API-203MZ Final Exam Review

This semester you learned the features and drawbacks of different policy research methods. On the final exam, you will use the insights you gained in class to critically evaluate three research papers to advise your boss on a course of action. Today we will prepare by considering the following scenario:

You work for a legislator who is deeply concerned about the future of innovation in your country. Your boss wants to drive up research and development (R&D) spending and is interested in promoting policies to foster R&D. She asks you to prepare a report that summarizes the evidence on **the effect of R&D tax credits on small firms** and provides a single number describing the effect of R&D tax credits on aggregate R&D spending and your level of confidence in that number (from 0 to 100%).

There are many studies on the effects of R&D credits on R&D, but we will focus on two. We want to consider (1) the setting that the researchers are studying, (2) the methods they are using to study it – including the modeling assumptions they make, (3) the key internal validity concerns, and (4) how the findings relate to our scenario, i.e. external validity.

Study 1

Tax Credits and Small Firm R&D Spending (2020) by Ajay Agrawal, Carlos Rosell, and Timothy Simcoe

In 2004, Canadian-controlled private corporations (CCPCs) with prior-year taxable income between C$200,000 and C$500,000 became eligible for a fully refundable 35 percent R&D tax credit on a larger amount of qualifying R&D expenditures. We show that firms eligible to benefit from the more generous policy spent more on R&D following the change compared to firms with the same taxable income before the change. Specifically, eligible firms increased their R&D spending by an average of 17 percent.

- What was the policy?
  - SRED, a fully-refundable tax credit for R&D. [1]
- Who was affected?
  - Firms with prior-year taxable income between C$200,000 and C$500,000.
- Where and when did the policy go into effect?
  - Canada in 2004.
- How did the researchers analyze the policy?
  - Difference-in-differences comparing the change in R&D for firms that became newly eligible for the increased credit based on prior-year taxable income.
- What concerns do you have about **internal validity?**
  - Parallel trends assumption: Firms that become newly eligible would have followed the same trend in R&D expenditure as other firms if they had not received the tax credit.
    - Do firms manipulate their taxable income to become eligible for the increased credit? If so, would those firms have increased their R&D expenditure even without the credit?

[1] A refundable tax credit can result in negative tax liability for firms, whereas a non-refundable credit cannot result in tax liability less than 0.

    - Paper shows no clear pre-trends but we cannot rule out non-parallel trends in counterfactuals.
  - Spillovers/SUTVA violation: Do potential outcomes (R&D expenditures) depend on tax credit eligibility of other firms?
    - An increase in one firm's R&D may produce knowledge spillovers that reduce other firms' R&D. This could happen if the policy causes Firm A to spend $1 million on R&D to invent a lower cost way to produce widgets and Firm B (which would otherwise have made the same investment) appropriates that knowledge, decreasing Firm B's R&D by $1 million.
- What concerns do you have about **external validity?**
  - Setting (the obvious one): You may not be working for a Canadian legislator in 2004.
  - ATT: diff-in-diff estimates the effect of credit eligibility for firms affected by the treatment. Are you interested in the effect firms with zero taxable income? More than C$500,000? What would happen if we expanded this policy to other firms?
  - Policy specifics: do you need to know the effect of a refundable credit? Do you need to know the effect of a larger/smaller credit?
- What does this study say more generally about the effect of tax credits on R&D? And how much should we trust that?
  - Compare estimates across studies: if I decrease the cost of R&D by 1% how much does this increase R&D spending, i.e. what is the cost elasticity of R&D?
  - Paper uses an economic model to calculate a range of elasticities given different assumptions. Let's suppose the true elasticity is -1.5, so that a 1% decrease in cost results in a 1.5% increase in spending.
  - Implies large response to refundable tax credits. How much of this is due to modeling assumptions? How much due to sampling fluctuations?
  - Z score > 3, implying this is a fairly precise estimate, let's say we're 95% certain in this estimate.

Study 2

Do Tax Incentives for Research Increase Firm Innovation? An RD Design for R&D by Antoine Dechezleprêtre, Elias Einiö, Ralf Martin, Kieu-Trang Nguyen, and John Van Reenen

We present evidence of a causal impact of research and development (R&D) tax incentives on [small firm] innovation. We exploit a change in the asset-based size thresholds for eligibility for R&D tax subsidies and implement a Regression Discontinuity Design using administrative tax data on the population of UK firms. There are statistically and economically significant effects of the tax change on both R&D and patenting… R&D tax price elasticities are large at about -2.6, probably because the treated group is from a sub-population of smaller firms and subject to financial constraints. There does not appear to be pre-policy manipulation of assets around the thresholds that could undermine our design…

- What was the policy?
  - Refundable tax credit that allowed firms to deduct additional R&D expenditure from taxable income.
- Who was affected?
  - Small and medium enterprises.
    - Assets less than €43 million before August 2008, then increased to €86 million.
- Where and when did the policy go into effect?

  - UK in 2000.

- How did the researchers analyze the policy?
  - Regression discontinuity at the new threshold of €86 million.
- What concerns do you have about **internal validity?**
- What concerns do you have about **external validity?**
- What does this study say more generally about the effect of tax credits on R&D? And how much should we trust that?
  - Elasticity is -2.6.
  - Standard errors are large, reflecting uncertainty in true value. Let's say we're 70% certain in this estimate.

Summary of Evidence

These studies both suggest R&D is quite responsive to tax credits, with an elasticity greater than 1. How much weight should we give to each study? Internal validity is likely quite high in Dechezleprêtre et al. (the RD study), but estimates apply directly only to firms with €86 million in assets. On the other hand, a parallel trends violation of the diff-in-diff design in Agrawal et al. seems possible despite no pre-trend. Moreover, Agrawal et al. also only applies to a limited group of firms.

The weights you choose should reflect your concerns about the studies' internal validity and the external validity of the studies to the scenario your boss is considering. For example, reasonable weights to assign to these two studies might be 40% to Study 1 and 60% to Study 2.

Weighting the elasticities accordingly, you tell your boss that a credit that reduces R&D costs by 10% would increase R&D spending by 21%. "Wow! And how confident in that are you?" she asks. "I'd say about"80% certain."