only after this that their financing can be properly mapped. Nonetheless, as academic scholarship plays catch up with real world developments, we think it is important to start a discussion on these issues of consequence.

Second, while the paper itself has its roots in an academic framework, the analysis incorporates the many practical constraints that governance and policymaking have to contend with. The paper is looking to develop a 'positive' analysis, bridging the academic and the practical experiences of

[1] For more, refer to the Report of the Committee of Members under B.N. Srikrishna.
https://www.meity.gov.in/writereaddata/files/Data_Protection_Committee_Report.pdf

[2] The European GDPR was the landmark law which set a baseline for other jurisdictions to set their laws as well. Leaping off these principles were laws governing operation of drones, health data, artificial intelligence, behavior of intermediaries, etc. The principles of digital competition for the private sector, as well as areas of greater government involvement such as digital tax, have also witnessed an unprecedented pace of evolution in the last few years.

[3] Multiple scholars have defined digital goods differently. Quah (2002) defines digital goods as those that have the following 5 characteristics: non-rivalrousness, infinite expansibility, recombinant, discrete and aspatial. Bidgoli (2003) defines it as goods that are not subject to wearing out, i.e., being indestructible and nonsubtractive. Loebbecke (2002) defines it as goods that 'can be fully expressed in bits so that commercial business cycles can be fully executed based on electronic infrastructure such as the internet.'

[4] Bonina et al. (2021) say: "We suggest that digital platforms are a distinct type of information technology (IT) artefact with distinct properties, which lend particular affordances for development. Furthermore, digital platforms are a socio-technical phenomenon that require careful consideration of how they function in a social context." They also mention 3 characteristics of digital platforms: technological mediation, enabling interaction with user groups, and allowing user groups to carry out defined tasks (Cusumano et al., 2019; de Reuver et al., 2018; Gawer, 2009). Rossotto et al. (2018) also review the definitions of multisided platforms, their technological enablers, business models and dynamics in their paper "Digital platforms: A literature review and policy implications for development."

[5] Shane Greenstein elaborates on the economics of digital infrastructure and services in his 2020 essay for NBER Economics of Infrastructure Investment.

financing, using examples from — for the most part — the Indian experience. It builds on the frameworks, solutions, and policies that have already been implemented and argues for a future course of action in light of the 'learnings' from that process.

Third, the unit of focus for this paper is India, without specific focus on any one sector (health, finance, etc.) of its economy. It aims to be a document that informs policymaking and provides a toolkit that can be used to think of financing models in the Indian context.

The rest of the paper is divided as follows. Section 2 will elaborate on the conceptual apparatus of Open Digital Ecosystems (ODE) framework, and the market/non-market failures literature. Section 3 will break down the components of a digital system and be prescriptive of the type of financing. Section 4 will be a short note on advantages and disadvantages of philanthropic capital. The last section will conclude the paper.

2. Conceptual Framework

In this paper, we restrict ourselves to the ODE framework[6] as a typology of the digital ecosystem. This is supplemented with thinking on market and non-market failures which is explained in the next section.

2.1. ODE Framework

The thinking on Open[7] Digital Ecosystems[8] builds on interviews with government officials, platform creators, users, civil society, and technology, digital governance and public policy experts from across the world. Secondary practices of digital platforms in countries such as Estonia, Singapore, the United Kingdom, among others, were also considered in framing this.

The framework comprises of 3 layers — digital platforms, community and governance.[9] In this paper, we use the distinct components outlined in the digital platforms and community layer to help us break down the universe of digital components and map it to specific financing models.[10]

[6] To formulate principles for financing, certain value-judgements have to be assumed and embedded ex-ante. For the purposes of this paper, we subscribe to the values embedded in the NODE framework adopted by the Ministry of Electronics and Information Technology, Government of India and the ODE framework further formulated by Omidyar Network and BCG.

[7] The framework considers 3 levels of openness:

a. Technical openness: Having open APIs, open standards and open source codes allows for easier access.

b. Legal openness: This refers to ensuring open licenses for software and data to be freely used and shared.

c. Financial openness: Ensuring universal access to digital platforms by making them free or minimally costly.

[8] The report defines ODEs as “open and secure digital platforms that enable a community of actors to unlock transformative solutions for society, based on a robust governance framework”.

[9] The third layer of governance is what defines the values that both digital platforms and communities layers must embody. Safeguarding privacy, ensuring transparency, operating sustainably and inclusion are some of the aims for which strong accountability mechanisms need to be set in place. Creating conditions for efficiency and sustainable funding are additional duties of the governance layer.

[10] We omit the governance layer in this analysis as it deals with the 'governance framework' with institutions of accountability and the responsibility to ensure fair and equitable access to stakeholders. Some of the analysis regarding the financing of governance layers is subsumed under other aspects of digital platforms and community. It is otherwise designed as a layer defining the principles that govern platforms and community members. See footnote 9 for details.

Digital platforms are technology infrastructure that enable stakeholders to provide public services and allow end-users to access services.[11] They include open Application Programming Interfaces (APIs) which are software intermediaries that enable free and open interactions between multiple applications. They also perform duties of a consent manager, have software for anonymisation of data and include analytical engines.[12] The framework conceptualises an ecosystem of digital platforms for use and delivery of public services across health, education, mobility and financial inclusion. They create shared infrastructure that integrates otherwise siloed data to unlock its potential for socio-economic and governance functions. The report categorises digital platforms into four types:

a. Data registries: Registries collect and store personal and non-personal information that is primarily used by the government or a provider of public services. It is a centralised database of all data related to social protection schemes. For instance, in India, Aadhaar is a unique digital ID and the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) registry is a database of all beneficiaries of that scheme.

b. Data exchanges: These are platforms that enable flow of various types of data generated by stakeholders such as governments, businesses and individuals across different types of entities. Account aggregators, the India Urban Data Exchange are examples of data exchanges.

c. Open stacks: These stacks are a combination of applications, software, data registries and protocols. Examples include, the recently launched National Health Stack which contains all health records of individuals, registry of doctors and even information on health insurance or the National Urban Innovation Stack which offers cloud-based services such as traffic management, women's safety solutions and grievance redressal.

d. End user solutions: This is a layer of services and user interface that applies across data registries, exchanges or open stacks. Three different types of solutions include:

- Marketplaces: An example of a marketplace includes the Government e-Marketplace (GeM).
- Information access portals: The Digital Land Records Modernisation Programme which will include all electronic land records is an example of information access portals.
- Co-creation platforms: Digital Infrastructure for Knowledge Sharing DIKSHA is an example of a co-creation platform that is used by teachers to access teacher training modules and create and share their course work. It is also used by students to access learning material.

