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*Liliana B. Andonova and Yixian Sun**

Abstract

In the Paris Agreement era of climate governance, private market-based initiatives are expected to play a catalytic role in achieving global commitments. However, the literature has been largely silent on the political causes of the variable and often limited uptake of such initiatives in the Global South. This article uses original project-level data to investigate the participation in voluntary carbon offset (VCO) programs across developing countries. We argue that, paradoxically, access to formal international institutions and linkages with domestic priorities are key factors for participation in voluntary carbon markets, reducing asymmetries in information, capacity, and interest in developing contexts. Our statistical analysis finds that institutions such as the Clean Development Mechanism and targeted foreign aid, as well as domestic concerns such as climate vulnerability and advancing renewable energy, shape in important ways the variable engagement in VCO projects. Our analysis also suggests that the design of private regulations can be fine-tuned to better capture synergies between local concerns and transnational climate action.

Addressing climate change requires both government commitments and direct action from nonstate and substate actors. Transnational initiatives, which link voluntary climate action across borders, have substantially expanded since the late 1990s (Andonova, Hale, and Roger 2018; Bulkeley et al. 2014; Hoffmann 2011). Their significance is amplified by the Paris Agreement (2015) under the United Nations Framework Convention on Climate Change (UNFCCC), with

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potential to support developing countries in reaching their nationally determined contributions (NDCs) and step-up societal efforts when formal engagement by major powers such as the United States wavers (Hale 2016).

However, the literature on climate governance has identified considerable disparity in the political geography of transnational initiatives, in favor of industrialized countries where most initiatives have emerged (Bulkeley et al. 2014; UNFCCC Secretariat 2017). Similar trends are broadly evident in transnational private governance. Certification programs, originally established to correct social and environmental failures associated with weak public regulations, remain more readily adopted in industrialized markets, where stronger incentives and capacity exist. For instance, although the Forest Stewardship Council (FSC) was created by advocacy groups concerned about tropical deforestation (Cashore, Auld, and Newsom 2004; Pattberg 2007), the majority of certified areas are in boreal and temperate forests (49 percent in Europe, including Russia, and 35 percent in North America).[1] Forest certification remains more limited, albeit with important variations, in developing regions (Cashore et al. 2006).

How can we account for the variable and so far limited uptake of transnational governance in developing countries? This is a critical question to address if transnational instruments are to play a catalytic role in addressing global issues in a manner that is seen as legitimate and appropriate to the scale of global challenges. Yet, the existing literature is largely silent on the factors that may be specific to developing countries in shaping their participation in transnational climate initiatives. This article opens a new research agenda to examine the conditions for unlocking societal action on climate change in the Global South.

Our argument starts with the premise that the diffusion of private regulations through incentives associated with global markets cannot be assumed. The cost of program entry, along with informational and capacity requirements for certification, may present important barriers in developing countries (Clapp 1998; Espach 2006; Rivera 2004). Therefore we need better understanding of the conditions under which voluntary programs are adopted in contexts characterized by more limited institutional capacity and harder trade-offs between immediate economic concerns and global public goods.

This article advances a theoretical framework that draws on studies of new interdependence and the layering of public and private rules[2] to stipulate that access to international institutions and linkages between domestic priorities and transnational governance are key variables influencing developing countries' participation in voluntary carbon markets and private regulations. This argument reflects on the limited direct pressure on private actors in the South for beyond-compliance climate action and the critical capacity and information

1. See https://ic.fsc.org/en/facts-and-figures, last accessed December 21, 2018.
2. See, among others, Andonova 2014, 2017; Andonova, Hale, and Roger 2017; Bartley 2011; Bruszt and McDermott 2014; Büthe and Mattli 2011; Farell and Newman 2015; Green 2014; Toffel, Short, and Quellet 2015.

requirements for engagement in transnational networks. Institutional factors that support capacity building and linkages between local concerns and global issues are therefore critical for realizing the opportunities for nonstate and substate actors in the Global South to participate in transnational climate initiatives.

