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LOCAL FISCAL STRATEGY TO RETAIN HETEROGENEOUS FIRMS*

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ABSTRACT. This paper is about the strategy of retaining unobservably heterogeneous firms attracted by unobservably valued outside alternatives. We prove that differentiating taxation and public good fiscal packages within one's own locale dominates offering the same packages to all firms. We rationalize the full range of observed practice by considering more than one type of firm, more than one type of fiscal instrument, and all kinds of utility in alternative locations, under asymmetric information. Mobile agents can earn rents under some conditions, and immobile agents earn rents under others. Ways to minimize budgetary exposure in tax wars and effects on the composition of local economies are discussed.

1. INTRODUCTION

Just as citizens with different public good preferences 'vote with their feet,' so do firms. Thus, state and local governments offer tax and nontaxation incentives to induce firms to relocate. Experience in the United States has shown that fiscal incentives matter in firm location choice (Bartik, 1991; Fisher and Peters, 1998). Even firms without dominant location alternatives may profit by pretending that they have alternatives (Holmes, 1995; Osmudsen, Hagen, and Schjelderup, 1998), or by demanding concessions to achieve horizontal equity (Bond, 1981).

This paper is about state and local government fiscal strategies for retaining heterogeneous, relocation-threatening firms when information is asymmetric. At the conference, "The Economic War Between the States," the lack of public disclosure of the public-private firm recruitment deals was the most widely cited problem (Farrell, 1996). We are concerned about the effects of this competition for firms on local government budgets and regional economic

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diversity. We model government and firms as logical, rational decisionmakers who choose fiscal packages and locations. We offer a unified theoretical rationale for the observed wide array of incentive packages offered and the wide array of firm types recruited, retained, or lost. We also show how firm retention can be done systematically and efficiently.

In most of the local public finance literature and some of the literature on strategic regional development policy, firms are assumed to be differentially mobile but otherwise identical, and information is complete. As explained by Wildasin and Wilson (1991), these assumptions allow analysts to focus on the consequences of under- or over-taxation and provision of public goods, but make it impossible to consider the sorting of different types of firms across jurisdictions. In such models, the optimal strategic fiscal policy with identical types is usually to offer mobile agents lower taxes or higher incentives, while taxing relatively immobile agents more (Henderson, 1994; Wildasin and Wilson, 1996). Thus, public good provision is inefficient. Even without perfect information, if firms are identical and interregional tax competition can be outlawed, deadweight losses are lower and public good provision is higher with uniform policies (Holmes, 1995).

However, also according to Holmes, discriminatory policies can be shown to enhance both local and aggregate welfare when firms are heterogeneous, particularly with respect to the types of externalities they bring to their locations. Indeed, the firm heterogeneity rationale for tax discrimination is well understood. In a complete information case, Wilson (1985) showed that an optimal property tax system usually does not consist of identical tax rates on capital in different uses. In this paper we show that identical tax rates are also suboptimal when there is unobservable firm heterogeneity either concerning firms' valuation of local public goods or that a firm has been recruited.

Furthermore, we show that when information is asymmetric, not only the mobile agents, but also the relatively immobile agents can extract rents, in contrast with the findings summarized above in which they always bear excessive burdens. Our findings are consistent with those of Osmudsen, Hagen, and Schjelderup (1998) who modeled how governments competing internationally should tax low mobility-high domestic productivity firms and higher mobility-low domestic productivity firms. They showed that immobile firms can obtain "favorable tax treatment by implicit threat of relocation."

Osmudsen, Hagen, and Schjelderup (1998) analyze the case where incentives are countervailing (Lewis and Sappington, 1989) because they consider one continuum of firm types. We generalize the results in the mobile agent retention literature by analyzing more than one type of firm, more than one fiscal instrument, and all kinds of utility in alternative locations, under asymmetric information. Thus, we can draw inferences about how fiscal policies affect regional specialization that other papers have not considered, especially for the more likely cases in which incentives are not countervailing.

We formalize the topic as a mechanism design problem (Laffont and Tirole, 1986). We show the existence of a feasible set of differentiated fiscal packages that generate more net tax revenue than the government can collect using a uniform package. Second, we show how the fiscal packages vary as a potential alternative increases in value and varies by type of firm. Third, we compare the rents earned under the optimal differentiated fiscal policy under asymmetric information to the first-best (perfect information) policy.

2. ANALYSIS

The Model

We model the strategic interaction between a local government and a firm in a situation where the firm possesses superior information about its own alternatives and preferences. The local government has two fiscal policy instruments: a lump-sum tax t, and a nontax incentive n that can be targeted to particular firms. Examples of n include local public goods, as defined in Kurz (1994, p. 1156), where the excludability of the good is directly related to the spatial character of the good, such as an access road or a telecommunication link (e.g., Fisher and Peters, 1998; Matsumoto, 1998). The firm's utility with respect to these fiscal instruments is

$$U = \theta n - t$$

where θn is the value of the local public goods (or nontax incentives) to a firm.

θ is one piece of the firm's private information. For simplicity, we consider just two types of firms. The $\underline{\theta}$-type firm values nontax incentives less than the $\overline{\theta}$-type, $\theta = \{\underline{\theta}, \overline{\theta}\}$, and $0 < \underline{\theta} < \overline{\theta}$. With respect to an alternative location, a firm's utility is the net value of the alternative location's existing and promised nontax incentives less the taxes, plus other profit differentials, less moving costs. We implicitly assume that firms own the space they occupy so that they also capture any rents. We summarize the value of the standing offer in an alternative location as u^A for a $\underline{\theta}$-type firm, and U^A for the $\overline{\theta}$-type. The alternative utility is the second piece of private information the firms have.

The government does not know a firm's preferences with certainty. Specifically, the government knows only that $\theta = \underline{\theta}$ with probability p and $\theta = \overline{\theta}$ with probability $(1-p)$. This model applies to a jurisdiction in which the portion p of local firms value local public goods or nontax incentives less. This means the government knows that the alternative any given firm may have is u^A with probability p, and U^A with probability $(1-p)$. This is equivalent to the real-world problem in which a local government does not know how credible a firm's relocation threat is.

