A Strategic Theory of Policy Diffusion and an Application to the Study of Lottery Competition Among the American States

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ABSTRACT

Two primary theories have been advanced to explain why polices diffuse across governments: policy learning and intergovernmental competition. We contend that when articulating either theory, scholars should consider (*i*) the specific nature of the expected interaction among governments, and (*ii*) the possibility of strategic behavior in which each government makes decisions that take into account the policies of other governments and the likely responses of these governments to its decisions. To facilitate this, we develop a general formal theory of policy diffusion within a network of strategic actors. Then we specialize our theory to construct a strategic model of lottery competition among American states. Our model predicts not only the *defensive* competition frequently described in extant research—in which states estimate their revenue loss due to residents playing neighboring states' lotteries and determine whether this loss justifies an adoption to curtail the loss of revenue. It also predicts that lottery competition (*i*) has an *offensive* element—in which states seek to "poach" revenue from residents of other states without lotteries when possible—and (*ii*) is *anticipatory* (or forward looking): when deciding whether to adopt a lottery, states consider their ability to compete successfully for revenues with neighboring states that do not *currently* have a lottery but might adopt one (defensively) if their neighbors adopt. Empirical analysis using data from the American states and measures constructed with geographical information systems (GIS) provides support for the model. This suggests that states compete against one another in a more sophisticated fashion than has previously been recognized. When deciding whether to adopt a lottery, states seem to behave as strategic rational actors interconnected in a network, taking into account the expected long-term revenues from a lottery—from both residents of their own states and residents of others. In the conclusion, we illustrate the potential applicability of our general theory of policy diffusion by discussing how it might be specialized to explain a quite different government action: military mobilization by nations.

There is a large body of empirical evidence that public policies diffuse across American states (e.g., Berry and Berry 1990; Mooney and Lee 1995; Mintrom 1997) and nations (e.g., Collier and Messick 1975; Simmons 2000; Jordana and Levi-Four 2005). But the development of theoretical explanations for how and why this diffusion occurs has been quite limited. Two primary theories have been proposed: policy learning/imitation and competition (Berry and Baybeck 2005; Boehmke and Witmer 2004). In a pure version of the former, a government observes the effects of a policy in another jurisdiction, and then uses this information to make a decision about adopting the same policy itself, but there are no externality effects of the actual policy that spill over jurisdictional boundaries (Walker 1969; Mooney and Lee 1995; Grossback, Nicholson-Crotty and Peterson 2004). In the latter, one government's policy has spillover effects on activities in another jurisdiction, and the jurisdiction affected must decide how to respond (Ka and Teske 2002; Berry, Fording and Hanson 2003; Bailey and Rom 2004). In both cases it is assumed that states or nations more closely tied, via spatial proximity or shared interests, have more of an impact on each other.

These theories are potentially quite rich and quite capable of explaining policy diffusion. Yet, with few exceptions, the hypotheses generated from these theories—and then tested empirically—have been overly simplistic. Indeed, the vast majority of empirical tests of both theories have involved models specifying that the probability that a government will adopt a policy is determined by the extent to which the policy has been previously adopted by those governments hypothesized to influence its choice about whether to adopt; most often, the influence of other governments is captured by a single independent variable: the number (or percentage) of neighboring jurisdictions that have previously adopted (e.g., Berry and Berry 1990; Mintrom 1997; Balla 2001). Such specifications are clearly incapable of determining whether any diffusion detected is due to learning or competition (Berry and Baybeck 2005). Moreover, as commonly specified, both the learning and competition hypotheses fail to clarify (*i*) the precise nature of the expected interactivity among governments, and (*ii*) the potentially strategic behavior that this interconnectivity entails.

We argue that it is important to take both into account when trying to understand policy diffusion due to learning or to competition, and develop a general theory of policy diffusion that does so. We then specialize the theory to develop a model of interstate competition designed to explain lottery adoptions by the Americans states. This specialized model makes explicit the role of strategic interactions among states within a network in accounting for adoptions. An accompanying empirical test utilizing measures constructed with geographical information systems (GIS) by Berry and Baybeck (2005), and additional measures we construct, provides support for the model.

Interconnectivity and Strategy: Understanding State Lottery Adoptions

Consider the case of lottery adoptions by American states. The first modern lottery was adopted by New Hampshire in 1964; over the next four decades most states followed suit, with North Carolina adopting in 2005 and becoming the 42nd state with a lottery. Many studies have found that the decisions by the states to adopt a lottery are interdependent (e.g., Berry and Berry 1990; Alm, McKee and Skidmore 1993; Erekson et al. 1999). Berry and Baybeck (2005, 507)—relying on insights offered by many scholars—specify a "lottery competition hypothesis" that seeks to characterize the nature of the interdependence among states. This hypothesis rests on a simple chain of causality. It is assumed that (*i*) a lottery substitutes for other goods subject to sales taxes—particularly entertainment—and thus when residents of a state cross borders to play the lottery, the state loses revenues, and (*ii*) as the distance people must travel to play the lottery rises, they are decreasingly willing to invest the time and expense to play. Thus, for a state without a lottery, the greater the concentration of the state's population near the borders of states with lotteries, the greater the revenue loss to other states. In turn, the greater the loss of revenues to neighboring states, the greater the likelihood that a lottery will be adopted in response. This implies that the higher the proportion of a state's population living near other states with lotteries, the more likely that state is to adopt a lottery.[1] Using GIS to measure this population, Berry and Baybeck (2005) find strong support for the competition hypothesis.

There are two important theoretical points to make regarding this case. The first is that, in this causal story, a state's decision about whether to adopt depends on the decisions of a specific subset of other states. While this is not a new insight to state politics scholars, or to political scientists more generally, researchers rarely model the interaction among states or nations as constrained by a specified network. As detailed in a rapidly-growing literature that spans both the natural and social sciences, the introduction of networks into the analysis does more than merely complicate matters—it changes fundamentally the outcomes one might expect (e.g., Chwe 1999; Fowler 2005; Gould 1993; Marwell and Oliver 1993; Siegel n.d.). It is thus insufficient to note that states' choices are interdependent; one must also account for the pattern of their dependence in a network of states.

The second theoretical point is that, under the competition hypothesis, the states are *strategic*. That is, their decisions take into account actions by other states. Specifically, states estimate their revenue loss from neighboring states' lotteries, and consider whether their own adoptions would be beneficial in this light. Although this kind of behavior—which we term

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[1] For simplicity, we distinguish dichotomously between persons who live near a border and those who do not. Berry and Baybeck's specification of the competition hypothesis actually assumes that the propensity of individuals to cross a state border to play the lottery is highest for those living right at the border and declines gradually as distance to the border increases.

defensive competition—is an example of strategic action, it is only one part of the larger strategic game that should be expected to occur within the network of states. A better understanding of the nature of policy diffusion requires a more complete consideration of this network game.

The following logic suggests why a more thorough analysis is needed. Berry and Baybeck's (2005) competition hypothesis assumes that a state (say B) adopts a lottery when it is losing revenue to a nearby state with a lottery (say A); B adopts so that its residents who were traveling to play A's lottery will instead stay home and play their own state's lottery. However, if we are willing to assume that B's adoption was motivated by the goal of increasing revenues, we should consider the possibility that A's adoption was based on the same desire. Although A's adoption could be a defensive reaction to some other state's lottery (say C), it is reasonable to assume that if A is motivated by the goal of increasing revenues, the absence of a lottery in B and the resulting opportunity by A to increase revenues by attracting residents of B to cross the border to play could have factored into A's decision to adopt a lottery. This would mean that there is an *offensive* component to A's competitive behavior.

Furthermore, we might expect that states strategic enough to engage in offensive and defensive competition will also anticipate that other states will behave similarly. When a state considers adopting a lottery—and takes into account the revenue it may gain by (*i*) having its residents stay home rather than play other states' lotteries (i.e., defensive considerations) and (*ii*) attracting players from other states (i.e., offensive considerations)—it should anticipate that its adoption would increase the likelihood that its neighbors that do not have a lottery would adopt one in response (i.e., engage in defensive competition), and factor the implications of such adoptions into its choice. We denote behavior motivated by a government's assessment of the effects a policy adoption by it would have on the future behavior of other states as *anticipatory*.

Thus, when they compete, strategic states should be expected to take into account defensive, offensive and anticipatory considerations. To derive hypotheses from a fully-strategic theory, however, we must elucidate the theory in more detail. This we do in the following two sections, first generally, and then specifically in the form of an interstate competition model of lottery adoptions.

