Changing Digital Identity Systems Across Africa: A Sociotechnical and Political Economy Mapping of Initiatives for Digital Public Infrastructure

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Abstract: There is a rising politics advocating for initiatives providing financial resources to upgrade digital identity systems under the rubric of digital public infrastructure (DPI). The DPI rubric advocates for three core elements -- identity verification, payments, and personal data exchange -- and often use the Indian national identity system as a model. Assessing the DPI rubric in the African context from the sociotechnical perspective and the perspective of political economy, this paper identifies three levels of organisational fields in identity systems in the provision of publicly verifiable identity. Employing these conceptual tools, a comparative survey of existing identity systems across a number of African states then identifies four different ideal-type variations on the configuration of these fields of public identity provision. Applying an industrial policy/competition policy perspective, this paper welcomes potential investment in digital public infrastructure across Africa but also calls for further research into the dynamics of competition (including infrastructural lock-in) in providing publicly verifiable identity across Africa as well as the appropriate balance of cooperation and competition and the regulatory opportunity structure in these three constitutive fields.

PART ONE: INTRODUCTION

A number of calls have been made recently promoting the concept of digital public infrastructure throughout the world.(Eaves, Pope, and McGuire 2019; Bhattacharya et al. 2023; A. Macdonald 2023b) The leading global example of such an infrastructure is the digital identity system built in India, Aadhaar. In terms of registered participants and monthly transactions, this platform is the largest government-issued identity program in the world. And, at least since India's Supreme Court judgment of 2018 which shored up its formal authorisation and provided some privacy protections, the Aadhaar system has been supported by many privacy advocates as "an interesting model to consider for large-scale deployments."(OpenID 2023, 13) Aadhaar's legitimacy only increased during the Covid pandemic.(Martin 2021)

The calls for the investment in and building of digital public infrastructure are having a particular impact – and draw a degree of their particular politics – from their location on and intersection with digital identity systems under the care of African governments. They have in some places taken social form as public, private, and/or public/private initiatives to change existing African public identity systems. Indeed, from the technology industry perspective, there is an identification revolution sweeping around the world and its prime testing and proving grounds are the jurisdictions of Africa. These claims have met with sharp pushback by civil society rights advocates, based both on the continent and elsewhere, who have put forward data protection principles and privacy rights as well as investigated the asserted industry claims to security and effective service delivery.

This article provides tools and categories with which to assess these initiatives to upgrade digital identity systems under the banner of digital public infrastructure (DPI). The DPI concept itself is constituted of three core elements -- identity verification, a linkage to the financial sector through a payments system, and a set of ground rules for personal data exchange. In order to assess the potential of digital public infrastructure, it is necessary to

explore beneath the industry claims and community resistance. Assessing the DPI rubric in the African context, this article combines two literatures, one associated with the sociotechnical perspective globally and one largely associated with the perspective of political economy in Africa. Employing these conceptual tools, a comparative survey of the sector of digital identity systems across a number of African states can identify four different ideal-type variations. Applying an industrial and competition policy perspective, this article discusses and potentially welcomes investment in digital public infrastructure across Africa but also calls for further research into the dynamics of competition (including infrastructural lock-in) in providing infrastructure for publicly verifiable identity across Africa.

In its next two sections (Parts Two and Three), this article first identifies and specifies the three-element core concept of digital public infrastructure that underpins these recent calls and initiatives. The article then surveys the study of digital identity systems from the perspective of two distinct disciplinary literatures -- information systems and political economy – and argues that a perspective combining both is necessary and appropriate to assess the calls for digital public infrastructure in Africa. Locating this study within existing literature linking identity systems and financial transactions, Part Four next identifies the key strategic action field of identity verification and gives context to this sector through providing two institutional vignettes of competing firms. Part Five describes the key argument and finding of the article, that are four different categories of digital identity systems across Africa can be usefully outlined. These four categories are roughly constituted by two dimensions, each aligned along one of the strategic action fields of verifiable identity and foundational/functional identity. Focusing on concepts of competition, infrastructure and investment, Part Six discusses two primary policy implications and Part Seven concludes, identifying further research directions.

PART TWO: DEFINING DIGITAL PUBLIC INFRASTRUCTURE THROUGH ITS CORE CONCEPTS

A good place to begin, one April 2023 call for digital public infrastructure put forward a fairly concise definition for the concept:(Sandman and Eaves 2023)

'[t]he set of capabilities that enable participation in society is constantly evolving, but over the past two decades, several countries have converged on three capabilities that they manage as digital public infrastructure, specifically the ability to: Digitally verify identities; Securely send or receive money; [and] Safely exchange personal information. While these capabilities are privately provisioned in many places, a growing number of governments have used a combination of public and private ownership, regulation, and provision to govern them as public infrastructure. Deploying digital identity, payments, and data exchange as public infrastructure allows societies to prioritise access, local sovereignty, interoperability, and safeguards for systems that might otherwise optimise for specific populations or profits.'

The digital public infrastructure concept nearly always refers to the infrastructure's adoption and implementation by a country. This fits with the national scale of most industrial policy for and regulation of digital identity systems. The countries used often as examples of digital public infrastructure consist prominently of India (discussed below) and to a lesser extent Estonia. Nonetheless, in many renderings of the concept such as the one quoted above, the definition is abstracted from the specific context of the country or countries adopting digital public infrastructures.[1]

[1] It is worth noting that defining digital public infrastructure in such terms aligns with specific standardizing assumptions within some versions of globalization analyses.

Indeed, more generally, the definition of digital public infrastructure is tightly bound up with its legitimacy and its justification. Like the term infrastructure on its own, it has a future dimension.[2] It is a policy or motivating idea itself – as distinct from a collection of ideas and technical notions that may have an elective affinity for a political programme or may come to be associated with a particular form of politics. Part of its definition is its appeal to legitimacy, to its justifications.[3]

It is valuable (and representative) to take this definition as exemplifying the calls made for digital public infrastructure. We thus have three core elements of the infrastructure: identity verification, payments, and personal data exchange. It is important to note that all three elements are digital and all are publicly deployed. In addition to the continuing and dramatic increases in computing power and technology and the spread and capabilities of mobile telecommunications, the digital dimension of this definition extends to the rapid successful use of biometrics within identification. The public dimension seems to signify funding and industrial policy support for this infrastructure at least as much if not more than the public attributes of governance and accountability.

Further, it is worthwhile to make explicit two easily overlooked propositions of the digital public infrastructure idea. First, these three elements are conceived of as in alignment with each other and as working together in a composite infrastructural whole. Second, each of these elements is actually necessary to the working of the whole. One way in which this can be seen is how the element of the safe exchange of personal information and data exchange ties together the elements of identity verification and of payment facilitation.