A firm threatens to relocate either because it has been recruited or because it wishes to exploit its informational advantages over the local government. The interaction starts with the local government's offer of a fiscal package because signaling of recruitment offers is not informative.

The government is willing to compete for firms to expand its tax base because this may reduce the per taxpayer cost of pure public goods. We address the broader issue of the business sector's contribution to nonexcludable public good provision in Appendix E so that here we can focus on the margin related to strategic firm retention or relocation. According to Wildasin and Wilson (1991), in models of small (price-taking) jurisdictions, local policies are chosen to maximize immobile property values or to satisfy the profit maximizing objectives of local land developers. We abstract from both land use and voting and simply assume that the government is a budget maximizer, as in Niskanen (1971), Bond and Samuelson (1986), or Heywood and Pal (1996). In fact, this is not significantly different. Government revenues from lump-sum taxes are directly proportional to the numbers of retained businesses, and thus to property values or local land use. Nevertheless, the usual caveats apply—different results may be obtained under alternative assumptions about decisionmaking in communities—as shown by Wildasin (1991), Henderson (1994), or Holmes (1995).

In anticipation or in response to a relocation threat by a firm, the government chooses a menu of contracts $\{(n, t), (N, T)\}$, in the first stage of a two-stage game. We denote by (n, t) the contract targeted to a $\underline{\theta}$-type firm, and by (N, T) the one targeted to a $\overline{\theta}$-type firm. Given the differences between firms by type, the contracts ranked first by one type of firm would not be ranked first by another. In the second stage the firm chooses among the local contracts and the outside alternative.

Firms are retained if a local fiscal package makes them at least as well off as the alternative. This vote-with-the-feet condition is known in the literature (e.g., Henderson, 1994) as the participation constraint or the individual rationality constraint, IR. For each type of firm, it is

$$(\underline{IR}) \quad \underline{\theta}n - t \geq u^A$$

$$(\overline{IR}) \quad \overline{\theta}N - T \geq U^A$$

The government's budget balance after firm retention is its strategic tax revenues less the costs of nontax incentives $c(n)$, where $c(0) = 0$, $c' > 0$, $c'' > 0$. The government will not incur a deficit that exceeds the amount in its war chest, which we normalize to zero. Because the government does not know, *ex ante*, the firm's type, expected net tax revenue is

$$ER = p[t - c(n)] + (1 - p)[T - c(N)]$$

We solve for the optimal pooling contract, given the constraint that only one fiscal policy can be applied to all firms that are distinguished only by their own private information (in Appendix A). The results are summarized in Table 1.

TABLE 1: Solutions

	Binding Constraints									
	$(\underline{IR})$	$(\overline{IR})$	$(\underline{IC})$	$(\overline{IC})$	n	t	u	N	T	U
Pooling	X				$c(n^P) = \underline{\theta}$	$t^P = \underline{\theta} n^P$		$N^P = n^P$	$T^P = t^P$	$n^P(\overline{\theta} - \underline{\theta})$
Full Information					$c(n^o) = \underline{\theta}$ $n^o = n^P$	$t^0 = \underline{\theta} n^0 - u^o$ $t^o = t^P$ for $u^o = 0$	u^o	$c(N^o) = \overline{\theta}$ $n^o = n^P = N^P < N^o$	$T^o = \overline{\theta} N^o - U^o$ $t^o = t^P = T^P < T^o$ for $U^o = 0$	U^o
$u^A = U^A$	X			X	$c(n^*) = \underline{\theta} - \frac{1-p}{p}(\overline{\theta} - \underline{\theta})$ $n^* < n^o$	$t^* = \underline{\theta} n^* < t^o$	0	$N^* = N^o$	$T^* = \overline{\theta}(N^* - n^*) + t^* < T^0$	$n^*(\overline{\theta} - \underline{\theta})$
I.1	X			X	$n^{I1} = n^o = n^P$	$t^{I1} = \underline{\theta} n^{I1} - u^A < t^o$	u^A	$N^P < N^{I1} = N^o$	$T^{I1} = \overline{\theta}(N^{I1} - n^{I1})$ $+ t^{I1} < T^0$	$n^o(\overline{\theta} - \underline{\theta}) + u^A$
I.2			X		–	–	u^A	$N^P < N^{I2} = N^o$	$T^P < T^{I2} = T^o$	0
II.1	X			X	$n^1 = n^0$	$t^1 = t^0$	0	$N^1 = N^0$	$T^1 = \overline{\theta}(N^1 - n^1) + t^1 < T^0$	$n^1(\overline{\theta} - \underline{\theta})$
II.2	X	X		X	$n^2 = \frac{U}{\overline{\theta} - \underline{\theta}} < n^0$	$t^2 = \frac{\underline{\theta}}{\overline{\theta} - \underline{\theta}} U < t^0$	0	$N^2 = N^0$	$T^2 = T^0 < T^o\vert_{U=0}$	U^{A2}
II.3	X	X			$n^3 = n^0$	$t^3 = t^0$	0	$N^3 = N^0$	$T^3 = T^0 < T^o\vert_{U=0}$	U^{A3}
II.4	X	X	X		$n^4 = n^0$	$t^4 = t^0$	0	$N^4 = \frac{U}{\overline{\theta} - \underline{\theta}} > N^0$	$T^4 = \frac{\underline{\theta}}{\overline{\theta} - \underline{\theta}} U > T^0$	U^{A4}
II.5		X	X		$n^5 = n^0$	$t^5 = T^5 - \underline{\theta}(N^5 - n^5) < t^0$	$U^{A5} - (\overline{\theta} - \underline{\theta})N^5$	$N^5 > N^0$	$T^5 = \overline{\theta} N^5 - U > T^0$	U^{A5}
II.6	X				$n^6 = n^0$	$t^6 = t^0$	0	–	–	

Differentiation

A Lindahl Equilibrium is a public competitive equilibrium in which the tax prices for public goods are individualized to each agent (Kurz, 1994). The main weakness of that concept is the lack of a mechanism to force agents to reveal their true valuations of public goods. It is not incentive compatible. In this section we show how a locality solves the incentive-compatibility problem (not the individualized tax price problem) by offering an array of fiscal packages. A firm reveals its valuation of the local public good by its choice of fiscal package.