A General Theory of Policy Diffusion within a Network

We begin by assuming a network of n heterogeneous actors; these may be cities in European Union, the U.S. states, or the nations of the world. For simplicity, we assume that at each time, t, each actor, s, makes a binary choice: to take some action (e.g., adopt a lottery) or not. We denote the choice of actor s at time t by $X_{s,t}$, with $X_{s,t}=1$ if the actor performs the action, and $X_{s,t}=0$ if it does not. The *action vector*—which describes the behavior of all actors in the network at time t—is given by $X_t=(X_{1,t}, \ldots, X_{n,t})$. Taking action entails a cost to the actor, to be denoted $c_{s,t}$. (In the case of the lottery, this cost could be that occasioned by having to overcome political interests opposed to this form of legalized gambling.)

The payoff to an actor from either taking the action or not is assumed to depend directly on the actions of a subset of the members of the network, as illustrated in the previous section. (Of course, following the chain of causality implies that the payoff of each actor depends *indirectly* on the behavior of all others in the network.) Let the subset of actors whose actions directly influence the payoffs of actor s be L_s; we call this s's *local network*. We denote the action vector of the members of this local network by $X_{L_s,t}$. All local networks are treated as static and exogenous in the model. The combined membership of all these local networks forms a larger global network, which we call L.

We denote the payoff for actor s when it takes the action (i.e., $X_{s,t}=1$), conditional on the behavior of the other actors in its local network, as $b_{s,t}(X_{L_s,t})$; and when it does not, as $d_{s,t}(X_{L_s,t})$. (In the case of the lottery, the payoff to a state can be equated with the revenues it collects.) We assume that these payoffs are constant through time (given a constant action vector for the local network, $X_{L_s,t}$). Thus, we can simplify notation by dropping the t subscripts for the payoffs to yield $b_s(X_{L_s,t})$ and $d_s(X_{L_s,t})$, and we will often simplify further by referring to b_s and d_s, making the conditionality on the local network action vector implicit. We model actors' decision-making processes in continuous time, with the utility each derives from all actions continuously decreasing according to a factor, ρ_s.[2]

In a model of competition, in which actions by actors are assumed to have externality effects on others members of their local networks, the payoffs for actor s—$b_s(X_{L_s,t})$ and $d_s(X_{L_s,t})$—will depend directly on the actions of others. Even in a pure model of learning—in which actions by an actor are assumed to have no externality effects on other actors—payoffs may also depend on the actions of others, in that such actions provide *information* about the state of the world (e.g., the utility of adopting a lottery). Since we believe that the competitive setting fits the application of this paper—the lottery—better, henceforth we will focus on payoff functions that apply in that setting, rather than in a learning environment. However, the main points we have raised—that one must consider both network interconnectivity and the strategic nature of behavior in diffusion processes—hold in both settings. For example, in a learning

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[2] This implies that the discounted expected utility for actor s looking forward from time t is: $U_{s,t} = \int_t^{\infty} e^{-\rho_s t}\left(X^*_{s,t}(b_s(X^*_{L_s,t}) - c_{s,t}) + (1 - X^*_{s,t})d_s(X^*_{L_s,t})\right)dt$ (where starred actions indicate equilibrium values).

model of state lottery adoption, each possible combination of adopting and nonadopting states in *s*'s local network provides *s* different information, making a full accounting of who did what essential. Furthermore, it may be beneficial for a state to delay adoption (strategically)—waiting for other states to adopt first, thereby passing off costly information acquisition to other actors (Volden et al. n.d.).

We assume that if the behavior of all members of *s*'s local network remains the same (and we ignore the cost of taking action, $c_{s,t}$), the payoff to *s* for taking the action is always greater than the payoff for not taking the action. Mathematically, this can be expressed as:

(A1): $b_s(X_{L_s,t}) > d_s(X_{L_s,t})$ for all local network action vectors $X_{L_s,t}$.

(In the case of the lottery, this means that adopting always yields higher revenues than not adopting, ignoring the political costs of adoption or the possibility that other states might adopt in response at a later date.)

With general payoff functions b_s and d_s and an unspecified network *L*, there is little more we can say about the system as a whole. To go further, we need to make some additional assumptions about the way in which the decision by actor *s* depends on the actions of the other actors. Mathematically, this amounts to specifying how *s*'s payoff from taking the action relative to its payoff from not doing so changes with the action vector of its local network, $X_{L_s,t}$. We denote this difference in payoffs by $V_{s,t} \equiv b_s(X_{L_s,t}) - d_s(X_{L_s,t})$, and refer to it as the *net payoff from taking action* (a value independent of the costs of action). Note that because of assumption (A1)—i.e., $b_s(X_{L_s,t}) > d_s(X_{L_s,t})$ for all local action vectors $X_{L_s,t}$—this net payoff from action is always greater than zero.

We consider two extreme cases. In the first, all actions by actors in a local network are strategic *complements*. Mathematically, this would mean that $\frac{\partial V_{s,t}}{\partial X_{r,t}} > 0$ for any state, *r*, in L_s. Here the net payoff from taking the action is increasing in all actions by members of the local network, implying that the more members who act, the more beneficial it is for *s* to take the action itself. Typically such a substantive story is attached to areas such as the diffusion of an innovative technique or the attainment of some collective action (e.g., Huckfeldt, Johnson, and Sprague 2004; McAdam 1986; Kuran 1991). In the first case, the more a technique becomes standard, the greater the positive economic externalities one obtains for adoption, since training and economic transactions between units become less costly. In the second, motivations like safety-in-numbers or increased quality of information encourage increased participation in some collective action as more people take part.

Under some assumptions about how members of the network respond to each other, strategic complements can lead individuals to become more likely to adopt a policy or participate in a collective action, the greater the number of others to which they are connected in the network (Jackson and Yariv 2007). Under other assumptions, however, this may not always be the case (Siegel n.d.). Further, the assumption of strategic complements has a poor fit to our substantive example: states do not take in more revenue when other states adopt lotteries.

Consider next the opposite extreme, where all neighbors' actions are strategic *substitutes*. Here the net payoff from taking action ($V_{s,t}$) is decreasing in all actions (mathematically, $\frac{\partial V_{s,t}}{\partial X_{r,t}} < 0$ for any state, *r*, in L_s), implying that the more members of the network that take the action, the less beneficial it is for *s* to take the action itself. Public good contributions past the threshold at which the good will likely be provided is of this nature; there is less reason to contribute oneself the more likely it is that one's contribution will not influence the provision of the good, which happens with a higher likelihood the more others contribute.

While strategic substitutes can lead someone to become less likely to contribute to a collective action the greater the number of others to whom she is connected, it is again the case that this depends on certain assumptions (Jackson and Yariv 2007). Further, this too fits our substantive setting poorly. It is doubtful that the prospect of increased lottery competition leads a state to be more likely not to bother competing.

Though neither extreme of strategic complements nor strategic substitutes is appropriate for the case of state lottery adoption, we can still make some plausible assumptions in this case about the components of the net payoff from taking action, $V_{s,t}$: the payoffs b_s and d_s. Specifically, we assume that an action by any member of s's local network lowers s's payoff, making it worse off, regardless of whether s takes the action itself. Mathematically, this is expressed by the assumption

$$\text{(A2):} \qquad \frac{\partial b_s}{\partial X_{r,t}} < 0, \frac{\partial d_s}{\partial X_{r,t}} < 0; \text{ for any state, } r \text{, in } L_s.$$

Note that this is fundamentally different from assuming that actions are strategic substitutes. We are not assuming that it becomes less beneficial to enact a policy when others enact it first, just that others' actions are detrimental to s, regardless of what s chooses to do. This, we feel, fits our illustrative context well. In the case of the lottery, others' adoptions result in either stronger competition for players (if s adopts too), or greater loss of revenue (if s does not adopt).

Even with the last assumption (A2), we cannot derive general analytic results that apply to all cases. However, we can begin to see informally the types of outcomes we should expect under the model. Since the net payoff from taking action, $V_{s,t} \equiv b_s(X_{L_s,t}) - d_s(X_{L_s,t})$, is greater than zero [by assumption (A1)], only the cost ($c_{s,t}$) of taking action limits the initial incentive to do so, absent others' responses. Furthermore, any resulting short-term incentive to enact can be overcome only by long-term incentives arising from others' potential later actions.

The short-term incentive reflects both *defensive* and *offensive* components, depending on the behavior of other members of *s*'s local network (i.e., the elements in the action vector for members of the local network, $X_{L_s,t}$). The defensive component arises from *s*'s attempts to increase utility from $d_s(X_{L_s,t})$ to $[b_s(X_{L_s,t})-c_{s,t}]$ when at least one member of its local network has taken action (i.e., at least one element of the action vector $X_{L_s,t}$ is 1), while the offensive component arises from the same attempt when at least one member of the local network has *not* taken action (i.e., at least one element of $X_{L_s,t}$ is 0). These considerations should become more important as the increase in payoffs obtainable by taking action grows larger. (For lottery adoptions, defensive considerations should increase with the amount of revenue lost to other states' lotteries, while offensive considerations should rise with the amount of revenue available from potential players from other states.)

