

This PDF is a selection from a published volume from the National Bureau of Economic Research

Volume Title: Economic Analysis and Infrastructure Investment

Volume Authors/Editors: Edward L. Glaeser and James M. Poterba, editors

Volume Publisher: University of Chicago Press

Volume ISBNs: 978-0-226-80058-5 (cloth),
978-0-226-80061-5 (electronic)

Volume URL:

<https://www.nber.org/books-and-chapters/economic-analysis-and-infrastructure-investment>

Conference Date: November 15-16, 2019

Publication Date: November 2021

Chapter Title: Comment on "Digital Infrastructure"

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Chapter URL:

<https://www.nber.org/books-and-chapters/economic-analysis-and-infrastructure-investment/comment-digital-infrastructure>

Chapter pages in book: p. 448 – 452

Comment Catherine Tucker

Chapter 8 is a very useful summary of the existing literature on digital infrastructure. There are some key highlights to the piece. You learn a lot about the history and technology underlying the internet such as root servers, fiber, broadband lines, networking switches and routers, content delivery networks, cloud facilities, and cellular towers. There are also intriguing pieces of data, such as that in 2018, 2 percent of US households still use dial-up. In general, chapter 8 highlights two factors that have held up the literature. First is the lack of convincing sources of exogenous variation that would allow an economist to measure the effects of digital infrastructure on outcomes. Second is that the literature has focused on broadband without much thought about additional technologies such as content distribution networks, cellular technologies, and cloud computing. The cloud added approximately \$214 billion in value-added to US GDP in 2017. The cloud added approximately 2.15 million jobs in 2017. In approximately 15 years since 2002, the cloud economy has nearly tripled in size. And yet it has been vastly understudied in economics. This useful summary helps frame and guide the forthcoming literature on this topic.

However, I want to focus my discussion on a passage in the chapter that reads as follows:

To close, consider this provocative question: Is Wikipedia digital infrastructure? Its ubiquity suggests it ought to be treated as such. . . . The Wikipedia example epitomizes the open questions of this topic: What is and is not infrastructure when public funding is absent? Where are the boundaries of public and private when the private infrastructure contains properties similar to public goods? Can something be called infrastructure merely if it is shared, inexpensive, nonexclusive, and seemingly essential? Is the source—either public or private—relevant to the economics or virtually irrelevant?

This strikes me as a very useful framing of a potentially large and looming question. Economists studying digital infrastructure have tended to focus on the wires, and physical manifestations of that infrastructure. However, a novel question that the chapter highlights is that perhaps platforms have actually become one of the most pressing digital infrastructure issues.

This topic is already being discussed in the popular press. For, example, a recent article in the *New York Times Magazine* reads:

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For acknowledgments, sources of research support, and disclosure of the author's material financial relationships, if any, please see <https://www.nber.org/books-and-chapters/economic-analysis-and-infrastructure-investment/comment-digital-infrastructure-tucker>.

All this is to say that a sufficiently successful social platform is experienced, much like Uber, as a piece of infrastructure. Except, instead of wrapping its marketplace around a city's roads, Facebook makes a new market around communication, media and civil society. This, from a founder's perspective, is an electrifying outcome. But this cultural metastasis has led to a swift and less-than-discriminate backlash. Already, calls for regulating the largest internet platforms are growing louder while remaining tellingly vague.¹

The 2020 pandemic has also led journalists to argue that Amazon fulfilled the role of a public utility and so should be treated like one.² However, it is notable that much of this discussion of infrastructure and public utilities with relationship to large technology platforms is really a call for either more regulation or antitrust action. This is already a debate among law scholars. Rahman (2018) has argued that digital platforms such as Google, Facebook, and Amazon are the core infrastructure of our twenty-first-century economy and public sphere.

It strikes me that economists have much that is useful to say about this debate that we have not yet engaged with. In particular, our research can help answer key questions:

- Do platforms meet the definition of infrastructure as economists use the term?
- What does our experience with making various parts of infrastructure public and then returning them to the private sector teach us about optimal conditions for public or private governance of digital infrastructure?

