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Abstract

This paper critically surveys the growing literature on the policy choices of local governments. First, we identify various reasons for local government policy interactions, including fiscal competition, bidding for firms, yardstick competition, expenditure spillovers, and Tiebout sorting. We discuss theoretically what parameters should be estimated to determine the reason for competition among local governments. We emphasize how the policy outcomes emerging from this competition are affected by the presence of constraints imposed by higher-level governments. Second, we integrate theoretical and empirical analyses on the effects of fiscal decentralization on mobility, spillovers, fiscal externalities, economic outcomes, and distributional issues. Third, we identify key issues that arise in the empirical estimation of strategic interactions among local governments and highlight recent quasi-experimental evidence that has attempted to identify the mechanism at work. Finally, a synthesis model, containing multiple mechanisms and fiscal instruments, resolves some puzzles and provides guidance for future research.

JEL-Codes: H200, H400, H700, R500.

Keywords: fiscal competition, yardstick competition, spillovers, strategic policy, interdependence, reaction functions, local public finance.

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1 Introduction

The behaviors of a central government and lower-level governments in a federation differ substantially. Important differences involve the effects of fiscal policies on the cross-border movements of businesses and investment, people and employment, sales and other economic activities. Additional differences include the extent of cross-border flows of information and spillovers of public good benefits. As a result of these movements and flows across borders, local governments operate in an open economy, but in contrast to the international setting, do not have strict border controls or fiscal frontiers that limit mobility. Furthermore, unlike central governments, local governments set policy in the presence of intergovernmental grants and operate under rigid constraints imposed by higher-level governments, which limit the available policy instruments related to their tax and spending authority.

Local governments are important. Many countries have a substantial number of local governments and economically integrated urban areas are fragmented into potentially hundreds of local governments (Brühlhart, Bucovetsky and Schmidheiny 2015). Taxes at the sub-federal level represent a large share of public revenue in many countries: for example, as much as 33% in Finland, 12-20% in the United States, Switzerland and Canada, and 15-22% in lower-income countries such as Bolivia and Iran.¹ Although developing countries have less decentralization than developed countries, decentralization is often viewed as critical to improving the public sector in low-income countries (Gadenne and Singhal 2014). Moreover, local spending finances critical public services, including primary and secondary education, local infrastructure, and public amenities. Some of these programs have a higher marginal value of public funds than federal programs (Hendren and Sprung-Keyser 2020). Given the importance of these policies, understanding how localities determine them is important.

Many classic problems in economics deal with externalities, imperfect competition, imperfect information, and undesirable distributions of economic well-being. Although not initially obvious, the literature on local policy choice provides interesting applications into each of these issues. First, both tax and expenditure decisions by local governments impose externalities on non-residents. The externality from the same policy even can have different signs under different conditions. In a standard model of tax competition, an increase in a jurisdiction's tax rate on capital investment imposes a positive externality on other jurisdictions by redirecting investment there, raising their tax bases. However, the use of the tax revenue is critical: if it is used to finance business public services, investment in other jurisdictions could be reduced. Second, imperfect competition may actually be welfare-enhancing

¹See Brühlhart, Bucovetsky and Schmidheiny (2015) for a survey of the number of jurisdictions and the fraction of revenue raised at the local level across various countries.

in this tax competition model, because large jurisdictions face less elastic supplies of capital, reducing the degree to which they lower taxes below the efficient levels in their attempts to attract investment. Imperfect information, which is central to political economy models of local government behavior, has conflicting effects in some cases. Government officials may use excessive subsidies to attract large investment projects to their jurisdictions, as such “achievements” are viewed favorably by imperfectly-informed voters. On the other hand, these officials may also have an incentive to keep taxes low, if voters compare these taxes to those of similar jurisdictions when assessing government competence. Finally, a theme of the local public economics literature is that factor mobility constrains the ability of local governments to redistribute income. One response of higher-level governments is to intervene in the decision-making and responsibilities of local governments. The implications for local policy choice is an important topic. An example is school finance equalization, where a greater share of local public school expenditures are financed by state governments and jurisdictions face restrictions on their use of local taxes.

We summarize the theoretical and empirical literature on how local governments set policy. We focus on interactions among local governments, emphasizing the resulting policy interdependence. The interactions may be strategic, where the behavior of one local government affects the behavior of other governments, or may instead involve competition among many price-taking jurisdictions. We cover various interactions, including fiscal competition, bidding for firms, yardstick competition, expenditure spillovers, and Tiebout sorting.²

Past reviews on policy interdependence are numerous,³ but they typically emphasize models that are more applicable to international tax competition, where workers and residents are not mobile across competing jurisdictions, or mobility is significantly more limited than in a federation. Any review of local competition should include competition for mobile capital and businesses, but we also focus on models involving the cross-border mobility of people in their roles as workers, homeowners, or shoppers. Finally, unlike many prior reviews focusing on either theory or empirical evidence, we discuss both and integrate the theoretical and empirical literature. We provide suggestions for how these two literatures can develop jointly in the future. In contrast to reviews that only focus on tax competition, we recognize throughout this review that localities offer a “package deal” – services as well as taxes. Thus,

²We only focus on higher level governments when their policies, including tax or spending policies, intergovernmental grants and constraints imposed on jurisdictions, influence competition among local governments, or provide a source of exogenous variation to identify the nature of local government behavior.

³Most surveys focus on fiscal competition. For theoretical surveys, see Gresik (2001), Wilson (1999), Fuest, Huber and Mintz (2005), Wilson and Wildasin (2004), Keen and Konrad (2013) and Wildasin (2006). Empirical surveys include Revelli (2006*b*), Revelli (2005), and Devereux and Loretz (2013). Brueckner (2003) and Brülhart, Bucovetsky and Schmidheiny (2015) survey both theory and empirics. In this Journal, Mieszkowski and Zodrow (1989) previously surveyed local policy determination.

we emphasize that studies that focus on a single fiscal policy have only limited relevance with respect to whether local competition is “good” or “bad.”

This is a good time to assess local policy determination. Due to globalization and technological change, the financial costs of moving,⁴ changing jobs, and transporting goods via cross-border or online shopping have decreased substantially over the last several decades. Technological advances that facilitate and encourage the mobility of factors and information, and changes in transaction technologies allowing for remote purchases, are affecting state and local governments. Aided by recent access to comprehensive panel data on government policies and administrative tax return data, there has been a surge in the literature on mobility of factors and the policy responses to the mobility of people and information. The growing empirical literature on interjurisdictional mobility is highly related to the literature on local policy competition, because the extent of mobility of resources, firms, people, or information determines the degree to which one jurisdiction’s policies respond to policy changes in other jurisdictions. We provide a guide to understanding the policy responses to this mobility.

On the theoretical side, we assess the progress that has been made from over half a century of research on competition and other mechanisms that produce policy interdependence. The modern literature starts with Tiebout’s theory of local public goods. We describe a subsequent formalization of the theory. We also give special emphasis to fiscal competition. While this literature started with static models of capital tax competition by welfare-maximizing governments, it now encompasses not only other taxes, but also various forms of public expenditure and regulatory competition, and has also been expanded to include the impact of fiscal decentralization on economic growth. It is now clear that the conclusion that fiscal competition reduces taxes to inefficiently low levels must often be modified. Taxes may be too high when they pay for efficiency-enhancing public inputs, but lower taxes may be beneficial in cases of non-welfare-maximizing local governments. Our review also points to important ongoing controversies in the literature on local government behavior. Whereas the tax competition literature previously found that this competition can lead to an inefficient diversity in tax rates across jurisdictions, the literature on bidding for firms raises the

⁴While labor migration across international borders has increased substantially in recent times and has critically influenced tax policy (Egger, Nigai and Strecker 2019), Americans are domestically less mobile now than in past decades. Moving costs can be broken into financial costs, psychic costs and information costs, each of which can be substantial (Bayer et al. 2016). Although financial and information costs may be declining, other factors may be changing over time. Coate and Mangum (2019) show that, without changing moving costs, changes in home attachment explains a large fraction in the decline in within-U.S. gross migration. Moreover, the ease of information about different far-away places (Kaplan and Schulhofer-Wohl 2017) and selection effects (Bayer and Juessen 2012) may facilitate better matches, which may lower migration rates in steady-state. The distinctions between these different types of mobility costs are often absent in the theoretical fiscal policy literature. Future work should devote special attention to the differing implications of declines in various moving costs.

possibility that the differences in firm-specific subsidies offered by jurisdictions may allocate firms across jurisdictions in an efficient way. The bidding-for-firms literature also illustrates the interplay between theory and empirical research: political-economy models explain why overbidding occurs, and the empirical literature provides evidence of this.

We also describe the evolution of the empirical literature on policy interdependence. This literature has focused on strategic interactions. Early contributions estimate reaction functions, and the use of quasi-experimental designs has improved this estimation. We dispel some common misconceptions. First, the absence of strategic interactions between a jurisdiction and its “neighbors,” appropriately defined, does not preclude the existence of decentralized competition and a resulting divergence from the policies that a central government would undertake. Second, whether strategic interactions are positive or negative (i.e., reaction curves slope up or down) says nothing about the welfare implications of policy interdependence, or whether the equilibrium policies are higher or lower than those that would be set by a social-welfare-maximizing central government. On the other hand, the recent empirical literature provides plausible evidence of which mechanisms are most important in determining local policies. Further work identifying these mechanisms will also allow more to be said about government objectives and welfare. We propose a tighter link between the literature on fiscal competition and the literature on policy-induced migration as a way to determine if governments compete for mobile factors rather than interact for other reasons.

In our review of fiscal competition, we seek to compare metropolitan models, where competition for households and workers is emphasized, with regional models, where the emphasis has been on competition for business capital. Doing so clarifies important issues in the literature – in particular, empirical work on capital tax competition in a metropolitan area appears to show that jurisdictions behave strategically by raising their tax rates when their neighbors’ tax rates increase. But this strategic behavior is difficult to reconcile with the availability of investment funding from outside the metropolitan area, including both national and international capital markets. In standard regional models of tax competition, if the metropolitan area faces a perfectly elastic supply of capital on these wider capital markets, then its jurisdictions do not strategically compete for capital with any one other jurisdiction. Moreover, there are no fiscal externalities with respect to capital within the metropolitan area, where a reduction in one jurisdiction’s capital tax results in higher capital tax bases and tax revenue in other jurisdictions. Nevertheless, we demonstrate that fiscal externalities re-emerge once the mobility of workers and residential households within the metropolitan area are taken into account. As will be highlighted throughout, the mobility of people at the local level is an important component of tax competition models, even those involving capital taxation. To reconcile the existing theories and the empirical evidence of

strong strategic interactions among small local governments, we propose a synthesis model that nests multiple sources of mobility and policy mechanisms.

The plan of this paper is as follows. We first examine what the theoretical literature tells us about local government decision-making. In Section 2, we briefly describe various mechanisms of policy determination at the local level, including fiscal competition, yardstick competition, and expenditure spillover models. We show that all of these mechanisms result in policy functions that have the same reduced form. Section 3 discusses a range of models of fiscal competition. We identify some empirically-testable predictions that emerge from these models, including what we can say about strategic reaction functions. In addition, we describe the cross-border externalities created by government decision-making, and what they tell us about the welfare implications of government decision-making, particularly efficiency.

Whereas models of local government behavior have been primarily static, there is a growing literature on local government decision-making with growth and dynamics. Section 4 demonstrates the tension between the effects of decentralization on public services and long-term economic growth. Decentralized policy-making may come with efficiency-enhancing benefits, including increased growth-enhancing total investment and labor productivity. In Section 5, we discuss the empirical evidence on the effect of local policy on economic outcomes. We discuss the effects of local policies on growth, spillovers, and migration, including how migration elasticities influence policy.

As an important distinction between federal and local policies is that localities are “creatures of the state.” Section 6 examines how federal governments intervene to alter the outcomes of lower-level governments. We emphasize the constraints that higher-level governments impose on local governments. Examples of these constraints include state restrictions on the use of property, sales and income taxes by municipalities within the state. Our focus is on how these constraints affect the interactions *among* local governments, and not on how local, state, or federal governments strategically interact with each other (Keen 1998). Intergovernmental grants also have important effects on local government decision-making, so we examine these policies with an emphasis on how local government behavior is influenced by fiscal equalization policies, including school finance reform.

We next examine what the empirical literature tells us about local government policy interdependence. Section 7 focuses on the identification of strategic interactions and the mechanisms that generate them. We emphasize that fiscal competition, yardstick competition, and expenditure spillovers all have the same reduced-form reaction functions, and we discuss creative ways to identify the form of the interactions without estimating a reaction function. We also describe some misconceptions in the interpretation of these estimates.

Section 8 describes our synthesis model, which encompasses different forms of mobility

and policy mechanisms. Finally, Section 9 assesses what we have learned from this review, and what important questions remain to be answered.⁵ In addition, at the end of most sections, we provide suggestions for future research and link theory and empirics. In these “reflections” we answer: (1) What broad themes emerge from the theory and empirics? What is well-understood? (2) What are important empirical questions generated by the theory literature and vice-versa? (3) What important open questions remain for future modeling?

2 Forms of Policy Interdependence

We first describe basic theoretical frameworks that illustrates the different forms of policy interdependence. We distinguish two types of policy interdependence: (1) strategic (or game theoretic) interactions, where the behavior of one local government affects the behavior of other local governments, or (2) atomistic competition, which involves many price-taking jurisdictions. In this section, we present three different models of policy interdependence that give rise to the possibility of strategic interactions between governments: fiscal competition, yardstick competition, and expenditure spillovers. We will return to discussing the empirical evidence on all four of these mechanisms in Section 7.

2.1 Fiscal Competition

Fiscal competition is the process by which governments set policy in the presence of competitive pressures caused by policy-induced mobility. Under the broadest definition of fiscal competition in Wildasin (2006), fiscal competition includes competition in taxes, expenditures, and regulations. For a model of fiscal competition, we may write the policy base (the tax base or the expenditure beneficiaries) in jurisdiction i , b_i , as a function of jurisdiction i 's own policy y_i , neighboring policies, given by vector \mathbf{y}_{-i} , and a vector of exogenous characteristics of the jurisdiction \mathbf{X}_i :

$$b_i = b(y_i, \mathbf{y}_{-i}, \mathbf{X}_i). \quad (1)$$

Here we use a generic letter y to denote policies, which may include taxes, expenditures, or other policies that affect the policy base. The policy-base b_i may either be a tax base or a subsidy base, such as the number of qualified subsidy recipients, where subsidies may also be in-kind (Figlio, Koplin and Reid 1999; Brueckner 2000*b*). We simplify by considering a single

⁵An online appendix discusses additional mechanisms of policy interdependence, international tax issues relevant for local competition, empirical estimation of spillovers (with applications to the environmental setting), and effects of place-based policies (Neumark and Simpson 2015).

base and policy, but more generally, both b_i and y_i can denote vectors. A government's objective function W_i has its policy, base and characteristics as arguments: $W_i = W(b_i, y_i, \mathbf{X}_i)$. Governments may maximize social welfare, tax revenue, property values, or other objectives. Maximizing the objective function, subject to the base constraint, yields the policy function:

$$y_i = y(\mathbf{y}_{-i}, \mathbf{X}_i). \quad (2)$$

Fiscal competition is present when an increase in an element *or* a set of elements of \mathbf{y}_{-i} affects the base b_i , that is, when the policy base of a jurisdiction is affected by the policies of other jurisdictions. The literature often focuses on the case of tax competition, where b_i is a tax base and y_i is a tax rate used to finance a public service that benefits residents. Here a government budget constraint ties the public service level to the tax rate. In some models, the public service is replaced by a public input that raises firm productivity and may therefore offset any negative effect of the tax rate on the tax base. In this case, we have a model in which there is both “tax competition” and “expenditure competition.” Equation (2) describes strategic interactions, whereby jurisdiction i responds to the policy decisions in another jurisdiction. Using this relation, we can define a Nash equilibrium in the usual way. Note, however, that this framework encompasses “atomistic fiscal competition,” where each jurisdiction becomes infinitesimally small and behaves as a price-taker in its interactions with other jurisdictions. With competition for capital, we could then replace (2) with

$$y_i = y(\rho(y_i, \mathbf{y}_{-i}), \mathbf{X}_i), \quad (3)$$

where ρ is the net, or after-tax, return on capital, which is determined by the policy decisions of all jurisdictions. Price-taking behavior is then present when each jurisdiction i treats ρ as independent of y_i . The Tiebout model described in the next section extends this concept to include “price-function-taking” or “utility-taking” behavior.

We include atomistic fiscal competition in the set of models we view as describing policy interdependence, although these price-taking models do not feature *strategic* interdependence. Given this broad definition and the importance of fiscal competition, we devote special attention to it in this review. Of course, fiscal competition is not the only mechanism that influences local policy determination.

2.2 Yardstick Competition

Under yardstick competition, resources do not move across borders; instead, information crosses borders. Voters use information about the taxes and spending levels in other ju-

risdictions as a “yardstick” to measure the competence of their own incumbent politicians. Incumbent politicians are either “good” or “bad”, and a jurisdiction’s voters update their beliefs about their incumbent’s type by observing policies in the jurisdiction and economically or spatially “neighboring” jurisdictions. They re-elect the incumbent if her probability of being good is at least as great as the exogenous probability that the challenger is good.

In particular, suppose that the cost of providing the observed public service level G_i in jurisdiction i is $G_i + \eta_i$, where η_i is a mean zero idiosyncratic cost shock unobservable to voters. Informational asymmetries arise because politicians differ in their honesty, which is also unobservable to voters. Following Revelli (2005), who modifies Besley and Case (1995), good politicians use all tax payments τ_i to fund the public service cost: $G_i + \eta_i = \tau_i$. However, bad politicians obtain $v_i(r_i)$ by extracting rents r_i while in office, levying taxes sufficient to fund these rents and public service costs: $G_i + \eta_i + r_i = \tau_i$. Bad politicians maximize their utility by selecting rents that can be appropriated in the current period, plus future rents conditional on being reelected with probability p_i , which depends on taxes and public service levels. In year t , bad politicians select r_i to maximize $V_i^t = v_i(r_i) + p_i V_i^{t+1}$.

Thus, voters must disentangle rents and common shocks. If the covariance between own public service cost and neighboring public service cost is positive, voters can disentangle rents and public service shocks. In this case, the re-election of a politician depends on the tax rate in her jurisdiction relative to the tax rate of nearby jurisdictions, and spending on services in her jurisdiction relative to nearby jurisdictions.

Yardstick competition models focus on pooling equilibria, whereby bad politicians set taxes at levels that are low enough to leave voters unable to distinguish between bad and good politicians with certainty, given the unobserved costs shocks. But because these shocks are correlated across jurisdictions, observing taxes in neighboring jurisdictions can affect the probability that a jurisdiction’s incumbent politician is the bad type. Letting \mathbf{G}_{-i} denote the public service levels in neighboring jurisdictions and $\boldsymbol{\tau}_{-i}$ denote the taxes in neighboring jurisdictions, the probability of reelection is given by a function:

$$p_i(\tau_i, \boldsymbol{\tau}_{-i}, G_i, \mathbf{G}_{-i}). \tag{4}$$

This probability function is similar to (2), yields spatial interdependence of policies due to information flows. But it is irrelevant for the behavior of good politicians. They behave non-strategically, so the only reason for spatial interdependence when they are in office is the correlated cost shocks. In a pooling equilibrium, however, bad politicians use this probability function to optimally tradeoff more rents today against a lower probability of re-election. Actually, the models in this literature typically assume either two or three

possible values of public service costs, in which case the probability-of-election function will be discontinuous in taxes because a tiny increase in a tax above its equilibrium level for a pooling equilibrium may then reveal a politician to be bad with certainty. In the 2-cost case considered by Bordignon, Cerniglia and Revelli (2004), voters in jurisdiction i do not know whether a high τ_i is due to public service costs being high or the incumbent being the bad type, though neighboring taxes affect the probability of each possibility. But, if τ_i is slightly increased, voters now know that costs could not be high enough to require this value of τ_i unless the politician was obtaining economic rents, in which case she must be bad. One shortcoming of this literature is that the parameters of the model must be limited to produce a pooling equilibrium. Bordignon, Cerniglia and Revelli (2004) produces examples where a pooling equilibrium becomes more difficult to achieve under yardstick competition than without it. In a separating equilibrium, a bad politician will set τ_i at its maximum possible value, regardless of the value of neighboring taxes, so that spatial interdependence will only be observed when good politicians are in office.

2.3 Expenditure Spillovers

Government spending in one jurisdiction often has spillover effects in nearby jurisdictions. For example, education or transportation may have positive benefits for residents of nearby jurisdictions. In contrast, police protection might have negative spillover effects if crime shifts from one jurisdiction to another. These spillovers are studied in Case, Hines and Rosen (1993). In a model of expenditure spillovers with a representative consumer, let y_i be public spending and $\phi_i(y_i)$ denote the negative technological relationship between public and private spending. Utility, $u_i = u(\phi_i(y_i), y_i, \mathbf{y}_{-i}, \mathbf{X}_i)$, depends on own-spending and the vector of spending of nearby jurisdictions, due to spillovers. A welfare-maximizing government sets

$$\frac{\partial u_i}{\partial \phi_i} \frac{\partial \phi_i}{\partial y_i} = - \frac{\partial u_i}{\partial y_i}, \quad (5)$$

where these derivatives are clearly a function of neighboring policies. Case, Hines and Rosen (1993) shows that differentiating with respect to an element of \mathbf{y}_{-i} , i.e., with respect to y_j :

$$\frac{\partial y_i}{\partial y_j} = - \left(\frac{\partial^2 u_i}{\partial y_j \partial y_i} - \frac{\partial^2 u_i}{\partial y_j \partial \phi_i} \right) / SOC, \quad (6)$$

where the second-order condition implies $SOC < 0$. Clearly the sign of equation (6) depends on whether public services provided by neighbors are more or less complementary to own public services or private consumption. This model assumes no direct strategic reaction of

own policies to neighboring policies, but derives it as a result of the spillovers. Thus, again, a policy determination equation like (2) continues to hold.

To conclude, all three models of policy interdependence yield similar reduced-form policy functions that may imply the presence of strategic interactions.

3 Specific Theoretical Models of Fiscal Competition

In this section, we focus on models of fiscal competition, but also discuss the bidding-for-firms literature. As much of the theoretical literature has developed with applications to taxes, we focus more on tax competition, but many of the insights generalize and rely on the presence of spending or regulatory instruments.

Following the review by Mieszkowski and Zodrow (1989), we may distinguish between two types of models of fiscal competition: metropolitan models and regional models. The Tiebout model and related models described below are metropolitan models, in the sense that they apply more to a single metropolitan area with many suburbs. In particular, they emphasize household mobility and residential housing markets, but do not endogenize wages. In contrast, regional models often replace housing markets with industrial production and emphasize competition for mobile capital, rather than mobile labor. We discuss these two types of models, income tax competition, bidding for firms, and commodity tax competition. We highlight how public expenditures are critical to the implications of these models.

3.1 Metropolitan Models: Tiebout and Property Tax Competition

We define metropolitan models as models in which residents of a metropolitan area choose where to live, based on amenities, taxes, and public services. Generally these models have an exogenous source of income. An important case is where all households work in the central business district, regardless of which suburb in which they live. Some alternative assumptions about mobility and income are discussed at the conclusion of this subsection. The first and most famous metropolitan model is that of Tiebout (1956).

3.1.1 Tiebout Models

In Tiebout models, households can costlessly move among many alternative jurisdictions. We describe a standard version where household utilities are functions of housing h , private consumption c , and a public service G (or a vector of public services). All three commodities are consumed where the household resides. Following Tiebout, the relevant tax is an efficient head tax, t . A central feature of this model is the capitalization of public services and taxes

into housing prices, as described by the price function $p(t, G)$, giving the unit price of housing for a jurisdiction with tax t and public service level G . Thus, the competitive jurisdictions are effectively “price function takers.” Following Tiebout’s original model, household incomes are treated as exogenous, so wages are not a consideration in choosing where to reside.

Given the price of housing, competitive housing producers combine land with housing capital via a constant returns to scale technology. The requirement that housing profits equal zero gives the relation between the gross, or before-tax, price of a unit of land, R , and p , which then gives the land price function, $R(t, G)$. Local governments also have access to a land tax, T per unit of land, which is chosen with G and t to maximize after-tax land value, $R(t, G) - T$. In a Tiebout equilibrium, households with different incomes and preferences for public services efficiently sort themselves across jurisdictions, so that each jurisdiction has only one type of household, and jurisdictions are indifferent about which type to attract. The head tax t is set equal to the cost of providing the public service to another consumer. If $\gamma(G, n)$ is the total public service cost, with n denoting the number of residents, then

$$t = \gamma_n, \tag{7}$$

and the land tax keeps the government budget balanced. The public service level satisfies the Samuelson rule, requiring the sum over residents of the marginal rates of substitution between public service and numéraire private consumption equal the marginal cost: $nMRS = \gamma_G$.

The standard concept of a Tiebout equilibrium assumes that there is an unlimited supply of jurisdictions, each with the same land area and production technology. Then jurisdictions are developed until the after-tax return on land drops to its exogenous opportunity cost. Subsequent research has departed from this static model and investigated the dynamics of jurisdiction formation, including political economy considerations (Barseghyan and Coate 2019). Note too that we could model the same price-taking behavior in a model with an exogenous number of jurisdictions, but this number must exceed the number of types of household types to achieve Tiebout sorting, an assumption that is violated in practice.

We can similarly model Tiebout competition for firms by assuming a public service that benefits firms, along with introducing a tax equal to the cost of providing the public service to an additional firm.⁶ A version of (7) will hold. In some models, the public service benefits are specific to capital, in which case the tax rate t becomes an efficient tax levied on capital.

⁶See Fischel (1975) and White (1975) for early extensions of the Tiebout model to include firms.

3.1.2 The Property Tax with and without Zoning

Inefficiencies often arise in models of fiscal competition because efficient head taxes are not available. The literature has focused on the use of property taxation. In the model sketched above, the property tax may be modeled as an excise tax on housing, which is equivalent to a uniform tax on the land and capital used to produce housing. Excise taxes cause deadweight losses by reducing consumption of the taxed good below its efficient level. But starting with Hamilton (1975), the “benefit view” of the property tax argues that efficient zoning rules eliminate these inefficiencies in housing consumption and turn the property tax into an efficient “user fee” for local public services; that is, each household’s property tax payment satisfies the marginal cost pricing rule. We return to this later.

