poid Programme on Innovation and Diffusion

General Taxation and Innovation Policies

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General taxation & Innovation: Issues

- Higher taxes reduce returns to income from successful innovation, so the obvious effect of tax is to **reduce** innovation incentives
- So questions include:
  – By how *much* is innovation reduced? “lone genius” model would suggest that there is little effect
  – To what extent do we identify an *aggregate* change or rather a **shifting** of location of innovation across units
    - e.g. does increase in state taxes just shift activity within the US without affected economywide innovation?
- Recent work has focused on <u>individual inventors</u> (as measured by patents) and the incentives they face

Some reasons to think aggregate innovation-tax elasticity might be small in magnitude

- Bell et al (2019, JEEA) model choice of inventor career:

1. A fall in tax rates induces more **marginal** inventors and R&D projects. Since these are lower quality, the aggregate effect is small (Jaimovich and Rebelo, 2017, JPE)
   - "forecastable" innovation

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2. Since innovation is uncertain, it is like buying lottery ticket. For an individual with concave utility, a difference between a $1m and $5m lottery win is not great, so tax impact is small (cf. optimal tax literature)
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   – "unforecastable" innovation
3. Decision to become an inventor depends on information and early motivation/exposure (e.g. evidence in Bell et al, 2019, QJE)

Akcigit, Grigsby, Nicholas and Stantcheva (2022, AGNS in QJE)

- USPTO 1920-2000 (estimate 1940-): Disambiguate inventor names (Lai et al, 2014, to tackle "John Smith" problem). From address know which in state inventors live
- Calculate state-specific Marginal Tax Rates (MTR) for corporations and for individuals
  - For innovators focus on the 90th percentile of income distribution compared to average (e.g. use Bakija, 2006, tax-sim model)
- Estimate at state ("macro") and individual ("micro) level of the effect of taxes (lagged 3 years) on:
  - Inventor counts (including cross-state mobility); Patent counts; Patent quality (citations)

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- **Key Result:** lower general taxes encourage significantly more innovation