In the short term, considerations of immediate costs are paramount. Strategic actors, however, will also consider the long term. Adoption of a lottery should draw rational responses from other states, and these responses alter payoffs. Under perfect information, even when *s* discounts the future completely, it will take these responses into account, as other members of *s*'s local network will predict any action by *s* and respond simultaneously to it. Thus, there will be no opportunity to prey on unaware members. Under imperfect information, delay in taking action is possible, but actors with some interest in the future still must consider the responses of other actors.

In summary, we posit the following model. Each of n actors in a network, L, faces a binary choice: to take some action or not. For each actor, s, taking this action entails a cost to s and also garners a payoff (relative to that from not taking the action) that depends explicitly on which actors within s's local network, L_s, also take the action. We assume that: (A1) the payoff to s from taking the action always exceeds that for not, and (A2) others' actions always lower s's own payoffs.

To help understand the incentives of actors inherent in this model, we next specialize the general model to the case of lottery adoptions, a context in which we believe assumptions (A1) and (A2) are clearly applicable. Then we derive hypotheses from the model, and test them empirically using pooled cross-sectional time-series data for the contiguous American states.

Applying the General Model to the Case of Lottery Adoptions

A Strategic Model of Interstate Lottery Competition

The general model presented above is not amenable to empirical testing. Further specification in the case of state lottery adoptions will enable us to operationalize variables and then test the model empirically. The sparseness of the general model makes this task straightforward: we need to specify the functional forms for payoffs—$b_s(X_{L_s,t})$ and $d_s(X_{L_s,t})$—and the costs of action ($c_{s,t}$).

Consider first the costs of lottery adoption. Two types are likely to be relevant. The first is the political cost of instituting a lottery. For example, there may be constituencies who are skeptical of institutionalized gambling for religious, ethical, or other reasons. This cost is most relevant before the initial adoption, and is likely to decline rapidly after adoption, as the lottery becomes the new status quo to which people are accustomed.

The second is the cost of running the lottery itself, which is in addition to the usual state tax apparatus. This cost varies with the competitive effort put into the lottery: the amount of advertising done to attract players, and the share of revenues returned to winners. This cost may, however, equivalently be conceived as a reduction in the value of the payoff from the lottery rather than as an independent cost, and so we simplify the model by including it with the payoff given that a lottery is adopted, $b_s(X_{L_s,t})$. Thus, political factors constitute the sole direct cost we consider in $c_{s,t}$. For simplicity, we assume that the drop-off in this cost over time described above is immediate, so that we may delete the time subscript on $c_{s,t}$. c_s is then a barrier to entry to be overcome before adoption, but does not offset subsequent lottery payoffs.

Next we consider the two payoff terms in the model: one given that state *s* adopts a lottery [i.e., $b_s(X_{L_s,t})$] and one given that *s* does not [i.e., $d_s(X_{L_s,t})$]. We equate the payoff to a state with the total amount of revenues it collects (from a lottery or any other source), and then decompose revenue by locations within states. Following Berry and Baybeck (2005), we make three assumptions about the behavior of the individuals who reside in the states making lottery decisions, all of which we view as noncontroversial:

(LA1): The propensity of an individual to play the lottery declines with the travel distance required to play.[3]

(LA2): There is some limiting distance, *D* miles, beyond which people will not travel in order to play the lottery.

(LA3): For any pair of neighboring states, there is at least one person living within *D* miles on either side of the border.[4]

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[3] We view travel distance as a reasonable proxy for the *cost* to the individual of playing the lottery. Clearly, although travel distance is a major determinant of the cost of playing the lottery, there are many other variables that factor into a determination of cost (e.g., whether someone owns a car). However, for simplicity—and since it is the only individual cost factor that we can observe in our empirical analysis—we restrict attention to travel distance.

(LA4): A lottery is a substitute for other goods subject to sales taxes, particularly entertainment.

Assumption (LA2) implies that there are two types of persons: (a) those who live more than *D* miles from any other state (having potential access to only one state's lottery), and (b) those who live close enough to another state to have potential access to two states' lotteries.[5]

Let $b_{s\{\}}$ and $d_{s\{\}}$ denote "internal" revenues, i.e., revenues derived from residents of *s* who live far enough away from any border so that they have potential access to just their own state's lottery. $d_{s\{\}}$ is the revenue obtained in the absence of a lottery, and is unaffected by other states' actions (since "internal" residents will not play other states' lotteries even if these other states have them); $b_{s\{\}}$ is the revenue obtained from "internal" residents when *s* has a lottery, and is influenced by other states' adoptions only to the extent that competition between states causes *s* to alter the share of lottery revenues it returns to winners.

The rest of each state's revenue is derived from those who have potential access to two states' lotteries, i.e., those individuals at risk of traveling to a neighboring state to purchase a ticket (if this state were to adopt a lottery). Consider two neighboring states, *s* and *r*. We define two "border" revenue terms: b_{sr} is the revenue that *s* can obtain from those individuals in *s* or *r* who have access to both states' lotteries *when s has a lottery*, and d_{sr} is this same revenue level *when s does not have a lottery*. Note that revenue in d_{sr} actually arises only from within *s* (since extracting revenues from *r* requires that *s* has a lottery) and is derived strictly from non-lottery sources, but that b_{sr} encompasses lottery revenue from both sides of the *s*-*r* border.

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[4] Although the precise value of *D* is not known, many people in the U.S. have demonstrated a willingness to travel many miles to play the lottery, thereby making this assumption quite reasonable.

[5] For simplicity, we assume in this specialized model that no individual has potential access to lotteries in more than two states. (The general model above and our empirical tests below allow this constraint to be relaxed.) Note that if *D* is very small, there are in fact few U.S. residents that violate this constraint; as *D* increases, the number of persons living close to multiple states rises.

In keeping with assumption (A1) of the general model, we assume that $b_{s\{\}}(X_{L_s,t}) > d_{s\{\}}(X_{L_s,t})$ and $b_{sr}(X_{L_s,t}) > d_{sr}(X_{L_s,t})$ for each state, *r*, in *s*'s local network and all $X_{L_s,t}$. Thus, given any pattern of lottery adoptions by the states in *s*'s local network (a network that in this case consists of *s*'s geographic neighbors), and ignoring the political barriers to adoption reflected in the model's cost term (c_s), when *s* adopts a lottery, it gains revenue both from "internal" citizens who will play only its lottery, and from those near the borders of neighboring states. How *much* it gains, however, is as yet undefined.

Let us denote the baseline revenue of a state, *s*, without a lottery and having no neighbors with lotteries by $d_s(0)$. By assumption (A2), each additional neighbor of *s* that adopts decreases *s*'s revenue from this baseline, as citizens cross borders to play. Thus, for any state, *r*, in *s*'s local network, d_{sr} always decreases when *r* adopts but all other states' behavior is unchanged.

States having adopted the lottery, but which have no neighbors that have adopted, are in the optimal position. They are a monopoly lottery producer, and accordingly, can set monopoly lottery payouts and minimize advertising. For a state *s* having a lottery but no neighbors with a lottery, we denote baseline internal revenue by $b_{s\{\}}(0)$. For this same state, denote its baseline border revenue along its border with state *r* by $b_{sr}(0)$, for any neighbor, *r*, without a lottery. Then, any adoption by *r* has two effects on *s*'s revenue, both negative. First, some individuals who were playing *s*'s lottery will now play that of *r*, decreasing b_{sr} from its baseline. Second, *s* will be forced to compete with *r,* which will lower both $b_{s\{\}}$ and b_{sr} as optimal revenue extraction will entail additional competitive costs (via some combination of increased payouts and/or increased advertising) (Brown and Rork 2005; Garrett and Marsh 2002).[6]

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[6] Note that our theory implies that a state would never choose to eliminate the lottery after having adopted it. [The actual behavior of states conforms to this prediction. Of the 42 states that adopted a lottery (since the first adoption by New Hampshire in 1964), none has abandoned it.] If a state were to "disadopt" a lottery, it would have the same

Any 48-contiguous-state equilibrium would be contingent on individual states' costs and their competitive efficiencies. Since, as we discussed in the previous section, our revenue functions do not display nice regularities like strategic complementarity or strategic substitutability, our only real option for solving this system is to fit all parameters and then look for a numerical solution. However, if we are looking solely to test hypotheses derived from the model's variation in its parameters—its comparative statics—we can do better than this with less work.