To obtain this separating equilibrium, we constrain the government's choice problem not only by the set of participation constraints (*IR*), but also by a set of incentive compatibility constraints (*IC*). These state that a firm's utility from the fiscal package intended for its type is not less than its utility from the package intended for another type

$$(\underline{IC}) \quad \underline{\theta}n - t \geq \underline{\theta}N - T$$

$$(\overline{IC}) \quad \overline{\theta}N - T \geq \overline{\theta}n - t$$

The fiscal mechanism design problem has four constraints on a four dimensional choice space. The optimal horizontally differentiated menu of fiscal contracts, $\{(n^*, t^*), (N^*, T^*)\}$, maximizes the government's objective function subject to the four (*IR*) and (*IC*) constraints. There are 16 possible permutations of binding and nonbinding constraints. It is instructive to identify the nonbinding constraints.

First, it is not optimal for the government to offer both types of firm the same contract. This is an immediate consequence of the fact that different types of firms rank fiscal packages differently, and hence offering the same tax or capital package to all types is inefficient. The proof of this proposition is in Appendix B.

Thus the government can do better by offering an array of fiscal packages than by offering a single package. It can have higher net tax revenues while making firm types equally well off. Or, it can make its own firms better off by differentially reducing taxes and nontax incentives while maintaining a balanced budget. The results summarized in Table 1 show one possible case in which more local public services are provided to the firm type that values them more while that type also pays higher taxes, but it no longer captures rents from the local government. This is a fully efficient outcome.

When there is a diversity of firms and contracts, not every firm wants an alternative type's contract. Formally, both incentive compatibility constraints do not bind simultaneously (Appendix C). Furthermore, if firms are offered the two optimal tax, nontax packages, one type of firm will be just indifferent between the two packages, whereas the other type of firm will strictly prefer one package. As shown in Appendix C, a binding incentive compatibility constraint for one of the firm types implies a binding individual rationality constraint for the other type of firm (Lemma 3).

The corollary and Lemmas 1–3 in Appendix C rule out ten sets of (*IC*) and (*IR*) constraints. Which of the remaining six sets apply depends on the firms' reservation utilities. When both types of firms have the same reservation utility, the (*IR*) constraints can be normalized to zero, and only constraints ($\overline{IC}$) and ($\underline{IR}$) are binding. When the $\underline{\theta}$-type has a higher reservation utility than the $\overline{\theta}$-type, there are two possible sets of binding constraints, depending on magnitude of the utility differential. Finally, there are six possible sets when the reservation utility, or alternative standing offer, of the $\overline{\theta}$-type is relatively higher. The following sections discuss these eight cases in detail.

Symmetric Case: $u^A = U^A$. Consider first the (very unlikely) situation in which the utility for both types of firm from a fiscal policy or the productive environment in another region is the same. It is unlikely because only a package with no public good gives the same utility to firms with different valuations of it. However, in the event that $u^A = U^A$, reservation utilities can be normalized to zero

$$(\underline{IR}) \quad \underline{\theta}n - t \geq 0$$

$$(\overline{IR}) \quad \overline{\theta}N - T \geq 0$$

Thus, as before, only constraints ($\overline{IC}$) and ($\underline{IR}$) are binding. The $\underline{\theta}$-type firm is on the verge of leaving the jurisdiction, whereas the $\overline{\theta}$-type is on the verge of pretending that it is a $\underline{\theta}$-type firm.

The fiscal packages that satisfy these constraints are illustrated in Figure 1 and summarized in Table 1. The lines $U_{\underline{\theta}}$ and $U_{\overline{\theta}}$ denote the indifference curves for firm types $\underline{\theta}$ and $\overline{\theta}$, respectively, over tax rates and nontax incentive levels.

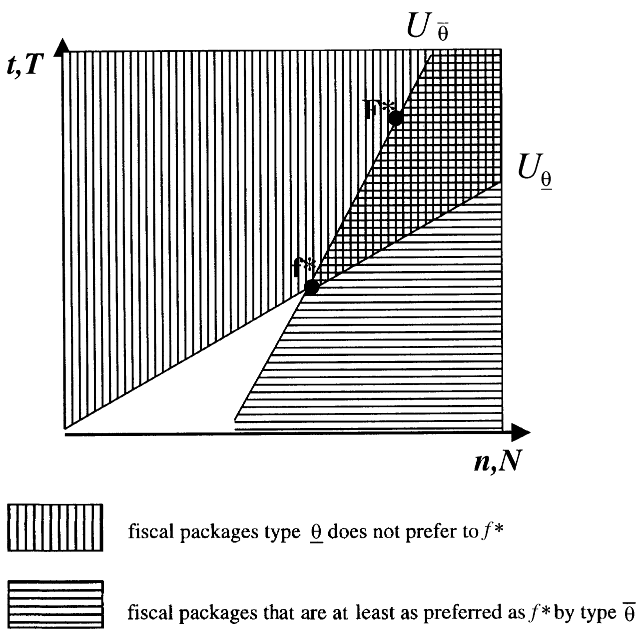

FIGURE 1: Optimal Fiscal Packages in the Symmetric Alternative Offer Case.

The slopes of the indifference curves are the marginal valuations, $\underline{\theta}$ and $\overline{\theta}$. By assumption, $\underline{\theta} < \overline{\theta}$, so $U_{\overline{\theta}}$ is steeper than $U_{\underline{\theta}}$. Packages to the right of the indifference curves satisfy the (IR) constraints. Point f^* represents an optimal fiscal package intended for the $\underline{\theta}$-type firm. The vertically shaded region is the set of points that $\underline{\theta}$-type firm does not strictly prefer to package f^*. The horizontally shaded region is the set of fiscal packages that are at least as preferred as package f^* to a $\overline{\theta}$-type firm. Hence, for both constraints to be satisfied, the package intended for the $\overline{\theta}$-type firm must lie within the cross-shaded region, such as package F^*. It lies on the boundary because the ($\overline{IC}$) constraint is binding.

