

Lost Einsteins

Innovation and Opportunity in America

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The opinions expressed in this paper are those of the authors alone and do not necessarily reflect the views of the Internal Revenue Service or the U.S. Treasury Department.

How Can We Increase Innovation and Growth in America?

 Innovation is widely viewed as the engine of economic growth

- How can we increase the rate of innovation?
 - Policy approaches range from STEM education to tax incentives
 - Effectiveness of these policies is debated, partly because of a lack of data on who innovates in America

We Use Big Data to Study Who Becomes an Inventor in America



Source: Bell, Chetty, Jaravel, Petkova, van Reenen 2017

We track inventors from birth to adulthood to understand the factors that determine who invents



Begin by analyzing inventors' characteristics at birth



Patent Rates vs. Parent Income





Patent Rates vs. Parent Income





Patent Rates vs. Parent Income





Lost Einsteins? Highly-Cited Patents vs. Parent Income





Why do patent rates vary with parent income? Three potential explanations





Children from high-income families have greater ability to innovate

Lower income children prefer other occupations (e.g., to avoid risk)



Lower income children have comparable talent and preferences but lack resources or exposure

Patent Rates vs. 3rd Grade Math Test Scores





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The Gap in Patent Rates Explained by Test Scores Grows as Children Progress Through School



Gaps in Innovation by Race and Gender





Patent Rates vs. 3rd Grade Test Scores by Race & Ethnicity





Percentage of Female Inventors by Year of Birth





Patent Rates vs. 3rd Grade Math Test Scores by Gender





Effects of Childhood Environment on Innovation



Impacts of Exposure to Innovation



Study impacts of childhood environment by focusing on effect of **exposure to innovation** during childhood through family and neighbors

Start by analyzing relationship between children's and their own parents' patent rates

Patent Rates for Children of Inventors vs. Non-Inventors





Exposure or Genetics?



- Correlation between child and parent's propensity to patent could be driven by genetics or by exposure (environment)
 - Isolate causal effect of exposure by analyzing propensity to patent by narrow technology class

 Intuition: genetic ability to innovate is unlikely to vary significantly across similar technology classes

 Define "similarity" of two technology classes based on the fraction of inventors who hold patents in both classes



Distance Between Technology Classes



Category: Computers + Communications	
Subcategory: Communications	
Technology Class	Distance Rank
Pulse or digital communications	0
Demodulators	1
Modulators	2
Coded data generation or conversion	3
Electrical computers: arithmetic processing and calculating	4
Oscillators	5
Multiplex communications	6
Telecommunications	7
Amplifiers	8
Motion video signal processing for recording or reproducing	9
Directive radio wave systems and devices (e.g., radar, radio navigation)	10

Innovation Rates by Technology Class





Exposure Effects Across Neighborhoods



 Parents are not an easily replicable source of exposure to innovation

 Next, analyze a broader source of influence: neighbors

 Examine patent rates by commuting zone (aggregation of counties analogous to metro area) where child grows up

The Origins of Inventors in America Patent Rates by Childhood Commuting Zone





Patent Rates of Children who Grow up in a CZ vs. Patent Rates of Adults in that CZ







- Neighborhood exposure effects are technology-class specific
- Consider two people currently living in Boston, one from Silicon Valley and one from Minneapolis (a medical device hub)





- Neighborhood exposure effects are technology-class specific
 - Consider two people currently living in Boston, one from Silicon Valley and one from Minneapolis (a medical device hub)
 - The one from Silicon Valley is most likely to patent in computers
 - The one from Minneapolis is most likely to patent in medical devices



- Neighborhood exposure effects are technology-class specific
- Consider two people currently living in Boston, one from Silicon Valley and one from Minneapolis (a medical device hub)
- Moreover, these patterns are genderspecific

Gender-Specific Innovation Exposure Effects

Change in Number of Inventors per 1000 Children



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Gender-Specific Innovation Exposure Effects

Change in Number of Inventors per 1000 Children









 Findings are consistent with other evidence that neighborhood environment in childhood matters greatly for long-term success

- But differences across areas in production of inventors are unlikely to be due to broad differences in school quality or resources
 - Technology-class and gender-specific patterns are more likely due to direct exposure effects (mentoring, role models)

Finally, characterize inventors' careers to understand how financial incentives affect individuals' decisions to pursue innovation



Distribution of Inventors' Income Ages 40-50





Inventors' Incomes vs. Patent Citations





Changes in financial incentives have limited potential to increase innovation



Changes in financial incentives are **unlikely to influence star inventors**, who earn more than \$1 million per year



And they can affect only the relatively few people who have exposure to innovation

Lost Einsteins: The Importance of Exposure to Innovation



If women, minorities, and children from low-income families invent at the same as high-income white men, the innovation rate in America would quadruple

How can we recover the Lost Einsteins?

Identify female, minority, and low-income children who excel in math and science at early ages





Increase exposure to innovation through tailored mentoring, internships, and expanding opportunity

Data presented here are available at EOP website

The Fading American Dream

Percent of Children Earning More than Their Parents, by Year of Birth

