Taxation and innovation in the 20th century

Ufuk Akcigit, John Grigsby, Tom Nicholas, Stefanie Stantcheva 16 October 2018

Understanding how taxation influences innovation is of central importance to create investment incentives for R&D, yet our knowledge remains limited due to a lack of data, especially covering a long period of time. This column uses newly constructed datasets from the 20th century to examine the effects of both personal and corporate income taxation on inventors, as well as on firms that do R&D. It finds consistently negative effects of high taxes on innovation over time as well as on individual inventors and firms.

The 2017 Tax Cuts and Jobs Act represents one of the most significant structural changes to the US tax system in several decades. In light of this legislation, there is intense debate about the potential impact of taxes on the real economy. Taxes have been shown to influence the behaviour of corporations (Chetty and Saez 2005), high-skilled immigrants (Kleven et al. 2014), superstar inventors (Akcigit et al. 2016, Moretti and Wilson 2017), and aggregate economic activity (Zidar 2018). Understanding how taxation influences innovation is of central importance given recurrent efforts by policymakersto create investment incentives for R&D (e.g. Bloom et al. 2003).

Yet, our knowledge ofthe effects of taxation on innovation remains very limited due to a lack of data, especially covering long periods. In a recent paper, we bridge the data gap and provide new evidence on the effects of taxation on innovation (Akcigit et al. 2018). Our goal is to systematically analyse the effects of both personal and corporate income taxation on inventors, as well as on firms that do R&D over the 20th century.

New data collection: Patents, R&D, and taxes

We use new data from the 20th century to show a negative effect of high taxes on innovation. We use three newly constructed datasets consisting of: (1) the universe of corporate and non-corporate inventors who patented since 1920, as well as the citations to their patents; (2) the patents, research employment, and location of laboratory facilities of firms active in R&D; and (3) an historical state-level database of corporate income taxes linked to personal income tax rates from Bakija (2017).

These sources provide us with a wealth of information, such as patents granted to superstar inventors like William Shockley, the Nobel-Prize-winning semiconductor pioneer (Figure 1); the R&D activities of innovative firms like Polaroid, a leading innovator in instant camera photography (Figure 2); and the evolution of personal and corporate taxation over time (Figure 3). These new datasets allow us to focus on the impact of taxes over the course of the 20thcentury and on a multitude of innovation measures, including the quantity, quality, and location of inventive activity.

Figure 1 An example of a patent in our dataset


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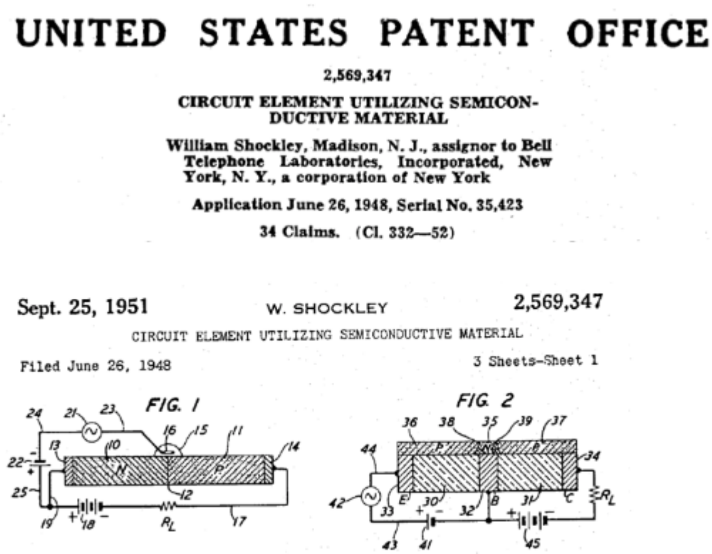

UNITED STATES PATENT OFFICE

2,569,347

CIRCUIT ELEMENT UTILIZING SEMICON-DUCTIVE MATERIAL

William Shockley, Madison, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 26, 1948, Serial No. 35,423

34 Claims. (Cl. 332—52)

Sept. 25, 1951 W. SHOCKLEY 2,569,347

CIRCUIT ELEMENT UTILIZING SEMICONDUCTIVE MATERIAL

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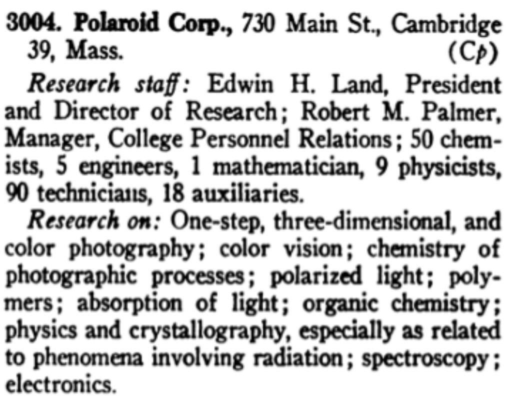
Figure 2 An example of an R&D firm in our dataset



