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## Effects of Copyrights on Science

### Evidence from the U.S. Book Republication Program

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Copyrights for books, news, and other types of media are a crucial mechanism for promoting creativity and innovation. Yet, with a few recent exceptions, economic analyses of copyrights continue to be rare. Empirical tests face two major challenges: First, the extreme length of modern copyrights (nearly 100 years in Europe and the United States) makes it difficult to observe all but exceptionally durable content off copyright. Second, there is almost no experimental variation in modern copyright laws because changes in copyrights typically occur in response to lobbying, reflected in names like the 1998 U.S. “Mickey Mouse Protection Act” and the European Union’s 2011 “Cliff (Richard’s) Law.”

To address these issues, existing work has exploited quasi-experimental variation in copyright piracy, and no significant effects have been found on sales or on the quality of popular music. Complementary analyses of historical copyright laws indicate that basic levels of copyrights can encourage creativity. Yet copyrights may also cause tremendous losses in consumer welfare by restricting access to existing work or by limiting the reuse of content in future creativity and innovation.

For scientific papers, a growing interdisciplinary literature on open access has shown that articles that are available for free tend to become more heavily cited, suggesting that open access can encourage cumulative science. However, even basic controls for article quality reduce the correlation between open access and future citations, highlighting the need for additional analyses.

Our research exploits a plausibly exogenous historical change in copyright policy as a result of World War II,

under the Book Republication Program (BRP). In 1942, the U.S. Office of Alien Property Custodian appropriated all enemy-owned property in the United States, including German-owned copyrights for books. The Custodian issued temporary (six-month) licenses to U.S. publishers, allowing them to republish the exact content of German-owned science books. At the end of the six months, copyrights reverted to the Custodian, who could license the book again, effectively breaking the monopoly of the copyrights.

To investigate the effects of the BRP on science, we examine changes in citations to all BRP books in the fields of chemistry and mathematics, along with a control group of Swiss books in the same fields.

First, we compare changes in citations to the same BRP book from English-language authors and authors publishing in other languages. This approach mitigates problems of selection by comparing changes in citations by two groups of authors to the *same* book. Most English-language authors were based in the United States and benefited directly from the U.S.-based BRP, whereas authors in other countries were less likely to benefit. Our estimates indicate an additional 80 percent increase in citations to BRP books from English-language authors after 1942, compared with other authors.

Our second, complementary identification approach addresses the potential issue that English-language citations may have increased mechanically after 1942, because the number of English-language articles increased independently of the BRP. To address this issue, we compare changes in citations by English-language authors to BRP books with changes in citations by English-language authors to Swiss books. Like German scientists, Swiss scientists were leaders

in chemistry and mathematics, but because of Switzerland's neutrality, books with Swiss-owned copyrights were not available to the BRP. To mitigate selection, we compare BRP books with Swiss books that have similar levels of pre-BRP (non-English) citations and cover similar research topics. Next, we combine the two strategies by comparing the differential change in citations to BRP books from English-language and other authors with the same differential change for Swiss books. This analysis, which is our preferred approach, implies an additional 67 percent increase in English-language citations to BRP books.

How did the BRP increase citations? The program's most dramatic immediate effect was a significant reduction in the price of BRP books. Under the BRP, U.S. publishers distributed exact copies of the same book for 25 percent less, on average. We exploit this change in price to examine the effects of access cost on cumulative science.

We show that scientists, who depend on access to existing knowledge, produce more new science when existing knowledge is cheap. Each 10 percent decline in the price of a BRP book is associated with 38 percent additional citations by English-language authors. Comparing English-language citations to BRP and Swiss books suggests that each 10 percent decline in price led to a 40 percent increase in citations to BRP books compared with Swiss books. Again combining the two identification strategies, our analysis implies a 46 percent increase in citations for each 10 percent decline in price.

A second implication of cumulative knowledge production is that the effects of lower prices should be larger for disciplines that are more dependent on human, rather than physical, capital. To test this prediction, we compare the effects of price for mathematics and chemistry, two disciplines that varied greatly in their dependence on physical capital. Mathematicians were able to create new work with little more than a pen and paper, whereas chemists required access to laboratory space and other types of physical capital. Comparing mathematics with chemistry confirms differential effects across disciplines: A 10 percent decline in price is associated with an 88 percent larger increase in citations for mathematics than for chemistry.

How did lower book prices increase citations to BRP books? Without digital copies, scientists depend on access to physical copies of library books. A reduction in price should, in principle, have allowed more libraries to buy BRP books

and allowed a new group of scientists to use these books for research. Sales records of BRP publishers show that libraries bought many BRP books.

To systematically examine the role of libraries, we construct data on historical library holdings from the National Union Catalog (NUC). Intended as a search tool, the NUC captures the stock of all books that were available in American libraries in 1956. Our analysis of the NUC data suggests that the BRP helped to diffuse books across the United States, thus allowing less affluent institutions to purchase them.

Next, we investigate when scientists at new locations started to use BRP books. To perform this test, we collect information on loans of BRP books from lending cards that are attached to the back of library books. These data show a striking overlap between the time when a book was first used and our data on citations. Scientists begin to use BRP books around 1946, four years after the BRP. First loans of a book peak around 1955, a striking match to the increase in citations.

To further examine the mechanisms by which lower book prices encourage follow-on science, we connect the locations of citing authors with the locations of libraries that held BRP books. Because the location of BRP libraries is not selected at random, we cannot estimate causal effects in these tests, but the geographic evidence supports the main tests. Scientists within 25 miles of a BRP book began to cite BRP books more after 1942 than scientists who were farther away. Estimates also attenuate with increasing distance from BRP books. Importantly, pre-trends in citations are comparable for nearby and distant locations.

Finally, we construct two alternative measures for changes in follow-on science: new PhDs in mathematics and U.S. patents that use knowledge in BRP books. Data on PhDs confirm the expansion in the geographic scope. An analysis of U.S. patents indicates a 15 percent increase in patents that use BRP books. Importantly, our analysis finds no observable differences in the pre-trends of PhD theses or U.S. patents across locations.

#### **NOTE:**

This research brief is based on Barabara Biasi and Petra Moser, "Effects of Copyrights on Science—Evidence from the US Book Republication Program," NBER Working Paper no. 24255, January 2018, <http://www.nber.org/w24255>.