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Local Economic Development as a Prisoners' Dilemma: The Role of Business Climate

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Abstract: We formally demonstrate the prisoners' dilemma fueling the incentives "arms race." Our simple game (1) includes only localities that are equivalent with respect to basic location requirements; and (2) explicitly models business climate. Localities are compelled to offer incentives despite potential drawbacks. If no other locality competes, a locality can win big; if others are competing, a locality can avoid big losses. Failing to compete sends a negative signal about a locality's business climate, so localities are compelled to give away the entire value of attracting the firm. The model provides a framework for investigating numerous aspects of interjurisdictional competition.

I. INTRODUCTION

Offering incentives to influence the location decisions of businesses is a popular economic development strategy. Virtually every state, for example, offers both financial assistance and tax incentives to attract new firms and retain existing firms (*Site Selection* 1998). There is, however, increasing criticism of this practice in the popular media as well as in academic and government circles. The arguments against offering incentives come in a variety of forms. Some point to the fact that incentives are not very effective at influencing firm behavior—surveys show that they affect location decisions at the margin and only after basic factors of production are considered (Kieschnick 1981). Others stress the practical difficulties of trying to offer *rational* incentives, that is, incentives that have a positive payoff to the locality. A recent *Time* magazine article claims, for example, that politicians are willing to make even bad deals with companies in order to create politically popular job announcements (Barlett and Steele 1998a). Political distortions, lack of information, and information asymmetries make it difficult to construct rational incentives packages (Rubin 1988; Reed 1996; Mahtesian 1994; Leroy 1995). Even those in favor of offering incentives concede that localities often make poor deals (Toft 1995-96, 1996). Burstein and Rolnick (1995, 1996) argue that incentives have more subtle costs: because resources are spent on targeting particular businesses, local governments provide too few public goods.[1] Other researchers argue that localities could do better by cooperating rather than competing (Hands and Mann 1987; Coates 1993). Most agree that offering incentives leads to something like an

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[1]This result concurs with the traditional tax competition literature (Wilson 1986; Zodrow and Mieszkowski 1986).

arms race—once the practice begins, it is difficult to control and no one "wins" (Grady 1987; Jenn and Nourzad 1996).

Why do localities continue to compete despite the criticism and controversy? Political incentives, miscalculation of costs and benefits, and the lack of other economic development alternatives are part of the answer.[2] In this paper, however, we emphasize a factor that has generally been neglected in the academic literature—the role of business climate. Many economic development officials emphasize that offering incentives is a way to send a pro-business signal. In reference to winning the Mercedes-Benz plant in Alabama (at a cost of more than $168,000 per job), Rob DeRocker of Development Counselors states, "It's an attention grabber. You can't measure it—how can you measure the public-relations value of Mercedes-Benz?—but you can't discount it either" (Demott 1994). Economic development practitioners are obviously concerned with demonstrating a business-friendly atmosphere. Establishing a positive business climate is a top priority for state and local officials. Without the right sort of atmosphere, they fear, firms will shun their localities and economic growth will suffer as a result (Venable 1995, 1996; Dabson, Rist, and Schweke 1996).

The perceptions of practitioners about the importance of business climate are not unfounded. In a review of empirical evidence, Wasylenko (1991) argues that "it is increasingly difficult to argue that business climate, however broadly defined, does not influence interregional firm locations" (pp. 27-28). Offering incentives is supposed to provide a powerful pro-business message. Subsidies to firms provide the right sort of signal because they show a willingness to promote growth and help businesses. "Governor Jim Folsum argues that, at least for his state, the Mercedes deal was [a] steal, if for nothing other than its symbolism—that is, to break through old stereotypes and announce to the corporate world that Alabama is open for business" (Mahtesian 1994). According to Governor Jim Hunt, "North Carolina has one of the strongest economies and one of the best business climates because of...our aggressive efforts to create and keep good jobs for our people" (Lyne 1998, p. 48). Corporate officials see incentives as a business climate signal as well. As Mahtesian (1994) notes, "Kentucky's ad scramble for industry has left little doubt in business circles as to its hospitality to industry and commerce" (see also Venable and Coffee 1993; Venable 1996).

Development practitioners are concerned with sending a pro-business signal, so they can not ignore incentives. Some proponents claim that offering incentives is a necessary condition for having a good business climate. Toft (1996) claims, for example, that "[i]ncentives are a cost of doing business." Essentially, localities look bad if they do not offer sufficiently attractive deals to firms. According to Gary Carlton, Director of Business and Industry Development for North Carolina, "You've got to have incentives to get your foot in the door" (Carlton 1996; see also Venable 1995, p. 728). The extent to which a locality bids for a

[2]Bartik (1991) provides an account of some of the potential benefits of state and local economic development policies. He focuses on the benefits that may be gained if policies are targeted to areas with high unemployment. Notably, he acknowledges that "economic development competition may redistribute national income towards wealthy business owners" (p. 207).

firm influences whether or not it is even considered by other firms in the future. The political pressure to preserve and create jobs pushes policy makers to "play the game" (Wolkoff 1992; Wolman 1988; Walker 1989; Spindler and Forrester 1993). Political leaders are afraid to do nothing (Duncan 1992). If each locality offers incentives, however, then they must compete for firms. A locality that would not compete for a firm, or only competed poorly, would diminish its chance at attracting other firms in the future. Each locality's desire to show that it has a superior business climate fuels the "arms race" mentality.