While Hamilton (1975) shows how zoning can transform the property tax into an efficient head tax, numerous authors have considered the implications of property taxation in metropolitan models in the absence of zoning, including Epple and Zelenitz (1981), Hoyt (1992, 1993), Krellove (1993), and Wilson (1997). In these no-zoning metropolitan models, the property tax distorts the land and capital mix in housing. Following the metropolitan models of Hoyt (1992, 1993), both the value of land and capital used in housing are subject to the property tax, all households are homeowners and mobile among the jurisdictions in the metropolis, and the price of capital is exogenous to each jurisdiction. To highlight strategic interactions, assume a finite number of jurisdictions, each occupied by identical residents who own the housing that they consume and possess the utility function, $U(c, h, G)$, over a private good, c , housing, h , and the public service provided by the jurisdiction, G . Further assume that there are constant costs in public service production, with total public service costs equal to nG . Each jurisdiction’s utility-maximizing public service level will satisfy

$$MRS \equiv \frac{U_G}{U_c} = \left[1 - \varepsilon \frac{t \left(\hat{p} + \frac{1}{(1+t)} \right)}{1 + t\hat{p}} \right]^{-1} \equiv MCF > 1, \quad (8)$$

where t is the property tax rate, $\varepsilon > 0$ is the elasticity of housing demand, and p is the price of housing. For notational simplicity, we suppress subscripts for the jurisdiction except in places where necessary for clarity. The hat symbol denotes the percentage change. As (8) shows, the marginal cost of funds (MCF) – given by the right hand side of the expression – exceeds unity as the gross price of housing, $p(1+t)$ increases as a result of the property tax. As the number of jurisdictions goes to infinity, the property tax is full capitalized into property values ($\hat{p} = 0$) and utility maximization becomes equivalent to land-value maximization. Then (8) reduces to the formula for the optimal public service level in an economy without household mobility, where ε is multiplied by the ad valorem tax rate on property.

3.1.3 Fiscal Externalities and Tax Reaction Functions

In the absence of zoning, property taxation generates a fiscal externality. At the property tax rate satisfying (8), balanced-budget increases in the property tax rate in a jurisdiction will increase its population. Then it follows that the populations in other jurisdictions will decrease. With the public service provided by constant costs, these population changes have no direct impact on the government budget constraints in the other jurisdictions (per capita revenue is unchanged). However, the decrease in population in these jurisdictions reduces the price of housing there and, by doing so, increases resident utility – generating a positive fiscal externality. More formally, we have $dU_j/dt_i > 0$.

With the change in one jurisdiction’s tax rate changing house prices in other jurisdictions, they respond by adjusting their tax rates, that is, a tax reaction. We can get an understanding of what determines the tax reaction function by considering the effects of a tax increase in another jurisdiction j . To determine the slope of the reaction function $\partial t_i/\partial t_j$, we differentiate (8) with respect to t_j and t_i , yielding

$$\frac{\partial t_i}{\partial t_j} = \frac{\frac{dMRS_i}{dt_j} - \frac{dMCF_i}{dt_j}}{SOC_i}, \quad (9)$$

where $SOC_i < 0$ is the second-order condition.

How the MRS changes with an increase in t_j depends on how tax base per resident (ph) is affected. As the increase in t_j will decrease p_i , the tax base and public service will increase [decrease] if housing is elastic [inelastic]. With elastic housing demand and diminishing MRS , we have $dMRS_i/dt_j < 0$, with the reverse sign for inelastic housing. The effect of an increase in t_j on the marginal cost of funds is more complicated, as it depends on how an increase in t_j affects the percent change in housing prices and not on how t_j directly affects the tax base. This effect is not easily signed in general. To summarize, critical to determining the sign of $\partial t_i/\partial t_j$ is the elasticity of housing demand, how changes in the public service affect the marginal rate of substitution, and how housing prices change and affect the marginal cost of public funds in response to changes in the other jurisdiction’s taxes. As we will see, signing the slopes of reaction functions for regional models will usually be less complicated.

3.1.4 Imperfect Sorting

The literature above focused on whether public services (or inputs) are efficiently provided in models of homogeneous residents, thereby ignoring the issue of efficient Tiebout sorting. Now consider restrictions in the number of jurisdictions that preclude the attainment of perfect Tiebout sorting. Suppose, for example, that there exists a continuum of households,

distinguished only by exogenous incomes, but only a fixed and finite number of communities are available. Then an equilibrium can be described where the set of incomes is divided into intervals, and each jurisdiction is occupied only by the households with incomes in one of these intervals. See Epple, Filimon and Romer (1984, 1993) for an early model of this type, and also Calabrese, Epple and Romano (2012) for an extension to include both income differences and differences in utility functions to reflect taste differences for the public service.

As described by Calabrese, Epple and Romano (2012), households choose where to reside in the first stage of the model, with their decision based on their knowledge of the public service level and the property tax rate chosen in the second stage, using majority rule. The authors assume that voters behave myopically by ignoring household mobility. Policy choices are *not* influenced by the effects on the cross-border movement of people, firms, or factors.

An alternative approach to this myopic voting behavior is the model developed in Calabrese, Epple and Romano (2007). There are the same two stages described above, but after the second stage voting process, households can move again. The reason for including this third stage is to model the use of zoning restrictions on housing. Given the assumptions of the model, including perfect foresight, no households actually move after the equilibrium policies are chosen in stage 2. However, each household takes into account household mobility when choosing how to vote. For example, a more restrictive zoning policy will make a jurisdiction less attractive to the relatively-low-income households residing there, causing some of them to move. As these households have relatively low housing demands, the tax base per household rises when they move, whereas there is no change in the unit cost of the public service under the assumption of constant returns to scale in public service provision. As a result, public service provision rises, even if the property tax rate does not change. The median voter trades off this benefit of more restrictive zoning against the cost associated with being required to consume more than the household's optimal amount of housing.

A special feature of this model is that public policies in the form of zoning are effectively being used to reduce the number of low income residents. A similar phenomenon arises in the literature on the “race to the bottom,” whereby jurisdictions reduce welfare payments in an effort to reduce the number of low-income households. More generally, a “race to the bottom” in a tax or expenditure occurs when jurisdictional competition for mobile factors or firms reduces its equilibrium levels below the equilibrium levels in the absence of mobility.⁷ Note that this competition is a form of fiscal competition, as previously described.

Recently, Barseghyan and Coate (2016) extends the Tiebout literature by developing a

⁷Brueckner (2000*b*) writes “... a race to the bottom sometimes connotes a draconian tendency to slash welfare benefits to the bare minimum, mimicking the outcome in the least generous state. The theory, however, only points to a downward bias in benefits...” Under our definition, the slope of the reaction function is not sufficient to determine its existence.

“dynamic Tiebout model” with property taxation and zoning. In each discrete time period, existing households exit the economy with an exogenous probability, and they are replaced by new households. There are only two jurisdictions and two types of houses, large and small, and housing construction is not restricted by land scarcity.⁸ Households differ in the additional value of owning a large house. Houses are also durable in a special way: a house does not deteriorate until its value instantly drops to zero, which happens with a constant probability in each time period. Public service levels, taxes, and zoning are chosen each period, where zoning consists of requiring houses to be the large type. The model again satisfies our definition of fiscal competition, because households seek to use zoning policies to maximize the values of their homes, and home prices depend on the attractiveness of the jurisdiction to new residents. Unlike the model in Calabrese, Epple and Romano (2007), households can obtain the benefits of zoning without bearing any of the costs, because new zoning laws allow existing small houses to be “grandfathered,” rather than replaced by large houses. As a result, the authors are able to show that an equilibrium with endogenous zoning is necessarily inefficient. In fact, they numerically describe an equilibrium where all houses in the economy become large, and aggregate welfare falls below its no-zoning level.

Because individuals differ only in their housing preferences, two jurisdictions are enough to allow for perfect sorting by house sizes. There exists an exogenous zoning policy that supports an efficient equilibrium. However, the small number of jurisdictions implies that each jurisdiction has market power: zoning by one jurisdiction affects equilibrium housing prices and utilities in both jurisdictions.

3.1.5 Sources of Inefficient Fiscal Competition

In the metropolitan models reviewed above, possible reasons for inefficient fiscal competition include (1) restrictions on the number of jurisdictions, thereby resulting in imperfect sorting of the population, and (2) restrictions on available tax instruments and other policy instruments (e.g., zoning). The first point needs to be qualified because the models reviewed above have not accounted for efficiency gains to jurisdictions with heterogeneous populations. In the case of production, there might be complementary labor types. Also, models with imperfect sorting require the specification of political processes to resolve differences in preferences for taxes and public spending, and such political processes are themselves a source of inefficiencies. See, for example, our discussion of bidding for firms.

⁸Diamond (2017) shows that less elastic housing supplies increase the ability of governments to extract rents. Inelastic housing supply, driven by exogenous variation in local topography, raises local government tax revenues and causes citizens to combat rent-seeking by enacting laws limiting the power of elected officials. Barseghyan and Coate (2020) studies Ricardian Equivalence in the presence of new construction.

One other source of inefficiencies is cross-border externalities resulting from the spillover effects of public service benefits. These spillovers effects are also in the form of fiscal externalities, whereby policy changes in one jurisdiction affect the benefits of public services in other jurisdictions. Spillovers have been central to models of optimal fiscal federalism, but to better focus on local government behavior, we will largely avoid this literature.

In contrast to the metropolitan models described above, Braid (1996) and Wildasin (2014) assume that residents within the metropolis are mobile with respect to employment, but immobile with respect to their residence. In other words, there is commuting between jurisdictions. This commuting creates labor linkages across municipalities. Given that mobility is with respect to employment and not residence, the focus of these papers is business (capital) taxation. Like the metropolitan models above, the capital supply to each jurisdiction and the metropolis is perfectly elastic (price-takers). Nevertheless, a source-based capital tax does affect the tax bases for other jurisdictions, because it alters worker decisions about where to work. Other jurisdictions' tax bases are affected, implying that fiscal externalities exist. When jurisdictions are non-atomistic in the labor market, we can expect these other jurisdictions to have non-zero tax reactions.

3.2 Regional Models

In this section, we review regional models, which focus on industrial production. Unlike metropolitan models, regional models are usually characterized by endogenous wages and immobile residents/workers. For our review of fiscal competition among localities, it is preferable to allow for both capital and labor mobility, but we start with a model originally developed by Zodrow and Mieszkowski (1986) and Wilson (1986), which we denote by *ZMW*, and later show that it can be easily extended to include mobile labor.

3.2.1 A Basic Tax Competition Model

The economy contains a fixed number of jurisdictions, containing immobile residents who each supply one unit of labor. Production within a jurisdiction is described by a constant-returns production function, $F(K, L)$, where K and L are capital and labor, and firms are competitive. The after-tax unit values of these factors are w for labor and r for capital. The total supplies of capital and labor are fixed for the system of jurisdictions as a whole. Output is sold as a numéraire private consumption good, or it is purchased by the government and transformed into a public service. All households are identical, with each household possessing the same endowments of capital and labor. Utility for each household is given by $U(c, G)$, where c is private consumption and G is the local public service.

A critical assumption in this model is that jurisdictions compete for capital through their choice of a capital tax rate, which is used to finance the public service. Assuming constant returns to scale in the production of the public service, we can then write the government budget constraint as $tk = G$, where k is the capital-labor ratio and t is the unit tax rate on capital. With profits equal zero in equilibrium, the wage rate is a decreasing function of the before-tax return on capital, $\rho + t$, where ρ is the after-tax return. In equilibrium, this after-tax return adjusts to equate total capital demand to total capital supply, where the latter is fixed. Because the jurisdictions' tax rates determine jurisdictional capital demands, ρ then depends on these tax rates, which can differ in equilibrium if jurisdictions differ. In particular, a rise in one jurisdiction's tax rate will lower ρ by an amount positively related to its size. A popular assumption – and the most reasonable for the study of local policy choice – is to assume many small jurisdictions, with each treating ρ as fixed – what is referred to as “atomistic” jurisdictions. Nonetheless, we allow for any degree of market power here, since this case is more general. Jurisdictions play a Nash game in tax rates, with public service levels determined by the government budget constraints.⁹ Each jurisdiction maximizes the representative resident's welfare. The resulting equilibrium condition for a jurisdiction's public service can be written in per capita terms, equating the marginal rate of substitution between the public service and private consumption to the relevant measure of marginal cost:

$$MRS \equiv \frac{U_G}{U_c} = \frac{1 + (1 - \frac{k^*}{k}) \frac{\partial \rho}{\partial t}}{1 + \frac{t}{k} k' (1 + \frac{\partial \rho}{\partial t})} \equiv MCF, \quad (10)$$

where k^* is a resident's capital endowment and $k' = \partial k / \partial t$.

The numerator of the MCF contains terms-of-trade effects, which are present because capital and numéraire consumption are traded across regions in this model: a tax-induced fall in ρ benefits a capital-importing jurisdiction, whereas it harms a capital-exporting jurisdiction, and the marginal cost of G is reduced [increased] by any such benefit [cost].

For efficient public good provision, MCF equals one, which is the marginal resource cost of the public service. However, the denominator of MCF is less than one, because the tax-induced increase in the before-tax return on capital lowers the capital tax base, causing a loss of revenue. However, this capital outflow also represents a positive fiscal externality from the viewpoint of the entire *system* of jurisdictions, as the rise in t increases capital in

⁹The literature typically picks the tax rate as the strategic variable, but another approach would be to let public expenditures serve this role, with the tax rates adjusting to satisfy the government budget constraints. Wildasin (1988, 1991) demonstrates that for models of capital tax competition, the equilibrium depends on which strategy variable is used, but both cases yield similar qualitative results about the inefficiencies from tax competition. Hoyt (1993) makes the same comparison between the two types of equilibria, but in a metropolitan model in which a tax on residential property is used to finance the public service.

other jurisdictions. If all jurisdictions are identical, eliminating terms-of-trade effects, the result of this fiscal externality is inefficiently low tax rates and public service levels.

The fiscal externality described here is the “horizontal” type, to distinguish it from “vertical” fiscal externalities. The latter occur when the federal and local governments tax the same base, in which case a rise in a locality’s tax rate leads to less tax revenue at the federal level because the shared tax base shrinks. The reduced tax base represents a negative externality, because it lowers centrally-provided public services. Thus, it is possible for welfare-maximizing jurisdictions to set tax rates too high. Moreover, relatively small jurisdictions may actually set higher tax rates if the vertical externality sufficiently dominates the horizontal externality, because a rise in a jurisdiction’s tax rate will reduce its access to centrally-provided public services by an increasingly small amount as it becomes smaller relative to the entire economy.¹⁰ This will not happen for pure Leviathan governments, which maximize tax revenue, because they do not care about public service provision.

3.2.2 Public Service Provision with Market Power

In the context of these models, the literature also shows that introducing market power in capital markets tends raise taxes, which improves efficiency. The marginal cost of the public service declines as identical jurisdictions grow in size because a greater portion of the capital tax increase is capitalized into a lower after-tax return on capital, represented by the term $\partial\rho/\partial t < 0$. This implies that the before-tax return (measuring the cost of capital) rises by a smaller amount, muting the outflow of capital. For this reason, Hoyt (1991) shows that as the number of identical jurisdictions increases, tax competition reduces taxes and public service levels by smaller amounts. Thus, the existence of many competing local governments heightens concerns about inefficiencies.

The underprovision result is central to the tax competition literature, but it could be violated if we introduce pre-existing inefficiencies into the model. The literature has focused on the presence of self-interested government decision-makers, whose objective is to maximize either tax revenue (a “Leviathan government”) or some combination of resident utilities and a portion of public expenditures that benefits only these decision-makers. In the first case, tax competition is desirable because it “tames” the Leviathan, whereas there are reasonable conditions under which tax competition is efficient in the second case (Edwards and Keen 1996). More interesting are cases where there is no one decision-maker, but rather a political process with multiple decision-makers. Janeba and Schjelderup (2009) model each country’s legislative process and show that tax competition is welfare improving in some cases.

¹⁰See Keen and Kotsogiannis (2002) for an analysis of vertical and horizontal tax externalities.

If the only difference between jurisdictions is size, measured by number of residents, then the equilibrium tax rates will depend positively on size. The basic reason involves the capitalization effects described above. A larger region chooses to set a higher tax rate, because more of a tax increase is capitalized into the after-tax return on capital, making the capital supply less elastic with respect to the tax rate. Given the resulting tax rate differences, sufficiently small jurisdictions will import capital from larger jurisdictions, resulting in terms-of-trade effects from a tax increase. But these effects exist only because of the tax rate differences. Wilson (1991) and Bucovetsky (1991) find that in a 2-jurisdiction economy, the small jurisdiction is better off than large jurisdictions under tax competition, because its low tax rate is increasing its tax base at the expense of the large jurisdiction. Wilson (1991) finds that a sufficiently small jurisdiction will be better off than in the absence of tax competition, where lump-sum taxes on residents finance public service provision.

In practice, modeling localities as being able to change the world rate of return on capital is unreasonable. Although such an assumption is commonly made to reconcile theoretical and empirical models, atomistic jurisdictions (localities) are likely to be price-takers. But jurisdictions can face a fixed world return on capital, while still possessing market power in their ability to attract specific large firms. This possibility gets us into the heterogeneous firm literature, which is a large part of modern international trade. Space constraints preclude an in-depth discussion, but note that our conclusion that the large jurisdiction sets the higher tax rate is also found in models of tax competition with heterogeneous firms. See, in particular, Davies and Eckel (2010) and Baldwin and Okubo (2014). Competition for heterogeneous firms is related to both the tax and expenditure competition literature and the bidding-for-firms literature, so we return to it when we discuss the latter literature.

3.2.3 Residential Choice

A defining feature of localities is that labor is locally mobile. The *ZMW* model can be easily extended to allow households to choose where to reside and work, if we assume that no single jurisdiction has more than a negligible impact on ρ or household utilities. Specifically, Wilson (1995) amends the original *ZMW* model to include immobile land in the constant-returns production function, and to allow perfect mobility of labor across many price-taking jurisdictions, which may differ only in their endowments of land. As before, total factor supplies are fixed for the system of jurisdictions as a whole, and households possess identical preferences and factor endowments. Assuming constant returns to scale in the production of the public service, we can write the government budget constraint as $t(\rho k + r q) = G$, where q is land per resident, r is the net return to land, and t is a property tax on land and capital. As in Tiebout models, jurisdictions maximize the after-tax value of land. With this setup, the

equilibrium condition (10) continues to hold with $\partial\rho/\partial t = 0$, but with $e = \rho k + r q$ replacing k , and the derivative e' replacing k' . Then, we have $U_G/U_C = 1/(1 + \frac{t}{e} \frac{\partial e}{\partial t})$. As before, the tax-induced decline in a jurisdiction's tax base represents a cost from the viewpoint of the jurisdiction. However, it also represents a positive fiscal externality from the viewpoint of the entire system of jurisdictions, because the rise in t increases per capita property values in other jurisdictions. Note, however, that the assumption of many jurisdictions eliminates any strategic interactions between *pairs* of jurisdictions.

Brueckner (2000*a*) introduces Tiebout sorting into a *ZMW* model. There is no land, so instead of land-value maximization, governments maximize the excess of capital tax revenue over public service costs, which is driven to zero in the absence of constraints on jurisdiction formation. Perfect Tiebout sorting occurs: workers with a relatively high [low] willingness to pay for the public service move to jurisdictions with a high [low] public service level, a high [low] capital tax rate, and a low [high] wage. In the final equilibrium, each jurisdiction is choosing the public service level that maximizes the utility of those workers that have chosen to live there, in which case optimality condition (10) holds. But the equilibrium is inefficient, with inefficiently low public service levels and capital misallocated across jurisdictions.

This underprovision result relies on the assumption that the tax revenue is spent on public services that enter the utility functions of residents, but not the production function. In the case of public input provision, including infrastructure investment, public expenditures counteract the capital tax by drawing capital or firms into the jurisdiction. In other words, tax competition is coupled with a form of expenditure competition. Equilibrium tax and public input levels may be too high or too low, with no reason to expect one outcome or the other. Bénassy-Quéré, Goyalraja and Trannoy (2007) emphasizes the importance of the relative values of the elasticities of capital with respect to the tax rate and public input level, and concludes that the tax elasticity is significantly larger than the public input elasticity, suggesting underprovision. They argue that competition for capital distorts the composition of public expenditures towards too much public input expenditures and too little expenditures that are directly valued by households, not firms, an insight originally developed by Keen and Marchand (1997).

The Bucovetsky (2005) analysis of public input competition is particularly noteworthy for our review because skilled labor is the mobile factor, in contrast to the assumption of fixed labor and mobile capital (though unskilled labor is still treated as fixed). Moreover, a major feature of his model is external economies of scale, modeled by assuming that the output of each “differentiated product” depends on the total amount of skilled labor in the jurisdiction. As we shall see, the recent literature on bidding for firms emphasizes the importance of such scale economies for the benefits obtained from attracting a large firm.

Another distinguishing feature is that tax competition is not an issue here, because lump-sum taxes are effectively available to finance the public input. Nevertheless, the equilibrium may involve too much or too little public input provision in each jurisdiction, relative to the efficient amount, depending on parameter values. A new result here, reflecting the scale economies assumption, is that it is possible for the equilibrium to be asymmetric, with not all jurisdictions producing the public input, although all jurisdictions are the same. Although such asymmetries are efficient in some cases, Bucovetsky (2005) identifies possible equilibria where too many jurisdictions produce the public input.

3.2.4 Reaction Functions

We now examine the reaction functions in the *ZMW* model. As with metropolitan models, the slope of *i*'s reaction function, $\partial t_i / \partial t_j$, is ambiguous in its sign. On the one hand, a rise in t_j can be expected to reduce the marginal benefit of the public service in *i*, U_G / U_C , because it leads to a lower equilibrium after-tax return ρ , causing *i*'s capital tax base to expand. By itself, this effect tends to increase *i*'s optimal public service level. However, the *MCF* in (10) may also fall. For example, if the derivative k' is constant, as would be the case if the relation between output and capital is described by a quadratic production function, then $d\rho / dt_i$ is constant, and an increase in t_j increases the denominator of *MCF*, while reducing the numerator, through its positive effect on k_i . However, if jurisdictions are atomistic with respect to the capital market, as most realistic for local governments, there are no tax reactions, that is, $\partial t_i / \partial t_j = 0$.

While the slopes of reaction functions have been studied extensively in the empirical literature, note that they tell us *nothing* about the welfare effects of tax competition nor the existence of the race to the bottom. That depends on the fiscal externalities associated with tax competition, which are not related to reaction function slopes. This is an important point that is often misunderstood in the literature. We further discuss this distinction when describing empirical work on reaction functions.

3.2.5 Summary

The class of regional models discussed above have limited applicability for three reasons. First, capital is increasingly mobile internationally, so the federal system should be treated as an open economy. In fact, a useful assumption is that the federal system does not significantly influence the world rate of return on capital. Second, although we did discuss models with mobile labor and capital, the regional models do not include key features of metropolitan areas, including household choices of not only where to reside but also possibly a different

choice of where to work (commuting). These features will be included in our synthesis model.

Third, the inefficiencies from tax competition result from a capital tax that is clearly inferior to a head tax, which would appear to be feasible within the context of the basic model. Tax competition models with multiple tax instruments do exist in the literature. For example, Bucovetsky and Wilson (1991) analyzes labor and capital taxes in a variant of the *ZMW* model that includes labor-leisure decisions, and Gugl and Zodrow (2019) analyze source-based capital taxes and taxes on production in a model where the public service enters the production function. But these papers still do not consider the full range of possible tax instruments, including head taxes. Again, our synthesis model attempts to extend the set of tax instruments. As we shall see, empirical work typically focuses on a single tax instrument, or an aggregate of multiple tax instruments, an issue we address below. Ideally, restrictions on tax instruments should be endogenized, perhaps using a political economy approach. One literature that deals more satisfactorily with restrictions on tax instruments is the literature on competitive income taxation, because restrictions to an income tax arise from the informational assumptions: governments wish to redistribute income but they do not know the “skills” of different workers. We next discuss this literature.

3.3 Competitive Income Taxation

A separate literature has developed on competitive income taxation.¹¹ This literature falls under the topic of tax competition, because governments are typically viewed as competing for high-income residents by reducing their tax burdens, in an effort to obtain more tax revenue. Similarly, governments have an incentive to reduce the income subsidies provided to low-income residents, in an effort to discourage them from residing in their jurisdictions. The models are mainly based on the Mirrlees (1971) model of optimal income taxation, under which the income tax is used to finance public services and redistribute income, with the goal of maximizing a social welfare function. The non-trivial challenge is to extend the model to an open economy and model the tax game played by independent jurisdictions.

In the Mirrlees model, workers differ according to some skill parameter, which we may take here to be an exogenous wage rate, w . Each worker supplies labor, L , and consumes a consumption good, c . Each worker chooses c and L to maximize utility, $U(c, L)$, subject to a budget constraint, $c = z - T(z)$, where $z = wL$ is before-tax income and $T(z)$ is a non-linear tax function. This tax is negative (i.e., a subsidy) for low-income workers when the tax system is used to redistribute income. In this model, the utility-maximizing income z is increasing in skill. The skill distribution is often, but not always, treated as continuous,

¹¹This section draws on material from Wilson (2015 *a, b*).

with the density function converging to zero as the skill level goes to infinity.

An important departure of this literature from the regional models reviewed above is the assumption of a linear technology, where there are no fixed factors that produce diminishing marginal utility of labor. Instead, the models of competitive income taxation assume heterogeneous mobility costs, which limit the migration of workers to any particular jurisdiction.

In a closed economy, or an economy with a unitary government, the optimal tax system maximizes a function of all workers' utilities, such as the sum of utilities. Unlike a unitary government, lower-level governments that independently choose to redistribute income via an income tax must contend with the migration effects of this redistribution. A central message from this literature is the importance of mobility costs. For an income tax used only to redistribute income, Bierbrauer, Brett and Weymark (2013) show that, without mobility costs, competition for the most highly-skilled workers becomes so intense that no jurisdiction taxes them in equilibrium. There is an additional race-to-the-bottom result in this model, where competition to prevent the lowest-skilled workers from moving to the jurisdiction results in the subsidies they receive going to zero. But with mobility costs, redistribution becomes possible, and the equilibrium nonlinear income taxes independently chosen by jurisdictions have now been extensively studied in this case.

3.3.1 The Semi-Elasticity of Migration

Another important message is that optimal marginal tax rates depend negatively on the “semi-elasticity of migration.” For workers with a given skill w , this elasticity is defined as the percentage increase in their number (mass) in the jurisdiction from a dollar increase their consumption c (after-tax income). The basic idea is as follows: Suppose that we decrease the marginal tax rate at incomes earned by workers in some skill interval, $[w, w + dw]$. Then consumption c rises by the same amount at skill levels above $w + dw$. Choose the reform to raise c by $dc = 1$. Then the percentage change in the number of taxpayers at each of these skill levels equals the semi-elasticity, $\eta(w')$ at skill w' in the given jurisdiction. Normalizing the residential population to equal one, and letting f denote the density function over skills in this jurisdiction, we can then let $\eta(w')f(w')$ represent the change in the number of residents at skill w' . We can then multiply this change by each type- w' worker's tax payments, $T(z(w'))$, to obtain the effect of this migration on tax payments by these workers. Integrating these changes from w' to the top skill level, \bar{w} , then gives the total change in tax payments from the total change in the number of residents. This enters the numerator of the optimal marginal tax formula presented by Lehmann, Simula and Trannoy (2014) for the marginal tax on a

type- w worker's income $z(w)$, denoted $\tau(w)$:

$$\frac{\tau(w)}{1 - \tau(w)} = \frac{\alpha(w)}{\epsilon(w)} \frac{\int_w^{\bar{w}} [1 - \eta(w')T(z(w'))] f(w')dw'}{wf(w)}, \quad (11)$$

where $\epsilon(w)$ is the elasticity of a type- w worker's labor supply with respect to $1 - \tau$, and $\alpha(w)$ is the elasticity of $z(w)$ with respect to w .¹² This formula can be re-expressed by replacing the semi-elasticity with the elasticity, ηc , and multiplying it by T/c , which is tax payments as a share of after-tax income, both of which are unit free.

