All Policies Are Glocal: International Environmental Policymaking with Strategic Subnational Governments

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November 7, 2010

Abstract

Practitioners and scholars emphasize that addressing global environmental challenges requires international cooperation. Indeed, many national governments have intensified their attempts to create and strengthen international environmental regimes. At the same time, however, local governments have begun to duplicate international efforts by setting their own environmental policies without awaiting global environmental regulation. This "glocalization" of environmental policy creates a patchwork of regulatory policies that increase the cost of economic exchange and carry distributional consequences. We explain this phenomenon by analyzing the interaction between local and national governments within a model of international environmental treaty negotiations. Our results emphasize that the glocalization of environmental policies can be understood as an attempt by local governments to strategically set local environmental policies that constrain national governments in international climate policy negotiations. We explore the role of heterogeneity in environmental policy preferences, the number of local governments, and concerns about international environmental treaty outcomes for subnational environmental policies. Our analysis contributes to the burgeoning literature on multilevel strategic interactions in environmental politics and global governance.

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Introduction

Environmental policies at the subnational level have proliferated in the last decade. Subscribing to the slogan of the sustainable development movement "think globally, act locally," local governments increasingly set environmental policies that aim at reducing air pollution, conserving the environment, and protecting the climate. According to Lutsey and Sperling (2007), for instance, 53 percent of the U.S. population live in a state or a city that have a target for greenhouse gas emissions reductions. In Europe a complex patchwork of environmental policies at the national, regional, and municipal level has evolved that aim at protecting nature and its resources (Collier and Löfstedt 1997).

In the case of transboundary environmental problems, such as climate change or ozone depletion, this phenomenon constitutes a noteworthy puzzle, since practitioners and scholars continue to emphasize that environmental challenges remain global and thus require international cooperation to be addressed successfully. Relatively small jurisdictions at the subnational level can contribute only negligibly to providing a global public good such as clean air or a reduction in CO2 emissions. Indeed, many national governments have recently intensified their attempts to create and strengthen international cooperation to address environmental problems at a global level. At the same time, however, local governments have begun to duplicate international efforts by setting their own environmental policies without awaiting global environmental policies (Kern and Bulkeley 2009; Lutsey and Sperling 2007).

We study this phenomenon by looking at the strategic implications of local environmental policy for national policy choices and international treaties. We argue that if local policymakers set (ambitious or lax) environmental policies, they shape the strategic environment in which national governments negotiate with foreign policymakers. For example, scholars and practitioners seem to agree that California's pathbreaking Global Warming Solutions Act of 2006, which aims at reducing climate emissions by 20 percent by the year 2020, "is leading the United States in promulgating policies to reduce greenhouse gas (GHG) emissions" and "intended to inspire and encourage coordinated actions by other western states and adjacent Canadian provinces and to align the state with leading policies being adopted in the European Union" (Mazmanian, Jurewitz and Nelson 2008,

400-401). According to Governor Schwarzenegger, "the world's national governments cannot make the progress that is needed on global climate change alone, they need the help of cities, states, provinces and regions in enacting real climate solutions. California has shown that a subnational government can lead the way to national change."[1]

In this article, we investigate how national and local governments interact strategically within a model of international environmental treaty negotiations. In the stylized world of our model national governments engage in treaty negotiations. National governments' own ideal policies and the domestic system of local environmental policies determine their preferred international treaty. If many local policymakers select ambitious (lax) environmental policies, choosing lax (ambitious) environmental policies implies higher costs to the national governments: coordination failure, inconsistent regulations, and loss of economies of scale generally favor policy coordination across levels. Consequently, local policymakers can try to influence international treaty negotiations either by enacting ambitious policies or by strategically lagging behind to prevent progress at the national, and, in turn at the international level. In particular, in equilibrium, 'green' policymakers *overregulate* while 'brown' policymakers *underregulate* to achieve a more favorable international treaty. Our results emphasize that the glocalization of environmental policies involves an attempt by local governments to strategically set local environmental policies to constrain national governments in international climate policy negotiations. We explore the role of heterogeneity in environmental policy preferences, the number of local governments, concerns about international environmental treaty outcomes, and the importance of national bargaining power for local environmental policies and the resulting international environmental treaties.

By analyzing the linkages between subnational, national, and international environmental policymaking we add to the burgeoning literature on multilevel governance of the environment and extend the work on two-level games (Putnam 1988; Mo 1994; Mo 1994; Tarar 2001) that explores when and how domestic politics affects international relations in two important ways. First, while standard approaches have almost exclusively focused on how national domestic factors influence diplomacy and international policymaking, we introduce and analyze the role of local politics for

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[1]"Gov. Schwarzenegger Urges World Leaders to Embrace Subnational Leadership in Climate Change Fight." California Office of the Governor, December 15, 2009. Available at [http://gov.ca.gov/press-release/14034/].

international environmental agreements. Second, current analyses applying the two-level game logic assume national governments to act strategically by anticipating domestic ratification hurdles and electoral constraints, but portray domestic actors as purely non-strategic players. We relax this restrictive and in some settings, such as regulatory policy, highly questionable assumption. Our theory explicitly models subnational environmental policy decisions as strategic choices with which local governments try to anticipate how their own decisions affect international policymaking. Thereby, subnational units try to influence the policy deals struck in international environmental negotiations. We illustrate implications of the model using anecdotal evidence from subnational environmental policy efforts and international treaty negotiations.

State of the Art: Environmental Politics at the Subnational, National, and International Level

While scholarship in international relations acknowledges the potential impact of domestic factors on international diplomacy and treaty negotiations (Putnam 1988; Mo 1994; Mo 1995; Tarar 2001), we still lack analyses that explicitly examine the linkages between subnational policymaking and international environmental treaty outcomes. Admittedly, previous research has emphasized the multilevel nature of environmental policymaking in which subnational policy choices play an important role for national preference formation. However, it has overlooked that this phenomenon and the presence of international environmental policy efforts, creates incentives for *strategic* subnational policymaking. The following stylized review of the literature on international, national, and subnational environmental regulation demonstrates that past studies have not yet provided an explicit account of how these three levels interact if we allow for strategic local governments. Our contribution explicitly models these strategic dynamics between local environmental policymaking, national preference formation, and international environmental negotiations.