Hypotheses Implied by the Lottery Adoption Model

Following our earlier discussion, let us analyze the strategic interaction between the states in three parts, focusing on defensive, offensive, and anticipatory considerations in a state's decision calculus. First consider the short-term defensive response. If a state, *s*, without a lottery and with no neighbors with lotteries sees its neighbor, *r*, adopt, but does not adopt the lottery itself, *s* receives an instantaneous payoff of $d_s(X_{L_s,t} \mid X_r=1)$ that is always less than $d_s(0)$.[7] If *s* responds by adopting, it receives $b_s(X_{L_s,t} \mid X_r=1) - c_s$. If the latter [i.e, $b_s(X_{L_s,t} \mid X_r=1) - c_s$] exceeds the former [i.e., $d_s(X_{L_s,t} \mid X_r=1)$], *s* will adopt. The more the latter exceeds the former, the more likely it is that we can find an equilibrium in which *s* adopts the lottery.[8]

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utility it would have had if it had never adopted in the first place, less the cost of adoption. Thus, any state that would chose to eliminate the lottery would never have adopted it in the first place. Of course, this conclusion depends on the assumptions of (*i*) constant payoffs and (*ii*) costs that decline to zero after adoption occurs. If payoffs were to change over time, or additional costs were to emerge, rational states may want to eliminate a lottery.

[7] The condition $X_r=1$ is meant to denote the situation in which *r* has a lottery, and *s*'s other neighbors may or may not have one. Yet, for ease of explication, the text focuses on the case in which *r* is the *only* neighbor of *s* that has a lottery.

[8] Were we to expand our model slightly to include errors in the adoption decision and utilize a quantal response equilibrium concept, this would translate into the statement that the more the latter exceeds the former, the more *likely* it is that *s* adopts the lottery. Since we believe that some error in decision-making by states is likely, we will indeed cast predictions in terms of probabilities of adoption.

What makes the difference between *s*'s utility if it adopts [i.e., $b_s(X_{L_s,t} \mid X_r=1) - c_{s,t}$] and its utility if it chooses not to adopt [i.e., $d_s(X_{L_s,t} \mid X_r=1)$] larger? Most obviously, the lower the initial cost of adoption c_s, the higher the probability that *s* will adopt. Following Berry and Baybeck (2005, 516), we operationalize this cost by the inclusion of variables reflecting the proportion of *s*'s population adhering to fundamentalist religions, the fiscal health of the state, per capita income, and the proximity to gubernatorial elections.

Increasing *s*'s revenue gain from lottery adoption [i.e., $V_{s,t} \equiv b_s(X_{L_s,t} \mid X_r=1) - d_s(X_{L_s,t} \mid X_r=1)$] will also increase the likelihood of adoption. By responding to *r*'s lottery adoption with its own, *s* gains revenue internal to the state ($b_{s_{\{\}}}$) and revenue around the border with *r* (b_{sr}), albeit revenue attenuated from its maximum due to competition with *r*. While we cannot determine how many people will choose to play *s*'s lottery, we can say that this number will be increasing with the number of residents of *s* who no longer choose to cross the border and play the lottery in *r*. This number, in turn, increases with the number of people who are willing to cross the border to play; i.e., those within *D* miles. Hence, we offer the following proposition:

> <u>Defensive Competition Hypothesis</u>: The probability that a state will adopt a lottery is positively related to the proportion of its population with access to another state's lottery (i.e., the proportion of its adult population living within *D* miles of another state with a lottery).[9]

The shaded region in Figure 1 depicts the population referenced by the independent variable in this hypothesis for a hypothetical state, S, with no lottery, and within *D* miles of five states, three

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[9] While we refer to "the proportion of [*s*'s] adult population living within *D* miles of another state with a lottery," our empirical analysis utilizes a more sophisticated measure of this variable that does not count all adults within *D* miles of a state with a lottery equally. Rather, in counting population, our measure weights individuals living right at the border with other lottery states maximally and weights those at greater distances less—thereby recognizing the gradual decline in propensity to play a lottery as the distance required to purchase a ticket increases. Note that our defensive competition hypothesis is equivalent to Berry and Baybeck's (2005, 507) "lottery competition hypothesis," despite the fact that it is worded differently; Berry and Baybeck characterize our measure of "the proportion of [*s*'s] adult population living within *D* miles of another state with a lottery" as an indicator of "the degree of concern of [*s*'s] officials about residents going to other states to play the lottery."

of which have a lottery (T, U and W) and two of which do not (R and V). Note that the shaded region is obtained by forming a band of width *D* internal to the border of state S, but excluding those sections of the band that are not within *D* miles of a state with a lottery. The most extreme southeast corner of state S is in the shaded region by virtue of being within *D* miles of nearby (but non-neighboring) state W.

Next we turn to short-term offensive considerations. Again, we start with a state, *s*, without a lottery and surrounded by states without lotteries. Consider one of these neighboring states, *r*. A lottery adoption by *s* will increase revenue arising "internally" (i.e., $b_{s\{\}}$), but also will introduce revenue from players in *r* near the border with *s* (thereby increasing b_{sr}). This latter source of potential revenue creates an incentive for *s* to compete offensively. The more people from neighboring states with potential access to *s*'s lottery (i.e., the more persons living within *D* miles of *s*), the larger is this potential gain, and so the greater is the chance of adoption. This logic leads to the following proposition:

> <u>Offensive Competition Hypothesis</u>: The probability that a state, *s*, will adopt a lottery is positively related to the number of persons in other states who (*i*) do not have access to a lottery but (*ii*) would have access to a lottery in *s*, relative to the population of *s* (i.e., the number of adults in other states without lotteries who live within *D* miles of *s* but not within *D* miles of any other state with a lottery, relative to the adult population of *s*).[10]

The shaded region in Figure 2 illustrates the population relevant to the independent variable in this hypothesis for the same hypothetical state, S, examined in Figure 1. To get the shaded region, we form a band of width *D* external to the border of state S, but we exclude those sections of the band that are within states that have lotteries or are less than *D* miles from another

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[10] Based on the same logic as in note 5, our empirical analysis relies on a measure of the independent variable in this hypothesis that weights individuals living right at the border with *s* maximally and weights those at greater distances less.

state with a lottery. Thus, the individuals in the shaded region constitute the population in nearby states without close access to a lottery.

Finally, we turn to what we call anticipatory considerations, which involve states engaging in long-term strategic thinking. Imagine a state, *s*, without a lottery and with no nearby states with lotteries. If *s* were to adopt, some neighboring states may have the incentive to adopt as well—based on the logic underlying the defensive competition hypothesis. If, for example, neighbor *r* adopted in response, *s*'s revenue (b_s) would decline due to both (*i*) a decrease in lottery revenues throughout the state resulting from *s*'s need to compete with *r* for players (via greater payouts or more advertising), and (*ii*) a loss of some players who will now play *r*'s lottery despite *s*'s efforts to retain their purchases. The latter increases with the number of adults within *D* miles of the border with *r*, on either side. The former rises with the size of this border population relative to the population of potential lottery players as a whole; the more people living in this border region, the more competition will matter to *s*, and so the more *s* will compete, decreasing revenues across the state.

People on the two sides of the *s*-*r* border are differentially important in anticipatory considerations, however. Such considerations come into play only when a state's adoption spurs a rival state to adopt as well. The potential loss of lottery revenue due to the rival's holding on to its own residents does not alter the choice of *s*, since *s* does not obtain revenue from any residents of *r* before *s* adopts. In other words, loss of revenue from the citizens of *r* is not an anticipatory consideration because *s* does not have this revenue before it adopts, and so losing it would not constitute a loss arising from adoption. Consequently, the potential loss of revenue due to the desertion of people on the other side of the border with *r* cannot make *s* less likely to adopt. Therefore, in relation to borders with states that have not yet adopted the lottery, only the people on *s*'s side of the border alter *s*'s decision. The more such people *s* has, relative to its overall population, the *less s* will be willing to adopt, as the presence of these individuals increases expected long-term competitive costs. Hence:

> Anticipatory Competition Hypothesis: The probability that a state, *s*, will adopt a lottery is negatively related to the proportion of its population that (*i*) does not have access to any state's lottery, yet (*ii*) lives close enough to another state to provide access to that state's lottery if it adopted (i.e., the proportion of its adult population living within *D* miles of another state without a lottery but not within *D* miles of any state with a lottery).[11]

The shaded region in Figure 3 depicts the population referenced by the independent variable in this hypothesis for the same hypothetical state, S, examined previously. To obtain the shaded region, we form a band of width *D* internal to S's border, but we exclude those sections of the band that are less than *D* miles from another state with a lottery.

