

Intellectual Development Statement

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My research informs how government intervention can help alleviate market failures and how different ways to finance the government impact firms and workers. Beyond characterizing the effects of policy changes, my research improves our understanding of economic phenomena that range from measuring how much people value public goods to how much firms respond to R&D subsidies by misreporting their expenses. These insights inform recent economic trends, such as why workers locate in certain areas, or why the contribution of R&D investment to economic growth may be declining. Overall, my research is guided by two principles: (1) a desire to inform debates over important policy questions at the regional, national, and international levels, and (2) the use of economic models to gain insight into economic behavior and market outcomes.

Before delving into the details of my research agenda, I first provide an overview of recurring themes in my research. I then describe each of my strands of research.

1 An Overview of Themes in My Research

I categorize my 19 papers and 3 works in progress into five themes in Table 1. Panel A of this table shows that most of my papers (17/22) analyze issues related to government spending or corporate taxation at the state, federal, and international levels, or in China. My dissertation (Section 2, [#1,11])¹ was devoted to studying causal effects of federal spending on local economic activity. My research as an assistant professor (Section 3, [#2,3,13,16]) built on this work by studying the local and aggregate effects of state business taxation. These papers, which were completed mostly pre-tenure, develop new models of spatial equilibrium that address the roles of tax incentives and amenities from public services.

My work as an associate professor builds on these areas of research in a number of ways. First, my recent work studies how local governments can use municipal bonds and property taxes to finance local public goods (Section 4, [#5,8]). Second, I expand my research on business taxation by studying the impact of corporate taxes on investment and worker outcomes (Section 5, [#7,10,18,21]). Third, I also build in this area by investigating how multinational corporations respond to international taxes and tax policies (Section 6, [#6,17,20,22]). My most recent work studies how governments can best incentivize activities with positive externalities, such as R&D investment, or discourage those with negative externalities, such as pollution emissions (Section 7, [#4,9,19]). Finally, Section 8 describes three of my research papers that contribute to other areas of economics [#12,14,15].

Panel B of Table 1 shows that the two outcomes I analyze most often are firm responses to taxation, including investment and firm location, and the effects of fiscal policies on local labor

¹Bracketed numbers refer to papers in the references, as in [#1] for Suárez Serrato and Wingender (2016). This list ranks papers in order of importance and coincides with my list of “Top 10 Contributions.”

Table 1: Overarching Themes in My Research

Theme	Sub-Theme	Papers	
<i>A. Topics</i>	Government Spending:	Federal	1, 11
		State and Local	3, 5, 8
	Corporate Taxation:	Federal	10, 21
		State	2, 3, 13, 16
		International	6, 17, 20, 22
Energy Regulation	4, 7, 18		
Other	9, 19		
		12, 14, 15	
<i>B. Outcomes</i>	Firm Taxation, Location, and Investment	2, 3, 4, 6, 7, 9, 10, 13, 16, 17, 18, 19, 20, 21, 22	
	Local Labor Markets	1, 2, 3, 6, 8, 10, 11, 22	
	Evasion and Real Effects of Misreporting	4, 6, 8, 14, 17, 20, 22	
	Incidence of Spending or Taxation	2, 3, 5, 11, 16, 21	
<i>C. Methods</i>	Develop and Test Explicit Theory	2, 3, 4, 5, 6, 7, 8, 9, 11, 14, 21, 22	
	Structural Estimation and Policy Simulation	2, 3, 4, 5, 7, 8, 11, 21	
	Reduced-form Estimation	1, 10, 12, 13, 15, 16, 17, 18, 19, 20	
<i>D. Related Fields</i>	Labor	1, 2, 3, 6, 10, 11, 14, 21, 22	
	Development	4, 7, 8, 9, 14, 18, 19, 20	
	Urban	2, 3, 5, 6, 8, 10, 11	
	Macroeconomics	1, 3, 4, 7, 21	
	Innovation/Entrepreneurship	2, 4, 6, 13	
	Industrial Organization	4, 5, 9, 19	
	Trade	3, 4	
	Environmental/Energy	9, 19	
	Applied Econometrics	10	
	Experimental	15	
<i>E. Co-Authors</i>	Junior / Solo	1, 2, 3, 6, 8, 10, 11, 12, 13, 14, 15, 16, 17, 20, 21, 22	
	Senior	4, 5, 7, 9, 18, 19	
	Graduate Student	5, 7, 10, 15, 17, 18, 21, 22	

Notes: Bracketed numbers refer to papers in the references.

markets. Seven of my papers document examples of misreporting, and how this behavior interacts with government policies. For instance, multinational corporations may misreport the location of their profits to avoid corporate taxation. These papers study how government efforts to limit misreporting affect real economic outcomes, such as investment or employment. Finally, six of my papers focus on estimating the economic incidence of taxes or spending programs. These papers answer the question: who benefits from a particular fiscal policy?

My research combines new empirical evidence with models of economic behavior. Panel C in Table 1 shows that most of my papers (12/22) develop a specific theoretical model and then test its empirical implications. Eight of my papers go further by estimating structural models and simulating the effects of counterfactual or actual policies. This blend of data and theory allows me to quantify the effects of fiscal policies on the welfare of different economic actors. While these

papers account for most of the papers in my list of “Top 10 Contributions,” the methods I use in each paper depend on the approach that is best suited for the particular policy question. In some cases, my work provides new reduced-form evidence that informs important policy debates, as in the cases of policies that aim to stimulate business investment through tax cuts or local economic growth through government spending [#1,10].

Another overarching theme of my research is that I integrate methods and models from different fields within economics. This inter-field approach allowed me to use quantitative trade models to measure the aggregate effects of state taxes in the US [#3]; to estimate the effects of tax subsidies for R&D in China using a structural model of investment [#4]; to estimate empirical auction models when studying the market for municipal bonds [#5]; and to estimate dynamic models of investment when studying the effects of tax policy on corporate investment [#7].² Beyond using tools from other fields, I find that bringing new perspectives to problems in public finance yields insights that can be overlooked by specialists in the field.

Finally, Panel E of Table 1 shows that 16/22 of my papers were started with co-authors who were juniors when we began collaborating, while six of my papers are co-authored with senior colleagues at Duke. Eight of my papers also include PhD students I mentor as co-authors.

The rest of this statement describes how each of my research projects combine empirical evidence with economic analysis to measure the effects of fiscal policies and to deepen our understanding of economic behavior.

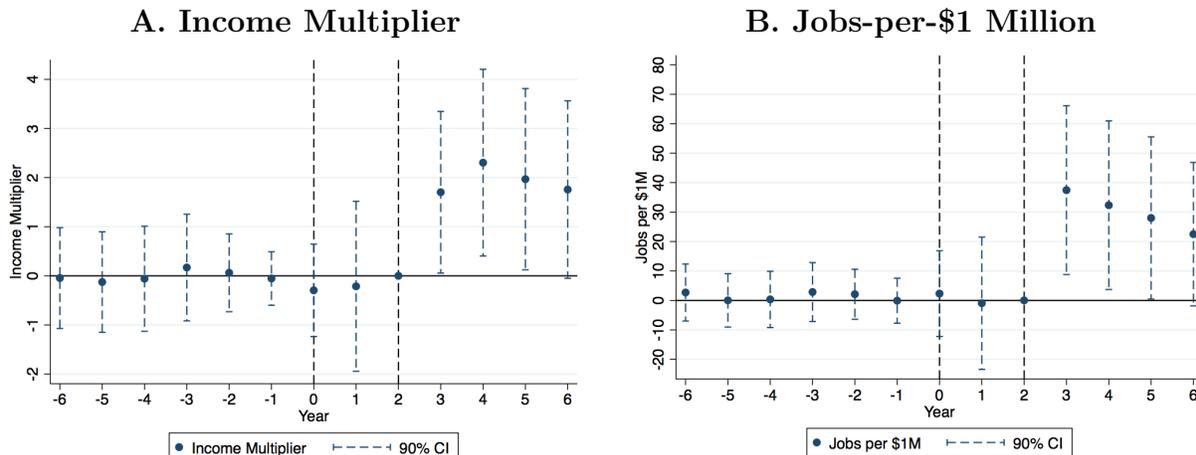
2 Estimating the Impacts of Government Spending

Recent economic crises have renewed policy interest in the classic question of whether government spending can reactivate the economy. Answering this question is complicated by the paucity of experiments where the government changes spending levels irrespective of the state of the economy. Previous approaches that relied on time-series data to answer this question lacked statistical precision and were subject to the critique that the change in spending was driven by the state of the economy. My dissertation contributed to this important debate by proposing a new source of cross-sectional variation to identify causal impacts of government spending on the economy.

