Bidding for Firms: Subsidy Competition in the U.S.

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Abstract

In the U.S., states compete to attract firms by offering discretionary subsidies, but little is known about how states choose their subsidy offers, and whether such subsidies affect firms' location choices. In this paper, I use an oral ascending (English) auction to model the subsidy "bidding" process and estimate the efficiency of subsidy competition. The model allows state governments to value both the direct and indirect (spillover) job creation of firms when submitting bids, and firms to take both subsidies offered *and* state characteristics into account when choosing their location. To estimate my model, I hand-collect a new and unique dataset on state incentive spending and subsidy deals from 2002-2016. I estimate both the distribution of states' (revealed) valuations for firms that rationalizes observed subsidies, and firms' valuations for state characteristics. In order to allow states to value potential spillovers, I estimate the effect of subsidy-winning firms' locations on the entry decision of smaller firms, using a discrete choice entry model. I provide the first empirical evidence that states use subsidies to help large firms internalize the positive spillovers, in the form of indirect job creation, they have on the states. Moreover, subsidies have a sizable effect on firm locations. In particular, I find that without subsidies approximately 68% of firms would locate in a different state, and the number of anticipated indirect jobs created would decrease by 32%. With subsidies, total welfare (the sum of state valuations and firm profits) increases by 22%, but this welfare gain is captured entirely by the firms.

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1 Introduction

> *Tax incentives seem to be a permanent part of the urban economic landscape. However, economists do not yet know why these incentives occur and whether they are in fact desirable.*
>
> "The Economics of Location-Based Tax Incentives" Glaeser (2001)

As state governments compete to attract large firms and create new jobs in their jurisdictions, discretionary incentives have become a mainstay of local economic development policy. In 2016 alone, states promised $7.3 billion in tax incentives and subsidies to just 36 firms.[1] There are opportunity costs of spending on incentives for only a few large firms, and some policymakers have proposed a ban on subsidy competition, arguing that it is a zero-sum game that creates a race to the bottom.[2] However, discretionary subsidies can be welfare improving if they compensate firms for locating where they will have the largest positive spillovers. Which of these forces dominate is a priori unknown. Therefore, determining whether subsidy competition is welfare enhancing or a zero-sum game is a necessary first step in evaluating the effectiveness of current economic development policy.

To address this question, I develop a tractable model of the subsidy competition "market," create a new dataset on state incentive spending and subsidy deals, and use the new data to estimate the model. In the model, states compete for large mobile firms, where the states' value for a firm can depend on both direct jobs promised by the firm and indirect jobs the firm may induce by attracting smaller firms, i.e., the spillover effect.[3] States bid for each firm in an oral ascending (English) auction, and firms locate in the state that gives the highest payoff, which is their profit in the state plus the subsidy. The model captures the most salient features of subsidy competition: states submit multiple bids for a single firm, and firms do not necessarily locate in the state with the highest bid because they also care about other state characteristics that affect their profits, like human capital, wages, and labor laws.

To estimate the potential spillover of large subsidized firms on firms that do not get discretionary subsidies, I also model the location choice of the non-subsidized, medium-sized, firms. Thus, states can internalize the indirect job creation spillovers that large firms might have when choosing their subsidy. Accounting for spillovers is crucial to evaluating

[1] This amounts to approximately $200 million per firm and $177,000 per direct job promised by the firm. Source is *Good Jobs First*, calculations made by the author. All numbers in this paper are calculated by the author unless otherwise stated.

[2] For example, see Badger (2014).

[3] In this paper, I consider mobile firms conducting a national search, that is, choosing a location within the U.S.

the welfare effects of subsidy competition, which hinges on states compensating firms for location-specific externalities. Estimating this model will answer both: (1) How important are subsidies to a firm's location decision? and (2) How do states value firms?

Understanding what works in local economic development policy is a growing concern, given the marked increase in geographic economic inequality within the United States.[4] States that struggle to grow their local economies, and might benefit more from the entry of a new firm, are eager to attract more firms to their area. However, they must compete with more attractive locales, where the firm would be more profitable. Discretionary subsidies are one economic development policy tool that can be used to allocate firms to states where they have greater positive externalities (Garcia-Mila and McGuire, 2002). If instead, political concerns determine subsidy size, competition will not necessarily result in higher externality location choices (Glaeser, 2001). Therefore, the welfare implications of subsidy competition depend on states' valuation for the firms, which is difficult to measure. To the best of my knowledge, this paper is the first to study this problem, and, specifically, the first to provide evidence that states do use subsidies to help firms internalize anticipated spillover effects.

One reason that we do not know enough about subsidy competition is the lack of coherent data on subsidies. To fill this gap, I read state tax and budget documents, news articles, and press releases to build a new dataset of state incentive spending and firm-level subsidy deals. I use this data to estimate the distribution of states' valuation for firms. My estimates provide the first empirical evidence that states use subsidies to compensate firms for their positive externalities; high unemployment states, states which benefit most from property value increases, and states that anticipate large positive spillovers have the highest valuations for firms. I also find that subsidies have a substantial effect on the firm location decision; almost 68% of firms would locate in another state in there was no incentive spending. Eliminating incentive spending would also decrease the total potential spillovers created by large firms by 27,000 jobs, or 32%, which provides more evidence that subsidy competition can increase total welfare.[5] However, total indirect job creation under subsidy competition is only 15% of the total achieved by a social planner who solely maximizes job creation.[6]

[4]Moretti (2012) calls this phenomenon "The Great Divergence." Also see Ganong and Shoag (2017).

[5]The number of indirect jobs anticipated is firm-state specific. Therefore, the total indirect job creation is not fixed, but dependent on the location choices of the large firms. Differences in the anticipated spillover of a large firm in each state are driven by the shape of the relationship between the average profit level of a state and the probabilities of medium firm entry.

[6]This highlights the role of state characteristics in the firm location decision, as well as the fact that states have heterogeneous valuations over job creation and other potential benefits of the firm. Indirect job creation only explains about 25% of the states' valuation of firms — it is not the only determinant of welfare.

The practice of states offering discretionary incentives in exchange for firm locations dates back at least to the 1970s. In 1976, after dozens of governors traveled to Germany to make their pitch to Volkswagen executives, Volkswagen decided to locate their first U.S. plant in Pennsylvania, receiving a subsidy deal worth $100 million.[7] This subsidy included financial (property tax abatement, low-interest loan) as well as in-kind (rail, highway, job training) incentives. Mazda, Mitsubishi, and Toyota followed in the mid-1980s, each spurring a subsidy competition between states. The competition has since expanded beyond the automobile industry (e.g. Amazon HQ2); states currently spend over one-third of their total economic development budget on discretionary subsidies to attract firms to their local areas.

Research on state competition for firms traditionally focuses on the corporate tax rate, and most empirical work finds no effect of corporate tax cuts on business location and activity (for example, Bartik 1985, Ljungqvist and Smolyansky 2016).[8] This may be because the posted tax rate is not the relevant tax object — the firm also considers tax credits and the tax base (Bartik 2018, Suarez Serrato and Zidar 2018). On top of that, only select firms receive specialized tax incentives. In this paper I carefully consider these discretionary incentives, both in terms of how important they are to firms and how states determine them.

Although there is limited evidence to show that taxes can induce firms to chose different states in the U.S., there is strong evidence in other contexts that economic agents respond to changes in tax incentives. See Hines (1996), Wilson (2009), Kleven et al. (2013), among others.[9] One important difference between my paper and these papers is that while I endogenize the subsidies — they are a function of the state's value for the firm and competition from other states — these papers take the taxes or subsidies as exogeneously given.

In order to study state subsidy competition, I create a new dataset on total state-level incentive spending and firm-level discretionary subsidies. A state has two ways to spend on firms: they can enact tax credits that lower the tax bill for all firms that qualify, or they can allocate money from their budget for economic development programs. I hand-collect the state-level data from state budget documents and tax expenditure reports. The final product is a rich dataset that tracks all economic development programs and tax credits for firms, in each state, from 2007 to 2014. States spend almost $20 billion a year in total on

[7] $100 million in 1976 converts to roughly $430 million in 2017 dollars. VW chose Pennsylvania after narrowing down their search to thirteen states and receiving multiple rounds of bids.

[8] Notable exceptions include Ossa (2018) and Mast (2018), which both study subsidy competition, between counties in New York (Mast) and states, in the aggregate (Ossa).

[9] See Hines (1996) for FDI in the U.S.; Wilson (2009) and Moretti & Wilson (2017) for R&D in the U.S.; Devereux & Griffith (1998) for U.S. multinationals locating in European markets; Becker et al. (2012) for multinational activities in German municipalities; and Kleven et al. (2013) for European football players.

incentives for firms, but there is considerable heterogeneity both across states and within states over time.[10] For example, a state spends $171 million per year at the median and $333 million at the mean, with a standard deviation of $520 million.

About one-third of this spending goes to a few large firms each year, in the form of discretionary subsidy deals. The policy group *Good Jobs First* tracks large firm-level subsidies, sourcing data from state documents, FOIA requests, and local newspapers. I use this dataset to assemble the universe of large subsidy deals. I supplement the data by reading articles on each subsidy deal, adding information on jobs promised, industry, runner-up location, and any non-discretionary tax credits the firm qualifies for in the state.[11] I collect details on subsidy deals from 2002 to 2016, which, in the context of state competition for firms, can be thought of a dataset of winning bids.[12] The data contain 485 firm-level subsidy deals. The average firm promises to create 1,700 direct jobs and receives a subsidy worth $156 million, which is about $92,000 per direct job.

According to state policymakers, the primary purpose of giving subsidies for firm locations is job creation. However, I find limited evidence of a positive relationship between direct jobs promised by the firms and subsidy size in the firm-level data. This may be due to differences in state characteristics; a less attractive state needs to offer a larger subsidy than its more attractive counterparts, all else equal. Differences in the number of anticipated indirect jobs created via spillovers, which is not observed, may also explain heterogeneity in subsidy size. Or, it could be that states do not only care about job creation, and have alternative, potentially political, motivations for subsidy-giving.[13]

In order to disentangle differences in firm profits in a given location from the subsidies, I model the state competition as a private valuation English Auction, and I allow firms to locate in the state that gives the highest profit plus subsidy. A state's valuation of a firm can depend on a variety of factors, including the revenue the state anticipates receiving from increased tax collections as well as any positive externalities the firm is predicted to create create via increasing demand for services, attracting other firms, or increasing local housing prices.[14] Therefore, I allow the state valuation to be an unspecified function of state and

[10] This does not include local (city and county) incentive spending.

[11] In some cases *Good Jobs First* provides all of this information, except the runner-up location.

[12] These incentive numbers include local contributions, usually in the form of property tax abatements.

[13] Many have found evidence of political variables, such as re-election concerns, affecting policy changes (for example, Besley and Case (1995)). In the aggregate spending data I find that governors who are up for re-election are more likely to increase incentive spending than their term-limited counterparts.

[14] This also allows the possibility that there are costs to providing services to the firm, and negative externalities through congestion.

firm characteristics, such as the number of jobs promised and the anticipated spillover.[15] I use the model to estimate both the conditional distribution of states' valuations for firms and firm preferences over state characteristics.

Subsidies and state characteristics are substitutes, so a winning state need not be the one who offers the largest subsidy. Therefore, the subsidies and characteristics of the winner are insufficient to identify firms' preferences for state's observed and unobserved characteristics. To achieve identification of states' valuations for firms, I also need to identify firm profits. In the English Auction, the winner bids up to the point where the payoff it can give the firm exceeds the payoff in the runner-up location. Therefore, the observed winning bid is the subsidy that sets the payoff in the winning and runner-up states equal. Then, the variation in the winning subsidies and the differences in winning and runner-up state characteristics allow me to identify firms' preferences. To account for the unobserved state characteristics I follow the literature on measurement error and use deconvolution (Carroll and Hall 1988).

Once I have an estimate of firms' preferences, I predict each firms' payoff in its runner-up state, and use the predicted payoffs to identify the distribution of states' valuations for firms. In the English Auction, the runner-up state ends up bidding their valuation for the firm. Therefore, the payoff the runner-up state gives the firm is the sum of their valuation of the firm and the firm's profit in the state. Because the payoff in this runner-up state is the 2nd order statistic of payoffs, I use the order statistic identity to recover the full distribution of payoffs across states (Athey and Haile 2002). I then exploit the relationship between valuation and payoffs, and invert the distribution of payoffs to recover the distribution of state valuations. Because the identification strategy is constructive, I closely follow the identification steps and use indirect inference for estimation.

I find that high unemployment states, states that would benefit most from property value increases, and states that anticipate large spillovers in the form of indirect job creation, have the highest valuations for firms. A high unemployment state values a firm promising 2,000 jobs \$3.1M (5%) more than a low unemployment state.[16] States that rely heavily on property taxes for revenue value a firm \$14.2M (23%) more than a state with less potential property tax collection. Lastly, a firm with large anticipated spillover (indirect job creation) is valued \$16.8M (27%) higher than a low spillover firm promising the same number of direct jobs.[17] States have a relatively small valuation for direct jobs; a firm promising 20,000

[15] I assume the state can accurately anticipate the value the firm will create in their jurisdiction.

[16] The difference grows to \$7.3M (12%) when the firm promises 10,000 jobs

[17] To measure anticipated indirect job creation, I estimate the location choice of medium-sized firms that do not receive subsidy deals, as a function of non-discretionary incentives offered by the state and the location of larger firms. I find a multiplier effect of about 0.15 at the median, that is, 10 direct jobs created at a large

direct jobs is worth only $3M more than one promising 2,000 jobs. Therefore, accounting for differences across states does not explain the lack of correlation between direct jobs promised and subsidy size found in the raw data, instead it is *indirect* job creation that rationalizes observed subsidies. These results suggest that subsidy competition can allow states to compensate firms for heterogeneous externalities across space, thereby increasing the efficiency of firm locations.[18]

Using these estimates, I consider a counterfactual exercise where I eliminate all subsidy spending; large firms locate in the state they prefer the most in the absence of subsidies.[19] I find that at the baseline, 85% of firms choose alternative locations, the majority to lower-cost (KS, SC, TX) or higher-productivity (CA, NC, VA) states. The number of firms that choose alternative locations decreases significantly, to 68%, when I incorporate the housing cost and wage increases that follow large firm entry. I use the counterfactual location choices to calculate the welfare effects of subsidy competition. With subsidies, total welfare (the sum of states' valuations for firms plus firm profits) increases by 22% ($18B). However, firms capture all of this welfare gain, and more — competition amounts to a 75% ($27B) increase in firms' payoffs.[20]

The paper proceeds as follows. Section 2 contains institutional details on subsidy competition in the United States and provides a brief review of the literature. Section 3 follows with a discussion of the data and possible determinants of subsidy size. Section 4 presents the model and Section 5 discusses identification. The estimation and results are together in Section 6, and the counterfactual policy analysis is in Section 7. Section 8 concludes.

2 Background: Subsidies and Site Selection

In this section I give a brief history of subsidy competition in the U.S., as well as an overview of the "industry" in its current state. This includes institutional details on the composition

firm translate to 1.5 indirect jobs created through spillovers. However, there is significant heterogeneity by industry; 10 direct jobs at an automobile plant leads to about 7 indirect jobs created through spillover.

[18]I also find suggestive evidence of politically motivated subsidy offers. Governors who face re-election value firms creating 100 jobs $6.63M (10%) more than term-limited counterparts. An alternative hypothesis is that new governors' do not value firms more in order to get publicity for re-election, but are learning on the job and tend to "over-value" firms more than experienced governors.

[19]The European Commission does not allow member countries to offer discretionary incentives to firms (See EC Competition Policy on State Aid - Part 3, Title VII, Article 107). In the U.S., some legal scholars argue that discretionary subsidies are in violation of the commerce clause of the Constitution (Enrich, 1996).

[20]Another way to illustrate this result is that states transfer $4B (80% of total spending), per year, in rents to the firm in competition. If the highest payoff state only had to compensate the firm for not locating in the highest profit (without subsidy) state, states would save $61B over my sample period (2002-2016).

of subsidies and the process of bidding for firms.

As noted in the introduction, the earliest evidence I can find of states competing with discretionary tax incentives is in 1976, when Volkswagen received $430 million (in 2017 dollars) to locate their first U.S. plant in Pennsylvania. Perhaps partly enticed by the success of VW, other foreign auto manufacturers followed, each spurring a subsidy competition between states. Mazda located in MI in 1984 for $125M, Mitsibushi and Toyota the next year in Kentucky ($147M) and Illinois ($249M) respectively.[21]

By the early 1990s the competition had expanded beyond the auto industry, and United Airlines was holding a bidding war for the location of a new maintenance facility. United set up their negotiations at a hotel, where representatives from the airline would meet up with representatives from cities and states. Jim Edgar, the governor of Illinois at the time, called for a truce with the other states. "If you've got some states doing it, it's hard for the others not to do it. It's like unilaterally disarming," Edgar recalls (Story 2012). Ultimately, not all states would join in the truce, and subsidy competition for individual firms continues to be part of the economic development landscape.

As in the 1980s, many subsidies in the last 20 years have gone to auto-manufacturers and the aerospace industry. Now competition also includes R&D intensive industries such as pharmaceuticals and software, as well as wholesale trade, retail, and corporate headquarters. This may be a result of more companies actively seeking out subsidies from local governments, as "site selection" has become an industry of it's own. A magazine by the same name gives companies information about expansion planning and subsidy deals, with a feature titled "Incentives Deal of the Month," which highlights deals other firms have received.[22] There are also consulting firms that specialize in site selection. Companies looking to relocate can hire a consultant to negotiate subsidies with local governments, advertised as "Public Incentive Identification & Negotiation."

The subsidy that a firm will receive is not a lump-sum payment from the governor, but sourced through various programs and state funds. One subsidy deal may consist of (1) tax credits and programs that the state already has in place to create jobs and investment, (2) tax abatements for the individual firm, (3) infrastructure projects, (4) low-cost loans,

[21] The VW deal is detailed in the book *The Last Entrepreneurs: America's Regional Wars for Jobs and Dollars*, published in 1979. Information on the Mazda, Mitsubishi, and Toyota deals from the *Good Jobs First* Subsidy Tracker. All of the state-level large deals tracked by *Good Jobs First* before 1987 are for foreign auto-manufacturers.

[22] *Site Selection* is not the only player, there is also *Business Facilities* (`https://businessfacilities.com/`), which markets themselves as "The leading source of intelligence for corporate site selection, expansion, relocation & area economic development solutions" and *Area Development* (`http://www.areadevelopment.com/`), "the leading executive magazine covering corporate site selection and relocation."

(5) job training programs, and (6) exemptions from state regulations. It often consists of more local level incentives as well, such as a property tax exemption. The governor and the state economic development agency, jointly with the specific locality in the state, if they are contributing, decide the subsidy offer. The state legislature may need to approve the offer, or pass a bill to enact any specialized legislation for the firm.

There are significant differences across states and firms in the composition of subsidy deals. For example, consider Foxconn, an electronics manufacturing company that received a subsidy worth almost $5 billion dollars to locate a plant in Wisconsin. The deal consists of 15 years of corporate tax abatements, amounting to about $2.85B. Due to two existing tax credits Foxconn would have little to no state tax liability, and would receive the $2.85B in cash from the discretionary tax abatement. The state also agreed to make road improvements worth over $252 million, and give sales tax breaks for construction worth $150 million. The locality created a Tax Increment Financing district, which amounts to an additional $1.5B. Lastly, Foxconn was also exempted from various state environmental regulations, the savings from which are hard to measure.

In California, however, the aerospace and defense company Lockheed Martin received a subsidy composed entirely of two tax credits. California passed a new tax credit specifically for Lockheed, in exchange for locating their production of new bombers for the Air Force in the state. The legislature enacted the *New Advanced Strategic Aircraft Program*, which specifically gives a credit of 17% of wages to "qualified taxpayers that hire employees to manufacture certain property for the United States Air Force." Lockheed also qualifies for California's R&D tax credit on any R&D expenses, which is the highest in the U.S. at 15%.[23] This is worth an estimated $420M to Lockheed.

Next, I discuss what we already know about subsidy competition in the literature, in terms of the theory model and empirical findings.

Literature: Theory

Much of the public finance literature on tax competition highlights the "race to the bottom" result, and argues that competition between governments for firms is a zero-sum game,

[23]Unlike at the federal level, state level R&D tax credits are used less to encourage innovation and more to attract businesses. In California, a report to the Council on Science and Technology reads:

> California is perceived as a high-tax business environment by firms contemplating setting up business or expanding...An R&D-related tax measure targets the particular types of firms that California desires to attract in spite of its relatively high position in the "tax" league tables.

redistributing jobs across state lines while leaving the number of jobs in the U.S. unchanged. Theoretical literature that emphasizes that tax competition leads to inefficiently low tax rates and public expenditure levels includes Oates (1972), Zodrow and Mieszkowski (1986) and Wilson (1986).[24] Theoretical literature that highlights benefits to tax competition as a regulator of government policy-makers includes Tiebout (1956) and Brennan and Buchanan (1980).

Black and Hoyt (1989) use a two-city model to show that subsidy competition is not necessarily a zero-sum game but it can actually lead to efficiency gains. In their model firm-specific tax breaks work against the distortions caused by average-cost pricing of public goods. The firm is large enough to decrease the average-cost of providing public goods, which puts downward pressure on the state tax rate, improving welfare for state residents. The state can use a discretionary subsidy to compensate the firm for this positive externality they have in the state. Garcia-Mila and McGuire (2002) highlight the role of agglomeration economies. Heterogeneous spillover effects lead to efficiency gains - cities that have the highest benefit from the firm's spillover effect will pay the most, and firms will be re-allocated to cities where their spillover is the greatest.[25] Bartik (1991) argues that heterogeneity in local labor markets can create value to redistributing jobs across states and cities, which means that even if the subsidy competition does not create additional jobs through spillover it is not zero-sum. However, if states do not compensate firms for externalities but instead try to win firms to increase political capital, competition will not necessarily be welfare maximizing (Glaeser 2001).

Literature: Empirical Results

The first contribution of this paper is to create a new dataset on incentive spending in the U.S. I use the data to estimate the effect of incentives, as well as the corporate tax rate, on firm location decisions. There is a large literature on corporate taxes and firm location. Using data on firms and establishments in the U.S., most researchers find very little evidence that corporate tax cuts boost entry (Carlton (1983), Bartik (1985), Papke (1991), Ljungqvist

[24]Oates and Schwab (1988) show that when the local government has two policy levers: taxes and environmental quality, competition can increase economic degradation.

[25]Janeba and Osterloh (2013) consider asymmetries across cities and rural areas to explain observed tax rates in a sequential tax competition model, where cities compete for mobile capital, and rural areas compete for capital within the metropolitan area. The model explains differences in tax rates across differently sized jurisdictions.

and Smolyansky (2016)).[26] With all the tax credits and subsidies available to larger firms, one reason that researchers haven't found strong evidence of businesses relocating in response to corporate tax rate could be that the corporate tax rate does not reflect the price those larger firms are facing.

Although there is limited evidence to show that taxes can induce firms to chose different states in the U.S., there is strong evidence in other contexts that economic agents respond to changes in tax incentives. In the U.S., the location of FDI, R&D, start-up activity, and highly-productive scientists responds to tax policy across states (Hines 1996, Wilson 2009, Curtis and Decker 2018, Moretti and Wilson 2017). Taxes, grants, and agglomeration effects affect location choices of multinationals and manufacturing plants in Europe (Devereux and Griffith 1998, Devereux et al. 2007, Becker et al. 2012). Also, high-earning individuals respond to differences in tax treatments across space (see Kleven et al. (2013) for star European football players, Akcigit et al. (2016) for inventors). One important difference between my paper and these papers is that while I endogenize the subsidies — it is a function of the state's value for the firm and competition from other states — these papers take the taxes or subsidies as exogeneously given.

More recently, tax credits and incentive programs in the U.S. are receiving more focus. Using a panel data base on tax rates and industry specific credits (Bartik 2017), Suárez-Serrato and Zidar (2018) find that tax credits and base explain more of variation in corporate tax revenue than the statutory rates, suggesting the importance of including business incentives in any study of state tax policy. The new database tracks marginal tax rates and business incentives for 45 industries in 47 cities and 33 states. This complements the data I have collected, and will hopefully encourage more work in this area, where data has been a limiting factor.[27]

This paper builds on the tax competition and firm location literature by considering how states make subsidy setting decisions. There are three papers that study subsidy competition empirically, and are the closest to my work. Ossa (2018) uses a quantitative economic geography model that he calibrates using total state manufacturing subsidies from the New

[26]Firms may respond to tax rates on the intensive margin, Giroud and Rauh (2016) find that multi-establishment firms respond to tax cuts by reallocating activity to the lower cost location.

[27]There are also work that looks at the effect of a certain tax credit: e.g. Wilson (2009) studies competition between states with the R&D tax credit, and measures the effect of the R&D tax credit on the location of establishments, workers and research activity. Chirinko and Wilson (2016) analyze the effect of state job creation tax credits, while Suárez-Serrato and Zidar (2016) and Fajgelbaum et al. (2016) use corporate, payroll, and income tax rates in their spatial equilibrium models to study the effect of taxes on establishment and worker location, but do not account for other incentives available to establishments.

York Times' Business Incentive database.[28] He finds that states have strong incentives to subsidize firm relocations in order to gain at the expense of neighboring states, which is mostly driven by agglomeration externalities. The analysis uses aggregate data: total manufacturing subsidy spending and employment flows at the state level. This masks the heterogeneity in the subsidies offered to firms within a state.

Mast (2018) also considers the government decision to offer tax breaks, estimating a model in which towns and counties in New York State compete for mobile establishments by offering property tax breaks. Towns choose their tax break offer to maximize the expected value from a establishment, offering a larger exemption increases the probability the establishment locates in the town, but decreases the benefit. Unlike Ossa (2018) he finds that eliminating tax breaks has a very small effect on equilibrium firm locations. This, he notes, may be because the firms are spatially constrained in their location choices.

Most recently, Kim (2018) uses the *Good Jobs First* data, which I will discuss in the next section, to estimate a model of subsidy competition at the state level. He models state competition as a first-price sealed-bid auction, considers a different sample, and does not focus on the spillover job creation. Despite the differences in our two approaches, he also finds that subsidy competition increases total welfare, and that the bulk of this welfare gain is captured by firms.