The framework also references the “community”, which is a group of stakeholders or actors involved in creating and using digital platforms. The group is also responsible for creating new solutions, ensuring participatory design, holding creators accountable, driving end-user engagement through continuous feedback loops, and redressing grievances. They are categorised into three groups:

a. Builders: These could be public sector entities like government departments or public agencies, private entities like businesses or start-ups, or developers and service providers who create digital platforms.

[11] Given that platforms collect vast amounts of personal and non-personal data and are catered for public service delivery, a value based governance framework is required.

[12] Digital platforms also follow certain standards and protocols on how various stakeholders interact and use these platforms. The aim is to make open, secure, reusable, scalable and interoperable technology infrastructure to enable efficient and innovative service delivery.

b. End-users: Entities or individuals who consume the services provided by the digital platform. They are part of the process of improving services by providing feedback.

c. Facilitators: These could be entities like non-profits, think tanks, academic institutions, multilateral organisations, experts from fields such as technology, law, data governance, public policy who have knowledge of building, governing or researching about ODEs. They provide strategy and design solutions, feedback, and provide work towards ensuring inclusion and addressing last-mile delivery issues.

2.2. Operating Principles to Choose Financing Models

In the recent past, there have been debates on the optimal forms of financing and relevant scholarship has emerged. Much of this is not specific to the digital ecosystem but keeping in mind other non-salient characteristics such as the nature of information and the evolution of technological development. Even though they are not directly prescriptive, they do form a bedrock to the discussion that follows.

Hermann (2010) and Mazzucato (2013) make a case for how government financing works towards addressing market failures endemic to the innovation sector. Mazzucato (2017) further stresses on how economists (such as Veblen, Keynes and Minsky) understood that the quality of financing was integral to the functioning of capitalism. She argues that innovation being uncertain, building gradually and collectively, requires high-risk capital. These characteristics require various forms of public and private financing.

Private financing is disadvantageous being focused on short-term goals. The digital economy requires long-term investments such as R&D and innovative ventures which require trial and error. Further, entire innovation cycles have been publicly financed. For instance, the basic technology on which the batteries and solar panels used by Tesla was funded by the U.S. Department of energy. Financing specific missions that create new knowledge and bring about institutional changes also call for different forms of financing. For instance, GPS was developed for the US Navy.

Some scholars (Bhattacharya and Romani, 2013; Katz, 2014; World Bank, 2019) are more prescriptive on the role of government in public financing digital infrastructures at country and regional levels of development. Atkinson et al (2016) argue that digital infrastructure which will be used nationally and which enables innovation, and must be publicly funded. Moreover, digital infrastructure and systems that aid policymaking, privacy and security, and create value for society must be encouraged and funded by the government. For instance, broadband networks can be funded by municipalities to improve connectivity in the local community.

Other scholars such as Ridley (2020), argue that innovation is a step-by-step, trial and error process that counters the top-down narrative that Mazzucato and others build. Ridley takes a larger interpretation of innovation with examples such as the Manhattan Project, the Interstate Highway System and even the Electric Bulb. Similarly, Zhao (2017) analyses the rise of internet industries in China to flesh out aspects of private financing. Digital startups are new, have high capital costs and have strong interdependencies with digital infrastructure— thus making their development necessary. UNCTAD (2017) also looked at the various licensing conditions and taxation devices which may need to be rethought to enable more industries to enter the area and mature the private financing ecosystem.

Assuming we are value-neutral, how do we decide which form of financing will lead to an optimal allocation, and long-run functioning of the digital economy? We think that the appropriate financial

model must be based on the extent to which they address market and/or non-market failures.

In the digital economy, there are largely three types of financing: government, private and philanthropic. The binary of market and non-market works towards all three critiquing the issues where market functioning breaks down, and those where the other non-market actors may lead to loss of efficiency. Below, we unpack the principles in light of the digital economy.

2.2.1. Market failures

The shortcomings of market interventions and their outcomes can be attributed to market failure. Wolf (1979; 1987) uses efficiency and distributional equity to judge the outcomes of markets and deems them successful or in need of non-market or government intervention.

We analyse the relevance of some of these concepts briefly in the context of the digital ecosystem.

a. Information asymmetry

In digital ecosystems, this arises when use of individual data is not disclosed. While the user may have information on the data that is collected, in some cases he/she may not have complete information on its use. Thus, one party of the transaction may have more information than the other party, which holds the potential to alter the terms of the transaction. Amazon tracks cookies of consumers and with every click, Amazon is able to target the consumers better as they reveal their preferences. Spence (2020) notes that information asymmetry is decreasing in the digital world due to inexpensive and scaled bilateral information exchanges via online discussion forums and user ratings. On the other hand, Kajtazi (2010) notes information asymmetry persists and categorises information exchange as influenced, intentional, hindered and unawares — and designs a model for analysing asymmetry in the newspaper, stock exchange and healthcare sector.

There are non-economic forms of asymmetry which have a direct bearing on the economic terms of transaction. For instance, while Instagram collects data on contact lists, location, has access to the microphone, SMS and so on, it does not specify all the uses. Since Instagram has been acquired by Facebook – personal data can be linked without knowledge and lead to privacy harms which affects consumer welfare.

b. Market power and reduced competition

Due to decreasing marginal costs and increasing returns to production, and provision of goods and services, digital platforms enable various economies of scale. For instance, the more users there are on a digital platform the more utility one derives from it. This increases the competitive advantage of a monopoly which already has a large user base and becomes a hindrance for a potential new player that does not have a large enough user base to benefit from economies of scale required to provide better services.

Social media such as Facebook are good evidence for this argument.[16] Additionally, online marketplaces and search engines tend to favour their own complementary products and services and exclude their competitors., which complicates the market power argument.[17]

c. Externalities

Externalities arise when the benefits or costs from economic activity go beyond the anticipated. The allocation of resources in such scenarios is inefficient because the additional costs or benefits were not accounted for in those calculations. There is thus a likelihood of reduced production when there are positive externalities and higher production when externalities are negative.