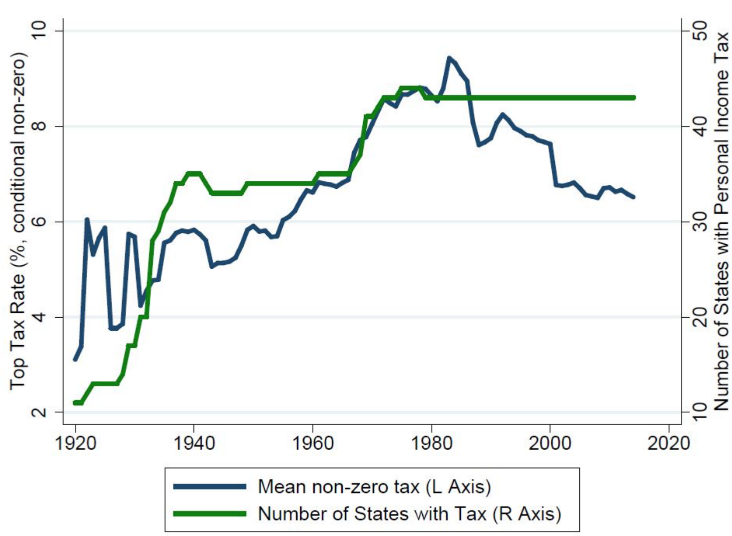
3004. Polaroid Corp., 730 Main St., Cambridge 39, Mass. (Cp)

Research staff: Edwin H. Land, President and Director of Research; Robert M. Palmer, Manager, College Personnel Relations; 50 chemists, 5 engineers, 1 mathematician, 9 physicists, 90 technicians, 18 auxiliaries.

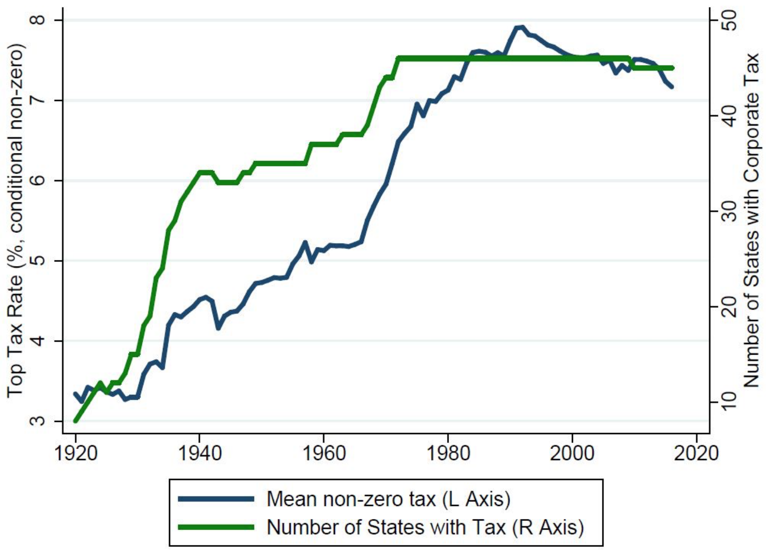
Research on: One-step, three-dimensional, and color photography; color vision; chemistry of photographic processes; polarized light; polymers; absorption of light; organic chemistry; physics and crystallography, especially as related to phenomena involving radiation; spectroscopy; electronics.

Figure 3 The evolution of personal and corporate taxes

Panel A: Personal taxes



Panel B: Corporate taxes



How taxes could influence innovation

There are many channels through which taxes can affect innovation. Suppose that innovation results from costly investments in research expenses and inventor effortand that taxes influence the net return to successful innovations. A prospective inventor can choose whether to work and how much effort to supply. Personal taxes, which reduce the inventor's payoff from this effort, may thereforedetermine the effective supply of innovative expertise in an economy. If, on the other hand, an inventor is employed by a firm, their compensation will depend on how much of the net return they share with the firm. In that case, the firm, as well as the inventor, could respond to both personal and corporate income taxes.