Empirical Analysis

Although Berry and Baybeck (2005) do not speak of "defensive" behavior, the independent variable they construct using GIS to measure their "lottery competition hypothesis" (p. 507)—a variable they term "the degree of a concern of a state about residents going to other states to play the lottery"—is equally valid as an indicator of the independent variable in our defensive competition hypothesis. Thus, we use Berry and Baybeck's measure without modification.[12] Because of theoretical uncertainty about the true value of *D*, the maximum distance someone would travel to play the lottery, we also emulate Berry and Baybeck's choice to estimate all models using four different values for *D* (100, 150, 160 and 170) as a test of the robustness of our results. Moreover—and again mirroring Berry and Baybeck—we do not

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[11] Based on the same logic as in note 4, our empirical analysis relies on a measure of the independent variable in this hypothesis that weights individuals living right at the border of *s* maximally and weights those at greater distances less.

[12] In this paper, we summarize the measurement procedure; more detail can be found in Berry and Baybeck (2005, 507-09).

assume that there is an abrupt decline to zero in the probability of traveling to another state to play a lottery as distance increases beyond *D*. Rather, we assume a gradual decline in the propensity of an individual to travel as distance increases, with the rate of decline steepest at a distance of zero and declining in magnitude as distance rises. Figure 4 shows the exact assumed functional relationships between distance and propensity to travel for all four values of *D*. Although three of the values for *D*—150, 160 and 170—seem quite similar, the four functions reflect quite different assumptions about how quickly the propensity to travel to another state to play the lottery declines with distance from the border. As can be seen in Figure 4, when *D* is 160 miles, at 50 miles from the border, the propensity to travel is 32% of the propensity right at the border; when *D* is 150 miles, at 50 miles from the border the propensity is 13% of the propensity right on the border.

Consider this measurement procedure when applied to state S in Figure 1. For each adult, *i*, in the shaded region, GIS is used to determine the distance, d_i, of that person from the nearest state with a lottery. This distance is converted to a propensity score (indicating the propensity to play that state's lottery). Finally, the ultimate variable of interest is computed by adding up propensity scores over all adults in the shaded region, and dividing the sum by the adult population of S.[13]

To measure the independent variables in the offensive competition and anticipatory competition hypotheses, we adapt the Berry and Baybeck GIS procedure to the alternative population of concern in the hypothesis. For the offensive competition hypothesis, when observing state *s* we need to measure the number of number of adults in other states without lotteries who live within *D* miles of *s* but not within *D* miles of any other state with a lottery,

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[13] Since individual-level data are unavailable, in practice, we must employ county-level data instead. Our procedure assumes that all persons in a county reside at its geographic center.

relative to the adult population of *s*. To illustrate our measurement procedure, we consider state S in Figure 2. For each adult, *i*, in the shaded region we use GIS to calculate the distance, d_i, of that person from S. This distance is then transformed to a propensity score (reflecting the propensity to play S's lottery). Finally, we sum propensity scores over all adults in the shaded region, and divide the sum by the number of adults in S, yielding the ultimate measure of interest.

For the anticipatory competition hypothesis, when observing state *s* we need to measure the proportion of *s*'s adult population living within *D* miles of another state *without* a lottery but not within *D* miles of any state *with* a lottery. Considering state S in Figure 3, we use GIS to calculate the distance, d_i, of each adult, *i*, in the shaded region from the state nearest her residence. We convert this distance to a propensity score (indicating the propensity to play this nearby state's lottery if it were to adopt one). We construct the ultimate measure of interest by adding up propensity scores over all adults in the shaded region, and dividing the sum by the adult population of S.

All remaining variables and data are drawn from Berry and Baybeck's (2005) study. We replicate the model Berry and Baybeck present in columns 1-4 in their Table 1 (p. 516), which reflects only defensive competition, adding the independent variables we construct to test the offensive and anticipatory competition hypotheses. This yields a discrete-time event history analysis model in which the observed dependent variable is whether or not a state adopts a lottery in a year (1=yes, 0=no), and the independent variables are the three competition variables, a set of variables assumed to measure the cost of adoption (c_s), and a time counter to allow for duration dependence. We estimate each model with four different assumed values for *D*—the maximum distance someone would travel to play the lottery—using probit and clustering by state (see Berry and Baybeck, 514-15 for additional estimation details). The results are reported in Table 1.[14] Column 2 in the table shows maximum likelihood estimates (MLEs) for the probit coefficients. Column 3 presents estimated changes in the probability of a lottery adoption when a variable is increased from its 5th percentile value in the sample to its 95th, and all remaining independent variables are fixed at their mean.

The results offer a substantial amount of support for the three competition hypotheses. Of the 24 point estimates in the table (12 for probit MLEs, 12 for effects on probabilities of adoption), all but one carry the predicted sign (positive for the defensive and offensive competition variables, negative for the anticipatory competition term), and the remaining estimate is near zero. Estimates for the defensive competition term are statistically significant (at the .05 level) at one of the four assumed values for *D*, and those for the offensive and anticipatory variables are significant at two values of *D* each. The estimated effects on the probability of a lottery adoption yield the most meaningful substantive interpretations. For example, assuming *D* is 160 miles, when the value of a state's anticipatory competition variable—reflecting the proportion of its adult population that does not have access to a lottery but lives close enough to another state to provide access to that state's lottery if it adopted—is increased from its 5th percentile value in the sample to its 95th percentile value (and all other independent variables are held constant at their mean), the probability that the state will adopt a lottery in a year decreases by .027, a value statistically significant at the .05 level. When *D* is assumed to be 100, 150 or 170, the corresponding declines in the probability of an adoption are .005, .013 and .028, respectively. Although these changes in probability may seem small, it should be noted that lottery adoptions are rare events: across the full set of state-years analyzed,

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[14] Table 1 reports coefficient estimates only for the competition variables of theoretical interest in this paper. However, the results for cost variables mirror those of Berry and Baybeck (2005). The appendix contains full statistical results.

the overall probability that a state without a lottery will adopt one in a year is just .030. Given this small overall probability, the estimated changes we detect are certainly meaningful. It is also important to recognize that there is more than trivial variation in results across the four assumed values for *D*.[15] Given that there is no clear theoretical or empirical justification for believing that one assumption about *D* is more likely to be correct than the rest, we should not place a great deal of faith in interpretations of specific point estimates of the magnitude of effects.

Yet, the consistency across the four values of *D* in the estimated direction of effects of independent variables testing three distinct predictions from our strategic interaction theory lends considerable support to that theory. Our theory implies that the probability that a state, *s*, will adopt a lottery increases with (*i*) the proportion of its population living close to another state with a lottery, and (*ii*) the number of persons in other states (relative to the population of *s*) who do not have close access to a lottery but would if *s* adopted. These two variables reflect the incentives of a state, *s*, operating within a local network of geographically proximate states to engage in short-term competition—by capitalizing on opportunities to increase revenues via a lottery adoption in two situations: (1) when there are large populations in other states near *s*'s border without access to a lottery that could be attracted to cross the border to play a lottery in *s* (an "offensive" action), and (2) when a large number of its residents have close access to another state's lottery (a "defensive" action).

Our theory also implies that the probability that a state will adopt a lottery decreases with the proportion of its population that does not have close access to a lottery but lives near a state without a lottery, and thus would have close access if that other state adopted. This last

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[15] Note that the values of probit coefficient MLEs across the four measures of one of the competition variables are not comparable since the metrics for the measures are different. It is more reasonable, however, to compare across values of *D* both t-ratios for these coefficients and estimated responses of the probability of an adoption to a change in the competition variable from its 5th percentile value to its 95th.

prediction assumes long-term strategic behavior by states, and its empirical confirmation indicates that states act as if they understand the sequence of events that may be triggered by their adoption of a lottery when no nearby state has one. Consider two neighboring states, *r* and *s*, where *s* has a larger share of its population near their shared border than *r*. This puts *s* at a competitive disadvantage with *r* in the long-term that tends to discourage *s* from adopting a lottery. If *s* were to adopt (engaging in offensive competition), leading *r* to adopt in response (thereby engaging in defensive competition), *s* will have to compete more vigorously than *r*—by increasing payouts or spending on advertising—to attract purchases from the population with close access to both lotteries.

Conclusion

There is much empirical evidence that public policies diffuse across both subnational and national governments. Two primary theories have been proposed to explain why this diffusion occurs, one of which contends that governments learn by observing the consequences of other governments' adoptions, the other pointing toward competition between jurisdictions. We argue that when policy scholars advance either of these theories, it is important that they consider (*i*) the specific nature of the expected interactivity among jurisdictions, and (*ii*) the possibility of strategic behavior in which each government, *s*, employs a decision calculus that takes into account actions by other governments and the likely responses of these governments to a policy adoption by *s*. Accordingly, we develop a general formal theory of policy diffusion within a network of strategic actors. Then, we apply this general model to the analysis of lottery competition among American states. The application suggests that the characterization of interstate competition in extant research about lottery adoptions is oversimplified.