The main message to emerge is that there is too little redistribution from the viewpoint of the system of jurisdictions as a whole. The basic argument is that the migration created by a more progressive tax system in one jurisdiction raises welfare in other jurisdictions, representing a positive externality. But Gordon and Cullen (2012) qualifies this message: jurisdictional governments may engage in excessive income redistribution if the federal government is levying an income tax, but is not optimizing its tax schedule. Suppose, for example, that the federal government were to choose the tax system that is optimal for a unitary government, ignoring income redistribution at the jurisdictional level. Then, there would be no role for jurisdictional income taxation in the Gordon and Cullen (2012) model.¹³ But jurisdictional governments will nevertheless choose to redistribute income via the non-linear income tax, resulting in excess redistribution for the system as a whole. The problem stems from the presence of vertical externalities. A jurisdiction essentially ignores the fact that its redistribution activities will impact other jurisdictions through changes in the federal tax schedule needed to satisfy the government budget constraint.

A comparison of the closed- and open-economy rules for optimal marginal tax rates suggests that migration lowers marginal tax rates at all incomes, leading to a less progressive tax structure. This issue has been studied extensively by Blumkin, Sadka and Shem-Tov (2015), Wilson, Ye and Zhang (2015), and Lehmann, Simula and Trannoy (2014). A major focus of this literature is on the asymptotic marginal tax rate; that is, the value to which the marginal tax rate eventually converges as incomes rise. These papers present conditions under which the asymptotic marginal tax rate is zero, in contrast to the U-shaped marginal tax schedules found for a closed economy. But the main condition is that the semi-elasticity of migration is constant across incomes. Unlike a closed economy, negative marginal tax rates

¹²Lehmann, Simula and Trannoy (2014) assume a Rawlsian welfare function, but the semi-elasticities similarly enter the formula presented by Gordon and Cullen (2012) for a model where each jurisdiction maximizes a welfare function that includes the utilities of all initial residents.

¹³They assume that all revenue is used to finance poll subsidies, but they also discuss the case where the federal and state governments finance expenditures that are not perfect substitutes, in which case the division of tax revenue between the two levels of government matters.

are possible when the semi-elasticity rises with skill w . But if the semi-elasticity falls with w , the marginal tax rate stays positive, and migration may have only small effects on its value at high incomes. In particular, Lehmann, Simula and Trannoy (2014) present calculations where the asymptotic marginal tax rate is 61.5 percent, whereas Diamond and Saez (2011) calculate an asymptotic rate of 73 percent for a closed economy.¹⁴ Unfortunately, there is not much empirical evidence on how the semi-elasticity varies with income, but the evidence in Schmidheiny and Slotwinski (2018) seems at odds with falling semi-elasticities.

3.3.2 Future Directions

One short-coming of this literature is that an actual simultaneous-move Nash equilibrium for jurisdictions is not modeled, as defined in the usual sense. In particular, it is typically assumed that each jurisdiction maximizes welfare, given the other jurisdiction’s entire tax policy. Piaser (2007) recognizes the shortcoming inherent in this approach, noting, “a government does not anticipate that after a deviation from equilibrium, the policy of the other government could not be sustainable...” Stated differently, it cannot be true that when one jurisdiction changes its tax policy, there will be no change in the other jurisdictions’ tax policies, because the migration resulting from this change will throw the other jurisdictions’ budgets out of balance. A jurisdiction should recognize the balanced-budget requirement for other jurisdictions and take into account how other jurisdictions’ tax schedules change.

Recognizing the balanced-budget requirement, Wilson, Ye and Zhang (2015) assumes that the governments’ strategies are their schedules of marginal tax rates, while their poll subsidies (i.e. “guaranteed income”) adjust to satisfy the government budget constraints. Migration elasticities are effectively higher under the new approach than under the traditional approach, due to the poll subsidy adjustments necessitated by migration. These higher elasticities tend to produce a less progressive equilibrium tax system. The basic lesson here is that explicitly recognizing the need for budget balance, as is critical at the local level, will alter the migration responses to tax changes, thereby affecting equilibrium tax schedules.

The models reviewed above assume that individuals reside where they work. When commuting is introduced into the model, an immediate issue is how residents and nonresidents are treated by the tax system (Agrawal and Hoyt 2018). In the U.S., the typical state income tax imposes a tax on all income earned within the state, a source-based tax. To avoid double taxation, tax credits are provided for taxes paid on incomes earned outside the state of residence. However, some U.S. states have entered into reciprocity agreements, which turn their

¹⁴Given that Lehmann, Simula and Trannoy (2014) assume a Rawlsian welfare function, the objective is to maximize the poll subsidy. But this objective holds more generally when calculating the asymptotic marginal tax rate, because the social marginal utility of income is typically assumed to equal zero for the very high-income workers who face marginal tax rates close to this asymptotic rate.

income tax systems into residence-based taxes, with no taxation of nonresident incomes and taxation of income earned by residents outside of the state. One might conclude that where competition for nonresident workers is important, these reciprocity agreements can be used to reduce this competition.¹⁵ Rork and Wagner (2012) express this view: “states may have less incentive to engage in income tax competition with neighboring states, as nonresident workers no longer contribute to the tax base.” However, more formal work in this area is needed, recognizing that jurisdictions may compete for both residents and employment.

To conclude, the literature on competitive income taxation has highlighted the importance of migration responses in determining equilibrium income taxes. But to better narrow the possibilities, we need more empirical evidence on the semi-elasticity of migration, including how it varies with income. We will discuss the empirical evidence on tax-induced migration in Section 5.2. In addition, the literature needs to be integrated into the literature on fiscal competition, so that we can examine how localities choose between the income tax and other local taxes. Finally, the literature has struggled with the issue of how to model government objectives. More explicit political economy approaches would be useful, but the political economy of nonlinear income taxation is not yet well-developed.¹⁶ Furthermore, we need to know more about place-based redistribution policies and whether they can redistribute more efficiently than place-blind transfers (Gaubert, Kline and Yagan 2020).

3.4 Cross-border and Online Shopping Models

Another class of models, which takes seriously the spatial dimension of fiscal competition, focuses on cross-border shoppers. These models, popularized by Kanbur and Keen (1993), Trandel (1994), and Nielsen (2001), assume that pairwise strategic interactions are of fundamental importance because the tax base is locally mobile, i.e., individuals cannot cross-border shop to places other than those in reasonable driving distance. The basic model features consumers uniformly located along a line segment, with perfectly-competitive firms potentially locating everywhere. Consumers make an all-or-nothing decision whether to purchase the good at home, in which case no transport costs are incurred, or to purchase the good “abroad,” in which case the individual incurs transport costs proportional to distance. Taxes are subject to the origin principle and not the destination principle.¹⁷ Thus, the place of sale triggers tax liability and the tax-inclusive price paid depends on the place of purchase.

¹⁵Rork and Wagner (2012) note other arguments for these reciprocity agreements, such as reducing the administrative and monitoring costs associated with taxing nonresidents.

¹⁶See Bierbrauer and Boyer (2016) and Brett and Weymark (2017), but they assume immobile workers.

¹⁷Under the origin-principle, taxes are due to the jurisdiction where the sale occurs. Under the destination principle, taxes are due to the jurisdiction where consumption occurs.

Jurisdictions have market power and compete in a Nash game, and for analytical simplicity, select tax rates to maximize tax revenue. Starting from a position of equal tax rates, the larger jurisdiction has a larger tax base, which translates into a relatively smaller elasticity. Following an inverse elasticity rule, it sets a higher tax rate than the smaller jurisdiction, a result that parallels the capital tax competition literature. Note here that reaction functions slope upward under the assumption that governments maximize tax revenue.

3.4.1 Adapting the Standard Model to Local Governments

This class of models was originally designed to explain tax competition between countries. In a series of recent extensions (Agrawal 2015; Agrawal 2016; Agrawal and Wildasin 2020; Agrawal and Mardan 2019), the model has been modified to apply to the state and local setting in the United States, where towns and counties are allowed to levy local sales taxes. This modified class of models allows for several extensions necessary to consider local policies that do not apply at the national level. First, cross-border shopping may occur at more than one border, such that a local jurisdiction may experience some outflow of shoppers but also experience an inflow of shoppers at the other border. Second, accounting for the federal system, towns near state borders have an “advantage” in the tax competition game if they are on the low-tax side of the state border relative to those on the high-tax side of the state border. Third, consumers purchase multiple goods with more-specialized goods only available for purchase at a point of retail agglomeration (retail shopping center), but with less-specialized goods purchased locally. Finally, both the origin and destination principle coexist in the U.S. system, due to sales and use taxes. With the first two modifications, if all jurisdictions are identical in size, towns on the low-tax side of a border set higher tax rates than towns on the high-tax side, and tax rates exhibit smooth spatial gradients moving away from the border. As a result of the third modification, taxes in the agglomerated jurisdiction increase with the extent of agglomeration as retail centers allow the jurisdictions to extract taxable rents – a result consistent with the literature showing that firms in agglomerated sectors are less responsive to taxation (Brühlhart, Jametti and Schmidheiny 2012).

3.4.2 Online Shopping

The model can also be modified to include online shopping (Agrawal and Wildasin 2020; Agrawal and Mardan 2019). Taxation in the presence of digital products and platforms raises interesting challenges for researchers focusing on local policies. In the United States, it was widely argued that increased online shopping was eroding state and local tax revenue. Tax losses stemmed from a Supreme Court ruling, *Quill Corp. v. North Dakota*, 504 U.S. 298

(1992), whereby online vendors were not required to remit state and local sales taxes unless the firm had a physical presence in the consumer’s state. This precedent was recently overturned in *South Dakota v. Wayfair*, 585 U.S. __ (2018); states can now require vendors with significant sales or economic activity into the state to remit taxes. From a tax competition perspective, online commerce provides an interesting case study. Under the *Quill* regime, online shopping from out-of-state vendors acts as an outside option, whereby consumers can buy goods tax-free. In turn, this virtual “tax haven,” creates pressures similar to corporate tax havens, which constrain states and localities from raising their sales tax rates (Agrawal 2019) if consumers are price sensitive. Indeed, Goolsbee (2000), Einav et al. (2014) and Goolsbee, Lovenheim and Slemrod (2010) show that consumers are price sensitive: higher tax rates induce more shopping online. Increases in online shopping increase the elasticity of the tax base, putting downward pressure on tax rates. This increase in internet penetration has both a direct effect on tax rates and a strategic effect: as a jurisdiction sets a lower tax rate, other jurisdictions will also lower their tax rates.

Following the invalidation of *Quill*, these downward pressures have been reduced. The taxability of online sales now expands the tax base and would put upward pressure on tax rates relative to the *Quill* era. Even with all online sales taxable, declining costs of e-commerce may still alter the fiscal equilibria (Agrawal and Wildasin 2020). This arises because some jurisdictions have concentrations of brick and mortar stores (shopping malls) and others do not. Under *Wayfair*, declining costs of e-commerce erode the tax base of large jurisdictions: non-residents no longer drive to shopping malls and taxes on their online purchases now go to their town of residence. This effectively transfers some of the tax base from large jurisdictions to small jurisdictions, facilitating tax convergence. Thus, a decline in the cost of online shopping lowers tax rates and revenues in large jurisdictions and increases tax rates and revenues in small jurisdictions, despite tax rates being strategic complements.

3.5 Bidding for Firms

A popular and frequently criticized practice among both state and local governments is “bidding for firms”, under which jurisdictions use firm-specific subsidies and other concessions to induce a firm to locate, remain, or expand its operations within their borders. In addition to direct firm-specific subsidies, there may also be in-kind benefits such as infrastructure investment and state funds for job training. Also, various reductions in current and future taxes are often provided, including tax abatements and credits.

Three major issues addressed by this literature are: (1) Why do governments offer firm-specific subsidies, rather than simply reduce their tax rates to attract firms? (2) Does the

bidding process produce a more efficient allocation of firms across jurisdictions? (3) Do local governments “overbid” for mobile firms, and if so, why? Given that much of this literature tightly links theory and empirics, we present both theoretical and empirical results together.

One answer to the first question is that the bids represent firm-specific benefits from attracting a firm, and the tax system cannot be feasibly designed to make tax burdens vary across firms in a way that reflects these benefits. As Glaeser (2001) describes, these benefits are also location-specific, which is why bids vary across jurisdictions. An important component of these benefits may be the spillovers and agglomeration effects, which may benefit both producers and consumers. Of course, large firms are more likely to generate the larger spillovers and agglomeration benefits, which is why jurisdictions tend to bid for relatively large firms. Another component of the benefits is future tax revenue. In fact, subsidies help solve the “holdup problem,” whereby jurisdictions have an incentive to impose high taxes on firms that have already sunk their investments, so initial subsidies are offered to offset the inefficiently high taxes. See Doyle and van Wijnbergen (1994) and Wilson and Wildasin (2004). These initial subsidies often take the form of “tax holidays.”

The possible efficiency-enhancing role of bidding for firms is a theme of the early literature. This literature assumes that jurisdictions maximize resident welfare. In Black and Hoyt (1989), two jurisdictions bid for a large firm, while financing a public service with an income tax on mobile residents. The low-cost jurisdiction wins, which is efficient. King, McAfee and Welling (1993) extends the analysis to the case where both the firm and jurisdictions are uncertain about the firm’s productivity when they bid for the firm, and the firm is allowed to relocate in the second period. The firm initially locates where it generates the highest expected surplus. This model is also extended to allow identical jurisdictions to invest in productivity-enhancing infrastructure. The pure-strategy equilibrium is asymmetric: the jurisdictions choose different investment levels, but these levels are efficient.

3.5.1 Agglomeration, Trade, and Economic Geography Models

The literature on trade and economic geography analyzes welfare-improving subsidy competition for monopolistically-competitive firms. See Ottaviano and Ypersele (2005), which demonstrates that subsidy competition between two competing jurisdictions raises welfare above its level in the absence of subsidies. These subsidies are uniform across firms. The welfare gains come from the equilibrium subsidies at least partially internalizing the benefits of agglomeration described in Glaeser (2001). These benefits are related to interjurisdictional trade costs, which raise the price of traded varieties relative to local varieties.

Ossa (2019) is particularly noteworthy because it allows both capital and workers to be interjurisdictionally mobile. The market structure is monopolistic competition, and the

production of final goods requires capital, labor, land and varieties of intermediate goods. In addition, firms in Ossa (2019) benefit from being close to firms producing intermediate goods, as these goods are also cheaper. The subsidy provided to a firm is modeled as proportional to all business costs, which include labor, capital, intermediate goods, and land. Each jurisdiction has a fixed amount of land.

Rather than obtaining analytical results, Ossa (2019) instead undertakes a calibration exercise. The author exploits aggregate data – state level subsidies that hide the heterogeneity of firm-specific subsidies in the bidding literature. Nonetheless, he finds that states subsidize firms to gain at the expense of other states. The key forces (openness to trade, state size, and trade costs) are analyzed to determine the benefits of subsidies. Ossa (2019) finds that observed subsidies have a very large effect on firm location, but are closer to cooperative subsidies than to non-cooperative subsidies. In other words, his evidence again suggests that subsidy competition is welfare-improving.

Unlike Ossa (2019), Mast (2019) finds that tax breaks have very little effect on firm location decisions. To analyze local tax breaks, he studies whether jurisdictions compete more intensely when they have more competitors nearby. As a source of exogenous variation, he constructs 25 kilometer circles around the centroids of every town and calculates the number of counties within that range. He find that one more jurisdiction within that area increases the probability that a business in the town receives an exemption from 25% to 30%. He also shows that the effects of more neighbors decreases dramatically beyond 25 kilometers. He then develops a model of towns offering these tax breaks, where towns compete in an auction framework. Firms have preferences over towns, so tax breaks are not the only factor that matters. He shows that eliminating the agencies that run these tax breaks results in 85% of firms choosing the same locations in the presence and absence of tax breaks.

3.5.2 Political Economy

Another strand of the literature looks at political economy models, where politicians do not necessarily act in the best interests of their constituents. Papers by Biglaiser and Mezzetti (1997) and Raiha and Slivinski (2018) share the assumption from the yardstick competition literature that voters do not know the incumbent politician’s type, which in this case, is high- or low-ability. But attracting a mobile firm or some other investment project provides information to the voters about the incumbent’s type. In Biglaiser and Mezzetti (1997), this information arises from the incumbent’s ability to provide valuable inputs for the project. As a result, the model can generate excessive subsidies for projects, although a bidding process among multiple jurisdictions is not explicitly modeled.

Raiha and Slivinski (2018) develop a model where an investment project can help the incumbent get re-elected, although the incumbent’s “skill” has no impact on the value of a project. The authors explain the use of subsidies as the outcome of “signal jamming.” A firm’s investment increases the likelihood of a good state of nature, and the voter is unable to distinguish between good states that are primarily the result of a competent incumbent and good states that are primarily the result of a positive investment by the firm. The actual expected net benefit of the firm’s investment project is not critical for whether the incumbent offers a subsidy. Thus, the model is consistent with evidence presented below that firm-specific subsidies leave the winning jurisdiction worse off.¹⁸

Although political economy concerns are important for bidding, the literature does not have much empirical evidence on the mechanisms by which subsidy-giving may affect voting. Slattery (2020) finds that states where the governor is eligible for re-election are willing to pay substantially more for a firm than term-limited governors, all else equal. This represents a promising area for future research.

3.5.3 The Benefits of Attracting a Firm

Missing from the above models are details about the composition of the benefits obtained from attracting a large firm to a jurisdiction. We can think of two different metrics: the valuation to local politicians and the measurable economic benefits to the locality. Estimating the benefits of attracting a large firm is a complex task, because firm investment projects in a jurisdiction may create indirect benefits, particularly in the form of production externalities. Slattery (2020) presents empirical evidence that government decision-makers behave as though these externalities are important. If there were no indirect benefits, then jobs created by attracting a large firm would have an unreasonably large subsidy cost per job. Instead, much of the job creation must be viewed as coming from attracting middle-sized firms, such as suppliers of intermediate goods that are purchased by the large firm.

Slattery (2020) uses data on the subsidies provided by U.S. states to estimate a structural model in which states and their localities bid for firms. The bidding process is modeled as an English auction, because, she argues, that seems to be roughly consistent with how subsidy competition for large firms actually occurs. A firm announces its intent to expand or relocate, and states learn each others’ bids and adjust their bids accordingly until a winner is chosen. These subsidies include both discretionary and non-discretionary incentive spending by states. The outcome of this auction is equivalent to that in a second-price auction: the winning state guarantees the firm the second highest payoff. This payoff is the firm’s profit plus subsidy, denoted $\pi_{winner} + b_{winner}$. But to attract the firm, the runner-up is willing to pay

¹⁸Raiha and Slivinski (2018) consider a single jurisdiction and do not solve for the bidding equilibrium.

a subsidy equal to the external benefits generated by the firm, $v_{runner-up}$. In equilibrium, we then have the indifference condition, $\pi_{winner} + b_{winner} = \pi_{runner-up} + v_{runner-up}$. This equality is used to estimate these external benefits.

Slattery (2020) shows empirically that states use subsidies to help large firms internalize positive spillovers from indirect job creation. In turn, the subsidies have a sizable effect on firm locations – absent the subsidies, over two-thirds of firms would locate in different states. Because subsidies increase indirect job creation, Slattery (2020) finds that the total difference in welfare between the subsidy competition and no-subsidy cases is substantial. Welfare increases by about 30 percent under competition, because firms are locating where they are valued more. But she also finds that this welfare increase is more than captured by firms through the subsidies that are provided. The welfare captured by the states actually decreases by 20 percent. Moreover, she finds that political concerns affect valuations.

The efficiency gain measured by Slattery (2020) is not consistent with the literature that attempts to quantify the actual benefits a jurisdiction receives from successfully attracting a firm. Slattery and Zidar (2020) review this literature and find little evidence that these firms actually create sizable spillover effects, and little evidence that successfully attracting a firm leads to significantly greater employment and growth.¹⁹ Thus, government decision-makers appear to be overestimating benefits, or they are engaged in a political process that produces excessive subsidies. Alternatively, they are simply corrupt.

Bartik (2019) also reaches a similar, but more nuanced, conclusion. He estimates his own model and does find that a dollar of incentives produces a \$1.52 in benefits. However, he emphasizes the large uncertainties involved in this calculation, which include uncertainties about the multiplier of the jobs generated from each job directly created from attracting a new firm. He also argues that other government expenditures, including public infrastructure and skills development, yield much higher benefit-cost ratios. In particular, he argues that, “Financing incentives via public school spending cuts is not only bad for the overall state economy but also has disproportionate costs for lower-income groups.”

Bartik (2019) also addresses the question of whether subsidy competition generates significant efficiency gains for the set of jurisdictions as a whole, through facilitating the creation of agglomeration economies, for example. His conclusion is “no,” at least for subsidy incentives as they are actually designed in the U.S.

In addition to efficiency issues, there is also the question of how subsidy competition affects the distribution of regional incomes. Slattery and Zidar (2020) find that the winning and runner-up counties in competition for a firm are much larger and richer than the U.S.

¹⁹An earlier paper, Greenstone, Hornbeck and Moretti (2010), uses runner-up counties as a counterfactual for counties that won “a million dollar plant.”

average. Bartik (2019) argues the the federal government should become involved in bringing about subsidies that are more targeted to distressed counties and high-tech counties, where the latter are favored because of potential agglomeration effects.

3.5.4 Bidding Versus Tax Competition

To summarize, unlike standard tax competition models, the theoretical literature on subsidy competition for individual firms contains numerous models where competition is welfare-improving. However, empirical investigations uncover evidence of excessive subsidies, which transfer any efficiency gains to the firms. The existence of significant efficiency gains is also questionable. In general, the empirical literature offers some support for political economy models as an explanation for the subsidies provided to mobile firms.

Let us return to the issue of firm-specific subsidies versus using the tax system to compete for firms. We have argued that jurisdictions can use subsidies to target particular firms that they want to attract. But there is also a literature on using discriminatory (or “preferential”) tax regimes for a similar purpose. See Mongrain and Wilson (2017) for a recent contribution and review of the literature. In particular, jurisdictions have an incentive to set low tax rates on mobile tax bases, while imposing relatively high tax rates on relatively immobile tax bases. For example, localities in the U.S. often implement classified property tax systems, where mobile industrial property is taxed a lower effective rates than residential housing. As with the literature on bidding for firms, the theoretical literature on discriminatory tax regimes obtains mixed results about the welfare effects of the preferential tax treatment of particular types of firms or capital. In some cases, it would be desirable for the federal government to outlaw such treatment. Note the contrast here with policy recommendations by Bartik for more targeted subsidies. In any case, it would be nice to see the development of models that merge bidding for firms with tax competition, and thereby explore how the use of firm-specific subsidies affects the design of discriminatory tax systems, and visa-versa. We would want to know, for example, how restrictions on preferential tax treatment of particular types of firms affect the propensity to use firm-specific subsidies. Given the variation in what states are doing, both in the cross section and over time, it would be interesting to see how the political economy incentive for subsidy-giving distorts the tax regime.

3.6 Corporate Taxation and Regulation

States within the U.S. use a system referred to as formula apportionment, whereas federal governments use separate accounting. In the latter case, the tax is levied on a firm’s taxable profits earned within the country’s borders. But administering such a tax requires the use of

(easily manipulated) transfer prices, which value inputs and outputs that are not bought and sold on private markets, but are rather transferred by the multinational from one country to another. The transfer-pricing problem is even greater for states within the U.S., because of the preponderance of multi-state firms. U.S. states avoid this problem by taxing a fraction of a firm's total U.S. profits, where the fraction is determined by a weighted average of the share of capital, payroll and sales located in the state. The firm's tax payment to state i is then calculated by applying i 's tax rate to the share of profits allocated to state i . States are taxing a fraction of a shared base, which removes incentives to shift taxable income from one state to another. But there are now incentives to manipulate the variables in the formula through decisions about where to place capital, payroll and sales.

Formula apportionment has similarities to taxes on capital, labor and sales. In particular, raising i 's statutory tax rate t_i will tend to raise the tax-inclusive marginal cost of capital and labor usage in i , depending on the formula weights, because a greater share of the firm's total profits will be taxed by i . Similarly, the presence of sales in the formula means that a higher tax rate will raise the tax-inclusive marginal cost of sales.

Turning to tax competition, note that formula apportionment introduces interjurisdictional externalities that are not those identified under separate accounting. Rather, these externalities result from the shared tax base. Gordon and Wilson (1986) addresses the implications of these externalities, using a model in which production exhibits constant returns to scale in labor and capital, with production functions identical across states. With profits equal to zero, total tax payments equal total before-tax profits, summed across states. If taxable income equals these before-tax profits plus some fixed share of capital, due to less-than-full deductibility of capital costs, then a rise in a state's tax rate will raise taxable income if it increases total tax payments. This raises tax revenue in all states that share this tax base. Gordon and Wilson (1986) and Sorensen (2004) make this point and show that if the usual source-based capital tax in the *ZMW* model of tax competition is replaced by an apportionment-based tax on capital, then equilibrium tax rates will be lower than under source-based taxation, that is, the inefficiencies from tax competition will be larger. But this disadvantage of formula apportionment needs to be traded off against the benefits from the elimination of income-shifting activities.

Gresik (2010) explicitly models the informational asymmetries that limit a government's ability to control income shifting. In particular, firms differ in a cost parameter, which is unknown to the government, but auditing a firm's choice of transfer prices provides an unbiased but noisy signal of its true cost. If this signal is sufficiently informative, then separate accounting results in higher equilibrium taxes than under formula apportionment. This result is consistent with the view that separate accounting should be favored over

formula apportionment when the transfer price problem is not too severe.

The corporate tax systems used in the U.S. and Canada offer an interesting comparison, because Canada effectively gives firms a choice between separate accounting and formula apportionment. Mintz and Smart (2004) examine the presence of income-shifting among multi-provincial firms in Canada. In their theoretical model, income shifting is accomplished through the use of corporate debt, where one subsidiary lends to another subsidiary. Their results show that income-shifting has important effects on provincial tax bases.