Are economists' definitions of infrastructure useful for this task? My impression is that the answer is no. Instead, most definitions have a "you know it when you see it" flavor, and focus on the idea that it is self-evident that something is infrastructure, as highlighted in chapter 1 in this volume, by Bennett, Kornfeld, Sichel, and Wasshausen:

We begin with the challenging question of how to define "infrastructure." Defining the economic boundaries of infrastructure is imprecise and somewhat subjective. We consider three broad categories of infrastructure that can gauge different aspects of infrastructure from a National Economic Accounts standpoint. "Basic" infrastructure (such as transportation and utilities) reflects a traditional definition of infrastructure. From there, we expand that core to include additional economic activity

1. John Herrman, "What If Platforms Like Facebook Are Too Big to Regulate?," *New York Times Magazine*, October 4, 2017.

2. See, for example, Wendy Liu, "Coronavirus Has Made Amazon a Public Utility—So We Should Treat It Like One," *Guardian*, April 17, 2020.

that would potentially be included in infrastructure, including social and digital infrastructure.

Therefore it is not clear to me that economists are going to be helpful for determining a precise definition and whether something like the Amazon or Uber platform would qualify. Economics is helpful, however, in understanding the underlying characteristics that digital platforms share with entities that are commonly thought of as infrastructure and understanding them through an economics lens.

Initially in the language of network effects or two-sided platforms, economists viewed the key challenges for businesses as being able to attract sufficient numbers of users. This is the focus of the early literature on digital platforms and allowed us to understand that essentially the key property of what may or may not be a digital platform is whether or not there are significant network effects. Given this early focus, it might be simple to dismiss the argument that platforms resemble infrastructure such as utilities or railroads as being related to arguments surrounding natural economies of scope or scale, which suggest that there will be only one platform that succeeds at any one point in the market.

However, I would argue that this analogy is not particularly accurate. Increasingly, digital markets are not characterized by there being only one platform or means of achieving a certain goal. If I am an advertiser, I have multiple platforms to choose to use, for example, to reach a potential consumer. As a ride-sharing user, I also have multiple platforms to choose between. Instead, in this essay I argue that the temptation to claim that digital platforms reflect digital infrastructure instead reflects the degree of governance platforms themselves impose on their users.

To initiate some of this debate, I want to introduce a term from the classroom that we use to describe one of the key challenges of building a platform and relate it back to the infrastructure debate. In the classroom, I introduce students to the idea of “coring” of platforms. “Coring” was initially introduced as a term to describe the idea that platforms need to ensure that their technology is at the “core” of interactions. The idea was that if a platform-controlled technology was not at the “core” of the interaction within the platform, then the platform risked losing control of that transaction. For example, if a real estate platform could not ensure that buyers and sellers used its technologies to execute real estate transactions, then it would risk losing control of the market (Gawer and Cusumano 2008).

However, since the early 2000s when this concept was introduced, the nature of digital platforms has changed. As a result of all the shifts documented in chapter 8, hardware and its technological manifestations have become less important. As a result, if platforms are to ensure that transactions or interactions take place on the platform, they have to erect steps

around governance that provide incentives for transactions to stay on the platform. The way I describe this in the classroom is that ultimately as a platform your major job is to make sure interactions on your platform do not just happen but also go well. This requires relinquishing a technical mindset and adopting the mindset of a government or police officer to put into place the right incentives for successful interactions. And it is the mindset that these platforms have to take on governance tasks that I think has led commenters to argue that the platforms are infrastructure.

Examples of “coring” are the erection of huge and complex rating systems that give insight into the likely unobserved quality of platform participants. These have been a key part of the literature on the underlying infrastructure of digital platforms in digital economics. Notable examples include Fradkin et al. (2015); Nosko and Tadelis (2015); and Tadelis (2016). As well as being notable in general, these examples are notable in particular for the fact that they reflect the work of economists at large technology platforms trying to set up optimal incentive systems for reputation systems using the classic tools of economics. Other examples of coring are constraints on who can use the platform and attempts to make sure that antisocial behavior by one user of the platform does not have negative spillovers for other users.

It is useful to recognize that just because something is “infrastructure” does not imply that governments should control that infrastructure or regulate access to this infrastructure. There are parallels here too with the early development of internet infrastructure that chapter 8 highlights. That digital infrastructure has “happened” swiftly, with very little government intervention. Furthermore, the US pathway for decentralized digital infrastructure has dominated worldwide. This has led to cries from non-US governments to have more control over underlying internet protocols. Similar, the recent increase in the importance of platforms have led non-US governments to seek to potentially intervene and gain more control.³ In other words, chapter 8’s question, whether digital platforms are infrastructure, sets up one of the most crucial technology policy debates of our time.

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