Previous research on the lottery has found evidence that states compete *defensively*: they estimate their revenue loss from neighboring states' lotteries and determine whether this loss, when balanced against the costs of adoption, justifies an adoption to stem the loss of revenue. This kind of defensive competition is a form of strategic behavior in the sense that it involves states responding to actions by other states. However, defensive competition is a very limited form of strategic behavior reflecting consideration of just the past actions of other states. A specialization of our general theory of policy diffusion to the case of lotteries allows us to generate the expectation not only that states compete defensively, but that they compete *offensively*, and in an *anticipatory* fashion that involves looking forward to the likely responses of other states to any action they may take. Offensive lottery competition occurs when a state estimates its potential revenue gain by adopting a lottery—including that earned from residents of other states crossing state boundaries to play the lottery—and determines whether this potential gain would exceed the expected cost of adoption. Anticipatory competition requires that a state be "forward looking"—i.e., that when deciding whether to adopt, it considers its ability to compete successfully for lottery revenues if some neighboring states without a lottery were to respond to the state's adoption by adopting their own. We find empirical support for all three expected forms of behavior: defensive, offensive and anticipatory. This not only strengthens the body of evidence that lotteries diffuse across states due to competition, but shows that American states compete against one another in a more sophisticated fashion than previous scholars have argued. When choosing whether to adopt a lottery, states appear to behave as strategic rational actors interconnected in a network, balancing the expected long-term revenues from a lottery—from both residents of their own states and residents of others—against the expected costs of adoption.

Our model of lottery competition is a specialization of a general strategic theory of policy diffusion that we believe has much wider applicability. To illustrate the potential diversity of settings in which the theory might fruitfully be applied, we briefly consider how the theory can be specialized to explain the diffusion of militarization by nations.

Here the network of actors consists of the nations of the world. Each actor is assumed to face the binary choice of militarizing or not.[16] Clearly, militarizing entails a cost for a nation: increased spending on personnel and materiel. Unlike in the lottery, we cannot assume these costs are a threshold to adoption but decline to zero once adoption occurs; a nation must continue to pay for military personnel, and must maintain weapons and replace them entirely as they become outmoded. Accordingly, we must keep the cost term in the model, $c_{s,t}$, time-dependent. Among other things, this implies that a nation may desire to demilitarize if the cost of militarization were to increase over time.

In the lottery specialization, (*i*) the composition of a state's local network is determined exclusively by spatial proximity, and (*ii*) network ties are *symmetric*, in the sense that if state A is a neighbor of state B (and thus A is influenced by B), then B is also a neighbor of A (and B is influenced by A).[17] Our general theory of diffusion does not require that local networks be defined based solely on spatial proximity; all that is necessary for an actor to be part of another actor's local network is that one jurisdiction's actions matter to another's decision calculus. The general theory does assume symmetry in network ties, but this feature was introduced largely to

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[16] To completely specify the model, one would have to establish a threshold for when a nation's military investments are extensive enough to constitute "militarization," so that one could clearly identify when the action of "militarizing" is taken and when it is not. (An alternative to establishing a threshold that permits militarization to be treated as binary would be to modify the formal model to allow nations to choose any level of militarization along an unbounded continuum. This would involve changing the discrete, conditional payoffs—b and d—to continuous functions of the level of militarization. It would also greatly complicate the calculation of equilibrium behavior.)

[17] This does not imply that A's influence on B and B's influence on A are equal. The relative influence on each other depends on the proximity of each state's population to the border with the other.

simplify its presentation, and it would be easy to modify the theory to allow each actor to have separate "offensive" and "defensive" local networks, which potentially contain a different subset of the global network's actors.

Consider the case of militarization. For any two nations, *s* and *r*, *s*'s actions may threaten *r*, even though *r* is unable, due perhaps to resource or technological limitations, to threaten *s* in return. We conceive of *s*'s offensive (local) network as consisting of directed (one-way) links pointing from *s* to the nations it threatens, and of *s*'s defensive (local) network as consisting of directed links pointing to *s* from the nations by which *s* is threatened. These local networks will be influenced by spatial proximity (c.f. Buhaug and Gleditsch 2008), but not exclusively so. Other factors potentially determining the membership of networks include territorial or maritime disputes, previous violent conflict among countries, and nations' levels of technological advancement. For example, increasing the range of missiles a nation is capable of producing can greatly increase the size of a nation's offensive network, while leaving its defensive network unchanged.

The payoffs to a nation, *s*, both when *s* militarizes ($b_{s,t}$) and when it does not ($d_{s,t}$), depend directly on the militarization choices made by the nations in its offensive and defensive networks, and we believe that assumptions (A1) and (A2) are easily satisfied in this context. Regarding (A1), if the behavior of nations in *s*'s offensive and defensive networks is held constant (and the cost of militarization is ignored), the payoff to *s* for militarizing is always greater than the payoff for not. Increased militarization by *s* increases the likelihood that *s* would win any war that it were to fight. This not only enhances *s*'s payoff from a potential war, but also enables *s* to achieve better outcomes in negotiations, either from pre-war threats or from interim- or post-war settlements (e.g., Fearon 1995; Powell 2006; Slantchev 2003). Moreover, consistent with assumption (A2), militarization by any nation, *r*, in *s*'s offensive and defensive networks lowers *s*'s payoff, since *r*'s increased chances of victory in a potential war lessen *s*'s expected utility in interactions with *r* (in addition to raising the possibility of inefficient skirmishes)

Given these assumptions, we can derive testable hypotheses directly analogous to those derived in the lottery specialization:

> <u>Defensive Militarization Hypothesis</u>: The probability that a nation, *s*, will militarize is *positively* related to the number of other nations that threaten *s* and have militarized, i.e., the number of nations in *s*'s *defensive* network that *have* militarized.
>
> <u>Offensive Militarization Hypothesis</u>: The probability that *s* will militarize is *positively* related to the number of other nations that it threatens and have not militarized, i.e., the number of nations in *s*'s *offensive* network that have *not* militarized.
>
> <u>Anticipatory Militarization Hypothesis</u>: The probability that *s* will militarize is *negatively* related to the number of other nations that both threaten *s* and are threatened by *s* yet are not militarized, i.e., the number of nations satisfying three conditions: (1) being in *s*'s defensive network, (2) being in s's offensive network, and (3) and not being militarized.

As in the case of the lottery specialization, the first two hypotheses relate to short-term considerations by *s*, while the third reflects *s*'s long-term strategic concern that other nations not currently militarized may choose to militarize in response if *s* were to militarize in search of a short-term gain. Testing these hypotheses would involve constructing operational definitions of (*i*) what it means for one nation to threaten another and (*ii*) when a nation has militarized, and then measuring these variables for an appropriate sample of nations. These are by no means trivial tasks. But we believe that our brief discussion of the militarization specialization of our strategic theory of policy diffusion adequately illustrates the potential applicability of the theory to actors quite different than the American states and to policy choices quite different than whether to adopt a lottery.