In global policy discussions (particularly those focused on development), the Indian example often drives or is conflated with the concept of a digital public infrastructure.(For

[2] "Of special importance is the futurity with which discussions of infrastructure are imbricated. Thinking infrastructurally involves (at times) thinking forward." (Kingsbury, 2019, p. 183)

[3] These seem to fall into three categories, which track the three necessary and sufficient elements of the digital public infrastructure concept: delivery of public services, economic growth via financial inclusion, and societal advancement through technological progress (tech optimism). See Appendix D.

instance, a critic of digital public infrastructure, Jaap van der Straaten, appears to use digital public infrastructure and the idea of a citizenship-agnostic ID as shorthand for the Indian Adhaar system van der Straaten 2023) While Aadhaar is most commonly cited and discussed, India Stack is the proper term for the Indian digital public infrastructure, of which Aadhaar is the crucial base but in fact only one component.[4] India Stack consists of Aadhaar and a number of application programming interfaces (APIs). With biometric data stored in the cloud through Aadhaar, these APIs enable various functions including identification verification, provision of a financial address (an identity allowing financial transactional participation), digital signing of documents, the United Payments Interface (UPI) upon which digital payments applications can be built, and a "consent" layer allowing for exchange of personal data.(Dattani 2020)

With Aadhaar and India Stack's construction in mind, the distinction should be made between platforms that deliver services (a platform as an architecture to deliver products and services(Roitman 2023)) and the technology, data, standards and other components that implement and constitute that architecture. While this distinction can be passed over in DPI advocacy, this is the difference between the functions that a DPI performs (or is desired to perform) and the socio-technical material constituent elements of the DPI. It requires an affirmative operation to obtain and assemble these elements together in a location – often done across Africa through a exercise of public procurement authority -- in order to build a digital public infrastructure.

Finally, a digital public infrastructure is best not thought of as a digital public good. The distinction between platform as architecture and the materials and components of a platform is used by the OECD in articulating the difference between the concept of a digital

[4] While other designs might be possible, there appear to be strong network effects with many if not all of the elements implemented with India Stack. The network effects are most obvious with the payments function and with the data exchange. They presumably exist with Aadhaar as well, explaining in part its extensive uptake, despite being formally voluntary.

public infrastructure and the concept of a digital public good. That distinction is articulated as follows: "Digital public infrastructure (DPI) refers to platforms such as identification (ID), payment and data exchange systems that help countries deliver vital services to their people. Digital public goods (DPGs) are open-source software, open data, AI models, standards and content that make DPI an operational reality. DPGs open format can be freely adopted and adapted, offering countries cost savings and digital sovereignty – control over technology and data – in building out their DPI."(OECD 2021, chap. 26 Digital Public Goods: Enablers of Digital Sovereignty) In the OECD's definition, countries construct their digital public infrastructures in order to deliver services to their populations. In its terminology, a digital public infrastructure is not a digital public good; it may or may not be made out of digital public goods.

PART THREE: KNOWLEDGE ON DIGITAL IDENTITY SYSTEMS ACROSS AFRICA

While the literature on the impact of digital technology globally and on the African continent is vast, the aim of this article and section is much more circumscribed. Taking its cue from a term of art in information systems, this article's unit of analysis is the identity system, specifically a digital (not analogue) identity system.(Nyst et al. 2016)

Digital identity systems are, of course, core subjects to the discipline of information systems. This is true to a lesser extent with the set of calls to change these digital identity systems along the lines of digital public infrastructure. While much of this literature is technical and approaches its topic from an information science point of view, an important strand uses and develops a sociotechnical perspective. For instance, from this developmental angle, Whitley and Schoemaker observe that "whilst it is broadly acknowledged that digital identity systems have significant technological components, it is important to recognise that

they operate within a broader socio–technical and political economy context."(Whitley and Schoemaker 2022, 3 (citations omitted)) While Whitley and Schoemaker recognize the significance of political economy, their method does not focus on markets and economic context and instead focuses centrally on institutions and on policy documents.

In a similar vein, other scholars in this scholarly tradition have highlighted three technological transitions underway in this field of digital identity systems.(Schoemaker, Martin, and Weitzberg 2023) The first, Big ID, is a movement towards centralized biometric systems. In the second, often but not always associated with blockchain technology and treating the digital wallet as a key component, "decentralized models for digital identity seek to remove the reliance on centralized parties by empowering users to control and manage their own identity data."(Schoemaker, Martin, and Weitzberg 2023) A third transition highlighted is the "explosion of [a] class of smartphone applications known as "super apps.""(Schoemaker, Martin, and Weitzberg 2023) The focus of this analysis is on underlying ideologies associated with these distinct transitions and thus on the political rather than the economic nature of the competitive jostling ongoing in the sector around these systems.

In order to complement the sociotechnical perspective of the existing literature, it is thus necessary to add a perspective from political economy. In the African context, this literature concerned with political has been applied to digital identity systems in several forms.(Andreoni and Roberts 2022; Khan and Roy 2019)

One form this application has taken is within the political settlements literature. That literature can be stated in terms closely aligned with a competition dynamics perspective, using concepts such as horizontal, vertical and holding power.(Behuria, Buur, and Gray 2017) This formulation is akin to the standard form analysis used in unilateral conduct analysis associated with enforcing competition law statutes.

In 2019, the acknowledged founder of the political settlements literature, Mustaq Khan together with P Roy published a study of digital identities, subtitled "a political settlements analysis of asymmetric power and information."(Khan and Roy 2019) In this analysis, Khan and Roy first argued that a key driver of the enthusiasm for adopting digital identity systems in Asia and Africa related to rule enforcement. In their view, what was behind this rush was the expectation that "by establishing the identities of citizens and their entitlements and responsibilities, these systems will reduce the information asymmetries that allow rules to be violated."(Khan and Roy 2019) The policy problem with this expectation, according to Khan and Roy, is that "this assumes that developing countries have a rule of law that ensures that evidence on violations will lead to enforcement regardless of the identity and power of the violator." Instead, Khan and Roy observe in developing countries "variants of rule by law, where enforcement has a higher likelihood of success when it benefits the more powerful party. In such contexts, reductions in the asymmetry of information achieved by digital identity systems can have anomalous effects, depending on the type of violation and the relative power of the parties involved." They argue that the impact of these systems on social inclusion/exclusion is context-dependent and that, in particular, such systems can "contribute to economic exclusion through … the 'premature formalisation' of informal, small and medium-sized enterprises."(Khan and Roy 2019)

While it is primarily directed to the study of political economy at the national scale, this political settlements perspective can be usefully employed the sector level. One work on industrial policy and political settlements theory did specify the political settlement for each of the four countries studied.(Whitfield et al. 2015) It then studied the dynamics of several sectors. They made the point explicitly that the industrial policy might differ within an ideal-typical political settlement. A later work on industrial policy in Africa did not study specific

sectors but essentially took for granted the legitimacy and utility of that level of analysis. (Cramer, Sender, and Oqubay 2020)

The study of sectors is a key characteristic of industrial policy and of competition economics. Combining these two intersecting analytical angles, Antonio Andreoni and Simon Roberts have argued in favour of an entrepreneurial/regulatory state as an appropriate response to the technology trap in which a middle-income developing state may well find itself in in today's global world.(Andreoni and Roberts 2022) Their argument is firmly in touch with the fast-paced (and at times breathless) global conversation over the power of digital platforms as wielded by Big Tech. Andreoni and Roberts work on the basis of a transnational theory of monopoly capitalism as they argue towards bolstering and creating the responsive potential of the state to the strategic capability of Big Tech. This strand of analysis of political economy highlights industrial policy, rather than embedding it within the power analysis of a political settlement.

