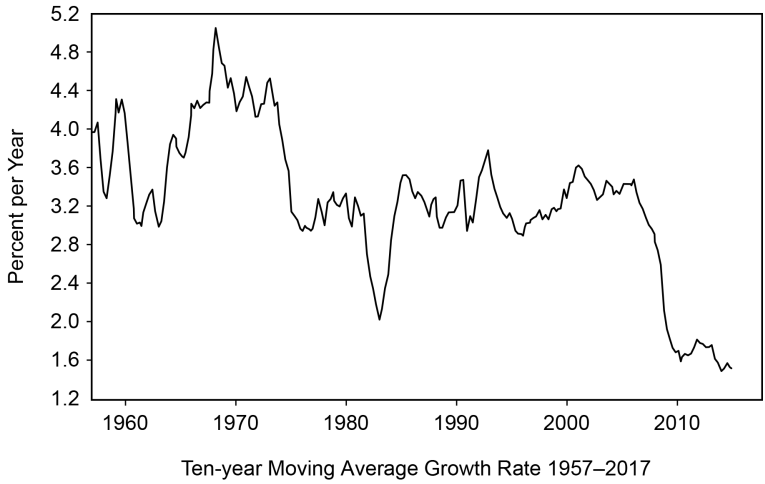

Fig. 1C.1 Real GDP growth in the United States remains below pre–Great Recession rates.
Source: Taylor (2017).

Comment Peter Blair Henry

Introduction

It is a pleasure to discuss this essay. There may be a few people in the country who know more about the Bureau of Economic Analysis' national income accounts than Bennett, Kornfeld, Sichel, and Wasshausen, but as I am not one of those people, my comments will be accordingly modest. I applaud the authors for taking on the issue of infrastructure measurement, and I thank the organizers for commissioning the piece. The topic of US infrastructure is an important one, but it tends to receive more heat than light, and this essay provides a step in the direction of correcting that imbalance.

Figure 1C.1 illustrates the proximate cause of the most recent instance of that imbalance. Even before the onset of COVID-19 and its cataclysmic impact on employment, incomes, and output, the growth rate of the US economy had been below its historical average since the Great Recession.

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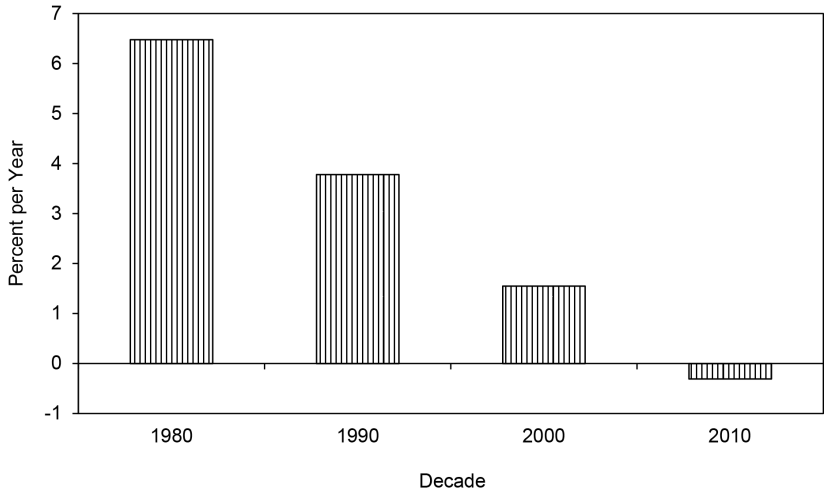

Fig. 1C.2 The average five-year real Treasury rate has declined over the past four decades.
Source: Hall (2017).

Declining productivity growth and the absence of structural reforms in the US have reduced expectations about the growth rate of potential output, reinforcing the slowdown in demand—especially for fixed investment—in spite of persistent, record-low real interest rates (figure 1C.2) and a reduction in corporate taxes, igniting fears of secular stagnation, and leading to advocacy for increased infrastructure spending as a way out of the slowdown (for example, Summers 2013).

Advocacy for greater investment in US infrastructure has a cyclical history dating back to a once-influential article by Aschauer (1989), which found that increases in the public capital stock (a proxy for infrastructure) had a large impact on output. Aschauer estimated that the elasticity of GDP with respect to public capital was 0.39, and argued that much of the US productivity slowdown in the 1970s was the result of reduced infrastructure investment. American policy makers seized on Aschauer's work as justification for higher levels of infrastructure spending (Rohatyn 1992; US Conference of Mayors 1992). Economists, in turn, pushed back.

