

Research Proposal for NBER-PIE Postdoctoral Fellowship
(*fellowships applied for: Innovation Policy and Digitization*)

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As a postdoctoral fellow at the NBER Productivity, Innovation, and Entrepreneurship program, I would like to advance two early-stage projects that are currently underway. The first of these projects studies the effects of technology standards on economic activity, exploiting the conversion of 19th century railroads to a standard gauge (track width) as a large-scale natural experiment in technology standards adoption. The second project uses data on the content of many thousands of classical music compositions to study the role of creative influence in the production of innovation and creative works. Both projects require data collection from non-traditional sources – the first requires digitization of archival records, and the second requires extracting content from musical scores – and I believe both will yield insights that may change how we understand and design policy to promote innovation.

Project 1: “Railroad Gauge Standards and Interregional Trade in the 19th Century U.S.”

Though technology standards have been explored through the lens of economic theory and are widely discussed in practice, evidence on their importance is limited at best. In theory, incompatibilities impose a fixed cost of conversion on transactions. This cost acts as a lump-sum tax, shifting up the supply curve, increasing price, and reducing trade in equilibrium – but is it large enough to have a statistically and economically significant effect on economic activity? I seek to answer this question by studying the standardization of railroad gauge in the late-19th century U.S., when breaks in gauge were common and were believed to impose large fixed costs on freight traffic.

In this project, I study the coordinated conversion of 14,000 miles of railroad track in the U.S. South to standard gauge between May 31 and June 1, 1886 as a large-scale natural experiment in technology standards adoption. The “Great Gauge Change” instantly integrated the entire South into the national transportation network. Using the archived freight traffic records of the Southern Railway and Steamship Association, I plan to test whether technological integration increased freight traffic in merchandise and cotton between cities in the South and those in other regions of the country.

To identify a causal effect of standardized gauge on trade, I plan to compare growth in traffic before/after the gauge change on routes connecting border and interior cities at varying distances, which generates exogenous variation in the average cost of the break in gauge: if breaks in gauge impose a fixed cost on freight traffic, they should constitute a larger fraction of total cost on short-haul routes relative to longer-haul routes. This variation will make it possible to identify the elasticity of freight traffic with respect to unit costs of gauge breaks, which are proportional to routes’ length.

This project is in the early stages of data collection. Railroad freight data for the U.S. South in the 1880s are available in astonishing detail, thanks to a (now-illegal) traffic pooling agreement between major southern railroads and steamship lines in effect between 1875 and 1895. The pooling agreement created the Southern Railway and Steamship Association (SRSA) and required independent monitoring and monthly reporting of freight traffic to ensure that members were abiding by their quotas and penalties were assessed on those exceeding their allotment. Many of the SRSA's records have been preserved, including monthly reports of freight traffic by railroad, route, and type of good between points around the border and interior, which are essential to the empirical strategy. Earlier this year I visited the New York Public Library and Yale University library to access archived volumes and obtain scans of tables with the data to be used in this analysis, and I am planning one more trip to fill in gaps in the sample. Analysis will proceed following the digitization of archival records.

The results of this analysis would likely apply broadly beyond railroad gauge, and indeed beyond even technology standards per se. For example, currencies face many of the same compatibility issues as new technologies: in order for parties banking in different currencies to transact, foreign exchange must take place. The fundamental question that I seek to address in this paper is how costly conversion is relative to a first-best in which disparate technologies are perfectly compatible.

Project 2: *“Creative Influence and the Diffusion of Content in Classical Music Composition”*

In this project, I seek to measure the strength of creative influence in classical music composition. The project is motivated by the observation from personal experience that teachers can wield considerable influence over their students' creative and intellectual tastes: for example, graduate students' research philosophy and tastes for different fields and methods often seem to reflect back those of the faculty who taught them. I would like to explore whether such influence exists in music production, how strong it is, how long it lasts, and what effects it has on the variety and quality of creative works.

To do so, I am collecting data on the content of tens of thousands of classical music scores and compiling teacher-student genealogy trees from composer biographies. With these data, I will be able to evaluate the similarity of works produced by composers with student-teacher or peer connections as well as trace the diffusion of musical ideas (e.g., chord progressions) across space and time. Because student-teacher network connections are largely determined by the exogenously accidental geography of birth, geography can be leveraged to empirically identify the influence of these relationships.

I currently have information on common chord progressions for every pair of scores in my sample (over 60 thousand compositions), as well as counts of chord progressions in published scores by composer and year. I am also in the process of collecting data on composers' networks. At a later date, I plan to collect information on modern performances and radio plays as a measure of compositions' longevity, which can proxy for quality. I anticipate data collection proceeding into the next year.

Research Objectives and Concluding Remarks

Broadly, my goals are to advancing the empirical study of innovation in new directions and to effect a transition from studying innovation in terms of inputs (e.g., R&D spending) and outcomes (patents) to studying innovation in terms of its content. Innovation is at heart about individual acts of invention and discovery. Because we cannot infer experimentation choices from R&D inputs alone, and patent data only reveal the successes (and only the subset that are patentable and its owners are willing to disclose; Moser 2005, 2012), we likely know far less about innovation than we think. As Weitzman (1996) puts it, "we need to understand, much better than we do, the act of human innovation."

The first project in this proposal is intended to advance our understanding of technology standards, an area where existing evidence is quite limited. The second project delves more deeply into the creative act itself, using content-based analysis of musical compositions. Some of my completed research (in particular, my job market paper) similarly uses data on the visual content of commercial logo designs to study the incentive effects of competition on creative production. In the future, I would like to develop even more projects that give us an inside look into the creative process.

References:

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