3 Data

A difficulty for empirical research on state incentive spending is the absence of a comprehensive and centralized dataset of state taxes, incentives, and subsidies. States vary widely in the structure of their corporate and individual income taxes and payroll, not to mention their economic development and incentive programs. Also, states do not make the subsidies they offer to individual firms public knowledge.[29] To this end, most empirical work to this point has focused on posted tax rates or a single credit program at a time.[30] In order to evaluate state subsidy competition we need the full picture of all the incentives states are offering, and we need to be able to compare this across states. A major contribution of this paper is the introduction of a dataset that tracks state incentive spending over programs

[28]This database is mainly sourced by data collected by *Good Jobs First*.

[29]See this New York Times article on transparency issues "Cities' Offers for Amazon Base Are Secrets Even to Many City Leaders," and the opinion piece by political scientist Nathan Jensen, "Do Taxpayers Know They Are Handing Out Billions to Corporations?"

[30]The notable exception being Suárez-Serrato and Zidar (2018), who leverage the new database on tax rates and credits created by Bartik (2017).

and time, and pairs this data with individual incentive deals. In this section I detail the data collection process and present descriptive statistics.

3.1 Data Collection: State-level spending

There are two primary ways a state can create financial incentives for businesses. The first is to offer a tax credit, or to lower the tax rate, which lowers the tax bill of the business. States track the amount spent (revenue foregone) on each credit program in their Tax Expenditure Reports. The second way to provide for incentives is to allocate money for economic development programs in the state budget (e.g. grant, discretionary fund, infrastructure project). States track the amount allocated and spent on each program in their annual (or biennial) budget documents. In Appendix A I discuss the process by which states set their budgets, and enact or change credits and economic development programs.

In order to create my dataset I download each tax expenditure report and budget document from state websites, for the years 2006-2016. If those items are not available I contact the state Department of Revenue and/or Budget Office. The tax expenditure reports and budget documents vary widely in formatting, not only across states but over time.[31] New economic development programs and tax credits are introduced over the sample period, names often change, and programs can be reorganized between departments. This makes any machine learning technique extremely difficult, so I read each document to identify tax credits and budget items targeted at businesses, and collect the data by hand. I record each program and credit in a state level dataset that covers the years 2007-2014. Based on the text description of the program (if any) I can classify the spending by stated purpose or target: Business Attraction, Jobs, Job Training, Investment, Manufacturing, R&D, High-Tech, and Small Business. In the state-program level data I note that funds are often earmarked for discretionary spending, e.g. "Strategic Attraction," and when states do break out tax credit expenditures by firm, the majority of spending goes to a few firms. Firms receive different tax treatments within one state, thus one needs firm-level data to understand state incentive spending policies.

3.2 Data Collection: Firm-level subsidy deals

The *Good Jobs First* Subsidy Tracker (Mattera 2016) complements my collected spending data in that it compiles establishment-level incentive spending. The source of establishment-

[31] For an example of the state-level source data see Appendix B, Figures 17 and 18.

level subsidies in the Subsidy Tracker is often the same state documents that I have collected. States that do not report establishment level data are still present in the *Good Jobs First* dataset, these deals are sourced from news articles, FOIA requests, and press releases. The coverage for these states is not as exhaustive, but the largest deals are tracked. For this reason, the *Good Jobs First* data cannot be used as a measure of the exact amount of tax credits each establishment in a state received, for example, but is used for the data on large discretionary deals. I use the *Good Jobs First* data as a starting point and build out a dataset with all the variables I need for analysis.

Sample Selection

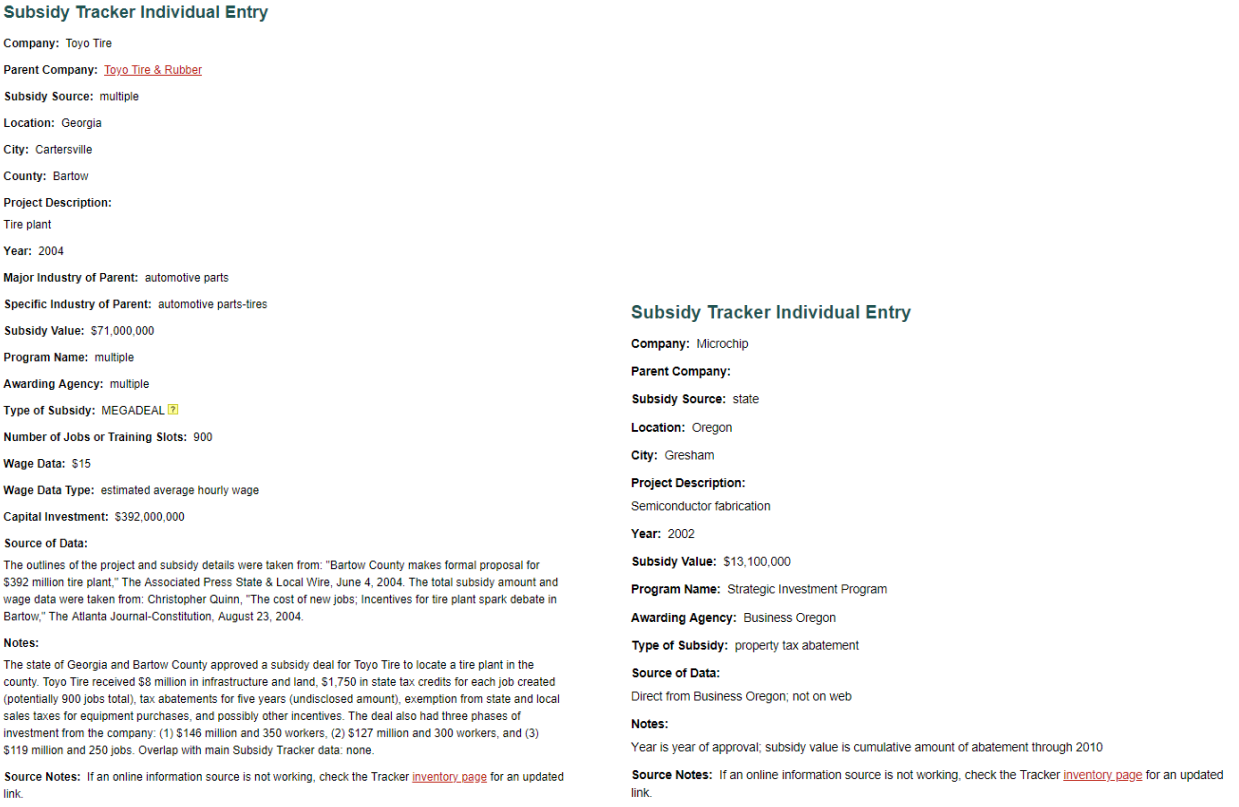
I start with the set of all entries over $5M. I limit the sample to entries that involve a discretionary program or mention expansion or relocation. I arrive at a sample of 485 establishments receiving discretionary subsidies over the period 2002-2016.

For each of these 485 data points the *Good Jobs First* data provides the variables listed in Figure 1. At a minimum this will include the company name, location, year, agency or program that gave the subsidy, and the value of the subsidy. The higher quality observations also include information on the number of jobs that will be created, wages, planned investment and the industry of the firm, as well as a description of the project and details breaking down the subsidy into it's various components. Take, for example, the entry for Toyo Tire in 2004 (Figure 1(a)). Toyo Tire agreed to locate their tire plant in Georgia and create 900 jobs at an average of $15 per hour. Toyo would also make a capital investment of $392M. In exchange, they would receive $71M from the state and county combined. The subsidy contains infrastructure, land, state tax credits, and exemption from certain state and local taxes. The only additional information that I need is the runner-up location - which state was the last one left in competition with Georgia? I use the runner-up locations to identify the firm preferences over state characteristics.

Additional Data

In this section I discuss how I compile any additional data that is missing or not included in the *Good Jobs First* subsidy entries. Figure 1(b) shows that Microchip received a discretionary property tax abatement from the state of Oregon, worth $13M, in 2002. From the project description I know that Microchip is a semiconductor firm. However, I do not know whether Microchip is a new entry to Oregon or expanding an existing facility, how many jobs they are creating, and whether they qualified for any existing non-discretionary state

Figure 1: Subsidy Source Data



Subsidy Tracker Individual Entry

Company: Toyo Tire

Parent Company: Toyo Tire & Rubber

Subsidy Source: multiple

Location: Georgia

City: Cartersville

County: Bartow

Project Description:
Tire plant

Year: 2004

Major Industry of Parent: automotive parts

Specific Industry of Parent: automotive parts-tires

Subsidy Value: $71,000,000

Program Name: multiple

Awarding Agency: multiple

Type of Subsidy: MEGADEAL

Number of Jobs or Training Slots: 900

Wage Data: $15

Wage Data Type: estimated average hourly wage

Capital Investment: $392,000,000

Source of Data:
The outlines of the project and subsidy details were taken from: "Bartow County makes formal proposal for $392 million tire plant," The Associated Press State & Local Wire, June 4, 2004. The total subsidy amount and wage data were taken from: Christopher Quinn, "The cost of new jobs; Incentives for tire plant spark debate in Bartow," The Atlanta Journal-Constitution, August 23, 2004.

Notes:
The state of Georgia and Bartow County approved a subsidy deal for Toyo Tire to locate a tire plant in the county. Toyo Tire received $8 million in infrastructure and land, $1,750 in state tax credits for each job created (potentially 900 jobs total), tax abatements for five years (undisclosed amount), exemption from state and local sales taxes for equipment purchases, and possibly other incentives. The deal also had three phases of investment from the company: (1) $146 million and 350 workers, (2) $127 million and 300 workers, and (3) $119 million and 250 jobs. Overlap with main Subsidy Tracker data: none.

Source Notes: If an online information source is not working, check the Tracker inventory page for an updated link.

Subsidy Tracker Individual Entry

Company: Microchip

Parent Company:

Subsidy Source: state

Location: Oregon

City: Gresham

Project Description:
Semiconductor fabrication

Year: 2002

Subsidy Value: $13,100,000

Program Name: Strategic Investment Program

Awarding Agency: Business Oregon

Type of Subsidy: property tax abatement

Source of Data:
Direct from Business Oregon; not on web

Notes:
Year is year of approval; subsidy value is cumulative amount of abatement through 2010

Source Notes: If an online information source is not working, check the Tracker inventory page for an updated link.

(a) Toyo Tire (b) Microchip

Notes: These are two examples of the information available in the *Good Jobs First* Subsidy Tracker. Each entry is a subsidy deal. Both entries include the company name, location, project description, year, size of the subsidy, and source of the subsidy funds.

tax credits or programs.

In order to fill in the number of jobs I take a brute-force approach, and read articles and press releases about each deal.[32] For this case, there is an article in the trade publication *Site Selection* titled "Oregon Incentives, Idle Plant Are 'Fab' for Microchip's Expansion Plan." From the article I learn how many jobs are planned (688) and the runner-up location (Puyallup, WA).[33] I can also use the state-level data I have collected to do a back of the

[32]When there is no information on the industry of the firm I match the company name to Compustat, if not in Compustat it is also sourced from the articles. About 25% of the observations in the sample have missing jobs, which I fill in.

[33]From the article: "Spurred by US$17.3 million in state incentives, Microchip Technology (www.microchip.com) has hired the first 60 of what may be as many as 688 employees at its newly acquired facility in Gresham, Ore....In 2000, Microchip bought an existing Matsushita fab in Puyallup, Wash., 155 miles (249 kilometers) north of Gresham. The Puyallup fab, which is also currently idle, was the clear frontrunner in Microchip's U.S. expansion plans."

envelope calculation of non-discretionary incentives a company would receive in a given state, if it is not included in the subsidy entry. In Microchip's case, Oregon has a 5% R&D tax credit for eligible R&D spending, which would mean an additional $2.2M in savings, given the number of jobs and average industry wage.

The runner-up locations are never included in the subsidy entries, so creating an establishment-level subsidy dataset that includes runner-ups is a considerable task. Source include *Site Selection* and other trade magazines, local newspapers, state documents, and company press releases.[34] I was able to find some information about the runner-up location for 95% of the subsidy deals in my sample. Of course, the runner-up "location" is sometimes not a location but a threat to shut-down or not expand. In 77% of cases I can identify a runner-up location in the U.S., for 7% it is outside of the U.S., and the remaining 16% reportedly do not consider other locations.[35]

Lastly, I normalize all the amounts by the length of the subsidy deal. In the majority of deals firms receive tax credits or abatements for a period of 10 years, so I standardize all deals in the data to the 10-year value. Table 1 shows a snapshot of the publicly available data and the finished product. The bulk of the new data comes in the form of the runner-up states, non-discretionary incentive spending, and direct job numbers.[36]

Limitations of the Data

The ideal dataset would consist of the detailed contract between the firm and state, as well as administrative data on state costs and firm savings for each year following the deal. Of course, those data are confidential, and still might not include all of the variables I would like, for example, the dollar value of in-kind subsidy items to a given firm. In this section I will briefly discuss the limitations of the data I do have.

Good Jobs First takes the value of the deal as given from the source (state documents, news article, press release), and states may calculate the present discounted value differently, and include or exclude certain costs when reporting the value of the subsidy deal. Similarly, certain parts of the subsidy deal are in-kind, for example, the state gives the firm land, a building, builds an exit to the highway. We rely on the estimate from the state on how much that is worth, and no distinction is made between how much it costs for the state to provide

[34] Collecting runner-up locations from *Site Selection* is at the heart of the identification strategy in Greenstone, Hornbeck and Moretti (2010). See examples from other sources in Appendix Section B.2.

[35] This is akin to saying they are not making national searches. The observations with no runner-up location are smaller, with a median of $26M and mean of $74. The observations with documented runner-up locations have a median of $67M and mean of $176M.

[36] Data on jobs promised was missing in 25% of cases in the publicly available data.

Table 1: Available vs. Completed Datasets

Publicly Available Subsidy Data

		State		Subsidy ($M)				
Company	Year	Won	2nd-place	Discr.	Non-Discr.	Industry	Jobs	Retain/ Expand
Microchip	2002	OR	?	17.7	?	Semicond.	?	?
Toyo Tire	2004	GA	?	90.1	2.0	Tires	900	0
ThyssenK	2007	AL	?	1,268.5	-	?	2,000	?
Chrysler	2010	MI	OH	1,514.5	-	Auto	?	1
Electrolux	2013	NC	?	28.9	?	?	?	?
Faraday	2016	CA	?	12.7	?	?	1,990	?

Completed Dataset

		State		Subsidy ($M)				
Company	Year	Won	2nd-place	Discr.	Non-Discr.	Industry	Jobs	Retain/ Expand
Microchip	2002	OR	WA	17.7	8.8	Semicond.	688	0
Toyo Tire	2004	GA	AL	90.1	2.0	Tires	900	0
ThyssenK	2007	AL	LA	1,265.1	3.4	Steel	2,000	0
Chrysler	2010	MI	OH	1.461.3	54.2	Auto	20,000	1
Electrolux	2013	NC	SC	28.9	6.7	Appliance	810	1
Faraday	2016	CA	NV	12.7	74.8	Auto	1,990	0

Notes: The upper panel in this table shows a snapshot of the publicly available data from the *Good Jobs First* Subsidy Tracker. Each observation is a subsidy "deal," therefore it should include the company that will receive the discretionary subsidy, and an estimate of the size of the subsidy, the year the deal was made, and the state that is giving the subsidy. Other details are not always available. The lower panel shows the data entries for the same six subsidy deals, after the author collected data from newspaper articles, press releases, state budget documents, and tax expenditure reports.

and how much it is worth to the firm.

Consider the two examples of subsidy deals I presented in Section 2. In the case of Foxconn, the subsidy deal reportedly included exemptions from state environmental regulations. I have no way to estimate how valuable that would be to Foxconn, and it is not included in the dollar amount of the deal. In the case of Lockheed Martin, the *Good Jobs First* data only includes the value of the discretionary tax credit, but Lockheed is also eligible for California's very generous R&D tax credit. I do not know the size of Lockheed's research and development expenses in California, so I will have to estimate the value of the credit using the number of jobs they will create, the expected wages of those jobs, and the proportion of R&D employment in that industry.[37]

Another consideration is the selection of firms that receive subsidies. If a firm relocated without any discretionary subsidy it is not considered in this dataset, because I do not have administrative data on establishment entry. Therefore, all of the analysis is with respect to this subset of "special" firms which receive discretionary subsidies. See Appendix B.3 for a discussion of various checks of the integrity and coverage of the *Good Jobs First* data.

3.3 Descriptive Statistics

The number of discretionary subsidies per year has grown over my sample period: from 15 in 2002 to 36 in 2016. There are 32 large subsidy deals made each year, on average, at about $156 million a deal, and promising to create just under 1,700 jobs per deal.[38] There is considerable geographic heterogeneity in subsidy-giving and total spending. Figure 2 highlights patterns in subsidy-giving, total incentive spending, and spending per establishment entry. Note that large states, such as Texas, California and New York are all top incentive spenders (Panel b), but do not necessarily give the most discretionary subsidies (Panel a). When spending is normalized by the number of establishments with at least 100 employees that entered the state (Panel c), it is states such as Idaho, West Virginia and Oklahoma that are the top spenders.[39] These are perhaps less attractive locations to the firms, so the compensation to locate there is higher.[40]

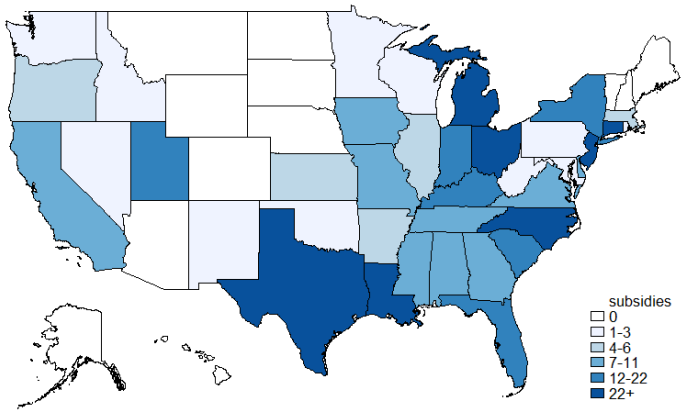
[37] Lockheed Martin is a publicly traded firm, so they do report their R&D expenditure to the SEC in the Form 10-K. However, this is not broken down by location of expenditure, and Lockheed operates "significant operations" in 22 locations across 16 states, according to their 2016 10-K.

[38] The median number of deals is 35, at $57 million and 775 jobs promised.

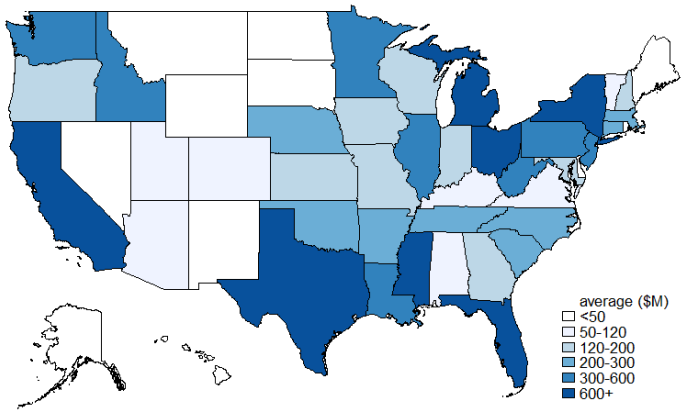
[39] I use data on entry of establishments with 100+ employees from the Census County Business patterns.

[40] Appendix Table 9 summarizes the data at the state level, considering the median corporate tax rate, total incentive spending, spending per establishment or job, and discretionary spending per job. Note that many smaller states are never observed giving large discretionary subsidies to firms. This may be due to budget constraints, which I discuss briefly in Section 4 and in more detail in Section A.

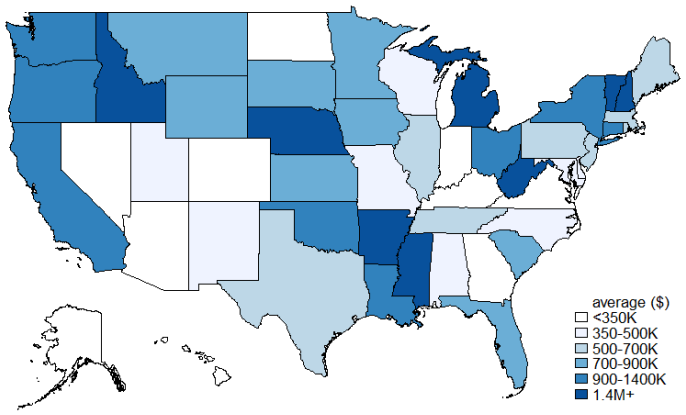
Figure 2: Geographic Distribution of Subsidy-Giving and Incentive Spending



(a) Subsidies



(b) Total Spending



(c) Spending Per Establishment

Notes: The three figures above show the geographic distribution of subsidy-giving and spending. Figure (a) is the number of subsidies given by each state over the sample period (2002-2016). Figure (b) is the yearly average of each states' total economic development spending (not only discretionary). Figure (c) is the average per-establishment incentive spending. This is calculated as the states' total economic development spending in year t, divided by the number of establishments with 100+ employees that entered the state in year t.

Table 2: Median Subsidy, Jobs, by Industry

Industry	Subsidy ($M)	Jobs	Subsidy $ per Job	# Sub	Popular State
Manufacturing					
Aerospace	94.9	1400	54,331	25	NC (20%)
Automobiles	139.8	1895	87,306	48	MI (15%)
Chemicals	21.3	165	325,780	23	LA (39%)
Oil/Gas	70.3	160	636,365	47	LA (60%)
Semiconductors	82.9	500	132,718	33	NY (24%)
Steel/Metals	50.9	638	99,315	36	KY (11%)
Tires	39.0	875	58,742	24	SC (17%)
Miscellaneous	55.2	847	68,927	50	MI (30%)
Services					
Data/Software	55.6	275	97,211	24	NC (25%)
Finance/Real Estate	26.0	1076	35,575	56	NJ (25%)
Pharma/Research	59.4	550	103,627	37	FL (22%)
Trade	64.1	938	49,028	40	TX (13%)
Miscellaneous	27.4	800	37,076	42	NC (16%)

Notes: This table displays industry level descriptive statistics on subsidy deals. For each group, the median subsidy size, number of direct jobs promised, and subsidy per job is displayed. I also list the number of subsidies and the most popular state that gives subsidies to that industry.

There is also a considerable amount of heterogeneity across industries (Table 2), not only in the size and incidence of the subsidies, but the amount paid per job.[41] For example, automobile manufacturers receive the largest subsidies, at a median of $139.8, but they also create the largest number of jobs. So, the subsidy per job for automobile manufacturers is much lower than in the chemicals or oil and gas industry. What is driving these differences? Why do they value a job in oil and gas more than at an automobile plant? This gets back to the research question, how do states decide how much a firm is worth?

I develop a model to answer this question. Firm locations and subsidy sizes are the equilibrium outcomes of state competition for firms, and the firm location choice problem. Firms do not necessarily locate in the state with the highest subsidy, they also care about how profitable they will be in the state.[42] If I observe a firm receiving a very small subsidy in a state it could be because the state is very attractive to the firm, or because all states had low valuations for the firm. In order to disentangle differences in firm profits in a location from the states' values for the firm, I will model the discrete choice location decision of the

[41] See also Appendix Section B for a finer industry breakdown.

[42] A case of this nature occurred in the competition for the Foxconn plant; Michigan offered a subsidy worth $800 million more than Wisconsin, but Foxconn chose to locate in Wisconsin (Associated Press, 2017).

firm within the subsidy competition between states.

Before getting to the model I discuss the potential determinants of subsidy size, suggested by the statements of policy makers, theory, and past empirical work.

3.4 What determines incentive spending?

The most commonly cited motivation for giving a discretionary subsidy is job creation. This is evident from both the legislative text and interviews with policymakers. For example, the legislation enacting North Carolina's Job Development Investment Grant (JDIG) program states:

> The purpose is to stimulate economic activity and to create new jobs for the citizens of the State by encouraging and promoting the expansion of existing business and industry within the State and by recruiting and attracting new business and industry to the State.

In an interview with the Washington Post about the Amazon HQ2 bidding war, Maryland State Senate President Thomas 'Mike' Miller says:[43]

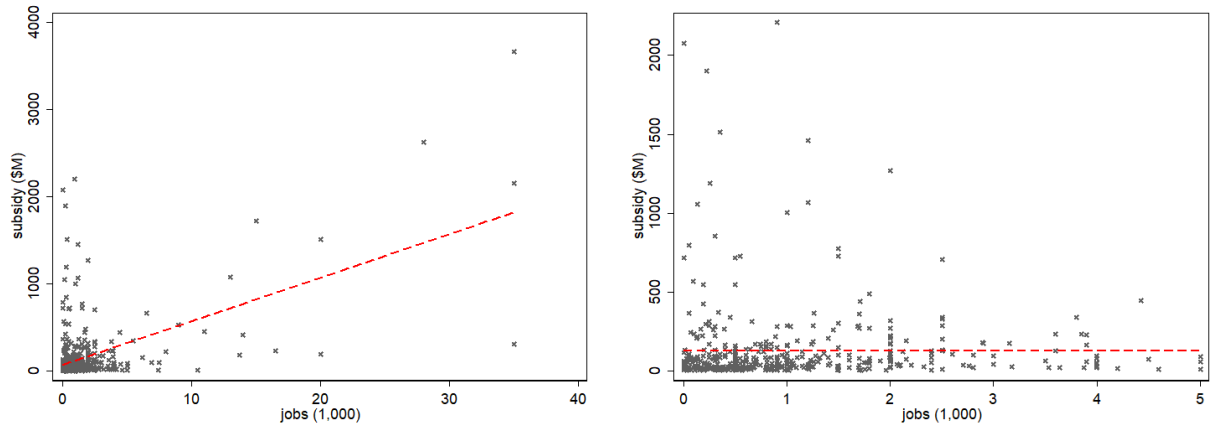
> Whether in Baltimore City, Prince Georges County or Montgomery County, we need to make it happen. Its jobs, jobs, jobs and more jobs.