Externalities also occur when there is overprovision of personalized services, which may lead to negative externalities. For instance, algorithms that enable targeted advertising, may show harmful content thereby creating behavioural biases which may harm not just the user but also people around the user. Similarly, sharing an individual's genome data creates externalities for the family whose data also gets disclosed in the process (Skloot and Turpin, 2010). Here the government would have to step in and set some data governance protocols or set fines.

d. Missing markets

Missing markets arise for multiple reasons. A key one in the digital economy is the inability to predict gains from an investment, which leads to under-provisioning of goods or services. The internet, itself, and GPS are examples of value-creation funded by public money. In such cases, markets don't develop as the private sector is not willing to put in a long term, high-risk investment.[18] There are other reasons, for instance, the market for personal information management services has not taken off due to high transaction costs due to regulation such as the General Data Protection Regulation (GDPR). In such cases, non-market intervention is often necessary for initial impetus to developing the market.[19]

[16] The more people use Facebook, better will be the user experience unlocking network effects and giving access to a wider network. This will, in turn, make switching costs to other social media platforms higher. Additionally, people are likely to face barriers in switching platforms — like technical features that disallow transferring data to other systems. For example, in the case of LinkedIn one can't switch their connections to another platform. A caveat: individuals also engage in multi-homing, i.e., using multiple platforms at the same time, since platforms may provide unique products or services. An individual may have a Netflix, Prime Video and a Disney Hotstar account even though they broadly offer the same service. However, dominant players tend to overcome this issue as well. For instance, gaming console producers exclusively partner with game publishers. High prices for the console and the games disincentivises consumers from multi-homing and locks them in.

[17] For instance, the online marketplace Amazon, promotes its own products even though they may not be the cheapest, highest rated or of the best quality, but their algorithm showcases their products at the top or those that are most profitable to Amazon. Similarly, Google's search engine puts its own products or services at the top of a search. In 2017, the EU even fined Google for such practices.

[18] There are cases such as Amazon and Tesla who are willing to investing into sat-based telecom services in markets such as India. This is a case where government is unwilling to invest but private sector is taking the lead. Similar is the case with electric vehicles or autonomous vehicles, where innovation in unformed markets is being driven by the private sector. Arguably, however, there must be a profit horizon that is visible for such endeavors to see private sector backing.

[19] The Joint Research Centre of the European Commission has a technical report which highlights some of these characteristics. https://ec.europa.eu/jrc/sites/default/files/jrc122896.pdf

2.2.2. Non-market failures

According to Wolf (1987), non-market failures arise due to absence of mechanisms for internal cost-benefit analysis and societal cost-benefit calculations. While mechanisms to address non-market failures are in the form of legislative and administrative functions by government agencies, the value and efficiency of these mechanisms is not evaluated. The differences between demand and supply of market and non-market outputs result in failures.

a. Distinction between costs and revenue and no accountability

Since investments in the provision of goods and services primarily comes from taxpayer money, the chain of accountability is broken. The mechanisms of government accountability for allocation of resources are generally weak. Additionally, since revenues do not sustain the investment, it is difficult to gauge efficiency of the allocations. In such scenarios, more resources may be used than are required which constitutes a failure on account of improper government provisioning. In infrastructure projects in India, as of February 2021, of 1,736 projects, 449 infrastructure projects had cost overruns and 547 have been delayed with total cost overruns of INR 4.29 lakh crore, as reported by the Press Trust of India (2021).

Additionally, the lack of internal goals, standards and performance indicators hamper efforts to evaluate the government's performance. Aiyar (2017) notes this extensively with the making of India's biometric system — Aadhaar —which was competing with other systems highlighting the issues of shifting goals, performance indicators, revenue horizons and accountability mechanisms.

b. Focus on equity over efficiency

Efficiency is identified as a paramount value, in most schools of economics. Leibenstein (1966) lists various ways to improve efficiency in markets: lowering costs and raising productivity by improving organizational standards and processes, and worker incentives, making appropriate decisions regarding promotions, salaries and performance goals, etc. Governments and philanthropies, however, often have other values taking precedence such as equitable allocation and distribution of resources that doesn't necessarily return the greatest 'bang for the buck'.

There are different ways to interpret equity — some may opt for equality of opportunity, others may have the view that socially equally-situated people must be treated equally, and some others may take the view that equality of outcome must be the focus of government efforts. Wolf (1987) argues that the ambiguity arising from various interpretations of equity and wide differences between these approaches may itself result in inefficiencies.

c. Government as a service provider and regulator

As a specific case of non-market failures, a government may observe a mismatch when it is responsible to regulate its own actions. The government has a mandate to provide certain services to citizens and businesses. For instance, the government provides data exchange services through the India Urban Data Exchange. But it also collects vast amounts of personal and non-personal data for which the platform must be regulated given security and privacy concerns that may arise from sharing and use of such data. In an attempt to provide the service, the government may fail to properly regulate itself. Such a possibility must be considered when determining the financing of such platforms as it will have implications on design and therefore security standards.

3. Financing different layers of the ecosystem

Based on the conceptual framework outlined, we analyse the suitability of government, market or philanthropic financing to each component of the digital ecosystem. Our general approach is to analyse how market or government failures can be a problem in financing. If both are unsuitable, we analyse why or how philanthropy can be the superlative option among the three.

Additionally, the Appendix has a list of financing mechanisms which we echo in some parts of this section. Figure 1, below, gives a snapshot of the mapping of financing to each component.

ODE			Financing Models		
			Public	**Private**	**Philanthropy**
Digital Platforms	Data Registries		■	■	
	Data Exchanges			■	
	Open Stacks				■
	End User Solutions	Marketplaces		■	
		Information Access Portals	■		
		Co-creation platforms	■	■	■
Community	Builders		■	■	

3.1. Data Registries

Data registries establish the primary entitlement for a given participant on the ODE to interact with the other participants. Consider lists of welfare beneficiaries and muster rolls that identify individuals to the government or other private players. Data registries facilitate the sharing of such information. They also improve efficiency — having a single root database is a hedge against unnecessary duplication and allows for data to be re-used thereby reducing costs of data entry (Fry, 2008). However, due to the fact that data is mergeable and can be aggregated and observed over time, potentially leading to profiling the security of such registries is essential (Drolet and Johnson, 2008).

The entity that controls the registry generally has the ability to determine who can or cannot participate in the ecosystem. The use and misuse of such power can lead to dire consequences for end-users. It would be important to ensure that this power is exercised with appropriate accountability. Thus, the operating principle upon which the decision as to the appropriate financing model for registries would be the accountability of the financing institutions.

Given that one of the main the objectives of the platform is to be openly accessible and to continue to develop new tools and datasets, this cannot be achieved with only state funding (Kitchin et al., 2015). This would suggest that two forms of financing models are preferable: either a public-utility model or a public-private financing model (see Appendix for details).

Given that the government is the primary user of registries, the primary burden to finance could presumably fall on the government itself. It's biggest advantage (in India) is that it can be held accountable through constitutional safeguards to ensure societal benefits, without having to focus on profit-making and stakeholder value creation. The proportionality test laid down in the Puttaswamy judgement further keeps actors accountable in maintaining privacies of individuals. However, the government being both a service provider and a consumer of these registries may lead to a non-market failure. Further, a regulator to maintain balance in these registries is needed, highlighting a third role of the government.

