KEY TAKEAWAYS

- Economists have long noted the economic benefits derived from the expanding rail network in the second half of the 19th century in the United States.
- However, those benefits have traditionally been described as relatively small compared to the pace of general economic growth.
- New research incorporates the indirect benefits derived from an expanded rail network to reveal broader and deeper gains.
- By connecting domestic markets and allowing for a more efficient use of inputs—including materials, capital, and labor—railroads had a substantial impact on US economic growth.

Of these two workers, who is more productive? Amy works for one minute every afternoon and produces 11 minutes’ worth of goods, for a net gain of 10 minutes’ worth of goods for her employer. Sally works for five hours and produces six hours’ worth of goods, for a net gain of 60 minutes.

Whom would you hire? Amy is clearly the most productive on a per unit, or ratio, basis: Her employer only has to pay for one minute's work for 10 minutes of net production. But Sally, in an aggregate sense, is more productive: She nets her employer 60 net units every afternoon, six times more than Amy produces. It would be great to hire Amy if she could maintain the same per-unit productivity and work for 5 hours, but perhaps she is not willing to work 5 hours or her productivity plummets after working 1 minute.

Richard Hornbeck of UChicago’s Booth School of Business uses that simple story with his students to describe alternative ways of thinking about productivity. This distinction—between ratio productivity and aggregate productivity—helps in thinking about the central findings of a recent paper he coauthored with New York University’s Martin Rotemberg, “Railroads, Reallocation, and the Rise of American Manufacturing.” Hornbeck and Rotemberg show that many US counties were held back from expanding by market...
inefficiencies, and when these counties were encouraged to grow by the expanding railroad network, there were substantial gains in aggregate productivity that have been missed in previous analyses.

**Efficiency unbound**

The manufacturing sector in the United States expanded substantially in the latter half of the 19th century. This increase occurred alongside the expansion of the railroad network, as coast-to-coast and regional rail lines opened large domestic markets to new areas and to new commodity resources. How important was rail in the development of US manufacturing and other sectors? While railroads were a clear technological improvement in the transportation sector, and while they brought competition to water-based transportation, previous research has revealed only a relatively modest contribution from rail lines. The direct benefits of improved transportation were clear from reducing resources spent on transportation itself, but—in the aggregate—they were small compared to the general rate of economic growth.

This new research upends this conventional wisdom by incorporating the indirect benefits of rail transportation through the expansion in manufacturing and other sectors that were inefficiently small. In effect, railroads induced increased manufacturing activity in places that were previously held back by expensive modes of transportation. Many of these new places—whether from the existence of untapped natural endowments, commodities, or labor supply—proved particularly efficient at production.

Before describing the authors’ findings in more detail, it is useful to revisit the above description of ratio vs. aggregate productivity. In the first
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To conduct their analysis, the authors employed US Census of Manufacturers’ data from 1860, 1870, and 1880. This 20-year period was the primary focus of their research, though they extend some of their analyses to 1890 and 1900. At the time, census takers were charged to include information from all manufacturers with more than $500 in sales, including smaller operations run, for example, out of semi-permanent structures like sheds or other outbuildings. Further, these manufacturing data included the annual value of output, the annual cost of materials, the annual cost of labor, and the value of invested capital.

To determine the contributions of an expanded rail network, the authors measure how changes in the network affected market access for various counties. This market access reflects the degree to which a county’s manufacturers had improved access to workers, consumers, and material inputs from the introduction of rail service. The authors’ findings were clear: relative increases in county market access resulted in substantial increases in manufacturing productivity (roughly 13 percent for every one standard deviation increase in county market access from 1860 to 1880). These gains were driven by the increases in market access in marginally productive areas, in other words, from increases in reallocative efficiency. Imagine, for example, a particular county that was endowed with abundant natural resources, but productive firms could not get enough capital or were pricing substantially above their costs – the overall economy benefits when those firms expand production.

With such gains at a county level, what was the impact on aggregate productivity? The authors estimate that absent an expanded rail network, US aggregate productivity would have been 25 percent lower in 1890, equaling about $3 billion or a 25 percent reduction in gross domestic product (GDP). Previous estimates put this loss at 3.2 or 2.7 percent of GDP. Further, the authors’ estimate a 43 percent annual social rate of return1 on the $8 billion of capital invested in railroads in 1890. Only 8 percent of that social rate of return was captured by the railroads.

Much of this increase in aggregate productivity growth extends from an increase in national population. Absent railroads, had US aggregate population remained fixed in 1890, the real wages...
CLOSING TAKEAWAY
Railroads allowed for increasing production in counties that were otherwise underutilizing inputs, or where the value marginal product of inputs (be they materials, capital, or labor) was greater than their marginal cost. In other words, counties that were inefficiently small experienced large gains after the arrival of rail lines. These potential gains from infrastructure are indeed largest when the economy is most inefficient, to which the authors cheekily note: “With great problems come great possibilities.”

of workers would have declined by 34 percent. In addition, the gains from reallocating workers across counties would have been lost, amounting to lower aggregate productivity of about 5.3 percent.

Conclusion
The contribution of railroads to the economic growth of the United States, especially in the latter half of the 19th century, has long been debated by researchers. For many decades, due in part to the Nobel prize winning research by Robert Fogel, conventional wisdom held that while railroads delivered clear direct benefits to the economy, the aggregate effect of extending rail lines to new counties was relatively small compared with the general pace of economic growth.

This research, though, reveals how railroad lines linked domestic markets throughout the United States (as the accompanying maps reveal). Railroads allowed for increasing production in counties that were otherwise underutilizing inputs, or where the value marginal product of inputs (be they labor, capital, or materials) was greater than their marginal cost. In other words, counties that were inefficiently small experienced large gains after the arrival of rail lines.

The indirect benefits derived from the expanded economic activities that were generated by the expanded railroad network were much larger than the direct benefits derived from lower transportation costs, which is how researchers have traditionally measured the impact of railroads on the US economy in the second half of the 19th century. As noted above, US aggregate productivity would have been 25 percent lower in 1890 absent railroads, much higher than previous estimates of around 3 percent.

While the authors do not offer specific policy prescriptions based on their work, their results suggest that, at a minimum, policymakers—especially those in developing countries—should pay attention to all benefits derived (both direct and indirect) from improved transportation networks. These potential gains are indeed largest when the economy is most inefficient, to which the authors cheekily note: “With great problems come great possibilities.”

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