Collin J Wardius
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February 11, 2026

Dear Selection Panel,

I am writing to apply for the NBER Innovation Research Boot Camp. I am a fourth-year Ph.D. candidate in Economics at UC San Diego, with research interests in education and spatial economics. My enclosed essay describes my current research, as well as my future research plans at the intersection of education and innovation.

My recommendation letter will be provided by Professor Gaurav Khanna (gakhanna@ucsd.edu), Department of Economics and the School of Global Policy and Strategy, UC San Diego.

Thank you for your consideration.

Sincerely,

Collin J Wardius

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Research interests: education, spatial economics

Education

Ph.D. Candidate, UC San Diego, Department of Economics, 2022–2028 (expected)
M.A. Economics, 2024

Visiting Ph.D. Student, U Penn Wharton Applied Economics, 2024–2025

B.A. Mathematical Economics, Temple University, 2016–2020

Employment

Short-term Consultant, World Bank Group, 2025–Present

Graduate Student Researcher, 2024–Present
UC San Diego, Department of Economics

Research Analyst, 2020–2022
Federal Reserve Bank of Philadelphia, Research Department

Works in Progress

Higher Education Investment and the Rise of College Attainment

The early 20th century saw a dramatic expansion in higher education investment and college attainment. The transformation in attainment was uneven across regions: the West experienced the strongest gains, whereas gains in the Northeast, Midwest, and South were more modest. What drove this transformation in American human capital, and why did it vary so sharply across space? Dissecting the causes of these regional differences is challenging because individual college-going decisions depend both on the costs of obtaining a college education, shaped by the quality and accessibility of the local colleges, and on local labor market returns as proxied by the college wage premium. This paper uses difference-in-differences empirical designs, linked decennial census data, and a newly created panel of the universe of U.S. colleges spanning 1890 to 1940, to isolate the effect of higher education investment on educational attainment. We estimate the causal impact of two types of investments made during this period on attainment: new junior college openings, which reduce the distance cost of attendance, and shocks to college funding from state and philanthropic sources, which increase the quality of existing institutions. We then develop a model of education choice in which individuals respond to both college costs and labor market returns, using our reduced-form estimates to discipline the model's key parameters governing the responsiveness of college-going to educational investment. We will use the model to conduct counterfactual experiments that redistribute higher education investment across states. If labor market returns primarily drive college attainment, reallocating higher education funding should have modest effects on enrollment—intuitively, if there are no local high-skill employers, very few will attend college regardless of its quality or accessibility. If instead the quality and accessibility of local colleges are the binding constraint, such reallocation should produce large changes.

Published Articles

[1] Mallick Hossain, Igor Livshits, and Collin Wardius. "Not cashing in on cashing out: An analysis of low cash-out refinance rates". In: Real Estate Economics (2026). Forthcoming.

Teaching

ECON 120A: Undergraduate Econometrics (UC San Diego)
Teaching assistant, Fall 2023, Winter 2024

Honors & Awards

Diversity Research Fellowship, UC San Diego (2024)

Regent's Fellowship, UC San Diego (2022)

Best Undergraduate Economics Thesis, Temple University (2020)

Coursework

UC San Diego: First-year sequences in microeconomics, macroeconomics, and econometrics; Spatial Economics; Political Economy; Public Economics: Goods and Externalities; Public Economics: Redistribution and Social Insurance; Labor Economics: Empirical Methods; Labor Economics: Education and Models of Self-Selection; Labor Economics: Recent Causal Inference Approaches; Econometrics E: Time Series Econometrics; Econometrics F: Causal Inference and Experimental Design

U Penn: Urban Economics in Developing Countries; Health Economics: Empirical Methods

Last updated: February 12, 2026

Application Essay for the NBER Innovation Boot Camp

Collin J Wardius, February 12, 2026

Between 1890 and 1940, college completion rates in the United States rose dramatically, but the gains were strikingly uneven across regions. The West led; the Northeast, Midwest, and South lagged. What drove this transformation in American human capital, and why did it vary so sharply across space? Two prominent explanations exist in the literature. The first emphasizes demand for highly skilled workers: the growing organizational complexity of American industry created new demand for educated managers, engineers, and professionals, pulling workers into higher education (Chandler 1977). The second emphasizes supply: investments in higher education drastically increased the accessibility and quality of college offerings (Goldin and Katz 1999). Distinguishing these channels is difficult because places with better higher education infrastructure also tend to be places with stronger demand for college-educated labor. Aggregate trends in attainment confound the two stories: the West's leadership in college completion could reflect superior educational infrastructure or increasingly favorable labor market conditions for skilled workers, or both. Existing evidence cannot tell us which channel mattered more.

My research isolates the supply-side channel using difference-in-differences designs, linked census data, and a newly constructed panel of the universe of U.S. colleges from 1890 to 1940. In particular, I focus on two methods through which the higher education infrastructure improved during this period: the opening of new junior colleges, which lowered the distance cost of attending college, and increased state and philanthropic expenditures on the existing college system, which increased the quality of their offerings.