The private sector's advantage is that it is agile. This is particularly useful if the registries are to grow and evolve. However, without appropriate safeguards to ensure neutrality, the private sector could subvert the registry to favour its own products and services. As the registry sits at the centre of the transaction, there are real risks that control of the registry by private sector players could lead to information asymmetry allowing certain sections of the private sector to gain disproportionate access to ecosystem information. This could lead to increased market power and reduced competition.

To take care of such market failures, protocols must be built to mitigate these risks. For instance, it is possible to create inter-operable registries along the lines of the multiple Domain Name System (DNS) servers that maintain list of all the URLs and IP addresses on the internet and that are designed to propagate changes throughout the entire system. Similar features could also be encoded in the ODE ecosystem to counter the asymmetry problem. With multiple registries, redundancy is built in the system preventing single party dominance and thereby creating a level playing field.

As far as regulation and policy design is concerned, multiple and interoperable registries must be the design for development of this aspect of the ODE.

3.2. Data Exchanges

Data exchanges are parts of the ecosystem that either move data between ODEs or move data from one part of the ODE to the other part. Thus, the exchanges will need the capability to handle large amounts of data and achieve scale of operations. Public and private financing can respectively result in market and non-market failures.

The non-market failures of cost and time overruns; and those of the government being a provider of service and regulating itself seem to be reasons for reducing efficiency of the enterprise. Private financing has done a much efficient job at scaling rapidly than public. Consider the evolution of IRCTC — the Indian government website to book railway tickets — which has majority ownership with the Government of India (via the Indian railways). Started in 2002, the website aimed at providing the service of booking railway tickets online. However, throughout its chequered past, it was not until 2015 that it installed 2 new linux-enabled servers and ordered 5 more to increase server capacity. Despite this, as late as 2020, the high traffic of passengers on the website caused it to crash multiple times. This stands in contrast to the United Payment Interface (UPI) — a service introduced in 2016 which has scaled up its capacity consistently meeting the demand. Between 2020 and 2021, UPI transactions doubled from 1.25 billion to 2.73 billion. While the service offered by the two companies is different, UPI is owned by a not-for-profit consortium with private banks and payment services as co-owners with public banks, while IRCTC has majority government ownership (with 100% ownership until 2019). The forms of financing and regulation of the two portals do make a difference in the services offered.

Further, the more exchanges the system has, the easier it would be to facilitate data flows. More exchanges in the system serves two purposes of (a) increasing competition between market players; and (b) solving for a 'missing market' of data aggregation.

Operationalising the prevention of market failures by public financing will be hard to achieve for a variety of reasons. First, there will be a political angle to such investments which will have to be sensitively navigated. The government in selecting a private company to fund a project may be condemned by political rivals for engaging in nepotism and corruption rather than fulfilling a social benefit. Since these decisions are rarely transparent, public investments may not be ideal in such a situation. Second, the process and paperwork to commission such data exchanges may delay timelines — with significant cost and time overruns — and may not be able to achieve the scale required for the success of data exchanges. Third, the empanelment of developers and choosing between them is prone to rent-seeking and red tapeism which would take away from building an effective data exchange. The government should allow the private sector to invest in building the exchanges. However, the exchange needs to be transparent which requires a level of trust to be built between two parties involved in data exchanges (Nicolaou, Ibrahim and Heck, 2013).

Thus, private financing should be preferred for data exchanges. However, appropriate regulatory protocols need to be designed to ensure the private players uphold necessary governance principles such as transparency.

3.3. Open stacks

Open stacks are a combination of applications, protocols and software (examples include the Modular Open Source Identity Platform (MOSIP) and the National Health Stack). Their financing needs to be analysed differently across two stages: (1) designing and building the stacks, and (2) for implementing and operating the stacks.

To design and build open stacks, it is critical that the financers recognize that the stack needs to be built to facilitate an exchange in the economy, yet the stack itself may not be able to see a visible revenue horizon. This would immediately disincentivise the market from entering leading to a missing market. Further, regulatory issues can create externalities such as tedious licensing processes and taxation concerns, and local standards which would all additionally disincentivise private investment (Gottschalk, 2020). Without a visible profit motive, private financing may not be best suited for this. This is especially detrimental to specific areas where markets are missing and require a non-profit angle to investment. Thus, either governments or philanthropies would be useful.

Governments, themselves, should not be involved in financing the design of stacks for reasons of efficiency, politicised investments and the soft-budget constraints that governments ordinarily face. As an examples, the Digital India initiative attracted a lot of attention to the Indian government's closeness with certain business houses thus bringing in attention to the move as furthering a profit-motive and generating kickbacks for the government officials. It also received criticisms on its revised FDI and media policy.

The design of open-stacks through philanthropic capital, brings in the efficiency of the private sector without being chained to its motives. For instance, the India Stack has been developed with expertise from a non-profit software product think-tank. While this has had criticisms of its own, it is a superior option than for the government to build stacks, which could lead to the non-market failures set out in the previous section.

In India, an organisation called iSPIRT has pioneered the building of these stacks for public and governance purposes, and has contributed tremendously to both India Stack and Health Stack. This model combines the expertise from the private sector with philanthropic initiatives. Modular Open Source Identity Platform (MOSIP) is a great example of such initiatives, where organisations have come together to make an impact without expecting revenue returns. It is a platform that allows governments

to implement a digital and foundational ID system, by harnessing private sector benefits of scalability, cost-effectiveness, privacy and security. This digital public good has been funded by philanthropic organisations such as Bill and Melinda Gates Foundation, Sir Ratan Tata Trust and Omidyar Network.

With regard to the second stage — the implementation and operation of open stacks — the operator will have access to personally identifiable data, even though it is not publicly available (Dykstra and Sherman, 2013). Thus, having the government as operator is a better alternative as this will maintain privacy of individuals and reduce non-economic costs that may be incurred via negative externalities. There are two reasons for this. First, there is a greater degree of checks exercised by civil society on government actions via Public Interest Litigations and bilateral talks with interest groups. Second, given that open stacks are usually developed for public purposes, the government will be more suited to ensure positive externalities, i.e., the marginal social benefit out ways the marginal private benefit. We know from economic literature that this is not always the case. However, for open stacks, we do think this is the best way forward.

Governments should oversee the creation of necessary protocols which adhere to principles while building open stacks. Thus, appointing a regulator to play the coordinator role among different stacks as they are being built will be the key role of the government. They should also find mechanisms to create more volunteer run and philanthropic funded organisations in order to completely build the ecosystem.