From a locality's perspective, the competition for firms is rational. Localities want to increase local employment levels and defend against losing the firms, both of which depend (to some extent) on their ability to send a pro-business signal. Opponents of the incentives competition, however, are also correct in emphasizing the practical difficulties in making good deals and in arguing that even with good deals, the escalating competition could be counterproductive for society as a whole. Economic development practitioners are not blind to these arguments. According to Stephen Goldsmith, Mayor of Indianapolis, "You can't say no, but you can't afford to say yes" (Schwartz et al. 1992, p. 40). Unfortunately, localities are essentially in a prisoners' dilemma: however much they might desire to do so, they can not afford to stop competing.

Examining the competition among localities for a firm as a simple non-cooperative game, we demonstrate that the practice of offering incentives to firms in a competitive environment has paradoxical results. Our model verifies the familiar result that, even in the best-case scenario of precise cost-benefit analysis and social welfare maximization, the general practice of offering incentives is bad for localities collectively (Hands and Mann 1987; Coates 1993). Following Black and Hoyt (1989), multiple localities compete for a single firm. We extend previous research by explicitly modeling incentive packages as signals about a locality's business climate.[3] If a locality fails to attract a firm, then it sends a negative signal about its willingness or ability to help business. Because each locality will offer incentives to avoid sending a negative signal, competing does not increase a locality's chance of getting a firm. Furthermore, if a locality succeeds in attracting a firm, the nature of competition forces it to give the firm, in the form of incentives, *all* of the benefit derived from attracting the firm to the locality. Consequently, localities do not gain by competing for firms but they can lose by not competing. Localities are thus compelled to compete, not because they stand to gain anything, but because they can not afford to send a negative signal about their business climates.

II. THE LOCAL ECONOMIC DEVELOPMENT GAME

In this section we model the competition for firms as a game. Our model is admittedly simple and abstracts from many practical issues associated with offering incentives. We assume identical localities compete for a single firm in a

[3]Bond and Samuelson (1986) discuss the use of tax holidays as signals of productivity for multinational firms. To the authors' knowledge, no research has modeled subsidies as a signal about business climate.

single period.[4] We assume benevolent governments have full and perfect information about the costs and benefits of attracting a particular firm. In our perfect planning world localities are assumed to be able to make the best possible deals for themselves. In reality, of course, these assumptions are heroic because bids are secret and costs and benefits are not known with certainty. The idea, however, is to show that even under these propitious circumstances, offering incentives would still have perverse consequences.

There are two important features that distinguish our model from previous research using a theoretical game to analyze interjurisdictional competition. First, we assume that only certain localities will be in the game—those that the firm *actually* considers. This is really part of our perfect planning assumption. Everyone knows which localities the firm is considering so there are no information asymmetries for the firm to exploit. Which localities does the firm consider? The evidence suggests that incentives only influence decisions if more than one location satisfies the basic investment criteria (Kieschnick 1981; Toft 1996). Companies decide on certain localities first and then shop for incentives: "Lynn Markley, a spokeswoman for Frito-Lay, says the company selects a general region where it wants to locate a new plant. It then prepares a sort of shopping list of requirements for the facility and contacts states about incentives" (Barlett and Steele 1998a, p. 41). The localities in the game are therefore assumed to be equivalent with regard to basic location factors, at least with respect to the needs of the particular firm. In addition, we restrict the localities in the game to those that would benefit the most from attracting the firm (Brooks 1989).[5] The firm wants to get the highest subsidy it can. A capacity to provide such a subsidy is one of the things it looks for in a locality (Toft 1996; Venable 1995, p. 728). A locality that is otherwise suitable but unable to provide much in the way of subsidies will not be attractive to the firm and everyone knows this. Given that localities are rational, the maximum amount they can offer a firm is the value of attracting the firm to the locality.[6]

The second distinguishing feature of our model is how we incorporate the role of business climate. We explicitly model the cost incurred if a locality fails to attract a particular firm that it could attract.[7] The cost results from sending a negative business signal. As we discussed before, these are reputation effects that result from not appearing to be "open for business." These costs will be reflected in future economic development efforts. Of course, for the localities that are not in the firm's feasible set and those with relatively little to gain from attracting the firm, not bidding could be construed as a positive signal about fiscal responsibility.

[4]In contrast, Black and Hoyt (1989) allow for heterogeneity among localities in terms of labor costs.
[5]In practice, localities that have little chance of winning may be induced into courting a particular firm. Given information uncertainty, it is difficult to separate the "players" from the imposters.
[6]In reality, different localities may have different benefits from attracting the firm. Given our other assumptions, the only locality that would bid would be the one with the most to gain since the firm has perfect information, too.
[7]We assume that a locality does not look any worse for failing to attract a firm that it had no hope of attracting. Thus, the argument that failing to compete in the high-stakes game actually sends a positive indication of fiscal responsibility is consistent with our model.

Our focus, however, is on why certain localities are compelled to enter into bidding wars.