In “Estimating Local Fiscal Multipliers” [#1] with Philippe Wingender, we use the fact that a large number of federal spending programs depend on local population levels. Every ten years, the Census provides a count of local populations. Since a different method is used to estimate non-Census year populations, this change in methodology leads to variation in the allocation of billions of dollars in federal spending. This approach solves the two problems that plagued the previous literature. First, by studying variation in federal spending that results from errors in the

²To be clear, I only consider myself an expert in public finance. These insights are the result of collaborations with a set of wonderful coauthors who specialize in other fields. However, this inter-field approach has been fruitful as my research [#1] has contributed to the debates over the macroeconomic effects of the stimulus package (Ramey, 2011), and other work [#4] has been included in review of recent work of the International Trade and Investment Program of the NBER (Feenstra, 2016). Similarly, along with my co-authors, we have presented projects across several NBER program meetings including Development, Entrepreneurship and Innovation, Public Economics, Macro Public Finance, State Business Taxation, Urban Economics, the Chinese Economy, and Economic Growth and Fluctuations.

Figure 1: Estimates of Local Fiscal Multipliers [#1]



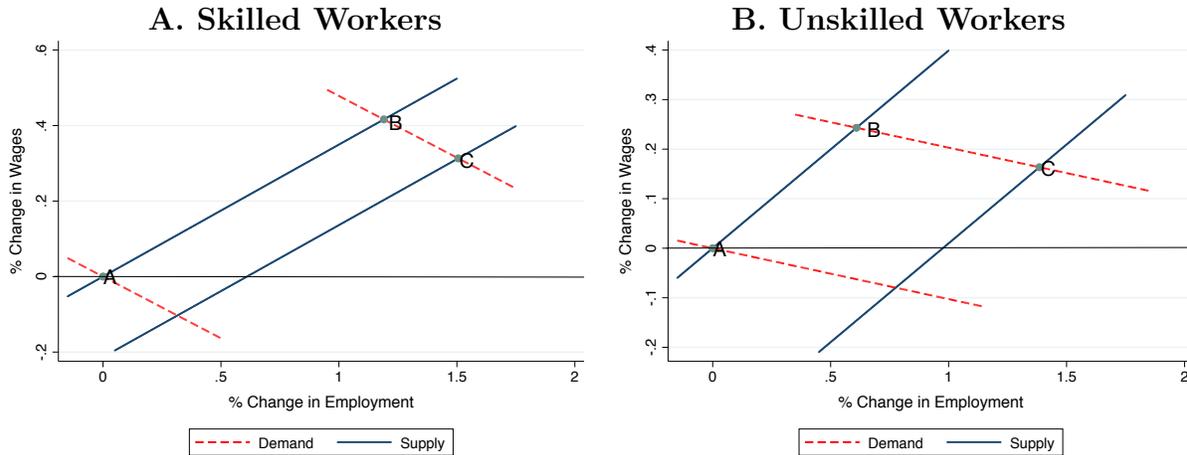
measurement of local population, we avoid using changes in spending that are driven by the local economy. Second, by using a cross-sectional approach, we are able to precisely estimate the effects of spending on the local economy.

Figure 1 displays our estimates of fiscal multipliers. These results follow from a treatment-effects framework where we estimate the effect of a Census Shock on federal spending, income, and employment growth by re-weighting the data based on an estimated propensity score. A positive Census Shock infuses additional federal funds to local economies starting two years after the decennial Census is conducted. Panel A of Figure 1 shows that once federal funds reach local labor markets, we see an increase in local income between \$1.7-2 for each additional dollar of federal funds. Panel B shows an increase of about 30 additional jobs for every million dollars of funds, which implies a cost-per-job created of \$30,000. A complementary instrumental variables strategy yields similar estimates.

Over a short period of time, data on employment and income provide a good approximation to social welfare. However, when considering persistent changes in government spending, public services may affect workers' overall well-being as well as their location decisions.

In “Estimating the Incidence of Government Spending” [#11] with Philippe Wingender, we consider how public services affect worker welfare by using the Census Shock from [#1] and a spatial equilibrium model to analyze the long-term effects of government spending. The logic of spatial equilibrium is that, as economic conditions in some regions improve, individuals with low attachment to other regions will migrate to locations where the economy is improving. This internal migration equilibrates local wages and costs of living, as the inflow of workers lowers wages and increases the demand for housing. From a long-term perspective, it is then unclear whether government spending will improve local economic conditions, such as real wages, whether workers or homeowners would be the main beneficiaries from additional spending, or how additional spending would affect inequality.

In this paper, we first show that sustained changes in federal spending have significant effects on migration, income, wages, and rents. However, the effects of government spending are different from

Figure 2: Estimated Effects of Federal Spending on Labor Demand and Supply [#11]

other changes in local economic conditions, such as labor demand shocks. Specifically, government spending leads to larger changes in migration and smaller changes in real wages (i.e., wage measures that account for local costs of living).

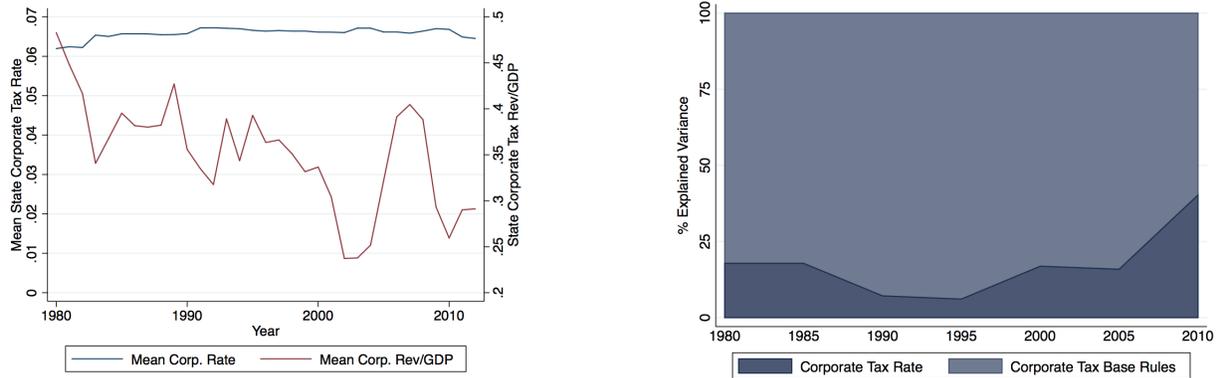
To explain these facts, we develop a spatial equilibrium model that shows that when workers value public services, a change in government spending at the local level affects equilibrium wages through shifts in both the labor demand and supply curves. Figure 2 plots estimated effects of government spending on the market for skilled (college-educated) and unskilled workers, and shows that the total change in employment and wages (from A to C) is due to two channels. First, additional spending increases labor demand, which shifts the down-ward sloping red lines, and which increases employment and wages (from A to B). Second, if workers value public services, they will be more likely to locate in areas with additional spending, which shifts the supply of labor. These shifts in the blue upward-sloping labor supply curves from B to C increase employment but reduce wages. These relative shifts in labor supply in fact reveal workers' monetary valuation of government services. According to Figure 2, unskilled workers have a larger shift in labor supply, which indicates that unskilled workers have a higher valuation of government services than skilled workers. Overall, our estimates imply that an additional dollar of government spending increases welfare by \$1.45 in the median county, and that 63% of this effect is due to workers' consumption of government services.

3 How State Business Taxes Impact Economic Activity and Inequality

Local and state policymakers are in perennial competition to attract companies to their jurisdictions. Proponents of using business tax cuts as incentives for firm location argue that increases in job creation justify losses in revenue, while detractors of these policies argue that incentives have little economic impact and mostly benefit firm owners. This section describes how my research as an assistant professor contributed to our understanding of how state business taxes impact economic

Figure 3: The Structure of State Corporate Taxation [#13]

A. Revenues and Tax Rates Over Time B. The Explanatory Power of the Tax Base



activity and inequality.

In “Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms” [#2] with Owen Zidar, we provide new empirical evidence of the effects of corporate taxes on local economic outcomes and develop a new framework to quantify the incidence of business tax cuts between firm owners, land owners, and workers.