Such an orientation would also facilitate the creation of multiple stacks that could be built through an open and transparent process. On the other hand, if the stack is built by a private organisation, there is a likelihood that it will be designed for its benefit, leading to concentration of market power and information asymmetries. Although, by definition, the stack is 'open' and thus issues of market power should be minimal, this design risk persists. Thus, models using development focused philanthropies and universal access funds will work best towards facilitating open stacks (see Appendix for details).

3.4. End User Solutions

According to the ODE framework, we look at three types of end-user solutions: (a) Marketplace; (b) Information access portals; (c) Co-creation platforms

a) Marketplaces

The Indian political economy experience dictates that marketplaces should be funded by the private sector, even if it is a platform for accessing government services. The problem the private sector solves for is last mile delivery. This is important for e-marketplaces to sprout and develop in India. The government does this well with services such as India Post or Mid-Day Meal scheme but not so much when it comes to last mile on the digital ecosystem as it requires continuous innovation to deliver digital services.

It is our view that innovation requires freedom and that is not the government's strength.[20] The tendency of the government is to exhaust its resources in projects having excessive political intervention breeding inefficiency. This was true of the Public Sector enterprises built in the 1960s and

[20] Matt Ridley drives this point home multiple times. His book 'How Innovation Works', and a long QnA with him here are instructive to this end. https://www.aei.org/economics/innovation-freedom-and-prosperity-my-long-read-qa-with-matt-ridley/

1970s, which had to shut down ultimately being termed as 'sick units'.[21] In the digital ecosystem, such inefficiency was visible in the battle between the government backed National Population Register and the technocratically developed Aadhaar.[22]

While the private sector does have the strength to innovate, it is motivated by profit horizons. In case of technological missing markets— the GPS, for instance — the government has a crucial role in supporting the ecosystem. In the non-digital world, airports are a good example as governments invest in basic infrastructure and enable market creation. Governments then facilitate private sector to invest in airports, and innovate on the services.[23] In the digital world, different kinds of pushes may be needed — like the one with Bharat Interface for Money (BHIM). In 2016, the National Payments Corporation of India launched the Unified Payments Interface (UPI) to facilitate digital transactions of online payments by linking banks and banking features into one mobile application. UPI formed the basis for the government to launch its own application, BHIM, which boosted digital transactions and encouraged other such private apps to be developed (Sebastian, 2021).

The other danger in private financing is the market failure of increased market power. The prevention of this depends on rules which put guardrails on private activity. The concerns of this are similar to those of big businesses, where conglomerates evolve under the shadow of the government.

There is a role of philanthropic capital as well in developing marketplaces. It should come in to identify gaps in the ecosystem and provide a direction of movement to such innovation. Let's say a tunnel needs to be built through the hill — and the government can build it and the private sector can commercialize it. But, that identification is crucial for the ecosystem to develop. Philanthropic capital will be best suited to absorb the additional pressures.

Thus, there isn't a clear answer on our preference on the financing models — depending on the design and implementation of regulation to prevent private sector take-over of market places. Generally speaking: financing must be private. But, in some cases we may need to set up the market from scratch and this is where the government can come in.

b) Information access portals

Information access portals are the interface between the citizens and the government. Goods and Service Tax Network (GSTN) and GeM platforms are some of the operational portals. These platforms can be privately established as long as the actual information is only controlled by the government.

[21] The Arjun Sengupta Committee Report (1984) highlighted multiple issues with why the Indian government is unable to run profitable enterprises, with a major reason being inability to innovate and compete. Many of those reasons apply to government intervention in 2021 as well.

[22] Even though Aadhaar was developed by government, its process was technocratic with many aspects brought in from private sector functioning. See Shankkar Aiyar's book 'Aadhaar: A Biometric History of India's 12-Digit Revolution' for rich detail and discussion.

[23] A point of caution: having the government involved with the marketplace for too long may also be detrimental to its development. Like, with airports, after the airport reaches a certain flow of passengers — it should be contracted out to the private sector. We can feel the difference between services in private airports versus those in government. According to a 2011 NITI Aayog report, 60% of the air traffic is handled by airports that are under the public-private partnership model (PPP) with the private players having majority of the share. The private sector has also invested the majority of the total investments in the aviation industry. Moreover, the customer satisfaction was much higher at privatised airports than those operated by the Airports Authority of India (AAI). Thus, one needs to be vary of government intervention if not done in a time bound manner.

The motivation here is to increase and improve the effectiveness of information access. Thus, the building of back-end technology, regular updating and servicing, and managing an infrastructure parallel to government function, should not be left to the government to do. Given that there are clear, tangible and visible deliverables, private sector players can be the builders.

The financing of such portals will be public with variants of the public-private partnership models such as the operator funded model or the PPP models that exist already. In other domains such as issuing of passports, the private sector has been involved in handling the infrastructure however maintaining the information securely with the governments. The same precedent can be used for information access portals as well. Further, necessary protocols will have to be put in place to keep governments accountable in using the information.

Additionally, while there are benefits to having the private sector implement the portals, there might be challenges with finding the appropriate incentive structure.

c) Co-creation platforms

A co-creation platform is like a sandbox, and its design would determine how it should be financed. Ideally, the government should be in charge and constantly draw from private sector and philanthropic inputs. However, government systems — more so in India — don't automatically evolve with technology capability or when they do, it is a slow take-up. Consider the Unique Identification Authority of India (UIDAI) which has clearly evolved institutionally but has remained relatively technologically stagnant.

In co-creation, the problem is not as much the source of financing, but the balance of control between government and private sector. Consider the Boeing 737 Max where the specifications were so technical that the US Federal Aviation Administration (FAA) that they were certified on information given by Boeing. Boeing circumvented scrutiny by the FAA of significant changes in its airplane design by terming them as incremental changes which required no additional pilot training. The software and hardware was so complex that the FAA couldn't independently certify the aircraft. It relied on the company itself to self-regulate and provide accurate data required for certification. This eventually led to two plane crashes.

The most successful model of a co-creation platform is the internet that functions through standards setting bodies but is also constantly evolving. Consider a simple example of browsers. When they were first created browsers did not have the capability to display videos. Yet, over time, they evolved to incorporate the protocols to play streaming inline videos that auto play in a newsfeed. Thus, the market does innovate to match the evolving technological capability and provides the service which government platforms may not be able to match.

There is plenty of role for philanthropic capital too — Apache and Mozilla are cases in point. The Apache Software Foundation is a community of software developers that produces and shares Free And Open Source Software. The community also provides legal and financial support for other open source software projects. Similarly, the Mozilla Foundation is a non-profit organisation which works towards making the internet an open space and as a public resource by building open source software tools. Thus, funding spaces with philanthropic capital, where such sandboxes can be built to further technological development giving regulators a heads up on the emerging technology without stifling innovation.

