Need for Speed: Broadband and Student Achievement

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Introduction

High-speed internet (broadband) is a crucial component of modern economies and a valuable input into the education production function. Broadband has affected the way educators teach students, assign homework, and more closely align with the needs of students and their parents. Likewise, students have adjusted to the emergence of this technology, making use of the wealth of resources available to complete assignments, study, and in the opposite extreme, cheat and plagiarize. Though access to the internet is clearly important on the extensive margin[1,2] it is less clear whether high-quality fiber internet is expected to improve student outcomes relative to DSL or cable internet.

There are several reasons to expect that the introduction of fiber internet can affect student outcomes. First, while high-income households generally pay to ensure sufficient bandwidth for all members of their household at peak times, many households with DSL or cable internet report inconsistent access to sufficient bandwidth. Second, though relatively few individuals take up fiber, fiber availability has the potential to affect all internet subscribers through competition among internet providers. Third, past work demonstrates that high-speed internet leads to employment growth, and the employment of parents can directly affect test scores.[3,4]

What This Paper Does

This paper studies the broad effects of the introduction of fiber broadband, through the lens of student achievement. I link granular data on new fiber construction and advertised download speeds with administrative test score data and local labor market data. I implement a difference-in-differences design by exploiting variation in the introduction of fiber at the census block group level. Accordingly, I address the following questions:

- Does fiber broadband have a causal effect on student outcomes?
- Explore heterogeneity across demographic characteristics and baseline speed.
- What are the mechanisms?

Data and Empirical Strategy

Broadband Availability Data

- National Telecommunications and Information Association's National Broadband Map (NBM), 2011-2013
- Federal Communications Commission's (FCC) Form 477, 2014-2018

Education Data

- North Carolina Education Research Data Center (NCERDC), 2011-2018

Employment Data

- Longitudinal Employment Household Dynamics (LEHD) program's Origin-Destination Employment Statistics (LODES), 2011-2018

Khan Academy Search Data

- Google Trends, 2011-2018

To identify the causal effect of fiber broadband, I use census block group variation in availability and the timing that a student is exposed to fiber within the same census tract. Formally, I estimate the following model:

$$y_{i,t} = \alpha_i + \gamma_{k(i),t} + \sum_{\tau=-5}^{-2} \beta_\tau D_{i,t}^{\tau} + \sum_{\tau=0}^{5} \beta_\tau D_{i,t}^{\tau} + \varepsilon_{i,t}$$

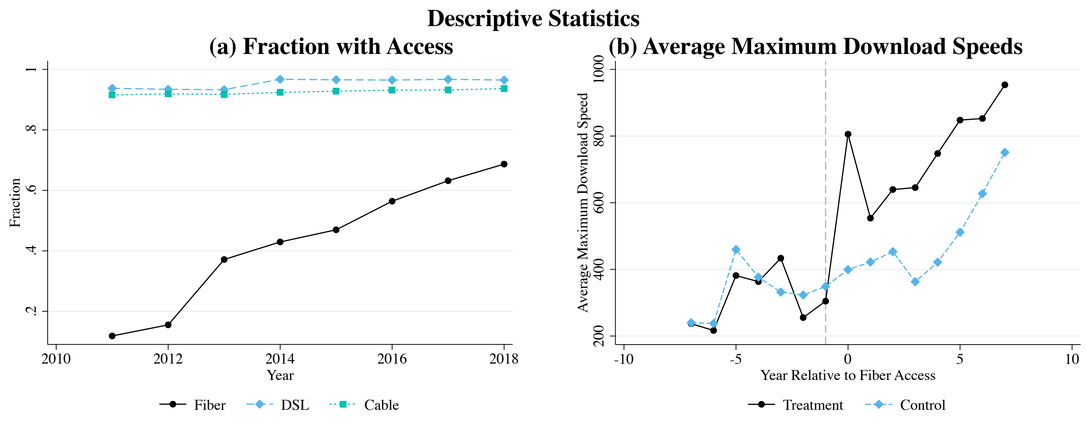

Figure 1. Panel (a) plots the fraction of census block groups covered by fiber over time. Panel (b) shows how the maximum download speed in a census block group changes with the arrival of fiber.

Main Results

- The arrival of fiber increases the maximum download speed by 132 percent or roughly 313 Mbps on average.
- The effects on math and reading standardized test scores monotonically increase after fiber becomes available, where six years of exposure increases math test scores by roughly 2.3 percent of standard deviation and by 1 percent of standard deviation for reading.