This paper begins with the observation that previous models of corporate taxation and spatial equilibrium were not able to answer this question. Models of corporate taxation usually assume that firms earn zero profits, which implies that firm owners are never able to benefit from business tax cuts. On the other hand, models of spatial equilibrium assume a single firm in each location, which obviates a meaningful role for firm location incentives. We develop a spatial equilibrium model with imperfectly mobile firms and workers. Firm owners may earn profits and may be infra-marginal in their location choices due to differences in location-specific productivities. This modeling innovation allows the answer to this important question to be informed by the data.

We provide empirical evidence that tax cuts are associated with an increase in the number of local firms. Moreover, as firms locate in areas with lower taxes, there is an increase in employment, wages, and rents. We use the reduced-form effects of tax changes to identify and estimate incidence as well as the structural parameters governing these impacts. In contrast to standard models, we find that firm owners bear roughly 40% of the incidence, while workers and landowners bear 30-35% and 25-30%, respectively. This implies that, while business tax cuts may grow the local economy, the benefits of the tax cut fall disproportionately on relatively wealthy firm-owners. In contrast, the burden of sales taxes, which are often used to counterbalance the reduction in revenue from business tax cuts, falls disproportionately on lower-income workers.

While states compete for businesses by lowering tax rates, they also attract them by providing tax credits and generous deductions. In “The Structure of State Corporate Taxation and its Impact on State Tax Revenues and Economic Activity” [#13] with Owen Zidar, we provide a reassessment of the state corporate tax structure — tax rates and tax base rules — and document how it has changed over time. As Panel A in Figure 3 shows, the average state corporate tax rate has remained relatively stable over the last three decades. In contrast, the ratio of corporate tax revenue to state

GDP has mostly decreased during this period.

This paper shows that tax base rules (such as loss carry forward provisions and investment tax credits) explain more of the variation in state corporate tax revenue to GDP than changes in state corporate tax rates. Panel B of Figure 3 shows that changes in the structure of the state tax system explain between 60-90% of the explained variation in corporate tax revenues. In particular, the trend toward narrower state corporate tax bases helps explain the reduction in corporate tax revenues as a share of GDP in Panel A. This result shows that relatively obscure changes in policy may be more important for state finances than well-debated changes in state tax rates. Overall, we find that the changes in the structure of the corporate tax system have been favorable for corporations, and are reducing the extent to which tax rate increases raise corporate tax revenue.

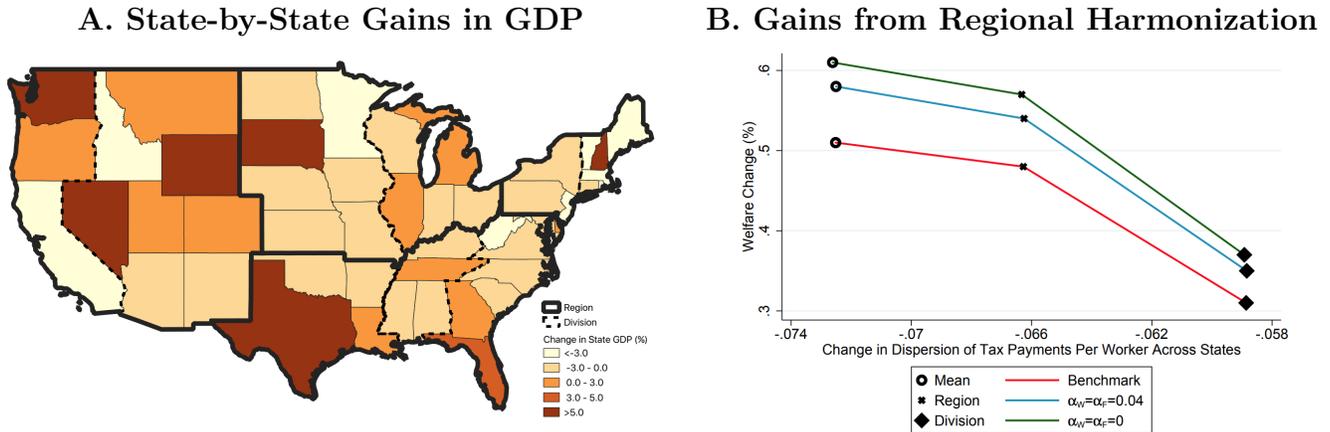
In [#2], we use the machinery of a spatial equilibrium model to quantify the degree to which changes in taxes affect inequality. After the publication of that paper, Frank et al. (2015) published a new data series measuring income inequality at the state-year level. These data allow us to directly ask the question: do corporate tax cuts increase inequality? In work with Ethan Rouen and Suresh Nallareddy, we use regression and matching techniques to provide empirical evidence that “Corporate Tax Cuts Increase Income Inequality” [#16]. Specifically, we estimate that a one percentage point (pp) state corporate tax cut increases the share of income to the top 1% of the income distribution by 1.5pp. Since the share of income accruing to the 1% increased by 6.1pp between 1990-2010, this implies that the average tax cut of 0.5pp was responsible for 12.4% of this overall increase in inequality. This result confirms the message from [#2] that landowners and business owners gain the most from business tax cuts.

Analyzing the regional effects of changes in spending and taxes allows us to use policy changes as plausibly exogenous natural experiments to measure the effects of fiscal policy on economic activity. The drawback of this approach is that reduced-form regional analyses are not able to measure the aggregate consequence of policy changes. In “State Taxes and Spatial Misallocation” [#3] with Pablo Fajgelbaum, Eduardo Morales, and Owen Zidar, we quantify the nation-wide effects of fundamental tax reform across states by combining the insights from [#11] and [#2] with a quantitative model of trade between the states.

One of the insights from [#2] is that when firms choose a location, they trade-off higher productivity, which is partly location-specific, with lower taxes and production costs. Thus, a location that lowers its taxes attracts more firms that were, on the margin, more productive elsewhere. While the local increase in jobs may benefit the local population, the aggregate consequences may be negative on net, as overall productivity and employment may decrease. This paper tackles this question by studying whether the wide variation in taxes we observe across states generates spatial misallocation in the United States.

To answer this question, we build a spatial general-equilibrium framework that incorporates salient features of the US state tax system. Importantly, the model allows us to compute national-level effects of reforms that limit cross-state competition in business taxation, as well as to simulate the effects of specific aspects of the Tax Cuts and Jobs Act of 2017 (TCJA). The model includes the amenity value of public services in [#11]. This feature allows us to compute the effects of tax reform on worker welfare, accounting for the fact that some states may be under-providing public

Figure 4: Aggregate Gains from Tax Harmonization [#4]



goods due to cross-state tax competition. Finally, we implement the model by using changes in state tax rates between 1980 and 2010 to estimate the model parameters that determine how worker and firm location decisions respond to changes in state taxes and government spending.

We find that state differences in tax rates generate spatial misallocation, which leads to aggregate losses in GDP and welfare. Specifically, worker welfare increases by 0.6 percent when we simulate the effects of harmonizing taxes across states while holding spending constant. The gains to workers are twice as large when government spending responds endogenously to the changes in taxes. Panel A in Figure 4 shows how the gains in GDP are distributed across states. While there is considerable variation in effects, states that experience large increases in government spending, such as Texas, Florida, Nevada, and New Hampshire, experience the largest gains from harmonization. Panel B shows that most of the gains from tax harmonization can be achieved by harmonizing state taxes within Census regions.

In addition to studying the effects of tax harmonization, the model allows us to simulate a component of the TCJA: the new limit on the state and local tax (SALT) deduction. Prior to the TCJA, taxes paid to state and local governments were deductible from federal income taxes. This policy effectively subsidized taxes in states with higher tax rates, but it also reduced the dispersion in taxes across states. We find that removing the SALT nearly doubles the standard deviation in average effective personal income tax rates across states. This increase in tax dispersion lowers welfare by 0.75 percent.

Taken together, my papers [#2,3,11] provide new frameworks to evaluate the welfare effects of fiscal policies. By developing spatial equilibrium models that are informed by credibly-identified reduced-form estimates, these papers form a strong foundation to evaluate other policies at the state and federal levels.

Additionally, by analyzing the effects of changes to the state corporate tax system, my papers [#2,3,13,16] yield the following evidence-based lessons for policymakers:

1. State corporate tax cuts yield additional economic activity in the form of new firms, more employment, and investment.

2. State corporate tax cuts increase inequality, as the majority of the gains from the additional economic activity accrue to business owners and top earners.
3. The corporate tax system is more complex than just the tax rate, and understudied aspects of the corporate tax base can have important consequence for state tax revenue.
4. Over the range of tax rates we observe in the data, state corporate tax cuts do not pay for themselves.
5. Finally, differences in state corporate tax rates across states are a source of misallocation that reduces national income and welfare.