The ideal case would be for the government to build a new framework and transition it into a self-sustaining model – like DARPA did for the internet. This would require initial financing would come

from the government, but gradually private sector and philanthropic capital should take over.

3.5. Community

The community in the ODE framework comprises builders, end-users and facilitators. For the purposes of financing, it is essential to focus on regulating the builders. End-users will be using the services provided, and facilitators will generally be non-profits and multilateral agencies.

For builders to make successful products, certain basic infrastructure will have to be provided or built. Thus, we think builders can be broadly divided into: first order builders and second order builders.

First-order are those that create the environment for the other builders to thrive. These would have to be financed by the government as the case of missing markets would not allow a market ecosystem to thrive. To continue our analogy with the airports, for airlines to be successful — airports need to be built and without them there is no ecosystem. Thus, the government plays the role of building the airport and then opening up the market. Consider the case of UPI —Google Pay may not have been as successful without the intervention of the government that resulted in the creation of BHIM. The extra push towards a cashless economy was necessary for private sector builders to innovate. Governments have invested resources so that the market can create value — where ever there are missing markets, first-order builders are needed and thus public financing will play a role.

The private sector's involvement may lead to market capture and may not enable an environment that is in line with the ODE principles. This was what stopped Facebook from rolling out Free Basics in India. The net-neutrality[24] debate highlighted the risk of allowing private profit driven entities to fund core infrastructure as they may have the ability to control and restrict choice from consumers and hoard benefits that accrue. In India, the Telecom and Regulatory Authority of India (TRAI) released regulations in 2016, to prohibit data service providers from engaging in discriminatory pricing of data services. Without this, private broadband providers would have had the ability to charge differential prices to customers for accessing different online services. Moreover, they could have favoured certain websites by allowing some data to pass through faster internet lines than others, which could have led to slowing down or blocking access to certain websites. Without these regulations innovation would have been curbed and newer players without deep pockets would not have been able to grow. This would have eventually resulted in free expression being curtailed.

Second-order builders are profit maximizing players that invest in certain areas of the market where they provide a value-added service for a monetary return. On the financial side, Google Pay and Amazon Pay would qualify as second-order builders. For these players, governance norms will have to evolve keeping in line with many of the principles outlined in this report – such as ensuring that the infrastructure interoperable. Funding mechanisms and other such details will have to be outlined by the regulator in order to enable tariff setting that appropriately balances cost recovery.

The key to balancing these is to set clear standards. For instance, technical standards are needed to operate in a sector. If the private sector lays these out, it is likely that they will be designed to benefit that company. Thus, the government must retain the right to come up with these standards. The role of public financing, in many ways, is to install the basic infrastructure and allow the market to build out and provide the service.

Thus, once the standards are set — the financing to meet this layer can come from either of the three parties: government, private sector or philanthropy.

[24] Tim Wu, first coined this term in 2003 when he discussed online discrimination.

4. The Role of Philanthropic Capital

While philanthropic foundations have been supporting public service delivery and government efforts since the early 20th century, different kinds of philanthropic funding have emerged over the years. It is important to discuss the benefits and dangers of such funding in the digital ecosystem.

In India, there has been an influx of philanthropic capital in the digital space. Traditionally, philanthropic investments have either followed the venture capitalism route or used market principles and the for-profit approach (Frumkin, 2003).[25] Centre for Social Impact and Philanthropy[26] categorizes four broad kinds of philanthropies in India: corporate, foreign, government and individual. The India Philanthropy Report (2020) further gives a disaggregation of the philanthropic ecosystem in India with specific investments, opportunities and case studies.

Irrespective of their category, intent or setup, there are three reasons to be wary of and to regulate philanthropic capital.

1. Irrespective of their impact, philanthropic foundations are not accountable to either voters or act as competitors which gives them too much power to determine societal outcomes (Reich, 2018). They don't have any force regulating their moral burden to be transparent. Financing digital platforms that are for public use and involve use of personal data of individuals must come with accountability mechanisms, thus dissuading philanthropic funding in these areas.
2. Philanthropic funding is tax-subsidized which in a way defeats the purpose of philanthropic funding for public benefit, since citizen taxpayer money is used to subsidise the funding. It gives them more leverage and power to further their interests (Haslanger, 2020). Additionally, philanthropies are often set up by private companies to reduce their tax burden while influencing the government to allow practices and protect institutions that benefit them. That said — while there are failures of philanthropic financing, it has been beneficial and successful in donations to poverty relief, education, art and research.
3. Philanthropic funding and its mission are also determined by the donors and the intent may not be completely clear.

Notwithstanding these criticisms, history has shown that philanthropic capital has brought about technological innovations which has improved lives. Consider the 911 helpline in the US which was funded by the Emergency Medical Services Program of the Robert Wood Foundation. The helpline handles 240 million calls per year at an average of 6,00,000 calls every day.[27] Similarly, the recent success of MOSIP — funded by Omidyar Network — has used philanthropic capital to build an open-source identity system which is being adopted by three countries — Ethiopia, Philippines and Morocco.

The benefits of philanthropic capital are plenty and there are as many reasons to embrace it. A few are listed below:

[25] Lately though, organisations such as Rockefeller Foundation advocate for a 'field building' approach — "A field is a community of organizations and individuals working together to solve a common set of problems, develop a common body of theory and knowledge, or advance and apply common practices."

[26] Centre for Social Impact and Philanthropy. (n.d.). Estimating Philanthropic Capital in India — Datasets. https://csip.ashoka.edu.in/estimating-philanthropic-capital-india-data/

[27] Walden University. (2021, March 25). 10 Things You Might Not Know About the United States' 911 Emergency Telephone Number. Walden University | Walden University. https://www.waldenu.edu/online-masters-programs/ms-in-criminal-justice/resource/ten-things-you-might-not-know-about-the-united-states-911-emergency-telephone-number

1. Philanthropic funding facilitates research which is the basis for any new venture or growth of a sector. It is long term and does not always yield immediate tangible results but has a multiplier effect. In the case of digital infrastructure, philanthropic investments have aimed at preserving and sharing data, which has enabled research. For instance, philanthropic capital in Europe has funded the Digital Research Infrastructure for the Arts and Humanities, Europe Strategy Forum on Research Infrastructures and e-Infrastructures Reflection Group, and other consortia of research organisations (Kitchin et al, 2015).
2. According to Olate (2007), philanthropy, as a form of individual voluntarism, is a way to establish democracy. It encourages civil society to push for social development and makes them responsible for building a society and determining the quality of democracy. In the digital age, a strong democracy allows for free expression on the internet and by extension in daily life. A humanitarian agency in Indonesia was able to improve public participation and improve civic voluntarism (Nurdiyanti & Suryadi, 2020).
3. Philanthropy pushes reform from both ends — demand and supply. On the demand end it encourages reform through advocacy, and engaging the media while on the supply end does so by developing new technologies that open up space for for-profit ventures.