However, when one considers the data, jobs do not go very far in explaining subsidy size. In Figure 3 I plot the number of direct jobs promised by a firm with the size of the subsidy it received. When I use the full sample (on the left) I find that there is a positive relationship, an additional 1,000 jobs is correlated with $46 million more in incentives, or $46,000 per job (also see the first column of Table 3). On the right I restrict to firms that create 5,000 jobs or under, which is 96% of the total sample. The positive correlation between jobs and subsidy size completely vanishes. Therefore, for the most part, it does not appear as though states only value job creation.

However, this is only accounting for the direct jobs promised by the firm. The unobserved indirect job creation of each firm, that is, jobs created through spillover, may help rationalize this lack of correlation. Heterogeneity between states, differing valuations of jobs in certain industries, revenue considerations, and economic conditions also could have a role in explaining subsidy size. I explore various potential determinants for subsidy size in the remainder of the section.

[43] See "Montgomery County lawmakers embracing Hogans $5 billion effort to woo Amazon," *The Washington Post*, January 22, 2018.

Figure 3: Direct Jobs Promised vs. Subsidy Size



Notes: This figure plots the number of direct jobs promised in a subsidy deal, with the size of the subsidy the firm receives. Jobs, in 1,000, is on the x-axis, and subsidy size, in $M, is on the y-axis. The red dashed line is the trend line, the predicted subsidy size using a linear regression of subsidy size on direct jobs promised. The figure on the left uses the full sample, while the figure on the right uses only deals with direct job creation of 5,000 jobs or less, which is 96% of the sample.

Spillovers: Indirect Job Creation

Spillovers are another oft-cited justification for the size of a subsidy or competition for a given firm, as well as a motivation for subsidy competition in the theory. However, there is limited data on firm-state specific spillovers. North Carolina provides predicted "indirect job creation" in the documentation of their discretionary grant program. They often estimate the indirect jobs created by attracting a given firm will be an order of magnitude greater than the direct jobs.[44]

There is a large literature on measuring the spillover effects between firms, and a smaller one which specifically studies large subsidized firms. Greenstone, Hornbeck and Moretti (2010) quantify agglomeration spillovers by estimating the impact of the opening of a large manufacturing plant on the total factor productivity of incumbent plants, and indirectly through the opening of new establishments. They have the list of runner-up counties, which they use as a control group. They find that the number of manufacturing plants increased by about 12.5% in winning counties after the opening, and there is an almost 15% increase in total output. The authors conclude that new manufacturing establishments decided to locate in the winning counties to gain access to productivity spillovers generated by the large plant.[45]

[44]See Figure 19 in the Appendix.

[45]This paper (Greenstone et al. 2010) focuses on the spillover effects created by large, subsidized, firms,

Table 3: Reduced Form Evidence: Determinants of Subsidy Size

	Subsidy Deal ($M)			
	(1)	(2)	(3)	(4)
Stated Objective:				
Jobs promised (1,000)	46.00***	45.94***	-59.66*	45.70***
	(5.18)	(5.19)	(36.02)	(5.17)
Economic Concerns:				
State unemployment rate (%)		7.18		
		(20.21)		
Revenue Considerations:				
Corporate tax (%)			22.95*	
			(12.72)	
Property tax reliance (%)			1.57	
			(9.52)	
Average wage			0.97	
			(1.77)	
Jobs × Property tax reliance			1.84**	
			(0.74)	
Payroll: Jobs × Average wage			0.64**	
			(0.30)	
Political Considerations:				
First-term governor				-56.81*
				(29.50)
N	485	485	485	485
R^2	0.54	0.54	0.55	0.54
Year FE	x	x	x	x
State FE	x	x	x	x
Sector FE (3 digit NAICS)	x	x	x	x

Notes: This table presents results from a regression of subsidy size on state and firm characteristics. Year, State, and Sector fixed effects are included in each specification. Standard errors are in parentheses. The sample is the 485 subsidy deals in my dataset, which covers 2002-2016.

It is possible that a lack of correlation between jobs promised and subsidy received can be explained by spillover; high-spillover firms that are creating a modest number of direct jobs are receiving the same amount of money as low-spillover firms with a larger number of direct jobs. I test whether states have higher valuations for high-spillover firms, where

not the motivations for subsidizing the firm. However, the model they develop to inform their results provides insights into the subsidy-setting problem of the state. They apply a Roback (1982) style model with spillovers between firms. In the model, the entry of the subsidized firm creates spillovers, which leads to the entry of other firms, who want access to the spillovers. However, this entry increases competition for inputs, increasing land values and wages. Outside of their model, but germane to this project, is the fact that increased land values and wages creates more revenue for the state, in the form of property tax and income tax collection.

I estimate spillover as the effect of the large subsidized firm on entry of smaller (medium-sized) firms. Of course, this is not the only channel that spillovers can operate. It may be that a new large firm also increases the productivity of existing firms (as in Greenstone et al. 2010), and raises property values and local revenues (Bartik 1991). I use the entry of medium-sized firms because it is publicly available in the data, and because they receive some non-discretionary incentives from the state. This allows me to begin to think about the trade-off of the state, and compare the effect of attracting a large firm on medium firm entry to the effect of increasing incentive spending to medium firms.

Economic Conditions

Local economic conditions may explain differences in how much a state values job creation. It is not immediately clear which way incentive spending varies with the business cycle; a positive shock brings in more tax revenue, which can be spent on economic development programs, while a negative shock creates a demand for jobs and the associated 'job-creation' programs. In column 2 of Table 3 I find a weak correlation between the unemployment rate and the size of a subsidy deal.

In the aggregate, I test whether greater spending follows employment increases or decreases in a state by running the following OLS regression of state level incentive spending on state-level employment, GDP, and employment changes:

$$\text{Incentive } \$_{st} = \alpha \text{Emp}_{st} + \beta \text{GDP}_{st} + \gamma(\text{Emp}_{s,t-1} - \text{Emp}_{s,t-2}) + \eta_t + \nu_s + \epsilon_{st}. \quad (1)$$

Table 4 presents the results. Surprisingly, total state employment is not highly correlated with incentive spending within a state (columns 1,4). However, employment changes do correlate with incentive spending. The results suggest that state incentive spending is counter-cyclical; states that lose 1000 jobs between $t-2$ and $t-1$ spend \$1.3 million more on economic development in year t in the aggregate. Thus, heterogeneity in local labor markets may drive difference in subsidy spending (Bartik 1991), as states which struggle to create jobs have a higher valuation for the marginal job.

Potential Revenue

Another possible determinant of subsidy size is the ability of the state to recoup revenue from the job creation, business activity, and spillover effects created by the new firm. For example, if the state has a high corporate tax rate, it both can gain more from attracting a new firm to the state, and is able to offer a larger subsidy in terms of corporate tax abatements. This also holds for property taxes - a locality with a high property tax rate can

Table 4: Is incentive spending pro or counter-cyclical?

	State incentive spending ($M)			
State employment (1000s)	0.718		2.334***	0.190
	(0.825)		(0.860)	(0.780)
State GDP ($M)		0.004**		0.006***
		(0.002)		(0.001)
Δ_{t-1} State employment			-1.887***	-1.305***
			(0.392)	(0.248)
R^2	0.076	0.240	0.270	0.346
N	384	384	288	288
State FE	x	x	x	x
Year FE	x	x	x	x

Notes: This table displays the results for the regression as specified in Equation 1. The sample period is 2007-2014. Observations are at the state-year level, and state and year FE are included in each specification. Standard errors reported in parentheses. Data is sourced from the Bureau of Economic Analysis (GDP), Census County Business Patterns (employment), and collected by the author (incentive spending).

both give a larger discount, by abating the property tax, and have more to gain if the firm increases local property values (even if the firm pays no property taxes).

I test for a correlation between subsidy size and three possible sources of revenue for the state: the corporate tax rate, the payroll of the firm, and property tax collection. The payroll of the firm is defined as the number of jobs promised by the firm, multiplied the average wage in the industry of that firm. Since property taxes are usually collected at the city or county level, I use a concept of "property tax reliance." This is defined as the percentage of state and local tax revenues that are generated by property taxes. I also interact this with the number of jobs promised by the firm, in an attempt to capture the magnitude of the investment.

Column 3 in Table 3 shows that all three possible revenue drivers are correlated with subsidy size. A one percentage point increase in corporate tax rate is correlated with almost a $23M larger subsidy, while a one percentage point increase in property tax reliance, holding number of jobs constant, is correlated with a $1.8M larger subsidy. Of course, this could be driven by firm preferences — a firm needs a larger subsidy to locate in a higher cost (higher corporate tax, property tax) state. In order to disentangle the firm preferences over location characteristics from the state's subsidy-setting decision I need a model of both firm location choice and state subsidy competition.

Politics

Lastly, I consider the possibility that state incentive spending and the subsidy-setting process is partly driven by political considerations. Past literature in public economics has explored political motivations for policy changes. Besley and Case (1995) study the effect of term limits on the policy behavior of U.S. governors, finding that governors who do not have re-election concerns (because of a term limit) levy higher sales, income, and corporate taxes. Meanwhile, Foremny and Riedel (2014) find that incumbent politicians in German city council elections lower business taxes in the year before an election, and raise the taxes in the year after.

I test whether there are correlations between the characteristics of the state governor and whether the state increases or decreases incentive spending using a linear probability model:

$$\mathbb{1}\{\Delta\text{spending}_{s,t+1} > 5\%\} = \beta \text{ governor characteristics}_{st} + \gamma_s + \eta_t + \epsilon_{st} \quad (2)$$

where the characteristics are whether the governor is in their first term, term-limited, or has further ambitions in politics.[46] The regression includes state and year fixed effects (γ_s, η_t).

Table 5 shows the results from Equation 2 using state-level spending data from 2007 to 2014. It shows that being a governor in the first term is associated with an increased probability that incentive spending increases in the aggregate. Term-limited governors are associated with a decreased probability of increasing total spending. This is suggestive evidence that governors may be using incentive spending to increase their chances of re-election.[47]

Previous work on subsidy competition (Ossa 2018, Mast 2018) does not allow for a revenue-maximizing Leviathan government. I will allow political considerations in the subsidy decision, by estimating the distribution of state valuations for firms conditional on whether the governor is term-limited.[48] There is some work on the role of politics in subsidy competition; Jensen and Malesky (2018) provide evidence that politicians use economic development incentives to pander to voters and Slattery (2018) shows that an increase in corporate involvement in state politics leads to an increase in state subsidy spending. If states do allow political considerations, such as re-election concerns, to affect their valuation

[46] "Future ambitions" is measured by whether I see the governor run for another political position (e.g. Senate, Congress, etc.) after their term is over.

[47] I don't find the same correlation in the subsidy-level data (Table 3).

[48] It is also possible that these subsidies are driven by corruption - governors can use discretionary incentives to funnel money to their friends and political supporters. Industries that have greater political influence in a state, such as oil and gas in Louisiana and Texas, may use their political capital to ensure more financial support from the government. I will not be able to speak to these motivations in this paper, but it is a rich area for further work.

Table 5: Linear Probability: Governor Characteristics and Spending

	Total spending in $t+1$					
	Increase by $> 5\%$			Decrease by $> 5\%$		
First term	0.41**			-0.15		
	(0.19)			(0.19)		
Term-limited		-0.40**			0.17	
		(0.20)			(0.20)	
Future run			0.10			0.13
			(0.27)			(0.29)
Republican	0.11	0.12	0.18	-0.57**	-0.58**	-0.59**
	(0.24)	(0.24)	(0.23)	(0.25)	(0.25)	(0.25)
N	315	315	315	329	329	329

Notes: This table presents the results for the regression as specified in Equation 2. Observations are at the state-year level, and the sample period is 2007-2014. Year and State fixed effects are included in each specification. Standard errors are in parentheses.

of a firm, subsidy competition could lead to inefficient firm locations.

Given the data on total state incentive spending and firm-level subsidy deals, and various motivations for spending which may affect a state's valuation for a firm, I proceed to the model.

4 Model

In this section I develop a model of state subsidy competition. I use an private valuation English auction framework to model states bidding for firms. Anecdotal evidence from state economic development agencies and company officials motivates this approach.[49] Bidding for a firm begins when the firm announces it is considering an expansion or re-location, and continues as states learn of other bids and adjust their subsidy offers. The firms that are being "auctioned" have a discrete choice problem; they locate in the state that gives the highest payoff, where payoff is a function of the subsidy offer and the profit they would receive in that state.

The English auction, through which states bid for firms and firms locate in highest payoff state, is the heart of the model. It captures the mechanism through which states compete for firms, and allows me to clearly separate the state valuation for firms and the

[49]I will duscuss the modeling choices in detail at the end of the section.

firm preferences over states. This will allow me to explain how states make subsidy decisions, and how subsidies influence firm location.

I enrich the auction model to capture two additional real world features of incentive competition: (1) spillover effects of subsidized firms (2) non-discretionary incentive spending.

Spillover, or agglomeration economies, is one reason a state would offer a certain firm a tax break. Intuitively, firms that have higher spillovers should get larger tax incentives. Also, the spillover of one firm may differ from state to state. States that will experience the largest spillover, or benefit most from agglomeration, are willing to pay the most for the firm and offer higher incentives. In this case I consider spillover to mean the effect of the subsidized firms in attracting more firms to the state.[50]

In order to incorporate potential spillover effects I model the location decision of firms who do not get discretionary subsidies. I call these the "medium" firms, due to their size.[51] The medium firms also solve a static discrete choice problem: they locate in the state that gives the highest profit, where profit is a function of the number of large firms, non-discretionary incentive spending, and the state characteristics. This occurs after the auction for the largest firms. By backwards induction the expected spillover of the large firm (the effect of the large firm on the medium firm entry) enters the state bid for the large firm.

Thus, with the addition of the medium firms the model allows states to value potential spillover effects of large firms, and encompasses both discretionary and non-discretionary incentive spending.

Model Set-up

There are three types of agents in the model: State Governments, Large Firms that receive discretionary subsidies, and Medium Firms. I outline the timing of the game and then detail the optimization problem for each agent. The timing of the game is as follows:

(t=0) *Large Firms* announce intention to relocate and/or expand

(t=1) *State governments* bid for firms

Large Firms locate in state with highest payoff

(t=2) *Medium Firms* observe the outcome of $t = 1$ and locate in state with highest

[50] Another type of spillover would be that the new subsidized firm made incumbent firms more productive, so they increased hiring, investment. There are also effects of new large plants on property values, this is heterogeneous, depending on the city the firm locates on. I use data on the state and local reliance on property tax revenues to try and capture the importance of increased property values. All of these potential spillovers are implicitly modeled as part of the private value of the state.

[51] From the data we know that medium sized firms do not receive discretionary tax breaks from the states, but often qualify for tax-credits and other general incentives.

profit

Multiple large firms can announce searches and choose locations each year (and at different times within a year). The medium firms make the location decision in the second year (t=2) after observing all of the location choices made by large firms in t=1. If more than one large firm locates in state s in t=1, the state considers the spillover of the $(n+1)$-th large firm, taking into account they have n new entrants.

State Problem

A state $s \in \{1, \ldots, S\}$ draws a private valuation for firm i, v_{si}, independently distributed $H(v|x, z, \nu)$. x is a vector of state characteristics, z is firm characteristics, and ν is the expected spillover of firm i. These state and firm characteristics are publicly observed by all states, but the spillover is firm-state specific and private information to the state.

States compete for the firm in a private valuation English auction. The English auction is a open-outcry ascending auction, which means that a state can announce a bid and then increase their bid once another bid makes a more attractive offer. This is strategically equivalent to the 2nd price auction, in which every bidder bids their value, and the highest value bidder wins the good, paying the price of the second highest bidder. The optimal strategy for the state is straightforward - they bid up to their value, v_{si}, for the firm.

If firm i chooses to locate in state s the state receives a payoff of $v_{si} - b_{si}$, where b_{si} is the bid for the firm.

Large Firm Location Choice

The large firm's objective is to maximize payoffs. This means that unlike a standard auction, the winning state is not always the highest bidder. Instead the firm will locate in the state that gives them the highest payoff, the sum of their profit in the state and the bid (subsidy) offered by the state.

I model firm i's payoff from locating in state s as:

$$w_{is} = b_{is} + \pi_{is} \tag{3}$$

where b_{is} is the bid (subsidy offer) of state s, and π_{is} is the profit of firm i in state s. Firm i draws a profit π_{is} in each state s from some distribution $G(\pi)$.[52] This profit is public information to all states.

[52]This profit may be a function of state and firm characteristics, and a firm-state match value.

Firm i locates in s if it gives the highest payoff of all states in S:

$$y_{is} = \mathbb{1}[b_{is} + \pi_{is} > b_{im} + \pi_{im} \ \forall \ m \in S].$$

Medium Firm Location Choice

The medium firm's objective is to maximize profit. Their profit in a state is a function of the expected non-discretionary incentives available to firm k in state s, $\mathbb{E}\chi_s$, the number of large firms in industry j, $\sum_i y_{ijs}$, and other state characteristics, x_s. A medium firm k has profit π_{ks} in state s:

$$\begin{aligned}\pi_{ks} &= \alpha \mathbb{E}\chi_s + \mu_j \sum_i y_{ijs} + \beta_m x_s + \zeta_s + \epsilon_{ks} \\ &= \delta_s + \epsilon_{ks}\end{aligned}$$

where δ_s is the mean expected profit for a medium establishment in state s. The ζ_s are unobserved state characteristics and ϵ_{ks} captures the firm-specific match value with the state. I assume that ϵ is distributed *iid* Extreme Value, and the outside option of not entering has a mean profitability of 0. Then, the share of medium firms entering state s is given by the logit formula:

$$\omega_s = M \times \frac{\exp(\delta_s)}{\sum_{m \in S} \exp(\delta_m) + 1} \tag{4}$$

where M is the total number of potential entrants. This follows the literature on discrete choice models, pioneered by McFadden (1974).

The spillover effect of large firm i in state s is given by:

$$\nu_{is} = \omega_s(y_{ijs} = 1) - \omega_s(y_{ijs} = 0)$$

Outcome

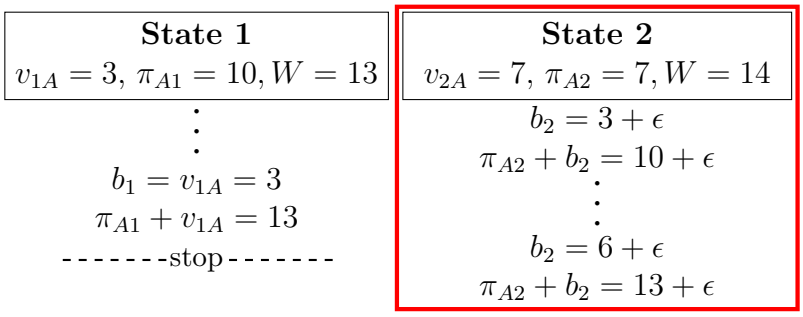
The outcome of the model is a set of equilibrium bids and large firm locations, $\{b^*_{is}, y^*_{is}\}$ s.t.

$$\begin{aligned}\text{losing bids:} \quad & b^*_{is} = v_{si}(x_s, z_i, \nu_{is}) \\ \text{winning bids:} \quad & b^*_{is} \leq v_{si}(x_s, z_i, \nu_{is}) \\ \text{locations:} \quad & y^*_{is} = \mathbb{1}[\pi_{is} + b^*_{is} > \pi_{ij} + b^*_{ij}] \ \forall \ j \in S.\end{aligned}$$

Example: Auction with 2 States

I will illustrate how the auction for firms works with a simple example (also shown in a diagram in Figure 4). Suppose there are two states, state 1 and state 2, competing for a firm, firm A. Firm A draws a profit for each state: $\{\pi_{A1}, \pi_{A2}\} = \{10, 7\}$. Each state draws

Figure 4: Subsidy Competition Example with 2 States



Notes: This figure diagrams an example of subsidy competition between two states. This example shows that subsidy competition can lead to a higher welfare outcome. This is due to heterogeneity in the benefit the firm will have in each state.

a valuation for the firm. State 1 values firm A at \$3M, and state 2 values the firm at \$7M: $\{v_{1A}, v_{2A}\} = \{3, 7\}$.

If there were no subsidy competition, firm A would locate in the state that gives the highest profit, state 1, receiving a payoff of \$10M. State 1 would receive their value for the firm, \$3M, for a total welfare ($\pi + v$) of \$13M.

If the states compete for the firm in an English Auction, state 2 can start the bidding with a bid of $3 + \epsilon$, making the payoff the firm would receive in state 2 ϵ higher than their payoff in state 1. However, state 1 can respond to that; and states will continue to increase their bids until one of the states reaches their stopping rule. In this example, it is state 1, which will not bid higher than their valuation for the firm, \$3M. Firm A receives a payoff of \$13M in State 1 when they bid their total value; State 2 responds with a payoff that is ϵ higher than \$13M, bidding $6 + \epsilon$. Therefore, state 2 offers the highest payoff for firm A, and firm A locates in state 2.

Note that the total welfare when firm A locates in state 2 is \$14M; welfare has increased due to subsidy competition. Therefore, in this simple example, subsidy competition is not a zero-sum game.[53] This is due to heterogeneity in the state values for the firm. Competition allows the state that would experience a larger benefit from the firm's entry to compensate the firm for that positive externality.

You may also note that in this example, subsidy competition reduces the total payoff of the states. Without competition, state 1 captured \$3M, their total valuation for firm A.

[53]One could easily formulate an example where competition is a zero-sum game. Consider the same case as the example above, except that the valuation of state 2 is 5 instead of 7. Competition would still result in firm A locating in state 1, but rent would be transferred from the state to the firm.

With competition, state 2 has a payoff of $v_{2A} - b_2 = 1 - \epsilon$. Therefore, although total welfare increases with competition, this welfare gain is captured by the firm, and total state welfare decreases. If v_{2A} (state 2's valuation of firm A) were larger, both state and firm payoffs would increase under competition.

Discussion

The model does not capture every feature of the incentive competition landscape. The main simplification is with respect to the state economic development budgets. I treat the state non-discretionary incentive spending as exogenous and independent from spending on discretionary subsidies. I do not impose a budget constraint on discretionary subsidies. In reality the state may be setting the total economic development budget, considering the trade-off between discretionary and non-discretionary spending. However, discussion with employees at various state economic development agencies made it clear that the "budget" is a very ill-defined concept, and large discretionary subsidy deals are often made under the assumption that the state will "find" or budget the money in the future.[54]

Another simplification is that I model this problem at the state level, although cities and counties often contribute incentives to the subsidy package and the firm is ultimately choosing a specific location within the state.[55] Lastly, I assume that whenever a firm announces its intention to locate, all the 48 states compete. This is a simplification that is primarily driven by the data I have because I only observe the location choice of the firm, after the fact. In other words, I do not know the "consideration set" of the firm. The best I could do was to determine the runner-up state. I will discuss this further in Section 5.2.

I chose the private value English Auction to model state competition for firms.[56] More specifically, it is a private value English *scoring* Auction, with an unobserved to the econometrician scoring rule. I use the English Auction because I have evidence from state documents on subsidy-giving that there are multiple rounds of bidding, and that states know each others bids.

The use of a scoring auction follows evidence that firms do not only care about the subsidy

[54]For a longer discussion of this assumption and the determination of economic development budgets see Appendix A. Relatedly, I assume the state valuations for firms are independently distributed, and thus do not consider any interactions in the valuations of large firms. For example, the state does not necessarily value large firms less once they have just won an auction for one.

[55]Mast (2018) models the competition between cities and counties for firms within New York State. One reason I do not do this at the more local level is a data constraint. However, the state and city or county usually makes the offer jointly, and the total bid includes the amount contributed by the city or county, usually in the form of property tax abatements.

[56]Kim (2018) uses the private value sealed-bid first-price auction.

offer, but have preferences over state characteristics. Using a scoring auction instead of a beauty contest, generally means assuming that the "scoring rule" (in my case, the firm profit function) is known to bidders (states).[57] However, in this setting, the format in which the English Auction is run is that the firm will update states when their offer has been dominated by another state. Therefore, the states do not need to know the scoring rule to compete.

One reasonable approach would to model this as a common value, as opposed to a private value, auction. In the pure common value auction, the bidders (states) have different information, but identical values for the good (firm). This means that the firm creates the same amount of value (in tax revenue, indirect job creation, etc.), regardless of the location it chooses. This assumption is not supported by most of the literature (e.g. Greenstone et al. 2010, Bartik 1991). Also, in this setting components of one state-specific value for the firm (e.g. the expected spillover effect in that location), should not affect the valuations of other states.

However, another way to think about common values in this context is that $H(v|\cdot)$ is not the distribution of true values, but the distribution of state beliefs about the value the firm will create, which is still location-specific, but has a common-value component. This comes back to the assumption that states know the value the firm will create in the state. Loosening this assumption is an area for further work.

5 Identification

The primitives from the model that I intend to identify are the large firm profits, π, large firm spillovers to medium-sized firms, ν, and the conditional distribution of state valuations for firms $H(v|x, z, \nu)$. I have data on large firm locations, winning subsidy bids, runner-up large firm locations, and medium-sized firm entry shares, along with state and firm characteristics. The identification of spillovers (ν) follows Berry (1994) closely — covariation in medium-sized firm entry shares and state characteristics identify the parameters of the medium firm profit function.[58] In this section I will focus on the large firm profit and the distribution of state valuations, which are not as straightforward to identify. Difficulties arise because (1) I only have data on winning bids, and (2) the winning bid does not represent the second highest valuation.

If firms only cared about the subsidy, and not other state characteristics, this would

[57] From the buyer (firm) perspective, Asker and Cantillon (2008) show that scoring auctions weakly dominate beauty contests in the open ascending format.

[58] I provide more details on spillovers when discussing estimation and results (Section 6.2).

be a straightforward problem. The winning bid would represent the second order statistic from the distribution of state valuations, and identification would be achieved using the order statistic identity (Athey and Haile 2002). However, because firms care about state characteristics, there are multiple steps. I must first recover firm profits. Here I use the model outcome, as well as techniques from the measurement error literature. Then I use the profits to calculate payoffs in the runner-up state, which allows me to apply the order statistic identity, and recover the full distribution of payoffs. Finally, firm payoffs are a function of state valuations, so I invert the distribution of payoffs to recover the distribution of state valuations for firms. I take the rest of the section to provide intuition and details.