The Correlates of National and International Environmental Policy

The literature on international environmental treaties recognizes the importance of several domestic factors in explaining international environmental cooperation. Congleton (1992) and Neumayer (2002a) find that democracies are more likely to sign international environmental treaties and join environmental organizations than autocracies. Bernauer, Kalbhenn, Koubi and Spilker (2010) report that trade intensity correlates with a reduction in the probability of ratifying an environmental treaty, while Neumayer's (2002b) results suggest that multilateral environmental cooperation depends on both trade openness and WTO membership. Recently, Perrin and Bernauer (2010) find that economically open countries are more likely to ratify treaties on air pollution reduction regimes. Several domestic factors, such as corruption and political institutions appear important as well. Fredriksson, Neumayer and Ujhelyi (2007) argue that green interests find it easier to lobby policymakers in countries with high levels of corruption. Their results suggest that involvement of environmental interest groups tends to increase the probability of ratifying an international environmental treaty, and that this effect gets stronger if the degree of corruption increases. Ehrlich (2009) argues that political systems that offer a high number of 'access points' decrease the costs of lobbying to industries that prefer less environmental regulation. While valuable, these empirical studies do not offer a strategic account of how local policies influence national governments' environmental policy preferences and international treaty outcomes.

Research on the correlates of national environmental policy reports comparable results. Li and Reuveny (2006) analyze five dimensions of environmental performance (carbon dioxide emissions, nitrogen dioxide emissions, deforestation, land degradation, and organic pollution in water). They find that democracies perform significantly better on each of these dimensions. Bernauer and Koubi (2009) build on selectorate theory and argue that larger winning coalitions induce policymakers to provide more public goods, such as environmental quality. The results suggest that an increase in the size of the winning coalition is associated with a significant reduction in SO2 emissions. Finally, corporatist modes of decisionmaking may influence the level of environmental regulation. Scruggs (1999) and Scruggs (2001) argue that inclusion of organized interests such as labor and capital in policymaking internalizes more of the costs associated with environmental regulation, which

increases the actors' willingness to enforce and monitor implementation of environmental standards. Empirically, corporatist systems' are indeed associated with better environmental performance.

Scholars have only recently begun to explore the strategic aspects of international environmental cooperation, i.e. how countries' behavior in international environmental policy affects other countries' strategies. Perrin and Bernauer (2010) study contingent ratification behavior in the case of the Long-Range Transboundary Air Pollution (LRTAP) Regime. According to their empirical results, the probability of ratification increases as the number of countries that have already ratified the agreement increases. Murdoch, Sandler and Vijverberg (2003) study treaty participation using an extensive form game in which countries first choose whether to ratify an environmental treaty and then decide on the level of participation. The findings suggest that lower levels of emissions that result from higher environmental protection efforts in other countries foster treaty ratification. However, a reduction in imported emissions at the same time increases the incentive to freeride on other countries' reduction efforts in the implementation stage. In Bechtel and Tosun's (2009) model, information asymmetries play a major role in explaining the inclusion of environmental provisions in bilateral trade agreements and their level of enforcement. However, none of these important contributions provides a model that allows for domestic actors to behave strategically. Also, they do not consider the role of local environmental policy choices for international environmental cooperation through their impact on national preference formation.

Subnational Policymaking Matters for National Policy Choices

The literature on local and transnational environmental policy emphasizes the growing importance of local policies and provides important arguments that we take up in our formal model. Betsill (2001) and Betsill and Bulkeley (2004) suggest that framing climate protection as a local issue facilitates the formation of local policy networks, such as the Cities for Climate Protection (CCP) program. Meyer and Konisky (2007) study predictors of communities' decisions to adopt local wetlands bylaws under the Massachusetts Wetlands Protection Act. Their results indicate that environmental need, e.g. the size of a community's wetlands area, as well as economic factors, such

as income, increase the probability of adopting a wetlands bylaw. These studies, however, do not investigate the interaction between local and national or international policy.

According to the empirical literature subnational policy choices significantly shape the costs and benefits of environmental policy at higher levels of the political arena. Lutsey and Sperling (2007) evaluate the effects of decentralized climate change policies on greenhouse gas emissions in the United States. They conclude that "efforts of states and cities are so pervasive at this point that future federal policy will benefit by adopting the most popular and best functioning GHG mitigation programs" (683). Selin and VanDeveer (2007) consider the informational aspect, arguing that local environmental policy programs enable national policymakers to "see which of the many available policy options are gaining support in the public and private spheres" and provide information to the national government about "which of the many available policy options are gaining support in the public and private spheres" (22). These claims motivate a first key assumption of our model, as they clearly imply that national policymakers should take into account environmental policy choices at the local level.

From this perspective, subnational jurisdictions function as policy laboratories in which policymakers can learn about the intended effects and side effects of environmental regulation. By observing local environmental policies they learn about the possibility and desirability of environmental regulation. Thus, the pattern of subnational environmental policy choices should influence the national policymaker's future policy decisions and national governments take these preferred policies to international negotiations. In our model, we seek to explicitly capture the strategic interactions between different levels of environmental decisionmaking. As the above review shows, scholarship recognizes the importance of such interactions, but few scholars have attempted to specifically capture them theoretically.[2]

We specifically attempt to include three important elements of the issue. The first is preference heterogeneity. We assume that local policymakers have divergent preferences, some being 'brown' and others 'green.' The intensity of brown and green preferences drives local policy choices

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[2]One exception is Urpelainen (2009) who argues that national governments may sometimes delegate environmental policy formation to local policymakers, because the latter hold an informational advantage on the local side benefits of environmental policy. However, his model does not allow the local policymakers to influence national policies.

and thereby constrains national governments in international treaty negotiations. As local governments care about international environmental policy, this gives rise to strategic subnational policymaking. Second, we examine the effects of changes in international bargaining power on the dynamics of local policy formation. Finally, we note that the number of relevant subnational policymakers (municipalities, regions, states) may vary greatly. Thus, we examine how the number of local policymakers influences strategic environmental policymaking and the resulting international environmental policies.