The government has to play a role in regulating philanthropic capital but it needs to actively involve it as well.[28] For digital infrastructure that is considered and is to be used as public goods, it becomes imperative for the government to incentivize philanthropic funding. Andreoni (2006) shows that tax deductions for donations have a positive effect in raising philanthropic donations by charities as well as individuals, highlighting the importance of governments in raising such capital.

We do think that there is a space for philanthropists to be involved in the policymaking process in general and the digital space in particular — some of this has been highlighted in the previous sections. However, it would be helpful to differentiate between philanthropists who are affiliated with profit making organizations vs. those that are charitable, non-profit entities. For instance, venture funds which comprise donors and investors funding social enterprises while expecting social, environmental or financial returns fall in the category of philanthropists associated with profit making entities. Alternatively, community foundations and single-issue funds are foundations or trusts that are either regionally focused or focus on a specific issue and are charitable, non-profit entities. More work is required to delineate the kind of philanthropic capital which may be suited to develop a specific kind of digital infrastructure, good or service.

In our analysis, for India's digital evolution, philanthropic capital can help the digital economy evolve in three ways:

1. **Standard setting:** Throughout the analysis there is a recurring theme of the government not having the requisite technology capability. This is largely due to the pushes and pulls of government functioning including its various roles as both referee and the player, the large setup which skews incentives, and the multiple and complex principal agent problems that emerge. Philanthropy could help the government to solicit various standards from the private sector and choose the best one based on a well-defined rubric/framework.

[28] Sugden (1982) dismisses the theory of philanthropic contributions that charity by one individual may induce the free-rider problem and another individual may contribute less or not at all, requiring government intervention. The paper cites evidence of only a small fraction of households in the US not contributing to charity.

2. **Informing regulatory evolution:** Regulatory evolution in technology is important yet difficult to achieve. Given the rapid developments in the technology sector, regulators need sources of deeper knowledge of the way particular sectors work in order to be effective. Consider the example of regulating Uber and Ola in Karnataka. Due to lack of any other precedent regulation, these businesses were regulated under the radio taxi regulations and forced to comply with such inappropriate regulations as having to install a fare-meter in the car. Philanthropic capital can help with developing necessary knowledge by facilitating cross-sectoral and cross-border flow of technical and regulatory knowledge that will eventually lead to the creation of rules that are more suitable to specific technological advancements.
3. **Fostering knowledge-based recommendations:** The government doesn't have the bandwidth to invest in long-horizon research, which is what technology regulation requires. While they may have soft-budget constraints, and thus may be able to earmark the necessary funding, given that governments themselves change every five years —goalposts shift regularly. Private sector, too, has profit-driven incentives as a result of which their investments in research may be detrimental to societal value and/or suffer from the market failures elaborated in the previous section. Thus, philanthropy is best suited to invest in research — especially that pertaining to areas in the intersection where both government and private players but both may not be very effective. Recommendations on framing of laws, assistance in building of technical standards, and large-scale, unbiased surveys collecting feedback on implementation of policies could be an area where philanthropic capital could be used to enable the evolution of open digital ecosystems.

5. Conclusion

In this paper we have weighed the pros and cons of financing mechanisms under the ODE framework. There is much to be said both for and against private, philanthropic and government funding. Each component of the digital ecosystem is suited to a different kind of investment, based on the failures of each kind of investment.

All three types of financing have issues and manifest in the digital economy in different ways. Failure to be agile and achieve scale and politicisation are some of the issues with public financing. Similarly, issues of increased market power, reduced competition, harm to individual privacy, missing markets affect the financing by private sectors. Further, influencing practices benefiting themselves and determining social outcomes due to lack of accountability come across when philanthropic organisations fund development of the digital ecosystem.

However, there are positives as well. The government with its regulatory mechanisms can hold the private sector accountable to fulfil objectives of public goods provision and efficient market functioning. The private sector is inherently efficient in its operation and brings in expertise as well as newer technologies which the government may not necessarily be able to offer. Lastly, philanthropic investments will bring in the long-term, risk free capital to finance innovation as well as create a market for newer areas of digital development.

Since our primary concern has been to ensure the development of an open and fair digital ecosystem while not stifling the arena, we propose various combinations of the three sources depending on the nature and characteristics of the digital platform and the kind of failure that is associated with investment sources.

While we have tackled the immediate and broader issues with the types of digital platform and funding sources, this work is to kickstart the discussion on financing models of digital goods and infrastructures. Further in-depth studies of each type of digital platform, in specific sectors are needed to detail the effectiveness of individual financing models.

Appendix I: Relevant Financing models

This Appendix outlines some financing models for financing digital infrastructures. Typically, public infrastructure is financed through government taxes and user charges but these resources are not always available and sufficient to cover the entire project life cycle (Gottschalk, 2020). Additionally, even once the project is ready, the project may not be able to generate a steady revenue stream for repaying the costs. Despite serving a public purpose, multiple funding sources are generally considered while building infrastructure.

This is true for the digital ecosystem as well. Kitchin et al (2015) suggest that a single source of funding for digital infrastructure is not viable and a blended approach may be best for open platforms. Gehring et al (2017) argue that fragmentation of donors for a given project may actually reduce transaction costs, delays and set clear accountability chains if there is coordination. Further with a higher number of entities involved, there will be more ideas brewing which may lead to higher efficiency. Sources of funding may also change over the cycle of development or operation of digital platforms.

We look at some specific traditional financing models below arising from the telecommunications literature.[29] The rapidly changing technology in telecommunications and of digital ecosystem can have similar effects on financing. The telecommunications sector has seen a combination of financing sources such as public private partnerships, financing from Universal Access Funds and development banks, which has worked for various purposes, whether upgrading technology rapidly, or providing services in remote rural regions. The complexity of open digital ecosystems requires expertise from the private sector but needs to fulfil public purposes. Five models are below:

a. Public-utility financing model

This directly borrows from the financing of utilities such as the electricity industry. Three stakeholders are generally involved: the municipal government, an investor such as a bank or a pension fund and a lender. In addition to financial support, the municipal government also contributes with feasibility studies, permits, etc. The bank or the pension fund would provide funding for equity and lenders demand assets as collateral.