The optimal contract, denoted $\{(n^*, t^*), (N^*, T^*)\}$ solves the government's maximization problem subject to the two binding constraints ($\underline{IR}$) and ($\overline{IC}$)

$$\underset{\{(n,t),\ (N,T)\}}{\text{Max}}\ ER = p\,[t - c(n)] + (1-p)\,[T - c(N)]$$

subject to

$$\underline{\theta}n - t = 0$$

$$\overline{\theta}N - T = \overline{\theta}\,n - t$$

After substituting the constraints into the government's objective function, the maximization problem is

$$\underset{n,N}{\text{Max}}\ [p\underline{\theta} - (1-p)(\overline{\theta} - \underline{\theta})]n - pc(n) + (1-p)[\overline{\theta}N - c(N)]$$

The first-order condition of the maximization problem under asymmetric information and normalized alternatives with respect to n (interior solution) is

$$c'(n^*) = \underline{\theta} - \frac{1-p}{p}(\overline{\theta} - \underline{\theta})$$

Both sides are positive, as assumed for $c'(n^*)$, when $\underline{\theta} > (1-p)\overline{\theta}$. The first-order condition implies that the optimal nontax incentive (n^*) offered to a $\underline{\theta}$-type firm under asymmetric information is smaller than the first-best level (Table 1 and Appendix D). The first-order condition for t shows that the optimal tax is lower than the first-best one because the optimal nontax incentive is lower, $t^* = \underline{\theta}n^* < \underline{\theta}n^o = t^o$.

The first-order condition with respect to N is $c'(N^*) = \overline{\theta}$, which is the same as the first-order condition under perfect information. The optimal nontax incentive for the $\overline{\theta}$-type firm when the outside offer is equally attractive to all types ($u^A = U^A$) is thus the same as the first-best, $N^* = N^o$ (Table 1 and Appendix D). Note also that N is provided such that the marginal cost of provision equates with marginal valuation $\overline{\theta}$, whereas n is not, so that $n^* < n^o < N^* = N^o$. However, the optimal tax on a $\overline{\theta}$-type firm is smaller than the first-best tax, $T^* = \overline{\theta}(N^o - n^*) + t^* < \overline{\theta}N^o = T^o$.

The difference to the firm between the first-best and the optimal strategic policy under asymmetric information is $n^*(\overline{\theta} - \underline{\theta})$. This informational rent captured by a $\overline{\theta}$-type firm in the form of lower taxes reflects its higher valuation of the local nontax incentives.

Finally, it is easy to verify that the $\underline{\theta}$-type firm has no incentive to misrepresent itself. Because $N^* > n^*$, the utility of the $\underline{\theta}$-type firm is negative if it chooses the package intended for the $\overline{\theta}$-type

$$\underline{\theta}N^* - T^* = -(N^* - n^*)(\overline{\theta} - \underline{\theta}) < 0$$

This analysis provides many interesting implications. First, when firms have private information, they extract rents in the form of lower taxes (see also Osmudsen, Hagen, and Schjederup, 1998). Second, these rents are often extracted by the firms with the higher valuations of nontax incentives. If valuing the local public good more is associated with relative immobility, as in Wildasin and Wilson (1996), our analysis suggests that the relatively immobile agents also extract rents in the form of tax concessions. Third, the optimal contracts provide less than first-best nontax incentives to the footloose, $\underline{\theta}$-type, firms. Finally, lower nontax incentives, neutralized by a lower tax, will retain a $\underline{\theta}$-type, or footloose, firm.

Optimal End-Game Strategy

In a “tax war” where both tax and nontax incentives are employed, a recruited firm is offered an alternative fiscal package (t^A, n^A). Note that the $\overline{\theta}$-type always values a given (t^A, n^A) contract more than a $\underline{\theta}$-type because $\overline{\theta} > \underline{\theta}$. A predatory government may also offer a package designed to recruit just one of the types. We formalize all possible scenarios by analyzing all situations in which reservation utilities vary by type. There are two cases for a total of eight situations. Only a few papers in the mechanism design literature, Champsaur and Rochet (1989), Laffont and Tirole (1990a, 1990b), and Lewis and Sappington (1989) investigate such problems. We follow Laffont and Tirole (1990a).

Case I, $u > 0$. Given that $\underline{\theta}$-type firms initially extract no rents, they are both cheaper to retain and more vulnerable to recruiters. Thus, we have referred to the $\underline{\theta}$-type as ‘footloose.’ An outside offer consisting of tax abatements appeals to the $\underline{\theta}$-type. The optimal end-game retention strategy is to lower the tax liability in the package designed for the $\underline{\theta}$-type. The government should match the alternative tax offer (Situation 1), but only to a point (Situation 2). That is the point at which the tax abatements would attract third-party firms ($\overline{\theta}$-types). Then it would become prohibitively expensive for the government to attempt to retain both types. In Situation 2 it should avoid overextending itself by letting the $\underline{\theta}$-type leave. These two situations are detailed below and summarized in Table 1. Note that in Situation I.2, the region can afford to retain, or, tends to specialize in only $\overline{\theta}$-type firms.

Case I, Situation 1. The $\underline{\theta}$-type vote-with-the-feet constraint is ($\underline{IR}$) $\underline{\theta}n - t \geq u^A$ and it continues to bind. The optimal contract solves the government's expected net revenue maximization problem subject to the two binding constraints ($\underline{IR}$) and ($\overline{IC}$). After substitutions, the constrained maximization problem is

$$\max_{n,N} \left\{ \left[p\underline{\theta} - (1-p)(\overline{\theta} - \underline{\theta})\right]n - pc(n) \right\} + (1-p)\left[\overline{\theta}N - c(N)\right] - u$$

From this we can see that a government's expected net revenue declines in direct proportion to the increase in value of the alternative standing offer. A tax war inflicts unavoidable costs. The best a government can do is to offer the pair of contracts in which the nontax incentives are the same as in the symmetric case (solved above), but the taxes are lower for both types of firm, $t^{I1} = \underline{\theta}n^{I1} - u^A$, and $T^{I1} = \overline{\theta}(N^{I1} - n^{I1}) + t^{I1}$. In other words, the optimal response to that kind of outside offer is to reduce taxes across the board, for both recruited and third party firms. Even with incentive contracts, the $\overline{\theta}$-type still earns informational rents (Table 1) which is the value of nontax incentives for which the $\overline{\theta}$-type does not pay tax.