States that increases taxes had lower slower growth in innovation

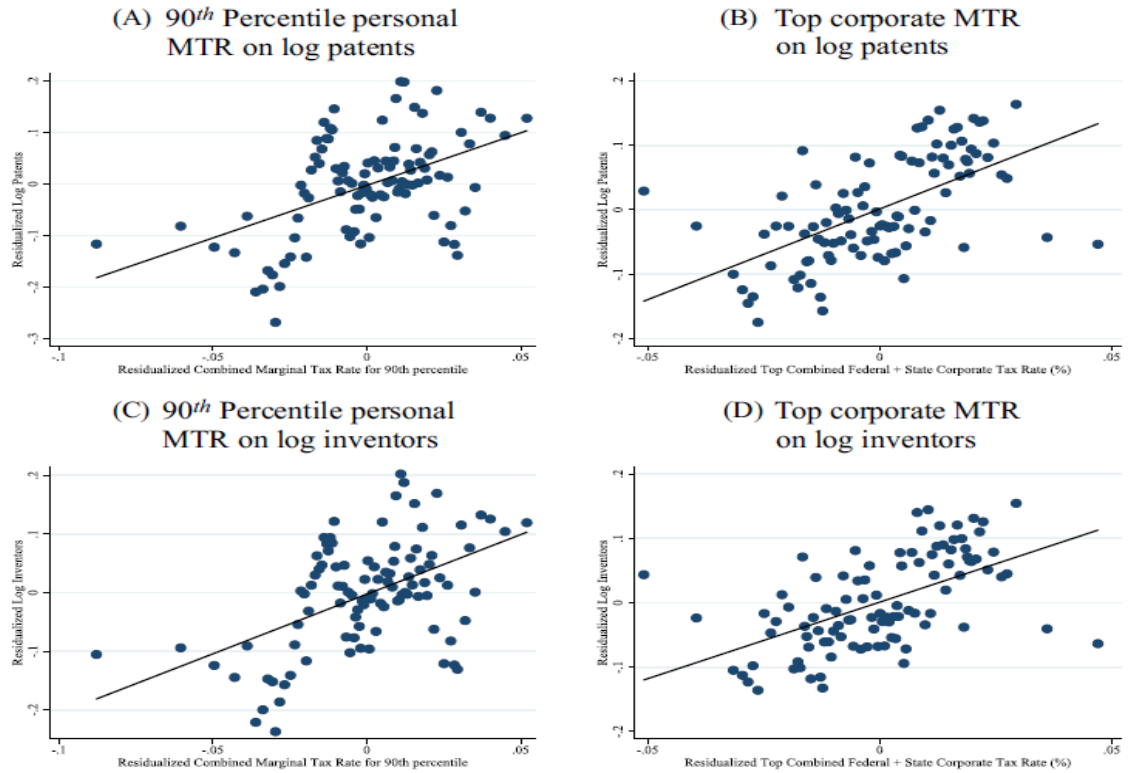

FIGURE I

Binned Scatters

This figure plots binned scatter plots for the effect of taxes at the state level. The top row shows the effect on log patents, and the bottom row shows log inventors. The leftmost column shows the relationship between innovation and the marginal tax rates (MTRs) for the 90th percentile earners, and the rightmost column shows the effect of top corporate MTRs. All tax rates include both federal and state taxes. Both the horizontal and vertical axes are residualized against state and year fixed effects, as well as lagged population density, personal income per capita, and R&D tax credits. Panels A and C also residualize against the lagged corporate tax rate, while Panels B and D residualize against 90th percentile personal income MTR. All mainland U.S. states except Louisiana are included over the period 1940–2000.

Identification concern: other factors change when states change tax burden

- Detailed fixed effects
  - For inventor-level regressions can control for individual fixed effects
- Compare top (argues relevant for inventors) vs. median personal tax. Then can include state by time dummies.
- Gruber-Saez (2002) synthetic IV. Tax burden of firm or individual is a mix of state and federal taxes. Use just the changing federal rules to instrument tax burden, keeping state rules fixed.
- Event studies…

Event studies around large tax reforms (synthetic cohort approach)