Local Environmental Policymaking in the Shadow of International Environmental Treaty Negotiations

We first provide an orthodox benchmark model based on Putnam's (1988) seminal article about the two-level nature of international bargaining and domestic politics. We compare the results from our theory against these baseline predictions. The Putnam model also offers a useful starting point to justify some key elements of our own model. We realize that Iida (1993), Mo (1994) and Mo (1995) present and analyze important formal extensions of the basic two-level game that permit uncertainty and preference heterogeneity between the chief negotiator and domestic interests. However, they maintain Putnam's crucial assumption of non-strategic domestic actors. Also, these extensions continue to exclusively focus at the international and the national level, thereby ignoring subnational policymaking. Consequently, using Putnam's original model instead of subsequent versions will not change the relevant benchmark predictions against which we establish the results from our model.

Benchmark: A Two-level Game of International Environmental Politics

In his seminal article Putnam (1988) informally outlines a two-period extensive form game with perfect information.[3] In period 1, a national government, represented by a chief negotiator, bar-

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[3]One might interpret some of the anecdotes and informal extensions contained in Putnam (1988) to imply that information asymmetries exist between the two chief negotiators. However, Putnam's basic setup, on which we base our benchmark model, assumes complete information.

gains with the chief negotiator of another country at the international level (level 1) and decides on an international treaty proposal. In period 2, domestic actors decide whether to ratify the proposal or not. Two key assumptions characterize this setup. First, the governments' ideal points, bargaining power, and domestic actors' preferences determine the international agreement. Second, domestic actors are non-strategic, i.e. they do not take into account that their own behavior affects international outcomes.

Consider a stylized world with two countries $C \in \{A, B\}$. Each country has two local governments and one national government.[4] A local government holds an ideal environmental policy $\theta \in (-\infty, \infty)$. We distinguish brown ($b$) and green ($g$) policy bliss points in the sense that $b < g$, i.e. the green type prefers higher level of environmental policy.

To reflect that the national government takes into account local environmental policies, we assume that national government's ideal point is given by $z_C = \frac{\overline{x}_C + y_C}{2}$, where $\overline{x}_C$ denotes the mean local environmental policy in country C.[5] The national government's utility function depends on its ideal environmental policy and the international environmental policy outcome, because the government's domestic constituents will evaluate this outcome. Formally, we define the utility function

$$U_C = -(T - y_C)^2, \tag{1}$$

where T denotes the international treaty outcome T and y_C is the national government's ideal environmental policy.

At the international level, both countries negotiate an environmental treaty that sets a global environmental policy and results in a global environmental policy outcome T.[6] We assume that T is a convex combination of the national governments' environmental policies, where bargaining power determines the weight given to the national policies. For simplicity, we first assume symmetric bargaining power, i.e. both countries are equally powerful.

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[4]We consider extensions with more than two local governments below.

[5]Another interpretation of z_C is that it reflects *de facto* environmental policies in C that are a mixture of national and subnational environmental policy decisions.

[6]We do not distinguish between *de iure* and *de facto* policies at this point.

A local government θ in country C holds the following utility function:

$$U_{C,\theta} = -(x_{C,\theta} - \theta)^2, \tag{2}$$

where $x_{C,\theta}$ denotes the local environmental policy in country C set by a θ-government. In our benchmark model, a local government will maximize its utility by setting $x_{C,\theta}^* = \theta$. This choice of environmental policy is not strategic, as the local government does not choose the local environmental policy in view of the resulting international negotiations.

Given this benchmark model, the resulting treaty is $T^* = \frac{z_A + z_B}{2} = \frac{\frac{\overline{x}_A + y_A}{2} + \frac{\overline{x}_B + y_B}{2}}{2}$, where $\overline{x}_A$ and $\overline{x}_B$ denote the mean local environmental policy in country A and B, respectively. Thus, we can rewrite the resulting treaty as $T^* = \frac{b_A + g_A + y_A + b_B + g_B + y_B}{4}$. Note that in this model, the local environmental policies remain unaffected by the expectation of international treaty negotiations. Although they feed into the international treaty outcome, local governments do not take into account that their own environmental regulations may matter for international environmental agreements through their impact on national policy choices.

According to this benchmark model, the effect of local environmental policies on international negotiations is direct. The government surveys the collection of local environmental policies and tries to achieve a negotiation outcome close to the average local environmental policy in the country. Since the average local environmental policy is also the average preference among local policymakers, it is as though the government was collecting preferences of non-strategic actors to form a bargaining position in international negotiations.

Environmental Politics with Strategic Local Governments

We now relax the assumption that local governments completely ignore the potential impact of their own environmental policy choices on international treaty negotiations and explore the role of three key factors: bargaining power, the degree of exposure to international environmental policy,

and the number of local governments. We start by assuming that a local government θ in country C holds the following utility function:

$$U_{C,\theta} = -(x_{C,\theta} - \theta)^2 - \beta_\theta(T - \theta)^2, \tag{3}$$

where $\beta_\theta > 0$ is a weighting factor reflecting how much a local government cares about the difference between international climate policy and its own ideal environmental policy. The utility function reflects that local governments do not only care about their own local policy, but also about international environmental policy (T, the treaty outcome), because this large-scale policy potentially has more power to mitigate the adverse effects of global environmental problems, such as climate change, than their own local policy. The weighting factor β_θ may also be interpreted as an exposure factor that captures how much changes in international environmental policy influence local environmental quality. In the initial setup of the model we set β_θ to 1 and consider extensions further below.

Let us first consider a situation with equally powerful national governments in which each government brings its own national environmental policy to the international negotiations. This constitutes a strong simplification that we find acceptable, because our focus is on strategic *local* environmental policymaking, not on *international* negotiations, which have been studied elsewhere (Mo 1994; Mo 1995; Tarar 2001). Note that power asymmetries are straightforward to include, and we will do so when considering extensions to our initial set up further below.