The rest of this document describes the evolution of my research agenda during my time as an associate professor, including some research projects I started prior to tenure.

4 Financing Local Public Goods

While my papers [#1,4,11] study the provision of public goods at the state and federal levels, a lot of public goods in are provided at the local level. This section describes my research into two tools that local governments use to finance local public goods: municipal bonds and property taxes.

In “Tax Advantages and Imperfect Competition in Auctions for Municipal Bonds” [#5] with Andrey Ordin, Daniel Garrett, and James Roberts, we study the market for municipal bonds, which is crucial in determining the costs of financing local public goods. The market for municipal bonds is one of the largest financial markets in the world with a total outstanding debt of \$3.7 trillion. Moreover, the annual financing cost for state and local governments is close to \$122 billion and is greater than expenditures on categories such as unemployment insurance, policing, and workers’ compensation. In order to increase the demand for municipal bonds, interest income from municipal bonds is excluded from taxation by the federal and most state governments. However, this policy is controversial since top-income individuals are the largest beneficiaries from the tax exclusion.

In this paper, we shed new light on this important but obscure market by analyzing new data on auctions for municipal bonds, and by studying how the tax advantage of municipal bonds affects the borrowing costs of state and local governments. We use data on 14,000 new issuances of municipal bonds sold at auction between 2008 and 2015. These bonds are bought by banks that bid for entire bond packages in order to underwrite the bonds and sell them to individual investors. Somewhat surprisingly, many of these bond auctions have few participants with half of the auctions obtaining bids from 5 or fewer bidders. This lack of competition raises the prospect that winning bidders walk away with substantial markups over their value for the bonds — the lowest interest rate at which they would be willing to lend to the municipality.

We first use variation in state and federal taxes over time to study how changes in the tax advantage affect the winning bids in the auctions. We find that increasing the tax advantage of municipal bonds by 3 percentage points lowers mean borrowing costs by 9-10%. Since bondholders compare the after-tax interest from a taxable bond, $(1 - \tau)i^{Taxable}$, to the interest from a tax-exempt muni bond, i^{Muni} , a large literature focuses on the passthrough elasticity of $(1 - \tau)$ to the muni

borrowing rate, i^{Muni} . Our estimates imply that, on average, a one percent increase in the keep-rate $(1 - \tau)$ increases municipal borrowing costs by 1.7-1.9%.

To better understand the origins of these large effects, we estimate a structural auction model where bidders strategically decide whether to participate in the auction and how much to bid for a given bond.³ This model clarifies the reason for the large passthrough elasticity. Specifically, when bidders participate in imperfectly competitive auctions, they profit by bidding an interest rate above their value. When the tax advantage increases, bidders' values go down. In addition, bidders know they may face a larger number of bidders, and that competitors may bid more aggressively. The effects of taxes on these strategic considerations have large effects on the equilibrium markups of the winning bid, and are the source of the large passthrough elasticities. While we explore these effects through the lens of our model, we provide non-parametric evidence that this mechanism is at play in the data.

This paper concludes by simulating the effects of several policy proposals, including changes in the TCJA which reduced the top personal income tax rate thereby decreasing the tax advantage of municipal bonds. Our model predicts that this component of the reform would increase the borrowing rates of state and local governments by 5%, or over \$6 billion per year. However, as mentioned above, the TCJA also capped the state and local tax deduction, which has the effect of raising the tax advantage of municipal bonds. We find that this component of the reform would decrease borrowing rates by 6%. On net, these two components of the TCJA lead to a decrease in borrowing costs of 1.6%, or about \$2 billion per year. Our model clarifies that this decrease is driven by large changes in equilibrium markups.

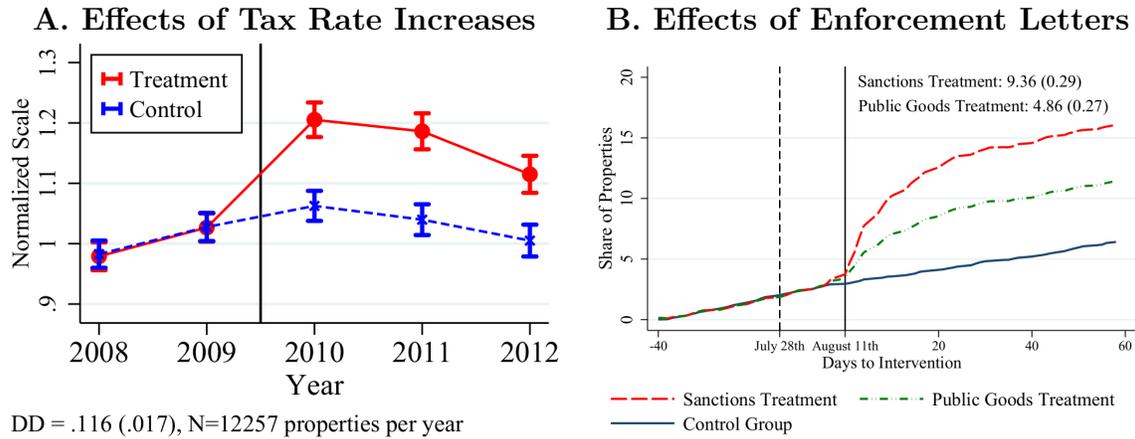
Overall, this paper shows that incorporating insights from industrial organization can significantly affect our understanding of a market that is crucial for the financing of local public goods. In this market, the interaction between tax advantages and imperfect competition amplifies the effects of tax subsidies on the borrowing costs of local governments. Alternative policies that directly increase competition for these bonds would also reduce borrowing costs without providing generous tax breaks to top-income individuals.

In more recent work, I have turned my attention to whether local governments in developing countries can rely on property tax revenue to provide public services and invest in infrastructure. In theory, property taxes can be a useful tool to raise revenue as the tax base is observable and—at least in the short term—immobile. Since developing countries may find it harder to implement a modern personal income tax, one might expect developing countries to rely on property taxes more than developed ones. In practice, however, developing countries under-utilize property taxes more than any other type of tax.

In “Taxing Property in Developing Countries: Theory and Evidence from Mexico” with Anne Brockmeyer, Alejandro Estefan, and Karina Ramírez, we study whether local governments in developing countries can rely on property tax revenue to fund local services or whether features of developing economies—such as weak administrative capacity and an under-developed credit market—limit the appeal of property taxes. We address these questions in the context of Mexico City, where

³Bond auctions are sealed, first-price, low-bid auctions. Bidders bid the interest they are willing to receive, so the lowest bid wins, and bidders do not know the number of other bidders in the auction.

Figure 5: Tax Rate Increases and Enforcement Raise Property Tax Revenue [#8]



access to administrative tax data for the universe of properties provides high quality information on the performance of the property tax system.

This paper begins by using a number of experimental and quasi-experimental sources of variation to estimate the effects of tax changes and enforcement campaigns on property tax revenue. We first use the fact that between 2010 and 2012, the government of Mexico City raised property tax rates three times but only for properties in sharply defined ranges of assessed values. Regression discontinuity analyses provide compelling evidence that, while tax rates increases do raise additional tax revenue, the fraction of compliant taxpayers also falls when tax rates increase. Panel A of Figure 5 reports the results of a complementary difference-in-differences analysis that shows that these tax increases had persistent effects on tax revenue.

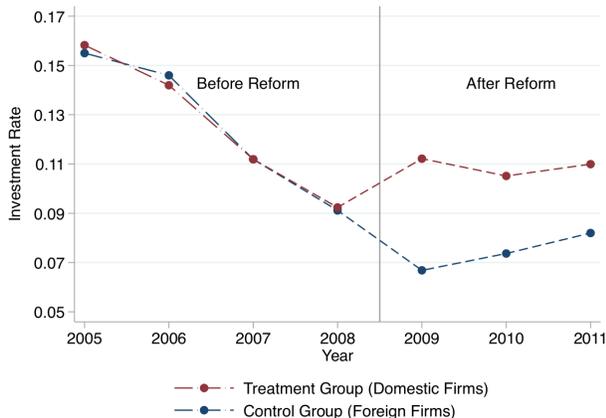
An alternative approach to raising tax revenue is to more strictly enforce existing tax liabilities on delinquent taxpayers. To evaluate this approach, we designed and implemented an experiment in which the ministry of finance of Mexico City sent enforcement letters to 80,000 delinquent taxpayers. Panel B of Figure 5 shows the results of this experiment. The dashed line shows the date when the letters were mailed and the solid line the date by which we expect taxpayers to make the first set of payments. This figure shows that 40 days after this second date, about 5% of delinquent properties that did not receive a letter made a payment toward their tax debt. For delinquent taxpayers that received a letter emphasizing sanctions, the rate of payment tripled to about 15%. We also find a significant but smaller effect when letters emphasize that property taxes contribute to funding public goods.