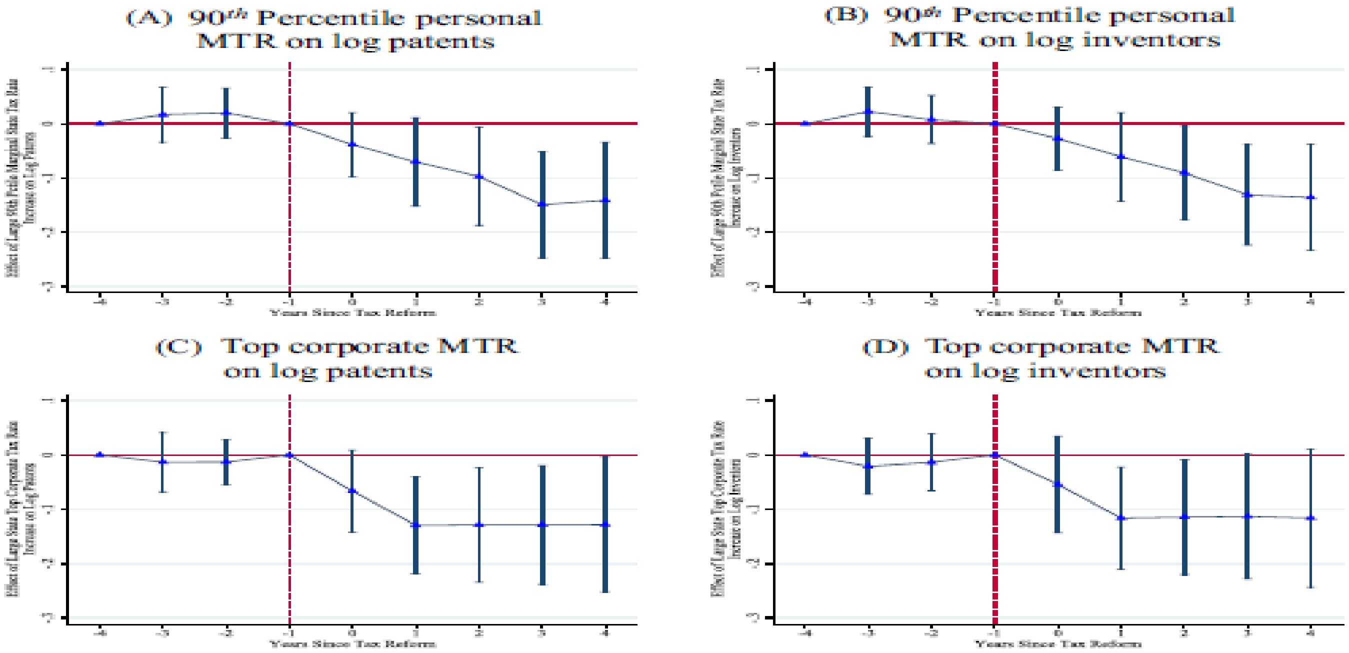

FIGURE III

State-Level Event Studies around Large Tax Reforms

This figure reports estimates of γ_l from equation (9), based on event study regressions around large tax reforms. A large tax reform is defined as being in the top 10% of state tax changes in the period 1940–2000 that does not have another large reform within four years before or after the focal reform. Panels A and B consider state tax reforms affecting the personal tax rate for the 90th percentile earner, while Panels C and D consider large reforms to the top statutory corporate tax rate. We generate a synthetic control state for each reform following Abadie, Diamond, and Hainmueller (2010) by matching on prereform outcomes (patents or inventors), population density, and personal income/capita averaged over the four years before the reform. Only states that do not themselves have a large reform in the event window are eligible to be included in the synthetic control. See Section IV.C for details. All regressions include reform × treatment state fixed effects and relative-year fixed effects and are unweighted. Bars represent 95% confidence intervals using standard errors clustered at the reform level

Elasticity of state innovation (Y) with respect to net-of-income personal tax rate (τ^p), $\varepsilon_{Y,p}$

$$\varepsilon_{Y,p} := \frac{dlog(Y)}{dlog(1-\boldsymbol{\tau^p})} =$$

Share of innovation by **corporate** inventors

$$\gamma_Y^c \varepsilon_{Y,p}^c + (1-\gamma_Y^c)\varepsilon_{Y,p}^p + \gamma_Y^d \eta_p^d + \left(1-\gamma_Y^d\right)\eta_p^o$$

Elasticity of **corp. inventors** innovation wrt personal tax

NB: Analogous expressions for elasticities wrt corporate tax rates

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Mobility effects

Share of innovation by **corporate** inventors

Share of innovation by **Non-corp.** inventors

Share of innovation by **out of state** inventors

Elasticity of **corp. inventors** innovation wrt personal tax

Elasticity of **non-corp.** inventors innovation wrt personal tax

Elasticity of **out-state** inventors mobility wrt personal tax

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Mobility effects

Share of innovation by **corporate** inventors

Share of innovation by **Non-corp.** inventors

Share of innovation by **in-state** inventors

Share of innovation by **out of state** inventors

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Elasticity of **corp. inventors** innovation wrt personal tax

Elasticity of **in-state** inventor mobility innovation wrt personal tax

Elasticity of **non-corp.** inventors innovation wrt personal tax

Elasticity of **out-state** inventors mobility wrt personal tax

AGNS Results

- **Elasticity of patents (citations) to:**
  - Personal net of tax rate is 0.8 (1.0)
  - Corporate net of tax rate is 0.49 (0.46)
    - Corporate taxes do not affect noncorporate (“garage) inventors, but do reduce proportion of inventors working for firms
- **Location choice** is affected: inventors significantly less likely to move to high tax state (but corporate taxes only affect location choices of corporate inventors)
  - Thus, taxes affect mobility. Corporate tax is likely all location choice, whereas personal taxes affect both mobility and aggregate
- No effect of tax on **patent quality** (as measured by citations)

Issue I: Why should personal tax rate matter for corporate inventors?

- Inventors working in firms do not own the IP from innovations they help produce, so why should they be affected by personal tax rates?
- This would not matter with standard competitive models of the labor market, but if the firm shares innovation rents with workers, then personal tax will matter
  - This seems to be true in Van Reenen (1996) and Kline et al (2019) rent-sharing from innovation evidence
  - Exact imperfect competition model still controversial. Does this represent bargaining over surplus or monopsony (wage posting)?