We start at the international environmental negotiations stage to solve for the subgame perfect equilibrium to this game. Given that both national governments are equally powerful, the outcome of the international environmental policy negotiations is $T^* = \frac{z_A + z_B}{2} = \frac{\bar{x}_A + y_A + \bar{x}_B + y_B}{2}$. A green local government in country A then chooses the optimal local policy $x^*_{A,g}$ equal to

$$\arg\max_{x_{A,g}} U_{A,g} = \frac{1}{272}(297g - 9b - 8y_A - 8y_B). \tag{4}$$

Since the setup is symmetric, equation 4 also characterizes the optimal local environmental policy for a green local government in country B. Let us indeed focus on a green local govern-

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ment to illustrate how policy choices and ideal points of the other actors affects its optimal local environmental policy. The optimal local environmental policy depends on four factors: the local government's own ideal environmental policy (i), the brown local government's ideal environmental policy (ii), and the ideal points of the national government in countries A and B. For a green local government, its own ideal policy plays the most important role, as can be seen from the coefficient on b in equation 4. In this sense, g represents a push factor, since the more green its ideal environmental policy, the higher the optimal local policy. Its optimal local environmental policy, however, decreases in all other three variables, which represent pull factors. A green local government will choose a lower environmental policy level the if brown local governments the national governments in A and B prefer higher environmental policies.

Despite the simplicity of the model this solution already has a rich interpretation that illuminates some of the complex interactions in international environmental policymaking and how these relate to subnational policy choices. Most importantly, equation 4 highlights the role of strategic policymaking on the side of local governments in the context of policy spillover effects. Because changing environmental quality requires coordinated efforts by many actors, in particular at the national and the global level, local governments choose their policies strategically to support or counteract choices by other political actors.

Although these results stem from a simple spatial model, they stand in contrast with the theorizing present in the growing literature on local environmental policy diffusion. The policy diffusion literature views local policy choices as being influenced by other actors' (typically neighbors') policy decisions and interprets policy mimicry, which by definition implies a certain degree of policy convergence, at least partly as the result of some form of learning (Braun and Gilardi 2006; Volden, Ting and Carpenter 2008). This means to conceptualize local governments as pure price takers with regard to other local governments.

Equation 4, however, implies that local policy decisions strengthen or counteract policy choices of other political actors. This may or may not lead actors to adopt a policy similar to that of a neighboring state. If viewed against this background, however, diffusion theories provide a more

simplistic account of policy adoption patterns than a spatial model with complete information in which players act strategically.

Asymmetric Bargaining Power

So far, we have assumed that the two national governments 'split the difference' in treaty negotiations. In reality, however, it may be that one of them has greater bargaining power. To investigate this issue, we now use a modified expression,

$$T^{**} = z_A + z_B = p\left(\frac{\overline{x}_A + y_A}{2}\right) + (1-p)\left(\frac{\overline{x}_B + y_B}{2}\right). \tag{5}$$

In this expression, $p \in (0,1)$ measures the bargaining power of country A. As p increases, the ability of country A to dictate the terms of the treaty grows.

Bargaining power p and national preferences y_A, y_B notwithstanding, the game is symmetric. Consequently, we can focus on local actors in country A without loss of generality. Solving the modified model yields equilibrium policies

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\begin{aligned}
x_{A,b}^{**} = {} & \frac{b(1881 + 4p(-33 + p(22 + (-2+p)p)))}{16(33 + 2(-1+p)p)} \\
& + \frac{g(-297 - 4p(-33 + p(46 + (-2+p)p)))}{16(33 + 2(-1+p)p)} \\
& + \frac{32(-33+p)py_A + 528(-1+2p)y_B}{16(33 + 2(-1+p)p)} \quad (6)
\end{aligned}
$$

for a brown local actor in country A. For a green local actor, we analogously find that

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\begin{aligned}
x_{A,g}^{**} = {} & \frac{g(1881 + 4p(-33 + p(22 + (-2+p)p)))}{16(33 + 2(-1+p)p)^2} \\
& + \frac{b(-297 - 4p(-33 + p(46 + (-2+p)p)))}{16(33 + 2(-1+p)p)^2} \\
& + \frac{32(-33+p)py_A + 528(-1+2p)y_B}{16(33 + 2(-1+p)p)^2}. \quad (7)
\end{aligned}
$$

These expressions seem somewhat complex, but the basic insights of the simple symmetric model remain intact. Local actors in each country not only consider their own ideal point, but also understand that they can influence the international treaty by strategically selecting local environmental policies. Almost unsurprisingly, these two expressions show, the bargaining power of country A influences this choice.

How, then, does the bargaining power of country A change the local environmental policies $x^{**}_{A,b}$ and $x^{**}_{A,g}$? To answer this question, each equilibrium strategy must be differentiated with respect to p. For the resulting proposition, the following expressions play a key role.

$$B^{**}_b = \frac{b(1881 + 4p(-33 + p(22 + (-2 + p)p))) + 32(-33 + p)py_A + 528(-1 + 2p)y_B}{297 + 4p(-33 + p(46 + (-2 + p)p))} \quad (8)$$

and

$$B^{**}_g = g\frac{(1881 + 4p(-33 + p(22 + (-2 + p)p))) + 32(-33 + p)py_A + 528(-1 + 2p)y_B}{297 + 4p(-33 + p(46 + (-2 + p)p))}. \quad (9)$$

These expressions are interpreted as cutoffs that determine whether changes in bargaining power have a positive or negative effect on local environmental policies that green and brown policymakers set.