Our results show that weak administrative capacity does not prevent the government from raising additional revenue by taxing property. However, the government may not want to increase tax rates if doing so exacerbates liquidity constraints for taxpayers. We show that taxpayer behavior is shaped by liquidity constraints as tax rate increases lead to drops in household consumption as well as to increases in the likelihood of paying taxes in installments rather than in full.

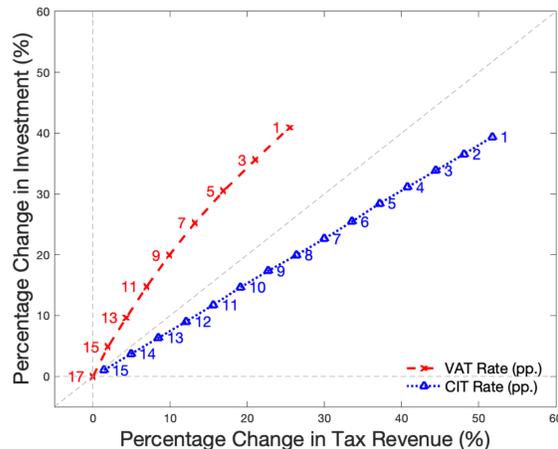
Finally, this paper goes beyond documenting the effects of these different policies to considering the welfare effects of raising tax revenue through either tax rate increases or enhanced enforcement. Even after accounting for liquidity constraints, we calculate that the welfare costs of raising property

Figure 6: Effects of China’s VAT Reform on Investment [#7]

A. Effect of VAT Reform on Investment



B. Relative Effectiveness of Tax Policies



taxes are modest. On the other hand, we find that additional enforcement actions can have large private costs for taxpayers. Thus, while the government can increase its reliance on property taxes, it is more desirable to do so by raising tax rates than through additional enforcement actions. By shining a light on the role of liquidity constraints, our study also reveals that the provision of liquidity to constrained taxpayers is an important and understudied dimension of property tax systems in developing countries.

5 Tax Policy, Corporate Investment, and Worker Outcomes

Governments around the world have recently turned to corporate tax incentives to stimulate investment and economic growth. In recent work, I expand my study of business taxes from [#2,3,13,16] by studying how different tax incentives for investment impact firms and workers.

In “Tax Policy and Lumpy Investment Behavior: Evidence from China’s VAT Reform” [#7] with Zhao Chen, Xian Jiang, Zhikuo Liu, and Daniel Yi Xu,⁴ we analyze the effects of a tax reform that incentivized firms to increase capital investment. Specifically, by changing the deductibility of fixed asset expenditures under the value-added tax (VAT) regime, the reform reduced the cost of eligible capital expenditures by 17%. We evaluate this reform using administrative tax data to estimate difference-in-differences models of firm investment. Panel A of Figure 6 shows that firms that are part of this reform increase capital investment relative to firms that are not subject to the reform. We estimate that the reform led to a relative investment increase of 36%, relative to pre-reform investment levels. We also document that the majority of the increase in investment is driven by “investment spikes” in which firms replace at least 20% of their total capital.

The result that tax incentives can lead to “lumpy” investment behavior suggests that adjustment costs play an important role in how firms respond to taxes. We investigate this hypothesis by estimating a dynamic investment model with adjustment costs (e.g., Cooper and Haltiwanger, 2006)

⁴This project was funded by a grant from the National Science Foundation.

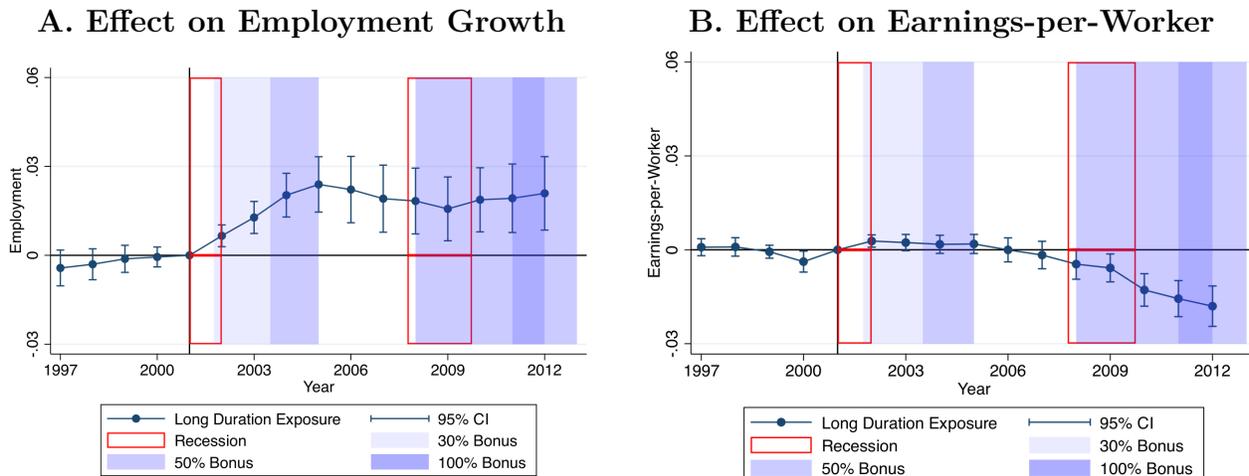
that is consistent with investment patterns and the reduced-form effects of the reform. The model shows that different tax policies (e.g., income tax cuts, VAT rates, depreciation rules) have specific interactions with different types of adjustment costs (e.g., convex adjustment costs, fixed investment costs, partial irreversibility). Thus, different tax policies can be more or less effective at stimulating investment than others, even if they have the same impact on the user cost of capital. We illustrate this insight by using the model to simulate the effects of different types of tax incentives. Panel B of Figure 6 shows that corporate income tax cuts are not very effective at stimulating investment. While lowering the effective corporate tax rate from 15% to 1% leads to increases in investment, these increases are substantially smaller than the reductions in tax revenue. This result follows from the fact that fixed costs may prevent firms from investing but these infra-marginal firms still benefit from lower tax rates. In contrast, decreasing the non-deductible portion of the VAT from 17% to 1% leads to investment increases that are greater than the corresponding revenue losses. This policy is more effective since it increases the likelihood of investment spikes by narrowing the price gap between used and new capital goods—i.e., partial irreversibility.

One of the insights of this paper is that business investment decisions can be affected by taxes that are often ignored in standard investment models. In this case, an unusual implementation of the VAT reduced capital investment. In “The Structure of Business Taxation in China” [#18] with Zhao Chen, Yuxuan He, Zhikuo Liu, and Daniel Yi Xu, we describe different features of the Chinese business tax system that may also impact economic activity. For instance, prior to 2012, China relied on a dual-track system under which some industries were subject to a gross-receipts tax, while others were subject to a more standard corporate income tax. Gross-receipt taxes can lead to undesirable outcomes, such as the cascading of distortions along the production chain. This occurs since the producer of a good that is used as an input in the production of a second good passes a portion of the gross-receipts tax along the production chain, which distorts the use of different inputs in production. Our detailed study of the Chinese business tax system helps us identify features of business taxation in the US that may also distort investment behavior. For instance, several US states also rely on gross-receipts taxes. In addition, the fact that firms often pay sales taxes on business-to-business transactions implies that US companies face similar distortions as those created by the unusual (pre-reform) VAT system in China.

As in China, policymakers in the US often rely on tax incentives for investment to stimulate the economy. While many of these incentives target corporate investment, policymakers often motivate these policies by arguing that the additional investment will create jobs and raise wages for workers. In contrast, detractors of these policies argue that—by lowering the cost of labor saving machines—tax incentives for investment may accelerate the pace of automation. In “Tax Policy and Local Labor Market Behavior” [#10] with Dan Garrett and Eric Ohrn, we study how workers are affected by a prominent US tax policy meant to stimulate investment.

