

PROPOSAL: THE REORGANIZATION OF INVENTION IN THE EARLY TWENTIETH CENTURY UNITED STATES

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According to the conventional wisdom, as technology became more complex in the early twentieth century—as cutting-edge invention required greater investments of human and physical capital and more team effort—the locus of technological change shifted from small firms and independent inventors to large firms with in-house R&D facilities. Evidence is accumulating, however, that this view is overdrawn. Although it is certainly the case that large firms increasingly built industrial research laboratories during this period, small firms and independent inventors continued to be a critical source of new technological ideas in the high-tech industries of the period. Intriguingly, these two alternative modes of technological discovery were centered in different regions of the country with different economic ecologies. On the one hand, large firms were disproportionately located in the Middle Atlantic, near the nation's main capital markets. Although their securities traded publicly, they increasingly turned to internal sources of funds for their investments in R&D. On the other hand, small innovative enterprises were concentrated in the East North Central states, where they were highly dependent on local networks of venture capitalists and local capital markets to support their inventive activity. Although there was eventually a shift toward large-firm R&D, our research suggests that it occurred later—during the middle third of the century—and that it owed more to the differential impact of the Great Depression than, as previously thought, to the inherent superiority of the industrial research lab. During the depression years, large firms used their internal resources to expand dramatically their research laboratories and stockpile new technology. By contrast, small firms found it difficult to continue to finance R&D as their external sources of funds collapsed.

The purpose of the project is to continue to explore empirically the effect of the Great Depression on these two alternative modes of technological discovery. We have collected a random sample of patents awarded to U.S. inventors on the eve of the depression. Most of the patents were assigned at the time of issue to a company, and we use information we have collected about the company and the patentee's relationship to the company, to divide the patents into categories according to the characteristics of the assignee—for example, the size of the company, whether the company had an R&D lab, whether its equities traded and on what markets, and so on. We have also collected all of the patents obtained by the inventors in the sample over their full patenting careers. We are still cleaning that data, but a preliminary difference-in-difference analysis suggests that inventors associated with small entrepreneurial enterprises in the late 1920s did relatively worse (in terms of number of patents awarded per unit time) during the 1930s than inventors associated with large firms. We have much more work to do before we can have confidence in these results, however, and understand what underlies them, and we would involve the undergraduate research assistant in all of these tasks. In addition to continuing our cleaning, we need to link our sample of inventors to other data sources, for example, manuscript census returns, so we can control for age and other characteristics. More importantly, we need to extend our knowledge of the inventors' careers by collecting and analyzing information (from *Moody's Manual of Industrial Securities*, the *R.G. Dun Co. Reference Book*, and other sources) on the changing array of companies to which they assigned their patents. For example, one might hypothesize that inventors who founded entrepreneurial companies during the 1920s might have to take employment positions with large firms after the crash. If so, their assignees would increasingly show up among the large firms covered by Moody's. Similarly, one might hypothesize that the credit rating of entrepreneurial firms (observable in the Dun books) would deteriorate after the Great Depression. In addition, *Moody's Manual* covers thousands of relatively small firms in addition to large, national-market enterprises, and we can use this information to track the effect of the depression of firms' balance sheets, on their bond ratings, and more generally on their access to debt and equity markets.

At a minimum, the RA should have a facility with Excel. Once the data are collected and cleaned, if the RA also knows Stata, s/he will be able to participate more fully in the analysis, but there is much that s/he will be able to learn just from manipulating the Excel spreadsheets.