Specifically, Munnell (1992) argues that Aschauer's estimates of the impact of aggregate infrastructure investment on output are implausibly large, even while acknowledging that investment in public capital has a positive and significant impact on growth. Gramlich (1994) is even more skeptical, finding, at best, mixed evidence that the US suffers from a shortage of infrastructure. Indeed, Gramlich's warning that the surfeit of interest in US infrastructure in the 1990s was out of proportion to its importance for long-run growth rings relevant at a time when talk of secular stagnation in

this country has triggered yet another surge (Eichengreen 2015; Gordon 2015; and Summers 2015).

The central contribution of the chapter by Bennett, Kornfeld, Sichel, and Wasshausen is that it increases the ratio of facts to advocacy in the context of US infrastructure. The essay does so by breaking infrastructure into three types (basic, social, and digital), giving us three categories of observations (trends, adequacy, and methodology), reaching modest conclusions, and providing some suggestions for future research. The chapter is replete with tables (eight) and figures (49) that provide a wealth of information about infrastructure stocks and flows that researchers interested in this area will find valuable as they build on the authors' contribution. Rather than trying to cover everything the chapter does—and it does a lot—I will focus my discussion on two areas.

First, I will provide some context for the broad trends presented by the authors and explain why the data work in which they are engaged is so important, especially in a digital context. Second, I will evaluate the authors' definition of infrastructure "adequacy" and suggest a measure that may be more useful.

Context and Broad Trends

In order to provide a useful guide to decision-making, debates about the wisdom of increased spending on infrastructure need to distinguish between cyclical arguments focused on a lack of aggregate demand and the impact of infrastructure stimulus spending on the growth rate of *actual output* in the short run, versus structural arguments about the impact that infrastructure spending has in the long run by raising the growth rate of *potential output*. Both of these issues are important, but we should not conflate them. There may be an argument for fiscal policy to stimulate growth in the short run, but that could take many forms to stimulate consumption rather than investment, including but not limited to direct payments to consumers and firms (to maintain employment). If we are going to spend resources on infrastructure, creating structures that are more or less permanent, then it is optimal to invest efficiently, to raise the trend rate of growth. Infrastructure stimulus enthusiasts will point out that there may be an intersection between the short-run and long-run arguments for infrastructure spending—that investment in infrastructure will both boost demand and raise the trend growth rate of output—but it is not clear that the data support this view, a point to which I will return later in my comments.

Turning to broad trends, the authors do a nice job of measuring and documenting important key facts about the changing composition of US infrastructure. The share of the US infrastructure stock comprising basic assets (such as roads) has decreased, while the share of social and digital assets has increased. In addition to the authors' documentation of these

facts, it would be useful to know the extent to which investment in digital infrastructure—data centers, for example—is public versus private. Let me elaborate a bit.

When it comes to basic and social infrastructure, we think of assets that are largely owned by the federal, state, and local governments and that provide public infrastructure services. When it comes to the continuing evolution of the economy, however, and the ever-increasing provision of services—business to consumer and business to business—through platforms, it is natural to ask which, if any, digital assets in the world of the platform economy have similar qualities to basic and social infrastructure, and the extent to which maximizing aggregate productivity will require public investment. This line of inquiry raises a series of related questions.

Are there parallels between the provision of roads and the provision of digital infrastructure such as data centers and cloud computing? For instance, do the same laws of motion and attendant assumptions about depreciation rates and maintenance costs apply to digital infrastructure as apply to traditional fixed assets in the national income accounts? Also, my anecdotal sense is that the vast majority of construction of data centers suggested by figure 1.8 in the authors' paper has been the province of megasized tech firms such as Amazon, Microsoft, Google, and IBM, but it would be good to know definitively. More precisely, it would be useful to know, outside of the Department of Defense's Joint Enterprise Defense Infrastructure (JEDI), to what extent have cloud facilities been built by the federal government versus by private providers? Does it matter? And do we need to be concerned that the concentration of cloud infrastructure among the Big Four will lead to a suboptimally low provision of digital infrastructure? The falling prices and margins that indicate an increased commoditization of this space suggest not, but what kind of rules and refereeing of the digital ecosystem do we need to ensure efficient entry and competition by smaller-scale firms? All of these questions require more and better data, and I applaud the authors' initial efforts in this area, which lay the foundation for other researchers to join the hunt.