5.1 Firm Profits

From the model we know that firm i goes to the state (bidder) that gives the highest payoff. We also know the optimal bidding strategy of each state is to bid up to their value, until no other state can raise their bid. This means that the winning state can stop bidding when the payoff they give the firm just exceeds the payoff in the runner-up state. Like the second price auction, the winning state will guarantee the firm the 2nd highest payoff. In other words, the payoffs in the runner-up and winning state are equivalent:

$$\underbrace{\pi_{\text{winner}} + b_{\text{winner}}}_{\text{payoff in winning state}} = \underbrace{\pi_{\text{runner-up}} + v_{\text{runner-up}}}_{\text{payoff in runner-up state}} \tag{5}$$

To formalize the argument, I assume:

Assumption 1 *States compete for firm i in a private-value English auction. In the auction, states observe all bids from competing states, b, and firm profits across all states, π.*

See Appendix Section C for evidence that states do observe the bids of their competitors. The more demanding assumption, perhaps, is that states know what the firm's profit would be in each state. This is necessary for the equality in Equation 5 to hold. If there is asymmetric information in profits, the state may not know the payoff they have to offer the firm to ensure they win the competition, causing them to "overbid". However, given the state has a long history of competing for firms and observing location choices, as well as access to financial information for publicly traded firms, this is not necessarily far from reality.

Assumption 2 *Large firm profits take the following functional form*

$$\pi_{is} = \beta_i x_s + \xi_s$$

where x_s are observed state characteristics, and ξ_s are unobserved (to the researcher) state characteristics.

Assumptions 1 and 2 give way to the following result:

Proposition 1 *The winning state, observing bids b, and profits π, will bid up to the firm's payoff in the runner-up state. Therefore, if firm i locates in state 1, the profit they get in state 1 is equal to the profit in the runner-up state, s, or:*

$$b^*_{i1} + \beta_i x_1 + \xi_1 = (b_{is} + \beta_i x_s + \xi_s)^{(2:n)} \tag{6}$$

where the notation $(2:n)$ refers to the ranking of the payoff of the state, $(2:n)$ is the 2nd highest payoff state of the n states.

This is given from the structure of the English Auction, winning state (state 1) will never bid higher than b^*_{i1}, as defined in Equation 6, because it will not change the probability of winning, but it will lower their payoff, $v_{1i} - b_{i1}$.

In the English Auction all losing states must have bid up to their value, which is their stopping rule. This means that $b_{is} = v_{is}$ and I can rewrite Equation 6 as:

$$b_{1i} = (v_{is} + \beta_i x_s + \xi_s)^{(2:n)} - \beta_i x_1 - \xi_1. \tag{7}$$

In order to identify β_i from Equation 7 I need to know the identity of the runner-up location, the state that gives the 2nd highest profit. Given that I know the identity of this 2nd highest payoff state (I will denote this state 2), and assuming independence of δx and $v + \delta\xi$, I can identify β_i from the following equation:[59]

$$b_{1i} = \theta_i + \beta_i(x_2 - x_1), \tag{8}$$

where $\theta_i = v_{i1} + (\xi_2 - \xi_1)$ is the residual of a linear regression of the observed winning bids (b_{1i}) on the difference in winning and runner-up state characteristics $(x_2 - x_1)$.

Given β_i I turn to the deconvolution of θ_i, with the aim of identifying the variance of the unobserved state heterogeneity, ξ.

Unobserved State Heterogeneity: σ^2_ξ

From the assumptions made in the previous section, I can write an equation for the winning bid (b_{i1}) where 1 denotes the winning state and 2 is the runner-up state:

$$b_{i1} = v_{i2} + \beta_i(x_2 - x_1) + (\xi_2 - \xi_1). \tag{9}$$

Given data on winning bids and observed state characteristics we can recover a residual, $\hat{\theta}_i$, from Equation 9, where:

$$\theta_i = v_{i1} + (\xi_2 - \xi_1) \tag{10}$$

[59]The assumption of independence between δx and $v + \delta\xi$ is very strong, and I am working to introduce correlation between state valuations for the firm and state characteristics, and finding an instrument for x.

However, we have no data on v or ξ. The identification challenge is to recover the variance of ξ from θ.

I provide details in Appendix Section D, but in short I rely on tools created for the deconvolution of measurement error (see, for example, Carroll and Hall 1988). Deconvolution was developed as a method to separate signal from noise. I observe a noisy signal, $\hat{\theta}$, of ξ. I can use the second moment of θ, to learn about the variance of ξ.

I assume that $\xi \perp v$, and $\xi \sim N(0, \sigma_\xi^2)$. I take the inverse Fourier transform of characteristic function of v_2, to get an expression for f_{v_2}, and then use the variance of θ to recover $\hat{\sigma_\xi^2}$:

$$var(\hat{\theta}) - \big[\frac{1}{S}\sum_{s=1}^{S}(v_{2,s} - \frac{1}{S}\sum_{s=1}^{S} v_{2,s} \times f_{v_2}(v_{2,s}; \sigma_\xi^2)))^2 + 2\sigma_\xi^2\big] = 0.$$

See Appendix Section D for more details.

5.2 State Valuation: $H(v|x, z, \nu)$

Given the identification of β_i and σ_ξ^2, I proceed to the final object of interest, the state valuation of firms, $H(v|x, z, \nu)$.

In a traditional second price auction, where the good being auctioned goes to the bidder with the highest bid, we know that the distribution of observed winning bids is equivalent to the second order statistic of the distribution $H(v)$, because the winning bidder will stop as soon as the 2nd highest bidder drops out. Then, the second order statistic of v can be used to identify $H(v)$. However, in this case the winning rule is that the good (firm) goes to the bidder (state) with the highest payoff. Therefore, I cannot identify H using only data on winning bids.

I will also note that the v_{i2} from Equation 9 is not necessarily the second highest v. The state that gives firm i the second highest payoff does not need to have the second highest valuation for i, just as the state that firm i locates in does not have to be the state with the winning bid. It very well could be that $v_{i2} > v_{i1} \geq b_{i1}$, if state 1 has more attractive characteristics. This means that even given v_{i2} I do not have the 2nd order statistic of $H(v)$.

Instead, I will consider what I know about firm payoffs. From Equation 3, payoff is defined as $w = b + \pi$. Suppose firm payoffs are distributed $F(w)$. Given $\hat{\beta}, \hat{\theta}, x$ and σ_ξ^2 I can estimate payoffs in the runner-up state:

$$\hat{w_i}^{(2:n)} = \underbrace{\hat{\theta}_i - \hat{\xi}_1}_{v_{2i}+\xi_2} + \underbrace{\hat{\beta}_i x_2}_{\pi_{i2}-\xi_2}. \tag{11}$$

The estimates of firm payoffs in the second highest state give way to an empirical CDF of

the second order statistic of payoffs $\hat{F}(w)^{(2:n)}$. Identification of $F(w)$ comes from the second order statistic identity. The i-th order statistic from an i.i.d. sample of size n from an arbitrary distribution F has distribution (see Arnold, Balakrishnan, and Nagaraja (1992), Athey and Haile (2002)):

$$F^{(i:n)}(w|\cdot) = \frac{n!}{(n-i)!(i-1)!}\int_0^{F(w|\cdot)} t^{i-1}(1-t)^{n-i}dt \tag{12}$$

where n is the number of bidders. Therefore the distribution of firm payoffs in all states, $F(s|x,\xi)$, is identified from data on the 2nd order statistic of payoffs, $w_i^{(2:n)}$.

As I mentioned in the model section, I assume that whenever a firm announces its intention to locate, all the 48 states compete, so $n = 48$. This is a simplification that is primarily driven by the data I have because I only observe the location choice of the firm, after the fact, I do not know the "consideration set" of the firm. If the real competition for a firm A is between VA, NC and GA, I am assuming that all other states are also in play. So, I estimate the model, I treat the observed bids as second highest among 48 states where as it should be second highest among 3 states. This usually does not affect the bids, because in an English auction it is weakly dominant strategy is to bid your own value irrespective of the competition. However, the firm location choice is a function of both bids and state characteristics, and the choice of n affects the distribution of firm payoffs. This will lead me to underestimate the distribution of valuations.

Recall, the goal is to identify the state valuation for firms, $H(v|\cdot)$. This is crucial to start to understand how states make subsidy-setting decisions. Whether or not states offer subsidies based on jobs and spillover, or re-election concerns, will have implications for how we evaluate this policy (Glaeser 2001). At this point, I know the distribution of payoffs, F, and from the model I know the relationship between payoffs (w) , profits (π) and state valuations for the firm (v):

$$w = v + \underbrace{\beta x + \xi}_{\pi} \sim F(w|\cdot)$$

Suppose firm profits are distributed with some known distribution G, with pdf $g(\pi)$. Then I can exploit the relationship between valuation and profit to recover $H(v|\cdot)$:

$$\begin{aligned} H(t|\cdot) = \Pr(v < t|\cdot) &= \Pr(w - \pi < t|\cdot) \\ &= \Pr(w < t + \pi|\cdot) \\ &= \int F(t+\pi|\cdot)\frac{1}{\beta}g(\pi)d\pi. \end{aligned} \tag{13}$$

I invert Equation 13 to recover the conditional distribution of state valuations for firms, $H(v|\cdot)$, as desired.

6 Estimation and Results

The estimation argument closely follows the identification argument. As in the identification section I will detail the estimation separately for each part of the problem: firm preferences, spillovers, and state valuation. The discussion of estimation of the variance of unobserved state characteristics is left to the appendix.

6.1 Large Firm Preferences: β

From Section 5.1, the relationship of interest is

$$b_{1i} = \beta_j(x_2 - x_1) + \underbrace{\alpha_t + \epsilon_{it}}_{v_{i2}+(\xi_2-\xi_1)} \tag{14}$$

where b and x are data, and 1 denotes the state that firm i located in, while 2 denotes the runner-up location. The regression equation also includes year fixed effects, α_t, which, in terms of the model, can be thought of the mean valuation of the runner-up states in that year. The year fixed effects will be included with the residual, ϵ, and used to recover the payoffs in the runner-up state. Equation 14 follows directly from the identification argument (Equation 7).

However, the model also implies that profit in the winning state (state 1) is the *highest*; it is greater than or equal to profit in *all* other states. This gives a set of inequalities that constrain the equation in Equation 14:

$$b_{1i} = \beta_j(x_2 - x_1) + \underbrace{\alpha_t + \epsilon_{it}}_{v_{i2}+(\xi_2-\xi_1)} \tag{15}$$

$$s.t.\ b_{1i} \geq v_{is} + \beta_j x_s + \xi_s - \beta_j x_1 - \xi_1\ \forall s.$$

So, the estimation of β_j is a constrained optimization problem. I present results for both the constrained and unconstrained estimation in Table 7, but before going over the estimates I introduce the state characteristics (x) and industry groups (j) that I will use in estimation.

Allowing for Heterogeneity by Industry

In the data section (Section 3) I present descriptive statistics by 13 industry groups, highlighting the heterogeneity in subsidy-giving and size by industry. In the estimation I will use broader classifications, allowing for 4 industry groups of approximately equal size, as shown in Table 6. I will estimate firm preferences at this industry group level, so that low-skill manufacturing firms may prefer right-to-work states, for example, more than high-skill services firms. This is driven by sample size considerations. I want to allow for as much

heterogeneity in the profit function by industry, to get realistic estimates of firm profits, but I only have 485 subsidies in my sample.[60]

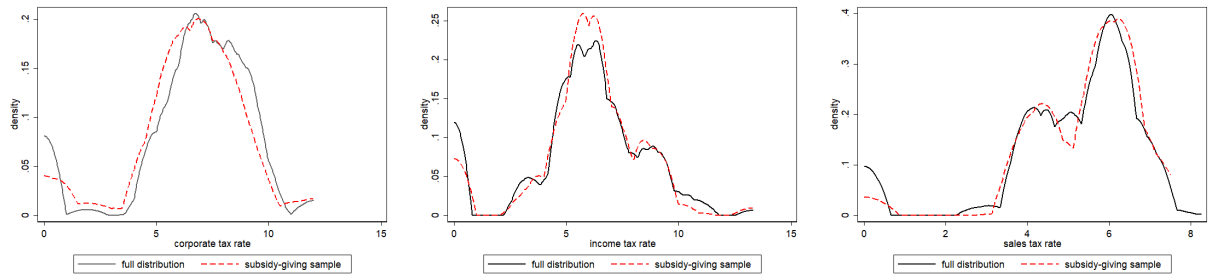
Table 6: Industry Groups for Firm Profit Estimation

Industry Group	N	Median Sub ($M)	Direct Jobs	$ per job
High-skill Manufacturing	104	86.0	1,182	81,650
High-skill Services	101	30.8	850	39,973
Low-skill Manufacturing	200	54.6	500	114,290
Low-skill Services	80	63.0	815	52,925
Total:	485	57.0	775	70,219

Notes: This table displays descriptive statistics by industry group. This includes number of subsidy deals (observations), the median subsidy size in $M, median number of jobs promised, and the spending per direct job. These groups are used in the profit function estimation.

Co-variates

Figure 5: Co-variates: State Tax Rates



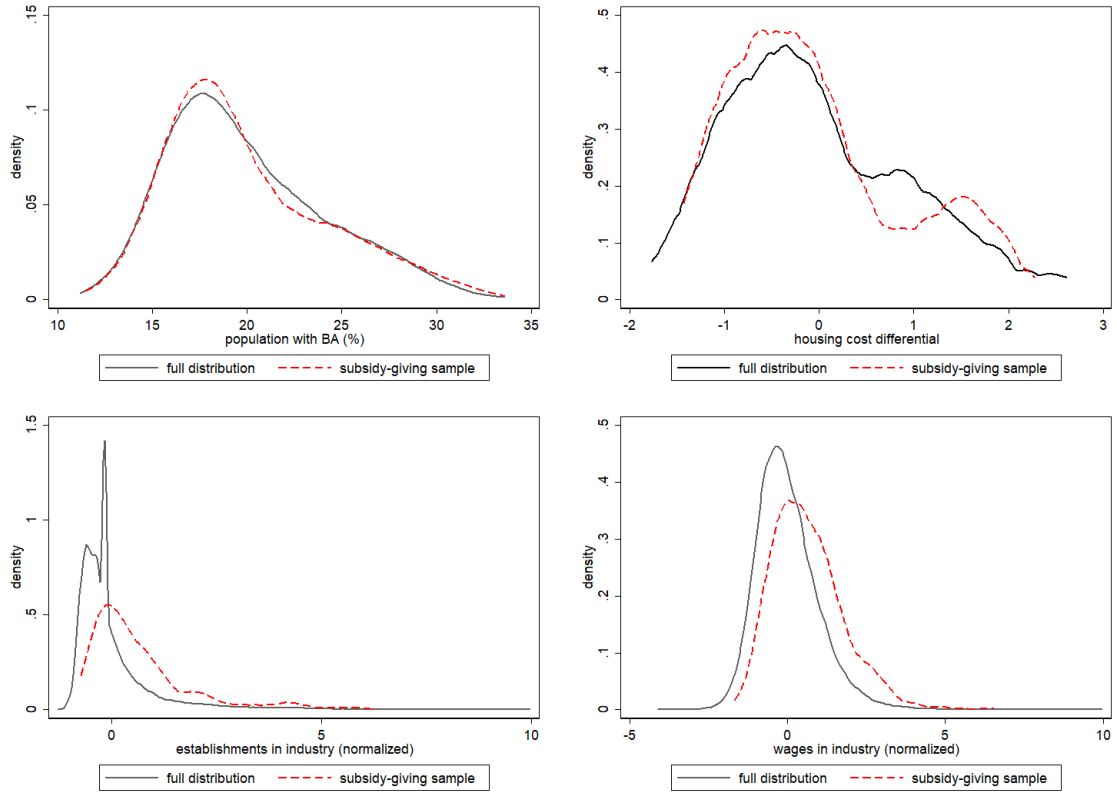
Notes: These figures display the densities of tax rates in the subsidy observations, and in the full sample (48 continental states, 2002-2016).

The state characteristics considered are the state corporate income tax rate, the state individual income tax rate, the state sales tax rate, the proportion of citizens with a college degree, whether the state is a right-to-work state, the housing cost differential in the state, and state-industry level establishments and wages.

Tax rate data come from the Tax Foundation. I use the highest bracket tax rate for the corporate and individual income taxes. The proportion of citizens with a college degree in the state is calculated using Census data, and the right-to-work status of the state is collected from the National Conference of State Legislatures. The housing cost data is from

[60]Note, I also do not allow for any firm-state level unobserved match value.

Figure 6: Co-variates: State Characteristics



Notes: These figures display the densities of state characteristics in the subsidy observations, and in the full sample (48 continental states, 2002-2016). The housing costs, establishments, and wages are normalized to have standard deviation of one and mean of zero. The establishment and wage variables are measured at the industry level, and the normalization is done at the industry level.

Zillow, and the differential is calculated à la Albouy (2016), and is normalized to have mean zero and standard deviation 1. The state-industry establishments and wages are the number of establishments and the wages at the four-digit industry level in the state, normalized to have mean zero and standard deviation 1.

Figures 5 and 6 show the densities of each of these co-variates in the sample of state-years that give subsidies and the full sample of all states and years (2002-2016). Figure 5 shows the tax variables: corporate, income, and sales. Figure 6 includes the other characteristics: population with a BA (%), housing cost differential, and industry-level establishments and wages. The states that win subsidy competitions have similar tax rates to the full sample, but have higher industry wages, and more existing industry concentration.

Table 7: Firm Profit

	Unconstrained		Constrained	
	β	SE	β	SE
Corporate tax (%)	-7.12	4.03	-2.37	0.26
Income tax (%)	15.59	5.84	4.53	0.27
Sales tax (%)	23.63	8.60	1.34	0.11
% with BA degree	6.75	5.20	4.06	0.56
Right to Work State × *Group*				
high-skill manufacturing	257.12	110.18	20.92	2.65
high-skill services	77.15	57.31	-9.60	6.04
low-skill manufacturing	70.29	42.54	17.63	0.44
low-skill services	-42.01	38.51	13.11	2.76
State Housing Costs × *Group*				
high-skill manufacturing	-78.29	56.57	-35.62	3.50
high-skill services	-42.29	33.05	-29.82	0.86
low-skill manufacturing	-60.47	34.56	-9.82	0.48
low-skill services	-64.99	30.32	-22.32	1.81
Industry level Establishments × *Group*				
high-skill manufacturing	-13.13	33.00	10.68	2.38
high-skill services	1.88	17.80	14.11	0.75
low-skill manufacturing	41.13	20.49	9.48	0.30
low-skill services	-4.28	13.09	8.49	0.83
Industry level Wages × *Group*				
high-skill manufacturing	66.58	52.94	1.58	4.32
high-skill services	-8.04	14.95	-1.10	0.66
low-skill manufacturing	-31.76	23.96	-2.57	0.86
low-skill services	-23.58	12.21	-1.64	3.61
R^2	0.29			

Notes: This table displays the results for the regression as specified in Equation 14 (unconstrained) and Equation 15 (constrained). The sample period is 2002-2016. Observations are firms. The regression includes year fixed effects. The industry specific variables are normalized within industry, so the coefficient reflects the effect of a standard deviation change in establishments/wages in that industry. Standard errors in the Constrained case are bootstrapped.

Results

Table 7 displays the estimates for both the unconstrained (Equation 14) and the constrained (Equation 15) estimation procedures. I will go through the results for the constrained case, which is the estimation procedure suggested by the model.

A one percentage point increase in the corporate tax rate decreases the profitability of a location by 2.4 million dollars, and a standard deviation (2.8 percentage point) increase in the corporate tax rate corresponds to a $6.6 million (6.2%) decrease in profits. However a one percentage point increase in either income tax or sales tax increases profitability of a location, this may reflect some amenity value of the state, and is also, of course, not necessarily paid by the firm, but more relevant for the firm's employees and managers. A one percentage point increase in the college educated population increases profits by $4.1 million, and a standard deviation (3.9 percentage point) increase leads to a 16 million dollar (15%) increase in profits.

I allow for industry-group coefficients on the right-to-work variable, housing costs, establishments, and wages. This is important to more realistically model the counterfactual location choice of firms.[61] These coefficients highlight differences across groups. For example, high-skill manufacturing firms are $21M (19%) more profitable in right-to-work states, while high-skill services firms are $9.6M less profitable.[62] Both high-skill groups (in manufacturing and services) are more adverse to high housing costs, and high-skill services firms benefit the most from proximity to other establishments in their industry, highlighting the importance of thick labor markets in skilled-industries.

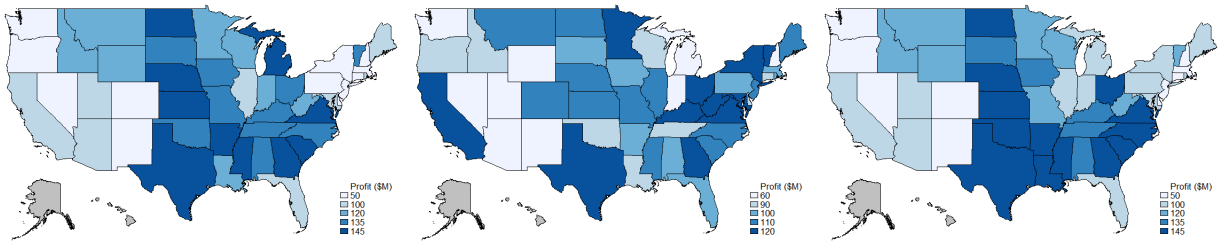
Figure 7 presents profits across states in three industries (Auto Manufacturing, Consulting, and Oil and Coal). Some states are always profitable (e.g. TX, NC), but industry level patterns emerge - Automobile manufacturers are most profitable in Michigan, South Carolina, and Georgia, while Oil and Coal are also profitable in Louisiana and Oklahoma, and consulting firms are profitable in New York and California.

Given the estimates of β I can calculate the profit of a firm in their observed and runner-up location. I will use this estimate of profit to recover an estimate of $H(v)$, the distribution of state valuations for firms. First, I use the model of medium firm location choice to estimate the potential spillovers from subsidized firms.

[61] Ideally I would have richer firm-level characteristics and I would be able to estimate a random coefficients model. I am constrained by the number of observations, which is why I do not estimate industry specific profit functions separately, or industry-specific coefficients for each variable.

[62] These results are consistent with Holmes (1998), who uses a border discontinuity approach and finds that establishments are more likely to locate in right-to-work states.

Figure 7: Estimated Profits by Industry (2016)



(a) Automobile Manufacturing (b) Consulting (c) Oil and Coal

Notes: These figures display the estimated profit across states in the year 2016, for three different industries. Profits are calculated using the estimated $\hat{\beta}$ from Equation 15, multiplied by the co-variates of the state.

6.2 Estimation of Spillovers

The model for medium firm location choice gives an expression for market share (Equation 4). My data has observed shares, which I denote $\hat{\omega}_s$. The goal is to recover the mean profitability of a location, δ_s. I apply the standard Berry (1994) inversion to solve for δ as a function of observed market shares:

$$\delta_s = \log \hat{\omega}_s - \log \hat{\omega}_0$$

which gives an estimable equation:

$$\log \hat{\omega}_s - \log \hat{\omega}_0 = \alpha \mathbb{E}\chi_s + \mu_j \sum_i y_{ijs} + \beta_m x_s + \zeta_s. \tag{16}$$

The coefficients of interest are α, the effect of increasing spending on expected incentives available to medium sized firms on their profit, and μ_j, the effect of winning the auction for an additional large firm in industry j on the profit of the medium sized firms. I allow for 11 industry groups in the medium firm profit function, allowing for heterogeneity in spillover across industries.

The results are presented in Appendix Section E (Tables 13 and 14). Note that the expected non-discretionary incentive has a positive effect on medium firm profits, an 10 thousand dollar increase in the expected non-discretionary incentive available is associated with about a 0.06 (3.1%) increase in medium firm profit in a location.[63] Attracting an additional large firm to the location via subsidy has a smaller effect on medium firm profit at 0.04 (2.1%), however, this effect is heterogenous by industry of the large firm. Firms in automobile, chemicals, and other high-tech manufacturing have a stronger positive effect on

[63] I calculate "expected" incentive by dividing the total available non-discretionary incentives with the number of medium firms that entered the state in the previous year. I instrument incentive spending with the state balance in the previous year.

medium firm profit, increasing profit by as much as 0.13 (6.7%).

I use the estimates in Appendix Table 14 to calculate the expected spillover effect, ν, borne by an additional firm i in industry j, locating in state s. From the model:

$$\hat{\nu}_{js} = \hat{\omega}_s(y_{ijs} = 1) - \hat{\omega}_s(y_{ijs} = 0) \tag{17}$$

In estimation this amounts to adding the value of the coefficient μ_j to state s's profitability, δ, and recalculating the market share, ω. I can translate this to number of firms with 100-249, 249-500 employees respectively, or number of new jobs created via entry of medium-sized firms. A histogram of predicted spillover, in terms of indirect jobs created via the entry (or exit) of medium-sized firms can be found in Figure 8 (a). This is the indirect job creation for the average large firm, and the heterogeneity in number of indirect jobs arises from the shape of the relation of logit probability to mean profits.[64] At the median, the spillover is 120 indirect jobs (224 at the mean). The median number of *direct* jobs promised by a firm is 775 (1658 at the mean), which translates to a multiplier effect of 0.15. For every 10 new direct jobs created by a large firm a state should expect 1.5 indirect jobs, at the median.