For Andreoni and Roberts, "[t]he evolution of business enterprise and corporate structure – from the national large corporation to the transnational corporation, until today's digital platforms – is intrinsic to the process of capitalist accumulation and oligopolistic competition."(Andreoni and Roberts 2022, 1434) In each of these forms, it is the "strategic capability" of leading firms (corporations) to attain, maintain or create a monopoly position has been key. The strategic capability able to be exercised by the leading firms (the digital platforms) of today's monopoly capitalism has significantly shifted from that of the transnational corporation of yesterday's monopoly capitalism. The decisive strategic capability of transnational corporations was "coordinating production from one centre of strategic "decision-making"". For the digital platforms, the key capability is "their different ability to shape markets and business ecosystems."(Andreoni and Roberts 2022, 1435, 1438)

As they explain, anticompetitive power (e.g. the power of lead firms in monopoly capitalism) has evolved into the sort of power that overlaps further into the scope of power exercised by states. "Through shaping industry standards, regulations and best practices in conjunction with government bodies (e.g., in regard to rules for sharing data) the platforms have institutional power which influence the development of markets (Dallas et al., 2019; Kira et al., 2021)."(Andreoni and Roberts 2022, 1440) There is a category of market-shaping power akin to the state's power to make rules -- available to the digital platform corporations beyond the usual dual competitive powers of large and/or transnational corporations in monopoly positions to exploit and to exclude. As we shall explore briefly below, this is a category of power akin to infrastructural lock-in and the type of power often feared and resisted by civil society advocates of privacy rights and data protection principles.

Andreoni and Roberts argue for combining the state's own market-shaping and market-regulating power into a responsive state. The purpose of the state action they argue for is to safeguard processes of value creation without unnecessarily allowing or enabling value extraction. Their term is "sustainable capture of co-created value".(Andreoni and Roberts 2022, 1445) The focus on processes of value creation and value capture (but not extraction) parallels the work of Janet Roitman, who has argued for the granularity of the study of platform economies across Africa beyond the use of Global South terminology. (Roitman 2023)

Both strands of the political economy literature explored above in this section are useful for comparing digital identity systems across Africa. Both strands are about the current state of global capitalism and use African evidence to demonstrate and prove their points. In this sense, they provide a theory of African capitalism.(Breckenridge 2021) Moreover, in their attention to political economy at the sectoral level, these works are further aligned with a paradigm seeing the emergence of regulatory capitalism across Africa.(Klaaren

2021; Dubash and Morgan 2012) While digital identity systems most often exist at national scale, they also exist at other scales, including within sub-national sectors(Effah and Owusu-Oware 2021) and within the large multinational corporation. Equally, they exist and operate with a sector that can be demonstrated comparing digital identity systems in the sector across Africa.

PART FOUR: LINKING DIGITAL IDENTITY SYSTEMS AND FINANCIAL PAYMENTS ACROSS AFRICA

As noted above, a necessary and core component to digital public infrastructure is a linkage from digital identity systems to the financial payments sector. As imagined within advocacy for digital public infrastructural that linkage is dominantly technological. However, as the sociotechnical perspective and civil society advocates for rights-regarding policies would both underline, any degree of implementation of digital public infrastructure would equally entail a linkage in legal/regulatory form. This section explores this linkage through the method of national case studies and that of strategic action field analysis.

First, a number of African case studies covering crucial episodes in national identity systems in South Africa, Ghana, and Kenya adopt an explicit focus on the technological linkages between digital identity systems on the one hand and the financial payments sector on the other.(Breckenridge 2019a; 2019b; n.d.) In his 2010 Ghana piece, the leading scholar of these studies, Keith Breckenridge, investigated the rise of a not-impossible plan for biometrically regulated money supply out of the ashes of yet another national identity card failure. Alena Theil likewise attended to the payment sector (specifically the government payments function) in her decade-later update and expansion of the Ghanian national identification case study from a ‘stategraphy’ perspective.(Thiel 2020)

In a South African case study of a maverick firm that was itself a major player in the early Ghana narrative, Breckenridge explicitly examined several instances of linkage between a biometric identity system and the formal banking system in chronicling the rise and fall of what Breckenridge terms a "South African anti-bank".(Breckenridge 2019b) While technology and finance are foregrounded in these pieces, regulation and law are an indispensable part of the background fabric. His analytical focus turns even more explicitly to law, regulation and legal institutions in his Kenya piece where his outline of a conflict between banks formally regulated as such and Safaricom, the monopoly telecommunications firm that has created the globally distinctive system of mobile money, turns very much on law (including South African law) and legal institutions (including the legal arrangements for credit information sharing).(Breckenridge 2019a)

In this hybrid technology and law/regulation vein of national scale case studies, Grace Mutung'u's work on Kenya emphasizes the specificity of national experience and links digitalisation, particularly in the public sector, to Kenya's historical context. As she points out, "how the country has advanced in the digital realm is not an accident, but the result of deep historical roots. In Kenya's case, these include the experience of colonialism and post-colonial governance, which, to date, are influenced by international development policies." The study furthermore finds a huge contrast in enforcement within the digital economy between Kenya and the EU, comparing four decisions to 144000 complaints and 1600 fines. (Mutung'u 2023) As Mutung'u accurately observes, "[t]he conditions in a country determine the extent to which individuals and groups can make use of mechanisms for access to justice."

Second, research methods based on identifying strategic action fields can assist in specifying the linkages between digital identity systems and the financial payments sector. (Fligstein and McAdam 2012) The body of knowledge around strategic action fields has

been built from the study of social movements and from that of markets. (Fligstein and Dauter 2007) It thus shares much with the tradition of political economy. As used here, a field is a relatively high-level term. The sociologists Fligstein and McAdam have articulated a theory of social change focusing on strategic action fields as the fundamental units of collective action in society.(Fligstein and McAdam 2012) In this analysis, [a] strategic action field is a meso-level social order where actors (who can be individual or collective) interact with knowledge of one another under a set of common understandings about the purposes of the field, the relationships in the field (including who has power and why), and the field's rules. In practice, fields are usually composed of incumbents, challengers, and governance units.

Two specific sector-level concepts prove relevant within this study of digital identity systems as a sector or a market and its linkage with the financial payments field.(Debos and Desgranges 2023) First, one acknowledged regulatory distinction is that between foundational and functional identity. An example of identification documents rooted in the field of registration and identity management would be a passport or an adult national ID cards. This is foundational identity. An example of identification documents rooted in the second-level field providing other official identification documents would be a driver's license. This is functional identity.

