Automation, Capital Investment, and Labor Markets in Mid-Twentieth Century America

Alec Hoover
Economics Major
Mentor: David Clingingsmith
Mentor Department: Economics

Objective: To use machine learning/text classification techniques to classify US Patents by industry of use. Such classifications are not performed by the United States Patent and Trademark Office. The classification will be used to study the diffusion of automation technology in the years after World War Two and will be applied to patents related to automation.

Project Description: My project studies the effect of new automation technologies on capital investments and the labor market in the United States during the decades following World War Two. Automation technologies employ machines to do tasks previously done by workers. They also may create new tasks for workers to do. Since the early 1980s the industrial robot has been the easiest to recognize automation technology. However, the term itself was coined in the late 1940s to refer to large integrated machine tools called transfer machines being deployed in the auto industry (Ashburn 1962). There has been a debate about whether automation leads to net reductions in employment and whether the skill level of workers falls or rises when automation is deployed (Acemoglu and Autor 2011; Acemoglu and Restrepo 2017; Autor 2015).

In particular, I am tracing numerically controlled machine tools, pioneered in the aerospace industry, during the early post World War Two era as they diffused into adjacent manufacturing industries (Hounshell 1984; Noble 1986). I measure diffusion using networks of patent citations. I will explore the effect of automation on the decision of firms to invest in new machinery and on the employment and wages of low- and high-skilled workers.

Methodology: The project has four main phases that require different research techniques.

The first phase requires me to identify the firms creating numerically controlled machine tools. I will use both the historical literature on innovation and leading technical and trade journals of the time, such as *Automotive Industries* and *American Machinist*, to identify these firms.

In the second phase, I will use Google Patents to identify all technologies patented by the leading firms in the period of initial adoption of the technology (Google 2017). I will then read the patents to decide which are related to numerically controlled machine tools given my understanding derived from the historical literature.

Having identified a set of core patents, I will then begin the third phase, using the network of patent citations developed by Kogan and coauthors to trace out additional technologies that draw on the innovations in the core patents, showing me how those innovations diffuse over time (Kogan et al. 2012). This network is created from the citations listed at the end of each patent application beginning in 1926. I can examine citations of varying degree. Higher degree citations of patents from midcentury continue to be made today.

The fourth and final phase is to link this data on how core innovations diffuse to the industries in which the patented technologies are used. This is challenging because the United States Patent and Trademark Office (USPTO) does not classify patents according to the industries in which they are expected to be used. Patent classification by the USPTO and other patent offices in general considers only the characteristics of the technology, not the application. An exception to this rule was the Canadian Patent Office, which during the period 1978-1993 supplemented standard patent classification with an assignment of each patent to the industry in which the technology would be manufactured and the industry in which it would be used (Ellis 1981).

Professor Clingingsmith has obtained resources from the Ohio Supercomputer Center to use machine learning text classification techniques to build an industry classifier for US patents. The classifier will exploit the availability in digital form of the full texts of all Canada and US Patents. The Canadian patent texts come from the Canadian Intellectual Property Office while the US texts

are scraped from Google Patents (Canada 2017; Google 2017). The classifier will be trained on the Canadian patent text and industry of use codes and the US patent texts will be used to predict industry of use.

Time Commitment: The project will require approximately 30 hours of work for 12 weeks from May 14th, to August 3rd.

Educational and Career Goals: This project will give me experience doing economics research that will benefit me as I work on my capstone next year and apply for graduate school.

Budget Summary: I will request $3500. This will go towards living expenses for me to live in Cleveland this summer.

Works Cited

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