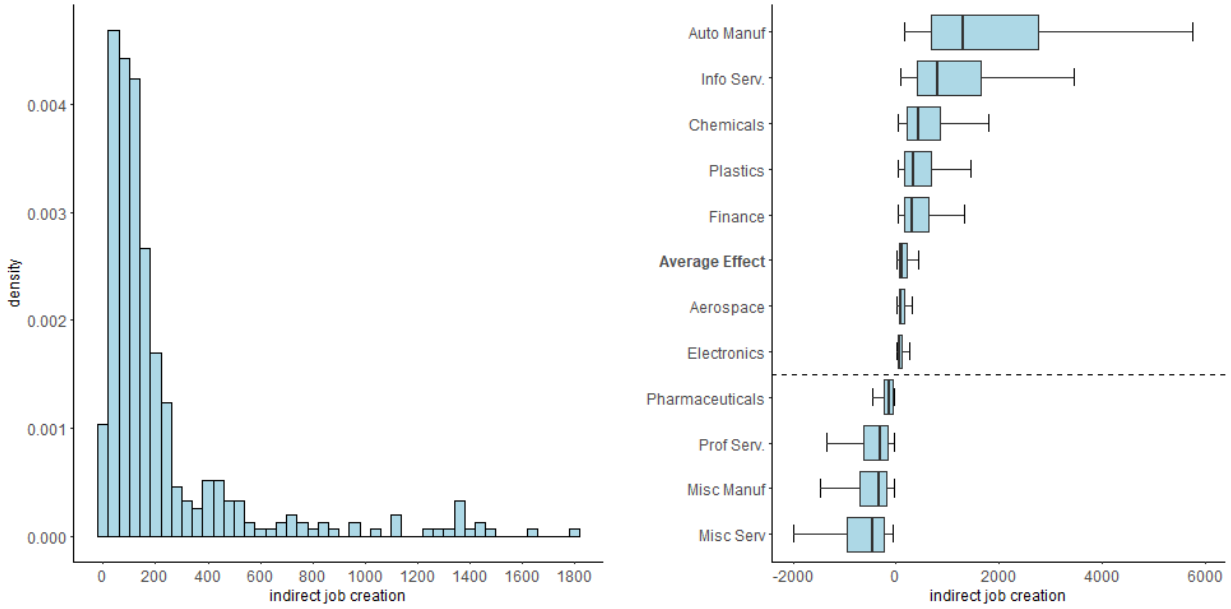
Note that there is significant heterogeneity within industry (predicted spillover is industry-state-year specific), shown in Panel (b) with box plots for each industry. Firms in the automobile manufacturing have the largest positive spillover effects, and other manufacturing and high-tech services firms drive the positive average effect. The multiplier effect for automobile manufacturers is 0.69, so for every 10 direct jobs created at an auto plant, a state should expect about 7 indirect jobs to be created from the entry of new establishments.[65] Miscellaneous services and manufacturing, e.g. wholesale trade and retail, have a negative effect, crowding out smaller establishments. In general, these estimates are a lower bound on the indirect jobs created via spillover. As shown in Hornbeck et al. (2010), indirect jobs are borne from new establishment entry *and* increased productivity of incumbents. These estimates only capture the first effect.

I will use this expected state-specific spillover of the firm as a conditioning variable when I estimate the distribution of state valuations, to say how much states value potential spillovers.

[64] The relationship between the logit probability and average profits (δ) is sigmoid (S-shaped), which means that an additional large firm will have different effects, depending on how profitable the state is to start. The S-shape means that the probability is flat at low and high profitability states, so an additional large firm will have little effect on the probability those states are chosen (other alternatives are either sufficiently better or worse). In the middle, a small change in profitability can swing the choices of the medium firms, and has a significant effect on entry shares.

[65] The median indirect job creation for auto plants is 1,308 (2,197 at the mean), while the median direct job creation is 1,895 (2,970 at the mean).

Figure 8: Predicted Spillover from Medium Firm Entry



Notes: These figures provide descriptive statistics for the predicted spillovers. The predicted spillover for a firm in industry group j is calculated in each state s, year t, according to Equation 17. The density of indirect job creation for the average firm is shown on the left, while a box plot for each industry group is shown on the right, with the average effect in bold, and the industries with negative indirect job creation below the dotted line.

6.3 State Valuations for Firms

I estimate the distribution of state valuations for firms via indirect inference. This follows from the identification (Section 5.2) very closely. I calculate payoffs in the runner-up state (Equation 11), and use the empirical CDF as the second order statistic of payoffs (Equation 19) to recover the distribution of payoffs. Then I simulate state characteristics and ξ and estimate H using the sample average (this corresponds to Equation 13 in Section 5.2).

The only component of the procedure not explained by the identification is the estimation of the conditional distribution of state valuations.

In the following subsection I will detail the estimation of the distribution of state valuations for firms, conditional on the number of jobs promised by the firms. The other variables I condition on (spillover, unemployment, politics) are mostly state specific, and I follow the estimation procedure below on that subset of the data. For example, I can split the sample into estimated payoffs ($\hat{w}_2$) and jobs when the runner-up state has a high potential spillover and when the runner-up state has a lower potential spillover, and compare the two estimated distributions.

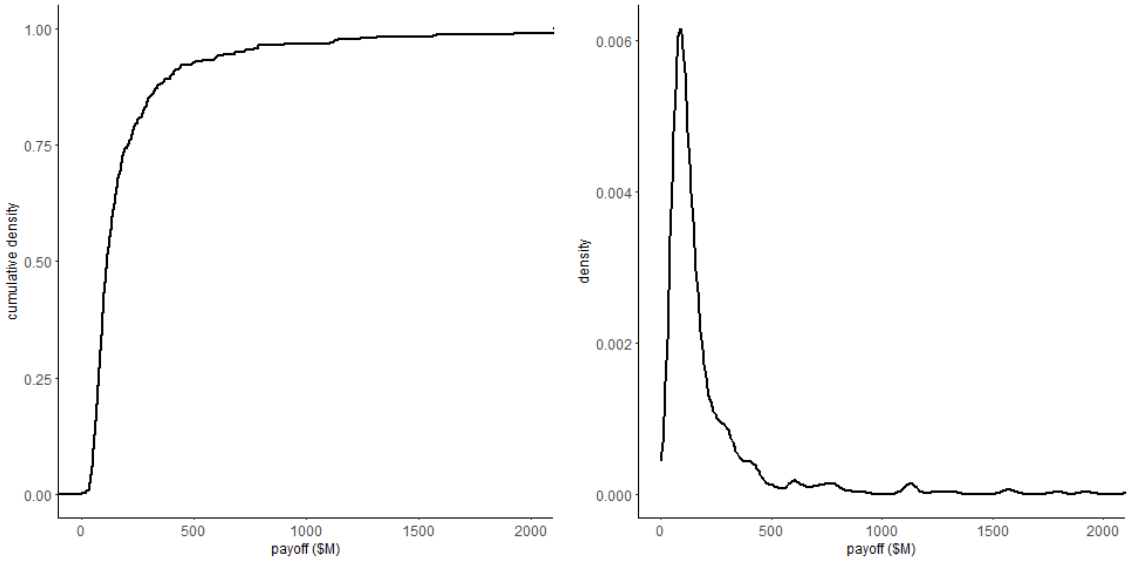


Figure 9: Payoffs in the Runner-Up State ($\hat{w}_2$)

Notes: This is the empirical cumulative distribution and density of firm payoffs in the runner up state. This is calculated using the estimated residual ($\hat{\theta}$), simulated unobserved state characteristics ($\hat{\xi}$), estimated firm preferences ($\hat{\beta}$), and runner-up state characteristics (x). See Equation 18 for the calculation.

The Conditional Distribution: $H(v|jobs)$

My goal is to estimate the distribution of state valuation for firms, conditional on jobs. Job creation, as mentioned in the data section, is the number one stated objective of states when they give discretionary subsidies to firms. Hence, in estimation, it will be important to allow the state valuation for firms to vary depending on the level of jobs the firm promises to create. In order to recover this conditional distribution I need to estimate the joint distribution of the 2nd order statistic of firm payoffs (from which I will derive the valuation), and jobs.

I estimate 2nd highest payoffs (w_2), firm i's payoffs the runner-up state:

$$\hat{w}_i^{(2:n)} = \underbrace{\hat{\theta}_i - \hat{\xi}_1}_{=v_{2i}+\xi_2} + \underbrace{\hat{\beta}_i x_2}_{=\pi_{i2}-\xi_2}, \tag{18}$$

and I know the number of direct jobs firm i promises to create. I am interested in the relationship between how each state values firm i, v_{si}, and the number of jobs i promises. I have no estimates of valuations at this point, but I do know that firm payoffs are a function of the state valuation, $w_{i2} = v_{2i} + \pi_{i2}$. Therefore, I exploit the relationship between the estimated payoffs, $\hat{w}_2$ and the number of jobs promised to recover the relationship between the valuations v and the number of jobs promised.

Specifically, I have an empirical distribution of payoffs in the runner-up states, $\hat{F}^{(2:n)}(w)$, (Figure 9). I need the conditional distribution $\hat{F}^{(2:n)}(w|jobs = j)$, which I can plug into the

order statistic identity to solve for $\hat{F}(w|jobs = j)$:

$$\hat{F}^{(2:n)}(w|jobs = j) = \frac{n!}{(n-i)!(i-1)!} \int_0^{\hat{F}(w|jobs=j)} t^{i-1}(1-t)^{n-i} dt \tag{19}$$

This estimate of the conditional distribution of payoffs, $\hat{F}(w|jobs = j)$, will subsequently be used in the estimation of $\hat{H}(v|jobs = j)$.

I can use a copula to estimate the joint distribution of F_{w_2} and F_{jobs}. From Sklar's Theorem I know that there is a unique copula C:[0,1]$^2 \rightarrow$ [0,1] such that:

$$F(w_2, jobs) = C(w_2, jobs) = C(F_{w_2}, F_{jobs}),$$

so, estimating $F(\cdot, \cdot)$ is the same as estimating $C(\cdot, \cdot)$ (Nelson, 1999). I consider a parametric copula, $C(\cdot, \cdot, \kappa)$ so that the copula is known up to the dependence parameter, κ. I employ the Frank Copula, from the Archimedian Family:

$$C_\kappa(w_2, jobs) = -\frac{1}{\theta} \log\left[1 + \frac{(\exp(-\kappa w_2) - 1)(\exp(-\theta jobs) - 1)}{\exp(-\theta) - 1}\right].$$

In order to exploit the copula to recover the joint distribution of payoffs and jobs I need to parameterize the marginal distributions. I use the gamma distribution to fit observed jobs and the gumbel distribution for "observed" (estimated) payoffs. See the histograms in Figure 10 for a comparison of the raw data and the fitted distributions.

Using these parameters and the estimated dependence between jobs and payoffs. I can generate the multivariate distribution of payoffs and jobs, shown in Figure 11.

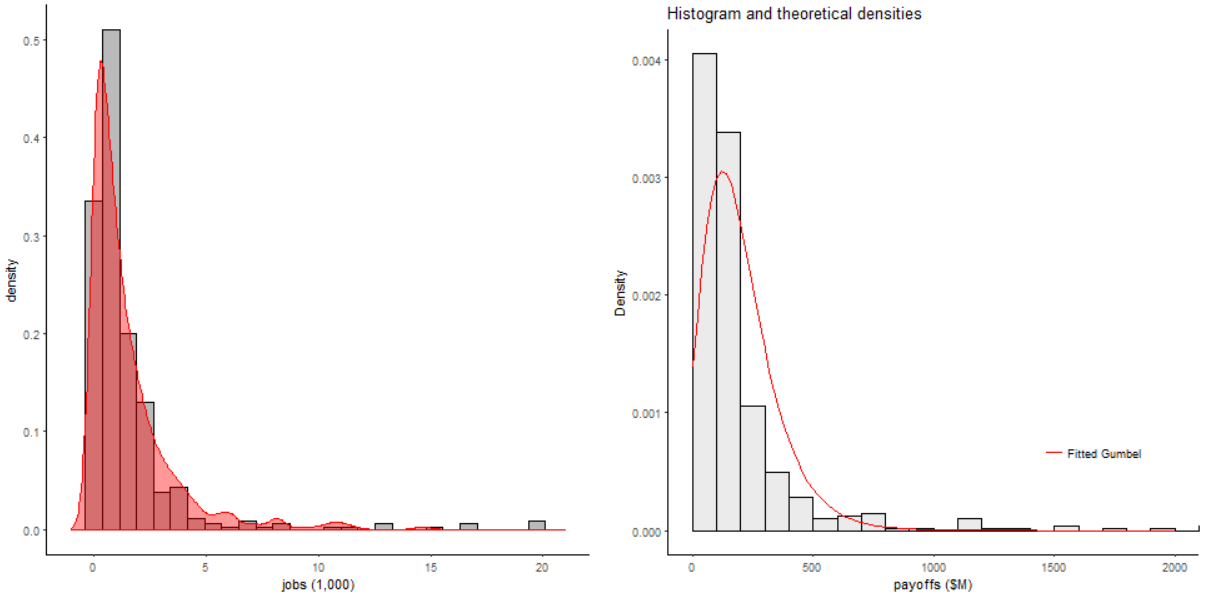
Given the multivariate distribution and the marginal distribution of jobs, I can calculate the conditional distribution of runner-up payoffs at any level of jobs, $\hat{F}^{(2:n)}(w|jobs)$. I then follow Equation 19, as outlined in the beginning of the section, using the order statistic identity to recover the full distribution of payoffs, $\hat{F}(w|jobs)$.

Once I have an estimate for the conditional distribution of payoffs across all states, I exploit the relationship between payoffs and valuations to recover the distribution of state valuations for firms.

Estimation of $H(v|jobs)$

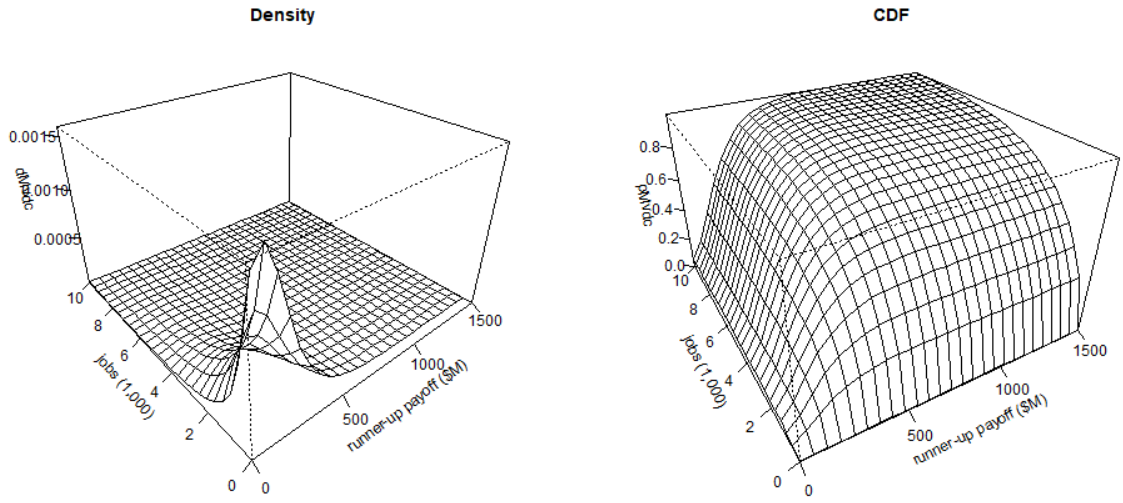
The last step in the estimation process is to draw $S = 1000$ state characteristics (x) from the underlying empirical distributions, and draw $S = 1000$ many ξ_s from $N(0, \hat{\sigma}^2_\xi)$, where $\hat{\sigma}^2_\xi) = 2.2$. See Figures 5 and 6 for the empirical distributions of state characteristics, in all states over the sample and only in the states giving subsidies. I sample from the underlying distribution, but there are noticeable differences in the two groups, especially when one considers the industry level variables, establishments and wages.

Figure 10: Simulated and Observed Jobs and Payoffs



Notes: These figures display the histograms of the data on direct jobs promised (left) and payoffs in the runner-up state (right) against the fitted density functions (in red). I use a gamma distribution to fit direct jobs promised, and a gumbel distribution to fit estimated runner-up payoffs.

Figure 11: Joint Distribution of Jobs and Payoffs



Notes: These figures display the joint density (left) and joint cumulative distribution (right) of direct jobs promised and payoffs in the runner-up state. The joint distribution of payoffs and jobs was recovered using the marginal distributions of jobs and payoffs and employing the Frank Copula.

I estimate H using the sample average (this corresponds to Equation 13 in Section 5.2):

$$H_S(t|jobs) = 1/S \sum_{s=1}^{S} \hat{F}(t + \hat{\beta}x_s + \hat{\xi}_s|jobs)$$

as S approaches ∞, $H_S(t|\cdot)$ approaches the true $H(t|\cdot)$ for all t. See Appendix Section F to see a simulation exercise confirming this.

Results

Figure 12 presents the results in graphical form. Each figure displays the estimated conditional distribution from which states draw their valuation for a firm, $\hat{H}(v|\cdot)$.[66] The distribution is conditioned on number of jobs promised by the firm, and, depending on the figure, other state and firm characteristics. The first thing to note, in Figure 12(a), is that the valuation does not seem to be very dependent on the number of jobs created.[67] In the full sample, a firm promising 2,000 jobs is worth on average \$4.9M (7.8%) more than one with 100 jobs. Increasing firm size from 2,000 jobs, a firm promising 20,000 jobs is only worth \$3.0M (4.6%) more on average than one with 2,000 jobs. These results suggest that states are not solely maximizing direct job creation when they decide their valuation for a firm, and that states have decreasing valuations for the marginal job. Therefore, the weak relationship between direct job creation and subsidy size that is evident in the raw data holds, even when accounting for differences in firm profits across states.

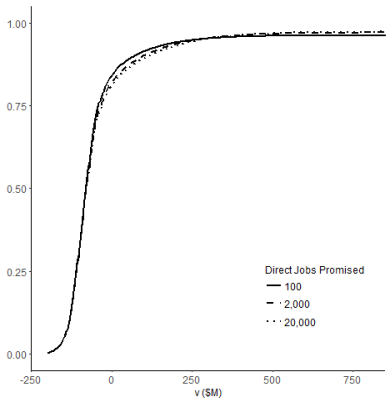
The valuation for increased direct jobs is slightly larger for the subset of manufacturing firms (9.7%) but smaller for non-manufacturing firms (3.6%). In general, manufacturing firms are worth more to a state, in that they reveal a higher valuation for manufacturing firms than non-manufacturing firms. This is shown in Figure 12(b), which plots the distribution of state valuations at 2,000 direct jobs for all firms, manufacturing firms, and non-manufacturing firms.

Indirect job creation (spillover) explains some of the small differences in valuations by job creation. First of all, when I account for the spillover levels a firm creating 2,000 direct jobs is worth on average 12% more than a firm promising 100 direct jobs, instead of 7% when I don't account for spillovers. Figure 12(c) presents the valuations conditional on

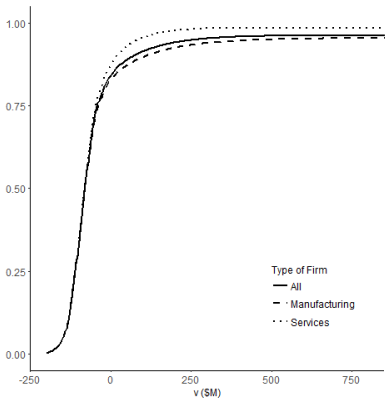
[66] As I mentioned in the previous subsection, in order to estimate the conditional distribution when the conditioning variable varies at the state level, I split the sample by the conditioning variable before I estimate the joint distribution of payoffs and jobs, and then proceed with the estimation process as detailed above. This is why I will use binary variables (e.g. high vs. low spillover, high vs. low unemployment, new vs. term-limited governor). As a result, I can evaluate $H(v|jobs, \nu = \text{high})$, for example. In future iterations I will use a single index model, which will allow me to condition on multiple continuous variables simultaneously.

[67] A distinction between the 3 different levels of jobs (0, 2,000 and 20,000) is more visible when I limit the sample to only manufacturing firms, but it is still relatively small.

Figure 12: State Valuation for Firms

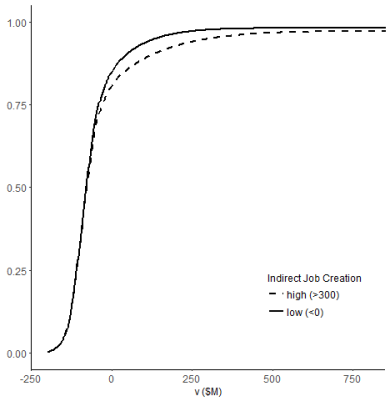


(a) All

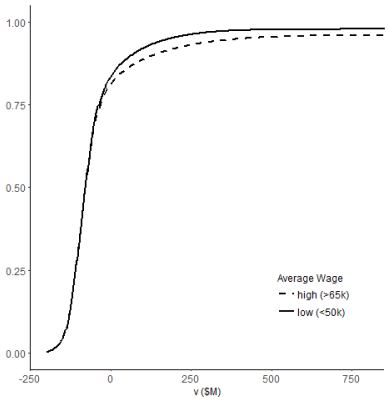


(b) By Type

Conditional on Firm Characteristics:

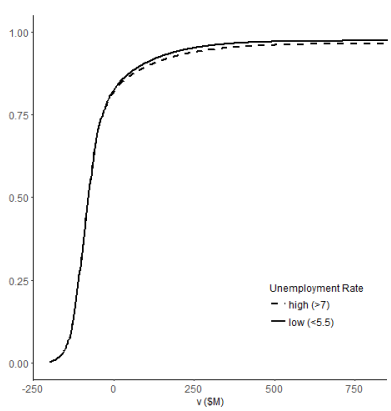


(c) Spillover

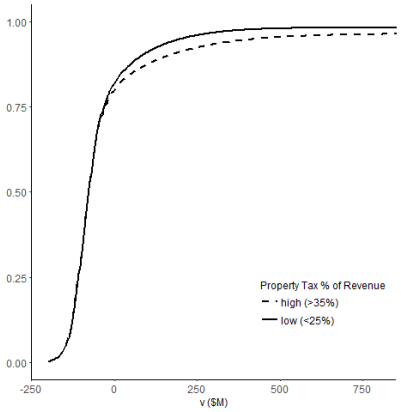


(d) Wages

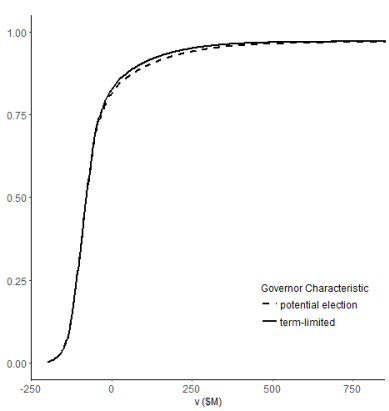
Conditional on State Characteristics:



(e) Unemployment



(f) Property Tax Revenues



(g) Governor Term

Notes: This figure displays the conditional distribution of states' valuation for firms. Each sub-figure shows the valuation distribution, conditional on a different variable. The y-axis is the cumulative distribution, and the x-axis is the valuation, in $M. The conditioning variables are in the legends.

predicted spillover, $\hat{\nu}$. I calculate the distribution of state valuations separately for low-spillover firms(the bottom third of firm-state pairs) and high-spillover firms (the top third of firm-state pairs), for a firm that promises to create 2,000 direct jobs. A high spillover firm promising to create 2,000 jobs is valued \$16.8M (27%) higher than a low spillover firm promising the same number of direct jobs. Figure 12(d) presents the distribution conditional on wages: Firms in high-wage industries are valued much more than low, a firm promising to create 100 jobs in a high wage industry is worth \$9.0M more than a low wage counterpart, and this difference grows with the number of jobs promised.

In the bottom row of Figure 12 I explore potential state level determinants of valuations for firms. Panel (e) shows the distribution of valuations conditional on unemployment, which is a measure of the economic conditions in the state. High unemployment states value a firm promising 2,000 jobs \$3.1M more than a low unemployment state, and this effect grows with firm size.[68] A firm promising 10,000 jobs is valued on average \$7.3M higher than a low unemployment state values a firm of the same size. Heterogeneous labor market conditions across states lead higher unemployment states to benefit more, that is, have a larger valuation for, job creation.

Figure 12 (f) explores the state potential to capture revenue from the firm, specifically via property taxes. States that rely heavily on property taxes for revenue value a firm \$14.3B more than state with less property tax collection, suggesting the importance of potential spillovers to property values, and property tax abatements as a component of subsidy size.[69]

Lastly, political motivations for winning a firm are potentially creating inefficiencies. Figure 12 (g) shows that governors who face re-election value firms creating 2,000 jobs \$3.8M more than their term-limited counterparts. The effect decreases with number of jobs, in fact the difference is largest for the smallest number of jobs promised, at \$6.6M. This suggests that there are political considerations, such as the effect of publicity of attracting a firm and creating jobs for the state on the chances of re-election, that affect the state subsidy-setting decision, and these considerations dominate when there is more uncertainty about the economic impact of the firm (low direct job creation).[70] This finding could also

[68] I define "high" unemployment as an unemployment rate larger than 7%, and low, as under 5.5%. The median rate in the sample is 5.5% and the mean is 6%.

[69] I define the state as "low" reliance if less than 25% of state and local revenues come from property taxes, and "high" reliance if it is greater than 35%. This corresponds to the 25th and 75th percentiles in the data (the median is 30%). Future work should explicitly model the spillover effects through property values.

[70] One concern is that new governors may enjoy more political support in the legislature than term-limited governors, and therefore, be more likely to get the funds they desire for subsidy deals. I do not find that to be the case in the data, at least in terms of party majorities. Term-limited governors are in the same party as the majority in the legislature in 52% of state-years, and "new" governors for 54%.

be the result of inexperience; new governors are learning on the job and overestimate the positive benefit of attracting a firm.[71]

Taken all together, the results suggest that competition allows states to compensate firms for heterogeneous spillovers, economic concerns, and revenue considerations across states, increasing the efficiency of firm locations. The indirect job creation and property tax reliance go the furthest in explaining state valuations. If I did not consider these unobserved spillover effects I would miss an important component in the state subsidy-setting decision, and it would be harder to rationalize observed subsidy-setting behavior.

Model Fit

Before getting to the counterfactual, Figure 13 compares the observed subsidies in the data, to subsidies generated by the model. In the simulation, I draw state valuations for each firm from the estimated distribution. I then allow the states to play the auction for each firm, given their valuation draw, $\hat{v}$. The simulated subsidies are those that allocate the firms to the highest payoff state, where the winning state pays the difference in their profits and the runner-up payoffs.

As you can see from the table, the simulated subsidies fits the data well until we get into the right tail, where it cannot justify the largest subsidies we see in the data. In the next section I will use the model to evaluate the effects of a counterfactual subsidy regime, which eliminates subsidy spending.