Adequacy

Turning to adequacy, the authors provide three measures: (1) net investment per capita; (2) growth in the real net infrastructure capital stock per capita; (3) age of the infrastructure stock. Focusing on the second measure highlights an important issue. Figure 1.17 in chapter 1 shows that the average growth rate of net per capita transportation infrastructure over the past four decades appears to be about 0.5 percent per year, which is lower than in it was in the 1950s and 1960s, and is certainly lower than the growth rate of total factor productivity. Looking only at this picture, it is tempting to lean in the direction of the narrative that the United States is underinvested in

transportation infrastructure. The problem, however, is that narrative does not consider whether a slower growth rate of transportation infrastructure is efficient. The central issue is whether, given a dollar of national savings, devoting that dollar to an increase in the stock of transportation infrastructure leads to a larger increase in GDP than allocating the dollar elsewhere, to private capital in particular.

If infrastructure is a public good that must be provided through state-funded investment, it is natural to define "adequacy" in terms of rates of return, and it would be useful to impose a little more structure on the data. In this case, the stock of infrastructure is "adequate" if the return on investing in an additional unit of infrastructure capital equals the rate of return on investing in an additional unit of noninfrastructure capital. If the return on investing in infrastructure is greater than the return on investing in an additional unit of noninfrastructure capital, then the stock of infrastructure is "inadequate." Similarly, if the return on infrastructure capital exceeds the return on noninfrastructure capital, there is an "excess" of infrastructure.

It is straightforward to capture these ideas succinctly using an aggregate production function that has two kinds of capital: infrastructure, X, and noninfrastructure, K, so that GDP, $Y = Y = AK^{\alpha}X^{\gamma}L^{1-\alpha-\gamma}$. Let $r_x = MPX/P_X$ be the (social) return on infrastructure, $r_K = MPK/P_K$ be the (private) return on noninfrastructure capital, and $= r_X/r_K$. Under these definitions, the stock of infrastructure is "inadequate" if $\rho > 1$, "adequate" if $\rho = 1$, and "excessive" if $\rho < 1$. Table 1C.1, constructed using data on r_K and r_x from Canning and Bennathan (2000), demonstrates the striking fact that at the time of

Table 1C.1 **The rate of return on paved roads in advanced economies is less than the rate of return on private capital**

Country	Rho
Australia	−0.02
Austria	0.00
Belgium	0.14
Denmark	0.4
Finland	0.68
Germany	0.55
Ireland	0.15
Italy	0.76
Japan	3.05
Netherlands	0.46
New Zealand	0.23
Norway	0.08
Sweden	0.21
United Kingdom	0.32
United States	0.26

Source: Canning and Bennathan (2000), table 7.

measurement, the stock of paved road infrastructure in 15 industrialized economies, including the United States, was excessive, in the sense that the rate of return to an additional unit of infrastructure capital was less than the return on an additional unit of noninfrastructure capital in every country except Japan. These numbers are consistent with the findings of Fernald (1999), who concludes that "the data seem consistent with a story in which the massive road-building of the 1950s and 1960s offered a one-time boost to the level of productivity, rather than a path to continuing rapid growth."

While there may be utility from investments that do not have an incremental impact on GDP, and the social rate of return to infrastructure does not capture such benefits, the advocates who want to ramp up infrastructure spending are focused on GDP. We need to think more carefully about the opportunity cost of increased public expenditure on infrastructure and the most efficient way to allocate national savings. Selective refurbishment of roads and other American hardscape may be in order and have a modest impact on national output, but figuring out the optimal role of public expenditure on digital infrastructure strikes me as a higher priority. If there is a compelling efficiency case to be made for the federal government to invest in digital infrastructure in a manner analogous to the way the government devoted resources to the construction of the Interstate Highway System, then that case should show up in measured social rates of return on digital infrastructure. The research required to properly calculate such rates of return is not for the faint of heart, but good public policy decisions require that we have these data. By initiating an ambitious and important effort to collect and measure data, the authors have pointed in us in the right direction. I look forward to their future contributions as well as the contributions of others inspired by their work.

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