A recent trend in the U.S. has been the move towards using only sales in the apportionment formula, or overweighting sales.²⁰ Capital and payroll usually receive equal weight, if any. This trend is understandable, given that weighting capital and payroll effectively tax production activities within a state, thereby discouraging investment and employment there. It is not well-understood how including sales in the formula affects tax competition. The studies reported above use capital or sales as the apportionment factor, with the justification that either provides a measure of the level of economic activity in a state. But sales can occur in a state without any production taking place there. Indeed, Gordon and Wilson (1986) show that including sales in the formula distorts where firms sell goods.

3.6.1 Regulatory Competition and Corporate Charters

We now turn to regulatory competition among states. Consider state competition for corporate chartering services. While this topic is rarely discussed in the economics literature, it has engendered a significant literature among legal scholars (Romano 1993). In particular, this competition has been criticized for being a “race to the bottom,” as well as praised for being a “race to the top.” Given this possible diversity of policies, states may be acting as laboratories for policy experimentation.

Barry and Hatfield (2012) notes that the literature on takeovers has included few formal models, or models that narrowly focus on particular aspects of the takeover market, and they attempt to fill the gap. Moreover, they do it in a way that provides some insights into why the regulation of corporations may differ across states. These regulations include the treatment of takeover defenses. One defense is a poison pill, which dilutes the acquirer’s equity investment by allowing shareholders of the target company to purchase additional shares of the target at below-market prices. No state has outlawed this defense. In addition, the target company can implement an “effective staggered board,” in which case its board seats are filled at different times, making it difficult for the acquirer to replace the entire board in a short period of time. A “race to the top” in regulations would occur if takeover defenses were highly restricted, making takeovers difficult to achieve, whereas a “race to the

²⁰See Figure 3 in Suárez Serrato and Zidar (2018).

bottom” would allow takeover defenses. The literature generally views a race to the bottom as occurring when regulations are designed to maximize the welfare of shareholders. However, Barry and Hatfield (2012) shows that a poison pill cannot reduce shareholder welfare, and will often increase it. Whereas the poison pill gives insiders some power to block takeovers, it serves as a commitment device to force the acquirer to produce a more attractive offer.

Barry and Hatfield (2012) concludes that the degree to which state regulations restrict takeover defenses can be expected to vary across states, depending on the characteristics of the firms they seek to attract. The relevant characteristics will differ across states, as the goods and services that they produce depend on differences in comparative advantage. The authors also note that nationalizing corporate law might better achieve the maximization of firm value, but that it would “remove the interstate competitive pressures that currently shape corporate law and which may be expected to produce socially optimal laws in those instances in which shareholders’ interests mirror those of society.” They also note that countries with nationalized corporation law often “insulate corporations from takeover attempt to a greater degree than U.S. states generally do”, suggesting that perhaps regulatory competition among states is preferable to national control.

3.7 Reflections

Several themes emerge from existing theories of fiscal competition. The first theme concerns the notion and nature of interjurisdictional fiscal externalities. The literature identifies conditions under which they are positive, and also when they might be negative, such as with the existence of public inputs. The link between the existence and sign of these fiscal externalities and whether public expenditures in equilibrium are under- or over-provided is well-understood. While much of the early theoretical literature on fiscal competition focuses on equilibrium policies, these models also provide conditions for understanding the magnitude and sign of tax reaction functions. Critically, the “market power” of jurisdictions, that is, their share of the mobile tax base, influences the magnitude of these tax reactions. Policy choices of an atomistic jurisdiction, whose policies will not affect the returns on mobile resources, cannot generate tax reactions by other atomistic competitors.

The focus on tax reactions in the theoretical literature informs an extensive empirical literature examining the existence, sign, and magnitude of these policy interactions. In contrast, the extensive focus of the theoretical literature on welfare considerations, specifically whether public services are efficiently provided, has little parallel in the existing empirical literature: there is scant evidence on whether public services are under- or overprovided, and by how much. In these models, tax base mobility is key to the magnitude of tax reactions

and the inefficiency in public services. While there is an extensive research, reviewed in Section 5, on the mobility on individuals and firms, the link between these estimated mobility elasticities and their implications for optimal decentralization needs further exploration.

There are a number of important open questions that future models of fiscal competition might address. One question not sufficiently studied in either theory or empirics is how governments interact when able to use multiple taxing instruments, as they indeed do, and the role and valuation of public spending in these interactions. Further modeling of multiple policy choices will give insights into how governments should optimally set a menu of policies.

As our review suggests, the literatures on tax competition and “bidding for firms” are distinct. Yet, balanced-budget considerations suggest that these are simultaneous and linked decisions – extending subsidies for single firms will likely increase general tax rates and decrease the tax base. Insights into the extent of tax competition and the mobility of the tax base might shed light on when and if subsidizing individual firms is efficacious for a jurisdiction. Moreover, the political economy of these decisions needs further study.

While there is a nascent literature on dynamic tax competition, much of this literature focuses on the dynamics of the tax base (Wildasin 2011). We need to better understand the dynamic patterns of policies and how governments respond over time to shocks.

4 Theory of Competition and Growth

How decentralization affects growth was first addressed with a focus on developing countries. Oates (1993) notes the striking difference in the extent of decentralization between industrialized and developing countries, measured by a number of fiscal measures. He reasons that the local determination of public services and infrastructure is likely to be more efficient than a centralized determination, and hence provides more stimulus for growth.

While limited, a theoretical literature comparing growth rates between a single central government and a decentralized system has emerged. This literature can be further separated into one that highlights population sorting by household preferences and another, including tax competition, that considers how differences in tax outcomes between centralized and decentralized systems affect capital growth. We discuss both in this section and return to empirical implications in Section 5.

4.1 Models with Household Sorting

Whereas static Tiebout models emphasize the efficiency gains from sorting, dynamic models emphasize the effects of sorting and competition on economic growth. For example,

Brueckner (1999) constructs an overlapping-generations model where the young and old sort themselves into separate jurisdictions under fiscal federalism, whereas they receive a common public service level under a unitary system. If the young have a lower demand for the public service than the old, then moving to fiscal federalism will lead to lower public service provision and lower taxes for the young, giving them more income for saving. Under reasonable assumptions about household preferences, fiscal federalism leads to more capital per worker in the steady state, and therefore higher wages. But the results can be reversed in other cases, including where the young have greater demands for the public service. Brueckner (2006) instead uses an endogenous growth model, where young workers divide their time endowment between work and education, whereas old workers devote their entire time endowment to work. The main result here is that capital and education per worker are both higher in the federalist equilibrium, and the economy grows faster under federalism than in the unitary case, as steady state growth depends positively on education. The basic idea is that the young want a lower public service level than the old, in order to obtain more income to invest in physical and human capital. Under a unitary system, they reduce their saving, and equilibrium is restored by declines in both physical and human capital.

Other models explicitly consider the public provision of education, financed by local taxes. A theme of this literature is that Tiebout sorting may be detrimental to human capital development and growth. In particular, an individual's human capital development might be enhanced by residing in a jurisdiction containing high-income families, due to positive peer-group effects. Also, low-income families might have access to better schools by residing in high-income jurisdictions. We might argue that there is too little heterogeneity within jurisdictions, at least according to a concept of second-best efficiency. Bénabou (1993), for example, describes equilibria where high-skilled and low-skilled workers obtain their skills in different jurisdictions, and as a result, the productive labor force is cut in half. Complementarity of skills is central to his analysis. When the high-skilled move away from the low-skilled, the costs of becoming low-skilled rise, reducing the number of low-skilled, which lowers the productivity of high-skilled workers and thereby also leads to a reduction in their numbers. Evidently, segregating high- and low-skilled workers can be quite damaging. While this model is static, there exists a large literature on dynamic models of residential sorting across jurisdictions in metropolitan areas. See Durlauf (1994) for a review. He presents a stochastic overlapping-generations model that synthesizes previous work in the area. A focus here is on the adverse distributional consequences of isolating poor and rich households in different jurisdictions, including the emergence of poverty traps. This isolation can incur endogenously, and the use of zoning can facilitate its occurrence. Bénabou (1996) uses an overlapping-generations model to show that the rate of economic growth can be

increased by mixing low- and high-human capital families in the same jurisdictions.

4.2 Growth Models with Mobile Capital

We now turn to growth models with competition for mobile capital. Gross (2014) embeds the neoclassical growth model into a 2-country model of competition for capital, where identical individuals are infinitely-lived and receive utility from consumption and leisure in each period. Governments are able to commit to both labor and capital tax rates in all future (discrete) periods. These taxes finance exogenous expenditures in each period that converge to some constant amount. But there is also government debt, so tax revenue need not equal expenditures in each period. Given the assumption of policy commitment, the two governments are playing a one-shot, non-cooperative game. The main result is that equilibrium steady-state capital taxes are zero. Furthermore, this result generalizes to allow for multiple differences between countries. Gross (2014) emphasizes that this is not a race-to-the-bottom implication of tax competition, because the same result holds when a central government chooses identical policies for each country: the optimal tax policies satisfy the Chamley-Judd result of zero steady-state capital taxes in a closed economy.²¹

Gross, Klein and Makris (2020*a*) extends Gross (2014) by also exploring the short-run effects of tax competition on the path to the steady state. Numerical analysis is now required to analyze this path. Off the steady state, an increase in a country's tax rate now creates a saving externality: the decline in its saving leads to lower future capital stocks for all countries. This externality is also present in simple 2-period tax competition models with saving. But Gross, Klein and Makris (2020*a*) find in their numerical work that the "net externality," taking into account both the saving externality and the horizontal tax externality, is positive in the short run but converges to zero in the long run. Although tax competition lowers capital taxes in the short-run, the effect turns positive in the median run, relative to a closed economy, resulting in capital taxes that may be too high, rather than too low.²²

Hatfield (2015) uses an endogenous growth model that allows him to compare growth rates under centralized and decentralized government systems. All jurisdictions are identical, and output is a function of a public service, capital and labor. Only capital is mobile across jurisdictions, and immobile workers all provide one unit of labor but differ in initial capital

²¹Straub and Werning (2020) provide a recent assessment of this result, including cases where it does not hold, and also limitations on its usefulness.

²²Gross, Klein and Makris (2020*b*) shows that if residence-based capital taxes are available, then the fiscal externality of source-based capital taxes disappears. Moreover, even though residence-based taxes are distortionary and capital markets are globally shared, the policy for sufficiently symmetric open economies is identical in all time periods to that in a closed economy. This analysis extends the results in the 2-period Bucovetsky and Wilson (1991) model to an infinite horizon setting.

endowments. The public service is financed by time-invariant taxes on labor and capital, which are chosen by majority rule. In equilibrium, wages and capital grow at the same rate, in which case the public service also grows at this rate. Moreover, the growth rate of capital is positively related to the after-tax return on capital.

Under decentralization, each jurisdiction chooses its own taxes. But a form of Bertrand competition occurs, because the Cobb-Douglas specification of the production function implies constant returns to scale in the public service and capital. With the public service linear in capital, output is effectively linear in capital. Jurisdictions then compete for capital by attempting to offer the highest after-tax return. In equilibrium, this after-tax return, and therefore the growth rate of capital and output, is maximized. In contrast, no such competition for capital exists under a centralized system, where a single tax policy applies to all jurisdictions. Instead, majority voting produces a system where growth is not maximized.²³

Another issue is portfolio diversification, which is not present in the perfect-foresight models reviewed above. Using a dynamic stochastic version of the *ZMW* model, Koethenbuerger and Lockwood (2010) model region-specific output “shocks” that affect the return to capital invested in that region. These shocks give households an incentive to diversify their investments across all jurisdictions. This creates a negative fiscal externality: a tax rate increase in one jurisdiction reduces the returns received by “foreign” investors in that jurisdiction. This externality, along with the standard positive externality from horizontal tax competition, creates an indeterminate fiscal externality, and an indeterminacy in whether decentralization results in higher or lower tax rates. Higher tax rates under decentralization are more likely with fewer jurisdictions and reductions in stochastic shocks to productivity.

4.3 Key Lessons

To conclude, the Tiebout-based models developed by Brueckner make the important point that Tiebout sorting can lead to greater capital per worker and higher economic growth, but they are based on sorting by young and old workers. Important efficiency benefits can be obtained by locating high- and low-income households in the same jurisdiction. Our review of growth models with capital mobility and tax competition finds that capital taxation can be limited by tax competition, with the rate of capital and output growth actually maximized in the endogenous growth model analyzed by Hatfield (2015). Decentralization does not affect steady-state growth in a neoclassical growth model, but there are interesting effects on the path to the steady state, including the possibility that that capital taxes can be too high in the “medium run”, due to an interjurisdictional saving externality.

²³Hatfield observes, however, that welfare-maximizing policies typically differ from growth-maximizing policies, depending on the initial distribution of wealth.

The empirical relevance of models of decentralization and growth is hampered by the standard assumption that governments can commit to future taxes. If commitment is not possible, then the above result that capital taxes equal zero in the steady state will not hold. Intuitively, the basic problem is that at each point in time, governments have an incentive to positively tax old capital, which is the outcome of past investment decisions, although new investment is distorted. But tax competition with mobile capital limits excessive taxation. A good example is Quadrini (2005), where the introduction of capital mobility leads to an immediate reduction in effective capital tax rates when two competing jurisdictions set their tax policies non-cooperatively.

5 Evidence: Decentralization, Growth, and Mobility

Although the prior theoretical analysis has highlighted the mechanisms underlying local policy choices, it is important to empirically study the economic effects of policies. Here, we focus on studies that provide empirical evidence on the possible effects local policy choices on growth and mobility, which might be consistent with tax competition, spillover, or sorting models; critical to our review is the mobility of the policy base. When discussing mobility, this could include mobile firms or factors, or in the case of people, migration. Spillovers are explicitly addressed in the appendix, using the example of regulatory policies and pollution.

5.1 Growth

In addition to the mechanisms discussed in Section 4, it has been argued that decentralization increases corruption and thus diminishes growth, and also that extreme fragmentation reduces economies of scale and administrative capacity, also lowering growth (Grossman, Pierskalla and Dean 2017). This theoretical debate implies the need for empirical work.

It is useful understand the identification challenges in the literature attempting to study the effects of decentralization on economic outcomes, including growth. In particular, the early cross-country literature is now broadly considered as uninformative. Rodden (2004) provides an excellent survey of cross-national fiscal decentralization, discussing its limitations and pitfalls. Specifically, the literature has missed important details concerning the measurement of differences in decentralization across countries. But more refined data that pays attention to institutional differences are difficult to collect. Ebel and Yilmatz (2002, 2003) also document the difficulty of measuring fiscal decentralization and using cross-national data to document the relationship between fiscal decentralization and macroeconomic outcomes. Much of this prior literature is sensitive to the variables used to define fiscal decentralization.

Given that fiscal decentralization is multifaceted and institution-specific, the uni-dimensional measures of fiscal decentralization in the early empirical literature are of limited value.

In this early literature, Davoodi and Zou (1998) use panel data on countries to identify a negative relationship between fiscal decentralization and economic growth. In contrast, Iimi (2005) finds a positive effect of decentralization on per capita growth. Xie, Zou and Davoodi (1999) use cross-state data and find that spending shares for state and local government are consistent with the growth-maximizing level, which implies further decentralization would be harmful for growth. Stansel (2005) uses data on U.S. metro areas to identify a positive relationship between the number of municipalities per capita and economic growth.

Against this backdrop, we turn to the recent literature, which has exploited cross-sectional variation in subnational policies, and more recently, panel data or quasi-experimental designs. As Rodden (2004) suggests, the subnational literature must grapple with the advantage of having a nationally-representative dataset with richer variation and stronger external validity, which has a cost of ignoring many important state-specific institutional features.

One important example of this new literature is Hatfield and Kosec (2013), which studies the effect of the number of governments (and thus interjurisdictional competition and decentralization) on income growth. The authors conclude that doubling the number of governments increases income growth of per worker earnings by 17%. Half of this effect is driven by changes in the composition of the workforce, and the other half is due to increases in worker productivity. Related, more interjurisdictional competition leads governments to raise more tax revenue and to spend more, but the added cost from higher expenditures is smaller than the increase in wages for the median worker.

Critical to the evolution of the literature is the focus on causal identification. Hatfield and Kosec (2013) regresses Metropolitan Statistical Area (MSA) growth rates on the number of competing jurisdictions in the MSA, other controls, and fixed effects. This specification suffers from an omitted variable bias and/or reverse causality, resulting from the possibility that interjurisdictional competition might also respond to economic growth. To deal with this, the authors instrument for the number of jurisdictions in an MSA with the length of small streams in the MSA. The relevance of small streams arises from the historical importance of waterways for boundary formation: streams provided easy-to-reference focal points in the 1800s. The exclusion restriction requires that the number of small streams does not affect growth directly, which is why the authors exclude major streams and man-made canals. Although miles of small streams may be predetermined, they may still not be exogenous, because they could be correlated with other variables. For this reason, the authors add additional controls that demonstrate invariance of the coefficient of interest.²⁴

²⁴Hatfield and Kosec (2018) considers a related question: does having more jurisdictions reduce or improve

In addition to economic growth effects, Greenstone, Hornbeck and Moretti (2010) and Slattery and Zidar (2020) study the effect of bidding for firms on economic outcomes or employment outcomes. See Section 3.5. Finally, we discuss the economic effects of place-based policies in the appendix.

5.2 Migration and Mobility

Local policies have important effects on residential migration, mobility of employment, and the movement of firms, factors and shoppers. Given that survey articles on these topics exist (e.g., Kleven et al. 2020), we highlight results from this literature that are important for identification of the mechanisms of local policy choice. Critically, Kleven et al. (2020) stresses that mobility elasticities (and other extensive margin elasticities) are not structural parameters and therefore cannot be extended to different subsets of the population or different-sized jurisdictions. In particular, extensive margin elasticities correspond to the share of pivotal individuals in the population. Once indifferent individuals migrate, the new set of indifferent individuals may be less numerous than the previous. Furthermore, as noted in Piketty and Saez (2013), the mobility elasticity is decreasing to zero as the number of jurisdictions in the world falls from infinite to one. Even when focusing on local mobility, the elasticities may be very different for different income groups or sizes of localities. Given that the mobility elasticity depends on the size of the jurisdiction, the optimal tax rates in a standard tax competition model where size matters, such as Kanbur and Keen (1993) can be rationalized.

The existence of interjurisdictional competition depends in part on whether governments have access to instruments that target specific populations. In the context of income taxes, this may be a progressive tax rate that can target high-income earners. As local income taxes in the United States are often flat taxes, this is not possible, but in countries such as Switzerland, local progressivity in income taxes can arise, making targeting of specific populations by state and local governments possible.

5.2.1 Migration Responses to Income Taxes

The literature on migration responses to taxes at the state and local level find both large and small elasticities (Agrawal and Foremny 2019; Epple and Romer 1991; Milligan and Smart 2019; Moretti and Wilson 2017; Schmidheiny 2006; Schmidheiny and Slotwinski 2018; Young et al. 2016). In particular, the largest mobility elasticities are among subsets of the population that are, ex ante, expected to be highly mobile due to the nature of their jobs or

environmental quality by triggering either a race to the bottom or race to the top? The authors show that more local governments leads to lower air quality and higher pollutants.

moving costs. Mobility estimates for the full population of all taxpayers are much smaller, and many localities in the United States do not have access to preferential tax rates for highly mobile individuals. Consequently, the extent of tax competition on local income taxes might be mitigated. At the same time, low-income households may not move in response to taxes, but may be mobile with respect to policies on the spending side, such as welfare benefits (Brown and Oates 1987; McKinnish 2007; Brueckner 2000*b*). Indeed, the mobility response is critically linked to whether an individual is a net beneficiary of public services relative to taxes paid. Consider the case where taxes increase at the top of the income distribution, but any spending adjustment predominantly benefits lower income households. Then, high income individuals are most likely to migrate in response to tax policies because they are net payers into the fiscal system, while low-income households are most likely to be mobile in response to spending policies because they are net recipients. As a result, low-income households might prefer to live in high-tax regions if the benefits are valued more. Other local policies such as rent control, may lower mobility (Diamond, McQuade and Qian 2019).

5.2.2 Firm Mobility In Response to Corporate Taxes

Of course, mobility of the tax base is not confined to individuals. Increases in corporate taxes do not increase business public services one-for-one because corporate tax revenues finance both business public services and public services for residents. Thus, the corporation may find it profitable to reoptimize its location decision.²⁵ Giroud and Rauh (2019) estimates an elasticity with respect to corporate taxes of the number of establishments of -0.5. When focusing on the response to personal income tax rates for pass-through entities, they find an estimate of -0.4. Convincingly, this latter group, which is not subject to corporate taxes, does not respond to corporate taxes. Similar patterns exist for the mobility of capital, and the results are largest for tradeable footloose industries. Giroud and Rauh (2019) use micro data and find smaller estimates than in Suárez Serrato and Zidar (2016), in part because of the time horizon they consider, and because the identification strategy allows Giroud and Rauh (2019) to control for state-level economic variation that is correlated with, but not caused by, state variation in taxes. In contrast to studies using national-level data (Mertens and Ravn 2013), the estimates are larger.

²⁵When not controlling for public services, elasticity estimates must be interpreted as the the effect of taxes on mobility after allowing for endogenous changes in public services. Similar to the income tax literature (Moretti and Wilson 2017), if higher taxes result in increases in public services, then the estimates are a lower bound of the effect of taxes holding constant public services.

5.2.3 Cross-border Shopping and Commodity Taxes

An empirical literature shows cross-border shopping is an important means of commodity tax avoidance – consistent with the theoretical models discussed previously. For example, Merriman (2010) and Lovenheim (2008) show that individuals near borders obtain low-tax cigarettes in nearby jurisdictions. Although home state *sales* fall in response to the home state’s tax rate, on average, total cigarette *consumption* is unchanged because of the close proximity of many individuals to a low-tax border. Individuals are also responsive to gas tax differentials (Doyle and Samphantharak 2008), retail sales tax differentials (Baker, Johnson and Kueng 2020) and regulatory policy differences (Hansen, Miller and Weber 2020).

5.2.4 Location Decisions and Regulatory Policies

Non-tax policies, such as regulatory policies, may also affect the location of firms.²⁶ Holmes (1998) considers the effect of pro-business and anti-business policies on economic activities. His approach, common in several other studies, is to compare counties that straddle a state border. Holmes (1998) shows, theoretically and empirically, that when adjacent states adopt different policies, a sharp discontinuity in manufacturing activity occurs at the state border, with extra activity on the pro-business side. While Holmes’ model is static, it can be extended to a dynamic context with state dependence.

5.3 Reflections

A key contribution of this empirical literature is the estimation of credible mobility elasticities, spillover effects, and economic effects in the presence of decentralization. However, a tight link between these reduced-form effects and theoretical models remains elusive. As a central tenant in public economics is that redistribution lies in the domain of the federal government, a tighter link with theory is necessary to make critical welfare implications. Are these mobility elasticities consistent with local governments being unable to engage in redistribution? Moreover, much of the literature focuses on the own-tax rate effect on growth or mobility. Nonetheless, if fiscal competition exists, mobility responses depend not just on the own-policy rates, but on the full vector of competitor policies. More work needs to be done on estimating the effects of competitor jurisdictions’ policies on mobility, especially in areas where governments may have market power due to commuting.

This leads us to questions of optimal decentralization. When is decentralization optimal, and what powers should be granted to local governments? Many policymakers have long

²⁶The environmental policy literature has reached varying conclusions with respect to the effect of regulatory policies on new firm births and firm location decisions (Jaffe et al. 1995).

advocated for more decentralization in low-income countries as a means to spur growth and possibly reduce corruption. Yet, our empirical understanding of local policy choice is mainly limited to high-income countries such as the U.S., Canada, Switzerland, and Germany. Many developing countries have decentralized tax and spending systems, and more work needs to be done to understand how decentralization affects economic outcomes in these countries. Moreover, tax competition and spillovers among localities in developing countries may be different due to tax evasion and the informal economy. Mobility due to movements of the tax base, information flows, and spillovers may be very different in such a settings.

6 States and Federal Government Interventions

Local governments operate in a constrained environment. In the United States, the Court decision in *Clinton v. Cedar Rapids and the Missouri River Railroad*, 24 Iowa 455 (1868), led to Dillon's rule, which implies that localities receive their authority to set policy only because the states allow localities to have this authority. For this reason, if the state wishes, it may also limit the powers of local governments. These limitations often take various forms. For example, states may grant or prohibit the use of certain tax instruments. Absent an outright ban on taxing authority, states may also impose minimum or maximum tax rate requirements. States not only impose restrictions on rates, but they also impose restrictions on the tax base. Many states require localities to cohabit the same tax base. These restrictions have interesting theoretical implications, and are discussed here, because they will provide arguably exogenous sources of identification for empirical analysis.

Federal governments also intervene in a variety of ways to alter the decision-making and outcomes of lower-level governments. Interventions include restrictions on the use of government debt; various regulations, including how local public expenditure policies are designed and implemented; and intergovernmental grants, which are often designed to elicit particular behavioral responses from local governments (e.g., matching grants). This literature is vast and related to the issue of how to optimally design a fiscal system, including the division of governmental responsibilities between different levels of government. While optimal federalism is beyond the concerns and scope of the current review, federal intervention is relevant for empirical research on strategic interactions among jurisdictions, because it also creates possibly exogenous shocks to local government policies.

To give some perspective on the importance of these interactions between higher and lower level governments, consider some data on U.S. state and local government finances and tax policies. According to the Institute of Education Statistics, approximately thirty-three percent of local government revenue came from state and the federal government transfers

in 2016, with the vast majority of this funding coming from state governments. State governments receive a similar amount from the federal government. The expanding role of state governments in the financing of elementary and secondary education has been particularly pronounced, with only forty-four percent of funding coming from local sources in 2016, and only twenty-nine percent coming from the traditional source of revenue, property taxation. Given the importance of education as a local policy and the extensive research on educational finance, we discuss these interventions at length in Section 6.3.

In line with our previous discussion, local governments face restrictions imposed by state governments on the tax instruments available, the tax rates, or the tax bases. The best known of these restrictions are on property taxation – Proposition 13, passed by referendum in California in 1978, and Proposition 2 $\frac{1}{2}$, passed by referendum in Massachusetts in 1980. Both propositions limit property tax rates and assessment increases. Other states directly regulate the levy increases, equivalent to restricting both tax rates and assessments. In all, forty-five states limit property tax rates or levies, and nineteen states limit the growth in assessed values. Restrictions imposed by higher-level governments are not just a U.S. phenomenon. At the E.U. level, controls on state aid (Heimler and Jenny 2012) largely prohibit firm-specific subsidies by national and subnational governments. State aid is defined as an advantage conferred on a selective basis to undertakings by national public authorities. For this reason, the E.U. generally prohibits state aid unless it is justified for economic development. Thus, national governments cannot offer different tax rates to different companies or sectors.

We do not discuss many other interesting ways in which federal policies influence local governments. For example, given that federal income taxation is based upon nominal income rather than real income, economic activity may be distorted. Related, the deductibility of state and local taxes against federal income taxes (Feldstein and Metcalf 1987; Albouy 2009), which was recently restricted (Altig et al. 2019), has important spatial consequences.