A second useful sector-level concept is that of identity verification, with which the DPI element of digital identity is often associated. Identity verification can be understood as a technical, standard. In the field of registration and identity management, it has the meaning of 'the process of confirming or denying that a claimed identity is correct by comparing the credentials (i.e., something you know, something you have, and something you are) of a person requesting access with those previously proven and stored on a card or in a system and associated with the identity being claimed.'(Harbitz and Kentala 2015, 46) This means that,

in identity verification, a token of identity (which might be a digital token or a biometric attribute or a physical document such as an ID card) is assessed (authenticated) in order to provide assurance and evidence to an institution that the identity asserted by the token-possessor is genuine. Once verified, an asserted identity can be authenticated as part of ongoing service delivery or party identification in transactions.

This function and this field is distinct from the field constituted by foundational and functional identification. When for instance a consular record of birth document and a series of family photographs taken at six-month intervals are both used as part of a foreign resident citizen child's application for a passport, both the use of consular record of birth and the resulting passport itself may be considered as part of the foundational identification field, while the age series of photographs was primarily an exercise of identity verification, verifying a particular individual and linking that individual to the two foundational identity documents.

PART FIVE: FOUR MODES OF VERIFIABLE IDENTITY ACROSS AFRICA

Across Africa, there are four different ideal-types visible in the sector of digital identity systems. These four categories are roughly constituted by two dimensions, each aligned along one of the strategic action fields of verifiable identity and of foundational and functional identity outlined above. Of course, this range of ideal-types is offered as a

heuristic and experimental scheme only. Moreover, a number of African countries fall outside of the ideal-types above.[5]

One category is the classic provision of public identity by a developed country in the Global North. Here, identity is normally verified by state agencies also providing civil registration and are in jurisdictions where foundational ID is an ordinarily used ID credential. South Africa may be on its own in this regard on the African continent. A second category is those nine African countries which are currently reported to be piloting and/or adopting MOSIP, the technological system that implements Aadhaar in India (or another variant). The official engagement with such non-core state provision of verifiable identity distinguishes this provision of foundational identity used as a central credential. The third and fourth categories are distinguished by the activity, governance, and firms in the foundational and functional identity field. In these African countries, an important distinction can be made between ordinarily used ID credentials linked to a core function close to the state – such as election registration or tax administration -- and thus relatively far from the core functions of the state – such as license to drive a motor vehicle or operate a telecommunications device or have and operate a bank account.

Classic Public Identity Provision

As the leading example in the first category, South Africa has on the whole built and maintained the infrastructure and legal/regulatory context to provide public identity sufficient

[5] African societies have several distinctive features by comparison with other societies engaging in the activities of public identity provision. One is comparatively globally low degrees of official coverage, whether of land or birth registration. This gives an African state interested in economic development relatively less leverage and fewer instruments with which to engage. A second is the colonial history and coercive character of many of the legacy identification systems across Africa. Such systems have arguably provoked active resistance as well as informal noncompliance. Their history complicates the uptake and use of these systems. A third is the need for access to credit among persons and small firms across Africa. This has driven growth within the field of financial transactions.

for most state services, as have arguably Namibia and Botswana. Despite rapid technological changes and processes of financialisation, neither the banks nor the telecommunications firms in such South African sectors have succeeded in breaking the monopoly of the Department of Home Affairs on civil registration and identity management.("Draft Official Identity Management Policy" 2020)

South Africa maintains a to-some-degree functional population register, one that is integrated to some degree with official government bureaucracy including civil registration. In contrast to apartheid's failures in this respect,(Breckenridge 2014b) South Africa's government has largely succeeded in rolling out public sector biometrically enabled identification to its population, albeit only from the 1980s.(Breckenridge 2014a) The population register supports service-providers in the functional areas of verifiable identity provision.[6] These areas include, crucially for South Africa, those of social protection and of financial transactions, credit checks, and payments. Where private firms play a significant role in this sector, they do so on the specified terms of the state. The operation of the private service provider VFS in the field of non-citizen visas and immigration control under the supervision of the Department of Home Affairs is an example of such partial private sector participation and operation in a field of functional identity.[7]

MOSIP Across Africa

The second category of public identity provision is comprised of African countries which are reported to be piloting and/or adopting the technological system that implements

[6] This level of support, or data exchange, is not generally provided by the national identity systems of other African countries, including for instance Uganda.

[7] An instance of routine competition authority scrutiny of a South African transaction involving in part an identity verification service provider is discussed below.

the India Stack or a similar system. The goal is to improve or ensure verifiable identity in a government-dominant context.

The leading technology in this category is the Modular Open-Source Identification Platform (MOSIP) associated with Aadhaar. In the OECD definitional distinction between digital public goods and digital public infrastructure, MOSIP is a prime example of a digital public good. Developed, supported, and governed in India, MOSIP has been marketed, in the wake of Aadhaar's development and implementation, as a developmental platform for running a national digital identity scheme and justified as a platform for avoiding vendor lock-in. By April 2023, seven African countries had signed up in one way or another for MOSIP: Morocco, Burkina Faso, Madagascar, Ethiopia, Togo, Guinea, and Sierra Leone. (Hersey 2023; Nash 2023) It is too early to argue that these investments are clearly destined for failure.

Outsourced Public Identity

The third category does not feature jurisdictions with reliable or consistent verifiable identity driven by the state or likely-to-succeed state-wide investments towards such an objective. In functional identity fields close to the core state function across Africa, such as voting registration and adult ID cards, service provision often consists of alliances between a private firm (nearly invariably a firm headquartered in the Global North) and a linked state institution or bureaucracy of an African jurisdiction. Often the private firms involved in these fields term their services as the provision of identity ecosystems.

In Cameroon, the launch of a programme to produce new biometric identity cards turned out to be a risky technological experiment. It has resulted in many nationals becoming "undocumented" in their own country and constitutes a civil identity crisis.(Eyenga, Mimboe,

and Bindzi 2022) The number of firms actually or potentially participating in the provision of public identity in Cameroon demonstrate the complex interactions that can take place in and among these fields.(Burt 2022; Eyenga, Mimboe, and Bindzi 2022)

Ghana similarly fits within this outsourced public identity category.(Thiel 2020) As of 2023, Gemalto and the Election Commission (Ghana) have an agreement to provide identity services (including voter registration) for elections administration. Elections administration is clearly a field close to the core of state legitimacy.(Debrah, Effah, and Owusu-Mensah 2019) While the activity in the field of identity verification is practically fully outsourced in the current arrangement, the state maintains some degree of control over the field of registration and identity management.