To begin, we assume that there is a particular firm and a set of localities where it might want to locate. The localities 1, ..., I that the firm considers are the *players* in this game. For the sake of simplicity, we model the players as identical.[8] We assume that each locality knows what it will gain if it attracts the firm and what it will lose if it fails to do so. We also assume that there is no information asymmetry among localities: each locality knows the identities of the other players, its legitimate competitors. Localities try to entice the firm by offering incentives. Incentives can come in many forms, but for the sake of simplicity we assume that localities offer cash subsidies.[9] The cash subsidy can be seen as the monetary value of the combined incentive package that a locality offers. The players are otherwise identical, so the firm moves to the locality that offers the highest subsidy. We assume that the citizens of the localities hold local officials accountable. As a result, subsidy offers can not exceed the benefit to a locality of attracting the firm. Let x be the discounted present value to a locality of attracting the firm. Let S_i = [0, x] be locality i's *strategy set*: the set of possible subsidies that locality i can offer the firm. Then s_i is a particular subsidy offer (*strategy*) from the set S_i. Let s = (s_1, ..., s_I) be a *strategy profile* that lists a strategy for each locality, where $s \in \times_{i=1}^{I} S_i = S$.

How any particular locality fares in the competition for a firm depends on the subsidies offered by each of the players. Suppose a locality is not among the high bidders. It does not pay the cost of the subsidy, but it does not get the benefit of having the firm, either. Localities that fail to attract a firm also look bad compared to a locality that does. By not offering enough to win the firm, the locality sends a negative signal to its citizens, other firms, etc., about its business climate. The strength of that negative signal depends on how the locality's subsidy offer compares to the highest bid(s). The greater the difference, the stronger the signal. Suppose a locality has the sole high bid. It gets x, the benefit of having the firm. It also has to pay out s_i, the subsidy offered. The net benefit of being the sole high bidder is, therefore, $x - s_i \geq 0$. Suppose a locality shares the high bid with another locality. We will assume that the firm chooses one of the high bidders at random, so each high bidder has an equal chance at the net benefit of having the firm. If a player that offers the highest subsidy does not win the firm, then there *might* be some small doubt about its business climate, which would show up as a cost, c(0).[10] The expected value of sharing the high bid with another locality, therefore, equals the chance of getting the firm multiplied by the value of getting the firm minus the chance of not getting the firm multiplied by the cost of doubt: $1/2(x - s_i) - 1/2(0)$.

[8]Our result does not rely on this assumption. Each locality can, for example, face different costs for failing to win the firm as long as those costs have the form outlined below.

[9]In reality, localities compete on many levels, including tax rates and service provision. We basically assume that the differences in these areas are equivalent across players in terms of the firm's profits. Our focus is on subsidies that are tailored for a particular firm rather than general policies that assist a broader array of firms.

[10]Even though there is perfect information for players and the firm that is being courted, nonplayers (those who do not enter the bidding) as well as other firms may not have access to the full information about the firm and about all possible localities. Alternatively, you can think of c(0) as the cost of actually assembling an unsuccessful bid.

To put all this formally, let $H = \{s_j \mid s_j \geq s_k \text{ for } k = 1, \ldots, I\}$ be the set of high bids, and h equal the number of elements in H, i.e., the number of high bids. The cost of sending a negative signal about the locality's business climate, $c(\cdot)$, is a function of the difference between a high bid and a locality's bid, $(s_j - s_i)$. The farther a locality is from the high bid, the larger the cost of doubt. Define $c(\cdot)$, then, as a strictly increasing function from the set $\{0, 1, \ldots, x\}$ into $\Re$, the set of real numbers, such that $c(0) \geq 0$. The probability that a player with a high bid wins the firm equals $1/h$. The payoff to a bid depends on the bids of all of the players. Define the payoff for player i as a function $p_i(\cdot)$ from the set of strategy profiles, S, into $\Re$ such that:

$$(1) \qquad \text{if } s_i \in H \text{ then } p_i(s) = \frac{1}{h}(x - s_i) - \left(1 - \frac{1}{h}\right)c(0), \text{ and}$$

$$(2) \qquad \text{if } s_i \notin H \text{ then } p_i(s) = -c(s_j - s_i) \text{ for } s_j \in H.$$

In other words, if player i offers a high bid (i.e., $s_i \in H$) then its payoff equals the probability of getting the firm multiplied by the net benefit of getting the firm minus the cost of doubt associated with offering the high bid and not getting the firm. If player i does not have a high bid (i.e., $s_i \notin H$) then its payoff is negative and equals the cost of doubt about its business climate, which, depends, in turn, on how low its bid is relative to the high bid(s).

What subsidies will localities offer? We start with a simple two-locality case. Note that it is always better for each locality to offer a small subsidy of ε rather than 0. To see this, suppose you are player one and your opponent bids 0. (You could be either locality, so the argument works for both players.) If you offer 0 you get a 50 percent chance at x and a 50 percent chance at -c(0), but if you offer ε you get $x - \varepsilon > 1/2(x - c(0))$. Now suppose your opponent also bids ε. If you offer 0 you lose the firm and get $-c(\varepsilon)$, but if you offer ε you get a 50 percent chance at $x - \varepsilon$ and a 50 percent chance at -c(0). As long as x is greater than or equal to ε, you would want to bid ε since $c(\varepsilon) > c(0)$ by assumption. Suppose your opponent bids more than ε. You lose the firm if you offer 0 or ε, but you send a stronger negative signal with an offer of 0 rather than ε.

