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German Jewish Émigrés and U.S. Invention

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Immigration policy has been the subject of heated debate in the United States. Much of the controversy surrounds low-skill immigration, but high-skill immigration policy is also contentious. One key claim in support of high-skill immigration is that it spurs innovation, but existing evidence is mixed (Hunt and Gauthier-Loiselle 2010, Kerr and Lincoln 2010, and Borjas and Doran 2012).

Our research provides new evidence on this question by examining the impact on innovation of German Jewish scientists who fled from Nazi Germany to the United States after 1932. Historical accounts suggest that these émigrés revolutionized U.S. innovation. In physics, for example, émigrés such as Leo Szilard, Eugene Wigner, Edward Teller, John von Neumann, and Hans Bethe formed the core of the Manhattan project that developed the atomic bomb. In chemistry, émigrés such as Otto Meyerhof (Nobel Prize 1922), Otto Stern (Nobel Prize 1943), Otto Loewi (Nobel Prize 1936), Max Bergmann, Carl Neuberg, and Kasimir Fajans "soon effected hardly less than a revolution. . . . Their work . . . almost immediately propelled the United States to world leadership in the chemistry of life" (Sachar 1992, p. 749).

Alternative accounts, however, suggest that émigrés' contributions may have been limited due to administrative hurdles and antisemitism. Jewish scientists met with a "Kafkaesque gridlock of seeking affidavits from relatives in America [and] visas from less-than-friendly United States consuls" (Sachar 1992, p. 495). Once they were in the United States, a rising wave of antisemitism made it difficult for these scientists to find employment; in "the hungry 1930s, antisemitism was a fact of life among American universities as in other sectors of the U.S. economy" (Sachar 1992, p. 498).

Our paper presents a systematic empirical analysis of how German Jewish émigrés affected U.S. innovation. Taking advantage of the fact that patents are a good measure of innovation in chemistry, because chemical innovations are exceptionally suitable to patent protection (e.g., Cohen, Nelson, and Walsh 2002; Moser 2012), we focus on changes in chemical inventions. By comparison, the contributions of émigré physicists (including those who worked on the Manhattan Project) are difficult to capture empirically because they produced knowledge that was often classified and rarely patented.

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The first component of our analysis compares changes in U.S. patenting by U.S. inventors in the research fields of German Jewish émigrés with changes in U.S. patenting by U.S. inventors in the fields of other German chemists. This approach allows us to control for a potential increase in U.S. invention in fields where German chemists, who had dominated chemical research in the early 20th century, were active inventors. Research fields are measured at the level of 166 United States Patent Office (USPTO) technology classes that include at least one patent by an academic chemist from Germany or Austria between 1920 and 1970. Baseline estimates indicate that the arrival of German Jewish émigrés led to a 31 percent increase in innovation after 1933 in the research fields of émigrés.

These baseline estimates may be biased if the United States attracted more productive scientists or if the émigrés were more likely to work in research fields in which U.S. inventors would become more productive. Historical evidence, however, suggests that émigrés to the United States may have been negatively selected, because Britain, which was geographically and culturally closer to the German university system, was the first refuge for many émigrés (Ambrose 2001, p.215), and universities such as Oxford and Cambridge were keen to offer employment to the most prominent dismissed German scientists.

Historical accounts also suggest that selection into research fields may have been negative because antisemitism in the United States restricted access to the most promising fields. For example, the U.S. chemical firm Du Pont rejected the "father" of modern biochemistry, Carl Neuberg, because he "looked" too Jewish (Sachar 1992, p. 495). According to Hounshell (1988, pp. 295–96), hiring practices in Du Pont's Chemical Department "were flawed in one important respect: A strong strain of anti-Semitism and sexism prevailed. . . . " More generally, Deichmann (1999, p. 3) explains that "biochemists and physical chemists were accepted at American universities, whereas organic chemists were not."

To examine whether our baseline estimates over- or underestimate the émigrés' effects as a result of such patterns of selection, we exploit the dismissal of Jewish scientists by the Nazi government. On April 7, 1933, only 67 days after the Nazis assumed power in Germany, the *Law for the Restoration of the Professional Civil Service* required that "Civil servants who are not of Aryan descent are to be placed in retirement" (*Gesetz* §3). After the annexation of Austria in 1938, dismissals were extended to Austrian universities, so the term "German scientists" includes chemists from both countries.

Our extended analysis uses the pre-1933 fields of *dismissed* chemists as a source of exogenous variation in the fields of émigrés to the United States. Pre-1933 research fields of dismissed German chemists are a good predictor for the research fields of émigré chemists. Moreover, the research fields that a chemist who was dismissed in 1933 chose to *pursue* before 1933 are unlikely to have depended on expectations about the types of research that would become productive in the United States after 1933. Consistent with historical accounts of negative selection, these estimates imply that émigrés generated a 71 percent increase in patenting, suggesting the baseline estimates under- rather than overestimates the émigrés' benefits for U.S. invention.

In the second part of the analysis, we investigate the mechanism by which the émigrés' arrival encouraged innovation in the United States, using a new data set on the patent histories of U.S. inventors in 166 separate fields of chemical invention in our data. This analysis suggests that the arrival of the émigrés encouraged U.S. invention by attracting domestic inventors to the research fields of émigrés, rather than by increasing the productivity of incumbent U.S. inventors. Data on the prior patent histories of entrants into the research fields of émigrés indicate that the majority of entrants had not patented in these 166 classes before 1933, suggesting that émigrés' arrival affected an increase in invention, rather than a shift across fields.

Additional data on the co-inventors of émigrés (and on the co-inventors of co-inventors) suggest that the effects of émigrés on U.S. invention may have been amplified and made more persistent through their effects on a network of co-inventors, who benefitted from collaboration with the émigrés. Co-inventors of émigrés became active patentees in the fields of émigrés especially after 1940, and continued patenting through the 1950s. These patterns suggest that a natural delay in the transmission of knowledge from émigré professors to their U.S. collaborators influenced the timing of the increase in U.S. invention. In addition to co-inventors of the émigré professors, co-inventors of co-inventors of the émigrés also substantially increased their inventive activity in émigré fields after 1933, and remained substantially more productive throughout the 1950s and 1960s.

Finally, in interpreting these results, it is important to remember that we observe only a small, albeit prominent segment of the flow of German Jewish immigrants to the United States. As a first step toward investigating the effects of this broader flow, we document the research activities of a group of more junior German chemists, who had not yet become professors at German universities. Patent data indicate that these more junior scientists were active in the research fields of émigré professors, suggesting these fields are a useful proxy for the fields of a broader movement of German Jewish émigrés.

In sum, our research shows that high-skilled German Jewish immigrants created large and persistent benefits for innovators in the United States. In interpreting these results it is important to keep in mind that the émigrés in our data were exceptionally qualified scientists comparable to present-day academic superstars. Our analysis indicates that policies, which encourage the immigration of such scientists, can be an effective mechanism to encourage innovation.

This Research Brief is based on Moser, Voena, and Waldinger (2013), available at http://www.nber.org/papers/w19962. All works cited are provided there.