6.1 Minimum and Maximum Tax Rates

While much of the theoretical research on local policy determination has ignored constraints and other interventions, there are studies that consider restrictions on fiscal competition among lower-level governments, involving both minimum and maximum tax rates or spending policies. For example, the work by Kanbur and Keen (1993) on cross-border shopping considers a minimum sales tax rate. If this rate lies between the two Nash equilibrium rates, then the low-tax jurisdiction, which has the lower population, will be forced to raise its rate. However, tax rates are strategic complements in the Kanbur and Keen model, so the high-tax jurisdiction will respond by raising its rate. Given that tax competition lowers the two

rates below the levels most preferred by the two jurisdictions, the minimum tax rate may be beneficial for both governments. Minimum and maximum tax rates are commonly imposed on localities, and their presence may result in many governments selecting a “corner solution” at one of these rates. For researchers, an advantage of this behavior is that changes in these minimum or maximum tax rates provide an arguably exogenous shock that can be exploited empirically. But a disadvantage is that when these rates do not change, their presence provides challenges for empirical researchers estimating reaction functions (Di Porto and Revelli 2013; Revelli 2013), if governments have settled into to a long-run equilibrium.

More generally, changes to centrally-determined parameters provide useful variation for empirical analysis. The comparative statics of a change in a parameter a on equilibrium tax rates pick up two effects: a direct effect and an indirect (or strategic) effect due to the simultaneous determination of tax rates as a result of strategic policy interdependence. Consider the case where the large jurisdiction sets a tax rate T and the small jurisdiction sets a tax rate t . Following Caputo (1996), when jurisdictions compete in a Nash game, the total effect of an increase in a on a jurisdiction’s tax rate, depends on whether it is the only jurisdiction effected or whether competitor tax rates are directly effected as well. Thus, the total effect on T , dT/da , from a shock affecting *both* jurisdictions is:

$$\frac{dT}{da} = \left[\frac{1}{1 - \frac{\partial T}{\partial t} \frac{\partial t}{\partial T}} \right] \frac{\partial T}{\partial a} + \left[\frac{\frac{\partial T}{\partial t}}{1 - \frac{\partial T}{\partial t} \frac{\partial t}{\partial T}} \right] \frac{\partial t}{\partial a}. \quad (12)$$

Then, $\partial T/\partial a$ and $\partial t/\partial a$ are the direct effect of the shock on each jurisdiction’s tax rate and the terms in square brackets reflect the indirect effects resulting from tax competition. When only the large jurisdiction experiences a shock, the second term in (12) is not present, since $\partial t/\partial a = 0$. The first term in square brackets is positive and greater than one if taxes are strategic complements, such as in Nielsen (2001). We see that the total effect is reinforced by strategic interactions, and unchanged in sign relative to the direct effect. For the small jurisdiction, a similar expression can be derived, in which the direct effect is still reinforced by strategic complementarity. In the case of strategic substitutes, notice that the first term in square brackets remains positive, and still greater than unity, so the sign of the total effect is still determined by the direct effect and reinforced by strategic interactions.

In the case where $\partial t/\partial a \neq 0$, the shock shifts both reaction functions. Consider a case where $\partial T/\partial a$ and $\partial t/\partial a$ are the same sign. With strategic complements, both bracketed terms are positive and so both shocks reinforce each other. With strategic substitutes, the second bracketed term is negative, thereby dampening the effect of the shock.

An extreme case would be where the local governments completely lose their authority over tax setting. Then there is no indirect effect. For example, Kanbur and Keen (1993)

consider the issue of tax rate harmonization, whereby the federal government requires that jurisdictions impose the same tax rate. The small jurisdiction is hurt by any harmonized rate between the two Nash equilibrium tax rates, but the large country may benefit if this harmonized rate is close enough to the large country's Nash rate.

6.2 Government Debt

Fiscal competition may also be constrained by restrictions on the use of government debt. In the United States, state governments often cap the amount of debt that localities can issue, or they place balanced-budget requirements on localities. While these restrictions may exist in the law, whether they actually bind or are “soft” often depends on the state. However, Poterba (1994) and Bohn and Inman (1996) have shown that these constraints do have significant effects on subnational fiscal policies. Jensen and Toma (1991) show that overprovision of public services may arise in the period that the debt is issued.

Constraints on the the ability to issue new debt also affect how governments adjust to higher levels of existing legacy debt. Janeba and Todtenhaupt (2018) investigate this issue in a 2-period model with infrastructure.²⁷ Heterogeneous firms decide in which of two jurisdictions to locate in each period, based on a comparison of business taxes and infrastructure levels. Governments have the same period-1 levels of infrastructure in the central case, but they choose infrastructure investment in period 1, which benefits firms in period 2. New debt is issued in period 1, and taxes are chosen in each period. Governments maximize a discounted sum of the benefits from attracting firms and providing a public consumption good, g . A reduced-form specification is used, where the benefits in each period are a function of a weighted sum of the number of firms and g . If only one government is constrained in the ability to issue new debt, then an increase in the legacy debt of the constrained government leads to a decline in its infrastructure investment, reducing the attractiveness of the jurisdiction to firms in period 2, and the period-2 tax rate is reduced to partially offset this effect. Public consumption is adjusted in each period so that the burden of the additional debt is smoothed across periods. A study of how German municipalities adjusted to the 2008-2010 financial crisis is broadly consistent with the predictions, though fiscal equalization schemes diminish the tax effects.

The desirability of restricting the use of government debt depends on political economy

²⁷Arcalean (2018) shows that with mobile capital, strategic policies generate two cross-border externalities that voters fail to internalize: (1) an increase in public spending can spur capital accumulation, but also (2) increase interest rates, which crowds out capital. The latter of these channels arises because deficit spending yields a negative pecuniary externality (an increase in the interest rate), as governments ignore the crowding out effect in other countries. This leads to higher public debt everywhere. This mechanism is less likely to be important at the local level, given jurisdictions are small and cannot affect the interest rate.

concerns, the mobility of households, and the extent to which potential residents take into account the higher taxes associated with current debt levels. If there is perfect foresight about these taxes and future public service levels, then higher debt levels will be fully capitalized into property values, removing incentives of current residents to lower current taxes by issuing more debt. But if undercapitalization occurs due to uncertainty or myopic households, then these incentives exist.²⁸ Higher future taxes may discourage investment, which raises the issue of dynamic consistency. Competition between jurisdictions may act as a partial commitment device and thus be preferential to tax coordination (Kehoe 1989).

The ability to issue debt raises questions over whether a centralized government will bailout lower-level governments. While central governments often engage in fiscal transfers to lower-tier governments, we view a bailout as being an irregular event in response to something exceptional that in turn induces moral hazard among the recipients. As highlighted in Wildasin (2004), bailouts resulting from fiscal distress may be mitigated by fiscal restraints and the presence of constitutional restraints. One recent area of potential fiscal crisis relates to the funding gap for public pensions; inevitably addressing this issue requires a reduction of unfunded liabilities in a manner that does not increase other government debt in the process. More generally, borrowing by subnational governments may not be readily controllable. The presence of these bailouts raises the question: if a soft budget constraint is bad, then why not make it hard? Perhaps the response arises from the normative argument that there is a missing insurance market for this risk. In addition, political economy concerns mean that bailouts may emerge as a form of rent extraction by large governments. In particular Wildasin (2001) shows that the ability of local governments to extract bailouts depends positively on jurisdictional size: budget constraints are more likely to be soft for large localities. Alternatively, what is it about the U.S. system of federalism compared to more recent federations that makes bailouts much less common? These issues are not well understood in the literature and merit additional research.

6.3 Intergovernmental Grants and Fiscal Equalization

In 2016, U.S. localities received almost a third of their funding from state governments, with state governments receiving approximately the same from the federal government. For school districts, the state share is over fifty percent. Broadly, we might think of two goals for these grants: (a) to achieve interregional equity; and (b) to achieve efficient local government

²⁸On the issue of household mobility and the capitalization of future public service benefits, see Sprunger and Wilson (1998). In some cases, overcapitalization can exist.

decision-making.²⁹ Grants with an efficiency rationale typically come in the form of matching grants, where the grant rises as the desired government activity rises. Grants used to achieve “fiscal equalization” are reviewed by Boadway (2004), who explains, “equalization is primarily concerned with eliminating differences in the net benefits that the public sector provides otherwise-identical households residing in different regions, so-called net fiscal benefits”.³⁰ But he also observes that equalizing grants have an efficiency justification: to correct for interregional fiscal externalities that arise when regions differ in their productivities.

The literature on intergovernmental grants is vast.³¹ We focus the possible efficiency-enhancing properties of fiscal equalization in two instances where there is fiscal competition among local governments: capital tax competition and competition among school districts. Our basic message is that in the case of local government decision-making, there is often no equity-efficiency tradeoff: it is possible to improve both interjurisdictional equity and interjurisdictional efficiency. This message is in contrast to the analysis of optimal income taxation, where the federal government increases welfare by making the combined federal and state income tax system more progressive, but at the cost of greater labor-leisure distortions.

6.3.1 Tax Capacity versus Tax Revenue Equalization

We first consider the equalization of “tax capacity” in the presence of capital tax competition. In this case, the transfer T is based on the difference between between some measure of the average capacity for all jurisdictions and the jurisdiction’s actual capacity. For the *ZMW* model of tax competition, capacity is the tax base, equal to capital supply k_i in jurisdiction i . Basically, the equalization formula is designed so that the jurisdiction can finance the expenditures it would be able to finance if it had the average capacity and applied an average tax rate to it: $T_i = \alpha \bar{t}(\bar{k} - k_i)$, where \bar{k} is the average capital supply, \bar{t} is average tax rate, and full equalization requires $\alpha = 1$. Koethenbueger (2002) demonstrates that tax competition among many identical jurisdictions is efficient in the case of full equalization. The basic idea is that a jurisdiction can receive a higher grant by increasing its tax rate,

²⁹Another role for intergovernmental grants is to close the “fiscal gap” between revenue and spending at each level of government. Boadway and Keen (1996) demonstrate that optimality may require that the transfer go from jurisdictions to the central government, due to negative “vertical tax externalities,” whereby the taxes used by jurisdictions reduce the tax base available to the federal government.

³⁰Albouy (2012) provides an interesting empirical examination of fiscal equalization in Canada. The focus of the study is the locational choices of households, specifically whether households are making efficient choices and the extent to which federal transfers to provinces ensure this efficiency. Calculating the net fiscal benefit, Albouy finds that locational inefficiencies cost Canada 0.41% of income and cause over-funded provinces to have populations in excess of 30% beyond their efficient levels.

³¹Intergovernmental grants also have an important role in developing countries. In a recent paper, however, (Gadenne 2017) finds that federal investments in local government tax capacity are more effective than federal transfers in increasing the quality and quantity of local government infrastructure.

because its capital supply then drops. Bucovetsky and Smart (2006) further extend these efficiency results by showing that full equalization supports a fully efficient equilibrium under conditions that allow for asymmetries between jurisdictions that possess market power. But these asymmetries are restrictive: capital demand varies across jurisdictions only by a factor of proportionality A_i : $k_i(\rho + t_i) = A_i k(\rho + t_i)$, where $\rho + t_i$ is the before-tax cost of capital. This condition holds when jurisdictions differ only by size, measured by the the number of workers. We previously noted that small jurisdictions choose tax rates below those chosen by large jurisdictions. Tax base equalization eliminates this inefficient difference in tax rates. Bucovetsky and Smart (2006) extend the results to a 2-period model and show that there is a level of partial equalization ($\alpha < 1$) under which the Nash equilibrium is fully efficient.³²

Another form of equalization is “tax revenue equalization.” In particular, the income transfer to jurisdiction i is now given by $T_i = \alpha l_i(\bar{r} - \bar{r}_i)$, where l_i is jurisdiction i 's population size, \bar{r}_i is i 's tax revenue per capita (negative for a subsidy), and \bar{r} is tax revenue per capita for the entire federal system. This scheme is designed to equalize revenue, but it clearly does not produce efficient outcomes in the standard tax competition model. However, it does so in the Gagné and Riou (2007) model of subsidy competition for mobile monopolistically-competitive firms, which builds on Ottaviano and Ypersele (2005). In particular, Gagné and Riou (2007) argues that full tax revenue equalization brings about the efficient difference in the subsidy rates levied by small and large countries. We are then left with the conclusion that the optimal equalization scheme depends on market structure, which makes sense because market structure determines whether local government taxes or subsidies should be equalized across jurisdictions or should differ.

6.3.2 School Finance Equalization

School finance equalization programs used by state governments throughout the U.S. have the potential to also increase efficiency. Historically, the local property tax has been the most important source of school financing, but its importance has diminished, particularly with the increased role of state governments. This role came about to address inequalities in school quality between rich and poor districts. Since 1970, every state in the U.S. has enacted a school equalization plan.³³ Under a district power equalization scheme, the state

³²Gross (2020) studies dynamic optimal taxation with a revenue-based equalization scheme. Capital tax competition is dampened in the short run, but long-run capital taxes are not affected. Infrastructure competition is dampened in the short run, whereas the long-run infrastructure provision is (globally) sub-optimal. Labor taxes and government consumption are (globally) sub-optimal at all times. Due to the dampening of capital tax and infrastructure competition in the short run, there are positive efficiency effects for low levels of equalization payments, but the long-run effects are always negative.

³³Hoxby (2001) provides an outline of alternative funding mechanisms for primary and secondary education in the United States, with a focus on equalization plans. See also Fernandez and Rogerson (2003) for a

funding to a school district is determined by the difference between its actual revenue and the revenue it would receive by levying the same tax rate on a “guaranteed base,” but districts are then allowed to set their own tax rates. Thus, if v^* is the guaranteed base per student and τ_i is the tax rate, then expenditures per student is $e_i = \tau_i v^*$. This system allows for any net cost of the program to be funded by a state tax on the districts’ tax bases. A variant of this system allows districts with tax bases above the guaranteed base to keep all of the revenue obtained by taxing their own bases: $e_i = \tau_i v_i$ for $v_i > v^*$.

Under a foundation grant, each district receives a fixed amount of funding per student, denoted f . The use of local taxes to supplement this grant is often restricted. If not, the budget constraint can be expressed as $e_i = \tau_i v_i + f$. In this case, the foundation grant does not affect the tax price of education, as $de_i/d\tau_i = v_i$ assuming v_i is fixed. But other formulas, including district power equalization, do affect this tax price. In general, equalization results in higher tax prices for those districts with higher property values per student than the levels guaranteed in the equalization schemes, and lower tax prices for the property-poorer districts. Thus, it tends to lead to less disparity in local funding.

While equalization schemes typically restrict the ability of districts to use local taxes to increase school funding, the focus of these schemes is on operating costs, consisting mainly of teacher salaries, rather than capital expenditures, for which other forms of state aid are available. This leads to distortions in capital-labor ratios, as illustrated by Conlin and Thompson (2014) in their comparison of the Michigan and Ohio systems, where Michigan essentially prohibits the use of local taxes to fund school operating costs. Note too that parents can respond to restrictions on local funding by turning to private schools.

We might also expect that these equalization schemes will result in more within-district household heterogeneity, as they reduce the ability of high-income households to obtain better schooling by moving to wealthy school districts. But the results are mixed. Aaronson (1999) examines how income heterogeneity changed from 1976 to 1989, measured by the fraction of households in the bottom quintile of the income distribution in “poor” districts and the fraction of households in the top quintile of the income distribution living in “wealthy” districts. He finds that school finance reform had little impact on the change in high-income households living in wealthy districts, but there was an increase in low-income households living in poor districts. The latter effects are larger for states where localities maintained a high level of discretion over local taxes. Chakrabarti and Roy (2015) looks at the effects of the Michigan 1994 reform, which basically was a foundation system that constrained future spending increases by high spending districts and provided significant increases in spending to the lowest spending districts, significantly reducing the gap in spending. The reform led to an

theoretical analysis of the different equalization schemes in a Tiebout model.

eight percent decline in median income for the highest-spending quintile and an eight percent increase for the lowest quintile, reducing inter-district stratification. Changes in segregation within districts (intra-district stratification) are examined by calculating dispersion based on a Herfindahl index. Within-district dispersion of income increases in low-income districts, but decreases in high-income districts. Epple and Ferreyra (2008) conduct a numerical analysis of the general equilibrium effects of a Michigan-type school finance reform, and conclude that, “although the reform favored the low-revenue districts, demographics in these (or other) districts did not change much. Nonetheless, low-revenue districts experienced the largest achievement gains, although these might not have been fully associated with revenue gains.” Perhaps the model favors this outcome, because housing supplies are fixed and households are stratified by income across districts, before and after the reform.

Increases in within-district heterogeneity would be considered inefficient in standard Tiebout models, but in our discussion of metropolitan models, there may be distributional and efficiency benefits of heterogeneous jurisdictions, once human capital development is taken into account. Bénabou (1996) identifies the implications of this literature for school finance reform. Moving school funding from the local to state level generates benefits that are similar to those that would be obtainable by mixing different types of workers in the same jurisdiction, as we discussed previously. In particular, long-run growth rates increase, though Bénabou (1996) shows that they decline in the short run.

A controversial issue in the empirical literature on school finance reform has been how school spending has been affected, and whether there actually has been significant gains in student achievement, at least for low-income districts. Previous literature, notably Hoxby (2001), emphasize some of the negative consequences of these reforms, which are sensitive to the type of reform. More recently, Jackson, Johnson and Persico (2016) characterizes the different types of equalization plans, and distinguishes between court-mandated plans and legislative plans. In short, they are able to relate changes in student achievement to exogenous changes in school expenditures by using court-mandated reforms as an instrument for changes in school expenditures. They can then relate changes in student achievement, which include not only test scores, but also future wages, to the school expenditure changes brought about by school finance reform. Small effects are found for children of affluent families, but there are sizable effects for low-income children. They conclude, “The results imply that a 25% increase in per pupil spending throughout one’s school years could eliminate the average attainment gaps between children from low-income (average family income of \$31,925 in 2000 dollars) and nonpoor families (average family income of \$72,029 in 2000 dollars)”. Apparently, the increase in expenditures provided to poor districts, which is particularly significant for court-mandated reforms, has the potential to not only bring about greater

equality in educational attainment, but also to produce efficiency gains by counteracting market failures, including private debt markets and the market for local public goods, that are worsening market outcomes for children from low-income families.

The school finance literature provides an interesting case where state-imposed reforms are used as an exogenous shock to study policy outcomes. We return to this in Section 7.

6.4 Empirical Evidence on the Effect of Constraints

6.4.1 Tax and Expenditure Limits

In addition to school equalization, several states have passed tax and expenditure limits (TEs). These limitations include revenue limits (restrictions that cap revenue growth relative to personal income or population growth or inflation, with any excess revenue refunded to taxpayers), expenditure limits (restrictions that similarly cap expenditure growth), appropriation and revenue limits (these spending limits tie spending to a percent of expected or forecasted revenues), or hybrid limits (some combination of these limits). For example, some states restrict the rate of growth of property tax revenues. Other states have enacted voter approval requirements, which require localities to seek voter approval for tax increases or tax increases above a certain amount. Many states are also bound by super-majority requirements to pass new taxes. A large literature suggests these types of limits have constrained government growth at the state and local level (e.g., Poterba and Rueben 1995; Cutler, Elmendorf and Zeckhauser 1999; Knight 2000; Brooks, Halberstam and Phillips 2016).

These rules are interesting because, as noted by Eliason and Lutz (2018), “it is unclear, though, whether these rules cause a change in budget outcomes, are evaded by policy makers, or merely ratify the existing preferences of a jurisdiction’s voters and officials.” These authors study Colorado’s Taxpayer Bill of Rights (TABOR), which are some of the most stringent restrictions on local governments in the United States. Using the synthetic control method, Eliason and Lutz (2018) finds that TABOR has no effect on budget outcomes of local governments in Colorado. They cite evidence that voters in Colorado had a preference for tax cuts: the control states were also issuing tax cuts at the time. Furthermore, the legislature adopted some complex measures to undermine TABOR, and local voters had buyer’s remorse, passing TABOR overrides in the years following its passage. Eliason and Lutz (2018), thus place some ambiguity into the literature on the effectiveness of TEs. As noted above, these limitations may result in less policy mimicking among local governments simply because the true variance in policy across localities cannot be realized. However, if the intent of the rules can be evaded, voters may find ways around these limitations, and true policy mimicking may still be possible.

6.4.2 Balanced Budget Requirements

Other constraints on local governments exist. For example, many states have balanced budget requirements, and the E.U. Stability and Growth Pact restricts member states' borrowing. Again, the stringency and effectiveness of these constraints vary by state (Alesina and Perotti 1996; Poterba 1994; Poterba 1996). Ultimately, the stringency of these rules is linked to whether the governor must submit a balanced budget, the legislature must pass a balanced budget, the governor must sign a balanced budget, or the state cannot carry over a deficit into the next year. The ability to escape these rules by circumventing the spirit of the law also differs by state. Swiss cantons also vary how stringent they are in requiring municipalities to balance their budgets. In particular, they differ over whether the locality is required to balance the budget or balance the end-of-year accounts. They also differ in how violations of the fiscal rules are enforced. In particular, the most stringent rules require automatic rebalancing, while less stringent rules require deficit compensation in future years, or sometimes no rebalancing mechanism. The penalties of a locality violating the fiscal rule range from a loss of local autonomy, sanctions, or no penalties. Christofzik and Kessing (2018) study the withdrawal of fiscal oversight measures and find a sizable effect on per capita debt of local governments that were previously constrained by fiscal oversight.

6.4.3 Intergovernmental Grants

We have already discussed how the grants associated with school finance equalization have both important efficiency and equity effects. Next, we briefly address a longstanding question in the grants literature, related to the flypaper effect:³⁴ Do federal grants crowd out state government spending, leading to little or no increase in combined public spending? The early literature testing this theory has assumed that grant levels are exogenous to the locality. However, the recent literature acknowledges that these grants come from a political process which may tilt grants towards states with certain fiscal preferences. Knight (2002) deals with this endogeneity issue by exploiting exogenous political instruments relating to the political power of a state's congressional delegations, such as committee representation, partisan affiliation, and tenure in Congress. While the prior literature found no evidence of crowd-out from grants, Knight (2002) finds federal grants crowd out state spending; that is, a change in the federal grants received by a state results in little to no change in total state spending. In contrast, using the American Recovery and Reinvestment Act apportionment

³⁴Given our focus is on the effect of intergovernmental grants on the strategic interactions of among governments, we omit a comprehensive review of the flypaper effect. The flypaper effect suggests that grant receipts increase public spending more than private income does, i.e., money sticks to where it hits. For example, see Hines and Thaler (1995).

mechanism, Leduc and Wilson (2017) finds an increase in grants raises state highway spending more than one-for-one. The lack of consensus suggests that researchers seeking to study fiscal competition over spending may consider total spending inclusive of grants, as mobility across borders will be a function of total spending rather than local spending. However, the implications for the revenue side are unclear. If spending is crowded-out, the local government may be able to lower its tax rates. If federal grants are spatially targeted, this could create a spurious correlation in local tax rates that is not a result of tax competition.

6.5 Reflections

An extensive literature on local government policy has considered the effects of constraints imposed by higher-level governments and the effects of intergovernmental grants and transfers. As explained subsequently, these interventions have provided the empirical literature a means of identifying local policy choices in response to arguably exogenous shocks.

More work needs to be done to understand the simultaneous setting of policies by multiple levels of governments. While a literature on optimal intergovernmental grants as a corrective mechanism for tax competition is an example of integrating policy choices of higher-level governments with the policies of lower-level governments, these examples are limited. More modeling in which both lower-level and higher-level governments choose policies would help us to better understand the global effects of these constraints. This is especially the case given the recent passage of federal restrictions on the deductibility of state and local taxes.

The grant literature has focused on both the efficiency and equity implications of grants. In fact, we have reviewed some cases where there is no equity-efficiency tradeoff, including grants that equalize tax capacity while eliminating wasteful tax competition, and also school finance equalization policies that help to correct market failures while improving educational outcomes in low-income districts. In contrast, the distributional implications of tax and spending limitations has been largely ignored. Moving beyond the efficacy of these constraints, how have they influenced the distribution of resources, public expenditures and well-being for localities with very different resources? More generally, we need to better understand the role of local policy on redistribution. Although it has often been argued that redistributive policies lie within the domain of the federal government, estimates of mobility elasticities suggest progressive redistribution at the local level may be possible. Given the well-documented geographic concentration of race, poverty, unemployment and upward mobility, more needs to be known both theoretically and empirically regarding how local governments can help address these observed spatial inequalities.

Recent work, such as Gaubert, Kline and Yagan (2020), studies place-based redistribu-

tion and the equity-efficiency tradeoff that arises when taxes and transfers are indexed to location. These authors find that place-based redistribution plays an important role in lowering the efficiency cost of redistribution in a federal system, and may provide additional equity benefits beyond what is possible through income-based redistribution.

7 Empirical Identification of Policy Interactions

As prior sections have focused on the effects of local policies or constraints, this section discusses empirical identification of policy interdependence. We emphasize how researchers identify the underlying mechanisms from Section 2 that give rise to interdependence.

7.1 Introduction to Empirical Identification of Local Policy Choice

The goal of good empirical analysis concerning local choice is threefold. First, the empirical literature seeks to determine whether strategic interactions exist in any form. In particular, a policy reaction function is estimated. Second, the literature seeks to estimate the external effects of decentralized tax setting – these may include the effect of a policy change on the neighboring jurisdiction’s tax base (fiscal externalities) or, as discussed in Section 5, the effect on economic output or growth in other jurisdictions (production externalities). Third, and perhaps most challenging, is identifying the causal mechanism (fiscal competition, tax base or expenditure spillovers, Tiebout sorting, yardstick competition or political economy motives) that explains the observed patterns of policy interdependence. As in Section 2, strategic interdependence means that the observed equilibrium policies of a jurisdiction are influenced by the policies of “similarly situated” jurisdictions, or for simplicity throughout this article, neighboring or competitor jurisdictions. An ultimate goal of answering these questions is to provide evidence on whether competition is “good” or “bad.” Although correlations between neighboring jurisdictions are interesting in their own right, to fully understand the policy setting process and to make conclusions about the welfare effects of competition, researchers seek to understand the causal mechanism that explains the influence of neighboring policies. However, the slope of the reaction function provides no information about whether these interactions increase or decrease welfare, nor the precise mechanism at work.

7.2 Reaction Functions and the Presence of Strategic Interactions

The literature on policy interdependence originally studied the fiscal policies of spatially-proximate countries, but has shifted to explain policy choices of sub-state jurisdictions.

7.2.1 The Spatial Lag Model

To study the interdependence of policies across jurisdictions, researchers have traditionally used a spatial lag model, as defined below. Although the term “spatial” conveys a sense of geography, spatial models need not be confined to a geographic dimension. For example, strategic interactions could arise between similarly economically-situated jurisdictions that do not share a border; this could happen if firms are more likely to be mobile to other high-income states rather than lower-income neighboring states.