Proposition 1 (Bargaining Power) *An increase in country A's bargaining power p prompts a decrease in $x^{**}_{A,b}$ if and only if $g > B^{**}_b$ and an increase in $x^{**}_{A,g}$ if and only if $b < B^{**}_g$.*

Proof. See appendix. ∎

Table 1 summarizes the results. Consider the brown actor first. If the green local actors in each country are aggressive enough, and thus pushing for an ambitious international treaty, then a shift in bargaining power from country B to country A, measured as an increase in p, will make the brown actor more aggressive in country A. Thus, greater national bargaining power increases the incentive to shape the international treaty through a strong commitment to a dirty policy. An increase in national bargaining power raises the stakes, therefore increasing the relative importance of strategic underregulation. Similarly, the green actor responds to an increase in

Table 1: The Effects of Bargaining Power on Local Policymaking

National preferences		Effect of exposure			
		$\frac{\partial x_{A,b}^{**}}{\partial p}$	$\frac{\partial x_{A,g}^{**}}{\partial p}$	$\frac{\partial x_{B,b}^{**}}{\partial p}$	$\frac{\partial x_{B,g}^{**}}{\partial p}$
$g > B_b^{**}$	$b > B_g^{**}$	+	-	-	+
$g > B_b^{**}$	$b < B_g^{**}$	+	+	-	-
$g < B_b^{**}$	$b > B_g^{**}$	-	-	+	+
$g > B_b^{**}$	$b < B_g^{**}$	+	+	-	-

Note: The table shows the direction of the effect of an increase in the bargaining power of country A on local environmental policy choices in each country.

national bargaining power by overregulating, so as to shift the negotiation balance towards an increasingly ambitious treaty.

How do the cutoffs B_b^{**} and B_g^{**} vary? Interestingly, the effect of increasing country A's bargaining power is always more likely to decrease $x_{A,b}^{**}$ and increase $x_{A,g}^{**}$, thus exaggerating brown local policies and moderating green ones, when national government A's preference y_A for environmental regulation grows. This follows from country A demanding overregulation in any case, so the need to influence its own position through local action goes down for green local governments but increases for brown local governments. Thus, local governments behave strategically especially when their own national government is hostile.

By contrast, country B's preferences y_B have an ambiguous effect on the cutoff. If country B is powerful, so that $p < 1/2$, then the effect is identical to that of country A. But if country B is weak, so that $p > 1/2$, then the effect is exactly the opposite. This highly counterintuitive effect stems from the indirect interdependence between the local levels. If country B is powerful, an increase in p can be thought of as a shift of responsibility from local actors in country B to local actors in country A. But if country B is already weak, then the effect of changing y_B is actually positive, because a green actor in country A also increases its efforts to influence treaty outcomes, and this triggers a costly race between green and brown local actors to affect the international bargain.

These results show that changes in bargaining power may have a complex effect on local environmental policies. If the struggle over the international treaty between green and brown actors is intense enough, local actors react to increased bargaining power by adopting more extreme local

environmental policies. But if the struggle is not intense, exactly the opposite may occur, as local actors in powerful countries can expect that the international negotiations will produce an outcome close their ideal points even if they fail to adopt extreme local environmental policies.

Interestingly, this result may prove particularly relevant for understanding multilevel environmental policy in the United States. As Lutsey and Sperling (2007) note, about one half of all Americans are under some form of local climate policy to reduce emissions while the other half has decided to do comparably little or nothing to mitigate global warming. It is exactly in such circumstances, under an intense struggle over the broad contours of national policy, that countries with substantial bargaining power can be expected to produce starkly diverging local policies. Thus, our model partly sheds light on why many U.S. states, especially those producing a lot of coal, have not done anything to mitigate global warming, while others, notably California and the Northeastern alliance of ten states for the Regional Greenhouse Gas Initiative, are substantially reducing emissions (Rabe 2004).

Concerns about International Environmental Policies

The initial setup allows local governments to hold different ideal climate policies, but assumes that they care as much about international environmental policy as they care about their local environmental policy. Several factors can influence how much local governments care about international environmental policies, however. For example, some environmental problems are more global than others, so that the international treaty will be more important than local environmental policy. In other cases, it may also be that local actors care a lot of about the international environmental policy because it conditions trade and investment patterns.

To examine the consequences of such variation across environmental problems, we now consider the possibility that local governments attach varying weights to the outcome of international negotiations, and explore how this affects the structure of their local environmental policy choice.[7] More precisely, we explore how an increase in concerns about international environmental policies

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[7]We ignore the degenerated case in which the local government only cares about its own local policy ($\beta_\theta = 0$).

affect strategic environmental policymaking at the local level. To simplify the problem, let $\overline{y}$ denote the symmetric mean ideal policy of national governments. Consider brown local governments first.

Proposition 2 (Exposure and Brown Local Policy Choices) *If $\overline{y} > D_b^*$, an increase in exposure of a brown local government, $\beta_{C,b}$, increases the optimal local environmental policy for a brown government. If $\overline{y} < D_b^*$, an increase in exposure decreases the optimal local environmental policy, where $D_b^* := \frac{24b - 8g + b\beta_b - g\beta_g}{8}$.*

Proof. See appendix. ∎

Proposition 2 implies that an increase in exposure to the effects of international environmental policy can affect local optimal policy of brown governments in two directions. If average environmental ideal policies fall below the threshold D_b^*, higher exposure will induce local governments to implement a higher level of environmental protection. But if the average policy preferred by national governments is higher than the critical value, local governments will strategically set lower local environmental policies. The threshold is a function of the difference between brown and green local ideal policies. The threshold will increase as the preferred local environmental policy by the green government increases and will decrease as the brown government's ideal policy gets more green. Since the set up is still symmetric with respect to local governments in A and B, this result holds for all brown governments irrespective of whether they belong to country A or B.

Proposition 3 (Exposure and Green Local Policy Choices) *An increase in exposure of a green local government, $\beta_{C,g}$, increases the optimal local environmental policy for a green government if $\overline{y} < D_g^*$ and decreases the optimal local environmental policy if $\overline{y} > D_g^*$, where $D_g^* := \frac{24g - 8b - b\beta_b + g\beta_g}{8}$.*

Proof. See appendix. ∎

Exposure to the effects of international environmental policy can again affect local optimal policy of brown governments in two directions. The direction depends on how green national governments are on average in relation to ideal point heterogeneity of local governments. The threshold D_g^* decreases (increases) if the environmental policy preferred by brown (green) governments increases.