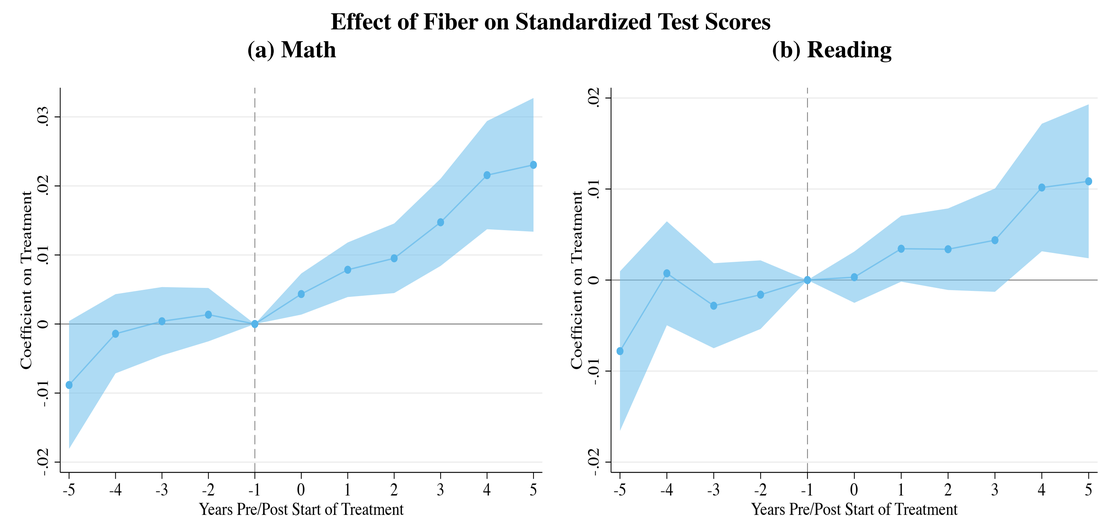

Figure 2. Panel (a) plots the estimates of the effect of fiber on maximum download speeds in the event years before and after the arrival of fiber for math standardized test scores. Panel (b) plots the effect of fiber for reading standardized test scores.

Mechanisms

I find evidence of each of the following mechanisms to explain the results on student achievement.

- **Income** – Fiber could affect student achievement through changes in household income, whereby households may allocate more resources to students, in turn improving test scores.
- **Competition** – Students may indirectly benefit if internet service providers compete on either prices or quality.
- **Productivity** – Students may use fiber for productive uses to supplement their education with materials such as Khan Academy.

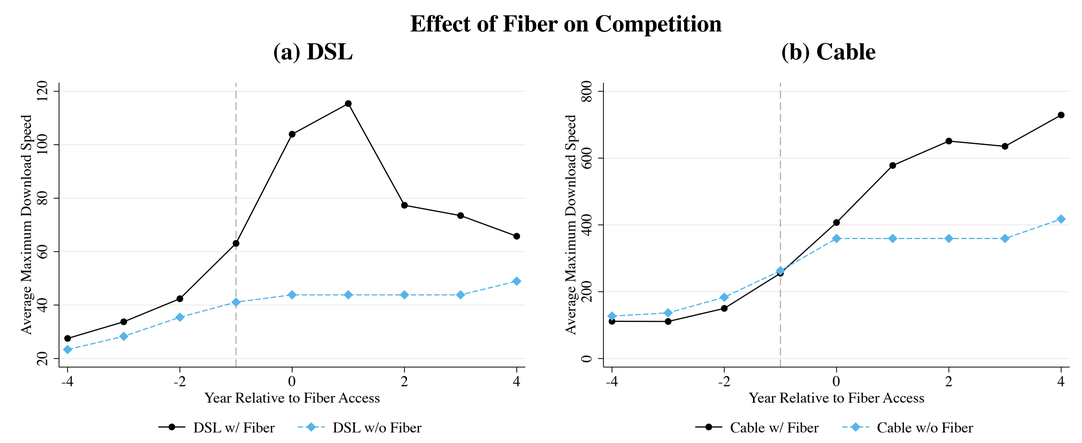

Figure 2. Panel (a) plots how the maximum download speed for DSL changes with the arrival of fiber. Panel (b) plots how the maximum download speed for cable changes with the arrival of fiber.

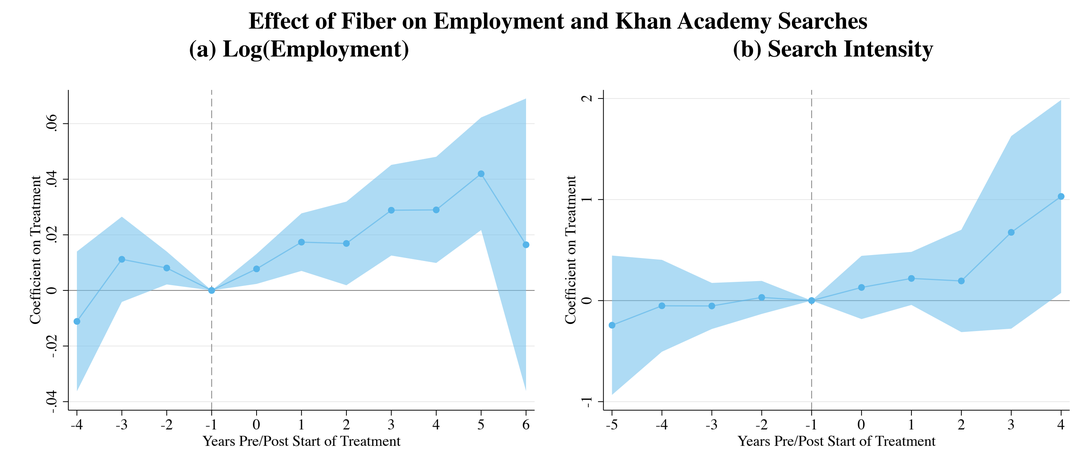

Figure 3. Panel (a) plots the estimates of the effect of fiber on log employment in the event years before and after the arrival of fiber. Panel (b) plots the effect of fiber on search intensity for Khan Academy.

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