In Uganda, an abortive contract awarded to a South African firm in 2006 and the initial 2010 contract to a German firm (Muhlbauer) for the rollout of national identity cards were both accompanied by a raft of alleged procurement irregularities.("Chased Away and Left to Die: How a National Security Approach to Uganda's National Digital ID Has Led to Wholesale Exclusion of Women and Older Persons" 2021, 64) Authority originally sourced in an inter-ministerial committee and in the Ministry of Internal Affairs was given to an independent authority – the National Identification and Registration Authority (NIRA) by empowering statute only in 2015. In April 2023, a battle was joined between "giant firms" (Muhlbauer and Veridos) for a state contract to provide new biometric ID cards and played out in April 2023 on national television, with allegations of MPs being bribed. Enrollment for those cards is due to start in August 2023, with 19 million non-biometric ID cards printed (and 16 million collected).(A. Macdonald 2023a)

Financialised Public Identity

The fourth category of financialised public identity is perhaps the most globalized. In sub-fields such as telecommunications or financial transaction, an African-grown large firm often dominates the field of functional identity (including verifiable identity) and does so to such degree that it encroaches upon the state's domain of civil registration and identity management. Kenya (Safaricom) and Nigeria (MTN(Sutherland 2015)) are both arguably examples where a functional identity field of public identity provision enjoys a high level of influence over the state's registration and identity management field.

While it does not have anything like the size and power of Google and Facebook, Safaricom is an emerging markets-origin multi-national enterprise home-grown in Kenya. Safaricom is a giant within Kenya and East Africa and is currently aiming to move into Ethiopia.(Bloomberg n.d.) From its initial origins, it has used its monopoly power in telecommunications to expand into banking and credit.(Breckenridge 2019a; Robb and Vilakazi 2016) SafariCom's ownership structure and strategic partnerships draw in elites from across the political spectrum, with a consequential de facto immunity from competition. (Tyce 2020)

An example of the power and reach of SafariCom is evidenced in research several years ago on Kenya's identification ecosystem, research attuned to the dangers of exclusion and breaches of privacy.(Caribou 2019) This research mentions SafariCom 23 times and Facebook only 3 times in discussing SafariCom as Kenya's provider of a de facto digital credit "developmental ID" system co-existing but also competing with the preexisting national identity card and the later National Integrated Identity Management System (NIIMS). While Safaricom has grown, Kenya's public sector large technology project, NIIMS (also known as Huduma Namba), has suffered several technical and courthouse setbacks. In 2020, Kenya's High Court found that the implementation of NIIMS should not

continue without a “comprehensive and appropriate” regulatory framework (including a data protection law) in place to guarantee the security of biometric data and to ensure the system is not exclusionary.

Nigeria, like Kenya, is also best categorized as case of significant financialized ID. Under pressure from foreign donors and as an inaugural action, the country’s newly elected President has signed into law a data protection law.(| Ayang Macdonald 2023a; 2023b) While there is no one clear ID provider, the market is evolving quickly, with some of the same contours as Kenya’s, in particular significant involvement of telecommunications providers and of traditional banks.

PART SIX: A COMPETITION/INFRASTRUCTURAL/INVESTMENT LENS ON DIGITAL PUBLIC INFRASTRUCTURE INITIATIVES

The Overlap Between Competition and Infrastructural Lock-In

The section above defining the core concept of digital public infrastructure noted the distinction made between digital public infrastructure and digital public goods. In addition to assisting in defining a digital public infrastructure, this distinction and its rationale is important for another reason. The OECD’s insistence on the open nature of digital public goods points us to an important underlying policy concern with digital public infrastructures: the high costs of switching among infrastructures and the associated problematic of lock-in.

The problematic of lock-in in disciplines (such as information systems) focused on infrastructure may be interpreted as an equivalent for the problematic of competition in the social sciences.(Macmillan, Paelo, and Paremoer 2016) For instance, Breckenridge used the concept of lock-in to describe two of the four significant competitive moments in his

contemporary history of the South African identity and payments firm, Net1.[8](Breckenridge 2019b) Indeed, scholars explicitly concerned with the industrial policy/competition policy interface have made the same point as the OECD did – noting practices and system features such as open standards and interoperability as solutions for anti-competition structures. (Andreoni and Roberts 2022, 1449)

From a competition economics perspective, the infrastructural lock-in phenomenon manifests in two features. The one use is the tethering and shepherding of a large group of consumers using a technological system (such as Net1's smart cards). This aspect plays out in the analytical economics literature in a number of ways, including through a network effect due to this large number.(Farrell and Klemperer 2007) The other use of lock-in in the infrastructure disciplines is referring to the relative difficulty or even inability of consumers to switch between networks (including digital platforms). Here, the primary difficulty of switching – of multi-homing – is in most situations exacerbated by network effects. Today's platform corporations such as Google or Amazon provide examples of infrastructural lock-in in their digital platforms and associated multi-sided markets.(Andreoni and Roberts 2020) Taken together, these two features show the anti-competitive potential of digital infrastructure -- scaling up the provision of public identity can increase lock-in.

However, at least in the African context, attention to the political economy surrounding this sociotechnical structure shows that it is necessary to go beyond pure competition policy and explicitly appreciated in two senses an infrastructural mode of

[8] First, the firm's founder, initially working with a consortium of banks, realized the niche value in a country like South Africa without extensive bank account linking infrastructure of a payment system through cards with chips storing consumer's information. The resulting company grew large and listed on the American stock exchange as well as in South Africa. Second, bumping up against a glass ceiling in the form of opposition from the international cartel-like structure consisting of Visa and Mastercard, Net1 was forced to give up its global aspirations.

thinking when considering lock-in, and thus also when considering competition in the underlying fields.[9]

The first sense of this infrastructural mode of thinking is to take explicit note of the degree of cooperation and the degree of competition residing within the infrastructure as it is constructed. In the study of digital identity systems, Aaron Martin is moving towards this way of thinking in two ways. The first is when he notes first that "the growing influence of Aadhaar outside of India forces us to rethink the North-South dynamic that is implicit in [David] Lyon's (2009) notion of card cartels". The second is when he points out that "the growth of industry opportunity around Aadhaar could itself represent a new kind of cartel."(Martin 2021, 104)

Martin is right to point to the anti-competitive potential of the MOSIP initiative. Nonetheless, it is worth noting that the same global power configuration – the card cartel -- that bested the South African biometrics payment firm Net1 in the 1990s(Breckenridge 2019b) may now be curbing MOSIP's spread. The Hindustan Times reported in April 2023 that people engaged in negotiations within the G20 framework said "developed countries had been less willing [than e.g. Singapore] to sign on for India's DPI for a variety of reasons, ranging from pushback from global payment processors such as Visa and Mastercard and knotty issues pertaining to governance."(Laskar and Jayaswal 2023)

In the second sense of infrastructural thinking about lock-in (and thereby also about its equivalent competition), lock-in is not simply a technical or organisation situation linking customers or users to a technological platform, although that is part of the concept. And it is

[9] "Thinking infrastructurally typically entails understanding infrastructure not simply as a thing, but as a set of relations, processes and imaginations. One well-established approach brings together in infrastructural thinking the technical (the designed and engineered physical and software elements), the social (the human and non-human actants in their intricate relations), and the organisational (the forms of entity, regulatory arrangements, financing, inspection, governance, etc.). It is only possible to understand the processes of infrastructure, and the consequences or potential of any intervention in infrastructure, by fully exploring each of these and their joint interactions and effects." (Kingsbury, 2019, p. 179)

more than the two dynamic effects (discussed above) to which that term is directed in economics literature.