Since we can rule out 0 bids, it is always better for each locality to offer a subsidy of more than ε rather than ε. Again, suppose your opponent bids ε. If you offer ε you get a 50 percent chance at $x - \varepsilon$ and a 50 percent chance at -c(0), but if you offer more, say $\varepsilon + \varepsilon'$, you get $x - (\varepsilon + \varepsilon') > 1/2(x - \varepsilon - c(0))$. Suppose your opponent bids $(\varepsilon + \varepsilon')$. If you offer ε you lose the firm, but if you offer $(\varepsilon + \varepsilon')$ you get a 50 percent chance at $x - (\varepsilon + \varepsilon')$. Suppose your opponent bids more than $(\varepsilon + \varepsilon')$. You lose the firm if you offer ε or $(\varepsilon + \varepsilon')$, but you send a stronger negative signal with an offer of ε rather than $(\varepsilon + \varepsilon')$.

The pattern suggested here continues until the only bid left is x: it is always better to bid a little more than your opponent if you can. If c(0), the cost of not winning even though you share the high bid, is positive $(c(0) \geq 0)$, then bidding x along with your opponent provides a negative expected payoff equal to $-1/2c(0)$.

The two-locality results generalize substantially to the multilocality case. Again, for each player, it is always better to offer a little rather than nothing; if subsidies of 0 are eliminated then it is always better to offer a little more than a little; if a little is eliminated then it is always better to offer a bit more than a little more; etc. As before, each locality has an incentive to outbid the others (see Appendix A). At equilibrium, each locality bids x, the whole benefit of having the firm.

The upshot is that each locality has an incentive to bid as high as it can. To even be in the running for a firm, the locality must provide the firm with a subsidy equal to all of the benefit of having the firm locate there in the first place. By each locality trying to improve its attractiveness to the firm, the end result is that no locality improves its relative attractiveness at all.[11] Consequently, each locality would do better if they would all refuse to offer subsidies and let the firm choose at random. That is not a feasible outcome, however, since there is a huge benefit to cheating in such a system: even a very small subsidy wins the firm.

III. IMPLICATIONS FOR ENDING THE COMPETITION

Is there any way to rein in incentive giveaways? A unilateral moratorium on incentives is not feasible. Any locality that tried it would be at a competitive disadvantage—it could not attract much business. Other localities would have no incentive to follow suit. For example, when North Carolina was banned from offering incentives during the Maready Case (*Maready v. City of Winston-Salem*, 342 NC 708), not only did competing states continue to offer incentives, they used the ban to their advantage by misrepresenting North Carolina's willingness and ability to assist firms (Howard and Harris 1996). This example highlights the essence of the prisoners' dilemma: cooperation is better for each of the parties but the cooperative solution is impossible to attain voluntarily since there is much to be gained from cheating. "Such unilateral action has not worked in the past and offers limited future prospects" (Toft 1995-96).

A voluntary multilateral moratorium on incentives is a popular proposal. Politicians, economists, academics, and planners have called for such a moratorium. A resolution by over 100 midwestern economists issued on September 20, 1995, for example, called for an end to state-sponsored selective business incentive programs, such as direct grants and targeted tax abatements (Toft 1996). There is no reason, however, to be optimistic about this approach. Multilateral agreements have been tried in the past with no success (Stern 1996; Reed 1996; Reich 1996). The noncompetition compact among New York, New Jersey, and Connecticut, for example, lasted just four days (Reich 1996). Basically, there is no reason for a locality to abide by a voluntary moratorium on incentives. As we saw before, a locality has much to gain by offering incentives. In particular, the officials of a locality want everyone else to stop offering incentives so they can offer smaller subsidies and realize greater gains. They have an incentive to *sign* compacts but not to *abide* by them.

[11] Fisher (1996, pp. 625-627) provides a very detailed analysis of this phenomenon in the context of tax incentives.

There is a glimmer of hope for a voluntary end to the bidding wars. Under certain conditions, localities might be able to develop a stable cooperative scheme. The idea is for communities to divide a series of firms among themselves by taking turns offering small subsidies. A locality might have to wait for its turn to court a firm, but when its turn arrives, the locality will realize most of the benefit of acquiring the firm. This strategy can be incentive compatible. Localities will restrain themselves for future benefits if the expected benefits are substantial enough, certain enough, and not too far off. The conditions for this sort of cooperation are quite rare, however. The set of localities must be stable. A locality outside the compact will not abide by its constraints, forcing the other localities to offer incentives to match. There must be a continuous supply of firms, arriving on the scene sufficiently often. If there are no more firms or if potential firms arrive too far in the future, then a locality will not have an incentive to leave the field to another locality. Localities must also take a long-run view. They have to value the future highly or they will have an incentive to cheat and go for the immediate gain. This condition is problematic for politicians who stand to gain from short-term success and may not get credit for success in the future (after their term ends). These conditions are likely to be met, if ever, only among a small number of localities with regard to a highly specialized sector of the economy. These results follow from an analysis of an indefinitely repeated version of the game described above (see Appendix B).

The prisoners' dilemma aspect of the interjurisdictional competition for firms highlights the need for federal intervention. Recently, there has been an increased call for federal-level solutions. The necessity of federally imposed solutions has even reached the popular literature (Bartlett and Steele 1998b). One such possible solution is a government-enforced moratorium. As we saw before, a moratorium works only if everyone actually stops offering incentives. As a practical matter, this implies federal action. Melvin Burstein and Arthur Rolnick from the Federal Reserve Bank of Minneapolis have suggested such a moratorium (1996). There is some question, however, about the authority of the federal government to impose a moratorium on incentives offers (Frickey 1996). Furthermore, there may even be outright opposition at the federal level. In a sense, the competition among localities results in a de facto national policy of providing business incentives to certain firms (Fisher 1996, p. 627). Subsidies offered by states and localities provide a way to circumvent international trade agreements, which limit federal subsidization of multinational firms.[12]