We assess the theoretical argument by examining the adoption of voluntary carbon offset (VCO) programs in developing countries, an arena of global significance that has so far attracted limited research. VCO programs establish specific rules to monitor, certify, and register projects that reduce greenhouse gas (GHG) emissions; they are more akin to "hard laws" than declaratory principles, with potential to advance mitigation efforts (Auld, Bernstein, and Cashore 2008; Michaelowa and Michaelowa 2017). While the role of offset programs has been politically contested and debated in the climate justice literature, their presence in developing countries has steadily increased and is one of many pathways to decarbonization (see the 2017 special issue of *GEP* 17 [3]; see also Bernstein and Hoffmann 2018; Hale 2016; Jordan, Huitema, and Forster 2018). This article presents for the first time broadly comparative data and analysis on the adoption, limits, and determinants of the variable diffusion of VCO programs as part of a complex system of climate governance.

The Demand and Supply of Voluntary Carbon Offsets

Carbon offsets allow emission reductions in one location to compensate for emissions made elsewhere. They create flexible mechanisms for states, companies, organizations, and individuals to purchase carbon credits when their direct emission reductions are too costly or difficult to implement. The Kyoto Protocol (1997) institutionalized this approach at the international level through its flexible mechanisms, including the Clean Development Mechanism (CDM), which allowed Annex I parties with binding targets to meet some of their obligations through offset projects in developing countries.

Voluntary carbon markets emerged in parallel with the Kyoto Protocol and other platforms of mandatory regulation (Biedenkopf et al. 2017; Green 2014; Meckling 2011; Newell and Paterson 2010). They reflected multiple streams of politics—including nonstate actors' frustration with slow or inadequate state action (Bumpus and Liverman 2008), the interplay of epistemic networks and private incentives across institutional domains (Abbott, Green, and Keohane 2016; Hamilton et al. 2009; Paterson et al. 2014), and a broader neoliberal turn in regulatory policies toward market instruments (Bernstein 2002). Corporate actors and environmental groups developed voluntary certification schemes out of the shadow of state regulations to support the functioning and creditability of the voluntary carbon market (Green 2013; Hoffmann 2011; Lovell 2010). VCO certification programs define rules to measure emission reductions and their additionality, accounting, and sustainability

co-benefits, depending on the nature of the standard (Hamilton et al. 2009; Newell and Paterson 2010).

Developing countries have historically assumed the position of suppliers both in mandatory schemes like the CDM and for voluntary carbon markets. Initially, developing countries expressed opposition to carbon offsets under the UNFCCC. They emphasized the historical responsibility of the industrialized world to lead mitigation efforts (Roberts and Parks 2006) and viewed offsets as outsourcing of these responsibilities and exploitation of low-cost mitigation projects (Ciplet, Roberts, and Khan 2013; Najam, Huq, and Sokona 2003), for instance, through HCFC-destruction offsets that may create incentives for their continued production, rather than innovation (Wara and Victor 2008).

Despite such concerns and in the footsteps of the overall successful implementation of the CDM, voluntary carbon markets expanded, and so did VCO programs in the Global South. Yet, the extent and variation in the supply of VCO projects and their significance in developing contexts has not been examined systematically. Table 1 provides new data on the adoption of VCO programs across developing countries as of 2016.[3]

Table 1 reveals that only about half of the VCO programs have a global coverage, whereas prominent networks like Climate Action Reserve and Social Carbon are confined to one region or country. Among the six global programs, only the Verified Carbon Standard (VCS) and the Gold Standard (GS) have a strong presence in developing countries. Together, the VCS and GS dominate the voluntary market, accounting for more than two-thirds of the total offsets, while programs characterized by a specific focus (e.g., biodiversity, local livelihoods) often serve as additional standards for offset projects that already comply with VCS or GS certification (Hamrick and Goldstein 2016).