7 Counterfactual Subsidy Regime

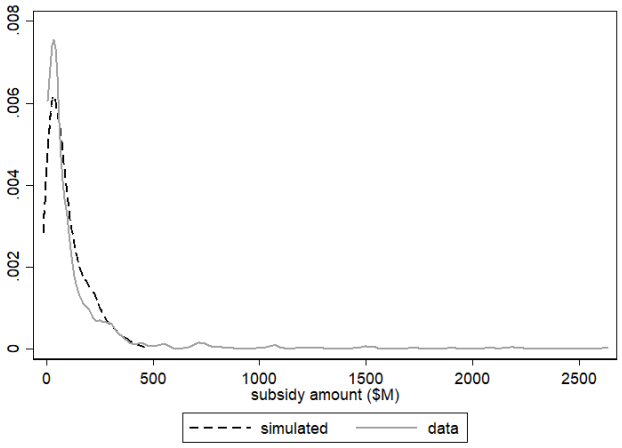
7.1 Eliminating Incentives

What if we were to ban states and cities from offering discretionary tax breaks to firms? This is the policy in place in the European Union, which restricts member countries from offering "state aid" to companies (European Commission 2008). In the U.S., legal scholars have posited that discretionary subsidies are in violation of the commerce clause of the

[71]Note that it may be the case that *all* states over-estimate (or, perhaps less likely, under-estimate) the effect of attracting a new firm. This results are driven by the *revealed* valuations of the states. I am not able to check whether the revealed valuations of the states align with the actual benefits that the firms create, as there is limited evaluation of subsidies post-disbursement. In fact, only 32 states have published evaluations of tax incentive programs (not individual deals) since the National Conference of State Legislatures started tracking them in 2007. Only 27 of 82 evaluations were published before 2014, so the majority are published in a recent push for transparency. Also, many evaluations concern film tax credits. When I drop the film tax credit evaluations I am left with 29 states and 65 evaluations over 2007-2017.

Figure 13: Model Fit

	Data	Simulated
10^{th} percentile	11.8	5.6
25^{th} percentile	22.0	30.5
50^{th} percentile	57.0	68.5
75^{th} percentile	136.3	143.7
90^{th} percentile	307.8	229.4
Mean	156.3	97.4
Standard Deviation	342.1	91.8



Notes: This figure compares the subsidies predicted by the model with subsidies observed in the data. The table on the left gives descriptive statistics for the data and simulated subsidies, while the figure on the right is the probability density function for each.

Constitution (Enrich 1996).[72] Also in the U.S., governors have proposed a truce on subsidy competition (Story 2012).

In this exercise I eliminate incentive spending and determine where firms would locate in the absence of subsidies. Eliminating incentive spending means that the large firms would have to pay the state's posted corporate tax rate, and receive no tax credits or non-discretionary incentives. This is the most severe potential policy change, which will illustrate the upper bound on the effect of limiting incentive spending.[73]

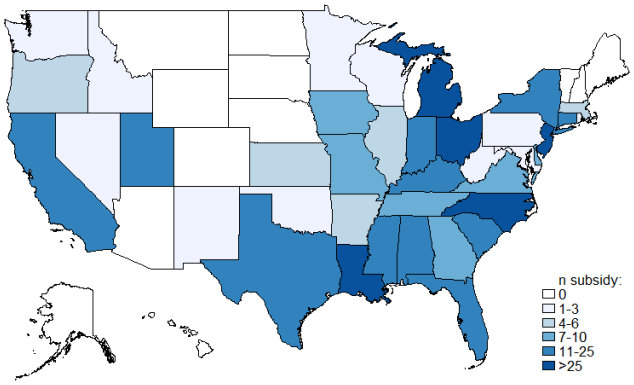
In order to determine the counterfactual location I calculate firm profit in each state, using $\hat{\beta}$ from Table 7. The counterfactual location is simply the state that gives the firm the highest profit, given that subsidies are set to 0.

Figure 14(a) shows the locations chosen by firms in the data, so, under subsidy competition. Panel (b) is the case without any cost increases, i.e., all of the firms could move to one state without changing the characteristics of that state. In this case, the majority of firms (85%) choose alternative states when I remove the subsidies. Many of the firms are moving to lower cost states (KS (9%), TX (16%)) or highly educated, thicker labor market states (CA (23%), NC (11%), VA (20%)). The locations are much more concentrated than in the

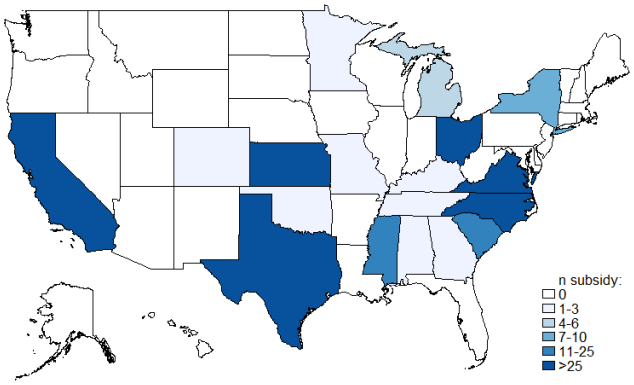
[72]In fact, a 2004 case brought against DaimlerChrysler and the state of Ohio, for an investment tax credit given to the car manufacturer, used this argument. The U.S. Court of Appeals in Cincinnati found the credit unconstitutional, but the ruling was struck down by the Supreme Court for a procedural flaw (Holder 2018).

[73]This is a partial equilibrium analysis. States who lose firms when they are not able to compete discretionarily would likely adjust by changing their corporate tax rate.

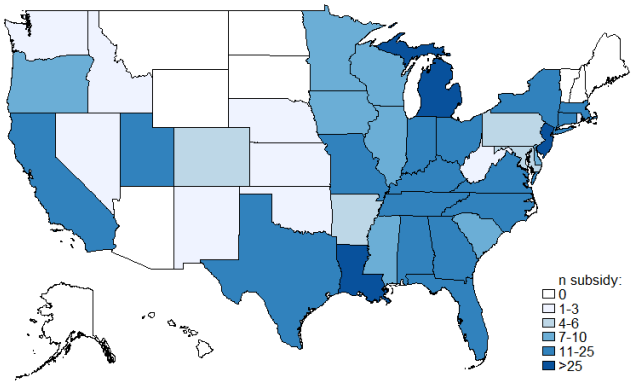
Figure 14: Counterfactual: Eliminating Incentives



(a) Original



(b) Counterfactual: No Cost Considerations



(c) Counterfactual: Increasing Costs

Notes: This figure displays the location choices of firms in the data (Panel (a)), and in two counterfactuals in which subsidy spending is set to zero (Panels (b) and (c)). In Panel (b) wages and housing costs in a state do not change following the entry of a large firm — in Panel (c) they do.

subsidy competition case. The result that the majority of firms choose an alternative state in the counterfactual, is due in part to a lack of general equilibrium effects. That is, when I calculate counterfactual profits and I have 9% of all large firms move to Kansas, the costs of housing and wages in Kansas do not change. In reality, the entry of a large firm increases competition for inputs, increasing land values and the cost of wages.

Table 8: Counterfactual: Incorporating Cost Increases Following Firm Entry

Cost Increase	# Firms Staying	% Firms Staying
-	73	15%
2.5% of SD	91	19%
5% of SD	127	26%
10% of SD	198	41%
estimated	153	32%

Notes: This table displays the results for the counterfactual firm locations, when I incorporate changes in costs following firm entry. The first column shows the amount by which I increased state wages and housing costs following the entry of a large firm. The last row uses the increases I estimate in the data, which is 18% of a SD in wages and 1.2% of a SD in housing costs for larger states, and 68% of a SD in wages and 7% of a SD in housing costs for smaller states.

Incorporating Cost Increases

In Table 8 I try to account for the increase in competition for labor and land following the entry of a large firm by inflating housing costs and wages following counterfactual moves. To be specific, I run the counterfactual exercise in each year separately, and make cost adjustments after the firms choose their locations. I start with the first year of the data, 2002. In 2002, I calculate the profits in all states, without subsidies, and identify the highest-profit states for the firms that entered in 2002. If a state was chosen in the counterfactual, I increased housing costs and industry wages by x% of a standard deviation. I then allow the 2003 entrants to pick locations, and repeat the adjustment. Table 8 shows how the number of firms that stay in their original locations increases with costs. The first line is the baseline, there is no cost increase, and only 15% of firms stay in the same states. If costs increase by 5% of a standard deviation (recall costs and wages are normalized to be mean 0 and standard deviation 1, see figure 6) after entry, 26% of firms chose to stay in their original locations, and if costs increase by 10% of a standard deviation, 41% of firms are stayers.

The last row is the "preferred" counterfactual prediction, using estimated changes in housing costs and wages. I use the data to calculate changes in housing costs and industry-level wages, after a large firm in the sample locates in a state. I allow these effects to differ

by size of the state, as one might imagine, a firm has a different effect on state-level wages and prices in Rhode Island than they do in California. I estimate that a large firm increases industry level wages by 68% of a standard deviation in small states (states with populations under 4 million), and by 18% of a standard deviation in larger states.[74] The housing price effect is 7% of a standard deviation in small states and 1.2% in larger states. When I use these estimated cost increases 68% of firms choose alternative states, and the remaining 32% choose the same locations they are observed choosing under competition. The counterfactual locations with this preferred specification are shown in Panel (c) of Figure 14.

Changes in Spillover

This counterfactual can also illustrate the role of subsidy competition in increasing welfare through indirect job creation (spillover). In the remainder of the section I will use the counterfactual locations chosen under my estimated cost increases (where 68% move), and compare potential spillovers in the counterfactual with the potential spillovers predicted by the observed location choices.

In the no-incentives case, firms locate in states where they induce a total of 57,480 indirect jobs via spillover. In the subsidy competition case (i.e. the factual case) they go to states where they create 84,693 jobs, an increase of over 27,000 jobs (47%). As suggested by the conditional distributions, states use subsidies to compensate firms for locating where they have larger positive externalities, increasing total welfare.

Figure 15 illustrates the loses and gains in state-level job creation when I eliminate subsidy spending. Panel (a) shows the changes in indirect job creation through spillover. This is the indirect job creation predicted by the counterfactual firm locations, less indirect job creation predicted with firm locations in the data. States in the Southeast and Southwest lose most of the indirect jobs created — North Carolina alone loses about 9,500 (88%) of the indirect jobs created through spillovers. Note that some states (e.g. Oklahoma, Kansas, Missouri) exhibit small gains in indirect job creation because they lose a firm that had negative spillover effects. This is highlighted with Figure 15(b), which maps the change in indirect and direct job creation in each state.

Suppose there was a social planner, whose goal was to maximize total job creation. The social planner does not care about firms' profits, or states' individual valuations for firms, they just want to allocate the firms to the locations where they will create the largest

[74]The states with populations under 4 million in the sample period are: AL, AR, CT, DE, IA, ID, KS, ME, MT, NE, NV, NH, NM, ND, OK, OR, RI, SD, UT, VT, WV, WY.

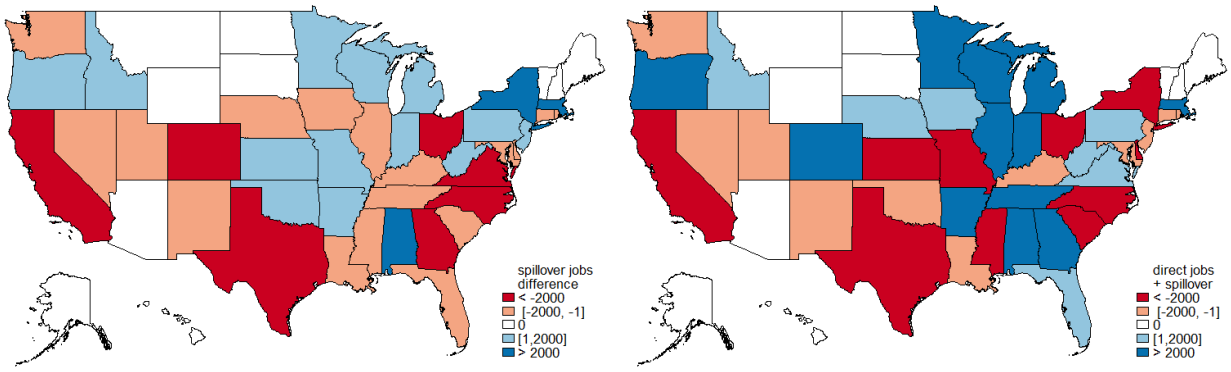
spillovers. If firms locate in the states with the largest predicted spillover, total indirect job creation would be 568,022, which means that subsidy competition only achieves about 15% of total possible indirect job creation. This highlights the role of state profits in the firm location decision, as well as the fact that states have heterogeneous valuation for indirect job creation, and value other benefits besides job creation.

Rents Transfer in Competition

What is the difference between the payoff each firm receives in the winning state in competition and their highest profit state in the counterfactual? Figure 16 is a histogram of the firm's gains from subsidy competition. This illustrates how states can bid away the surplus the firm will create in the state. The median amount a firm receives, over the profit they could expect in a zero subsidy case, is \$41M, and the mean is \$145M.

If the winning states only had to compensate firms for not locating in their highest profit locations, states would save \$61B over the 14 years in my sample, or about \$4.3B a year, which is 80% of total subsidy spending. This means that 80% of the revenues which are transferred to firms would remain with the states. In the next section I quantify the change in total welfare between subsidy competition and the counterfactual.

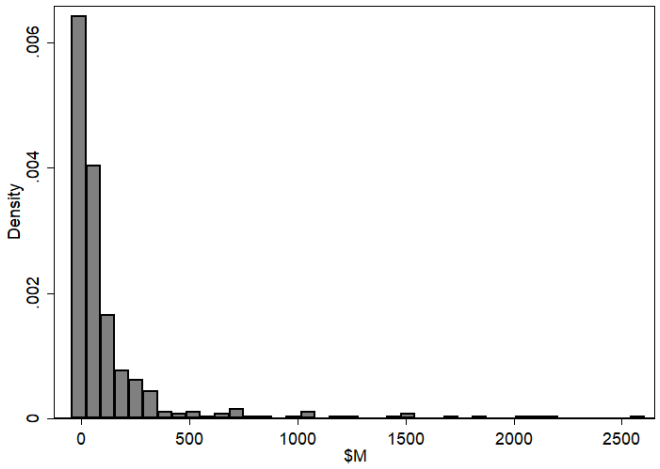
Figure 15: Counterfactual Spillovers: Eliminating Incentives



(a) Change in Spillover (Indirect Jobs) (b) Change in Direct + Indirect Job Creation

Notes: In this figure the difference in predicted job creation given locations chosen in the data, and predicted job creation given locations chosen in the counterfactual, is shown for each state. The red represents negative changes (job losses), while the blue represents positive changes (job gains). The figure on the left only considers *indirect* job creation, that is, jobs created via spillovers. The figure on the right uses both the direct jobs promised and the indirect jobs in the calculation.

Figure 16: Difference in Firm Payoff in Winning State and Highest Profit State



Notes: This is a histogram of the difference in the payoffs (estimated profit + subsidy) a firm receives in their observed location choice, less their estimated profit in the state where they would have the highest profit, in the absence of subsidies.

Total Welfare

Lastly, I perform a back of the envelope calculation of the change in total welfare between the subsidy competition and no-subsidy cases. Total welfare is the sum of the states' valuations for firms plus the firms' profit. During competition, states can transfer some of their welfare (valuation for the firm) to the firm, in the form of a subsidy. I simulate state valuations for each firm from the estimated conditional distributions, given the number of direct jobs promised by the firm and the number of indirect jobs anticipated by the state.

I find that total welfare increases by 22% under competition, due to firms locating where they are valued more. However, this welfare increase is captured entirely by the firms. Total welfare increases by about $18B, and firms' payoffs (firm profits plus subsidies) increase by $27B. This means the total welfare captured by the states actually decreases due to competition, by $9B, or 21%.

A social planner might discount the increases in welfare created by firm profits, especially if the firms are foreign and profits are enjoyed outside of the United States. These welfare calculations should also be considered when states think about the trade-off on spending in incentives for a few large firms, and broader based economic development programs. I discuss this further in the conclusion.

8 Conclusion

States offer generous tax credits and subsidy deals to attract individual firms to their jurisdiction. The extent to which these incentives are effective in attracting firms and creating jobs depends on the characteristics of the state as well as the states' valuation of the firm and its potential spillover effects. In short, subsidy competition can increase welfare if subsidies allow firms to internalize part of the positive externality they will have in a state.

This paper answers two questions along this line of inquiry: How do states determine discretionary subsidies, and what is the effect of these incentives on firms' location choice? To answer these questions, I introduce a new dataset on state-level incentive spending and firm-level subsidies, which I create by reading state budget documents and tax expenditure reports, as well as press releases and news articles on each subsidy deal.

In this paper, I use an open outcry ascending auction to model the bidding process. To capture the fact that, all else equal, a less "attractive" state must offer a larger subsidy to attract a firm, I embed the location choice problem of the firm within the auction framework. I allow a state's valuation for a firm depends on firm and state characteristics, such as the number of direct jobs promised by the firm and the potential indirect job creation (spillover) the firm would have in the state. To measure these spillovers, I estimate an entry decision of smaller, non-subsidized, firms as a function of entry choice of larger, subsidized, firms.

I find evidence that high unemployment states, states who will benefit most from property value increases, and states that will experience large spillovers in the form of indirect job creation, have the highest valuations for firms. This suggests that subsidy competition can allow states to compensate firms for heterogeneous externalities across space, increasing the efficiency of firm locations. In fact, I find that competition increases total welfare, by allocating firms to states that have higher valuations for the firm. However, this increase in welfare is experienced entirely by the firm; firm payoffs increase by 75% between the no-subsidy and subsidy-competition cases.

One caveat of the way I model competition among states is that I assume that whenever a firm announces its intention to locate, all the 48 states compete. This is a simplification that is primarily driven by the data I have because I only observe the location choice of the firm, after the fact. In other words, I do not know the "consideration set" of the firm. If, in fact, the competition is not between all states, I am underestimating the true valuation. In this paper, the best I can do is determine the runner-up state, but going forward it may be possible to gather more information about the firms' consideration set.

Another caveat is that I treat the subsidy choices of a state to be independent of the choices of its neighboring states. But we know from the work of Case, Rosen and Hines (1993) that there can be interdependence across states. To allow for dependence across states in their subsidy choices require more data on state and a different approach that is based on social networks and is beyond the scope of this paper. It is an important extension of my approach that requires substantially more data and I leave that for future research.

Lastly, I assume the states' can accurately predict the benefit a firm will have in their jurisdiction, and I estimate the state valuations using data on realized subsidy deals. I use a revealed preference approach; the subsidy deals offered by the state reveal the states' underlying valuation for the firm. However, it is possible that states overestimate (or underestimate) the effect a firm will have once it locates in the state. Whether states can accurately predict the revenue and job creation effects of a potential entrant is an open question, because the analysis of the economic effects of firms post-subsidy disbursement is limited. However, a recent push for transparency might soon provide the data to verify this assumption.[75]

Although the results in this paper point to subsidy competition being welfare increasing, there is still much to learn about state incentive spending. Future work should consider the trade-offs between spending on discretionary subsidies for a few large firms and more broad-based incentive programs. There are opportunity costs to states spending on incentives for a few large firms; they could instead lower taxes for citizens, invest in public goods, or create incentive programs for small businesses. Also, giving discretionary tax breaks to a few large firms may have anti-competitive effects on the product market, as these firms now have lower costs then their competitors.[76] The medium size establishment location results suggest that increasing the expected non-discretionary subsidy available to an establishment by $10,000 has a similar effect on the profit of a medium sized establishment as having an additional large establishment in the state. Therefore, in some cases it may even be more affordable to increase incentives for smaller firms.

In short, this paper provides the first evidence of how states value firms, contributing to one part of a larger discussion of state economic development policy. The data introduced in this paper can be used to push research in this arena further.

[75] As of 2015, the Government Accounting Standards Board requires that state and local governments disclose all tax abatements to firms (GASB 77). Relatedly, the National Conference of State Legislatures has noted an increase in state-level incentive programs evaluations published post-2014.

[76] Rossi-Hansberg et al. (2018) find that although national product market concentration is increasing, when the top firm in an industry opens a plant, local concentration declines. The effect of discretionary subsidies on product-market competition, both at the local and national level, as yet to be studied.

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Appendix

A Institutional Details: State Economic Development

State Budget Process

The budget process of the state generally follows these steps:[77]

1. Each department and agency of the state government prepares a budget request and submits it to the governor. This process begins at least one year before the budget year, when the governor sends instructions on what level of resources the department should plan for.

2. The governor receives the agency budget proposals in the Fall, and prepares the final budget proposal, submitting it to the state legislature by late January/early February.

3. The budget is received by the appropriations committee in the House and then sent to the Senate. If the budget approved by the state senate differs from that approved by the house the two groups must work out a compromise in conference committee.

4. The budget is sent back to the governor, who signs it, vetoes the entire bill, or vetoes certain line items.

[77] This is written with a July 1-June 30 fiscal year, though four states follow a different schedule.

Differences in state budget processes lie in the governors ability to line-item veto, biennial or annual budget setting, the rigidity of the balanced budget requirement, and super-majority legislature rules.[78]

Unlike at the federal level, most of the power lies at the governor. The governor must submit a budget in balance, which makes it more difficult for the legislature to make changes. The governor also has a full-time staff and generally has more information and time for budget setting than the legislature, especially in states where the legislature is a part-time job and only convenes for a couple of months. Lastly, 43 states give the governor the power to line-item veto items from the budget.

State Legislative Process

The budget process determines how much money goes to existing programs. Changing and enacting tax credits and economic development programs requires legislation. States' legislative processes are much more heterogeneous than the budget process. Each state may establish it's own rules for procedure, which means that it has it's own process for considering and enacting bills. In broad strokes, the bill will be introduced in the house or senate, or in committee, and then goes through steps of being debated, opened to public opinion, and amended, with votes at various parts of the process, in both chambers of the state congress. In the last step it goes to the governor, who has veto power. 46 state legislatures meet annually, so those states may enact new legislation each year.

States can also call special, or extraordinary sessions, in order to address unfinished business or special topics, such as emergencies and natural disasters. Governors sometimes call special sessions in order to approve incentive packages for discretionary subsidy deals.

[78] 19 states have a biennial budget setting process, which means that they set the budget for two years. However only 4 states have biennial meetings, so most states till meet annually, and enact supplemental budgets to amend the biennial budget. For this reason, many argue that setting a biennial budget is wasteful, as the state will need to amend and set supplemental budgets in the "off" year.

B Data

As discussed in Section 3, there are two ways for a state to provide financial incentives for a business: they can provide tax credits, or they can allocate money for incentive spending in the state budget. The amount foregone in tax revenue due to tax credits is recorded in the states' tax expenditure reports. Figure 17 provides two examples of tax expenditure reports, from Virginia and North Carolina. In Virginia's document, each credit is listed, along with the number of returns filed that take the credit, and the total amount that was claimed on those returns. In North Carolina, the state reports the description of each credit along with an estimate of the amount that will be claimed in each fiscal year.

Figure 18 provides an example of budget documents in both states (Virginia and North Carolina). Virginia has a website for their budget, which allows you to search for keywords, e.g. "economic development." However, the line items are not very specific, as evidenced in the figure. The footnote provides more information, detailing that these "Economic Development Services" are used at the discretion of the Governor to attract economic development prospects to locate or expand in Virginia. North Carolina's budget has very specific line items, and the amount spent and authorized each year. Another section of the document provides descriptions of each of the line item programs.

In Section 3 I also mention anecdotal evidence that states consider *indirect* job creation when determining their subsidy offers. Figure 19 provides such an example. This is an excerpt from a report on North Carolina's discretionary grant program. North Carolina is one of the few states to publish spending at the firm level. The 4th column in the table lists the number of expected (direct) jobs the firm will create, while the 5th column is the number of indirect and induced jobs. In this paper, these are the "spillover" jobs. The table also suggests that the state cares about the firm's effect on GDP and state revenue (columns 7 and 8).

Table 9 summarizes the collected data by state, considering the median corporate tax rate, total incentive spending, spending per establishment or job, and discretionary spending per job. This is a more detailed version of the data presented in Figure 2, in the text of the paper.