A variant of the moratorium idea is to impose a federal excise tax on incentives. If set at a rate of 100 percent, businesses would no longer have an incentive to go shopping for deals, since any incentives received would be confiscated. If set at a rate of anything less than 100 percent, however, firms would still want to participate in the competitive bidding process (Barlett and Steele 1998b). The federal government evidently does have the Constitutional authority to impose such a tax, but, as with the moratorium, it would face strong political opposition from

[12]We are indebted to Scott Loveridge for this observation.

local economic developers. Moratoriums or other limitations on economic development incentives are especially unlikely in this era of new federalism since such legislation would directly reduce a state's ability to promote economic development within its borders. An alternative to a policy based on regulation and taxes is to attack the problem through the judicial branch of the federal government. Some legal scholars argue that the practice of offering incentives results in discriminatory taxation and so violates the commerce clause of the Constitution. There have been some cases along these lines, but the jury is still out on the relevant legal questions (e.g., Frickey 1996; Hellerstein 1996; Kramer 1996).

The political obstacles to federal solutions are formidable. State and local economic development professionals will continue to resist policies that will limit their ability to send highly visible signals about their community's business climate. Consultants who help package and market incentives will join the resistance. Considering also the firms who ultimately capture economic rents from the competition, we can understand why federal solutions are not forthcoming. There are no easy solutions even if everyone recognizes the inherent problem with offering incentives to attract firms. From a practical standpoint, we can expect the bidding competition to continue.

IV. CONCLUSION

Our analysis demonstrates the paradox of offering incentives from a locality's perspective. There are good reasons why a locality would not want to offer incentives. Still, driven by the desire to send a positive signal about its business climate, a locality finds it almost impossible to resist the urge. Once localities start to compete for firms, however, a bidding war is inevitable. Consequently, communities give away all of the benefits of attracting new firms. It is clear that localities would be better off if the unbridled competition for businesses could be ended. Unfortunately, coordination among places to that end is virtually impossible in the absence of external constraint because each locality would benefit by trying to attract firms if all other localities stopped trying.

In order to focus tightly on a neglected feature of local economic development competition, our model of the incentives bidding process makes a number of simplifying assumptions. We isolate the influence of business climate by essentially allowing localities to make good deals for themselves. By showing how competition in offering incentives, even apart from practical problems, influences payoffs, we identify an *upper bound* on the benefit to a locality of engaging in such competition. Still, our no-frills model and its basic result are amenable to further development. It would be possible to augment our game with, for example, a formal account of the cost of sending a negative business climate signal or a further exploration of the practical problems of developing appropriate incentives offers. Our simple model provides not only an interesting result but also a good framework for further extensions. It is hoped that this study will stimulate further investigation.

Given the inevitability of the competition between places, at least in the immediate future, some analysis about how to make *good* deals is vital. Practitioners have very little room for error when offering incentives. Even when they do well, the best outcome for a locality may be to break even. Measures such as claw-back provisions that attempt to ensure full disclosure, strict accountability, and improved cost-benefit analysis are essential to minimize errors (Ledebur and Woodward 1990). Consequently, the focus in the literature on improving the practice of offering incentives is not inconsistent with the goal of restraining interjurisdictional competition. It is needed to minimize the risk of giving away more than what a locality stands to gain by attracting a firm.

APPENDIX A

This appendix provides some technical results for the I-player game, along with a brief explanation of what they might mean to someone trying to understand the practice of offering incentives to firms.

Result 1: $s^* = (x, \ldots, x)$ is a Nash equilibrium.

Proof: Without loss of generality, consider payoffs to player one. It suffices to show that $p_1(x, \ldots, x) > p_1(x - y, x, \ldots, x)$ for all $y \in (0, x]$.

$p_1(x, x, \ldots, x) = (1/I)(x - x) - ((I - 1)/I)c(0)$
$p_1(x, x, \ldots, x) - p1(x - y, x, \ldots, x) = c(y) - ((I - 1)/I)c(0)$
$c(\cdot)$ is strictly increasing so $c(y) > c(0)$
$c(0) \geq 0$ and $(I-1)/I < 1$ so $c(0) > ((I - 1)/I)c(0)$
therefore $c(y) - ((I - 1)/I))c(0) > 0$

A Nash equilibrium is a strategy profile in which each player does the best she can given what every other player does. The outcome of a game with rational players will be a Nash equilibrium unless some player has false beliefs about what some other player will do. The first result highlights the defensive nature of the competition for firms. Each player's best strategy is to offer everything to the firm when any of the other players do likewise.

Result 2: $s^*(x, \ldots, x)$ is the *sole* Nash equilibrium.

Note: A strategy $s^{\#}_i$ *dominates* another strategy s'_i for player i if and only if i does better playing $s^{\#}_i$ rather than s'_i, no matter what anyone else does (for any s^{-i}, $p_i(s^{\#}_i, s^{-i}) > p_i(s'_i, s^{-i})$, where s^{-i} is the strategy profile s without s_1). A rational player never plays a dominated strategy because she always does better by playing the dominant strategy. The proof proceeds by iterated elimination of dominated strategies: for each player i, strategies $s_i \in [0, x)$ are successively eliminated.