Figure 1 presents further mapping of the global distribution of VCS- and GS-certified projects. It reveals that in the Global South, these markets are dominated by large emerging economies, and that they spread relatively broadly, but highly unevenly.

Some important differences emerge across the two programs. The supply of projects certified by the VCS—a business-dominated standard emphasizing reduced transaction costs and accounting integrity—is dominated by India (429 projects) and China (319 projects). However, other developing countries are also active, including Brazil (86), Thailand (36), Chile (20), Peru (19), and Vietnam (15). VCS projects are also developed in Annex I countries, in particular, Turkey (110), the United States (85), and Germany (35).

In comparison, the supply of GS-certified projects is more broadly spread across developing countries. India and China still have a leading role, each

3. Developing countries are defined here as non–Annex I parties of the Kyoto Protocol. The list of VCO programs is drawn from the transnational climate governance database by Andonova, Hale, and Roger (2017). From each program's website, we collected additional new data on the number of registered projects in developing countries. "Global" programs are defined as those adopted on more than one continent.

Table 1
Survey of VCO Programs and Projects in Developing Countries

Name	*Start Date*	*Geographical Scale and Focus*	*Registered Projects in Developing Countries (data as of 2016)*
Verified Carbon Standard	2007	Global	1,098
The Gold Standard	2003	Global, focusing on sustainable development	462
Climate, Community and Biodiversity Standard	2005	Global, focusing on biodiversity	131
VER+	2007	Global, certifying projects that cannot yet be implemented under the CDM	26
Plan Vivo	2009	Global, promoting sustainable development, rural livelihoods and ecosystems	17
Carbon Fix Standard	1999	Global, focusing on forestry, acquired by the Gold Standard in 2011	6
Climate Action Reserve	2009	Only in the North American market	4 in Mexico (the rest in the US)
Chicago Climate Change Offset Program	2003	Only in the US market	0
Green-e Climate	2008	Focusing on the US, certifying retailers' offset products	2 in Brazil (the rest in the US)
Social Carbon	2008	Developed by a Brazilian NGO, focusing on sustainable development	20 (18 in Brazil)