Case I, Situation 2. If the alternative utility for a $\underline{\theta}$-type firm is too large, it will be optimal for the government to offer a single fiscal package designed to retain only a $\overline{\theta}$-type firm, and to let a $\underline{\theta}$-type "leave." In this situation, only ($\overline{IR}$) binds. The solution (N^*, T^*) satisfies the equalities $c'(N^*) = \overline{\theta}$ and $T^* = \overline{\theta}N^*$, which is the full-information solution.

Case II, $U^A > 0$. Consider now the most likely possibility that the alternative offer is attractive to a $\overline{\theta}$-type, that is, $U^A > 0$. This is most likely because the $\overline{\theta}$-type values targeted public goods more, so any given package will be valued more by that type. Again, the optimal differentiated fiscal packages vary according to the magnitude of U because different sets of the (IR) and (IC) constraints bind as the alternative utility increases. In contrast with the $u^A > 0$ case, in which there were only two possible permutations of binding constraints, now all six permutations may apply. The solutions to the six possible situations are summarized in Table 1, in the order of increasing magnitude of U.

Situation II.1. The first $U^A > 0$ we consider is any $U < n(\overline{\theta} - \underline{\theta})$ that does not exceed the informational rents available to a $\overline{\theta}$-type firm in the symmetric case. The threat package, while possibly preferable to a pooling contract, does not dominate the optimal differentiated package that could be offered by its own local government. Thus, if the local government was not offering incentive contracts before the threat, it should do so now, and it can retain all types of firms at no net cost to the government budget. In other words, this threat could be avoided if a local government offered incentive packages from the start.

Situation II.2. When the threat package provides an alternative utility that just exceeds informational rents for the $\overline{\theta}$-type in the base case, its vote-with-the-feet constraint will start to bind. Under the three binding constraints—($\underline{IC}$), ($\overline{IR}$) and ($\underline{IR}$)—the optimal tax and nontax incentives for the $\overline{\theta}$-type are at the full information levels. But a lower tax (and nontax incentive) must be offered to retain the $\underline{\theta}$-type and ensure that neither type of firm earns informational rents. Note that this level of tax competition drives fiscal choices to their first-best full-information optima.

Situation II.3. Now consider an outside offer so good that a $\overline{\theta}$-type would rather leave than pretend it is a footloose firm. A Lindahl solution is incentive-compatible because only the two vote-with-the-feet constraints ($\overline{IR}$) and ($\underline{IR}$) bind. Both contracts equal the full-information contracts (Table 1, row II.3). This level of tax competition also drives fiscal choices to their first-best full-information optima.

Situation II.4. An outside offer could entail such low taxes that the retention package for a $\overline{\theta}$-type inspires the $\underline{\theta}$-type to bluff. Formally, ($\overline{IR}$),($\underline{IR}$) and ($\underline{IC}$) bind. The $\underline{\theta}$-type does not find nontax incentives as attractive, so nontax incentives should be raised to retain the $\overline{\theta}$-type. To minimize the budgetary costs, the tax on a $\overline{\theta}$-type firm is also higher, but not so high that its utility falls below what it would get if it took the outside offer (Table 1, row II.4). Note that although the retention package over-provides local public goods compared to the first-best full information optima, no informational rents are being paid.

Situation II.5. Sometimes a government has to compete with such a valuable alternative for the $\overline{\theta}$-type that it must offer the $\underline{\theta}$-type an incentive to keep it from pretending (bluffing) to be a $\overline{\theta}$-type. The alternative continues to make the vote-with-the-feet constraint bind for the $\overline{\theta}$-type, whereas the $\underline{\theta}$-type would rather bluff than leave. Formally, ($\overline{IR}$) and ($\underline{IC}$) bind. The optimal nontax incentives N^5 targeted to the $\overline{\theta}$-type must satisfy $c'(N^5) = \overline{\theta} + \frac{p}{1-p}(\overline{\theta} - \underline{\theta})$. Furthermore, the optimal tax T^5 forces the local government to internalize the costs of competing with the outside alternative, plus the costs of informational rents captured by the $\underline{\theta}$-type through reduced taxes (Table 1, row II.5).

Situation II.6. Finally, it is possible that the reservation utility for the $\overline{\theta}$-type firm is so high that the government budget is balanced only if it simply offers a single contract to retain only $\underline{\theta}$-type firms. The optimal contracts are the first-best ones. In this case, because the region cannot afford to retain the $\overline{\theta}$-types, it tends to specialize in $\underline{\theta}$-type firms.

3. PRACTICAL IMPLEMENTATION

The eight cases discussed above describe optimal end-game strategies for a local government confronted by a firm threatening to leave unless offered a fiscal incentive. To implement the strategy the government needs to form expectations about θ, the probability or proportion p, and outside offers (u^A, U^A). It must estimate the probability p that a threatening firm places a low value $\underline{\theta}$ on nontax incentives or local public goods. For example, if firm profits (or some other observable firm characteristic) are correlated with the value of local public goods to them, then both θ and the distribution (proportions) of firms by type can be estimated by collecting such data on firms in one's jurisdiction, controlling for all other determinants of firm profitability.

The government must also form expectations about outside opportunities (u^A, U^A) relative to what they offer locally. Our analysis helped distinguish more likely opportunities from less likely, or mere bluffing threats. The least likely is an alternative that appeals to all types of firms equally. Offers of lower tax liabilities that appeal to "footloose" types are hypothetically more likely. The most likely are relocation threats from firms that value local public goods or non tax incentives highly. Those types of firms have more opportunities to capture informational rents, and thus may be more likely to bluff.