Proof: Without loss of generality, consider payoffs to player one. It suffices to show that for any $k \in [0, k)$, if $k = 0$ or the $s_1 \in [0, k)$ are already eliminated, then $k \in S_1$ is dominated by $k + \alpha \in S_1$ for all $\alpha \in (0, (I\text{-}1)/I)(x - k + c(0))$. There are two cases:

(1) $p_1(k + \alpha, k, \ldots, k) > p_1(k, k, \ldots, k)$
$p_1(k + \alpha, k, \ldots, k) = x - (k + \alpha)$
$p_1(k, k, \ldots, k) = (1/I)(x - k) - ((I - 1)/I)c(0)$
$p_1(k + \alpha, k, \ldots, k) - p_1(k, k, \ldots, k) = x - k - \alpha - (1/I)(x - k) + ((I - 1)/I)c(0)$
$= ((I - 1)/I)(x - k + c(0)) - \alpha$
$\alpha < ((I\text{-}1)/I)(x - k + c(0))$
therefore $((I - 1)/I)(x - k + c(0)) - \alpha > 0$

(2) $p_1(k + \alpha, \ldots, k + \beta, \ldots) > p_1(k, \ldots, k + \beta, \ldots)$
where $\beta > 0$, $k + \beta \in \{s \mid s_i > s_j \text{ for } i, j = 2, \ldots, I\} = H^{-1}$
and h^{-1} is the number of high bids in H^{-1}.

There are three subcases:

(i) $\alpha > \beta$
$p_1(k + \alpha, \ldots, k + \beta, \ldots) = -c(k + \beta - (k + \alpha))$
$p_1(k, \ldots, k + \beta, \ldots) = -c(k + \beta - k)$
$p_1(k + \alpha, \ldots, k + \beta, \ldots) - p_1(k, \ldots, k + \beta, \ldots) = c(\beta) - c(\beta - \alpha)$
$c(\cdot)$ is strictly increasing and $\beta > \beta - \alpha$ so $c(\beta) > c(\beta - \alpha)$
therefore $c(\beta) - c(\beta - \alpha) > 0$

(ii) $\alpha < \beta$
$p_1(k + \alpha, \ldots, k + \beta, \ldots) = x - (k + \alpha)$
$p_1(k, \ldots, k + \beta, \ldots) = -c(k + \beta - k)$
$p_1(k + \alpha, \ldots, k + \beta, \ldots) - p_1(k, \ldots, k + \beta, \ldots) = x - (k + \alpha) + c(\beta)$
$k + \alpha \in S_1$ so $k + \alpha \leq x$ and so $x - (k + \alpha) \geq 0$
$c(\beta) > c(0) \geq 0$ so $x - (k + \alpha) + c(\beta) > 0$

(iii) $\alpha = \beta$ (Note: In this case $h = h^{-1} + 1 > 1$.)
$p_1(k + \alpha, \ldots, k + \beta, \ldots) = (1/h)(x - (k + \alpha)) - ((h - 1)/h)c(0)$
$p_1(k, \ldots, k + \beta, \ldots) = -c(k + \beta - k)$
$p_1(k + \alpha, \ldots, k + \beta, \ldots) - p_1(k, \ldots, k + \beta, \ldots) = (1/h)(x - (k + \alpha)) + c(\beta) - ((h - 1)/h)c(0)$
$k + \alpha \in [0, x]$ so $x - (k + \alpha) \geq 0$ and so $(1/h)(x - (k + \alpha)) \geq 0$
$c(\cdot)$ is strictly increasing and $\beta > 0$ so $c(\beta) > ((h - 1)/h)c(0)$
therefore $(1/h)(x - (k + \alpha)) + c(\beta) - ((h - 1)/h)c(0) > 0$

Result 2 underwrites our main thesis. It shows that if localities compete for firms then the *only* incentive offer that makes sense is *everything*. The upshot is that when localities care about development, the best they can do is pretty poor: they must give away all of the benefit of attracting the firm in the first place.

Result 3: If $c(0) > 0$ then $p_i(s^*) < 0$ for $i = 1, \ldots, I$.

Proof: Without loss of generality, consider the payoff to player one.

$$p_1(x, \ldots, x) = (1/I)(x - x) - ((I - 1)/I)c(0) = - ((I - 1)/I)c(0)$$
$$c(0) > 0 \text{ and } (I - 1)/I > 0 \text{ so } - ((I - 1)/I)c(0) < 0$$

The third result is stronger than the second. If there are positive costs associated with not winning a firm even when the locality matches the best offer, then each locality has a negative expected payoff. Competition for firms not only fails to help localities, it can actually hurt them.

APPENDIX B

Playing the same game over an indefinite number of times can make certain series of actions optimal even though none of those actions would be optimal with respect to the unrepeated game. In other words, repeated play can lead to new equilibrium actions. Modeling economic development as a repeated game might be appropriate in some situations.