Table 2: The Effects of Exposure to International Policy Outcomes on Local Policymaking

National preferences		Effect of exposure	
		$\frac{\partial x_{C,b}}{\partial \beta_b}$	$\frac{\partial x_{C,g}}{\partial \beta_g}$
$\overline{y} > D_b^*$	$\overline{y} > D_g^*$	+	-
$\overline{y} > D_b^*$	$\overline{y} < D_g^*$	+	+
$\overline{y} < D_b^*$	$\overline{y} > D_g^*$	-	-
$\overline{y} < D_b^*$	$\overline{y} < D_g^*$	-	+

Note: The table shows the direction of the effect of an increase in concerns about international environmental policy on local environmental policy choices. $\overline{y}$ denotes the mean ideal policy preferred by national governments. D_b^* and D_g^* denote thresholds as defined in propositions 2 and 3.

Differences in the international orientation of local government types give rise to interesting patterns of strategic subnational environmental policies. Table 2 illustrates these patterns.

These results helps us to understand why local policymakers often motivate climate policies with vulnerability to global warming. According to standard theories, such concerns should be largely irrelevant as no individual policymaker can significantly reduce the rate of global warming in the absence of strategic interactions with others (Urpelainen 2009). If some local policymakers believe that their leadership efforts can change national policies, however, vulnerability to climate change does create an incentive to select ambitious local policies for strategic reasons. Thus, for instance, it is not altogether surprising that vulnerability concerns have played a key role in the formation of Californian climate policy (Franco et al. 2008; Hayhoe et al. 2004).

Multiple Local Governments

In the initial setup we restricted the number of subnational jurisdictions to two. Clearly, multilevel political systems in reality have more than two subnational jurisdictions. We now consider an extension of the model with an arbitrary, finite number of local jurisdictions. To make the model even more general, we relax the assumption that the number of green local government types equals the number of brown local governments and we allow for different numbers of brown and green governments in the two countries A and B. Therefore, the model now allows for a situation in which there might be effective strength in numbers. We can study how this affects strategic policy

decisions by governments at the subnational level. To that end, we differentiate with respect to the number of brown local governments in A and B. This requires additional notation. Let $M_C \in \mathbb{N}$ denote the number of local governments in C and $M_{C,\theta}$ is the number of θ-type local governments in country C.

To find the optimal local policy, we need to consider the outcome of international negotiations separately for each local government type. For concreteness, we focus on local governments in country A.[8] We express the number of green local governments in terms of the total sum of local governments and the sum of brown governments, i.e., $M_{A,g} = M_A - M_{A,b}$. For a brown local government in country A, the international bargain is given by

$$T_{A,b} = \frac{1}{4} \left(\frac{x_{A,b} + \tilde{x}_{A,b}(M_{A,b} - 1) + x_{A,g}(M_A - M_{A,b})}{M_A} + y_A \right.$$
$$\left. + \frac{x_{B,b}M_{B,b} + x_{B,g}(M_B - M_{B,b})}{M_B} + y_B \right), \quad (10)$$

where $\tilde{x}_{A,b}$ denotes the local environmental policy choices by other brown local governments in country A.[9] Reversing the subscripts A and B in equation 10 yields the treaty from the perspective of a brown government in country B. Treaty outcomes for green government types are characterized analogously. We are interested in whether and how the number of brown and green local governments in A and B affect strategic environmental policies at the subnational level. Therefore, we first solve for the optimal local policy. We explore how the optimal policy of a brown local government in country A reacts to an increase in the number of brown governments and an increase in the number of green governments by partially differentiating the optimal policy with respect to $M_{A,b}$ and $M_{A,g}$.

---

[8]Because the setup is symmetric, the results hold for both countries.

[9]In the appendix we demonstrate that the game has a unique and symmetric equilibrium in which $x^*_{A,b} = \tilde{x}_{A,b}$.

The local optimal policy is

$$
\begin{aligned}
x^*_{A,b} = {} & \frac{(g-b)M_B^2(M_{A,b} + M_A(4M_{A,b}-1))}{4M_A^2 M_B(M_B + M_A(16M_B+1))} + \\
& \frac{4bM_A^3 M_B(1+16M_B) + M_A^2}{4M_A^2 M_B(M_B + M_A(16M_B+1))} + \\
& \frac{((g-b)(M_{B,b} + M_B(4M_{B,b}-1) + 4M_B^2(5b-2g-y_A-y_B))}{4M_A^2 M_B(M_B + M_A(16M_B+1))}.
\end{aligned}
\tag{11}
$$

First, we note that according to equation 11, the policy choice by a brown local government in A now obviously depends on the total number of local governments and the number of brown and green local governments in both country A and country B. Therefore, the distribution of brown and green subnational governments in both countries affect strategic policy decisions at the subnational level. This transboundary effect simply follows from national governments bringing subnational policy choices to international treaty negotiations, thereby connecting their domestic arenas. This creates transboundary strategic behavior at the subnational level, as strategic local governments in one country take into account both, preference heterogeneity in their own as well as in the foreign country. How does the number of brown and green governments change a local government's optimal policy choice?

To answer this question, we hold the total number of governments in country A, namely M_A, constant. How do optimal local policies change if one brown actor is replaced by a green actor?

$$
\frac{\partial x^*_{A,b}}{\partial M_{A,b}} - \frac{\partial x^*_{A,b}}{\partial M_{A,g}} = \frac{(g-b)(4M_A+1)M_B}{4M_A^2(M_B + M_A(1+16M_B))}.
\tag{12}
$$

Similar changes in the other country prompt

$$
\frac{\partial x^*_{B,b}}{\partial M_{B,b}} - \frac{\partial x^*_{B,b}}{\partial M_{B,g}} = \frac{(g-b)(4M_B+1)M_B}{4M_B(M_B + M_A(1+16M_B))}.
\tag{13}
$$

Since $(g-b) > 0$, the expressions in equations 12 and 13 are positive. Thus, a brown local government will set a greener policy if the proportion of other brown local governments in either country increases. The reason is that as the number of brown local governments increases, their collective ability to influence the international treaty negotiations grows. Thus, each individual

brown government has fewer incentives to manipulate the treaty, and so they all focus more on reducing the distance between their local policies and ideal points.

The result is exactly identical for green local governments. If the number of brown local governments increases, greens have greater incentives to choose aggressive local policies to compensate for the loss of collective bargaining power in the international treaty negotiations. We summarize this as follows:

Proposition 4 (Multiple Local Governments) *If a green (brown) local government is replaced in either country by a brown (green) local government, all local governments select a greener policy* $x_{C,\theta}^*$.