With these types of conceptual arguments in mind, we posit six hypotheses:

- Personal and corporate income taxes can affect both firms and inventors.
- The response to taxation may be shaped by the resource costs required to produce particularly high-quality inventions.
- The impact of taxation may depend on the extent to which innovation requires intentionally directed inputs, and how sensitive those inputs are to net returns.
- Corporate and non-corporate inventors may exhibit different responses, given their differential exposures to corporate and personal tax rates, as well as their motives for innovating.
- Inventors may choose to trade off a higher tax in favour of other factors — for instance, they may prefer to remain in a place with more inventors in general, or more inventors in one's own technology field, to benefit from the associated amenities.
- Tax revenues can lead to investments in infrastructure, which may create environments that are particularly conducive to innovation.

Given that hypothesis 5 implies that taxes may be only one factor in attracting an inventor to a particular location, we estimate how sensitive our estimates are to 'agglomeration' — the tendency of inventors to locate close to like-minded inventors who are active in the same technology area. Because hypothesis 6 implies taxes and innovation may be jointly determined, we employ empirical specifications that attempt to rule out the influence on innovationof confounding policies in a state that may be correlated with tax rates.

Finally, in an effort to establish causality, we use two complementary estimation strategies. First, we employ an instrumental variables approach that exploits differences in pre-existing state tax rates and deductibility rules to predict changes in the total tax burden facing a firm or inventor with changes in the federal tax rate only. Second, we exploit tax variation across neighbouring counties that lie in different states. Both strategies confirm our headline findings, which we summarize below.

Main findings: Taxes do affect innovation

Due to the completeness of our data, we are able to estimate the impact of taxes on states over time (the macro level) and on individual inventors and firms (the micro level).

Macro level

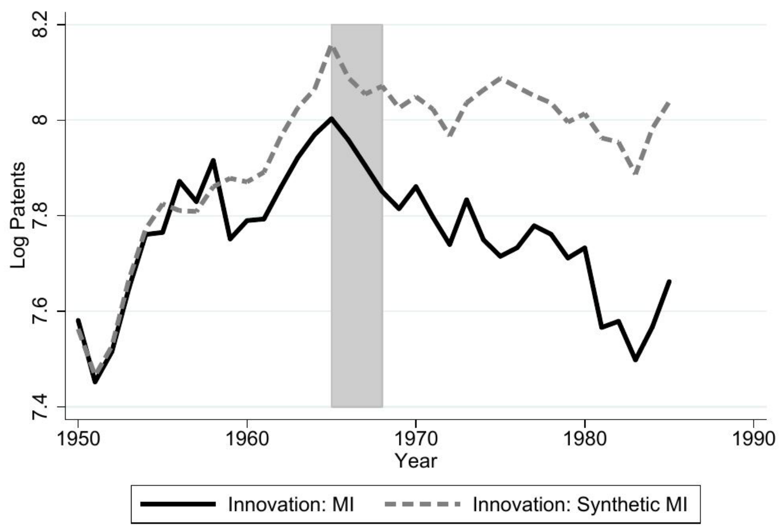
At the macro level, we find that the effects of taxes are strongly negative and quantitatively important. For example, a one percentage point increase in either the median or top marginal tax rate is associated with an approximately 4% decline in patents, citations, and inventors, and a close to 5% decline in the number of superstar inventors in the state. A one percentage point higher top corporate tax rate leads to around 6-6.3% fewer patents, 5.5-6% fewer citations, 4.6-5% fewer inventors, and 8.5-9.3% fewer superstar inventors.

Furthermore, we find that the share of patentsassigned to corporations appears to be extremely sensitive to the corporate tax rate. A one percentage point increase in the top corporate tax rate is associated with close to 1.2 percentage points fewer patents assigned to companies.

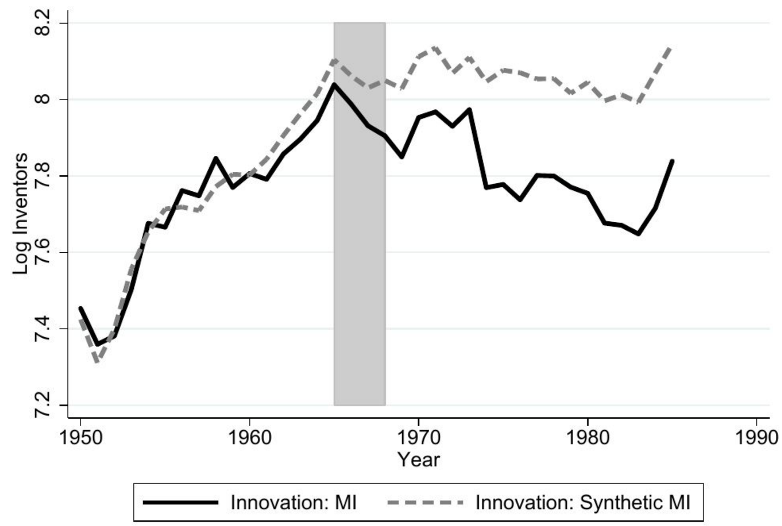
Individual case studies of tax regime changes underscore how important the effect of taxation could be. As one example, Figure 4 shows the depressing impact on innovation of Michigan's 1967 and 1968 tax reform bills. In 1967, Michigan introduced its personal income tax, at a rate of 2.6%. In 1968, it then introduced its corporate income tax, at a rate of 5.6%. In the subsequent years, the state experienced a substantial decline in innovative output relative to its peer states.