For example, consider a locality where 20 percent of the firms heavily rely upon local infrastructure such as utilities, roads, and the local school system for skilled employees to remain competitive. The other 80 percent of businesses employ unskilled labor, and need minimal publicly-supplied infrastructure to be competitive. Given those estimated proportions, the local government can identify the types of packages it can afford to offer. Then businesses will reveal their types by their choice among packages that offer targeted local public goods plus higher taxes, or no targeted public goods and no taxes (above the tax share every firm must contribute to pay for the nonexcludable public goods—Appendix E).

If a firm in the 80 percent set threatens to relocate to enjoy a better fiscal package (Case I), then our analysis suggests that the local government should attempt to match the value of the alternative by lowering tax rates for that type, to the extent possible given the broader budgetary constraints (Situation I.1). If this does not retain the threatening firm, then local government should let it go (Situation I.2).

If a firm in the 20 percent ($\overline{\theta}$-type) threatens to relocate for fiscal reasons (Case II), our analysis suggests offering the firm more nontax benefits plus a higher tax liability that still leaves the firm strictly better-off than before the threat. Again, this would be done to the extent possible given the broader budgetary constraints (Situations II.2–5). If this does not retain the firm, then local government should let it go (Situation II.6). This strategy is superior to lowering taxes two ways. First, it is clearly less costly than uniformly reducing taxes because the government must internalize only the cost of retaining the threatening firm. Second, it minimizes copy-cat costs by driving informational rents to zero. The offer of higher nontax incentives is unlikely to inspire the $\underline{\theta}$-types to bluff because they do not value the nontax incentives enough to want that kind of payoff.

In addition, assume that the probability of each situation (u^A, U^1, U^2, U^3, U^4, U^5) is equally likely and in equal dollar value increments. If the locality offered the best affordable packages to each type (giving u^A to the $\underline{\theta}$-types and U^5 to the $\overline{\theta}$-types), about 44 percent of the strategic retention budget would be spent providing tax breaks, and 56 percent would be spent providing nontax incentives. This happens to be in the neighborhood of the empirical evidence provided by Fisher and Peters: "At the local level and averaged over all 16 firm types, 48% of the increment in [firm] income due to incentives derived from tax incentives, 52% derived from non-tax incentives" (1998, p. 206). Furthermore, in the context of a relative preponderance of Case II outside offers, we would expect to see many localities with a larger proportion of $\underline{\theta}$-type firms and few localities able to retain a larger proportion of the $\overline{\theta}$-types. This implication is evocative of Central Place Theory.

4. CONCLUSIONS

We have shown that when local governments offer different fiscal packages to unobservably different firms within their own jurisdictions, they can make their constituent businesses better off while maintaining the same budgetary balance. Or, the strategy can enhance net revenues in the absence of any relocation threats. It also allows the local authorities to respond to threats during tax wars at the minimum cost. Our analysis clarifies that mixes of both tax and nontax incentives are optimally used to retain a variety of firms in a tax war context. Thus, it provides a formal rationalization of what governments actually do. We also clarify how it can be done systematically and efficiently. In particular, offering a menu in advance dominates reacting to each relocation threat as it arises.

An implication is that the recommended fiscal policy supports local economic diversity. If menus are not offered and jurisdictions are the same in all nonfiscal aspects, some relocation will occur as firms unilaterally migrate to places offering their preferred fiscal package. Moreover, when predatory recruiting occurs, budgetary limitations will result in places specializing in the single type of firm that prefers the one fiscal package they offer. In contrast, we show that a jurisdiction can most efficiently retain a set of heterogeneous firms by offering a set of heterogeneous fiscal packages. An empirically testable hypothesis is that regions offering a wider variety of tax-incentive packages are more hospitable to a wider variety of firms.

Furthermore, we showed that when information is asymmetric, agents that value local public goods highly can extract rents (pooling, the symmetric $u = U$ case, and cases I.1 and II.1). These cases may correspond to the widely-reported phenomena whereby large firms with significant place-specific assets are retained by concessions awarded by local authorities ostensibly in response to interjurisdictional fiscal competition. This finding is also consistent with the finding by Osmudsen, Hagen, and Schjelderup (1998), for example, that unobservably immobile firms (bluffing firms) can extract rents in the form of lower taxes during international tax wars.

We also identify one instance where firms with the least place-specific attachment, the lower valuation of local public goods, or more mobile firms, can also extract informational rents in the form of lower taxes that induce them not to bluff (Case II.5) This case is consistent with implications from models of homogeneous but differentially mobile agents. According to those papers, mobile agents enjoy lower tax burdens, and relatively immobile agents bear excessive tax burdens compared to the value of the public goods they enjoy, such as in Wildasin and Wilson (1996).

In sum, our analysis generates all possible second-best outcomes in which neither type, only mobile, or only immobile firms capture rents. We rationalize the simultaneous existence of a wide range of tax or non tax incentive packages, which is consistent with empirical observation. This is achieved by modeling heterogeneous firms under asymmetric information and noncountervailing incentives.

Heterogeneity among firms is not the only heterogeneity we consider. Jurisdictions also differ in nonfiscal ways, which are reflected in our model by the varying utility of the outside alternative. Outside utility may reflect the profitability of a site for a firm. For example, Bond and Samuelson (1986) argue that recruited firms tolerate higher later taxes (imposed to recoup an initial subsidy) only in high productivity locations. Thus, only high productivity jurisdictions can afford to offer tax holidays to recruit firms in the short run. Governments signal the profitability of their sites by offering tax holidays of limited duration. If this is done facetiously, firms relocate when their exemptions expire. Bond (1981) provided empirical evidence that indeed, tax holidays of limited duration lead to small firm size and rapid turnover. In contrast, we implicitly assume that a government can indefinitely provide a retention package if it is initially feasible. Firms will not be induced to leave because exemptions need never expire. However, testing whether mechanism design can also solve firm size and turnover issues when the government can incur short run deficits requires an extension of the model to a dynamic setting.