A second sense of infrastructural thinking can pick up a historical/cultural element such as may be specific to public identity infrastructure across Africa. The sensibility and that element are this. In infrastructural thinking as demonstrated in the work of Benedict Kingsbury, the examples of infrastructure most often "are of infrastructure enabling and organising flows." Digital platforms, at least at the global scale are examples of this type of infrastructure, where the platform corporations each occupy their own public monopoly niche and are less interested in countering other firms and more interested in scaling up their operation. Here, infrastructure is aligned with cooperation.

However, as Kingsbury continues, "[b]ut infrastructure may also be designed to block or channel (the US–Mexico Border wall/fence/gaps, or Hadrian's Wall), it may have the effect of constructing vulnerable chokepoints in local or global flows, and all over the world public discussion of infrastructure is often about the non-designed obstructions, bottlenecks, overloading and intermittencies of infrastructure."(Kingsbury 2019, 183) This is often the case in the Africa.(Beeckmans 2022; Melly 2017)

This dimension of infrastructure as bottleneck and the cultural element it references has been employed in a study set within the South African digital identity system. As Breckenridge was arguing in his case study, the volatility and power of lock-in in the digital infrastructure then operated by NET1 (revealed in the sequence of dramatic face-offs at the Constitutional Court) draws a portion of its power directly from dilapidated and inadequate alternative physical infrastructures then (and still) available to the largely rural and locked-in set of customers then served by NET1.(Breckenridge 2019b, 97) This is a generalizable insight in the African context.[10]

[10] (Kingsbury 2019, 184) "Taking examples from Bengaluru, and also the long-delayed Narita Airport near Tokyo, Akhil Gupta persuasively puts in question the temporality in which infrastructure is designed, constructed and inaugurated at a ribbon-cutting by politicians. He accents instead the long-non-completed, the

To some extent, the value-add of the mapping undertaken in this article is straightforward; it assists in evaluating the costs and benefits (always a contested exercise itself) of investments in digital public infrastructure. Adding political economy into a sociotechnical analysis of digital identity systems across Africa assists in providing a framework to answering the key question faced by numerous jurisdictions across Africa of whether to use public resources to build a digital public infrastructure. Such a framework allows public and private actors to approach, as Andreoni and Roberts put it, 'the policy challenge posed by the rising digital platform economy [with] an industrial policy perspective into which competition policy is integrated as a way of refocusing the policy discussion. (Andreoni and Roberts 2022, 1444)

On the whole, the sociotechnical and political economic perspective elaborated in this article is one that encourages investment in public infrastructure. Infrastructures across Africa are inadequate to respond to the needs of the citizens and residents of various jurisdictions. As the South African example demonstrates, this stems from underinvestment as well as from lack of maintenance.(Watermeyer and Phillips 2020) The provision of verifiable identity, which is a key attribute to both the formal economy and to the rule of law, deserves public support. And that policy support 'includes ensuring investment in the necessary digital infrastructure and data centres.'(Andreoni and Roberts 2022, 1448) Alluding to changes within competition policy in advanced economies responding to the rise of digital markets, Andreoni and Roberts argue that '[i]t is essential that the rethinking on

'ruins' of perpetual construction and debris, and the ruins of obsolete infrastructure (sometimes repurposed). Non-achieved or uncompleted infrastructure is often linked to underlying property rights (legal or protesting prevention of expropriation) or to finance problems; and 'law reform' in many countries has been about overcoming these."

competition law and policies is combined with digital industrial policies for investment in basic and intermediate digital capabilities and broader access to high-quality digital infrastructures.'(Andreoni and Roberts 2022, 1450)

The necessary warning here is that public investments in enabling technologies can become captured by private interests. Investment in public infrastructures has been the topic of debate in the context of digital technologies.(Andreoni and Roberts 2022) On one side, the economist Teece argues that "technological and innovational complementors present both coordination and market design challenges to the innovator that generally lead to market failure in the form of an excess of social over private returns. The low private return leads to socially sub-optimal underinvestment in future R&D that can be addressed to some extent by better strategic decision-making by the innovator and/or by far-sighted policies from government and the judiciary."(Teece 2018) Countering, the sociologist Nelson highlights "the roles of different institutional actors in [the technological advancement] community, which generally involves actors from universities and in many cases from government, as well as from business, and in particular the roles that government programs play in shaping how the community works."(Nelson 2018)

A perspective drawing on industrial and competition policy will of course not play out uniformly in the jurisdictions discussed in this article. While competition policy is spreading quickly not in a uniform Africa but rather across the diversity of jurisdictions and contexts on the continent, significant policy and enforcement gaps as well as blockages exist.(Fox and Bakhoum 2019) Nonetheless, regional structures coordinating African competition policy in the digital space are fast-developing. For instance, competition authorities from Egypt, Kenya, Mauritius, Nigeria and South Africa announced a joint working plan in February 2022. And, while industrial policy is arguably more suited for middle-income than lower-income states, it is also a perspective that can be integrated into regional policy discussions.

(Boys and Andreoni 2023) Such regional frameworks have been significant in the emergence of African regulatory capitalism.(Klaaren 2021)

PART SEVEN: CONCLUSION

This paper has mapped out the African landscape of digital identity systems and drawn two interrelated policy prescriptions – that the effects of proposed changes such as DPI to these digital identity systems on the competitive dynamics and infrastructural lock-in features of these systems be assessed in detail and that the costs and benefits of those effects be carefully evaluated from the perspective of digital industrial policy. Other significant regulatory and policy implications – such as the importance of pursuing privacy rights and data protection principles in an integrated fashion across the digital identity and the financial payments sectors or the fit of particular regulatory strategies to the problematics of digital identity systems – remain to be explored.(McCallum and Aziakpono 2023)

REFERENCES

Andreoni, Antonio, and Simon Roberts. 2020. "Governing Data and Digital Platforms in Middle Income Countries: Regulations, Competition and Industrial Policies, with Sectoral Case Studies from South Africa." https://pathwayscommission.bsg.ox.ac.uk/Governing-data-and-digital-platforms-in-middle-income-countries.

———. 2022. "Governing Digital Platform Power for Industrial Development: Towards an Entrepreneurial-Regulatory State." *Cambridge Journal of Economics* 46 (6): 1431–54. https://doi.org/10.1093/cje/beac055.

Beeckmans, Luce. 2022. "Caroline Melly. Bottleneck: Moving, Building, & Belonging in an African City. Chicago: University of Chicago Press, 2017. References. Index. $32.00. Paper. ISBN: 978-0-226-48890-5." *African Studies Review* 65 (3): E54–56. https://doi.org/10.1017/asr.2022.61.