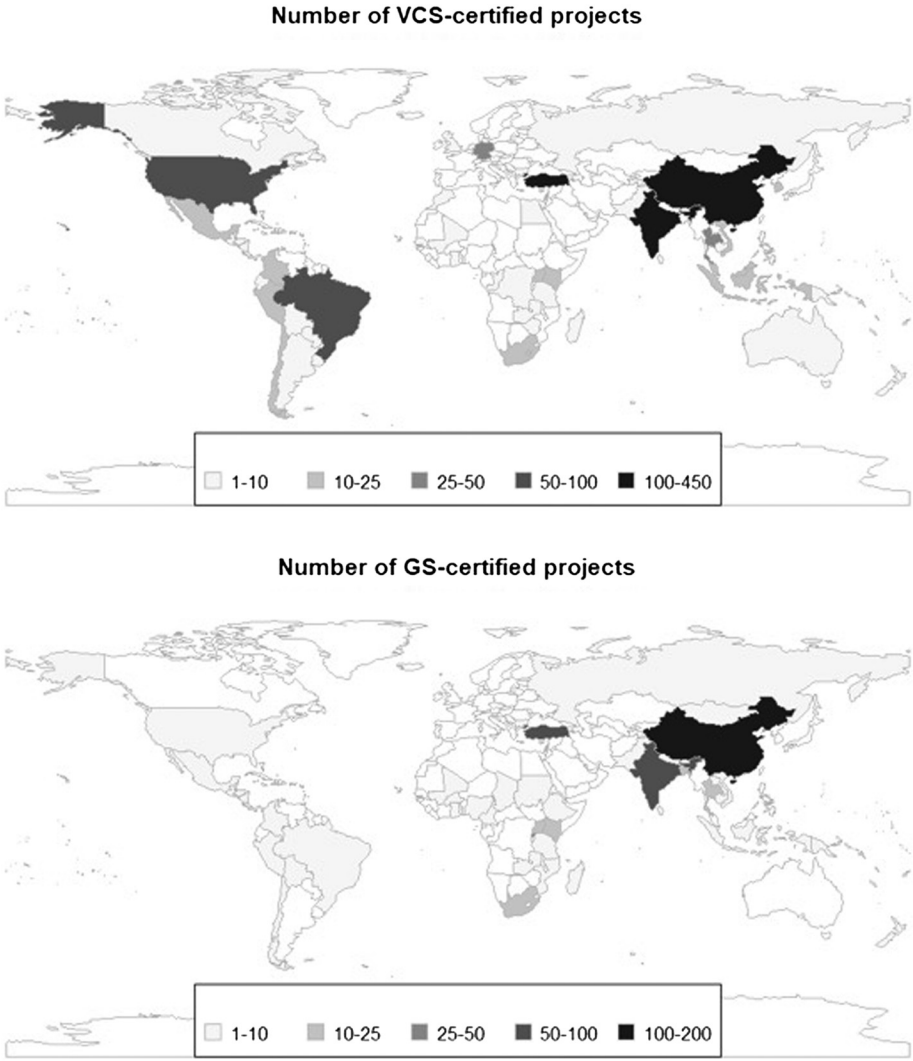

Figure 1
Global Distribution of VCS- and GS-Certified Offset Projects

attracting more than 60 projects; some Asian countries are also important hosts including Bangladesh (17) and Thailand (15). Compared to the VCS, the GS has a greater reach on the African continent and higher uptake in countries such as Rwanda (28), Kenya (24), and South Africa (17). GS projects have also been implemented in large numbers in Turkey, an Annex I country. What are the political determinants of this important variation in the adoption of the two leading VCO programs? We elaborate next a theoretical

framework that aims to account for the uneven uptake of private regulation across developing countries.

Theory: Public Drivers of Private Regulations

Contemporary global governance has evolved toward a complex system of overlapping intergovernmental and transnational mechanisms. The scholarship on these trends points to an apparent paradox, however. On one hand, the creation of transnational initiatives like private certification, public–private partnerships, or city networks often responds to the environmental and social failures of global markets or the insufficiency of hierarchical public institutions (Andonova, Betsill, and Bulkeley 2009; Cashore, Auld, and Newsom 2004; Hoffmann 2011). On the other hand, the adoption of transnational initiatives is closely interdependent with the capacity of regional and domestic public institutions to create favorable environments for private self-regulation (Andonova 2014; Andonova, Hale, and Roger 2017; Bartley 2018; Berliner and Prakash 2014; Büthe and Mattli 2011). Thus Farrell and Newman (2014) speak of "new interdependence" of institutions, while Bartley (2011) refers to the "layering" of public and private regulations.

Our theoretical framework is rooted in conceptual approaches that explore the interplay of public institutions and private regulations. We posit that such a perspective is critical for understanding the uptake and future prospects of voluntary carbon markets in developing countries. The beyond-compliance market has taken cues from both mandatory schemes and private demand associated with pressures for corporate social responsibility or motivations of substate actors in industrialized countries (Bumpus and Liverman 2008; Hamilton et al. 2009; Newell and Paterson 2010). However, as mentioned in the introduction, the same types of private motivations to supply voluntary offsets do not automatically occur in developing countries. Historically, actors in the Global South have not been subjects of direct regulatory or advocacy pressure to engage in mitigation, as developing states had no formal mitigation obligations until the adoption of the Paris Agreement (2015). While the voluntary carbon market itself could present incentives to invest in VCOs for profit, the actual opportunities to engage in transnational markets and certification imply the need to overcome a range of asymmetries in access to information, capacity, available technical skills, and capital (Clapp 1998; Hamilton et al. 2009; Schröder 2012). For certification in other sectors, it has been shown that public institutions and societal associations can have an important role in reducing such asymmetries (Espach 2006; Rivera 2004; van Kooten, Nelson, and Vertinsky 2005) and mediating incentives associated with transnational markets (Bartley 2011; Berliner and Prakash 2014). Our framework develops further this line of inquiry by specifying how international institutions as well as linkages to domestic concerns and public policies are likely to influence the adoption of VCO programs in developing countries.