To justify the use of the spatial lag model, we start with an example of fiscal competition, but as we will see, it can be motivated by other sources of local policy determination. To model fiscal competition, we can follow Brueckner (2003) and Revelli (2005) and modify (1) to allow for changes over time. Then, the tax base in jurisdiction i and period t , b_{it} , is a function of the own policy y_{it} , and exogenous characteristics of the jurisdiction \mathbf{X}_{it} . In addition, the base depends on the vector neighboring policies, \mathbf{y}_{-it} . To facilitate identification and to reduce the number of parameters to estimate, researchers traditionally spatially aggregate this vector into a simple spatial average. Specifically, assume that i 's base is a function of a weighted average of the policies of neighboring jurisdictions, \bar{y}_{it} , so that $b_{it} = b(y_{it}, \bar{y}_{it}, \mathbf{X}_{it})$. Then, the spatial lag is $\bar{y}_{it} = \sum_{j \neq i} w_{ij} y_{jt}$, where j indexes the set of competitor jurisdictions (possibly geographically proximate) and w_{ij} are exogenously given weights between jurisdictions to be defined subsequently. In particular, the weights are usually chosen such that $w_{ii} = 0$ and then row-normalized such that for a given jurisdiction i , the sum of the weights is equal to one. This linear combination of policies allows the research to study, for example, the effect of changes in the (weighted) average of neighboring policies. Then, the policy function (2) can be modified as $y_{it} = y(\bar{y}_{it}, \mathbf{X}_{it})$, which can be expressed in linear form:

$$y_{it} = \rho \bar{y}_{it} + \mathbf{X}_{it} \lambda + \alpha_i + \alpha_t + \epsilon_{it}. \quad (13)$$

This equation says that the policy y_{it} of jurisdiction i in a given year t is a function of a weighted average of the policies in other jurisdictions. By the normalization above, the coefficient ρ can easily be interpreted as the slope of the strategic reaction function with respect to the average competitor rate. Of course, in addition to the time and cross-sectional unit fixed effects, the researcher may add covariates and has various options for the treatment of the standard errors, which we do not discuss in this article. See Gibbons, Overman and Patacchini (2015) for a complete discussion of spatial econometric methods.

In the presence of fiscal competition, $\rho \neq 0$ implies the presence of some strategic interactions; if $\rho = 0$, this does *not* imply that fiscal competition is absent. Rather, jurisdictions may be atomistic or price-taking, as in the regional model, in which case a jurisdiction does

not respond to policy change in any small number of other jurisdictions.

In addition to the econometric concerns discussed below, estimation of (13) comes with concerns relating to the underlying economic mechanisms. In particular, estimation of such a spatial lag model can only indicate policy interdependence between the jurisdictions, and not whether this interdependence arises from fiscal competition or another mechanism discussed in Section 2. All of the mechanisms outlined have the same reduced-form reaction function.

First, consider the case of yardstick competition, where the probability of reelection is given by (4). Furthermore, note that if public service costs are only composed of the random component over which the government has no control, then the probability depends only on the tax rate in the own-jurisdiction relative to the tax rate in the competing jurisdiction. Linearizing the policy function then implies a reduced-form reaction function that has a form that is indistinguishable from (13). More generally, if the probability of reelection is given by (4), then the tax reaction function should include both the neighbor's tax rate and spending. Finally, in the presence of expenditure spillovers, we can again simplify by replacing \mathbf{y}_{-i} with the spatial average of other jurisdiction's policies. Then maximization of the welfare function in the presence of spillovers implies a policy function $y_{it} = y(\bar{y}_{it}, \mathbf{X}_{it})$, which obviously is exactly identical to (13) when linearized.

7.2.2 Econometric Concerns

This specification requires that we address two important issues. First, how does a researcher best specify the exogenous weights between jurisdictions? For example, how much weight does California give to Oregon versus New York when setting policy? To deal with this issue, researchers often use information from theory to exogenously impose weights. For example, in the case of a tax with a locally-mobile base, such as a sales tax, researchers often impose weights related to geographic proximity, such as inverse distance weights. Survey evidence, such as in Janeba and Osterloh (2013), could help guide empirical analysis here.

A second econometric concern is that the policies of jurisdiction i and j are simultaneously determined. This means that the spatial lag is, by definition, endogenous. Researchers have resolved this problem by using maximum likelihood approaches (Case, Hines and Rosen 1993) or instrumental variable strategies (Kelejian and Prucha 1998), where in the early literature, the instruments are the spatial lags of the exogenous \mathbf{X}_{it} . The basic idea is that jurisdiction j 's characteristics do not predict jurisdiction i 's fiscal policies except in so much as they influence j 's policy. This exclusion restriction may be debatable if the true model is one where relative characteristics of the jurisdictions matter for equilibrium policy. In addition to the problem of simultaneity, endogeneity may also arise because other unobservable variables that explain fiscal policies may be spatially correlated (see Brueckner

2003). This implies an omitted variable problem, whereby fiscal competition cannot be distinguished from common shocks using OLS.³⁵ The standard approach is to resort to IV methods again. But this again requires strong assumptions on the instrumental variables that are available. This has led researchers (Gibbons and Overman 2012; McMillen 2010) to critique the standard spatial lag model as not being able to provide anything more than just simple correlations. Even if the parameter ρ can be identified as a true spatial interaction, what causal relationship can it give? To be causal, it would require that the researcher identify an increase in \bar{y}_{it} , holding all other things constant. Because \bar{y}_{it} is an average of the dependent variable, then thinking of this as a system of equations, it cannot easily be changed by holding other factors constant. This critique of the empirical tax competition literature also calls on more quasi-experimental variation for causal identification.

7.2.3 Results of Spatial Lag Models

Given the importance of the spatial lag model, we summarize some of the findings in this literature before proceeding to alternative models.³⁶ Early models were cross-country and sometimes cross-subnational, but much of this literature is uninformative as to which mechanisms are at work. More recent models have utilized panel data approaches with local data. This literature provides useful and consistent results: (1) fiscal reaction functions generally slope upward, (2) the magnitude of this slope often depends on the fiscal instrument being studied and the level of government, and (3) even if the size of the municipality relative to the world market is small, positive reaction functions exist. However, more recent studies utilizing quasi-experimental approaches are split: some find positive reactions, some find no reactions, and others find negative reactions. This inconsistency should not be viewed as a limitation of the literature: the slope of the reduced-form reaction function is not a structural parameter and may differ in sign and magnitude across various fiscal instruments and institutional settings. Regardless of the sign, these often strong relationships between own-jurisdiction policies and nearby jurisdiction policies suggest that at least one mechanism is at work. In the subsequent sections, we explore identification of the mechanism at work.

³⁵Higher level government restrictions often provide a useful source of exogenous variation to overcome this issue, but they also may create complications. Positive spatial correlations may emerge if the state government has automatic triggers that influence the locality's decision to change tax rates, or that force the locality to change tax rates. For example, seven states index their gasoline taxes to inflation or adjust them based on wholesale prices. Then the estimation of a reaction function will (falsely) result in confirming the existence of strategic interactions. Other indirect channels for spatial mimicking may exist. For example, many local governments rely heavily on grants, which are often formula based. If the formula affects jurisdictions within a spatial region similarly, perhaps due to common demographic shocks, then nearby municipalities may receive similar changes in grant dollars, which may be falsely attributed to competition.

³⁶The spatial lag model of strategic fiscal interactions is voluminous. We do not try to cite all of this literature. Instead, see Brueckner (2003) and Revelli (2006*b*) for a list of citations.

7.3 Identifying Policy Interactions: Quasi-experimental Studies

Recent studies of fiscal competition use quasi-experimental variation. These quasi-experimental studies take three different approaches. The first approach uses reforms by higher level governments that exogenously shift the tax rates of some municipalities but not other municipalities. The second approach exploits geography by utilizing idiosyncratic variation in the spatial layout of municipalities or discontinuities at state borders to see how municipalities respond. Finally, the third approach uses close elections to identify interactions.

7.3.1 Exploiting Reforms by Higher-level Governments

Lyytikäinen (2012) pioneered the first type of identification strategy. Studying property tax competition by localities in Finland, he exploits a reform by the central government that increased the minimum tax rate that municipalities must set. This reform allows him to partition the set of municipalities into those that were directly affected by the reform (setting tax rates below the new minimum) and those that were indirectly affected by the reform (they had tax rates above the minimum tax rate, but are affected by tax competition). Lyytikäinen (2012) argues that the central government forcing municipalities to change their tax rate provides an exogenous shock that shifts \bar{y}_{it} in equation (13). As in Section 6, the basic argument is that those jurisdictions below the new minimum will simply raise their tax rate to the new minimum, which in turn, may result in competitor municipalities changing their tax rate even if the minimum does not affect them directly. Given that most municipalities are small, the central government is unlikely to pass the reform in response to any one municipality. Focusing on the sample of municipalities not already at the minimum tax rate, Lyytikäinen (2012) estimates (13) using the spatial average of the “forced” changes from the reform as an instrument for the spatial average tax rate of nearby municipalities. When doing this, he identifies a coefficient that is statistically insignificant from zero, which suggest no spatial relationship between spatially proximate competitor and own-jurisdiction tax rates. In contrast, when he uses the standard approach discussed above and instruments for the tax rates using the spatial lags of the covariates, he finds very strong effects, consistent with the earlier literature. This methodological improvement allows him to circumvent the simultaneous setting of local tax rates. The approach of using higher-level government shocks has subsequently been used by Baskaran (2014), which has also found zero-sloped results. Continued work in this area may shed light on how reaction functions may be context-specific.

Although the literature often concludes that a zero-sloped reaction function rules out tax competition, this is not necessarily the case. To see this, recall that any one municipality is small with respect to the world capital market. Then if the researcher uses a few

nearby jurisdictions to construct \bar{y}_{it} , governments will not react to this atomistically small set of neighbors unless capital markets are segmented. A reaction function with a precisely estimated coefficient that cannot reject a zero-sloped reaction function suggests small or no strategic interactions, at least *locally*. Empirical studies estimate the slopes of reaction functions in the neighborhood of the equilibrium. Thus, although the reaction function may have a zero slope locally, an economic shock may change the equilibrium to a point where the slopes of reaction functions are non-zero, in which case the reaction functions exhibit strategic interactions in a *global* sense. Alternatively, a zero-slope reaction function could indicate atomistic (non-strategic) tax competition. The use of the shock from the federal government, however, allows these studies to rule out expenditure spillovers and information flows from yardstick competition, as the change in the minimum tax rate does not signal any information about the quality of the politicians.

7.3.2 Discontinuities at Borders

The second type of quasi-experimental studies of local policy choice utilizes policy discontinuities that arise at borders. Agrawal (2015) uses state borders to identify tax competition. He creates a theoretical model to show that local sales tax rates, when set in the presence of fiscal competition, will be higher in states with low state tax rates and lower in states with high state tax rates. Thus, near state borders, otherwise identical towns on opposite sides of a state border, will set discretely different levels of local tax rates. The basic idea is that border towns in high-tax states lower their tax rates to lessen the tax base changes (via cross-border shopping) that occur in response to the state sales tax rate differential. In addition to a level effect at the border, the model implies that local taxes should follow smooth spatial tax gradients away from the state border: local taxes should rise moving away from the border in the high-tax state, but local taxes should fall moving away from the border in the low-tax state. The study argues that yardstick or spillover effects would not have discrete level effects at the state border, but should be similar to any yardstick competition or expenditure spillovers occurring at the interior of the state.

One novelty of this study is that empirically, it identifies tax competition indirectly, that is, without identifying the slope of the reaction function. No tax reaction function is ever estimated, and instrumental variables are not necessary. Instead, assuming the cross-section of local sales tax rates are in equilibrium, identification follows a regression discontinuity (RD) design. The RD design focuses on the equilibrium pattern of tax rates, which results from cross-border shopping flows occurring from the high-tax state to the low-tax state. The running variable is the driving time from each town centroid to the nearest intersection of a major road crossing at a state border. Towns are partitioned to the high-state-tax and

low-state-tax side. The assumption that towns on the low-tax side of state borders are not systematically different from towns in high-tax states facilitates a comparison of local tax rates in otherwise identical municipalities. The empirical results indicate that at the state border, local sales tax rates nearly eliminate the state sales tax rate differential: border towns in low-tax states set local taxes that are, on average, 1.25 percentage points higher than border towns in high-tax states. Furthermore, distance is a significant contributor, which generally consistent with theory, delivers spatial tax gradients. Of course, other state policies beyond the state sales tax rate may systematically change at the state border; but these other factors are less likely to have differential effects with distance to the state border. The existence of this dramatic level difference in local tax rates at the state border and smooth gradients implies the existence of tax competition. Changes in the state sales tax rate would strengthen identification.

Even with access to panel data, one may worry that other time-varying policies may change when the state sales tax rate changes. To address this concern, Eugster and Parchet (2019) improves the border design strategy to identify tax competition. These authors exploit cultural (“language”) borders *within* cantons in Switzerland. As a multilingual country, language usage and culture change discretely at certain places, and these cultural borders do not always occur at the cantonal borders. In particular, German speaking municipalities are more conservative in the public services desired than the French speaking municipalities. Given this difference, the authors construct a model similar to Agrawal (2015), but for the case of local income taxes and public expenditures. The authors show that, even with differences in public services preferences, tax competition should erode any tax differentials at the language border if individuals are locally mobile among nearby jurisdictions. In addition, taxes will exhibit smooth spatial gradients away from the border. Any observed differences in taxes near the border reflect both differences in preferences (culture) and tax competition. Differences in taxes at the interior of the French region and German region reflect only differences in preferences.

Given a single difference at the border reflects preferences and tax competition, the authors need a second difference. Differences of French and German towns sufficiently far away from the border allow the authors to remove cultural differences in order to isolate tax competition. Empirically, the authors show that preferences for spending at these cultural borders changes discretely: in local referenda, French-speaking localities prefer much higher spending than German-speaking municipalities and this difference is constant near the border and away from the border. Consistent with theory, despite these strong differences in spending preferences, local taxes exhibit no discontinuity at the language border and, on the French-speaking side, exhibits a sharp spatial gradient until converging to a higher-level at

the interior. The difference-in-differences design demonstrates that taxes just over the French side of the language border are lower than would be expected, given spending preferences. The authors point to the existence of tax competition as the explanation: French-speaking municipalities are constrained by mobility of the tax base and therefore must set similar rates to their German-speaking counterparts.

Although these studies find indirect evidence of tax competition, they do not estimate a reaction function. Follow-up studies have exploited spatial location in order to identify a reaction function, and have utilized various instruments to identify tax competition. For example, Agrawal (2016) uses proximity to a border combined with geographic features to estimate a local sales tax rate reaction function consistent with Agrawal (2015). As mentioned previously, Mast (2019) exploits the number of nearby counties within 25 kilometers as an instrumental variable, which is related to whether the town is interior or near the border of the county, and to the idiosyncratic shapes of the counties. Using this geographic-based instrument, where the number of jurisdictions reflects competitive forces, he finds that spatial competition increases firm tax exemptions. Parchet (2019) utilizes the neighboring canton tax rate change as an instrument for the spatial lag and finds that tax rates are strategic substitutes: reaction functions slope downward in contrast to Eugster and Parchet (2019). However, it still may be the case that taxes are inefficiently low in this setting.

7.3.3 Close Elections

A third approach (Isen 2014) utilizes a close-elections regression discontinuity design. Exploiting voter referendums on local tax policies, this paper first shows that passage of a ballot proposal in a close election raises taxes in that jurisdiction relative to those towns where the ballot failed marginally. He then uses this result to test for effects of the referendum passage on the tax rates of nearby jurisdictions. Utilizing the average tax policy in nearby jurisdiction as an outcome variable, the paper shows no statistical difference in neighboring jurisdictions' outcomes for those places near a close ballot passage relative to those places near a close ballot failure. This suggests a lack of evidence of spatial mimicking. This rules out yardstick competition and expenditure spillovers, but may be consistent with locally zero-sloped strategic reaction functions or atomistic tax competition.

7.3.4 Key Results

The results of this literature, combined with the prior spatial lag model, suggests that *strategic* interdependence is likely more important in some circumstances than others. Theoretically, given that the slope of the reaction function is not a structural parameter, the reaction

function slope may depend on the size of the jurisdiction being considered, the institutional setting, and the particular policy base in question (i.e., globally or locally mobile). A non-zero reaction function slope is suggestive of pairwise strategic interactions.

We want to emphasize, estimating a zero-sloped reaction function does not rule out the existence of fiscal competition. Regardless of the slope, tax competition among jurisdictions may still be generating inefficiently low equilibrium tax rates.

7.4 Mechanisms of Policy Choice

Do spatial patterns emerge because of fiscal competition, yardstick competition or political economy concerns, spillovers, social learning or constitutional constraints? Although the quasi-experimental literature has made progress, other approaches for identifying the mechanism exist. As shown theoretically, the mechanism underlying the spatial patterns has important welfare implications.

7.4.1 Fiscal Competition and Its Link to Mobility

Fiscal competition is especially important for local governments, because we might reasonably expect mobility of the tax base across municipal borders to be higher than across country borders, where language differences and border controls may reduce mobility of the fiscal base. This issue is nicely summarized by Piketty and Saez (2013), who write: “...the size of the migration elasticity depends not only on individual preferences but also on the size of the jurisdiction.” With very small jurisdictions, the elasticity becomes infinite.

As defined in Section 2, mobility of the policy base is a necessary component for the existence of fiscal competition. This base mobility will not necessarily exist in the case of other mechanisms underlying spatial mimicking. In the current section, we seek to further explore the relation between fiscal competition and mobility.

Following Revelli (2005), mobility of the tax or expenditure base implies that

$$b_{it} = \beta_1 y_{it} + \beta_2 \bar{y}_{it} + \mathbf{X}_{it} \lambda + \alpha_i + \alpha_t + \epsilon_{it}, \quad (14)$$

which says that the base, b_{it} , in a given jurisdiction is a function of its own policy, y_{it} , as well as its competitor policies, \bar{y}_{it} . In particular, for taxes, we expect $\beta_1 < 0$ and $\beta_2 \geq 0$ with the latter approaching zero for very small competitor jurisdictions. These signs follow because a tax reaction function will only arise in the presence of tax competition when the tax base is mobile across jurisdictions in response to the tax differentials. Note, however, that the existence of strategic interactions in the presence of mobility relies on information available

to the policymaker about mobility. If the policymaker believes the tax base is mobile, but it is not, strategic interactions may still arise. Similarly, if the tax base is mobile but politicians do not believe it to be so, then no reaction function will arise.

Subject to the caveat above, we suggest that researchers seeking to identify tax competition also verify that the base is responsive to tax rates. Buettner (2003) and Brülhart and Parchet (2014) attempt to do this, with additional studies analyzing migration in response to welfare policies. Buettner (2003) studies the response of the local business tax base in Germany. He finds that the effect of the own-tax rate on the own-base is significant and negative, but he finds little effect of the neighboring jurisdiction's tax rates on the own-jurisdiction tax base. Only when interacted with population size does he find an effect of neighboring tax rates on the tax base, suggesting that small jurisdictions are being impacted by fiscal externalities (Buettner 2003). The null effect of neighboring jurisdiction's tax rates on the tax base is likely consistent with globally-mobile factors, implying a regional price-taking model of tax competition, rather than metropolitan model. The null effect for large jurisdictions could also be a result of a misspecification of the identity of the competitor jurisdictions; in particular, Buettner limits his study to nearby jurisdictions. However, recent empirical evidence suggests it is reasonable to believe that large jurisdictions are competitors with towns in different states or even different countries (Janeba and Osterloh 2013). The innovation of Buettner (2003) was to supplement estimation of a reaction function with estimation of (14) in order to identify the mechanism underlying the strategic interactions. However, most studies that look for tax policy mimicking do not separately estimate (14).

As noted above, a recent literature on migration has emerged to study the sensitivity of firms and individuals to income tax rates. One common theme is that, on average, taxes seem to only matter for very high income taxpayers. What is the implication for tax competition? If governments had access to a single flat income tax rate, then the government could not easily "discriminate" between high-income taxpayers and lower-income taxpayers. As a result, governments could more easily compete for high-income earners if they had access to a progressive tax system. However, if the tax system is characterized by multiple tax instruments, then governments could adjust top marginal tax rates to compete for top-income earners and could adjust transfer payments to compete for low-income earners. As a result, the mobility (and lack of mobility) for particular income groups helps shed light on which tax instruments may be the subject of intense fiscal competition. Tax competition could arise on top marginal tax rates, but not on lower bracket marginal tax rates; instead, governments may use welfare policies to engage in fiscal competition for low-income households.

As noted above, the literature on business taxes often finds effects on growth. Given formula apportionment and the vast array of corporate tax credits, increases in employment

or economic growth need not necessarily guarantee that the corporate tax base of a given region will increase. For this reason, the literature has turned to looking at several measures, such as actual location decisions, employment decisions, sales and capital allocations (Giroud and Rauh 2019). As discussed in the case of formula apportionment, the mobility of the tax base is possibly even more complex in the presence of multi-state enterprises.

We do not survey all other fiscal instruments, but again note only that fiscal competition need not be confined to tax instruments.

In order to relate these mobility and competitive forces to welfare implications, government objectives must be known. In Brülhart and Jametti (2019), when policy decisions are made by elected officials, these governments are assumed as Leviathan; governments where decisions are made in assemblies or by referendum are assumed benevolent. Using Swiss data, they find that benevolent governments in less-populated jurisdictions set higher tax rates, whereas there is no such relationship for Leviathan governments. Their interpretation of the results is that “...tax competition has a moderating impact on equilibrium taxes because governments are Leviathan.” This “moderating impact” is welfare-improving.

7.4.2 Yardstick Competition

Given that yardstick competition’s reduced-form equation is fundamentally the same as that used to estimate tax competition, it must be distinguished from tax competition in some other way. Lack of a tax base effect in equation (14) might be suggestive of yardstick competition, but could also be consistent with other theories. To get at the possibility of yardstick competition, linearizing (4) implies a reelection probability, p_{it} :

$$p_{it} = \delta_1 \bar{\tau}_{it} + \delta_2 \bar{G}_{it} + \delta_3 \tau_{it} + \delta_4 G_{it} + \mathbf{X}_{it} \lambda + \alpha_i + \alpha_t + \epsilon_{it}, \quad (15)$$

where $\bar{\tau}_{jt}$ is a spatial lag of taxes and \bar{G}_{it} is a spatial lag of public services. The coefficient δ_1 is expected to be positive and δ_2 is expected to be negative. These effects are not expected to arise in the presence of tax competition or expenditure spillovers. In this way, supplementing the reduced-form reaction function with voting results helps to isolate yardstick competition, as information about tax base mobility helps to identify fiscal competition.

Similar in spirit to estimation of (15), researchers have used election cycles to help distinguish yardstick competition. In particular, Besley and Case (1995) exploit gubernatorial term limits to identify yardstick competition. They argue that term-limited governors should be less subject to yardstick competition. In particular, “tax rates among neighbors should be uncorrelated in those years in which a state is run by a governor who cannot run for reelection. Sensitivity to neighbors’ taxing behavior should be manifest *only* during those

years when the governor is eligible to run again.” Empirically, they find no policy relationship with neighboring jurisdictions when governors are lame ducks, but a positive relationship when they are eligible for reelection. Moreover, they find that an increase in the tax rate in the governor’s state raises the probability of an incumbent’s defeat, but this effect is offset by increased taxes in neighboring states. Other researchers have exploited vote margins and look for spatial correlations that vary depending on the margin of victory. Allers and Elhorst (2005) and Elhorst and Fréret (2009) identify spatial mimicking that is more pronounced in places where the government has a smaller coalition majority and less pronounced in places that have a large coalition majority. This is consistent with yardstick competition because large majorities have more room to set their tax rates independent of information flows across municipalities. Revelli (2006*a*) uses the implementation of a national performance assessment system as a shock to information, and finds that it reduces yardstick competition. More recently, Buettner and von Schwerin (2016) show that even after accounting for state-level institutional features, many jurisdictions set exactly the same tax rate. The authors argue that the pooling equilibrium in yardstick competition is a potential explanation.

The presence of yardstick competition raises some concerns. If voters have information about the policies of other jurisdictions and observe that they are strictly superior to those in their own municipality, then why do they not migrate to those jurisdictions? Such a form of Tiebout sorting could also discipline politicians.

7.4.3 Expenditure Spillovers

Models with only expenditure spillovers assume no direct strategic reaction of own-policies to neighboring policies due to tax competition. This then implies that the researcher can estimate a model of the form of (13), using spending on public services as y_{it} . Notice that the reduced form is the same as in all other mechanisms, but the interpretation of ρ is now the extent of expenditure spillovers. Thus, Revelli (2002) notes: “Since public spending and local tax effort are related via the local government budget constraint, correlation between neighbors’ spending levels might be due to tax competition or yardstick competition, and not to an expenditure spill-over. Mimicking of local tax rates due, say, to capital tax competition, could in fact generate correlation in public expenditures, even though the benefits of local public services do not spill over jurisdictional boundaries.”

Thus, researchers seeking to identify expenditure spillovers often resort to ruling out mobility of the tax base. Also, certain categories of spending should theoretically have more spillovers than others. For this reason, Case, Hines and Rosen (1993) look for larger spillover effects in some spending categories than others. Solé-Ollé (2006) also finds benefit spillovers across Spanish localities by estimating a reaction function where governments interact in

expenditures. Of all the mechanisms, this one has received the least attention empirically.

7.5 Multiple Policies

Any relaxation of the government budget constraint may spur contemporaneous correlations in other fiscal policies. Of course, this raises the question of multiple instruments: even absent state grant changes, if governments have access to multiple instruments, how should we think of reaction functions? We focus on the case of multiple tax instruments, but the presence of public input competition discussed in Section 3 has similar implications.