Publicly run municipal models can be seen when the public authority builds a digital infrastructure (a broadband network, for instance). The public entity also owns the network and is in charge of operations and maintenance. Projects and initiatives such as Smart cities, ICT infrastructures and regional digitization are typically funded using this model.

[29] In the same way spectrums that serve as infrastructure for the telecommunications sector can be considered a public good, open digital platforms serve a public purpose — making one relevant to the other. Similarly, telecom services being primarily distributed by the public sector in the 1990s, lends its experience to open digital infrastructure that is being developed for public services.

b. Public-private financing model

This model involves stakeholders like construction companies (software companies in the digital world), banks, pension funds and infrastructure funds as well as lenders like private sector project finance banks.

The public authority retains ownership of the infrastructure. The private entity usually builds and operates the infrastructure. Since the infrastructure is being built as a public good and must remain neutral, the private authority building and operating the infrastructure must not be permitted to provide its own services. Competing service providers can provide services using that infrastructure as the medium of delivery.

On the finance side, generally, a special purpose vehicle is created and lending is based on projected income from the project. Lenders ring-fence the revenues to be used only for that particular project and require collateral against the project assets. Development banks also make certain contributions to mitigate some risks of performance of some equipment.

As suggested by Grimsey & Lewis (2007), there are several types of contracts with varying degrees of public private partnerships (PPP) including Build-Operate-Transfer, Build-Own-Operate, Build-Lease-Transfer, etc. which have been running in infrastructure development. They take examples from Rondinelli (2002) who studied projects in Africa, where water infrastructure was built by the municipality and a private firm was contracted to operate and maintain it. Similarly, tourism runs on PPPs in Costa Rica. The government builds national parks but private entities finance and create tourism campaigns and programmes.

As an example, the Korean government established the Informatization Promotion Fund to finance digital infrastructure projects. The fund has contributions from the public and the private sector through spectrum licensing fees, contributions based on revenues from telecom operators, and earnings from the operation of the fund.[30] The project enabled public-private partnerships, established an information promotion fund that encouraged private firms to invest for the long term. While the Korean government invested more than US$900 million in the Korean Infrastructure Information project, the total investment was US$33 billion, majority of which was funded by the private sector.

c. Operator funded

In such a model, the public authority subsidises an existing market player to upgrade its infrastructure to be able to offer it for public use. There are examples of this in the telecom sector where the public authority compensates telecommunication providers to bridge the gap between infrastructure that is commercially viable and that which is required for greater coverage. The public authority conserves funds and instead of building new infrastructure from scratch existing infrastructure is rapidly upgraded. These are usually funded from the capital budget but may also be supported by borrowing from lenders or issuing a bond.

[30] While half of the value of the fund came from the private fund, the remainder came from government resources such as spectrum auctions. The fund is used to support ICT related research and development, maintain standardization in the ICT industry, train personnel, promote broadband network rollout, and promote e-government.

For instance, Singapore's Infocomm Development Authority (IDA) contracted Singtel and HP to provide services via a private cloud called G-Cloud. G-Cloud improves Singapore's existing infrastructure platform known as SHINE with Infrastructure-as-a-service (IaaS), allowing government agencies to procure platform-as-a-service (PaaS) and software-as-a-service (SaaS). Singtel and HP also provide training to ease transitioning to the new technology. IDA chose one supplier so as to make it easy for agencies to shop for services. Within six months, over 50% of the agencies had opted for G-Cloud.

d. Development Banks

Regional development banks use their own resources and use investment platforms to leverage resources from partners as well as contributions from the private sector to finance public digital infrastructure projects.

The Asian Development Bank (ADB) has created a Digital Technology Development Unit and is supporting the building of Information and Communications Technology (ICT) infrastructure. While the WB has been financing private digital solutions through its Digital Development Partnerships. The Inter-American Development Bank (IADB) and the African Development Bank (AfDB) are also regional development banks that finance digital development. The AfDB is the coordinator of the Connect Africa Initiative to bridge the ICT infrastructure gaps in Africa.

Additionally, sub-regional development banks usually fund projects in the South and are based in Africa and Latin America and the Caribbean (LAC). They loan finances to these projects which would need to be repaid since they are accountable to their creditors and shareholders. However, their lending capacity is not as large as regional development banks like the ADB due to their limited equity base. These banks also have member states as well as banks, pension funds, insurance companies and non-financial corporations as shareholders.

As small and medium sized countries don't have negotiating power with global institutions, funding from regional and sub-regional development banks is comparatively more viable (Ocampo, 2006). Moreover, information asymmetry will be far lesser since proximity of regional banks to the region that they are investing in improves information flow and increases tacit knowledge (Griffith-Jones, Griffith-Jones and Hertova, 2007). They have more knowledge of the political constraints and economic needs of the place (Birdsall & Rojas-Suarez, 2004).

Some of the largest contributions of the ADB, has been over 55 billion USD to India (the largest amount to any member state). Similarly, it has granted 44 billion USD to China and 42 billion USD to Indonesia in the form of Cumulative Loans, Grants, Equity Investments, Technical Assistance, and Trade and Supply Chain Finance and Microfinance Program Commitments. The largest share of funding has been for transport projects, followed by energy and finance. The ADB also fast-tracked loans and grants to member states' government responses during the Covid-19 pandemic.

e. Universal Access and Service Funds

Universal Access and Service Funds (UASF) are used to finance areas that are sparsely populated and therefore fail to attract private sector investments. They contributed to universalisation of telecommunication services and are usually useful for projects of scale at the national level. In a large number of countries, a share of the telecom operators' annual revenue is used as a contribution to the fund. Additional funding comes from institutions such as the World Bank and from licensing fees. Asia deploys a large share of broadband and wireless infrastructure and services through UASFs.

The Universal Service Support Policy of India came into effect in 2002 and the Universal Service Obligation Fund (USOF) received a statutory status in 2003. It was set up to support broadband projects and provide telecommunications networks in rural areas, and has since implemented broadband projects through UASFs. Between 2002 and 2o10, INR 10,371 crores was disbursed as subsidies by the USOF. The largest disbursements have been for installing rural household telephones and village public telephones for public access. Other regions that have UASFs include Indonesia, Malaysia, New Zealand, Thailand, and so on.

The European Union (EU) has also set up multiple funds that finance different components of the development of a single digital market for the union – the European Cloud Initiative which aims at providing high quality data infrastructure, high-speed connectivity and high-performance computers. This initiative is supported by the European Investment Bank (EIB) that takes support from the public as well the private sector. The EIB partnered with the Connecting Europe Facility to manage the Connecting Europe Facility Broadband Fund which was created to support investment in broadband infrastructure across Europe.

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