Formally, an indefinitely repeated game consists of a series of *stage games*. The stage games we are interested in are each just like the game outlined above: the players are 1, ..., I; the sets of actions for each player at each stage are the strategy sets S_i; and the payoffs at each stage are determined by the payoff functions $p_i(\cdot)$. Let $s(t) = (s_1(t), \ldots, s_I(t))$ be the action profile for the t period of the game, where $t = 1, 2, 3, \ldots$. The history of play up to t is given by $\lambda(t) = (s(0), s(1), \ldots, s(t))$, where $\lambda(t)$ is a particular history of play from the set of all possible histories, $\lambda(t) \in \Lambda(t) = \times_t S$. A strategy for player i in the full game, σ_i, is a sequence of functions from histories into actions, σ_i: $\Lambda(t) \rightarrow S_i$. $\sigma_i \in \Sigma_i$, the set of all such possible strategies. A strategy profile of the full game is σ, which is an element of the set of all strategy profiles, $\sigma = (\sigma_1, \ldots, \sigma_I) \in \Sigma = \Sigma_1 \times \ldots \times \Sigma_I$. The payoff to player i of strategy profile σ is $\Sigma_t(\omega\delta)^t p_i(\sigma(\lambda(t)))$, where $\omega \in (0, 1]$ is the chance that the game willcontinue to the next stage and $\delta \in (0, 1]$ is the discount factor. This payoff is, roughly, the discounted sum of the expected values of the stage payoffs given the actions implied by the strategy profile.

Let σ^*_i be the strategy of bidding 0 at each stage until the first player bids more and bidding x after that. $\sigma^* = (\sigma^*_1, \ldots, \sigma^*_I)$. This strategy profile is symmetric (every player plays the same strategy) and provides Pareto efficient payoffs (no locality can increase its payoff without decreasing the payoff of another locality). The players are cooperating when they play σ^*: they refrain from bidding in order

to avoid having to offer incentives. According to the folk theorem of repeated games, σ^* is a Nash equilibrium (optimal for each player if the other players go along) if and only if $\omega\delta$ is large enough.[13] (Without loss of generality, we will be treating player 1 as a representative player.) How large does $\omega\delta$ have to be in order to support σ^* as a Nash equilibrium? Suppose player 1 were to defect from σ^*: she would bid 1 at the first stage game before the gain from defecting could be discounted. Let σ^D_1 be a strategy in which she does just that. Player 1 plays σ^D_1 when everyone else plays their part of σ^* only if $\pi_1(\sigma^D_1, \sigma^{*-1}) \geq \pi_1(\sigma^*)$ where σ^{*-1} is the strategy profile of all players except player 1. Player 1 will not defect if $\omega\delta$ is large enough as shown below.

(B1) $\pi_1(\sigma^*) = \sum (\omega\delta)^t [(1/I)x - ((I - 1)/I)c(0)] = (1/(1 - \omega\delta))[(1/I)x - ((I - 1)/I)c(0)]$

(B2) $\pi_1(\sigma^D_1, \sigma^{*-1}) = x - 1 + \sum (\omega\delta)^t [-((I - 1)/I)c(0)] = x - 1 - (\omega\delta/(1 - \omega\delta))[((I - 1)/I)c(0)]$

(B3) $(1/(1 - \omega\delta))[(1/I)x - ((I - 1)/I)c(0)] \geq x - 1 - (\omega\delta/(1 - \omega\delta))[((I - 1)/I)c(0)]$ implies that

(B4) $\omega\delta \geq 1 - (x/[I(x - 1) + c(0)(I - 1)])$.

Let $\underline{\omega\delta} = 1 - (x/[I(x - 1) + c(0)(I - 1)])$. $\underline{\omega\delta}$, therefore, is the smallest level of $\omega\delta$ that supports cooperation among localities. How does $\underline{\omega\delta}$ change as I, x, and c(0) change?

(B5) $\partial\underline{\omega\delta}/\partial I = (\partial/\partial I)[1 - (x/[I(x - 1) + c(0)(I - 1)])] = (x^2 + c(0) - x)/(I(x - 1) + c(0)(I - 1))^2 > 0$, so $\underline{\omega\delta}$ increases as I increases.

(B6) $\partial\underline{\omega\delta}/\partial c(0) = (\partial/\partial c(0))[1 - (x/[I(x - 1) + c(0)(I - 1)])] = (x(I - 1))/(I(x - 1) + c(0)(I - 1))^2 > 0$, so $\underline{\omega\delta}$ increases as c(0) increases.

(B7) $\partial\underline{\omega\delta}/\partial x = (\partial/\partial x)[1 - (x/[I(x - 1) + c(0)(I - 1)])] = (I + c(0) - c(0)I)/(I(x - 1) + c(0)(I - 1))^2$. $I + c(0) - c(0)I > 0$ if and only if $c(0) < (I/(I - 1))$, so $\underline{\omega\delta}$ increases as x increases, where $c(0) < (I/(I - 1))$, and $\underline{\omega\delta}$ decreases as x increases, where $c(0) > (I/(I - 1))$.

REFERENCES

Barlett D., and J. Steele. "Corporate Welfare." *Time*, 9 November 1998a, 36-54.

_____. "Five Ways Out." *Time*, 30 November 1998b, 66-67.

Bartik, Timothy J. *Who Benefits From State and Local Economic Development Policies?* Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 1991.

Black, D.A., and W.H. Hoyt. "Bidding for Firms." *American Economic Review* 79 (5) (1989), 1249-1256.

[13] See Fudenberg and Tirole (1991, pp. 150-160) for an explanation of the folk theorem.

Bond, Eric W., and L. Samuelson. "Tax Holidays as Signals." *American Economic Review* 76 (4) (1986), 820-826.

Brooks, D. G. "Competitive Subsidization in Regional Development." *Regional Science and Urban Economics* 19 (1989), 589-599.

Burstein, M.L., and A.J. Rolnick. "Congress Should End the Economic War for Sports and Other Businesses." Federal Reserve Bank of Minneapolis *fedgazette* (January 1996).