Behuria, Pritish, Lars Buur, and Hazel Gray. 2017. "Studying Political Settlements in Africa." *African Affairs* 116 (464): 508–25. https://doi.org/10.1093/afraf/adx019.

Bhattacharya, Amar, Margaret Biggs, Matthew Bishop, Caren Grown, George Ingram, Homi Kharas, John W Mcarthur, et al. 2023. “Ideas for Doing Things Differently.” Brookings.
Bloomberg. n.d. “Safaricom Likely to Borrow to Fund Ethiopia Telecom Bid.” Daily Maverick. Accessed February 20, 2020. https://www.dailymaverick.co.za/article/2020-02-19-safaricom-likely-to-borrow-to-fund-ethiopia-telecom-bid/.
Boys, Julian, and Antonio Andreoni. 2023. “Does Regionalism Increase Industrial Policy Space? An Analytical Framework Applied to the East African Textiles and Apparel Sector.” *Third World Quarterly* 0 (0): 1–19. https://doi.org/10.1080/01436597.2023.2211009.
Breckenridge, Keith. 2014a. *Biometric State*. Cambridge University Press.
———. 2014b. “The Book of Life: The South African Population Register and the Invention of Racial Descent, 1950-1980.” *Kronos* 40 (1): 225–40.
———. 2019a. “The Failure of the ‘Single Source of Truth about Kenyans’: The NDRS, Collateral Mysteries and the Safaricom Monopoly.” *African Studies* 78 (1): 91–111. https://doi.org/10.1080/00020184.2018.1540515.
———. 2019b. “The Global Ambitions of the Biometric Anti-Bank: Net1, Lockin and the Technologies of African Financialisation.” *International Review of Applied Economics* 33 (1): 93–118. https://doi.org/10.1080/02692171.2019.1523836.
———. 2021. “What Happened to the Theory of African Capitalism?” *Economy and Society* 50 (1): 9–35. https://doi.org/10.1080/03085147.2021.1841928.
———. n.d. “The World’s First Biometric Money: Ghana e-Zwich and the Contemporary Influence of South African Biometrics.” *Africa* 80 (4): 642–62.
Burt, Chris. 2022. “Web of Connected Players Could Complicate Cameroon’s Biometric ID Card Tender: Report.” March 16, 2022. https://www.biometricupdate.com/202203/web-of-connected-players-could-complicate-cameroons-biometric-id-card-tender-report.
Caribou. 2019. “Kenya’s Identity Ecosystem.” Commonwealth Digital ID Initiative.
“Chased Away and Left to Die: How a National Security Approach to Uganda’s National Digital ID Has Led to Wholesale Exclusion of Women and Older Persons.” 2021. Center for Human Rights and Global Justice. https://chrgj.org/wp-content/uploads/2021/06/CHRGJ-Report-Chased-Away-and-Left-to-Die.pdf.
Cramer, Christopher, John Sender, and Arkebe Oqubay. 2020. *African Economic Development: Evidence, Theory, and Policy*. Oxford University Press.
Dattani, Kavita. 2020. “‘Governtrepreneurism’ for Good Governance: The Case of Aadhaar and the India Stack.” *Area* 52 (2): 411–19. https://doi.org/10.1111/area.12579.
Debos, Marielle, and Guillaume Desgranges. 2023. “L’invention d’un marché : économie politique de la biométrie électorale en Afrique.” *Critique internationale* 98 (1): 117–39. https://doi.org/10.3917/crii.098.0117.
Debrah, Emmanuel, John Effah, and Isaac Owusu-Mensah. 2019. “Does the Use of a Biometric System Guarantee an Acceptable Election’s Outcome? Evidence from Ghana’s 2012 Election.” *African Studies* 78 (3): 347–69. https://doi.org/10.1080/00020184.2018.1519335.
“Draft Official Identity Management Policy.” 2020. Department of Home Affairs. https://www.gov.za/sites/default/files/gcis_document/202101/44048gon1425.pdf.

Dubash, Navroz K., and Bronwen Morgan. 2012. “Understanding the Rise of the Regulatory State of the South.” *Regulation & Governance* 6 (3): 261–81. https://doi.org/10.1111/j.1748-5991.2012.01146.x.
Eaves, David, Richard Pope, and Ben McGuire. 2019. “Government as a Platform: How Policy Makers Should Think about the Foundations of Digital Public Infrastructure.” *Kennedy School Review* 19: 126–31.
Effah, John, and Emmanuel Owusu-Oware. 2021. “From National to Sector Level Biometric Systems: The Case of Ghana.” *Information Technology for Development* 27 (1): 91–110. https://doi.org/10.1080/02681102.2020.1818543.
Eyenga, Georges Macaire, Gaëtan Omgba Mimboe, and Joseph Fabrice Bindzi. 2022. “Être sans-papiers chez soi ? Les mésaventures de l’encartement biométrique au Cameroun.” *Critique internationale* 97 (4): 113–34.
Farrell, Joseph, and Paul Klemperer. 2007. “Chapter 31 Coordination and Lock-In: Competition with Switching Costs and Network Effects.” In *Handbook of Industrial Organization*, edited by M. Armstrong and R. Porter, 3:1967–2072. Elsevier. https://doi.org/10.1016/S1573-448X(06)03031-7.
Fligstein, Neil, and Luke Dauter. 2007. “The Sociology of Markets.” *Annual Review of Sociology* 33 (1): 105–28. https://doi.org/10.1146/annurev.soc.33.040406.131736.
Fligstein, Neil, and Doug McAdam. 2012. *A Theory of Fields*. Oxford University Press, USA.
Fox, Eleanor M., and Mor Bakhoum. 2019. *Making Markets Work for Africa: Markets, Development, and Competition Law in Sub-Saharan Africa*. Oxford University Press.
Harbitz, Mia, and Kristo Kentala. 2015. *Dictionary for Civil Registration and Identification*. Washington DC: Inter-American Development Bank.
Hersey, Frank. 2023. “MOSIP Registrations Pass 76M, Burkina Faso Partners for Pilot with More in Pipeline | Biometric Update.” January 5, 2023. https://www.biometricupdate.com/202301/mosip-registrations-pass-76m-burkina-faso-partners-for-pilot-with-more-in-pipeline.
Khan, Mushtaq, and Pallavi Roy. 2019. “Digital Identities: A Political Settlements Analysis of Asymmetric Power and Information.” Anti-Corruption Evidence 15. https://ace.soas.ac.uk/wp-content/uploads/2022/05/ACE-WorkingPaper015-DigitalIdentities-191004.pdf.
Kingsbury, Benedict. 2019. “Infrastructure and InfraReg: On Rousing the International Law ‘Wizards of Is’*.” *Cambridge International Law Journal* 8 (2): 171–86. https://doi.org/10.4337/cilj.2019.02.01.
Klaaren, Jonathan. 2021. “The Emergence of Regulatory Capitalism in Africa.” *Economy and Society* 50 (1): 100–119. https://doi.org/10.1080/03085147.2021.1841934.
Laskar, Rezaul H, and Rajeev Jayaswal. 2023. “G7 States Adopt Cautious Approach to India’s Push for Digital Public Infra.” *Hindustan Times*, April 13, 2023. https://www.hindustantimes.com/india-news/indias-digital-public-infrastructure-dpi-gains-more-interest-from-developing-countries-despite-pushback-from-g7-states-says-report-101681327576846.html.
Macdonald, | Ayang. 2023a. “Agency to Engage New Nigerian Govt on Passage of Delayed Data Protection Bill | Biometric Update.” June 6, 2023. https://www.biometricupdate.com/202306/agency-to-engage-new-nigerian-govt-on-passage-of-delayed-data-protection-bill.
———. 2023b. “Nigeria Now Has a Data Protection Legislation after Years of Back and Forth | Biometric Update.” June 15, 2023.

