Research Briefs
IN ECONOMIC POLICY

CATO INSTITUTE

February 6, 2019 | Number 149

Taxation and Innovation in the 20th Century

By Ufuk Akcigit, University of Chicago; John Grigsby, University of Chicago; Tom Nicholas, Harvard Business School; and Stefanie Stantcheva, Harvard University

Major reforms to the U.S. tax code under the 2017 Tax Cuts and Jobs Act have renewed interest in the longstanding question—do taxes affect innovation? If innovation is the result of intentional effort, and if taxes reduce the expected net return, then the answer should be yes. Yet when we think of path-breaking, superstar inventors from history, such as Wallace Carothers (DuPont), Edwin Land (Polaroid), or William Shockley (Bell Labs and Shockley Semiconductor), we often imagine hard-working and driven scientists who ignore financial incentives and merely seek intellectual achievement. More generally, if taxes affect the amount of innovation, do they also affect the quality of the innovations produced? Do they affect where inventors decide to locate and what firms they work for? Do they affect where companies allocate research and development (R&D) resources and how many researchers they employ?

Answers to these questions, while crucial to a clearer understanding of a vexing current policy issue, have remained elusive because of a paucity of empirical evidence. In fact, in the absence of systematic data, ambivalence toward tax policy may stem from a reliance on isolated cases or anecdotes to confirm or reject particular viewpoints. The gap in our knowledge is especially large when trying to understand the impact of tax policy on technological development over the long run. Although the United States experienced major changes in its tax code throughout the 20th century, we currently do not know how these tax changes influenced innovation at either the individual, corporate, or state levels.

We both bridge the data gap and provide new evidence on the effects of taxation on innovation. Our goal is to systematically analyze the effects of both personal and corporate income taxation on inventors as well as on firms that did R&D during the 20th century. To our knowledge, this has

Editor, Jeffrey Miron, Harvard University and Cato Institute

never been done before because of the lack of data. Our analysis leverages three new datasets. First, we construct a panel dataset on inventors based on digitized historical patent data since 1920. These panel data allow us to track inventors over time and observe their innovations, citations, places of residence, technological fields, and the firm (if any) to which they assigned their patents. Second, we build a dataset on firms' R&D activities over the 20th century, specifically the number of laboratories operated and research employment. These data were obtained from National Research Council Surveys of Industrial Research Laboratories of the United States for the period 1921–1970.

Third, we combine the new inventor-level panel data and firm-level R&D data with a new dataset on historical state-level corporate income taxes and a database on personal income tax rates. The corporate tax data were compiled from a range of handbooks and reference works. The result of this extensive data collection effort is a comprehensive historical dataset covering individual inventors, R&D labs and research workers of firms, and taxation at the corporate and personal levels for much of the 20th century in the United States. Because of the richness of our data, we can analyze the impact of taxes on innovation for both individuals and firms.

We provide a conceptual framework to help motivate our analysis and interpret the various effects of taxes on innovation that we identify. This framework has the following intuition: Consider an innovation production function in which the quantity and quality of innovation result from costly investments in research expenses and effort. Inventors can work for firms or be self-employed. Personal and corporate income taxes affect the net return to innovation. Since innovation inputs are costly, they exhibit elasticities to net returns, the magnitudes of which will depend on the market environment. If inventors work for firms, for example, their compensation derives from surplus sharing with the firm. As a result, both firms and their inventors could be responsive to both personal and corporate income taxes. These effects, in turn, may reflect a mix of extensive margin responses (inventors or firms moving across states and individuals making occupational choices and entering or exiting the labor market) and intensive margin responses (inventors choosing how hard to work on their research or companies choosing how many employees to hire).

We begin by describing patterns in innovation and taxation over the 20th century. We focus on key facts in relation to inventors, making use of the new panel data to show where inventors located over time; where firms' R&D labs were placed; and trends exhibited by the time series of patents, citations, and research lab employment. We then document central patterns in taxation on personal and corporate income over the 20th century in the United States, focusing specifically on our newly constructed corporate tax database.

Next, we focus on macro state-level results. We study the baseline relationship between taxes and innovation, exploiting within-state tax changes over time and differences across borders. On the personal income tax side, we consider average and marginal tax rates, both for the median income level and for top earners. Our corporate tax measure is the top corporate tax rate. We find that personal and corporate income taxes have significant effects at the state level on patents, citations, inventors, "superstar" inventors in the state, and the share of patents produced by firms as opposed to individuals. The implied elasticities of patents, inventors, and citations at the macro level are between 2 and 3.4 for personal income taxes and between 2.5 and 3.5 for the corporate tax. We show that these effects cannot be fully accounted for by inventors moving across state lines and therefore do not merely reflect "zero-sum" business stealing of one state from other states.

We then turn to the micro level, which consists of individual firms and inventors. In addition to many detailed inventor-level controls, we exploit within state-year variation. We make use of the fact that inventors of different productivities have different incomes and will therefore be subject to different tax brackets. Again, we find that taxes have significant negative effects on the quantity and quality (as measured by citations) of patents produced by inventors, including on the likelihood of producing a highly successful patent (which gathers many citations). At the individual inventor level, the elasticity of patents to the personal income tax is 0.6–0.7, and the elasticity of citations is 0.8–0.9.

Furthermore, we show that individual inventors are negatively affected by the corporate tax rate but much less so than by personal income taxes. Corporate inventors are much more elastic to personal and corporate income taxes than non-corporate inventors (individual "garage" inventors operating outside the boundaries of firms) and are especially strongly elastic to the corporate tax rate. We also show that an inventor is less sensitive to taxes when there is more agglomeration—that is, more inventors in the same technological field in the state. At the individual firm level, we find that corporate taxes—and, to a lesser extent, personal income taxes—have significant negative effects on the level of patents, citations, and research workers employed in corporate R&D laboratories.

Finally, we estimate a location choice model in which inventors can choose in which state to reside, trading off state characteristics against the effective tax rate in each state. We

find that inventors are significantly less likely to locate in states with higher taxes. The elasticity to the net-of-tax rate of the number of inventors residing in a state is 0.11 for inventors who are from that state and 1.23 for inventors not from that state. Inventors who work for companies are particularly elastic to taxes. Agglomeration effects appear to matter for location as well: inventors are less sensitive to taxation in a potential destination state when there is already more innovation in that state in their particular field of inventive activity. This is also true if an inventor's employer already has a record of innovation activity in that state. We confirm that firms are responsive to corporate taxes when they choose where to locate by estimating a location choice model at the individual R&D lab level.

Our main findings can therefore be summarized as follows: Taxation—in the form of both personal income taxes and corporate income taxes—matters for innovation along the intensive and extensive margins and both at the micro and macro levels. Taxes affect the amount of innovation, the quality of innovation, and the location of inventive activity. The effects are economically large, especially at the macro state level where cross-state spillovers, extensive margin location, and entry decisions compound the micro, individual-level elasticities. Not all the effects of taxes at the macro level are accounted for by cross-state business stealing or spillovers. Corporate inventors are most sensitive to taxation, and positive agglomeration effects play an important role, perhaps by offering a type of compensating differential for taxation.

NOTE:

This research brief is based on Ufuk Akcigit, John Grigsby, Tom Nicholas, and Stefanie Stantcheva, "Taxation and Innovation in the 20th Century," NBER Working Paper no. 24982, September 2018, http://www.nber.org/papers/w24982.