_____. "Congress Should End the Economic War Among the States: 1994 Annual Report Essay." Federal Reserve Bank of Minneapolis *The Region* (March 1995). Available: http://woodrow.mpls.frb.fed.us.

Carlton, G. "A Conversation with Gary Carlton." 1996. Available: http://ksg.www.harvard.edu/battle/ncbattle/rntble/trcarlt.html [12/11/98].

Coates, D. "Property Tax Competition in a Repeated Game." *Regional Science and Urban Economics* 23 (1993), 111-119.

Dabson, B., C. Rist, and W. Schweke. "Business Climate and the Role of Development Incentives." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Demott, J.S. "States Scramble for Fewer Prizes." *Nation's Business* (September 1994), 56-58.

Duncan, H. "Interstate Tax Competition: The Good, the Bad, and the Ugly." *State Tax Notes*, 24 August 1992, 266.

Fisher, R.C. *State and Local Public Finance*. 2d ed. Chicago: Irwin, 1996.

Frickey, P.P. "The Congressional Process and the Constitutionality of Federal Legislation to End the Economic War Among the States." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Fudenberg, D., and J. Tirole. *Game Theory*. Cambridge, MA: MIT Press, 1991.

Grady, D.O. "State Economic Development Incentives: Why Do States Compete?" *State and Local Government Review* (1987), 86-94.

Hands, D.W., and B.D. Mann. "Urban Industrial Tax Subsidies: A Non-Cooperative Equilibrium Approach." *Regional Science and Urban Economics* 17 (1987), 179-190.

Hellerstein, W. "Commerce Clause Restraints on State Tax Incentives." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Howard, J.L., and D. Harris. "Too Many Projects Lost May Trigger N.C. Incentives." *The Business Journal*, 1 January 1996.

Jenn, M.A., and F. Nourzad. "Determinants of Economic Development Incentives Offered by States: a Test of the Arms Race Hypothesis." *The Review of Regional Studies* 26 (1996), 1-16.

Kieschnick, M. *Taxes and Growth: Business Incentives and Economic Development*. Washington, D.C.: Council of State Planning Agencies, 1981.

Kramer, L. "The Power of Congress to Regulate Interstate Economic Competition." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Ledebur, L., and D. Woodward. "Adding a Stick to the Carrot: Location Incentives with Clawbacks, Recisions, and Recalibrations." *Economic Development Quarterly* 4 (3) (1990), 221-237.

Leroy, G. "No More Candy Store: States Move to End Corporate Welfare as We Know It." *Dollars and Sense Magazine* (May/June 1995).

Lyne, J. "The Governors Speak: How the Top 10 Did It." *Site Selection* (February/March 1998), 48-49.

Mahtesian, C. "Romancing the Smokestack." *Governing Magazine* 8 (1994), 36-40.

Reed, L. "Time to End the Economic War Between the States." *Regulation* 19 (2) (1996), 35-44.

Reich, R.B. "Bidding Against the Future." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Rubin, H.J. "Shoot Anything That Flies; Claim Anything That Falls: Conversations with Economic Development Practitioners." *Economic Development Quarterly* 2 (1988), 236-251.

Schwartz, J., T. Barret, F. Washington, B. Fisher, and L. Rodado. "Can You Top This?" *Newsweek*, 17 February 1992, 40-41.

Site Selection. "33rd Annual Survey: '50 Legislative Climates.'" (October/November 1998), 862-882.

Spindler, C., and J. Forrester. "Economic Development Policy: Explaining Policy Preferences Among Competing Models." *Urban Affairs Quarterly* 29 (1993), 28-53.

Stern, G.H. "Like All Wars, This One Requires Political Leadership." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Toft, G.S. "Industrial Development in the New Economy." *The Journal of Applied Manufacturing Systems* 8 (1) (Winter 1995-96).

_____. "Doing Battle over the Incentives War: Improve Accountability but Avoid Federal Noncompete Mandates." Federal Reserve Bank of Minneapolis *The Region* (June 1996). Available: http://woodrow.mpls.frb.fed.us.

Venable, T. "Sunny Sessions for Business: Incentives Soar, Taxes Slashed." *Site Selection* (October 1995), 726-800.

_____. "Tax Cuts, Incentives Blitz Top 1996's Sunny Year for U.S. Business Climates." *Site Selection* (October 1996), 822-862.

Venable T., and H. E. Coffee. "Incentives Boosted, Budgets Bashed in '93 Legislative Sessions." *Site Selection* (October 1993), 1086-1169.

Walker, L. *Economic Development in the States: The Changing Arena*. Washington, D.C.: Council of State Governments, 1989.

Wasylenko, M. "Empirical Evidence on Interregional Business Location Decisions and the Role of Fiscal Incentives in Economic Development." In H.W. Herzog and A.M. Schlottmann (eds.) *Industry Location and Public Policy*. Knoxville: University of Tennessee Press, 1991.

Wilson, J.D. "A Theory of Interregional Tax Competition." *Journal of Urban Economics* 19 (1986), 296-315.

Wolkoff, M. "Is Economic Development Decision Making Rational?" *Urban Affairs Quarterly* 27 (1992), 340-355.

Wolman, H. "Local Economic Development Policy: What Explains the Divergence Between Policy Analysis and Political Behavior?" *Journal of Urban Affairs* 10 (1988), 19-33.

Zodrow, G. R., and P. M. Mieszkowski. "Tiebout, Property Taxation, and the Under-Provision of Public Goods." *Journal of Urban Economics* 19 (1986), 356-370.