Proof. See the main text for $x_{A,b}$. The proof for $x_{A,g}$ is almost identical. By symmetry, all results hold for $x_{B,b}, x_{B,g}$. ■

The same holds for the number of brown governments in the other country. The underlying logic is that if the number of brown local governments increases, their policy choices will receive more weight in the international negotiations and this provides an incentive to implement a greener policy to ensure that the treaty outcome will not be below what brown governments' actually prefer.

This implies that local climate policies may ultimately feature the following balancing dynamics: if the number of brown local actors increases for some reason, perhaps due to increased production of fossil fuels or energy-intensive manufacturing goods, the green actors elsewhere have an incentive to respond by ramping up their regulatory efforts. Conversely, if some local actors become greener than previously, the current brown actors will respond by doing even less to protect the environment. In view of this observation, it may not be surprising that the greening of certain constituencies in Europe and the United States has not created enough momentum to allow their leaders to form an alliance for a comprehensive international environmental treaty.

We now turn to another "balancing" implication of these results which we term transboundary strategic local policy. Since subnational policy choice in both countries affect the outcome of international negotiations over environmental governance, local governments will anticipate these effects and choose strategic local environmental policies to achieve a more favorable outcome. If we consider. Figure 1 simulates how local environmental policy choices in one country (A) change

due to variations in the number of brown local governments and the total number of governments in the other country (B) while all other parameters have been set at what appear reasonable values. Thereby this figure illustrates the transboundary balancing dynamics implied by our model. Since the number of brown local governments is always less or equal to the total number of local governments, the domain of the function is restricted at $M_{B,b} \leq M_B$.

Figure 1: Transboundary Strategic Environmental Policy by Brown Local Governments
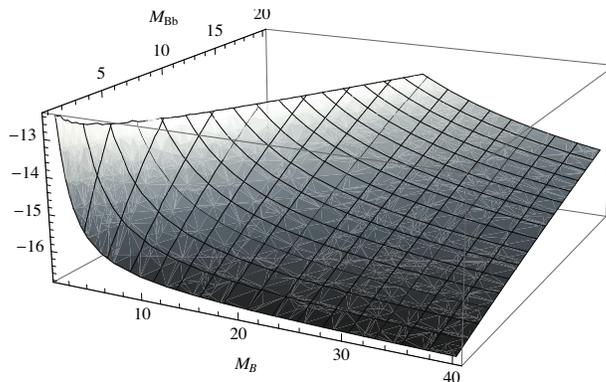
Note: The figure shows the optimal strategic environmental policy of a brown local government in country A (vertical axis) as a function of the number of brown local governments in country B, $M_{B,b}$, and the total number of local governments in B, M_B. The other parameters have been set as follows: $b = -10, g = 10, y_A = -20, y_B = 20, x_{A,b} = x_{B,b} = -10, x_{A,g} = x_{B,g} = 10, M_A = 30, M_{A,b} = 20$. The domain of the function is restricted at $M_{B,b} \leq M_B$

As the number of brown local governments in B increases, a local government in country A will try to counterbalance the increase's downward-pulling effect on the international environmental treaty by adopting a greener policy. As can be seen from figure 1, this is a nonlinear relationship that depends on the total number of local governments in country B. If this number is low, increasing the number of brown governments in B leads local governments in country A to change the level of local environmental policy more drastically than if the total number is high. This relationship reflects strength in numbers. For a large number of local governments, a given change in environmental policies adopted by brown governments has a smaller effect on the policy preferred by that nation's government at the international level than if the total number of local governments is low. This results in smaller effects on the international bargain, which in turn reduces the incentive to local governments in the other country to counterbalance changes in environmental regulation. In figure 1, given five local governments in B in total, increasing the number of brown local governments from one to five increases local environmental policies in country A by about 3

points (from -16 to -13). With 20 local governments in total, this quantity reduces to about one point (from -16.6 to -15.8).

We can also illustrate the within-country link between local and international policymaking through the impact of the number of local governments on the national governments' preferred level of international environmental regulation brought to the negotiations. To this end, figure 2 shows how the preferred international environmental policy changes in response to variations in M_A and $M_{A,b}$. We set all other parameters at the same values as in the previous simulation. Since the number of brown local governments is always less or equal to the total number of local governments, the domain of the function is again restricted at $M_{B,b} \leq M_B$.

Figure 2: National Government's Environmental Policy Position at the International Negotiation Stage and the Number of Local Governments
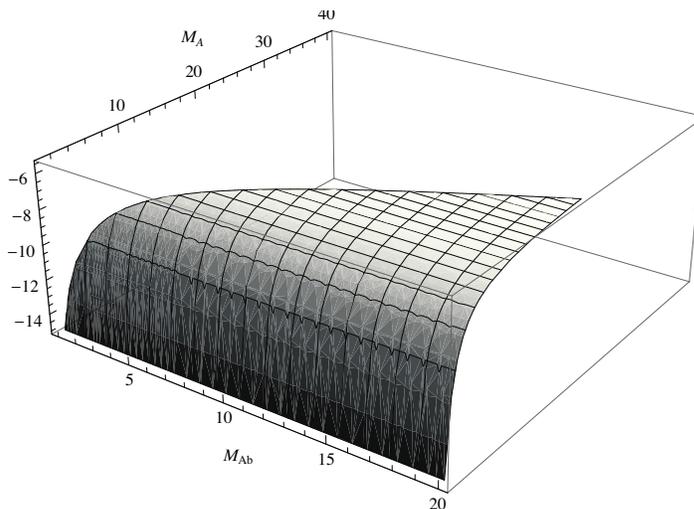
Note: The figure shows the national government environmental policy position in country A (vertical axis) as a a function of the total number of local governments, M_A and the number of brown local governments, $M_{A,b}$. The other parameters have been set as follows: $b = -10, g = 10, y_A = -20, y_B = 20, x_{A,b} = x_{B,b} = -10, x_{A,g} = x_B = 30, M_B = 30$. The domain of the function is restricted at $M_{A,b} \leq M_A$.