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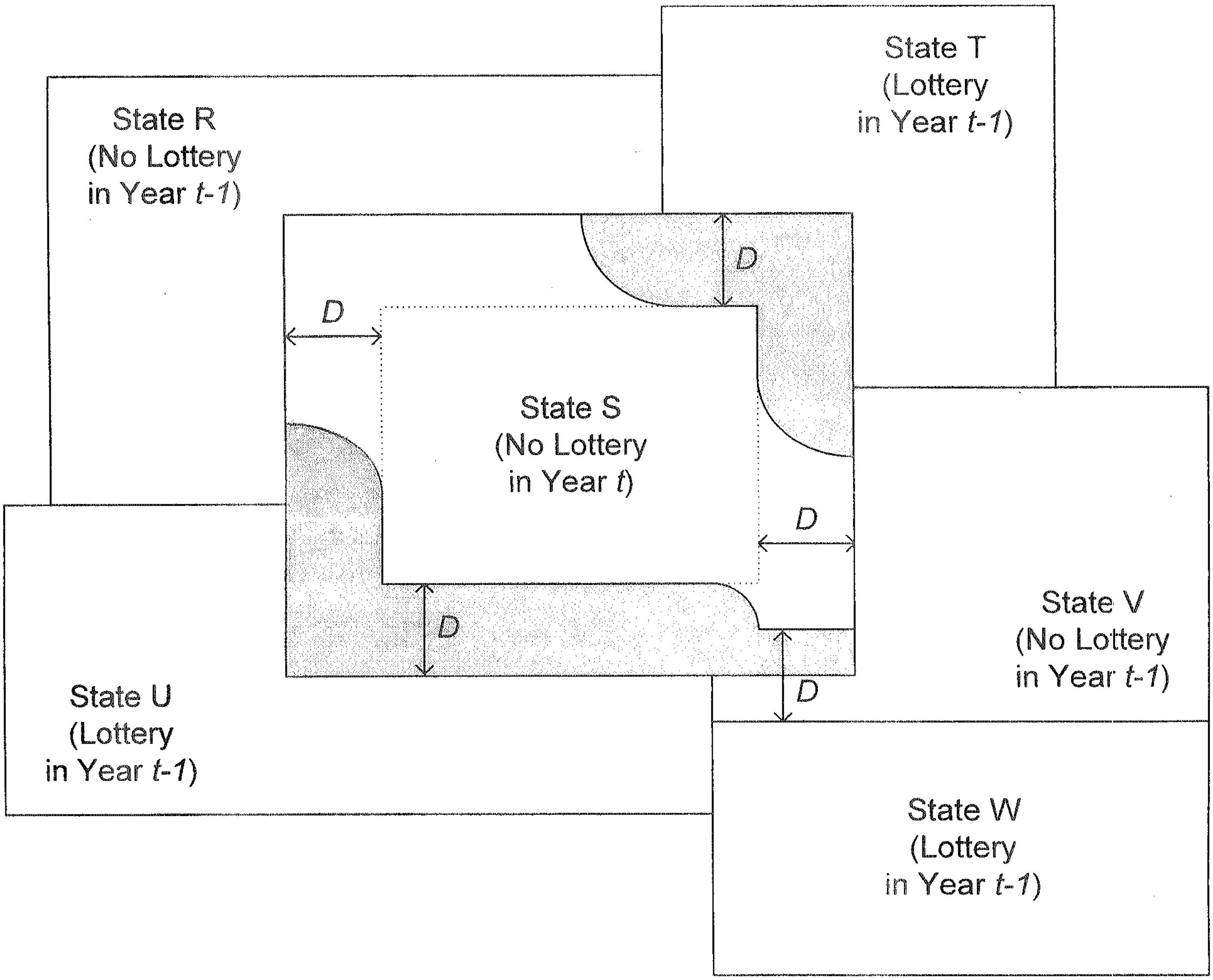
Figure 1. Schematic Depiction of the Population Referenced in the Defensive Competition Hypothesis



Source: Figure 1 in Berry and Baybeck (2005, 508)

Figure 2. Schematic Depiction of the Population Referenced in the Offensive Competition Hypothesis

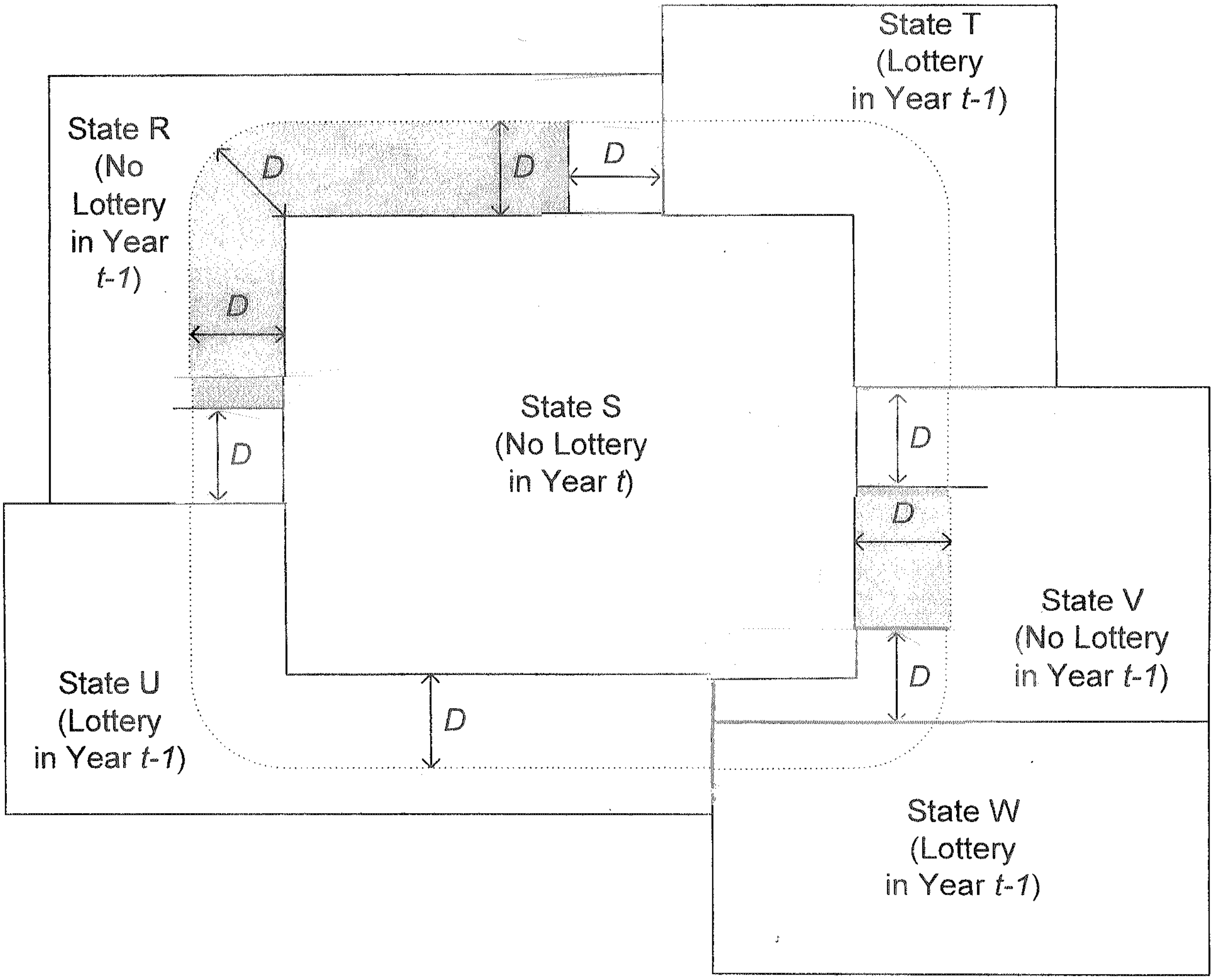


Figure 3. Schematic Depiction of the Population Referenced in the Anticipatory Competition Hypothesis