Our static approach to the asymmetric information problem also leaves room for other useful extensions. If a local government would precommit to offer the same pair of fiscal packages in all subsequent periods, the static model characterizes the outcome of a dynamic relationship. However, for a government to offer the same differentiated tax or capital package over time would be time-inconsistent. Once a government learns the types of firms, it can impose the first-best packages. If firms anticipate this, they may refuse to reveal their types in the short run. It may be more profitable to forgo the short-run benefits of the packages designed for them, to earn informational rents over the longer run. Thus, if our model is extended to a dynamic setting, we expect to find equilibria where different types of firms choose the same fiscal package (pooling).

It would also be interesting to endogenize the strategic behavior of the competing government. For example, Wildasin (1991) investigated the strategic choice of the type and level of fiscal instruments in a tax war. As noted in the introduction, in his analysis information is complete and agents are homogeneous. We have analyzed the end game strategy under imperfect information about heterogeneous agents. It would be fruitful to analyze a competition in menus of contracts between two governments, assuming asymmetric information, firm heterogeneity, and two periods.

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APPENDIX A

POOLING

According to a harmonization principle, local governments offer the same (pooled) tax or nontax contract to firms, regardless of possible differences in firms by type. The best pooled fiscal package, denoted $\{n^p, t^p\}$, maximizes expected net government revenue subject to the individual rationality constraints

$$\operatorname*{Max}_{t,n}\; t - c(n)$$

subject to $(\underline{IR})$ and $(\overline{IR})$

We consider the base case when $u^A = U^A = 0$. Note that when $\underline{\theta} < \overline{\theta}$, if $(\underline{IR})$ is satisfied at $\{n, t\}$, then $(\overline{IR})$ is also satisfied with a slack. Satisfying the $(\underline{IR})$ constraint also implies that the tax liability of the firm equals its value of the public works it enjoys, $t = \underline{\theta}n$. Substituting this expression for t into the government's objective function and differentiating with respect to n yields

$c'(n^p) = \underline{\theta}$. This equates the marginal cost (or, average cost for a nonrival public good) to the payer's marginal valuation. This gives us the familiar condition that the tax price of the public good should equal the payer's marginal valuation of it, $t^p = \underline{\theta} n^p$.

APPENDIX B

PROPOSITION 1: *A horizontally differentiated fiscal policy dominates a harmonized policy, that is, a pooling contract is not optimal.*

Proof. Suppose to the contrary that the pooling contract $(n^p, t^p) = (n^*, t^*) = (N^*, T^*)$ is optimal when a differentiated contract could be chosen. At the optimal pooling contract, at least one of the (IR) constraints is binding. Thus, there are two possible pooling situations depending on which (IR) binds:

(i) Assume $(\overline{IR})$ binds. Then $\overline{\theta} = c'(n^p) > \underline{\theta}$. In this case, the government can decrease n (the nontax incentive for the $\underline{\theta}$-type firm) and t (the tax for the $\underline{\theta}$-type firm) by amounts $dn = \Delta$ and $dt = \underline{\theta}\Delta$, respectively, so that the $\underline{\theta}$-type firm is indifferent to the change and both $(\underline{IC})$and$(\underline{IR})$ constraints remain satisfied. The $(\overline{IR})$ constraint is unaffected, whereas the right-hand side of the $(\overline{IC})$ constraint is smaller. Thus, all (IR) and (IC) constraints are satisfied. The new pair of packages is $\{(n^p - dn,\ t^p - dt),\ (n^p,\ t^p)\}$. The value of the government's objective function will increase by $-p\left[\underline{\theta} - c'(n^p)\right]\Delta > 0$. Thus, pooling is not optimal in case (i).

(ii) Assume $(\underline{IR})$ binds. Then $\overline{\theta} > c'(n^p) = \underline{\theta}$. That is, the marginal cost of the nontax incentive is lower than its marginal value to the $\overline{\theta}$-type firm. The government should increase n and increase the tax liability by increasing t by amounts $dn = \Delta$ and $dt = \overline{\theta}\Delta$, respectively. Consider the new pair of packages $\{(n^p,\ t^p),\ (n^p + dn,\ t^p + dt)\}$. Again, all (IR) and (IC) constraints are satisfied, while the government's budget surplus will increase by $(1 - p)\left[\overline{\theta} - c'(n^p)\right]\Delta > 0$. Hence, a pooling contract is not optimal in case (ii) either.

APPENDIX C

NON-BINDING CONSTRAINTS

COROLLARY: *If the two types of firms are offered different contracts, it is not possible that both incentive compatibility constraints are binding*

Proof. Suppose to the contrary that both (IC) constraints are binding. Then we have that

$$\underline{\theta} n - t = \underline{\theta} N - T$$

$$\overline{\theta} N - T = \overline{\theta} n - t$$

Adding these two inequalities and rearranging yields $t = T$. But then, by either of the (IC) constraints we have that $n = N$. Thus, if both (IC) constraints bind,

$t = T$, $n = N$, that is, the contract is the same—which contradicts the assumption of two different packages.

We identify three more sets of binding and nonbinding constraints in three Lemmas. If the two types of firms are offered different contracts, it is not possible that both incentive compatibility constraints are binding.

LEMMA 1: *If the two types of firm are offered the optimal different tax or nontax packages, then a binding incentive compatibility constraint for one of the firm types implies a binding individual rationality constraint for the other type of firm*

Proof. Proof of case $(\overline{IC})$ and $(\underline{IR})$. (Proof of the other case follows exactly the same lines). Suppose by way of contradiction that $(\overline{IC})$ binds but $(\underline{IR})$ does not. From the corollary we have that $(\overline{IC})$ binding implies a nonbinding $(\underline{IC})$. Because neither $(\underline{IR})$ nor $(\underline{IC})$ bind, the government could increase its net revenue by decreasing n without violating any of the (IR) or (IC) constraints, implying that $(\underline{IR})$ must bind when $(\overline{IC})$ is binding, or the contracts are not optimal.