Given this setup, the total number of local governments play the major role and again enters the function nonlinearly. With more local governments in A, the national government prefers a higher level of international environmental policy. This relationship decreases considerably in strength as M_A reaches higher levels.

Conclusion

Many of the most pressing global environmental challenges cannot be solved without international cooperation. The observable cooperation between governments to address environmental issues such as air pollution, global warming, or biodiversity loss may vary in degree and resolution. However, national governments' efforts to regulate the global commons at least indicates their awareness of the fact that transboundary challenges need to be addressed through transboundary political action. At the same time, though, we observe a proliferation of subnational environmental regulation directed towards global environmental problems, despite the presumably negligible effect of these subnational efforts on the global environment.

In this paper we examine this phenomenon as the result of strategic local governments acting in the shadow of international environmental policy efforts. We argue that the more local governments care about the environment, the more they pay attention to and try to influence their national government's policy stance in international negotiations over global environmental rules. Our game theoretic model assumes a stylized world with two countries, each consisting of a national government and several subnational governments with different environmental policy preferences. In each country local governments have either a preference for low environmental policies (brown local governments) or prefer relatively strict environmental policies (green governments). Local governments set an environmental policy observable by the national government. The national governments then engage in international bargaining over environmental rules. The negotiations result in an environmental treaty that sets a policy at the international level.

Our analytical focus is on how exposure to environmental problems, bargaining power, and the number of local governments affect strategic local environmental policymaking in the shadow of international negotiations over environmental governance. The results suggest that exposure to environmental problems (or environmental concerns) can affect local environmental policy decision in two directions. If average environmental ideal policies fall below a threshold, higher exposure will induce brown local governments to implement a higher level of environmental protection. But if the average policy preferred by national governments is higher than the critical value, local governments will strategically set lower local environmental policies. Second, given intense

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conflict over the international treaty between green and brown local governments, local actors react to increased bargaining power by adopting more extreme local environmental policies. But if the struggle is not intense, local actors in powerful countries can expect that the international negotiations will produce an outcome close their ideal points even if they fail to adopt extreme local environmental policies. Third, if the number of brown local governments increases, their policy choices will receive more weight in the international negotiations and this provides an incentive to implement a greener policy to ensure that the treaty outcome will not fall below what brown governments' actually prefer.

These stylized dynamics illuminate some of the complex interactions and patterns of environmental policy change we observe at the subnational level nowadays. From the perspective of our model, these policy decisions can be understood as strategic choices to counterbalance other actors' policy influences. While scholarship on policy diffusion would interpret movements of environmental policy that go in the same direction as indicative of some form of learning, emulation, or adaption, our model suggests that these movements may also arise through strategic policy changes intended to offset shifts in the number of subnational governments that actually share the same ideal policies. Moverover, international negotiations and the transboundary nature of environmental goods link local policy decisions in different countries, giving rise to transboundary policy balancing efforts in the shadow of attempts to create international policies that protect the environment.

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A   Appendix

A.1   Characterizing International Treaties

The following equation characterizes the treaty from the perspective of a green government in country A:

$$T_{A,g} = \frac{1}{2} \left(\frac{x_{A,b}M_{A,b} + x_{A,g} + \tilde{x}_{A,g}(M_A - M_{A,b} - 1)}{M_A} + y_A + \frac{x_{B,b}M_{B,b} + x_{B,g}(M_B - M_{B,b})}{M_B} + y_B \right).$$

(14)

Reversing the subscripts A and B yields the treaty from the perspective of a green government in country B.

A.2   Bargaining Power Proof

Proof. Differentiate equations 6 and 7 with respect to p to obtain $x_{A,b}^{**}$ and $x_{A,g}^{**}$, respectively. Each respective equation obtains a positive value if and only if g and B, respectively, obtains a value higher than B_b^{**} and B_g^{**}, respectively. ∎

A.3   How Changes in Exposure Affect Optimal Local Environmental Policy Choices

Proof. Consider brown local governments. The optimal local policy is

$$x_{C,b}^* = \frac{8b(32 + \beta_g) + \beta_b(32b - 8g - 8y_A - 8y_B + (b-g)\beta_g)}{8(32 + \beta_b + \beta_g)}.$$

(15)

Differentiating with respect to β_b yields

$$\frac{\partial x_{C,b}^*}{\partial \beta_b} = \frac{(32 + \beta_g)(24b_8g - 8y_A - 8y_B + (b-g)\beta_g)}{8(32 + \beta_b + \beta_g)}.$$

(16)

Recall that $D_b^* = \frac{24b - 8g + b\beta_b - g\beta_g}{8}$ and $\bar{y} = \frac{y_A + y_B}{2}$. Now consider the following two cases:

1. Suppose $\bar{y} < D_b^*$. This is equivalent to $24b - 8g - 8y_A - 8y_B + (b-g)\beta_g > 0$. Since $\beta_g > 0$, the numerator in equation 16 is positive as well. Because β_g and β_b are both positive, the denominator is always positive. Thus, $\frac{\partial x_{C,b}^*}{\partial \beta_b}$ will be positive.

2. Suppose $\bar{y} > D_b^*$. It follows that $24b - 8g - 8y_A - 8y_B + (b-g)\beta_g > 0$. Since $\beta_g > 0$, the numerator in equation 16 will be negative. We already know that the denominator is always positive. Therefore, $\frac{\partial x_{C,b}^*}{\partial \beta_b}$ will be negative.

The proof for green local governments proceeds analogously. ∎

A.4   Equilibrium with Multiple Local Governments

Proof. Recall that there are M_C actors in country C. Local actor i maximizes $U_i = -(\theta - x_i)^2 - \beta(T - x_i)^2$, where T is defined as in the main text. The first-order condition with respect to x_i is therefore $2(\theta - x_i) - 2\beta(T - x_i)(1 - \frac{1}{M_A + M_B}) = 0$. Thus, we have linear system of $M_A + M_B$

equations with $M_A + M_B$ variables. Verify that these equations are linearly independent and note that with $2\theta \neq 0$ for at least one of b, g, so that the system is not homogeneous. Since the number of equations equals the number of variables, the system has a unique solution. ∎