Issue II: Identification

- How well is **extensive** margin captured? When include inventor fixed effects, this conditions on people who are inventors at some point in their lives.
  - What about those who could have invented, but did not? (this is key to "Lost Einstein" work in Bell et al, 2019a,b)

- Where are inventors in the income distribution? They use the top 10% in citation distribution for the top inventors (assume these are at p90 in income distribution) and use p50 for the rest
  - Just using p90 seems very crude – could do much better using inventor income distribution
  - Even bottom 90% of citations do better than p50 worker

Issue III: Firm Incentives

- Link to existing firm R&D tax credit literature vague
- R&D tax credits are "controlled for", but not integrated into the analysis (e.g. higher corp tax rate makes them *less* valuable)
- Major US firms operate across many states (and indeed countries). Within such a multi-state firm, why would a corporate tax cut in one state generate more incentives to do more **innovation** in that state?
  - Indeed, logic of R&D tax credit says the opposite (state R&D credits *less* valuable when statutory rate cut)

Issue IV: Aggregate effects

- Unclear that aggregate effects can be cleanly identified
  - AGNS conclusion comes from comparing state-level elasticities to aggregates of individual level, but unclear how to do correct aggregation
- Moretti and Wilson (2017) also find much relocation of star scientists from state-specific personal & corporate taxes
- Akcigit, Baslandze and Stantcheva (2016) look at international mobility of inventors 1977-2003 in EPO, USPTO, PTC
  - Use citations to stratify inventors in top 1%, top 1-5%, 5-10%, etc. Then construct counter-factual income in different countries
  - Elasticity of number of domestic (foreign) superstars to net of tax rate is 0.03 (1.00)

Policy implications

- Risk of beggar-thy-neighbor tax policies since much of effects are re-location, so zero-sum game.

- **Note:**
  - AGNS find that tax elasticities are lower when state has more innovation in their field
  - Akcigit, Baslandze and Stantcheva (2016) find tax elasticities are lower when inventors' company performs more R&D there

- Implies that building up amenities/research infrastructure may be a better way of reducing risk of "brain drain" than just cutting taxes

Conclusions

- Standard approach is to focus on **firms** and how their R&D incentives are influenced by changes in corporate tax rates and base (including R&D tax credits)
  - Can be done in a sophisticated way via details of tax code and tax-adjusted user cost

- Alternative approach to focus on how **individual** incentives are shaped by personal (and corporate) tax rates
  - Can use tax-sim models to do this, but less clear theoretically why these should matter

- AGNS do find some evidence for effects of top taxes on innovation. How general?

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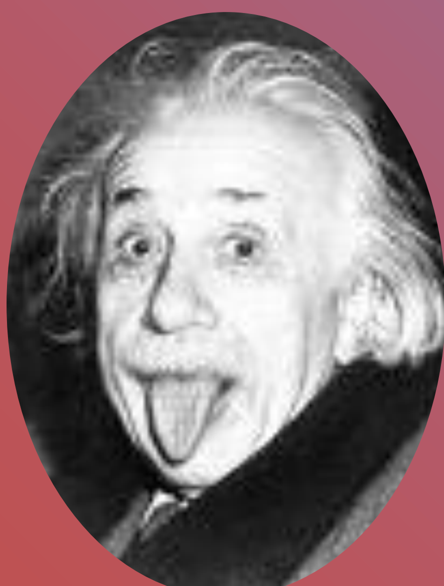

Summary of AGNS

	Individual Level		*State level*		*Relocation*	
	Individual income tax	*Corporate income tax*	*Individual income tax*	*Corporate income tax*	*Individual income tax*	*Corporate income tax*
Individuals (garage)	-ve	0	-ve	-ve	+ve 0.72	+ **0.6**
Individuals (corporations)	-ve	-ve	-ve	-ve	0	+ve 1.25
All individuals	0.8	0.49	0.8-1.8	1.3-2.8		
Corp share		0.6				

Note: Numbers are elasticities wrt net of tax income; -ve means a significantly negative coefficient, etc.