To estimate the effect of junior college openings on attainment, I use a difference-in-differences design comparing individuals in the same childhood county who were young enough to benefit from a college opening to those who were too old. From this exercise, I estimate that the opening of a junior college increases attainment by 1 percentage point (8%).

To estimate the effect of increased expenditures on enrollment, I am digitizing tabular data from The Commissioner's Report on Education (United States Bureau of Education 1868–1917) and the Biennial Survey of Education (United States Office of Education 1916–1958) to build a college-level panel of enrollment, finances, faculty, and assets. These data capture both revenue shocks from state and philanthropic sources and enrollment outcomes at the college level, which allows me to use a difference-in-differences design to estimate the elasticity of enrollment to spending increases.

These results discipline a model of education choice, enabling the paper's central counterfactual experiment: redistributing higher education investment across states. If labor market returns primarily drive college attainment, reallocating funding should have modest effects, as few attend college without local high-skill employers, regardless of its quality or accessibility. If instead the quality and accessibility of local colleges are the binding constraint, such reallocation should produce large changes.

The period 1890–1940 was also critical for the development of the American college as an institution of research. A growing literature studies how funding shocks to established research universities translate into scientific output and local innovation (Cristelli 2026; Kantor and Whalley 2014; Babina et al. 2023), but little is known about how fledgling institutions first build scientific capacity. What investments matter, in what sequence, and at what stage of institutional

development? In future research, I plan to use the college panel I've created to address these questions. As a first step, I focus on one discrete institutional transformation that my panel can cleanly identify: the establishment of graduate departments. American colleges adopted graduate training at different times during this period, driven by a mixture of competitive pressure, state legislative action, and philanthropic incentives. I exploit this staggered adoption in a difference-in-differences framework. This design allows me to test whether a graduate program is a necessary input for building research capacity or whether the productive use of institutional resources for science can precede formal doctoral training.

The spatial inequality in higher education investment that my research documents likely had lasting consequences not only for educational attainment but also for where scientific and inventive capacity concentrated in the United States. If early college investments shaped local innovation capacity in addition to human capital, then the welfare effects of redistributing higher education funding across states are potentially much larger than an attainment-only analysis would suggest. Recent text-based measures of patent significance that do not rely on forward citations offer a potential approach to measuring innovation in this period (Kelly et al. 2021), and my college panel allows me to link institutional characteristics like faculty, expenditures, and the adoption of graduate training to local patenting activity. The boot camp would provide both the conceptual foundations for thinking about innovation measurement and an opportunity to discuss strategies for working with nonstandard historical data alongside faculty and panelists who have deep experience in this area.

References

Tania Babina, Alex Xi He, Sabrina T Howell, Elisabeth Ruth Perlman, and Joseph Staudt. Cutting the Innovation Engine: How Federal Funding Shocks Affect University Patenting, Entrepreneurship, and Publications. *The Quarterly Journal of Economics*, 138(2):895–954, April 2023. ISSN 0033-5533, 1531-4650. doi: 10.1093/qje/qjac046.

Alfred Chandler. *The Visible Hand: The Managerial Revolution in American Business*. Harvard University Press, 1977. ISBN 978-0-674-94052-9.

Gabriele Cristelli. Funding the Ivory Tower: The Effects of NSF Institutional Grants on Universities and Local Innovation. January 2026.

Claudia Goldin and Lawrence F Katz. The Shaping of Higher Education: The Formative Years in the United States, 1890 to 1940. *Journal of Economic Perspectives*, 13(1):37–62, February 1999. ISSN 0895-3309. doi: 10.1257/jep.13.1.37.

Shawn Kantor and Alexander Whalley. Knowledge spillovers from research universities: Evidence from endowment value shocks. *The Review of Economics and Statistics*, 96(1):171–188, 2014. ISSN 00346535, 15309142.

Bryan Kelly, Dimitris Papanikolaou, Amit Seru, and Matt Taddy. Measuring Technological Innovation over the Long Run. *American Economic Review: Insights*, 3(3):303–320, September 2021. ISSN 2640-205X, 2640-2068. doi: 10.1257/aeri.20190499.

United States Bureau of Education. Report of the commissioner of education, 1868–1917.

United States Office of Education. Biennial survey of education in the united states, 1916–1958.

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Dear Members of the Selection Committee,

I am very pleased to recommend Collin Wardius for the NBER Innovation Boot Camp. Collin is my student and co-author, and he is an exceptionally promising young economist.

His research examines the uneven rise in college attainment across US regions between 1890 and 1940, carefully isolating the supply-side role of higher education investment using linked census data and a newly constructed panel of US colleges. He combines ambitious historical data work with thoughtful difference-in-differences designs and clear economic reasoning. Importantly, he connects these estimates to broader questions about innovation, research capacity, and the long-run spatial distribution of scientific activity .

Collin is rigorous, independent, and intellectually mature. He has the technical skill and curiosity that make him an excellent fit for the Boot Camp. I recommend him enthusiastically.

Sincerely,



Gaurav Khanna
Associate Professor of Economics
UC San Diego, School of Global Policy and Strategy