Figure 17: Example of Tax Expenditure Reports

Table 3.1
Fiscal Year Tax Credits
Returns Processed During Fiscal Year 2015

Code Section(s)	Credit	Year Enacted	Credit Claimed Against	Number of Returns	Amount
§§ 58.1-439.18 et seq.	Neighborhood Assistance Act Credit	1981 (effective July 1, 1981)	Individual, Corporate, Insurance and Bank	4,393	$14,512,830
§ 59.1-280	Enterprise Zone Business Tax Credit	1982 (effective July 1, 1982)	Individual, Corporate, Insurance and Bank	12	1,218,516
§§ 58.1-334 & 58.1-432	Conservation Tillage Equipment Credit	1985 (effective 1985)	Individual and Corporate	255	486,727
§ 58.1-435	Low-Income Housing Credit	1989 (effective 1990)	Individual, Corporate, Insurance and Bank	*	15,542
§§ 58.1-337 & 58.1-436	Advanced Technology Pesticide and Fertilizer Application Equipment Credit	1990 (effective 1990)	Individual and Corporate	99	156,193
§ 58.1-438.1	Tax Credit for Vehicle Emissions Testing Equipment and Clean-Fuel Vehicles and Certain Refueling Property	1993 (effective 1993)	Individual and Corporate	41	9,482
§ 58.1-439	Major Business Facility Job Tax Credit	1994 (effective 1995)	Individual, Corporate, Insurance and Bank	74	4,109,769
§ 58.1-439.2	Coalfield Employment Enhancement Tax Credit (Refundable)	1995 (effective 1996)	Individual and Corporate	49	28,363,515
§ 58.1-439.1	Clean Fuel Vehicle and Advanced Cellulosic Biofuels Job Creation Tax Credit	1995 (effective 1996)	Individual and Corporate	191	307,062
§ 59.1-280.1	Enterprise Zone Real Property Investment Tax Credit (Refundable)	1995 (effective July 1, 1995)	Individual and Corporate	0	0
§ 58.1-339.2	Historic Rehabilitation Tax Credit	1996 (effective 1997)	Individual, Corporate, Insurance and Bank	1,038	97,998,279
§ 58.1-439.4	Day-Care Facility Investment Credit	1996 (effective 1997)	Individual and Corporate	0	0
§§ 58.1-339.3 & 58.1-439.5	Agricultural Best Management Practices Tax Credit	1996 (effective 1998)	Individual and Corporate	471	1,144,933
§ 58.1-439.6	Worker Retraining Tax Credit	1997 (effective 1999)	Individual, Corporate, Insurance and Bank	6	160,926
§ 58.1-439.7	Recyclable Materials Processing Equipment Credit	1998 (effective 1999)	Individual and Corporate	91	623,285
§ 58.1-332.1	Foreign Tax Credit	1998 (effective 1998)	Individual Only	1,689	507,562
§ 58.1-339.4	Qualified Equity and Subordinated Debt Investments Tax Credit	1998 (effective 1999)	Individual Only	241	2,096,539
§ 58.1-439.10	Waste Motor Oil Burning Equipment Credit	1998 (effective 1999)	Individual and Corporate	62	124,387
§ 58.1-439.9	Tax Credit for Certain Employers Hiring Recipients of Temporary Assistance to Needy Families (TANF)	1998 (effective 1999)	Individual and Corporate	0	0
§ 58.1-512	Land Preservation Tax Credit	1999 (effective 2000)	Individual and Corporate	3842	67,668,579
§ 58.1-339.6	Political Candidates Contribution Tax Credit	1999 (effective 2000)	Individual Only	17,357	604,377
§ 58.1-339.7	Livable Home Tax Credit	1999 (effective 2000)	Individual and Corporate	284	823,494
§ 58.1-433.1	Virginia Coal Employment and Production Incentive Tax Credit	1999 (effective 2001)	Corporate Only	7	8,909,576
§ 58.1-339.8	Low-Income Taxpayer Credit	2000 (effective 2000)	Individual Only	364,370	133,791,162
§§ 58.1-339.10 & 58.1-439.12	Riparian Forest Buffer Protection for Waterways Tax Credit	2000 (effective 2000)	Individual and Corporate	98	229,754
§ 58.1-339.9	Rent Reductions Tax Credit	2000 (effective 2000)	Individual and Corporate	0	0
§ 58.1-339.11	Long-term Care Insurance Tax Credit	2006 (effective 2006)	Individual Only	4,081	1,174,845
§ 58.1-439.12:02	Biodiesel and Green Diesel Fuels Producers Tax Credit	2008 (effective 2008)	Individual and Corporate	0	0
§ 58.1-439.12:05	Green Job Creation Tax Credit	2010 (effective 2010)	Individual and Corporate	*	752
§ 58.1-439.12:04	Tax Credit for Participating Landlords (Community of Opportunity)	2010 (effective 2010)	Individual and Corporate	20	42,041
§ 58.1-339.12	Farm Wineries and Vineyards Tax Credit	2011 (effective 2011)	Individual and Corporate	63	180,535
§ 58.1-439.12:03	Motion Picture Production Tax Credit (refundable)	2011 (effective 2011)	Individual and Corporate	4	7,176,474
§ 58.1-439.12:06	International Trade Facility Tax Credit	2011 (effective 2011)	Individual and Corporate	13	146,096
§ 58.1-439.12:08	Research and Development Expenses Tax Credit (Refundable)	2011 (effective 2011)	Individual and Corporate	317	4,210,012
§ 58.1-439.12:09	Barge and Rail Usage Tax Credit	2011 (effective 2011)	Individual, Corporate, Insurance and Bank	*	41,700
§ 58.1-439.12:10	Virginia Port Volume Increase Tax Credit	2011 (effective 2011)	Individual and Corporate	34	736,816
§ 58.1-439.12:07	Telework Expenses Tax Credit	2011 (effective 2012)	Individual and Corporate	10	112,843
§ 58.1-439.26	Education Improvement Scholarships Tax Credits	2012 (effective 2013)	Individual, Corporate, Insurance and Bank	347	1,613,525

Notes:
1. Number of returns and amounts are for income tax and insurance returns processed during FY 2015, regardless of taxable year. For most credits, returns for multiple taxable years were processed during the fiscal year. The total for each return may include carryovers from prior years.
2. If a return was amended or audited during the fiscal year, only the additional credit amount (or reduction) is included.
3. The amount shown for the Coalfields Employment Enhancement Tax credit includes the amount refunded to taxpayers, as well as that deposited with the Coalfields Economic Development Authority.
4. A refundable tax credit is one which is not limited by the amount of the taxpayer's tax liability.
5. Some credits may be claimed against taxes in addition to income taxes; amounts in table are for only individual and corporate income tax, premium license tax and bank franchise tax.
6. Number of returns and amounts for bank franchise tax are for taxable year 2014 processed during FY 2015. The total for each return may include carryovers from prior years.

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Research & Development Credits

Research and Development Credits (Article 3F)

1. **Small Business R&D Credit**
Citation: G.S. 105-129.55(a)(1)
Description: A small business that has qualified North Carolina research expenses for the taxable year is allowed a credit equal to 3.25% of the expenses. A small business is defined as a business whose annual receipts did not exceed $1 million. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16.....$0.3 FY16-17 ..... $0.2

Data Source: Department of Revenue "Economic Incentive Reports"

2. **Low-Tier R&D Credit**
Citation: G.S. 105-129.55(a)(2)
Description: A taxpayer that performs research in a development tier one area is allowed a 3.25% credit for eligible expenses. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16.....$4.0 FY16-17 ..... $2.2

Data Source: Department of Revenue "Economic Incentive Reports"

3. **University Research Credit**
Citation: G.S. 105-129.55(a)(2a)
Description: A taxpayer that has NC university research expenses for the taxable year is allowed a credit equal to 20% of the expenses. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): FY15-16.....$0.5 FY16-17 ..... $0.3

Data Source: Department of Revenue "Economic Incentive Reports"

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Research & Development Credits

4. **Eco-Industrial Park R&D Credit**
Citation: G.S. 105-129.55(a)(2b)
Description: A taxpayer that performs research in an Eco-Industrial Park certified under G.S. 143B-437.08 is allowed a 35% credit for eligible expenses. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2010-147 - effective for taxable years beginning on or after Jan. 1, 2011
Sunset Date: Expires Jan. 1, 2016

Estimate (in millions): Unavailable

Data Source: Department of Revenue "Economic Incentive Reports"

Note: No credits have been taken through tax year 2012.

5. **Other R&D Credit**
Citation: G.S. 105-129.55(a)(3)
Description: A taxpayer that has qualified North Carolina research expenses not covered under another subdivision of this section is eligible for 1.25% credit on expenses up to $50 million; 2.25% of expenses between $50 million and $200 million; and 3.25% of expenses over $200 million. The amount of credit taken in any tax year cannot exceed 50% of the taxpayer's tax liability after other credits taken. Unused credits can be carried forward 15 years.
Enacting Legislation: S.L. 2004-124 - effective for business activities occurring on or after May 1, 2005
Sunset Date: Expires Jan. 1, 2016

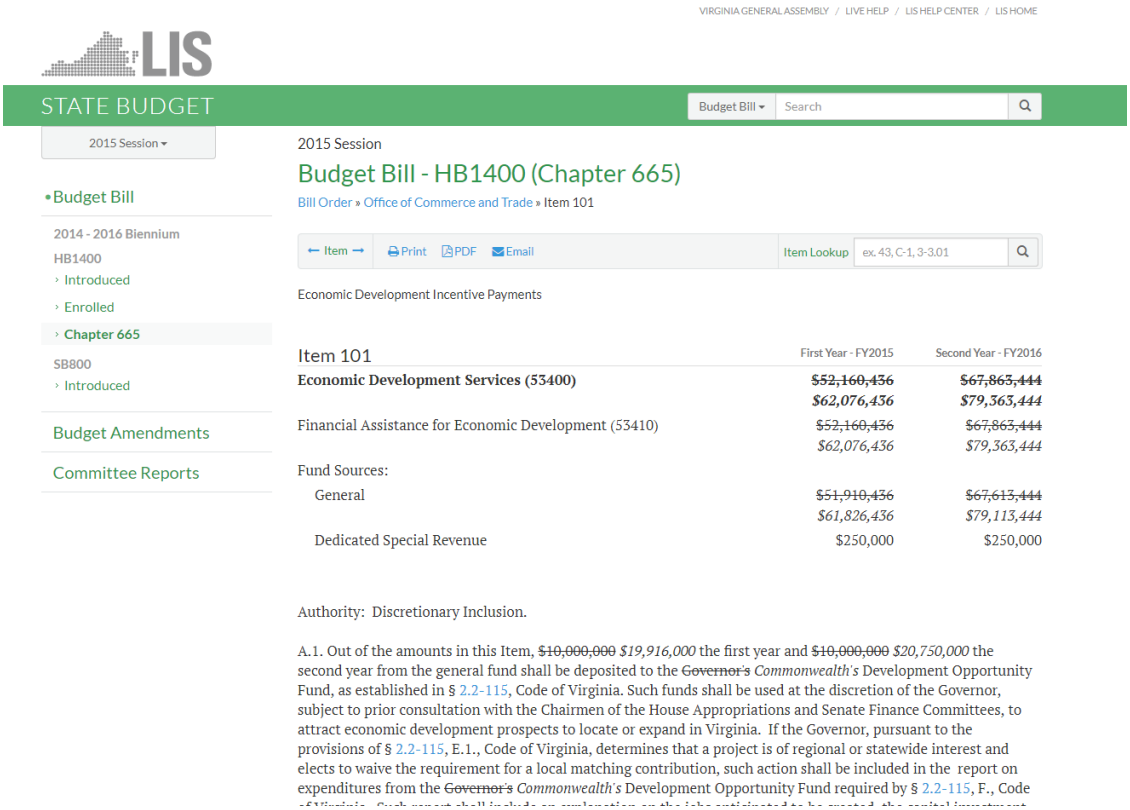
Estimate (in millions): FY15-16.....$44.0 FY16-17 ..... $24.8

Data Source: Department of Revenue "Economic Incentive Reports"

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Notes: Above are two examples of source data for tax expenditures, the top from Virginia, and the bottom from North Carolina. This is just a snapshot of the tax expenditure report from both states.

Figure 18: Example of Budget Documents



VIRGINIA GENERAL ASSEMBLY / LIVE HELP / LIS HELP CENTER / LIS HOME

LIS

STATE BUDGET

Budget Bill ▾ Search

2015 Session ▾

- Budget Bill
  - 2014 - 2016 Biennium
  - HB1400
    - Introduced
    - Enrolled
    - Chapter 665
  - SB800
    - Introduced
- Budget Amendments
- Committee Reports

2015 Session

Budget Bill - HB1400 (Chapter 665)

Bill Order » Office of Commerce and Trade » Item 101

← Item → Print PDF Email Item Lookup ex. 43, C-1, 3-3.01

Economic Development Incentive Payments

Item 101	First Year - FY2015	Second Year - FY2016
Economic Development Services (53400)	~~$52,160,436~~	~~$67,863,444~~
	$62,076,436	*$79,363,444*
Financial Assistance for Economic Development (53410)	~~$52,160,436~~	~~$67,863,444~~
	$62,076,436	*$79,363,444*
Fund Sources:		
General	~~$51,910,436~~	~~$67,613,444~~
	$61,826,436	*$79,113,444*
Dedicated Special Revenue	$250,000	$250,000

Authority: Discretionary Inclusion.

A.1. Out of the amounts in this Item, ~~$10,000,000~~ *$19,916,000* the first year and ~~$10,000,000~~ *$20,750,000* the second year from the general fund shall be deposited to the ~~Governor's~~ *Commonwealth's* Development Opportunity Fund, as established in § 2.2-115, Code of Virginia. Such funds shall be used at the discretion of the Governor, subject to prior consultation with the Chairmen of the House Appropriations and Senate Finance Committees, to attract economic development prospects to locate or expand in Virginia. If the Governor, pursuant to the provisions of § 2.2-115, E.1., Code of Virginia, determines that a project is of regional or statewide interest and elects to waive the requirement for a local matching contribution, such action shall be included in the report on expenditures from the ~~Governor's~~ *Commonwealth's* Development Opportunity Fund required by § 2.2-115, F., Code

Summary by Purpose

24609 Commerce - Special Funds GF

CODE DESCRIPTION	2011-2012 ACTUAL	2012-2013 CERTIFIED	2012-2013 AUTHORIZED	2013-2014 INCR/DECR	2013-2014 TOTAL	2014-2015 INCR/DECR	2014-2015 TOTAL
REQUIREMENTS							
2535 NC Green Business Fund	104,040	0	0	0	0	0	0
2536 GREEN BUS ENERGY SUB GNT	7,522,630	208,725	0	0	0	0	0
2537 ENERGY RESEARCH GRANTS	15,625	0	0	0	0	0	0
2560 ONE NORTH CAROLINA FUND	104,484,675	49,685,986	54,000,000	-45,000,000	9,000,000	-45,000,000	9,000,000
2562 ONE NC SMALL BUSINESS	529,013	0	0	0	0	0	0
2564 JDIG FEES	405,646	190,489	448,020	0	448,020	0	448,020
2565 JDIG SPECIAL REVENUE	19,951,815	19,000,000	15,000,000	0	15,000,000	0	15,000,000
2566 INDUSTRIAL DEVELOPMENT	790,000	1,141,800	1,141,800	0	1,141,800	0	1,141,800
2567 INDUSTRIAL DEV UTIL ACNT	3,451,510	3,023,074	3,750,000	0	3,750,000	0	3,750,000
2584 ECONOMIC DEVELOPMENT RES	0	811,493	49,688	0	49,688	0	49,688
2586 JOB MAINT & CAP DEV FND	5,745,079	0	0	0	0	0	0
TOTAL REQUIREMENTS	143,000,033	74,061,567	74,389,508	-45,000,000	29,389,508	-45,000,000	29,389,508
ESTIMATED RECEIPTS							
2536 GREEN BUS ENERGY SUB GNT	4,589,395	208,725	0	0	0	0	0
2560 ONE NORTH CAROLINA FUND	110,000,000	5,000,000	9,000,000	0	9,000,000	0	9,000,000
2562 ONE NC SMALL BUSINESS	12,621	0	0	0	0	0	0
2564 JDIG FEES	213,000	176,475	176,475	0	176,475	0	176,475
2565 JDIG SPECIAL REVENUE	20,169,879	19,000,000	15,000,000	0	15,000,000	0	15,000,000
2566 INDUSTRIAL DEVELOPMENT	40,000	821,693	821,693	0	821,693	0	821,693
2567 INDUSTRIAL DEV UTIL ACNT	4,694,826	3,023,074	3,750,000	0	3,750,000	0	3,750,000
2586 JOB MAINT & CAP DEV FND	6,000,000	0	0	0	0	0	0
TOTAL RECEIPTS	145,719,721	28,229,967	28,748,168	0	28,748,168	0	28,748,168
CHANGE IN FUND BALANCE	2,719,688	-45,831,600	-45,641,340	45,000,000	-641,340	45,000,000	-641,340

Notes: Above are two examples of source data for economic development program spending, the top from Virginia, and the bottom from North Carolina. This is just a snapshot of a relevant part of the budget document from both states.

Figure 19: Discretionary Spending: North Carolina

J·D·I·G
JOB DEVELOPMENT INVESTMENT GRANT

Award Year	Company Name	Grant Term (Years)	Expected Jobs	Indirect and Induced Jobs	Total Jobs	Estimated NC GDP Impact (millions)	Estimated Net State Revenue Impact (millions)
2015	Novo Nordisk Pharmaceutical Industries, Inc. III	12	691	4,276	4,967	$7,361	$208.8
2015	Premier Research International LLC	12	260	683	943	$568	$9.5
2015	RBUS, Inc. II	12	500	701	1,201	$583	$12.9
2015	Royal Appliance Mfg. Co.	12	200	398	598	$613	$14.5
2015	**Total (Grant Term is average)**	**12**	**4,788**	**13,363**	**18,151**	**$15,995**	**$354.4**
2016	Aurobindo Pharma USA Inc.	12	275	1,231	1,506	$1,126	$15.8
2016	Avadim Technologies Inc.	12	551	1,359	1,910	$1,817	$43.2
2016	Citrix Systems, Inc. II	10	400	640	1,040	$659	$8.1
2016	Corning Optical Communications LLC (Cable)	12	205	345	550	$460	$8.7
2016	CSX Intermodal Terminals, Inc.	12	149	170	319	$2,485	$97.1
2016	Everest Textile USA, LLC	12	610	698	1,308	$733	$15.5
2016	GF Linamar LLC	12	350	349	699	$606	$8.4
2016	GKN Driveline Newton, LLC II	12	143	284	427	$307	$5.9
2016	GKN Driveline North America, Inc. III	12	159	316	475	$449	$10.7
2016	INC Research, LLC II	8	550	836	1,386	$750	$6.2
2016	JELD-WEN, Inc. II	12	206	313	519	$456	$7.2
2016	K-Flex USA L.L.C.	12	100	125	225	$231	$4.4
2016	LendingTree, LLC	12	314	1,061	1,375	$1,106	$22.7
2016	PrescientCo Inc.	12	205	258	463	$444	$9.6
2016	Relias Learning LLC	12	470	790	1,260	$1,583	$43.5
2016	**Total (Grant Term is average)**	**12**	**4,687**	**8,775**	**13,462**	**$13,212**	**$307.0**

Notes: This is an excerpt from North Carolina's 2013 Job Development Investment Grant Report. For each firm they receives a discretionary subsidy from the program, there is a description of the characteristics of the firm: the expected direct jobs, indirect jobs, total jobs, increase in state GDP, and increase in state revenue.

Table 9: Median State Tax Rates, Incentive Spending, Subsidies

State	Corp. Tax(%)	Incentive ($M)	Spending ($) per: new estab	new job	job at new estab	Discretionary: incentive $ per job	# of sub
Alabama	6.5	99.39	380,765	169	1,207	209,257	9
Arkansas	6.5	246.08	2,005,896	785	7,435	286,092	3
Arizona	7.0	96.99	162,560	75	480		0
California	8.8	2,619.37	877,680	391	1,799	247,684	2
Colorado	4.6	83.25	188,266	80	591		0
Connecticut	7.5	187.65	879,915	317	3,451	108,052	19
Delaware	8.7	45.87	328,948	217	1,500	13,329	5
Florida	5.5	1,332.93	808,495	346	1,616	85,614	12
Georgia	6.0	132.71	193,868	84	402	46,297	5
Iowa	12.0	149.91	809,588	305	3,049	661,039	11
Idaho	7.6	360.14	3,308,467	1,970	17,806	1,256,891	4
Illinois	8.4	562.24	566,691	245	1,065	9,989	16
Indiana	8.5	120.37	305,841	124	870	23,006	4
Kansas	7.4	178.24	779,070	412	2,258	17,234	4
Kentucky	6.0	62.50	180,242	88	590	69,968	14
Louisiana	8.0	276.58	1,073,770	456	3,210	214,747	34
Massachusetts	8.5	268.72	576,235	233	2,156	82,815	2
Maryland	8.3	164.85	350,842	172	1,052	37,174	2
Maine	8.9	52.02	646,874	394	2,588		0
Michigan	5.0	820.02	1,383,297	543	3,695	70,306	45
Minnesota	9.8	321.03	801,160	294	2,469	139,291	2
Missouri	6.3	167.83	433,291	184	1,172	43,367	9
Mississippi	5.0	59.60	534,478	213	2,210	104,625	16
Montana	6.8	15.68	303,067	235	1,473		0
North Carolina	6.9	154.84	254,157	106	642	32,901	63
North Dakota	5.8	8.56	171,433	99	692		0
Nebraska	7.8	198.36	1,682,723	742	8,089		0
New Hampshire	8.5	126.48	1,374,329	727	5,348		0
New Jersey	9.0	309.74	456,440	213	1,175	64,713	24
New Mexico	7.6	34.06	306,669	193	1,189	98,669	2
Nevada	0.0	8.84	37,679	17	161	102,506	5
New York	7.1	1,963.33	1,116,105	538	2,185	713,866	9
Ohio	0.0	817.92	1,009,545	386	2,759	26,828	28
Oklahoma	6.0	292.50	1,353,401	616	5,420	72,609	3
Oregon	7.6	194.28	1,037,174	419	4,547	72,100,000	5
Pennsylvania	10.0	496.32	527,029	234	1,233	282,009	2
Rhode Island	9.0	33.49	523,219	250	2,578	233,208	1
South Carolina	5.0	200.42	753,667	300	2,255	67,926	14
South Dakota	0.0	46.14	783,633	435	3,912		0
Tennessee	6.5	205.77	485,014	204	1,535	136,312	13
Texas	0.0	1,244.08	541,990	239	1,135	8,915	16
Utah	5.0	120.90	471,767	212	1,776	56,437	17
Virginia	6.0	81.29	119,467	57	275	134,298	13
Vermont	8.5	63.95	1,954,428	935	7,352		0
Washington	0.0	315.94	747,410	374	2,611	104,620	2
Wisconsin	7.9	141.23	456,104	204	2,179	89,157	2
West Virginia	8.5	328.09	3,956,275	1,724	17,964	262,369	5
Wyoming	0.0	14.77	772,135	281	3,279		0

Notes: Above are descriptive statistics at the state-level, over the sample period. The incentive spending statistics are for the period 2007-2014, the tax rates and subsidies are for the period 2002-2016

B.1 Industry Classification

In the paper I present descriptive statistics by 13 industry groups, and in estimation I use an even broader definition, with 4 groups (high and low skill, manufacturing and services). However, there are over 100 unique industries that receive subsidies in the data. In Tables 10 and 11 I document total spending, job creation, and number of subsidies by the 4-digit industry classification. For 4 digit industries with only one observation in the data, I group these into broader (2,3 digit) classifications.

Table 10: Non-Manufacturing Industries

NAICS Code	Industry Name	N	Total Sub ($M)	Jobs (1,000)
2111	Oil and Gas Extraction	3	334.0	1.4
212	Mining	6	466.0	1.2
22	Utilities	5	465.6	6.6
42	Wholesalers	7	458.6	11.6
44	Stores	15	1,548.2	32.4
4541	Electronic Shopping and Mail-Order Houses	5	230.6	9.4
48	Transportation	4	328.8	4.0
4921	Couriers and Express Delivery Services	2	211.6	5.9
4931	Warehousing and Storage	7	783.6	10.0
5111	Newspaper, Periodical, Book, and Directory Publishers	2	62.5	2.1
5112	Software Publishers	12	423.3	7.0
5121	Motion Picture and Video Industries	3	305.6	10.1
5172	Wireless Telecommunications Carriers (except Satellite)	2	114.9	4.0
5179	Other Telecommunications	2	72.7	2.3
5182	Data Processing, Hosting, and Related Services	12	2,070.0	5.8
5221	Depository Credit Intermediation	6	297.8	8.9
5222	Nondepository Credit Intermediation	5	184.1	8.2
5223	Activities Related to Credit Intermediation	4	90.7	3.3
5231	Securities and Commodity Contracts Intermediation	7	1,082.6	9.0
5239	Other Financial Investment Activities	23	2,148.7	56.7
5241	Insurance Carriers	6	467.0	13.1
5242	Agencies, Brokerages, and Other Insurance	3	87.9	4.1
5412	Accounting, Tax Preparation, Bookkeeping, and Payroll	2	461.8	2.3
5413	Architectural, Engineering, and Related Services	3	88.4	3.3
5415	Computer Systems Design and Related Services	14	2,354.8	34.7
5416	Management, Scientific, and Technical Consulting	2	269.6	1.6
5417	Scientific Research and Development Services	19	2,408.8	14.2
51-56	Miscellaneous Services	8	309.6	6.6
622	Hospitals	2	318.3	35.1
7211	Traveler Accommodation	4	623.3	10.1
	Total Non-Manufacturing	195	19,069.27	325.0

Notes: The table above lists the number of subsidies, total spending, and total direct job creation, for each 4-digit industry classification (not in the manufacturing sector). The source is the firm-state level subsidy deal dataset, assembled by the author.

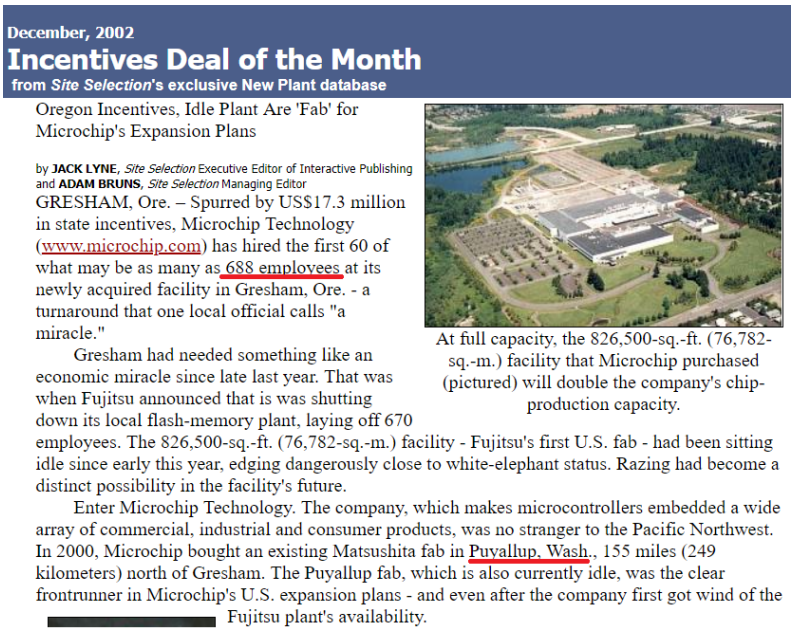
Table 11: Manufacturing Industries

NAICS Code	Industry Name	N	Total Sub ($M)	Jobs (1,000)
311	Food	5	127.9	4.9
312	Beverage and Tobacco	2	82.3	1.5
313	Textile	2	174.2	2.9
3221	Pulp, Paper, and Paperboard Mills	3	171.1	0.9
3241	Petroleum and Coal Products	13	1,678.0	18.0
3251	Basic Chemical	25	8,710.8	4.6
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers	7	430.5	4.3
3253	Pesticide, Fertilizer, and Other Agricultural Chemical	6	1,205.0	0.5
3254	Pharmaceutical and Medicine	18	1,001.1	10.9
3256	Soap, Cleaning Compound, and Toilet Preparation	3	44.8	1.6
3259	Other Chemical Product and Preparation	3	116.4	9.0
3261	Plastics Product	6	141.2	3.3
3262	Rubber Product	15	1,659.1	22.6
3273	Cement and Concrete Product	2	47.0	0.7
3311	Iron and Steel Mills and Ferroalloy	10	2,189.6	8.5
3312	Steel Product from Purchased Steel	3	70.2	1.7
3313	Alumina and Aluminum Production and Processing	5	2,353.2	3.0
3329	Other Fabricated Metal Product	4	104.9	5.0
3331	Agriculture, Construction, and Mining Machinery	3	106.8	3.2
3336	Engine, Turbine, and Power Transmission Equipment	5	331.0	3.0
3339	Other General Purpose Machinery	2	47.2	5.1
3341	Computer and Peripheral Equipment	10	2,389.8	9.2
3342	Communications Equipment	4	1,137.7	17.8
3344	Semiconductor and Other Electronic Component	23	7,106.9	15.7
3345	Navigational, Measuring, Electromedical	4	956.4	5.7
3352	Household Appliance	4	269.9	3.6
3353	Electrical Equipment	2	122.8	1.3
3359	Other Electrical Equipment and Component	7	794.5	6.6
3361	Motor Vehicle	48	12,622.4	142.6
3363	Motor Vehicle Parts	8	645.5	8.1
3364	Aerospace Product and Parts	25	8,850.1	140.2
3369	Other Transportation Equipment	3	283.1	3.1
32-33	Miscellaneous	10	783.5	10.0
	Total Manufacturing	290	56,755.1	479.0

Notes: The table above lists the number of subsidies, total spending, and total direct job creation, for each 4-digit industry classification (in the manufacturing sector). The source is the firm-state level subsidy deal dataset, assembled by the author.