LEMMA 2: *With respect to optimal menu of contracts, at least one (IR) constraint binds*

Proof. By way of contradiction, suppose that neither $(\underline{IR})$ nor $(\overline{IR})$ are binding at the optimum. This means that the government could increase taxes by the same positive amount Δ (e.g., $\Delta = 0.5\ \mathrm{Min}\{\underline{\theta}n - t, \overline{\theta}N - T\}$) without violating either the individual rationality or the incentive compatibility constraints. The government's budget surplus would increase, implying that any solution in which neither (IR) binds could not be optimal. When neither (IR) constraint binds, the original tax or nontax package(s) strictly dominate any outside alternative(s).

LEMMA 3: *As long as both types of firms are present, if only one (IR) binds, the alternate (IC) binds*

Proof. (For the case of $(\underline{IR})$ and $(\overline{IC})$; the opposite case follows the same lines). By way of contradiction, suppose only $(\underline{IR})$ is binding and $(\overline{IC})$ is not binding. Neither $(\overline{IR})$ nor $(\overline{IC})$ are binding, so the government could raise T by a positive amount without violating any of the constraints, which it would prefer to do because it would increase its net revenue.

APPENDIX D

THE FULL INFORMATION CASE

When the firm's type is known to be $\underline{\theta}$, the government's optimization problem is

$$\underset{(n,t)}{\mathrm{Max}}\ t - c(n)$$

subject to $\underline{\theta}n - t \geq u^A$

The government offers a package such that $t = \underline{\theta}n - u^A$. Thus, the government's optimization problem can be written as

$$\operatorname*{Max}_{n} \underline{\theta}n - c(n) - u^A$$

The optimal level of public works n^o is given by $c'(n^o) = \underline{\theta}$. If the value of the government's objective function is less than 0 at n^o, then the optimal n^o is equal to zero. A deficit on the strategic retention budget is not allowed.

When the firm's type is $\overline{\theta}$, the government's optimization problem is

$$\operatorname*{Max}_{(N,T)} T - c(N)$$

subject to $\overline{\theta}N - T \geq U^A$. The government offers a package such that $T = \overline{\theta}N - U^A$. Thus, the government's optimization problem can be written as

$$\operatorname*{Max}_{N} \overline{\theta}N - c(N) - U^A.$$

The optimal level of public works N^o is given by $c'(N^o) = \overline{\theta}$.

APPENDIX E

RETENTION WITH NONEXCLUDABLE PUBLIC GOODS

In this Appendix we take into account the broader problem of nonexcludable public good provision. If a government fails to retain a footloose firm, it diminishes the tax base for provision of nonexcludable and nonrival public goods. In turn, this will adversely affect the government's ability to tax (lump-sum tax t) remaining firms in the jurisdiction. Thus, though the government does not benefit directly from levying taxes to finance the provision of those public goods (it does not enter its objective function) it indirectly benefits from higher levels of the local public good. We show that this extension does not change the character of our analytical results. However, it does mean larger net spending on retention would be optimal with respect to each outside alternative.

Suppose that in addition to the targeted public good n *or* N, the local government provides a nonexcludable and nonrival public good z that is equally valued by all firms in its jurisdiction. The value of the public good z to both types of firms is given by a concave function $v(z)$. Without loss of generality we assume that z denotes both the level and the cost of the public good. Good z provision is financed by levying equal taxes on all firms in the jurisdiction.

The number of firms in the jurisdiction depends on whether the government decides to keep both types of firms or allows one type to leave. Let I denote the proportion of firms that stay in the jurisdiction:

$$I = \begin{cases} 1, & \text{if both types are retained} \\ p, & \text{if only type-}\underline{\theta}\text{ firms are retained} \\ 1-p, & \text{if only type-}\overline{\theta}\text{ firms are retained} \end{cases}$$

Given proportion I of firms in the jurisdiction, the type-θ firm's utility with respect to the fiscal instruments n, t, and z is given by $U = (\theta n - t) + \left[v(z) - \frac{z}{I}\right]$. The only modification from the cases considered in the text is the second term in the sum, which is the net benefit to the firm from the nonexcludable public good.

Firms in the jurisdiction bear the total cost of z, so the government's objective function is unchanged, $ER = p[t - c(n)] + (1 - p)[T - c(N)]$. The government is interested in increasing its tax base by keeping as many firms as possible, so it will choose the level of z optimally: $v'(z) = \frac{1}{I}$. Let $z(I)$ denote the solution to this equation. Because $v(z)$ is concave, $\left\{v[z(I)] - \frac{z}{I}\right\}$ is increasing in the number of firms I in the jurisdiction. In other words, each type of firm in the jurisdiction benefits if the local government offers financial incentives to prevent relocation of firms from the jurisdiction. If the local government decides to keep both types of firms we can write the government's optimization problem as

$$\underset{\{(n,t),(N,T)\}}{\text{Max}} \; ER = p\,[t - c(n)] + (1 - p)\,[T - c(N)]$$

$$(\underline{IR})\; \underline{\theta} n - t + v[z(1)] - z(1) \geq u^A$$

$$(\overline{IR})\; \overline{\theta} N - T + v[z(1)] - z(1) \geq U^A$$

$$(\underline{IC})\; \underline{\theta} n - t \geq \underline{\theta} N - T$$

$$(\overline{IC})\; \overline{\theta} N - T \geq \overline{\theta} n - t$$

Note that the incentive compatibility constraints are unchanged and only the two individual rationality constraints are (identically) affected. The solution to this problem is identical to the one in the text if we modify the reservation utilities by subtracting $v[z(I)] - \frac{z(I)}{I}$ from the reservation utilities of both types of firms.

The government's problem when it keeps only $\underline{\theta}$-type firms is given by

$$\underset{(n,t)}{\text{Max}} \; ER = p[t - c(n)]$$

$$(\underline{IR})\; \underline{\theta} n - t + v[z(p)] - \frac{z(p)}{p} \geq u^A$$

The government's problem when it decides to keep only type-$\overline{\theta}$ firms is similar. Suppose that the type-$\overline{\theta}$ firm is footloose (Scenario II). Then, the larger the difference $\{v[z(1)] - z(1)\} - \{v[z(p)] - \frac{z(p)}{p}\}$ the more the government is willing to pay to keep the footloose firm from leaving the jurisdiction. Packages intended to retain that type should offer even larger nontax incentives or tax holidays.