Suppose the researcher is trying to estimate a sales tax reaction function of the form (13), where the y_{it} and its spatial lag are the sales tax rate. Suppose municipalities have access to local property taxes as well. For (13) to be valid, neighboring property taxes and neighboring sales taxes cannot co-vary. Agrawal (2016) highlights this problem. If the researcher estimates (13), we can think of property tax rates as an omitted variable. For simplicity, let $\bar{\tau}_{it}$ denote neighboring property tax rates. Then, the policy function for sales tax rates becomes $y_{it} = y(\bar{y}_{it}, \bar{\tau}_{it}, \mathbf{X}_{it})$. The true linearized model becomes

$$y_{it} = \rho_1 \bar{y}_{it} + \rho_2 \bar{\tau}_{it} + \mathbf{X}_{it} \lambda + \alpha_i + \alpha_t + \epsilon_{it}. \quad (16)$$

If the researcher omits $\bar{\tau}_{it}$, the researcher would estimate $\hat{\rho}$ in (13) as

$$\hat{\rho} = \rho_1 + \frac{\text{cov}(\bar{y}_{it}, \bar{\tau}_{it})}{\text{var}(\bar{\tau}_{it})} \rho_2. \quad (17)$$

Then it is easy to see that if the coefficient ρ_1 is zero, the misspecified model may yield a coefficient that is either positive or negative. The sign of the bias above is ambiguous, given that the covariance may be positive or negative, depending on how jurisdictions adjust taxes in response to shocks. The empirical literature has not yet determined the direction of the relationship between multiple tax instruments. However, the theoretical literature has made some progress. Braid (2013), for example, theoretically finds that if towns are sufficiently large, property taxes and sales taxes should equalize, but if towns are sufficiently small, the sales tax will be zero and the property tax will be positive in equilibrium. Future empirical work might study tax competition in the presence of multiple tax instruments, but researchers will need to find creative identification strategies given that (16) contains two endogenous tax policies. An alternative approach that deals with multiple instruments (Jacobs, Ligthart and Vrijburg 2010) is to construct a outcome variable that measures the effective tax rate in a jurisdiction by creating an index of multiple tax instruments. The basic intuition of this strategy is to develop a single variable that is sufficient for summarizing the

tax system as a whole. While this consolidates the problem to a single endogenous regressor, it is unclear of how to construct the effective tax rate, especially if different taxes feature different degrees of base mobility or underlying mechanisms by which they are set.

7.6 Capitalization: Identifying Tiebout-type Mechanisms

As mentioned in Section 3, Tiebout sorting is an important mechanism influencing local policy setting. Epple, Zelenitz and Visscher (1978) provides a systematic study of the testable implications of the Tiebout hypothesis. Following this tradition, many empirical papers test various implications of the model. Here we focus on several important articles.

7.6.1 Structural Models

A common approach to verifying the assumptions of metropolitan models discussed in section 3.1 has been to estimate the extent that taxes are capitalized into property values. Epple and Sieg (1999) provides a structural framework in which households vary in both tastes and income and sort among a discrete set of jurisdictions à la Tiebout models, and choose their desired amount of housing. A significant departure from the earlier literature focused strictly on capitalization is that sorting, as well as capitalization, is the focus of the study. This allows for the consideration of general equilibrium effects, including household mobility.

Development of their structural model requires a characterization of the equilibrium conditions that generate sorting based on income and tastes for a public service. As households vary both in income and tastes, jurisdictions will be heterogeneous in equilibrium – a mix of higher income/lower taste for public services households and lower income/higher taste households. After outlining the equilibrium conditions, Epple and Sieg (1999) postulate an indirect utility function. Then, using this indirect utility function, a boundary indifference condition can be obtained and, given the parameterization of the model, yields the distribution of income and population across jurisdictions.

After deriving these predictions of the income distribution and population distribution, they bring the model to the data on jurisdictions in the Boston MSA from the 1980 Census. The first stage of estimation is to match the income quantiles predicted by the model with their empirical counterparts. This stage does not require data on housing prices and public service provision, but only identifies a subset of parameters. The second stage exploits data characterizing local public services, amenities, and housing prices to estimate the remaining parameters, using the boundary conditions as the identification strategy. While the focus of the paper is on demonstrating that estimates of these structural models can approximate public service, house price, and income ordering in jurisdictions, these models also provide

estimates of capitalization similar to those found in reduced-form models – housing prices increase with lower crime and increase with higher educational spending.

Epple, Romer and Sieg (2001) extends Epple and Sieg (1999). Using both a similar model and the same data, they compare the “fit” of the data to two alternative assumptions about voter perceptions, discussed in Section 3.1. The first assumption is the “myopic” voting model, in which voters ignore the effects of migration, taking the population as fixed. Second, they consider a “utility-taking” framework in which voters anticipate migration in response to changes in public services and housing prices in their jurisdiction. The key relationship that distinguishes “myopic” and “utility-taking” voter perceptions is the government services possibility frontier (GPF), the locus of feasible public service and housing price pairs, given the jurisdiction budget constraints, housing market clearing, and perceived migration. With utility-taking perceptions, migration is incorporated into the (slopes of the) GPF. The results of the estimation of the two alternative models suggests that the utility-taking framework provides a better fit to the predicted GPF of the structural model.

To conclude, the capitalization results from the estimation of these structural models are generally consistent with the predictions of metropolitan models.

7.6.2 Boundary Designs

As in the structural models discussed above, other reduced-form studies have focused on capitalization. In contrast to the traditional hedonic model pioneered by Oates (1969), which relies on identification of the capitalization of public services or taxes into housing prices in panel or cross-sectional comparisons across jurisdictions, Black (1999) applies boundary-fixed effects to the estimation of hedonic models in order to better control for the characteristics of housing. Her focus, as is most of the following literature using variants on border-fixed effect models, is on elementary and secondary education. She compares houses within similar neighborhoods but across school attendance boundaries. The regression results show a 2.5 percent increase in house prices from a five percent increase in test scores. Gibbons, Machin and Silva (2013) use British data and boundary discontinuities to examine the response of housing prices to school test scores and find similar effects.

While the boundary-fixed-effect approach has distinct advantages, recent studies have identified several concerns. One issue that affects the interpretation of the estimates is that with growing school districts, school boundaries are uncertain and subject to change. In this case, risk reduces the extent of capitalization (Cheshire and Sheppard 2004). In contrast, while the boundary-fixed-effect literature is based on the assumption that houses near school boundaries are in the “same” neighborhood and exhibit the same characteristics along long-lasting boundaries, sorting based on school quality is likely to occur.

Bayer, Ferreira and McMillan (2007) provides strong evidence for clear differences in demographics along school boundaries. Using boundary fixed effects with neighborhood demographic controls, Bayer, Ferreira and McMillan (2007) find that the impact of school quality on property values is reduced by almost fifty percent relative to estimates with the boundary fixed effects alone. Moreover, this was the first paper that brought modern IO methods to the literature and, in combination with models in the spirit of Kline and Moretti (2014), allow for reasonable mobility elasticities that can be tied to model primitives.

7.6.3 Other Approaches to Identifying Tiebout Effects

In Section 6.3.2, we discussed the effects of school funding equalization on heterogeneity in spending and residential characteristics between school districts. Gramlich and Rubinfeld (1982), too, focus on heterogeneity in public service spending demands among and within jurisdictions as a “test” of the Tiebout hypothesis. Conducting a survey of Michigan households where respondents were asked to report their demand for public spending, the authors find smaller within-jurisdiction variance compared to the variance across jurisdictions. The authors also test if jurisdictions respond to citizen demand by comparing the median desired spending with the actual level and find evidence consistent with the median voter hypothesis. Rhode and Strumpf (2003) take a similar approach, but add a time dimension: as mobility costs fall, heterogeneity across jurisdictions will weakly increase. Covering over a century of municipal data, the authors find a decline in heterogeneity. Thus, they find “little evidence” that the “Tiebout mechanism played a dominant role in sorting over the last 150 years.” They argue that the literature needs to determine alternative motives for residential choices. As alternatives, they sketch a framework where individuals select jurisdictions based on employment opportunities in addition to public services, or a framework where sorting occurs over limited geographic areas but not nationally. In addition, Roller and Schmidheiny (2016) document how sorting by income across Swiss cantons means that effective taxes (i.e., average tax burdens actually faced by different income classes) are regressive at the top because high-income taxpayers disproportionately choose low-tax jurisdictions. Such income sorting is another “Tiebout-type” mechanism.

The literature on capitalization of educational services has also been moving toward other quasi-experimental approaches. Bogart and Cromwell (2000) employ a difference-in-differences framework to examine the impact of redistricting schools on house values. They find that the impact of losing a neighborhood school reduces house values by 9.9 percent. Ries and Somerville (2010) use repeat sales and exploit a redistricting process that redraws school-service areas to study the impact of school quality on housing values. They find that the only significant effects of this redistricting occur for top-quartile residences. Collins

and Kaplan (2017) utilize arguably exogenous boundary changes to estimate the effects of school quality and district attributes on housing prices. Their result shows that within the original school zone, areas zoned to higher-quality schools do not experience increases in price, relative to areas redistricted to lower quality schools.

To conclude, the literature on capitalization provides evidence of mobility, but not necessarily of sorting, which is better studied by understanding the variance within jurisdictions.

7.7 Structural Models Estimating Welfare Implications

Many studies of local policy choice have isolated the mechanisms through which governments strategically interact, but have faced difficulty in translating these empirical estimates into welfare implications. In particular, as noted in the theoretical section, the slope of the strategic reaction function is informative of the existence of policy interdependence, but is not informative as to whether taxes are “too high” or “too low.” In particular, the slope of the reaction function is not a sufficient condition for the existence of the “race to the bottom”.

7.7.1 Spatial General Equilibrium Models

The recent literature has made progress on the welfare implications of local policy choice through the use of spatial general equilibrium models. Although these models are appealing in this sense, many of these models have not incorporated endogenous strategic interaction. We view these classes of models as a promising way to estimate welfare effects. Future research should incorporate endogenous policy determination in these models. As discussed previously, several papers document that firm locations are responsive to taxes. But given their reduced-form setup, there was no way to translate what those estimated elasticities meant for labor demand or incidence. Suárez Serrato and Zidar (2016) is an excellent example of research that maps incidence to reduced-form coefficients. Their work shows a way forward for the local policy literature: both models and reduced-form results can be linked together.

While much of the previous literature has discussed the efficiency implications of local policies, one may also be concerned about the distributional impacts across different groups in society. Suárez Serrato and Zidar (2016) estimate the effect of (state) corporate taxes on incidence, focusing on how the corporate income tax affects private returns (wages and rents for workers, rents for landowners, profits for firm owners). In doing so, they provide information on the attractiveness of corporate taxation in an open economy. In this context, the authors must account for the fact that some high corporate tax states have substantial economic activity within the state. Their approach is to allow firm profits to vary across locations as one possible explanation as to why, for example, technology firms might agglom-

erate in Silicon Valley even in the presence of high corporate tax rates.³⁷ In the model, tax increases mechanically increase the cost of capital, which repels firms from the jurisdiction and reduces labor demand. Critically, the incidence on wages depends on the extent to which firms respond to the corporate tax change. In such a model, the authors can reject that 100 percent of the corporate tax is borne by workers. Further, the authors find a 1 percent cut in business taxes increases establishments by 4 percent over ten years. The authors also estimate a specification with the own-jurisdiction tax rate and external (other state tax) rates, to account for the effects of tax competition, that is, changes in other jurisdictions' tax policies on firm location. They find symmetric (opposite signed) effects to those of own-state tax rates. The authors also use their results to estimate the revenue-maximizing state corporate tax rate. When only considering the mobility response of firms, this rate is near 32 percent, but once the authors account for fiscal externalities and apportionment rules, the revenue-maximizing state tax rate is closer to the average statutory rate of 7 percent.

Suárez Serrato and Zidar (2016) obtain estimates of the incidence of state corporate tax cuts using reduced-form estimation of the effects of the (log) tax shocks on growth in wages, population, rents, and establishments that provide identification for the parameters of the structural model, and also by direct structural estimation. The incidence of the corporate tax on labor is the percentage change in wages less the product of the change in rents and share of housing in consumption; the incidence on landowners is the change in rent growth; and the incidence on firm owners is the change in profits, equal to the reduction in the capital “wedge” from the corporate tax less higher labor costs. Then the incidence is borne 40 percent by firm owners, 30 - 35 percent by workers, and 25 - 30 percent by landowners.

Fajgelbaum et al. (2019) studies tax rate dispersion within the United States to evaluate the welfare implications of tax rate decentralization. In a spatial general equilibrium model with both firm and worker mobility, the authors allow for several sources of tax revenue, and allow states to be heterogeneous in terms of productivity for firms and trade frictions. In this context, reducing tax dispersion across states may have positive or negative welfare effects. For example, the effect on aggregate income is ambiguous because its effect will depend on the initial correlation between tax rates and amenities and public services. The model depends critically on the mobility elasticity for workers and firms, and the extent to which public services matter for workers and firms. Moreover, how much people value government spending and how infrastructure affects production are key parameters, suggesting the value of public funds is critical. In the context of this model, the authors conduct counterfactual exercises where they hold constant public spending at initial levels or they allow state spending to endogenously respond to changes in taxes. The first exercise allows for isolating

³⁷Such a model shares similarities with Wildasin (2003), which allows for infra-marginal “old” capital.

changes in the variance of taxes across states that is budget-balanced in the aggregate (all states), while the second allows for the study of changes in the tax distribution via changes in spending. They find that dispersion in U.S. tax rates across states leads to aggregate welfare and output losses. This result is consistent with the theoretical models discussed in Section 3, in particular where large and small jurisdiction set different tax rates even if residents have the same preferences for government expenditures. Although taxes are not set competitively as in Ossa (2019),³⁸ one key counterfactual for tax competition is the role of tax harmonization. The authors find that as taxes are harmonized across a greater number of U.S. states, the overall dispersion in tax payments per capita shrinks and, consequently, welfare gains increase. Quantitatively, however, they find that harmonizing taxes across states within the same U.S. Census region generates welfare gains that are similar to those obtained under complete harmonization. How much people value government spending and how infrastructure affects production are key parameters.

As discussed above, structural models have also been used in traditional Tiebout-style models. We refer the reader to the survey by Holmes and Sieg (2015), which examines the application of structural models to local fiscal competition.

7.7.2 Heterogeneous Welfare Effects

Brühlhart et al. (2019) apply structural modeling and estimation to examine the capitalization of local income taxes into rental prices, using transaction-level data for municipalities in Switzerland over the 2004 – 2014 period. These authors are the first to estimate heterogeneous welfare effects across household types. Relaxing the assumptions of costless mobility and inelastic housing in the structural model of Epple and Sieg (1999) and Epple, Romer and Sieg (2001), the authors allow for heterogeneity in the extent of the tax incidence by type of household. Incidence is defined as the change in renter welfare, following Kline and Moretti (2014) and Suárez Serrato and Zidar (2016). Focusing on distinctions of households by the presence of children and income, they find that for households without children, there is large “positive incidence” (increases in welfare) in the bottom 50% of the income distribution, while strong “negative incidence” (reductions in welfare) for households in the top 25%. For households with children, the incidence is about zero across the income distribution. As well, they reject the assumption of an inelastic supply of rental housing, finding a price elasticity of approximately 0.7.

³⁸As noted by the authors, this has its advantages: “Our focus does not involve computing the equilibrium of a non-cooperative game, so it does not require taking a stand on the objective function or the information sets of policymakers, or on the process through which observed taxes are determined.”

7.8 Reflections

A major theme of the empirical literature is that local jurisdictions behave strategically when setting their policies. While many studies find that the policies of one jurisdiction are positively related to the policies of competitor jurisdictions, some studies find no relationship or negatively-sloped reaction functions. Although much progress has been made on dealing with the estimation of reaction functions, the literature must better address several aspects of local policy determination. First, localities offer a “package deal” by setting multiples taxes and spending policies. Thus, jurisdictions may react to a competitor jurisdiction changing a particular tax instrument by changing a different policy lever. Second, reduced-form models of strategic interactions are not well linked to their welfare implications. We believe the structural approach provides an important path for future research, but to do so, these models must endogenize policies among jurisdictions. Furthermore, the presence of strategic interactions must be more tightly linked to fundamental elasticities, including mobility estimates, but also to the pattern of information flows and spillovers across jurisdictions. These linkages are critical to understanding the precise mechanism underlying the strategic interactions, which in of itself, is critical to understanding welfare. Third, issues of dynamic adjustments are critical empirically. Although much of the theoretical literature focuses on a one-shot Nash game, policies adjust gradually over time, perhaps due to uncertainty or political/administrative costs of changing tax rates. Understanding the dynamics of policy adjustment empirically will be helpful for crafting theoretical models on the dynamics of tax competition. Finally, we believe that heterogeneity in how governments interact with each other is a critical avenue of future research. While much of the literature assumes that competition is similar among all localities, the response of a city to suburban policies may be very different than the response of the suburbs to city policies.

Relating back to the theoretical literature, we need more work that connects models with empirics. Bayer, Ferreira and McMillan (2007), for example, allows reasonable mobility elasticities that can be tied to model primitives. As a further example, although prior reduced-form mobility elasticities existed, Suárez Serrato and Zidar (2016) provide a way to think about what those elasticities mean for labor demand or incidence. The fact that their results map incidence to reduced-form coefficients shows that researchers can have both comprehensive models and tight reduced-form results together. Furthermore, although much of the policy choice literature has focused on taxes, the value of public funds matters for policy choices and deserves a central place in these models. Although much progress has been made to link reduced-form parameters and theoretical models, we believe that future research should include tax competition, yardstick competition, and other policy determination processes in spatial models that link theory and empirics.

8 Synthesis Model

A puzzle emerges from our review of the theoretical and empirical literatures on policy interdependence. In the theoretical literature, atomistic jurisdictions do not strategically react to the policy choices of any one other atomistic jurisdiction. For strategic reactions to occur in response to a single jurisdiction changing its tax rate, the theoretical literature assumes that jurisdictions have market power.³⁹ The market-power assumption seems reasonable for locally-mobile factors, such as those subject to commodity taxes (Kanbur and Keen 1993). But assuming governments have market power in the capital market (Keen and Konrad 2013) is unsatisfying at the municipal level. Nevertheless, the empirical literature often focuses on capital taxation and, in fact, provides evidence that jurisdictions raise their capital tax if their (small) neighbors raise their capital taxes.⁴⁰ While appealing to the joint use of immobile land and capital in production might be one way to generate tax reaction functions from taxes on mobile capital (Hoyt 1992), this link between land and capital is not the general assumption found in the theoretical literature, probably due to the small share of land in production. Unless capital markets are segmented, this leaves the puzzle that, empirically, localities strategically react to each others' taxes, but the theoretical models resort to the heroic assumption of localities having market power in capital markets to explain why.

Furthermore, we have noted that many theoretical and empirical studies have developed in large part to focus on specific taxes, and are consequently not amenable to considering complex, multi-instrument decisions that localities face. In particular, the empirical analyses typically focuses on a single fiscal instrument. This too raises puzzles.

Here, we present a unifying theoretical model of tax competition that includes mobile workers, mobile residents, and mobile capital, and is appropriate for empirical analysis using local tax rate data, that is, it will generate capital tax reaction functions for local governments, as well as cross-instrument reaction functions. Our model features the mobile capital component of *ZMW*, the mobile labor component of Braid (1996) and Lehmann, Simula and Trannoy (2014), and the possibility that residence may also be mobile, as in Hoyt (1993) and Parchet (2019). In this way, our model synthesizes several types of tax competition models: “regional models,” which focus on capital mobility; “metropolitan models,” which focus on employment or resident location decisions; and “income tax models,” which implicitly assume that the place of work and residence is the same. Our framework can address the simultaneous use of expenditures and many tax instruments (taxes on capital, property,

³⁹Alternatively, many jurisdictions of positive measure may adjust their tax rate simultaneously. However, given that the spatial lag used in estimating a tax reaction function is created from a small number of jurisdictions, it is unlikely that even all of these jurisdictions combined have market power in capital markets.

⁴⁰For example, Brueckner and Saavedra (2001) finds strong positive strategic interactions.

employment-based earnings, residential income, sales, and commuting), some of which are not typically addressed in tax competition models. Here, for simplicity, we focus on capital and residential income taxes. Agrawal, Hoyt and Wilson (2019) formally present the model.

8.1 The Model

Inspired by Wildasin (2014), our model links local governments through locally-mobile labor and residents. We consider a metropolitan area that faces an exogenous after-tax return on capital, determined on national or world markets. But jurisdictions within this area possess market power in labor and residential markets. Although individuals are homogeneous, the model can be easily extended to include Tiebout sorting, and also expenditure spillovers.

As the results we highlight do not depend on the number of jurisdictions in the metropolis, we assume for this review that the jurisdictions consist of a central city and a suburb. The metropolitan area contains a fixed number of residents, \bar{N} , who can reside in either the city or suburb, as well as be employed in either place. Labor productivity is higher in the city, resulting in commuting from the suburb to the city. But some suburban residents work in the suburb. Let $i = 1, 2$ index the city and suburb, respectively. Then N_i and L_i denote the residential population and employment in jurisdiction i , where L_i need not equal N_i because of commuting. Next, let N_{21} denote the number of individuals commuting from the suburb to the city. We denote the labor-population ratio in the suburb by $l_2 = \frac{L_2}{N_2} = 1 - \frac{N_{21}}{N_2}$. This ratio is less than one, whereas the city's labor-population ratio, $l_1 = 1 + \frac{N_{21}}{N_1}$, is greater than one. In our model, commuting is costly with the cost of commuting, $A(N_{21})$, increasing at an increasing rate in the number of commuters, reflecting commuting costs.

Labor and capital are used to produce an industrial good, which is tradeable at a fixed world price. A nontradeable commodity, housing, is produced from capital and land. The technologies exhibit constant returns to scale. This specification of production is based on the relatively large amount of land devoted to residential housing in urban areas, compared to land in non-residential production activities. Profit maximization yields a housing supply function, $H_i(p_i)$, where p_i is the after-tax price of housing in jurisdiction i .

To proceed, we will focus on a residential income tax, levied at rate t_i^R , and an industrial capital tax or subsidy with rate t_i^I , though in our discussion of tax reaction functions we also briefly discuss the implications of using a property tax t_i^P , levied on both the land and capital used in housing. With profits equal to zero in equilibrium, the wage in jurisdiction i , w_i , is declining in t_i^I , given the exogenous after-tax return on capital.

We simplify by assuming a quasi-linear utility function, $U_{ij} = Y_{ij} + S(p_i(1 + t_i^P)) + V(G_i)$, where G_i is the public service, Y_{ij} is income net of commuting costs and taxes for a

resident of i working in j , and $S(p_i(1+t_i^P))$ is consumer surplus from housing. Recalling that commuting costs only apply for a resident of the suburb commuting to the city, we have $Y_{21} = w_1 - t_2^R - A(N_{21})$, while for a non-commuter in the city or the suburb, $Y_{ii} = w_i - t_i^R$. Finally, we assume that all housing is owner-occupied.⁴¹

Public service production exhibits constant costs with respect to the level of the public service and population. Dividing revenue by N_i yields the per-capita government budget constraint, $t_i^I k_i l_i + t_i^R + t_i^P p_i h_i = G_i$, where k_i denotes the capital-labor ratio in the production of the tradeable good, l_i is the labor-population ratio, and h_i is housing per resident.

We consider two equal utility conditions. First, the utility of a suburban resident does not depend on whether she commutes, in which case the after-tax wage in the suburb equals the after-tax wage in the city less commuting costs. Second, a resident/worker in the suburb has the same utility as a resident/worker in the city. The housing market clears as well. A jurisdiction's aggregate demand for housing is $N_i h(p_i(1+t_i^P))$, so $N_i = \frac{H_i(p_i)}{h(p_i(1+t_i^P))}$. Summing over both the city and suburb gives $\sum_i \frac{H_i(p_i)}{h(p_i(1+t_i^P))} = \bar{N}$.

The governments play a Nash game in tax rates, with each maximizing the utility of its residents, given the taxes chosen by the other government. As the governments compete in tax rates, public service levels are determined by the government budget constraints, meaning that the effects of changes in tax rates on prices and population are implicitly the effects of both the change in the tax rate and the balanced-budget change in public services.

8.1.1 Capital Taxation

We begin by considering the case when the capital tax is the only source of revenue. Using the government budget constraint to substitute for the derivative of a jurisdiction's public service with respect to its capital tax, we express the first-order condition as

$$MRS \equiv V'(G) = \frac{1}{l \left[1 + t^I (\hat{k}_{t^I} + \hat{l}_{t^I}) \right]} \equiv MCF_{t^I}, \quad (18)$$

where jurisdictional subscripts are dropped and hats denote a percentage change from a tax increase. This condition equates the marginal benefit from the public service, $V'(G)$, to the marginal cost of funds, MCF .

Absent any effects of the tax on the capital-labor or labor-population ratios ($\hat{k}_{t^I} = \hat{l}_{t^I} = 0$), whether the public service is over- or under-provided relative to the efficient level ($V'(G) = 1$) depends on whether the worker-population ratio is greater or less than one. In

⁴¹Although the assumption of homeownership eliminates the standard incentive to export taxes to absentee landlords, we shall see that both tax-exporting and tax-importing incentives remain. Housing appreciation affects both the income of households and the costs of the housing they consume.

the central city, $l_1 > 1$ implies overprovision ($V'(G_1) < 1$), and in the suburb, $l_2 < 1$ gives underprovision ($V'(G_2) > 1$). The city's capital tax effectively exports some of the tax cost of public services to suburban residents, in the form of reduced wages.

However, the capital-labor and the labor-population ratios both respond to a tax increase. The capital-labor ratio, k , falls because the tax increase raises the rental-wage ratio. The fall in k raises the MCF , because it lowers per capita tax revenue. This effect is the one highlighted in traditional tax competition models, where neither residents nor employment is mobile. If only employment locations change, then a higher tax in the city reduces commuting, lowering l_1 , whereas a higher tax in the suburb increases commuting, lowering l_2 . Both effects occur through wage reductions, and they lower the MCF for both jurisdictions. There is no change in housing prices, which are affected only by changes in populations. Then the MCF exceeds one in the suburb, implying underprovision of the public service. However, this need not be the case in the city, due to the tax-exporting effect because $l_1 > 1$.

As well, when the city's higher tax rate reduces the number of commuters, the resulting rise in suburban labor-population ratios raises per capita tax revenue in the suburb, representing a positive fiscal externality. This increase in per capita tax revenue translates into a balanced-budget increase in public services in the suburb, inducing some city residents to move to the suburb. Taking into account the changes in both the city's employment and residential populations, we cannot sign the change in l_1 , which is another reason for which the city's MCF may be less than one. In contrast, we can show that a rise in the suburb's tax rate must lower l_2 , taking into account both the fall in both its employment and residential population, and its MCF must be less than one.

8.1.2 Residential Taxation

As an alternative to the tax on capital, consider a tax on residents. Because each resident's labor supply is inelastic, this tax is simply a head tax. Not surprising, when the residential tax is the sole source of revenue, we have $MRS \equiv V'(G) = 1$, the condition for efficient public service provision. Although we do not observe localities using head taxes, they are equivalent to a property taxes when there is perfect zoning, that is, zoning that restricts both the capital/land ratio and lot size. Note that while the head tax will result in the efficient provision of public services, it does nothing to address inefficiencies associated with commuting that result from untaxed congestion.

8.1.3 Capital and Residential Tax

More interesting is the case where jurisdictions have the possibility of taxing or subsidizing capital and taxing or subsidizing residents. When jurisdictions can levy a tax on residents, both jurisdictions will set taxes to ensure the efficient level of the public service: $V'(G) = 1$. But the city can do better by reducing the residential tax and replacing the lost revenue with a capital tax. Doing so reduces the wage, but unlike the residential tax, part of the burden is passed on to non-resident commuters. Thus, some capital taxation is desirable, though the amount is limited by the excess burden from the distortion to the capital-labor ratio. But in some cases, it may be desirable to subsidize residents, allowing for a higher capital tax and more tax exporting. Note, too, that the burden of the lower wage received by commuters is offset by a reduction in travel costs, due to less congestion. Essentially, the capital tax is similar to a tax on congestion externalities, albeit one that distorts the capital-labor ratio.