Figure 4 Case study of tax reform: Michigan 1967-68

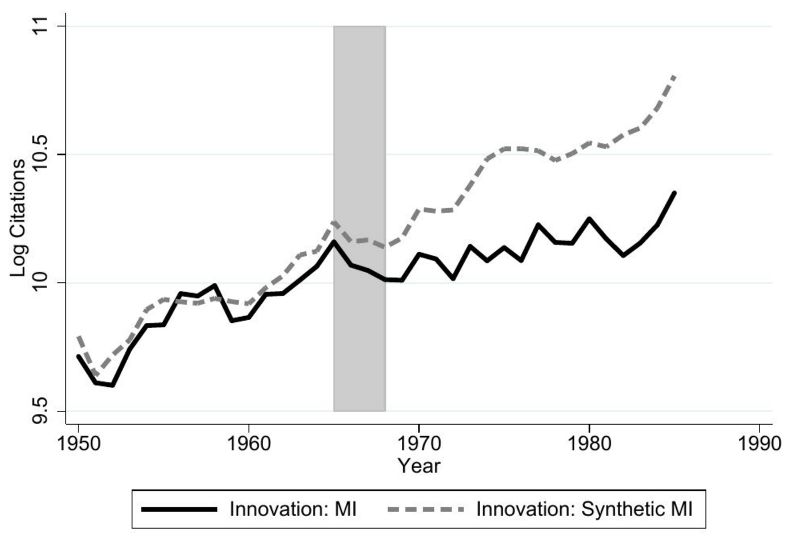
Panel A: Patents



Panel B: Inventors



Panel C: Citations



We also show that while cross-state spillovers (inventors moving across states) and business-stealing (one state might lower its taxes, merely to attract innovation from other states) are important, these factors cannot account for all of the effectsof taxes on innovation that we identify.

Micro level

At the micro level, we similarly find that taxation negatively affects innovation. To estimate the effect, we assign inventors to their tax brackets based on their productivity, which we observe in the patent data. A one percentage point higher tax rate at the individual level decreases the likelihood of having a patent in the next three years by 0.63 percentage points, even controlling for inventor quality and all other state-level policy changes. The likelihood of having high-qualitypatents with more than ten citations decreases by 0.6 percentage points for every percentage point increase in the personal tax rate. We also show that corporate inventors — inventors who appear on at least one patent assigned to a company — are much more responsive to personal and corporate income taxes than non-corporate inventors, consistent with the profit-sharing narrative posited above, as well as with different motives for innovation.

Inventors prefer to locate in places where other inventors are active in their particular technology area. This suggests there are particular characteristics which may matter to inventors, and which can ultimately dampen their responses to taxation. Silicon Valley, for example, still attracts an abundance of tech inventors due to its rich network of capital and labour resources for innovation, despite California being a high tax state.

At the firm level, we find consistently negative effects of taxation on patents and citations. We also find that the top corporate tax rate has a significantly negative effect on the decision of a firm to locate its R&D laboratory in a given state.

Conclusion

Due to an extensive data collection effort, our analysis is unique in its ability to document the effect of taxes on innovation at the macro (state) and micro (inventors and firm) levels during the 20th century. We isolate the economic responses to taxation for critical agents — inventors and R&D firms — finding the effects are strongly negative.

While our analysis presents a number of key findings pertaining to the relationship between taxation and innovation, it also opens up scope for future research. For example, we show that business-stealing across states does not account for all of the effects we identify. But if taxes can have an impact on the international mobility of inventors or firms, business-stealing could also operate at a more global level. Such questions need to be addressed if policymakers are to make fully informed decisions about welfare impacts and the responsiveness of innovation to tax changes.

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