B.2 Runner-up State Examples

Figure 20: Sources for Identification of the Runner-up State



December, 2002

Incentives Deal of the Month

from *Site Selection*'s exclusive New Plant database

Oregon Incentives, Idle Plant Are 'Fab' for Microchip's Expansion Plans

by **JACK LYNE**, *Site Selection* Executive Editor of Interactive Publishing and **ADAM BRUNS**, *Site Selection* Managing Editor

GRESHAM, Ore. – Spurred by US$17.3 million in state incentives, Microchip Technology (www.microchip.com) has hired the first 60 of what may be as many as 688 employees at its newly acquired facility in Gresham, Ore. - a turnaround that one local official calls "a miracle."

Gresham had needed something like an economic miracle since late last year. That was when Fujitsu announced that is was shutting down its local flash-memory plant, laying off 670 employees. The 826,500-sq.-ft. (76,782-sq.-m.) facility - Fujitsu's first U.S. fab - had been sitting idle since early this year, edging dangerously close to white-elephant status. Razing had become a distinct possibility in the facility's future.

At full capacity, the 826,500-sq.-ft. (76,782-sq.-m.) facility that Microchip purchased (pictured) will double the company's chip-production capacity.

Enter Microchip Technology. The company, which makes microcontrollers embedded a wide array of commercial, industrial and consumer products, was no stranger to the Pacific Northwest. In 2000, Microchip bought an existing Matsushita fab in Puyallup, Wash., 155 miles (249 kilometers) north of Gresham. The Puyallup fab, which is also currently idle, was the clear frontrunner in Microchip's U.S. expansion plans - and even after the company first got wind of the Fujitsu plant's availability.

(a) *Site Selection* Magazine

Electrolux Home Products, Inc. ("EHPI")

In addition to North Carolina, EHPI management considered two other potential locations: South Carolina and Tennessee. South Carolina offered several desirable locations in York and Lancaster Counties. South Carolina submitted a formal proposal that included significant up-front cash incentives and cash grants valued at approximately $54 million. EHPI recently established a large manufacturing facility in Memphis, Tennessee. That facility was located there after extensive analysis of the incentives offered in Tennessee, Alabama, and North Carolina. Tennessee was chosen in large part due to its superb incentive package.

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(b) State of North Carolina Subsidy Report

- Nexteer Automotive (Steering Solutions Services Corporation) - The former steering division of Delphi Corporation, which operates in **Saginaw** under the Nexteer brand name, is the only global Tier One automotive supplier focused on advanced steering and driveline systems technology. The company plans to invest $413 million to actively pursue diverse new business opportunities. The project will retain 8,711 total jobs, including 2,400 directly by the company. The MEDC estimates the increased economic activity created by the project will retain an additional 6,311 indirect jobs. Based on the MEDC's recommendation, the MEGA board today approved a state tax credit valued at $70.7 million over 10 years to encourage the company to expand in Michigan over competing sites in Europe and China. Buena Vista Charter Township is considering an abatement in support of the project. http://www.nexteer.com/

(c) State of Michigan Press Release

Notes: This figure contains three examples of sources that I use to find information on the runner-up state in the subsidy competition. The source can be an article from a magazine or newspaper (a), state reports on discretionary subsidies (b), or state/company press releases (c).

B.3 Data Integrity

I do three checks to ensure the data integrity of the *Good Jobs First* (GJF) subsidy data: (1) Compare subsidies for new establishments against establishment entry in Business Dynamics Statistics, (2) Compare GJF subsidies for the state of Virginia with an administrative list from a contact at Virginia's Joint Legislative Audit & Review Commission (JLARC), (3) Check against "Deal of the Month" articles in the *Site Selection* magazine.

All of the subsidies from the administrative data and that I read about in a random sample of the "Deal of the Month" articles are in the GJF data. Table 12 displays the results comparing establishment entry from the Census with the subsidy data. Note that 52 new manufacturing establishments with over 1000 employees entered the U.S. between 2008 and 2014, and I observe 52 manufacturing firms promising over 1000 jobs receiving discretionary subsidies in the GJF data over the same period. The numbers do not always line up at the annual level, as the GJF data sometimes uses the year the deal was made (before the establishment physically locates in the state), and other times the year the subsidy began to be disbursed (after the establishment locates). As the establishments get smaller they are less likely to receive a discretionary subsidy (50% of establishments creating 500-999 direct jobs are presumed to receive discretionary subsidies, and 6% of establishments creating 250-499 jobs), or the subsidy they do receive is too small to be picked up in my sample selection process. These data checks suggest that the GJF data has a fairly comprehensive list of large subsidies given for establishment location.

Table 12: Manufacturing Entry vs. Manufacturing Subsidy Deals

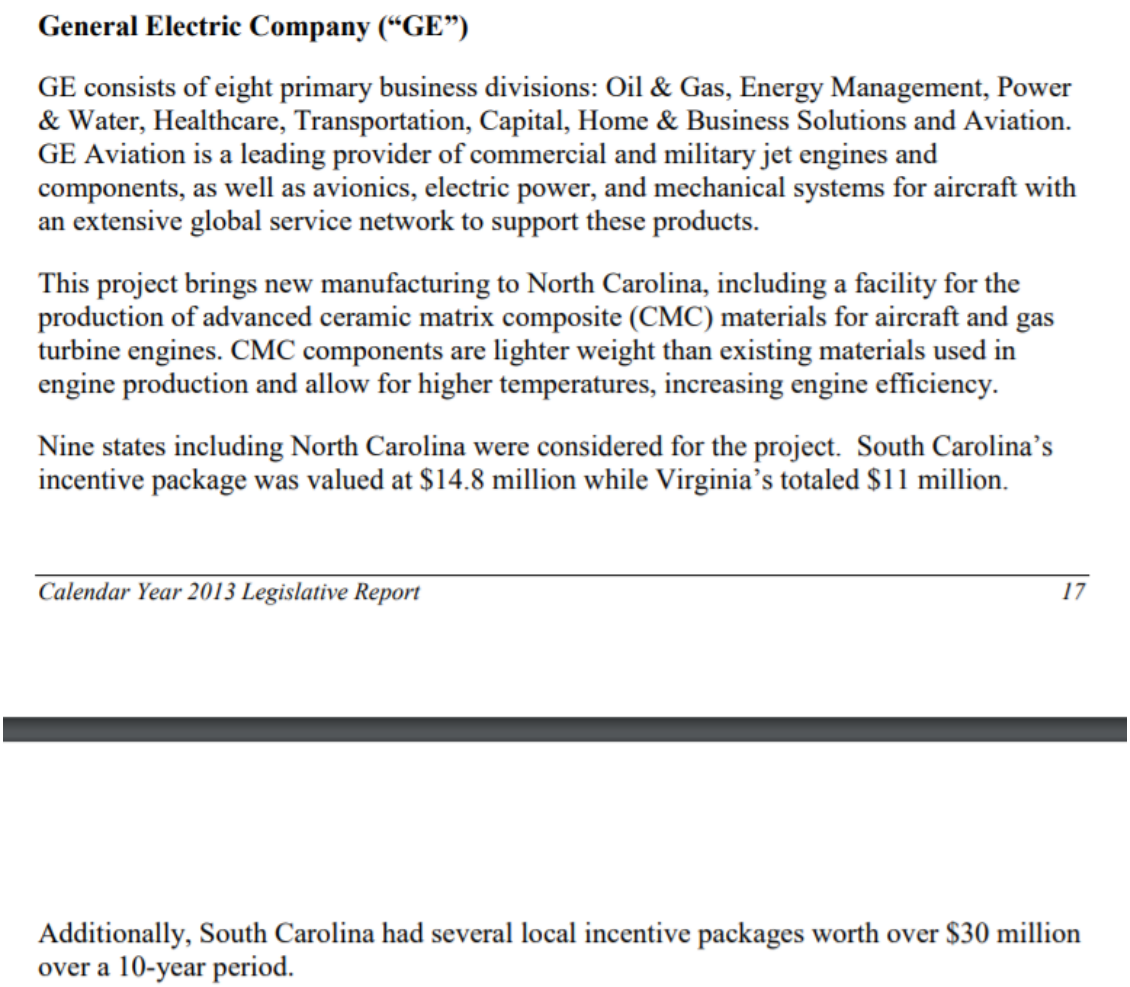
	Establishment Entry			**Subsidy Data**		
Year	250-499	500-999	1000+	<500	500-999	1000+
2008	147	34	12	9	6	9
2009	123	27	7	3	11	11
2010	106	9	8	6	10	8
2011	94	23	4	3	12	5
2012	78	9	6	8	12	5
2013	89	12	7	14	7	6
2014	90	31	8	12	15	8
Total:	727	145	52	55	73	52

Notes: The left side of the table above lists the counts of manufacturing establishments entering U.S. states by year and size of establishment, according to the Census Business Dynamics Statistics. The right side of the table lists the counts of manufacturing establishments that received discretionary subsidies from states for entering or expanding, in my dataset of discretionary subsidy deals.

C Evidence for Assumption 1

Figure 21 presents anecdotal evidence that states are aware of their competitors bids. This is an excerpt from North Carolina's discretionary subsidy report (see Figure 20(b) for another example from the same source). Therefore, the more demanding assumption is that states know the firm's profit in each state. Firms may not want to be truthful about where they have the highest profit, in order to extract a larger subsidy from the state.

Figure 21: Evidence that states know competitors' bids



General Electric Company ("GE")

GE consists of eight primary business divisions: Oil & Gas, Energy Management, Power & Water, Healthcare, Transportation, Capital, Home & Business Solutions and Aviation. GE Aviation is a leading provider of commercial and military jet engines and components, as well as avionics, electric power, and mechanical systems for aircraft with an extensive global service network to support these products.

This project brings new manufacturing to North Carolina, including a facility for the production of advanced ceramic matrix composite (CMC) materials for aircraft and gas turbine engines. CMC components are lighter weight than existing materials used in engine production and allow for higher temperatures, increasing engine efficiency.

Nine states including North Carolina were considered for the project. South Carolina's incentive package was valued at $14.8 million while Virginia's totaled $11 million.

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Additionally, South Carolina had several local incentive packages worth over $30 million over a 10-year period.

Notes: This is an excerpt from North Carolina's 2013 Job Development Investment Grant Report. For each firm they receives a discretionary subsidy from the program, there is a description of the firm and the competition. As detailed above, North Carolina is aware of the value of the incentive offers in runner-up states.

D Unobserved State Heterogeneity: σ_ξ^2

In this section I present the identification argument and estimation procedure I use to recover the variance of the unobserved state characteristics, σ_ξ^2.

D.1 Identification

From Section 5.1 I have an equation for the winning subsidy bid (b_{i1}) where 1 denotes the winning state and 2 is the runner-up state:

$$b_{i1} = \beta_i(x_2 - x_1) + \underbrace{v_{i2} + (\xi_2 - \xi_1)}_{\theta_i}. \tag{20}$$

Given data on winning bids and observed state characteristics I can recover a residual, $\hat{\theta}_i$, from Equation 20, where $\hat{\theta}_i = b_{i1} - \hat{\beta}_i(x_2 - x_1)$. I know that $\theta_i = v_{i2} + (\xi_2 - \xi_1)$ but have no data on v or ξ. The identification challenge is to recover the variance of the unobserved state characteristics, σ_ξ^2, from the residual, $\hat{\theta}$.

To give a brief preview, I use the following moment condition for identification:

$$var(\hat{\theta}) - var(\theta) = 0. \tag{21}$$

The first term is observed — it is the variance of the residual recovered from Equation 20. I rewrite the second term as a function of the variance of v_2 and the variance of ξ, σ_ξ^2. I then use deconvolution techniques to express $var(v_2)$ as a function of σ_ξ^2. Finally, I solve for σ_ξ^2, as desired.

To start, I make the following assumptions:

Assumption 3 *Unobserved state characteristics (ξ) and valuations (v) are independent, $\xi \perp v$.*

Assumption 4 $\xi \overset{i.i.d.}{\sim} N(0, \sigma_\xi^2)$.

Given Assumption 3, I can write the variance of θ as the sum of the variance of v_2 and $\Delta\xi$:

$$var(\theta) = var(v_2 + \Delta\xi) = var(v_2) + var(\Delta\xi). \tag{22}$$

From Assumption 4, $var(\Delta\xi) = 2\sigma_\xi^2$. Therefore, I can rewrite the moment condition from Equation 21 as follows:

$$var(\hat{\theta}) - var(\theta) = var(\hat{\theta}) - var(v_2) - 2\sigma_\xi^2 = 0.$$

Therefore, given the variance of v_2, I can identify σ_ξ^2.

D.1.1 An expression for the variance of v_2

Due to the assumption of independence of v_2 and $\Delta\xi$, the characteristic function of θ can be written as the product of the characteristic functions of v_2 and $\Delta\xi$:

$$\varphi_\theta(t) \equiv \varphi_{v_2}(t) \times \varphi_{\Delta\xi}(t)$$

which gives an equation for the characteristic function of v_2:

$$\varphi_{v_2}(t) = \frac{\varphi_\theta(t)}{\varphi_{\Delta\xi}(t)}. \tag{23}$$

I can use the residuals of Equation 20, $\hat{\theta}$, to calculate the characteristic function of θ, φ_θ:

$$\hat{\varphi}_\theta(t) = \frac{1}{N}\sum_{j=1}^{N} \exp(it\hat{\theta}_j). \tag{24}$$

I have assumed that ξ follows a Normal distribution with mean 0 and variance, σ_ξ^2, so the characteristic function for $\Delta\xi$ is:

$$\varphi_{\Delta\xi}(t) = \exp(-\sigma_\xi^2 t^2). \tag{25}$$

I plug in for $\varphi_{\Delta\xi}$ (Eq. 25) and φ_θ (Eq. 24) in Equation 23:

$$\varphi_{v_2}(t) = \frac{1}{N}\sum_{j=1}^{N} \exp(it\hat{\theta}_j + \sigma_\xi^2 t^2) \tag{26}$$

Now the characteristic function of v_2 is a function of σ_ξ^2 and observables, $\hat{\theta}_j$. Recall, the goal is to recover σ_ξ^2.

By definition, the characteristic function of a random variable, x, is the Fourier transform of its' probability density function.[79] Therefore, given that the characteristic function of v_2 is integrable, I can invert it to recover the density, f_{v_2}:

$$f_{v_2}(v_2) = \frac{1}{2\pi}\int \varphi_{v_2}(t)\exp(itv_2)dt$$

I plug in for $\varphi_{v_2}(t)$ using Equation 26:

$$\begin{aligned} f_{v_2}(v_2) &= \frac{1}{2\pi}\int \frac{1}{N}\sum_{j=1}^{N} \exp(it\hat{\theta}_j + \sigma_\xi^2 t^2)\exp(itv_2)dt \\ &= m(v_2;\sigma_\xi^2) \end{aligned} \tag{27}$$

and I have an expression for the density of v_2 as a function of σ_ξ^2.

[79] The characteristic function of a random variable x has the following expression:

$$\varphi_x(t) = \int \exp(itx) f_x(x)dx.$$

From the density of v_2, denoted $m(v_2; \sigma_\xi^2)$ I can calculate the mean and variance:

$$\mathbb{E}(v_2) = \frac{1}{S}\sum_{s=1}^{S} v_{2,s} \times m(v_{2,s}; \sigma_\xi^2) \tag{28}$$

$$var(v_2) = \frac{1}{S}\sum_{s=1}^{S} (v_{2,s} - \mathbb{E}(v_2))^2.$$

Therefore, I have an expression for the variance of v_2, given σ_ξ^2, as desired.

Recall, I have the following moment condition:

$$var(\hat{\theta}) - var(v_2) - 2\sigma_\xi^2 = 0.$$

Now, I use Equations 27 through 28 to plug in for $var(v_2)$:

$$var(\hat{\theta}) - \big[\big(\frac{1}{S}\sum_{s=1}^{S}\big(v_{2,s} - \frac{1}{S}\sum_{s=1}^{S} v_{2,s} \times m(v_{2,s}; \sigma_\xi^2)\big)\big)^2 + 2\sigma_\xi^2\big] = 0.$$

I can use this equation to estimate σ_ξ^2, as desired.

D.2 Estimation

The identification argument in Section D gives a moment condition which I rewrite below:

$$var(\hat{\theta}) - \big[\big(\frac{1}{S}\sum_{s=1}^{S}\big(v_{2,s} - \frac{1}{S}\sum_{s=1}^{S} v_{2,s} \times m(v_{2,s}; \sigma_\xi^2)\big)\big)^2 + 2\sigma_\xi^2\big] = 0.$$

I will recover $\hat{\sigma}_\xi^2$ by searching over a grid of potential $\sigma_\xi^2 = \tau$, and minimizing the moment condition:

$$\min_{\tau>0} \frac{1}{j}\sum_{j=1}^{J}\Big[\big(\hat{\theta}_j - \frac{1}{j}\sum_{j=1}^{J}\hat{\theta}_j\big)^2\Big] - \big(\frac{1}{S}\sum_{s=1}^{S}\big(v_{2,s} - \frac{1}{S}\sum_{s=1}^{S} v_{2,s} m(v_{2,s}; \tau)\big)\big)^2 + 2\tau\big) \tag{29}$$

where $\hat{\theta}_j$ are data (recall, $\hat{\theta}_j = b_{1j} - \hat{\beta}_j(x_2 - x_1)$). Note that the density of v_2, $m(v_2; \sigma_\xi^2)$, is still a function of σ_ξ^2. This means that for each candidate variance τ_i, I need to estimate $f_{v_2}(v_2) = m(v_2, \tau_i)$ and simulate $v_{2,s}$ from that distribution. I calculate $m(v_2; \sigma_\xi^2 = \tau_i)$ from:

$$\begin{aligned} f_{v_2}(v) &= \frac{1}{2\pi}\int \exp(itv)\big(\frac{1}{N}\sum_{j=1}^{N}\exp(it\hat{\theta}_j + \tau_i t^2)\big)dt \\ &= m(v_2; \tau_i) \end{aligned}$$

I then can plug in m, and search over τ_i, as specified in Equation 29.

E Medium Firm Location Choice

Tables 13 and 14 below present the results from the medium firm location choice problem, which are used to calculate the potential spillover for a subsidized firm.

One of the variables in the medium firm profit function is the expected non-discretionary incentives in that state. One may be concerned about the endogeneity of this variable, states which are struggling to attract medium-sized firms would make more of such incentives available to them. I instrument for the non-discretionary incentives with the state budget balance in the previous year. The intuition is that the state with a budget surplus has more money to spend on economic development programs. The first stage is presented in the first column of Table 13. The estimates for firms with 100-250 employees and 250-500 employees are separate, which is denoted on the top of the table. Table 14 breaks out the effect of a large, subsidized, firm, by industry.

Table 13: Medium Firm Location Results

	First-Stage	100-249 employees		250-499 employees	
	$\mathbb{E}$(Incentive)	OLS	IV	OLS	IV
$\mathbb{E}$(Incentive) ($10K)		-0.00	0.03**	0.00	0.06***
		(0.00)	(0.01)	(0.00)	(0.02)
Budget Balance$_{t-1}$	0.86***				
	(0.31)				
Corporate tax (%)	-0.04	0.00	0.01	-0.00	0.00
	(0.19)	(0.01)	(0.01)	(0.01)	(0.01)
Income tax (%)	0.92***	-0.04***	-0.06***	-0.03**	-0.07***
	(0.26)	(0.01)	(0.01)	(0.01)	(0.02)
Sales tax (%)	1.05***	-0.00	-0.03	-0.02	-0.08***
	(0.30)	(0.02)	(0.02)	(0.02)	(0.03)
log(Population)	-2.44***	1.01***	1.07***	0.83***	0.94***
	(0.75)	(0.03)	(0.04)	(0.03)	(0.05)
Amenity diff.	-13.35**	1.00***	1.44***	0.95***	1.79***
	(5.89)	(0.24)	(0.31)	(0.34)	(0.51)
# Subsidies	-0.86***	0.01	0.03**	-0.00	0.04*
	(0.23)	(0.01)	(0.01)	(0.01)	(0.02)
(# Subsidies)^2	0.03***	-0.00	-0.00*	0.00	-0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
N	384	384	384	384	384
R^2	0.14	0.94	0.89	0.82	0.46

Notes: This table displays the results for the regression as specified in Equation 16. The sample period is 2007-2014. Observations are state-years. Robust standard errors are in parentheses, and * p<0.10, ** p<0.05, *** p<0.01.

Table 14: Medium Firm Location: Heterogeneous Spillovers

	100-249 employees		250-499 employees	
$\mathbb{E}$(Incentive) ($10K)	0.03**	0.05	0.06***	0.08*
	(0.01)	(0.03)	(0.02)	(0.04)
# Subsidies	0.03**		0.04*	
	(0.01)		(0.02)	
# Subsidies by Industry				
chemicals		0.11*		0.12
		(0.06)		(0.07)
pharmaceuticals		-0.01		-0.09
		(0.06)		(0.10)
plastics and rubber		0.10		0.08
		(0.10)		(0.13)
electronics		0.01		0.03
		(0.04)		(0.05)
automobiles		0.29		0.39*
		(0.18)		(0.22)
aerospace		0.00		0.07
		(0.07)		(0.11)
finance		0.06*		0.13***
		(0.04)		(0.05)
prof. services		-0.10		-0.09
		(0.07)		(0.09)
info services		0.21**		0.21
		(0.10)		(0.13)
other manufacturing		-0.10*		-0.12*
		(0.05)		(0.07)
other services		-0.12		-0.19*
		(0.09)		(0.11)
N	384	384	384	384

Notes: This table displays the results for the regression as specified in Equation 16. The sample period is 2007-2014. Observations are state-years. Robust standard errors are in parentheses, and * p<0.10, ** p<0.05, *** p<0.01.

F Simulation Exercise: Estimation of H

In Section 6 I estimate the distribution of state valuations for firms, H, using the sample average:

$$H_S(t) = 1/S \sum_{s=1}^{S} \hat{F}(t + \hat{\beta} x_s + \xi_s)$$

In this section I show that as S approaches ∞, $H_S(t)$ approaches the true $H(t)$ for all t.

I do this by simulating data from a known distribution. Let $F(x)$ be exponential with rate 1 and $G(x)$ be exponential with rate 1.5, and let $\beta = 1$. Then I have:

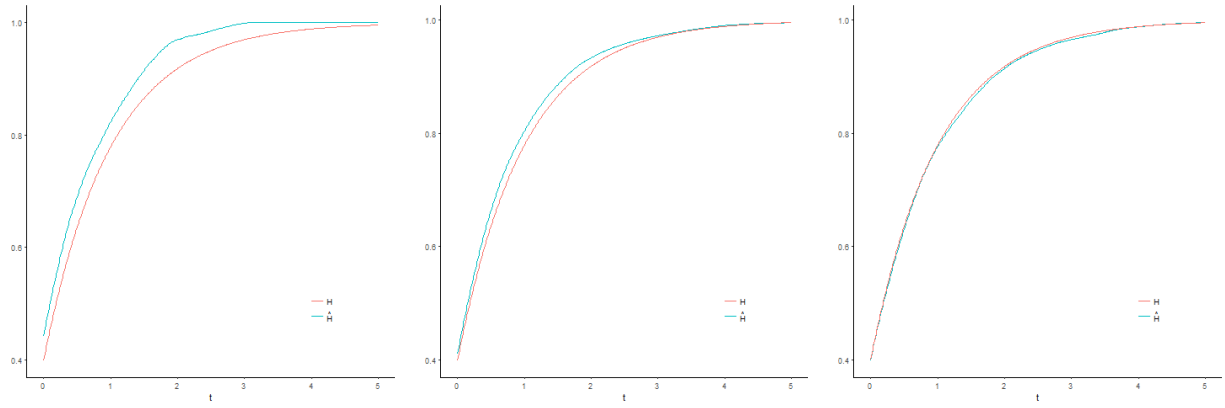
$$\begin{aligned} H(t) &= \int_0^{\infty} F(t + \beta x) g(x) dx \\ &= \int_0^{\infty} (1 - e^{-(t+x)}) 1.5 e^{-1.5x} dx \end{aligned} \tag{30}$$

and:

$$H_S(t) = 1/S \sum_{s=1}^{S} \hat{F}(t + \beta x_s) \tag{31}$$

where x_s are drawn from exponential rate $\lambda = 1.5$ and $S \in \{100, 500, 1000\}$. See Figure 22 for a graphical representation of the results. The estimates from the sample average ($\hat{H}_S$) approaches the true distribution, H, when I increase S from 100 to 500 or 1000. .

Figure 22: Simulation Exercise



(a) S=100 (b) S=500 (c) S=1,000

Notes: The figure plots the true distribution H (Equation 30) with the sample average H_S (Equation 31) using S draws of x. In the three panels I change the number of draws from 100 (Panel (a)) to 500 (Panel (b)) to 1000 (Panel (c)). As shown, by Panel (c) the true distribution is almost indistinguishable from the estimate.