The policy we study—bonus depreciation—lowers the tax cost of investment by allowing companies to claim an additional tax deduction in the year that equipment investments are made. While this policy applies to all corporations in the US, firms in industries that rely on assets with longer depreciation schedules benefit more from the policy. We evaluate the effects of this policy by identifying local labor markets with a greater exposure to the types of industries that have the most to

Figure 7: Effects of Bonus Depreciation on Local Labor Markets [#10]



benefit from the policy. Panel A of Figure 7 plots the results of an event-study analysis that shows that the introduction of the policy in 2001 led to significant employment growth in locations with greater exposure to bonus depreciation. Specifically, we find that increasing a location’s exposure to bonus depreciation from the 25th to the 75th percentile of the distribution increased employment by 2.1 percent on average over our sample period. Relative to estimates of the fiscal cost of this tax incentive, we compute that every job created by this policy cost taxpayers between \$20,000 and \$50,000. On the other hand, Panel B of Figure 7 shows that these employment increases were not accompanied by increases in the average earnings of workers.

The fact that we estimate employment increases suggests that the worst fears of bonus depreciation did not materialize. However, we also find that the initial employment gains did not compound in the later years of the policy. Moreover, our evidence does not support the notion that—by stimulating investment—bonus depreciation can raise the earnings of the average worker.

We build on this research by studying the effects of bonus depreciation using confidential plant-level data from the Census Bureau in “How Does Capital Investment Affect Workers? Evidence from Bonus Depreciation and Matched Employer-Employee Data” [#21] with Mark Curtis, Dan Garrett, Eric Ohn, and Kevin Roberts.⁵ These data allow us to study in a detailed way how manufacturing plants respond to this tax policy. In addition to estimating effects on investment, capital accumulation, and employment, these data allow us to study how labor market features—such as unionization, collective bargaining laws, and labor market concentration—shape how capital investments impact the employment and earnings of workers. These results will inform the debate on whether changes in the cost of investment lead plants to replace workers with machines, or whether such policies create jobs. These results will also be relevant to ongoing tax debates since the TCJA enacted a powerful version of 100% bonus depreciation that is estimated to cost the US Treasury close to \$120 billion over the next five years (JCT, 2017).

⁵This project is being funded by grants from the Washington Center for Equitable Growth and the Russell Sage Foundation.

6 International Tax Policy

One salient aspect of international taxation is that multinational corporations employ complicated tax planning strategies to minimize their tax obligations. For example, revelations in the so-called “Paradise Papers” showed that corporations such as Apple and Nike were able to avoid paying US taxes by artificially shifting the location of their profits to jurisdictions with low or zero tax rates (New York Times, Nov 11, 2017). Clausing (2016) estimates that about \$100 billion in US corporate tax revenues are lost to tax avoidance strategies, such as profit shifting. News of tax avoidance by multinational corporations motivate policymakers to adopt reforms that limit profit shifting. Indeed, the Tax Cuts and Jobs Act of 2017 enacted new minimum taxes on multinational corporations that earn profits in low tax locations from intangible assets, such as patents.

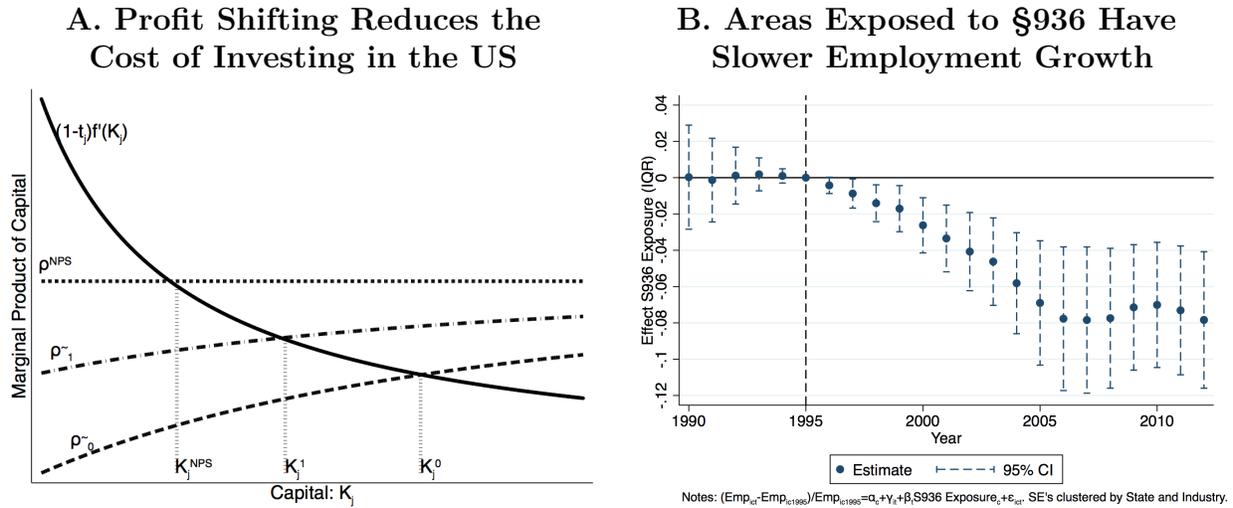
While profit shifting results in revenue losses, my research shows that reforms that eliminate firms’ access to tax havens can also impact the domestic economy. In the “Unintended Consequences of Eliminating Tax Havens” [#6],⁶ I provide empirical evidence that limiting tax avoidance by multinationals can impact domestic investment and employment. The intuition for this result is that when any company decides how much to invest, it compares the returns from investing to the cost of investing. In Panel A of Figure 8, we show that when there is no profit shifting (NPS), firms equate the after-tax marginal product from capital $(1 - t_{US})f'(K_{US}^{NPS})$ to the user cost of equity capital ρ^{NPS} . However, when a company like Apple decides how much to invest and how many workers to hire in the US, it knows that its advanced tax planning strategies mean it will pay much lower taxes. I develop a model in [#6] that incorporates this insight. The model shows that when firms can shift profits to tax havens, they equate the benefit from investment to a lower effective cost of capital, $\tilde{\rho}_0 < \rho^{NPS}$, and that this increases investment and employment in the US. That is, Apple hires more engineers in the US because it knows that it will not pay US taxes, so it requires a lower rate of return. This logic also implies that reforms that limit profit shifting increase the cost of investing in the US, $\tilde{\rho}_1 > \tilde{\rho}_0$, and that this reduces domestic economic activity.

I then study the effects of repealing §936 of the Internal Revenue Code as a natural experiment that limited profit shifting by US multinationals. §936 allowed US multinationals to operate essentially tax-free in Puerto Rico and other US possessions. Companies took advantage of this incentive by locating intellectual property in Puerto Rico, which shifted their tax obligations from the high tax rates of the US to the essentially zero tax rate of Puerto Rico. Policymakers were concerned that excessive profits were being shifted to Puerto Rico since the tax costs of §936 per worker in Puerto Rico were greater than the average compensation per worker (GAO, 1993).

Consistent with the predictions from the model, I show that firms that were exposed to §936 reduced global investment, increased the share of investment in foreign affiliates, and reduced domestic employment. I then show that the firm-level responses to the repeal of §936 had persistent consequences for local labor markets. By relating the fraction of establishments in a local labor market that could take advantage of §936 to the employment growth at the county-level, I show that a higher degree of exposure to §936 reduced employment growth for a period of over 15 years. Panel B of Figure 8 shows that increasing a county’s exposure to §936 from the 25th to the 75th

⁶This project received funding from the International Tax Policy Forum.

Figure 8: Domestic Effects of Repealing §936 [#6]



percentile reduced employment growth by 7 percentage points by 2005. I also find that exposure to §936 resulted in decreases in income growth, wage growth, declines in property values, and an increased reliance on federal income transfers.

Overall, this paper shows that limits to profit shifting can impact domestic employment and investment. As with other tax policies, the revenue gains from limiting profit shifting should be weighed against the effects on economic activity.

The results from this paper suggest that US multinationals that took advantage of §936 were not able to substitute other tax havens for Puerto Rico. In “How Elastic is the Demand for Tax Havens? Evidence from the US Possessions Corporations Tax Credit” [#17] with Daniel Garrett, we show that §936 corporations did not respond to the repeal by increasing their exposure to other tax havens. This makes sense since Puerto Rico was a unique tax haven in that it allowed immediate repatriation of income at a zero tax rate—which is more valuable than the standard deferral benefit associated with other tax havens. This result is also consistent with the finding that exposed firms saw a decline in stock prices following news that §936 would be repealed, suggesting that in this case firms were not able to substitute across tax havens.