This argument is reversed for the suburb, where the worker-population ratio is less than one. In this case, subsidizing capital and taxing residents is similar to a commuter tax, because the suburban wage rises, but only residents who do not commute receive the benefit of the higher wage. The commuter tax is desirable because the model contains congestion externalities. But again, the excess burden from the capital subsidy limits its use.

8.2 Tax Reaction Functions

Tax reaction functions are a focus of the empirical literature, but the existence of non-zero-sloped reaction functions is at odds with metropolitan areas facing an exogenous after-tax return on capital. With our model of jurisdictions that are atomistic with respect to capital markets but have market power in labor markets, we resolve this tension between the empirical and theoretical literature. To investigate tax reaction functions, assume that $V(G) = \ln(G)$. Then the first-order condition for the capital tax may be rewritten as follows:

$$W_{t_i^I}^i = -k_i + \frac{1}{t_i^I} \left[1 + t_i^I \left(\frac{k_i'}{k_i} + \frac{l_i'}{l_i} \right) \right] = 0, \quad (19)$$

where a prime denotes the derivative with respect to own tax rate. Implicitly differentiating this first-order condition gives dt_i^I/dt_j^I , with its sign equal to the sign of $-W_{t_i^I t_j^I}^i$.

As the after-tax return on capital is assumed fixed, strategic interactions occur only through changes in employment and residential populations. In this case,

$$\text{sign} \left\{ \frac{dt_i^I}{dt_j^I} \right\} = \text{sign} \left\{ -\frac{l_i'}{l_i^2} \frac{dl_i}{dt_j^I} + \frac{1}{l_i} \frac{dl_i'}{dt_j^I} \right\}. \quad (20)$$

To investigate this sign, first consider the case in which residents are immobile. A tax increase in the suburb will lead to more commuting to the city, lowering the suburb's labor-population ratio ($l'_2 < 0$), while a tax increase in the city reduces commuting, lowering its labor population ratio ($l'_1 < 0$). But the increase in each jurisdiction's tax raises the other jurisdiction's labor-population ratio ($\frac{dl_i}{dt_j} > 0$, $i, j = 1, 2$, $i \neq j$). Thus, the sign of the first term is positive. For the second term, note that if there is more [less] commuting, then a change in commuting has a greater [smaller] marginal impact on congestion costs, by the strict convexity of the commuting cost function. For this reason, we can use our previous results about the effects of the city and suburb taxes on commuting to show that the derivative l'_2 declines with a rise in the city's tax, whereas l'_1 increases with a rise in the suburb's tax. Thus, the city's reaction function has a positive slope, whereas the slope of the suburb's reaction function may be positive or negative, depending on the sensitivity of marginal congestion costs to the number of commuters. This heterogeneity is novel to the literature and raises empirical issues that we discuss at the end of this section.

We previously observed that a change in a jurisdiction's tax rate causes residents to move to the other jurisdiction. Next, considering a case with fixed commuting, a rise in the city's population lowers its labor-population ratio, whereas a rise in the suburb's population raises its labor-population ratio (because a smaller fraction of resident's commute). These population changes create additional ambiguities, and we are left with the conclusion that both reactions functions have ambiguous signs. In fact, they may have opposite signs.

The possibility that different jurisdictions have reaction functions with slopes that differ in sign creates challenges for empirical studies that estimate the slopes of reaction curves. In these cases, an empirically estimated slope of zero may correspond to a mix of jurisdictions with opposing signs of reaction functions. Then the researcher must take care to model this heterogeneity in the reduced-form tax reaction function, but few papers specify multiple weight matrices (Cassette, Di Porto and Foremny 2012).

8.2.1 Cross-Instrument Reaction Functions

If a residential tax is also employed, then a change in one jurisdiction's capital tax will cause the other jurisdictions to adjust their residential taxes to maintain a balanced government budget with efficient public service provision. On the other hand, there is no strategic response to other jurisdictions raising their residential tax rate.

Suppose that we replace the residential tax with a property tax. The property tax does not affect commuting, because it has no impact on wage rates. However, an increase in the property tax in one jurisdiction (city or suburb), along with the resulting rise in public service provision, attracts additional residents to the jurisdiction. The per capita tax bases

for the capital and property tax both change in the other jurisdiction, causing it to adjust both taxes. Cross-instrument strategic effects between the property tax in one jurisdiction and the capital tax of another jurisdiction are now present.

8.2.2 Key Lessons

To conclude, three important implications emerge. First, strategic interactions among systems of jurisdictions that are atomistic with respect to the capital market are plausible. Local jurisdictions are linked by locally-mobile factors, and it is the mobility of these factors that gives rise to non-zero tax reactions in capital taxes. Second, in the presence of multiple taxing instruments, researchers must account for all relevant neighboring jurisdictions' tax instruments. In the presence of a property and capital taxes, the reduced-form reaction function for capital taxes must include both the neighboring jurisdictions' property and capital taxes. Otherwise, estimates of reaction function slopes will be biased, where the sign of the bias depends on whether the cross-reactions are strategic complements or substitutes. Third, the slopes of tax reaction functions may be heterogeneous across jurisdictions: some jurisdictions may treat others' tax rates as strategic substitutes, while others may treat their competitors' policies as strategic complements. Empirical researchers must carefully consider the underlying form of policy interdependence and model this heterogeneity appropriately.

9 Assessment of the Literature and Future Research

From our review of the theory, we see that the literature has come a long way from early Tiebout and tax competition models. Multiple mechanisms for policy interdependence have been identified, and the literature has moved beyond capital tax competition to consider multiple tax instruments, public expenditures, firm-specific subsidies, regulations, growth effects, and political economy concerns. In doing so, we no longer have simple answers to questions like: "Does competition lower taxes?" or "Is competition welfare enhancing?"

Going forward, we view four areas of future research as especially promising. First, models with multiple policy choices (multiple taxes, zoning, or expenditures) are especially important at the local level, where the bundling of many services and taxes are important for residential and firm sorting. Second, dynamics (Wildasin 2011) are critical to understanding the time evolution of policies. When governments set policies, movements of the tax base are not instantaneous: frictions make old capital and labor move slowly across jurisdictional borders in ways that may influence the dynamic adjustment process of tax rates. Third, recent empirical studies have focused on using higher-level constraints on local governments as an exogenous source of variation. For this reason, understanding the effects of minimum

tax rates, spending requirements, and other higher-level policies on lower-level governments is critical and deserves attention beyond the literature on vertical strategic interactions, which often assumes no horizontal interactions. Finally, in moving beyond welfare-maximizing governments, the literature has created greater ambiguities about the welfare effects of policy interactions. Progress is being made on understanding phenomena such as excessive firm-specific subsidies, but further progress would be welcome.

On the empirical side, this article conveys an important message about local policy choice. Understanding how and why governments choose particular policies also has implications for analyzing the effects of these policies on behavior and welfare. In particular, when estimating behavioral responses, researchers often exploit spatial and temporal variation in policies. Besley and Case (2000) write: “To estimate the effect of policies on economic behaviour, one needs a source of policy variation.... However, time varying state level policies can be studied as either left or right hand side variables. . . . [I]nvestigating the determinants of policies is an important prerequisite to understanding when and whether one can legitimately put policy on the right hand side. If interstate variation in policy is to be useful in estimating the impact of a policy change on an identifiable group, the source of the policy variation must be fully understood by the researcher. This is a necessary, but not sufficient, condition for unbiased estimation of a policy’s effects.”

Many recent studies of economic outcomes utilize local policy variation on the right hand side, assuming that the policy variation is exogenous. As reviewed here, the vast literature on local policy choice suggests that policies are not determined in a vacuum; they are determined subject to constraints under which localities operate and strategic and competitive forces that arise due to the open economy nature of localities. This competition results in spatial dependence and correlated policy changes across time and space. Given that policies are not set randomly, understanding the mechanisms by which policies are chosen is essential to developing empirical strategies to identify the effects of local policies. As with Besley and Case (2000), estimating policy determination equations (with policies on the left hand side) are useful for researchers to find appropriate sources of exogenous variation, and to then use these policies on the right hand side to predict economic outcomes. Let us stress that the recent empirical literature (Eugster and Parchet 2019; Agrawal 2015; Lyytikäinen 2012) has made some important progress in uncovering, or at least ruling out, the mechanisms that produce strategic behavior. The papers determining the mechanisms underlying the equilibrium policies provide a starting point for how to appropriately analyze their effects.

Combining theory and empirics, we have little empirical evidence on whether local policy interdependence is “good” or “bad.” Spatial general equilibrium and structural models have made some progress and allow us to estimate the welfare effects of counterfactual policy

experiments. Due in part to the complexity of these models, however, these structural models often abstract from any strategic interactions or fiscal externalities. Incorporating these considerations would seemingly represent an important contribution, so that the existing reduced-form literature can then be used to shed light on this canonical debate.

Ascertaining welfare effects also requires some knowledge of the welfare function or political process employed by local governments. For example, we may confirm the prediction from the *ZMW* model that capital tax competition leads to lower tax rates and public spending levels, but these lower taxes could be welfare-decreasing in the case of welfare-maximizing governments, while they are welfare-improving when government decision-making is controlled by revenue-maximizing government officials. There is little evidence on what local governments maximize or what political process they employ. Models of fiscal competition with multiple policy instruments might be useful, as different government objectives lead to different mixes of taxes. For example, revenue-maximizing governments would want to employ excessive taxes on land or property, compared to land-value maximizing governments.

Despite having many unanswered questions, much progress has been made in the last ten years. In particular, empirical work is now better connected to theory and has made progress to uncovering the mechanisms by which governments strategically set policy. Given recent advances, and the dramatic increase in local public finance databases, it is an exciting time to be doing research on local policy determination.

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Online Appendix for “Local Policy Choice: Theory and Empirics”

David R. Agrawal, William H. Hoyt, and John D. Wilson

A Introduction

In this online appendix, we discuss additional issues not covered in the main text of the paper. Section B discusses two additional mechanisms of policy interdependence: learning and policy diffusion. Section C discusses international tax issues. While this review is focused on local policy choice, we emphasize what the literature on local governments might learn from the international tax competition literature. Section D discusses empirical evidence on additional economic outcomes, including interjurisdictional spillovers and the effects of place-based policies. Finally, section E emphasizes the empirical evidence on learning and policy diffusion, including a large literature in political science.

B Additional Mechanisms: Diffusion and Learning

Social learning is a process whereby information is mobile across borders. However, unlike yardstick competition, this information is not used to discipline policymakers, but rather is information that can be used in the optimal setting of policy. With incomplete information over policy outcomes, governments can learn from their own policies and outcomes, in addition to the policies and outcomes of other jurisdictions. Such observations allow the government to update their priors on a state of nature, such as, the elasticity of the tax base. States and localities act as laboratories and learn from experimental first-moving jurisdictions. In this model, beliefs converge over time, resulting in tax rate convergence.¹

Becker and Davies (2017) show that even in the absence of fiscal externalities, learning reduces the difference between an initial tax rate and the optimal tax rate. Because the information set from which learning occurs is the same for all jurisdictions, changes in the information set have similar changes in all jurisdictions. Thus, “although each country’s payoff is completely independent of the taxes set elsewhere, those taxes alter the information set it has and therefore the tax it chooses.” As a result, it appears that jurisdictions interact strategically with each other, even though they have no strategic motives. However, the implications of finding a positive correlation between own-tax and neighboring jurisdictions’ policies are dramatically different. In the presence of tax competition, tax coordination may be welfare improving. In the presence of learning, tax coordination prevents learning and thus prevents jurisdictions from getting closer to their optimal tax rate.

C International Tax Issues

The conclusion that small jurisdictions set lower tax rates appears throughout the tax competition literature, even in models that seemingly differ in important ways. In particular,

¹In a model without learning, Agrawal and Trandel (2019) shows that first-movers may set policies that are different from later-moving jurisdictions. In this model, policies need not converge.

this result arises in models of cross-border shopping, discussed in the text. Mongrain and Wilson (2017) obtain the same result for a model with two types of firms, domestic and foreign, where domestic firms have heterogeneous costs of becoming foreign firms by moving from their country of origin. Both types of firms pay the same tax. Here, jurisdiction size is measured by the number of domestic firms.²

There is now an extensive literature on tax competition with heterogeneous firms, and these models often borrow from the heterogeneous-firms literature in international trade, including their common assumption of monopolistically-competitive firms. Davies and Eckel (2010) assume that firms all possess the same fixed costs but differ in marginal costs. Those with lower costs enter the industry first, with the marginal firm indifferent about entering the industry. Two jurisdictions compete for these firms through their choice of a profit tax, which is used to finance a public service. The low-tax jurisdiction attracts the more productive firms, whereas the less productive firms benefit from lower wages offered by the high-tax jurisdiction. A pure-strategy Nash equilibrium in tax rates exists only if one jurisdiction is sufficiently large compared to the other jurisdiction, and the large jurisdiction always sets the higher tax rate. Again, the basic reason is that the large jurisdiction faces the less elastic supply of capital. In fact, as the small jurisdiction becomes infinitesimally small, the profits of the firm that is indifferent between the two jurisdictions approaches zero, in which case the large jurisdiction's profit tax has little effect on firm location. Davies and Eckel (2010) compare their model to Wilson (1987), because in both models, there is no pure-strategy equilibrium with equal taxes. But the latter paper extends a *ZMW* model with many identical price-taking jurisdictions to include interjurisdictional trade in two private goods. An asymmetric equilibrium with different tax rates results because tax competition causes jurisdictions to necessarily specialize in producing only one of the two traded goods. Exogenous size differences, therefore, do not play a role. In both papers, however, the socially-optimal tax policy requires equal tax rates. In other words, tax competition may result in inefficient diversity in tax rates.

The international trade literature has emphasized the “home market effect” as an important advantage enjoyed by large countries. These models typically include trade costs for goods shipped from one jurisdiction to another, and a larger home market allows a firm to sell a greater share of its output to consumers within its jurisdiction, therefore avoiding these costs. Thus, if firms can move between jurisdictions, the share of firms located in a jurisdiction will be proportionally larger than the relative size of the jurisdiction in terms of consumer demand.

Baldwin and Okubo (2014) is a model of tax competition with trade costs and, therefore, a home market effect. The assumption of firm heterogeneity allows them to obtain a Nash equilibrium, which would not exist if firms were homogeneous, as in Baldwin and Krugman (2004). The large jurisdiction, measured by number of immobile workers, is able to take advantage of the home market effect and set the higher tax rate, without causing all firms

²Keen (2001) shows that preferential treatment leads to lower tax revenue in a tax competition game, but Janeba and Peters (1999) obtain the opposite result in a model where the mobile tax base is infinitely elastic. The importance of this elasticity is also evident in Wilson (2005), Konrad (2008), and Marceau, Mongrain and Wilson (2010). Janeba and Smart (2003) investigate a more general model, where tax bases also respond to a uniform increase in both regions' tax rates. A limitation of this literature is that governments are usually assumed to maximize tax revenue, rather than the welfare of their residents.

to locate in the low-tax jurisdiction. This model builds on Haufler and Stähler (2013), who also find that the large jurisdiction sets the higher tax rate, but does not allow for interjurisdictional trade and instead models the size advantage in a reduced-form way by assuming firms can sell at a higher price in the large jurisdiction. Burbridge, Cuff and Leach (2006) provided an early analysis of tax competition with heterogeneous firms, but where a firm’s productivities differ across jurisdictions.

D Economic Effects of Local Policy

D.1 Spillovers

Even in the absence of mobility, policies in one jurisdiction may have spillovers on nearby jurisdictions. For example, pollution regulations set by one government may improve the environmental quality of nearby jurisdictions. Spending on education or human capital formation may create productivity gains in other jurisdictions. In light of the literature that has used policy reaction functions to determine the existence of spillovers, we discuss the effects of these expenditure spillovers below. A large literature on agglomeration suggests spillovers are highly localized in nature (Ahlfeldt et al. 2015; Arzaghi and Henderson 2008; Rosenthal and Strange 2001, 2008). This may contrast with expenditure spillovers from public services that are consumed by both residents and commuters.

In this section, we focus on spillovers in the context of decentralized environmental policy, because these spillovers have received attention in the literature, and because they result from sub-national policy decentralization.³ With respect to environmental spillovers, it is useful to discuss the expected effects. Ogawa and Wildasin (2009) nicely summarize:

An important theme in the literature of fiscal competition, exemplified by a well-known paper by Oates and Schwab (1988), is that both fiscal and regulatory instruments influence the amount and location of such externality-producing activities. In some cases, depending on the range of available instruments and on informational and other constraints, competitive pressures may lead governments to control pollution or other externalities efficiently, with the important proviso that these effects do not spill over jurisdictional boundaries. When there are interjurisdictional spillovers, the literature consistently finds, as intuition would suggest, that decentralized policymaking produces socially inefficient outcomes.

Against this backdrop, Ogawa and Wildasin (2009) provide a counter-example where, even in the presence of spillovers, decentralized policymaking may lead to efficient environmental regulations in the absence of corrective mechanisms by higher level governments. In particular, and in contrast to the literature on fiscal competition, competition for mobile capital plays a crucial role in providing efficiency-enhancing interjurisdictional linkages.

³By spillovers in the environmental setting, we mean the effect of one jurisdiction’s policy on pollution in other jurisdictions. This does not include other effects such the mobility of firms or consumers following a change in regulatory policy, which falls under the mobility section in the main text. Indeed, Cohen and Keiser (2017) consider the case of phosphate bans on detergents. They find that residents in phosphate-ban counties travel across county borders to purchase high-phosphate detergent.

Much of the literature has focused on the effect of environmental programs on treated areas, with less emphasis on spillovers to untreated areas (for a survey, see Pfaff and Robalino 2017). We focus on spillovers to untreated areas and not the race to the bottom in environmental policy (see for example, Konisky 2007). Similar to studies of the effect of policy decentralization on growth, much of the early literature focused on international comparisons. Sigman (2002) shows that water monitoring stations that are upstream relative to the international borders of the E.U., and thus not subject to environmental regulation, have higher pollution than other stations; this is not the case for stations on rivers upstream to borders internal to the E.U. This suggests that countries free-ride on the environmental policies of other jurisdictions. Sigman (2005) finds similar results for the United States, exploiting the fact that states can control their Clean Water Act programs.

Recent studies have looked within countries. Lipscomb and Mobarak (2017) estimates the magnitudes of spillovers from rivers that cross county boundaries within Brazil. Identification comes from the frequent redrawing of county borders. For example, the number of counties increased by over 1500 (relative to a baseline of 4000 counties) during a twenty year period. As the number of county borders increases in between pollution monitoring stations, it is expected that the incentive to pollute increases, as the county's politicians do not consider downstream individuals following a redrawing of borders. Pollution increases as the river reaches the downstream pollution monitoring station, and it does so at an increasing rate. Furthermore, each additional border crossing induced by a border change raises pollution. Finally, the level of pollution shows a structural break at the county border where the downstream monitoring station is located, suggesting that this county restricts polluting activity. By exploiting changes in border status, the authors can isolate changes in pollution, controlling for the fixed location of the monitoring stations. Furthermore, identification can come from changes in distances, after controlling for a county's decision to split its borders. Thus, the authors exploit the fact that some border changes lead to large changes in distance between the pollution monitoring station, while other changes lead to smaller changes in distance. This strategy accounts for the potentially endogenous decision of a county to split.

The presence of these spillovers, and the fact that being upstream or downstream has different implications for who bears the burden of pollutants, implies that states have perverse incentives on getting firms to locate in various places. In particular, states have incentives to locate polluting facilities, through the use of zoning, near borders. In doing so, more of the pollutants will be borne by neighboring jurisdictions than by their own jurisdictions. Using the case of negative externalities, and not pollution per se, Jacob and McMillen (2015) shows that the city of Chicago is more likely to zone commercial areas near the city boundaries. Monogan, Konisky and Woods (2017) show that major air polluting firms are more likely to be located near a state's downwind border; the effect is especially large for firms with toxic air pollution. In particular, the authors argue that states may use regulatory or economic development policy incentives to induce air-polluting firms to locate near down wind borders. Some of this may also be due to companies being forward looking, and therefore avoiding upwind sites where political opposition may arise. To test these channels, they compare states with stronger environmental programs and states that make greater use of economic development incentives.

In addition to environmental policies having important spillover effects, a large literature also focuses on the effect on housing prices. Some representative articles include Chay and

Greenstone (2005), Currie et al. (2015) and Greenstone and Gallagher (2008).

D.2 Place-based Policies and Economic Effects

With respect to place-based policies, we focus on policies – surveyed in Neumark and Simpson (2015) – that apply differentially within a jurisdiction and thus treat some firms and households differentially. The emphasis in this literature is on whether these policies improve the economic outcomes of the jurisdictions in which the policy is instituted and, critically, if these improvements are a result of a zero-sum mechanism that simply “steals” activity from nearby jurisdictions. One of the largest of these policies is the federal Empowerment Zone and Enterprise Communities Program. Under this program, local governments can submit applications for eligible high-poverty and unemployment tracts to receive grants and employment credits. Many states have also created additional programs, and similar policies target places in European countries. The empirical literature on place-based policies must deal with the endogeneity of places where policies are adopted, but also must address spillover effects, which may make selection of counterfactual control groups very difficult.

Within this literature, numerous studies have focused on the effect of enterprise zones on own-jurisdiction employment, finding either no effects or positive effects (Kolko and Neumark 2010; Neumark and Kolko 2010; Freedman 2013; Busso et al. 2013). Our focus is on where this economic activity comes from: does it arise because new firms create spillovers to other spatially close firms in the jurisdiction through agglomeration effects or does it come from a zero-sum game where economic activity in the zone comes at the expense of lost activity from nearby jurisdictions. Papke (1993) found that most of the additional activity in the zone was simply activity that relocated. Of course, if the program was targeted to specific places in order to obtain agglomeration benefits, such a result may still have positive welfare implications from a social welfare perspective. Thus, to evaluate the policy, one must know the net benefit to the jurisdiction and net cost to the neighboring jurisdiction. Even if all economic activity in the zone increases due to mobility of economic activity from nearby places, the net benefits may still exceed the costs if the zone has large agglomeration benefits.

Busso et al. (2013) study federal empowerment zones. These authors identify large employment effects for workers in the zone. Using a general equilibrium model, they express the welfare change from the policy as a function of the elasticities of several responses that they estimate. The authors find relatively large welfare gains, in part because the benefits of the program are capitalized into house prices in the zone, and because their analysis suggests that migration responses do not substantially reduce the gains of the program. Other papers are more negative. For example Hanson (2009) finds no effect on employment in the zones. In a follow-up paper, Hanson and Rohlin (2013) study the effect of zones on tracts that are similar to the enterprise zones, but not in the zones. They find negative spillover effects: these similar tracts experience reductions in the amount of employment and the number of establishments. In the international setting, Givord, Rathelot and Sillard (2013) studies Franches Urbaines and find an increase in the number of establishments in the zones. To identify spillovers, the authors study firms outside the zone and find results that are opposite in sign, but similar in magnitude, to the effects in the zone. These offsetting effects happen in 300 meter rings around the zones, which suggest that the welfare effects are likely negative if agglomeration benefits do not differ over small geographic spaces.

E Empirical Evidence on Policy Interdependence

A large literature in political science analyzes policy adoption in federalist systems. This research field comes under the broad definition of policy diffusion. Policy diffusion can be defined as how policies spread from one government to the next, or, how one government’s policy choices are influenced by other governments (Shipan and Volden 2012). Given this broad definition, political scientists also seek to distinguish the mechanisms discussed in the text and study additional mechanisms not empirically discussed in the economics literature.⁴

Within political science, Shipan and Volden (2008) define four mechanisms of diffusion: learning, competition, imitating, and coercion. These mechanisms, as in the economic literature, are normatively important. Learning can be defined as the process by which jurisdictions observe the adoption of policy and learn from the experience of other governments. In other words, governments simplify their analysis by reaching a solution based on policies that have been successful elsewhere (Berry and Baybeck 2005). Learning leads to the states acting as “laboratories of democracy” (Justice Louis Brandeis writing in *New State Ice Co. v. Liebmann*, 285 U.S. 262 1932). Economic competition is the process by which governments interact competitively over their tax base (Franzese and Hays, 2007, 2008) or face economic spillovers. Berry and Baybeck (2005) argue that learning and competition can be distinguished because learning can take place across many states while competition will be confined to nearby states. However, such a distinction assumes the local mobility of the tax base. As we argue in the text, this may be appropriate for sales taxes but is unlikely the case for global capital markets. Imitation involves copying the actions of another in order to look like that other jurisdiction (Meseguer 2006 and Simmons, Dobbin and Garrett 2006). The key difference from learning is that learning focuses on information about the policy itself, but imitation focuses on the other government (i.e., the action versus the actor). Thus, in the case of imitation, leaders and laggards might imitate each other. Finally, coercion involves attempting to force, encourage, or pressure governments to take actions that meet common expectations (Simmons, Dobbin and Garrett 2006). Although common in the international setting, this might be less common in the local setting. However, coercion may arise between higher-level and lower-level governments. Nonetheless, different levels of government often stimulate policy adoptions at other levels (e.g., Allen, Pettus and Haider-Markel 2004; Karch 2006; Shipan and Volden 2006; Walker 1973; Welch and Thompson 1980). For example, the federal government may threaten a reduction of highway funds unless states change the drinking age. But, recently, the Supreme Court has placed limitations on such coercion by the federal government. For example, the Court recently struck down the Medicaid expansions in Obamacare.

Similar to the economics literature, articles on policy diffusion have also faced challenges to isolating the causal mechanisms underlying the policy diffusion process. Shipan and Volden (2008) focus on smoking bans in the policy diffusion literature, constructing four different variables that attempt to get at each mechanism. These tests draw on theory that we view as having strong assumptions. They test for learning, which they argue should increase if other cities in the state have adopted smoking bans, by calculating the fraction of the state population at each point in time that faces a local smoking ban. To determine

⁴As an exception, see Strumpf (2002).

the presence of economic competition, the authors create a variable that captures the city's concern that it will lose out economically; to do this, the authors identify all other cities within ten miles of a given city and calculate the population of these cities that do not have antismoking policies. For imitation, the authors look at whether the nearest city with a larger population than the one in question has adopted the policy previously, arguing that cities will imitate other similar neighbors. Finally, coercion is tested by focusing on state laws that are passed related to smoking. The authors conclude that multiple mechanisms are at work. Nonetheless, the assumptions required such that these variables can isolate the mechanisms at work are strong.

In addition, the political science literature has attempted to identify the role of public opinion on policy diffusion (Pacheco 2012), the role of executive initiatives that create prescriptive but voluntary competitions (Howell and Magazinnik 2017), and the role of political parties in the diffusion process (Böhmelt et al. 2016).

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