# Information and Innovation: Evidence From Railroad Expansion in the 19th Century


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## RESEARCH QUESTION
## How does the information flow shape the innovation activity?

- Schumpeter's **creative destruction**
- Information is key driver of innovation (*Aghion and Howitt 1992*, *Acemoglu 2008*, *Mokyr 2011*).

**The First Challenge: Measurement**

How to measure information flow?

**The Second Challenge: Causation**

How to isolate information effect?

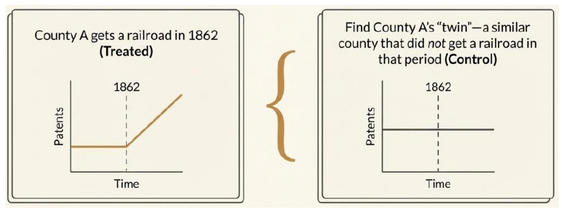
## AN IDEAL LABORATORY
## 19 Century US


The railroad was the primary artery for US mails (through mail contract), newspapers & magazines.


Speed: Transcontinental travel fell from 20 days to 8 days.
Reliability & Volume: trains carry larger volumes & operate in inclement weather.

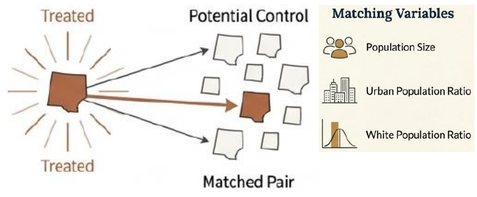

The networks gradual, staggered expansion across counties allows for a comparison across times and counties.

## EMPIRICAL METHDOLOGY
### Stacked DID around 1st rail



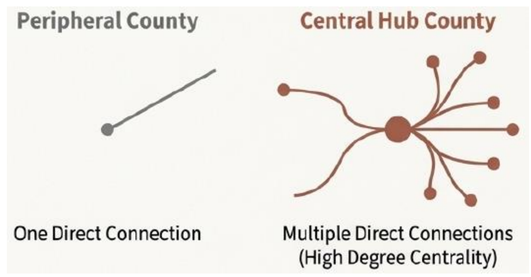

For each year a county gets a railroad (a "cohort"), create a clean 11-year window. Then stack these cohorts.

### Propensity Score Matching




This matching ensures comparing apples to apples, isolating the information effect.

### 3. Network centrality amplified information effect.

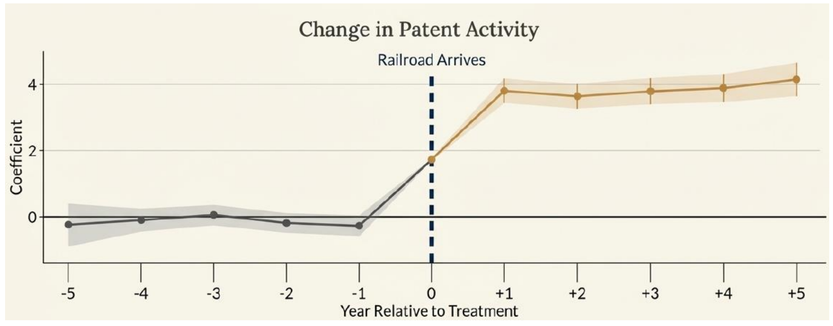



A county's **degree centrality**: the number of counties it was directly connected to by rail.

- **Quantity**: Each additional direct rail connection was associated with a 0.6-0.7% increase in patenting.
- **Quality**: Patents from more central counties were significantly more important and impactful.

## FINDINGS

### 1. Railroad access led to a 9-15% increase in patents.




### 2. Innovation became more impactful but less novel.


- Patents became more similar to subsequent inventions.
- Greater influence on subsequent innovations


Higher ratio of future influence to past similarity


- Patents became more similar to prior inventions
- Inventors drew more on existing knowledge

## MECHANISM
### Connected counties began innovating in sync.

**County-pair analysis**: measure the similarity of patents produced in two different counties before and after a direct rail line connected them.


**Finding**: Patents generated in two counties become more similar to each other after they are newly connected by a railroad.