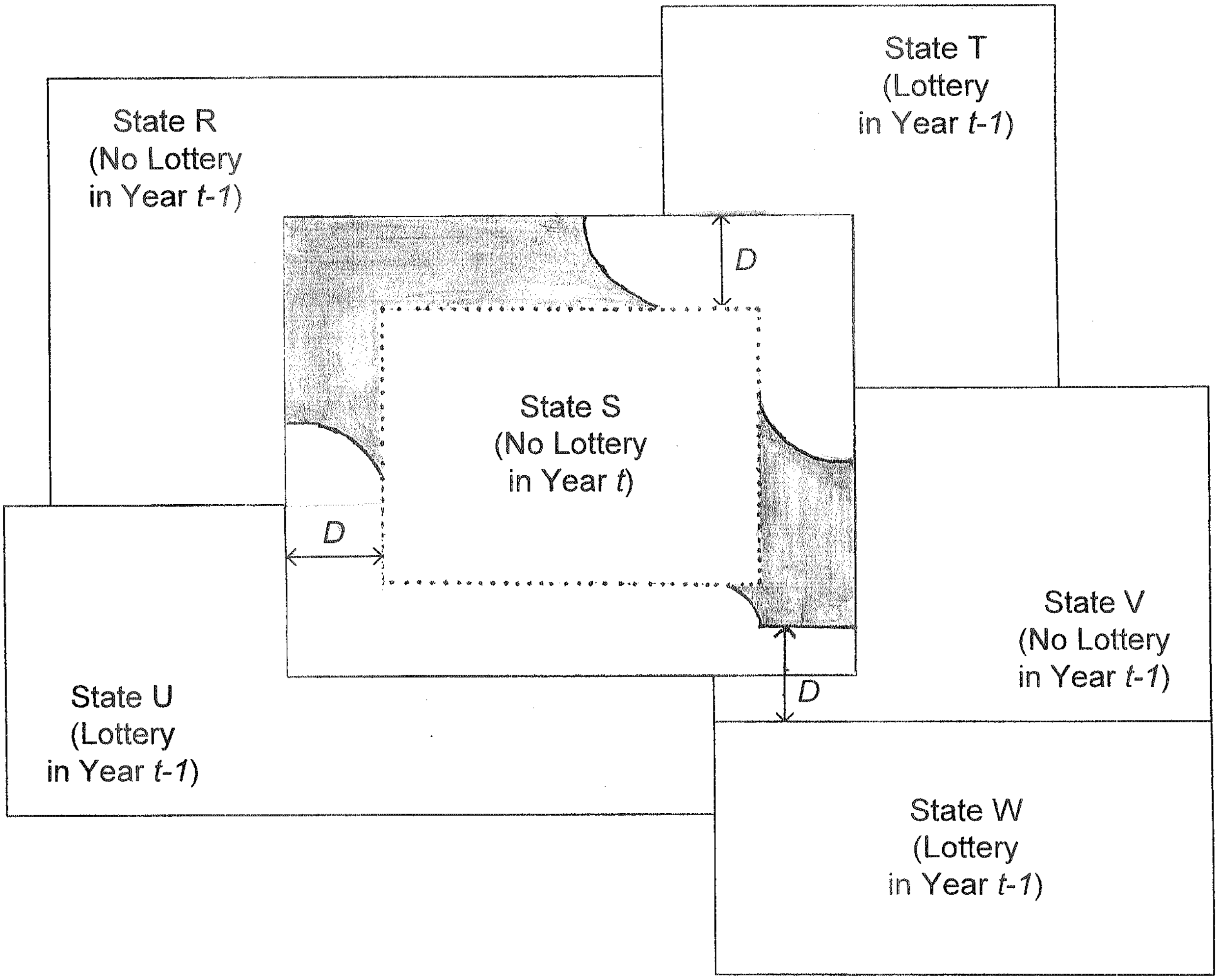
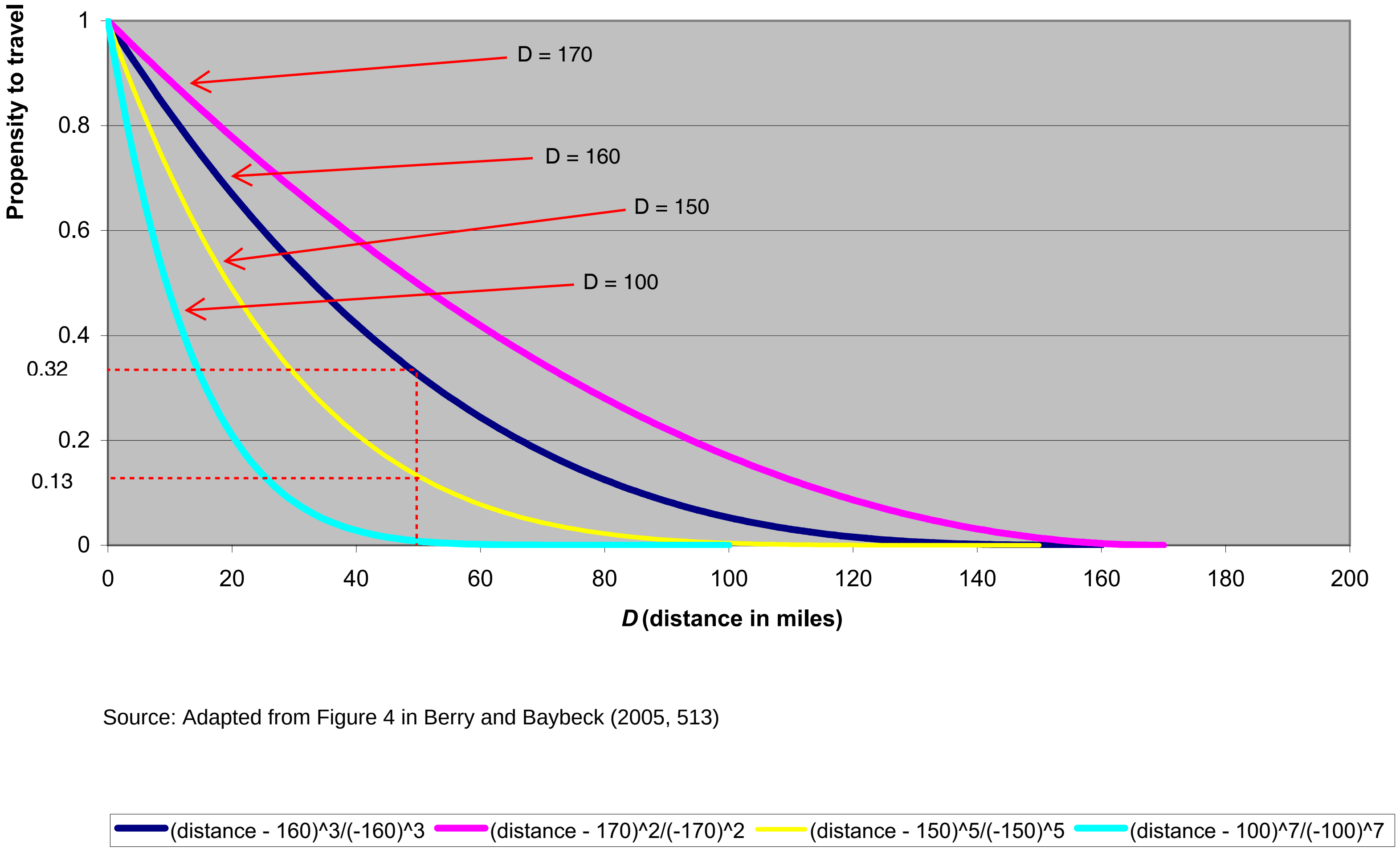


Figure 4

Specific Functions Mapping an Individual's Georgraphic Location into Propensity to Travel to Another State to Play the Lottery



Source: Adapted from Figure 4 in Berry and Baybeck (2005, 513)

Table 1. Probit Results for Testing the Strategic Model of Lottery Adoptions

Independent Variable	(1) Value assumed for *D*	(2) Probit MLE (with Z statistic in parentheses)[a]	(3) Change in probability of adoption associated with increase in independent variable from 5th to 95th percentile (when all other variables held at mean) [with 95% confidence interval in brackets]
Defensive Competition	100	1.544** (3.06)	0.012 [.002, .034][†]
	150	0.826 (1.61)	0.010 [-.001, .040]
	160	0.213 (0.38)	0.005 [-.004, .036]
	170	-0.006 (0.01)	0.004 [-.006, .037]
Offensive Competition	100	0.402 (0.65)	0.004 [-.007, .021]
	150	0.248 (1.32)	0.005 [-.002, .020]
	160	0.326* (2.10)	0.005 [.000, .018][†]
	170	0.275* (1.95)	0.005 [.000, .017][†]
Anticipatory Competition	100	-0.836 (0.46)	-0.005[-.041, .036]
	150	-1.234 (1.36)	-0.013[-.046, .006]
	160	-1.971** (2.71)	-0.027[-.072, -.004][†]
	170	-1.739** (2.47)	-0.028[-.078, -.005][†]

Notes: MLEs are obtained using the probit procedure (with the cluster option) in Stata 9; predicted changes in probabilities are estimated using Clarify 2 (Tomz, Wittenberg and King 2003).

[a] Z statistics are based on robust standard errors, clustering by state.

*$p < .05$, ** $p < .01$ (one tailed)

[†] $p < .05$ (two tailed); i.e., 95% confidence interval excludes zero.

Appendix

Complete Probit Results for Testing the Strategic Model of Lottery Adoptions

Assumed value of *D*:	100	150	160	170
Independent Variable				
Gubernatorial election year? (1=yes, 0=no)	0.769* (2.23)	0.757* (2.12)	0.800* (2.28)	0.794* (2.28)
Neither election year nor year after an election? (1=yes, 0=no)	0.562 (1.58)	0.556 (1.50)	0.595 (1.63)	0.589 (1.63)
Per capita income	0.008 (0.97)	0.007 (0.74)	0.005 (0.50)	0.005 (0.49)
Fiscal health	-2.913** (2.45)	-2.729* (2.27)	-2.495* (1.97)	-2.489* (1.94)
Prop. of population adhering to fundamentalist religions	-0.056** (2.55)	-0.055** (2.44)	-0.057** (2.36)	-0.060** (2.39)
Defensive competition	1.544** (3.06)	0.826 (1.61)	0.213 (0.38)	-0.006 (0.01)
Offensive competition	0.402 (0.65)	0.248 (1.32)	0.326* (2.10)	0.275* (1.95)
Anticipatory competition	-0.836 (0.46)	-1.234 (1.36)	-1.971** (2.71)	-1.739** (2.47)
Time counter	0.079** (3.57)	0.080** (3.25)	0.084** (3.25)	0.085** (3.33)
Constant	-4.083** (4.75)	-3.815** (4.17)	-3.408** (3.39)	-3.285** (3.19)
Observations	901	901	901	901

Notes: MLEs are obtained using the probit procedure (with the cluster option) in Stata 9.
*Z statistics are based on robust standard errors, clustering by state.
*$p < .05$, **$p < .01$ (one tailed)