In ongoing research, I study how other international tax policies impact worker outcomes and tax revenue. In “International Taxation and Local Labor Markets” [#22] with Dan Garrett and Eric Ohrn, we use a similar regional approach as in [#6,10] to study the labor market effects of two international tax policies: “check-the-box” (CTB) regulations and the 2004 repatriation tax holiday. CTB regulations surreptitiously allowed US MNCs to engage in complex tax planning strategies that enabled these companies to avoid paying taxes in high tax foreign jurisdictions. To avoid paying the US corporate income tax on these earnings, US MNCs reinvested their profits abroad. To encourage these companies to repatriate these earnings, the American Job Creation Act created a temporary tax holiday that allowed these companies to repatriate these earnings at a lower tax rate. We evaluate the effects of the adoption of the CTB regulations and the subsequent tax holiday by identifying the local labor markets that were most exposed to US MNCs. Our preliminary results suggest that CTB led to significant declines in the employment of counties

that were more exposed to US MNCs. Intuitively, CTB lowered the cost of investing abroad by facilitating the avoidance of foreign taxes. Our results are consistent with the hypothesis that US MNCs responded to this regulation by increasing their investment and employment abroad, at the expense of domestic employment. In contrast, we estimate that the repatriation holiday had no impact on local employment. This is consistent with the hypotheses that US MNCs were not cash constrained and would have been able to invest in the US absent the tax holiday.

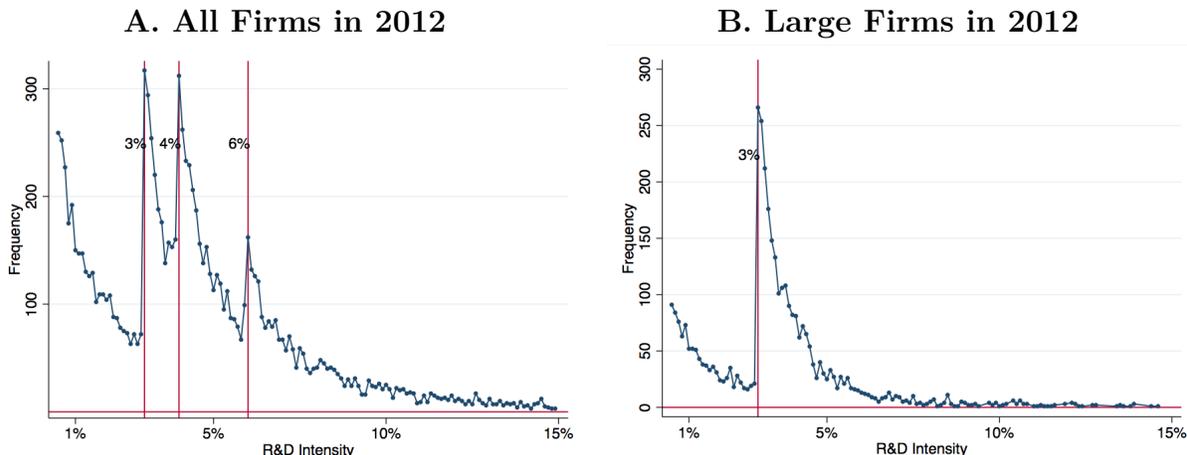
Finally, in “The Failed Promise of Curbing Profit Shifting through Information Monitoring: Evidence from a Natural Experiment in Chile” [20] with Sebastian Bustos, Dina Pomeranz, Jose Vila-Belda, and Gabriel Zucman, we study a Chilean reform that aimed to limit profit shifting. The reform increased the information that MNCs were required to report when conducting within-group transactions. Additionally, the reform shifted the legal responsibility to make it easier for tax authorities to detect profit shifting. Using detailed tax data from the Chilean tax authority, we evaluate whether this reform increased tax collections and whether the increased information monitoring clamped-down on profit shifting transactions. Contrary to the hopes of the tax authority, we estimate a null impact of the reform on tax revenues and we do not find that the reform limited the extent of profit shifting. To further understand these results, we conducted interviews with tax accountants, who revealed that the reform led to a sharp increase in the number of profit shifting specialists that were hired by top accounting firms. These results show that in the enforcement game between governments and MNCs, the ease with which tax consultants can expand their services can be an important determinant of whether reforms to international tax policies can increase tax revenue and limit profit shifting.

7 Externalities and Corrective Policies

An important theoretical insight of public economics is that governments can improve the functioning of markets by encouraging activities with positive externalities and by discouraging activities with negative external effects. This section describes recent papers that study two such real-world policies and how firms’ efforts to avoid the cost of these policies can undermine their effectiveness.

Governments around the world encourage R&D investment through tax subsidies based on the belief that spillover effects from innovation contribute to economic growth. In “Notching R&D Investment with Corporate Income Tax Cuts in China” [4] with Zhao Chen, Zhikuo Liu, and Daniel Yi Xu, we use data on corporate tax returns from China to analyze the effects of a large fiscal incentive for R&D investment. The fiscal incentive we analyze is part of the InnoCom program, which awards a lower average corporate income tax rate of 15% to qualifying firms—a large reduction from standard rates of 25-33%.

The program generates sharp incentives for R&D investment by requiring that qualifying firms maintain an R&D intensity (R&D-to-sales ratio) above a given threshold. In 2012, for example, the program required R&D intensities of 3% for large firms, 4% for medium firms, and 6% for small firms. In Panel A of Figure 9, we plot the distribution of R&D intensity, which shows firms bunching at the values corresponding to the InnoCom thresholds. We use variation in the location of these notches over time and across firm categories to show that firms respond to the InnoCom program

Figure 9: Bunching at Thresholds of R&D Intensity [#4]

by increasing their reported R&D. For instance, Panel B shows that when we restrict the sample to only include firms in the large sales category, we only see bunching at 3% of R&D intensity.

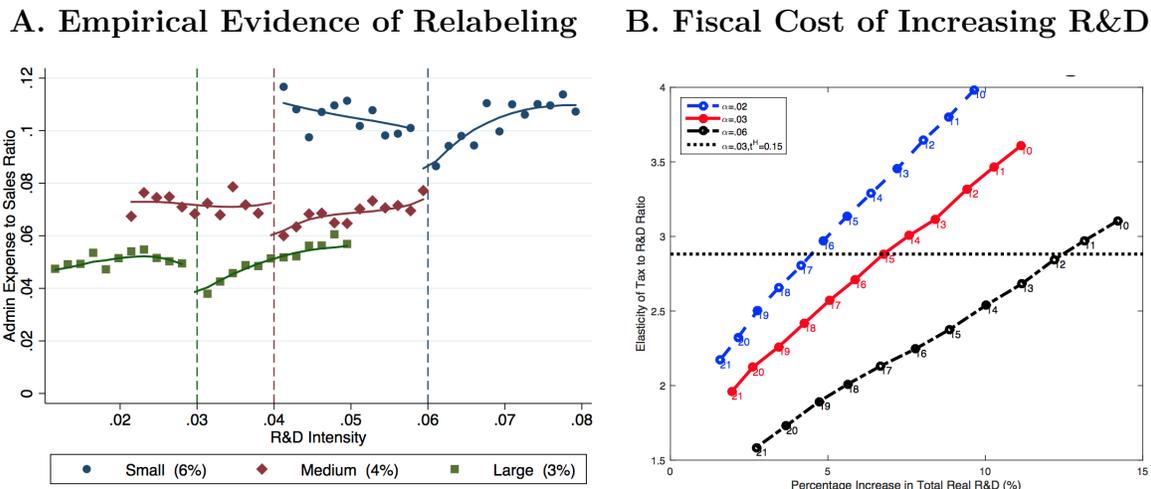
A well-known problem in the study of R&D is that—even in developed countries (GAO, 2009)—firms may respond to tax incentives by relabeling non-R&D expenses as R&D. Relabeling undermines the effectiveness of R&D tax incentives by diverting tax benefits to firms that do not perform additional innovative activities. This paper carefully considers different forms of relabeling. Due to institutional reasons, such as third-party reporting in the value-added-tax (VAT) system and pre-auditing in the InnoCom program, we rule out forms of misreporting like all-out evasion and phantom expenses. Since in Chinese Accounting Standards R&D is reported as a subcategory of administrative expenses, the most likely form of misreporting is the relabeling of expenses in this category. We provide empirical evidence of this form of misreporting in Panel A of Figure 10. This graph plots the average value of the administrative expense to sales ratio as a function of R&D intensity. For the three types of firms, we find that the admin-to-sales ratio drops significantly at the respective notches, which is consistent with a significant relabeling response.⁷

We reconcile the effects on reported R&D and relabeling by estimating a structural model of R&D investment in which firms face heterogeneous adjustment costs of investment and may respond to the tax cut by relabeling. The model shows that about a quarter of the increase in reported R&D is due to relabeling, on average. However, the degree to which firms relabel depends on their productivity and on their firm-specific costs of adjustment. Firms with lower productivity and higher adjustment costs have stronger motives for relabeling. The model also shows that the real effects on firm productivity are consistent with large return to real R&D of about 9%.