https://www.biometricupdate.com/202306/nigeria-now-has-a-data-protection-legislation-after-years-of-back-and-forth.
Macdonald, Ayang. 2023a. “Uganda New ID Plans Reportedly Stalled; 3M Current Cards Unclaimed.” April 20, 2023. https://www.biometricupdate.com/202304/uganda-new-id-plans-reportedly-stalled-3m-current-cards-unclaimed.
———. 2023b. “Stakeholders Examine Benefits of Digital Public Infrastructure at IMF Meeting.” April 21, 2023. https://www.biometricupdate.com/202304/stakeholders-examine-benefits-of-digital-public-infrastructure-at-imf-meeting.
Macmillan, Rory, Anthea Paelo, and Tamara Paremoer. 2016. “The ‘Evolution’ of Regulation in Uganda’s Mobile Money Sector.” *The African Journal of Information and Communication*, no. 17 (December): 89–110. https://doi.org/10.23962/10539/21627.
Martin, Aaron. 2021. “Aadhaar in a Box? Legitimizing Digital Identity in Times of Crisis.” *Surveillance & Society* 19 (1): 104–8. https://doi.org/10.24908/ss.v19i1.14547.
McCallum, Wendy, and Meshach J. Aziakpono. 2023. “Regulatory Sandbox for FinTech Regulation: Do the Conditions for Effective Adoption Exist in South Africa?” *Development Southern Africa* 0 (0): 1–17. https://doi.org/10.1080/0376835X.2023.2182759.
Melly, Caroline. 2017. *Bottleneck: Moving, Building, and Belonging in an African City*. University of Chicago Press.
Mutung’u, Grace. 2023. “Checking the Power of Technology Business in Public Roles through Strategic Litigation: Case Examples from Kenya.” *Javnost - The Public* 30 (2): 236–52. https://doi.org/10.1080/13183222.2023.2201796.
Nash, | Jim. 2023. “Togo Brings in Atos and Idemia to Build National Digital ID Program | Biometric Update.” June 1, 2023. https://www.biometricupdate.com/202306/togo-brings-in-atos-and-idemia-to-build-national-digital-id-program.
Nelson, Richard R. 2018. “Observations and Conjectures Stimulated by David Teece’s ‘Profiting from Innovation in the Digital Economy….’” *Research Policy* 47 (8): 1388–90. https://doi.org/10.1016/j.respol.2017.11.012.
Nyst, Carly, Steve Pannifer, Edgar A. Whitley, and Paul Makin. 2016. “Digital Identity: Issue Analysis.” Consult Hyperion for Omidyar Network. http://www.chyp.com/wp-content/uploads/2016/07/PRJ.1578-Digital-Identity-Issue-Analysis-Report-v1_6-1.pdf.
OECD. 2021. *Development Co-Operation Report 2021: Shaping a Just Digital Transformation*. Development Co-Operation Report. OECD. https://doi.org/10.1787/ce08832f-en.
OpenID. 2023. “Draft Report: Government-Issued Digital Credentials and the Privacy Landscape.” OpenID. https://openid.net/wordpress-content/uploads/2023/04/DRAFT-Government-issued-Digital-Credentials-and-the-Privacy-Landscape-publiccomment.pdf.
Robb, Genna, and Thando Vilakazi. 2016. “Mobile Payments Markets in Kenya, Tanzania and Zimbabwe: A Comparative Study of Competitive Dynamics and Outcomes.,” December. https://doi.org/10.23962/10539/21630.
Roitman, Janet. 2023. “Platform Economies: Beyond the North-South Divide.” *Finance and Society* 9 (1): 1–13. https://doi.org/10.2218/finsoc.8089.
Sandman, Jordan, and David Eaves. 2023. “What Is Digital Public Infrastructure?” *UCL IIPP Blog* (blog). April 5, 2023. https://medium.com/iipp-blog/what-is-digital-public-infrastructure-6fbfa74f2f8c.

Schoemaker, Emrys, Aaron Martin, and Keren Weitzberg. 2023. “Digital Identity and Inclusion: Tracing Technological Transitions.” *Georgetown Journal of International Affairs* 24 (1): 36–45. https://doi.org/10.1353/gia.2023.a897699.

Straaten, Jaap van der. 2023. “Twenty Years of Peace in Liberia. Will It Last?” *Bhalisa*. https://app.box.com/s/jlh8n80mh9o2nw762q5m771h3j9tzj4a.

Sutherland, Ewan. 2015. “MTN: A South African Mobile Telecommunications Group in Africa and Asia.” *Communicatio* 41 (4): 471–505. https://doi.org/10.1080/02500167.2015.1100645.

Teece, David J. 2018. “Profiting from Innovation in the Digital Economy: Enabling Technologies, Standards, and Licensing Models in the Wireless World.” *Research Policy* 47 (8): 1367–87. https://doi.org/10.1016/j.respol.2017.01.015.

Thiel, Alena. 2020. “Biometric Identification Technologies and the Ghanaian ‘Data Revolution.’” *The Journal of Modern African Studies* 58 (1): 115–36. https://doi.org/10.1017/S0022278X19000600.

Tyce, Matthew. 2020. “Beyond the Neoliberal-Statist Divide on the Drivers of Innovation: A Political Settlements Reading of Kenya’s M-Pesa Success Story.” *World Development* 125 (January): 104621. https://doi.org/10.1016/j.worlddev.2019.104621.

Watermeyer, Ron, and Sean Phillips. 2020. “Public Infrastructure Delivery and Construction Sector Dynamism in the South African Economy.” Final Report. National Planning Commission. https://www.nationalplanningcommission.org.za/assets/Documents/Public%20infrastructure%20delivery%20and%20construction%20sector%20dynamism%20in%20the%20South%20African%20economy.pdf.

Whitfield, Lindsay, Ole Therkildsen, Lars Buur, and Anne Mette Kj’r. 2015. *The Politics of African Industrial Policy: A Comparative Perspective*. Cambridge University Press.

Whitley, Edgar A., and Emrys Schoemaker. 2022. “On the Socio-Political Configurations of Digital Identity Principles.” *Data & Policy*, October. https://eprints.lse.ac.uk/116874/.