We use the estimated model to simulate the effects of alternative policies. Panel B of Figure 10 shows how changing the parameters of the InnoCom program impacts its effectiveness, measured as the elasticity of tax expenditures to real R&D. Increasing the required threshold of R&D intensity improves the effectiveness of the program as the average cost of stimulating R&D decreases. The intuition for this result is that policies that select higher productivity firms tend to be more effective.

⁷We also test misreporting of sales and of other expenses and find no evidence of misreporting along those margins.

Figure 10: Relabeling of R&D: Evidence and Implications [#4]



The government can target these firms by increasing the location of the notch. In contrast, lowering the preferential rate from 15% to 10% reduces the effectiveness of the program as it encourages firms to engage in relabeling. The black line shows that with a notch of 6% and a tax rate of 12%, the government can achieve a similar average cost while doubling the increase in real R&D. These simulations show that firm selection and relabeling plays a crucial role in determining the cost-effectiveness of this type of R&D subsidy.

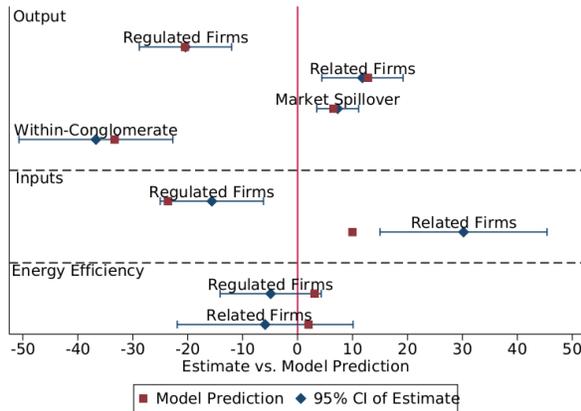
Relabeling may also explain why the government relies on a notch-based policy, as opposed to a more standard R&D investment tax credit. Specifically, while we find that firms engage in relabeling, the overall extent of this problem may be limited by the program design, which focuses the government’s auditing efforts on the relatively few firms that participate in the program. Relabeling may be a more prevalent issue under standard R&D tax incentives since it may be harder for the government to prevent relabeling among a larger number of firms. Finally, we consider whether the program raises welfare. Even though relabeling limits the increase in real R&D, we find that the program improves welfare even under modestly-sized productivity spillovers.

A crucial problem facing governments around the world is how to limit emissions that contribute to both local pollution and global warming. In “Regulating Conglomerates in China: Evidence from an Energy Conservation Program” [#9] with Qiaoyi Chen, Zhao Chen, Zhikuo Liu, and Daniel Xu, we study the effects of a prominent regulation that aimed to reduce the energy use of large industrial firms. The regulation we study—the Top 1,000 program—targeted the largest industrial firms in the most energy-intensive sectors with the goal of saving energy and improving energy efficiency by 20%. This was an important program since the close to 1,000 firms in the program accounted for 47% of industrial energy use in China and for 33% of the country’s overall energy use.

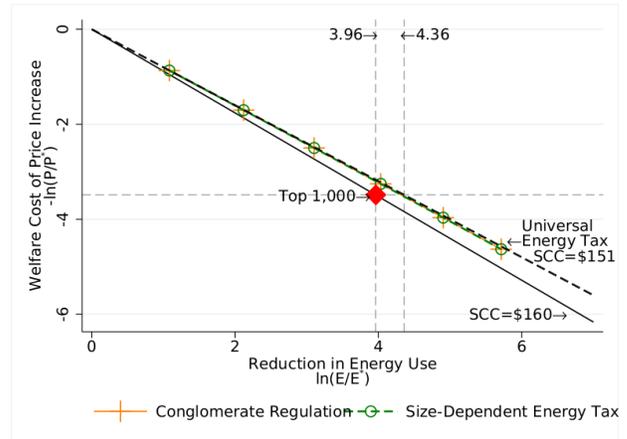
A key feature of these large firms is that they are often part of much larger business networks. This paper studies how the regulation impacted the output and energy use of regulated firms, as well as how unregulated firms in the same conglomerate respond to the program. We combine difference-in-differences research designs with a quantitative model of conglomerate production to estimate the firm-level, conglomerate-level, and market-level effects of the policy.

Figure 11: Empirical and Welfare Effects of the Top 1,000 Program [#9]

A. Empirical Effects and Model Predictions



B. Welfare Effects



Panel A of Figure 11 shows that regulated firms reduce their output as well as their use of energy inputs but do not improve their energy efficiency. Unregulated firms in the same conglomerate see significant increases in both output and energy use but do not improve their energy efficiency. Finally, we also find significant market-level spillovers on unrelated firms. To reconcile these effects, we estimate an equilibrium model of conglomerate production based on descriptive statistics of the firm and conglomerate size distributions prior to the program. Panel A of Figure 11 shows that our model does a good job of fitting the effects of the program as out-of-sample predictions.

The estimated model allows us to quantify the aggregate effects of the program on industrial production and energy use, to evaluate the welfare effects of the policy, and to simulate the effects of alternative policies. Panel B of Figure 11 shows that after we account for within-conglomerate and market spillovers, the program reduced overall energy use by about 4%. However, the program also led to a price increase of 3.5%. The program would raise welfare as long as the value of reducing emissions related to energy use is greater than the cost of production distortions. We calibrate that the program raises welfare as long as the social cost of carbon is greater than \$160, which is generally larger than values used by policymakers. Finally, we compare the Top 1,000 program to a simulated regulation that limits the total energy use within conglomerates (as opposed to targeting the largest firm in the conglomerate) as well as to size-dependent and universal energy taxes. The conglomerate-level regulation increases energy savings by 10% for the same welfare cost and implies a welfare trade-off that is close to that of an energy tax. Our results therefore show that the government can improve the regulation of energy by using publicly available data on conglomerate networks.

8 Other Research

In addition to my main research agenda, three of my papers contribute to other areas of economics.

In, “Broken or Fixed Effects?” [#12] with Charles Gibbons and Michael Urbancic, we explore whether ordinary least squares with fixed effects (FE) is a consistent estimator of the average

treatment effect (ATE) in the presence of heterogeneous treatment effects. We document that heterogeneous treatment effects are common and that the ATE is often statistically and economically different from the FE estimate. We demonstrate this point with a replication study of eight influential papers. In all but one of our replications, we find statistically significant treatment effect heterogeneity and, in six, the ATEs are either economically or statistically different from the FE estimates. We then propose estimators that consistently estimate the ATE in the presence of group-specific heterogeneous treatment effects.

In “The Limits of Meritocracy: Screening Bureaucrats Under Imperfect Verifiability” [#14] with Shuang Zhang and Xiao Yu Wang, we show that meritocracies aiming to identify high-ability bureaucrats are less effective when performance is imperfectly observed. This result is particularly important for the case of China, as scholars argue that democratic reform in China is not necessary since meritocratic promotions may be able to select high-ability bureaucrats (Bell and Li, 2012). We show that Chinese provincial governments used the One Child Policy to screen mayors, implying a meritocratic objective. However, we also find that misreporting of performance metrics sapped the screening power of the meritocracy, as promoted mayors were not of higher ability. We thus challenge the notion that meritocratic promotions are effective substitutes for democratic institutions.

Finally, in work with Emiliano Huet-Vaughn and Ethan McClure, “A Kinky Consistency: Experimental Evidence of Behavior Under Linear and Non-Linear Budget Sets” [#15], we use a laboratory experiment to test whether individual behavior is affected by the complexity of the environment. We explore whether individuals exhibit internally consistent behavior when facing linear or non-linear (piece-wise linear and convex) budget sets. In each setting, the revealed preferences of most subjects are internally consistent and satisfy the axioms of utility maximization. However, for about half of the subjects, the choices are not internally consistent across settings. This implies that, while in each case individuals behave as if they were maximizing a utility function, this utility function depends on the complexity of the decision-making environment.

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Work in Progress

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