The Pull of International Institutions

The close interface in the development of mandatory and voluntary carbon markets implies that international pull factors are likely to be at play in the adoption of VCO programs (Green 2014; Paterson et al. 2014). While some developing countries were skeptical about market-based instruments in negotiating the Kyoto Protocol, the implementation of CDM projects has created political constituencies and new capacities at the national and subnational levels for carbon offsets management (Biedenkopf et al. 2017; Hale and Roger 2017; Schröder 2012). The CDM has drawn critique, however, for the disproportionally high share of projects implemented, at least initially, in large emerging economies like China, India, and Brazil, with limited attention to low-income countries and development co-benefits (Castro and Michaelowa 2011). In response, capacity-building mechanisms were established by development banks and transnational public–private partnerships to reduce the asymmetries in knowledge and institutional capacity (Andonova 2010; Michaelowa and Michaelowa 2011). As standards for VCOs developed, many of them hedged the methodologies in reference to CDM rules to increase their credibility and attractiveness for private actors (Green 2013) or sought to influence the CDM by placing a premium on sustainable development co-benefits (Lovell 2010).

The interdependence between international and transnational arrangements for carbon offsets suggests that these vehicles of governance are likely to create transnational interests to simultaneously promote both (Newell and Paterson 2010; Paterson et al. 2014). In addition, CDM projects are likely to enhance the knowledge, incentives, and capabilities of actors in developing countries to identify and profit from VCO investments. Hence our first hypothesis (H1) stipulates a positive reinforcement between the formal CDM institutions and private VCO programs:

> H1: The uptake of VCO projects is likely to be higher in developing countries with larger CDM portfolios, all else equal.

Another international pull factor relates to the interest of industrialized countries to promote voluntary carbon markets, either to reduce the cost of domestic compliance with climate legislation or to compensate for weaknesses in domestic regulation (Bulkeley et al. 2014). A similar logic has affected the diffusion of transnational standards related to other environmental issues, creating overlaps between public and private instruments (Gulbrandsen 2014). Donor governments have used their capacity to orchestrate climate initiatives or to create targeted funds to support participation in transnational governance (Andonova 2010, 2017; Biedenkopf et al. 2017; Hale and Roger 2014). Targeted financial assistance promotes alliances of the "green and greedy" that link environmental, market, and technology motivations across borders (Hicks et al.

2008). Therefore, hypothesis 2 (H2) anticipates that targeted development aid is likely to support the capacity and incentives for the adoption of VCO programs:

> H2: The uptake of VCO projects is likely to be higher in developing countries receiving greater amount of climate aid, all else equal.

The Push of Domestic Concern

Much of the literature on private regulation starts from the presumption that nonstate actors in industrialized countries adopt beyond-compliance regulations in response to normative pressures, market failures, or weak institutions affecting their supply chains. The diffusion of private regulation proceeds from advanced to developing markets, and Southern actors are thus the "takers of regulation" (Bruszt and McDermott 2014; Garcia-Johnson 2000; Prakash and Potoski 2006). The comparative literature on the layering of public and private rules suggests, however, that the politics of private regulation in the developing world is more dynamic. It highlights the interplay between transnational rules and domestic policies and institutions in shaping different motivations and ability to engage in transnational regulation (Andonova 2014; Auld, Betsill, and VanDeveer 2018; Berliner and Prakash 2014; Cashore et al. 2006; Espach 2006; Rivera 2004).

Such dynamics require further examination in the context of carbon markets. While, at least initially, market-based instruments were primarily established in industrialized countries, our analysis departs from the traditional assumption about lack of interest in mitigation in developing countries. Policies in developing contexts have nonetheless advanced around linkages between domestic concerns and climate change (Biedenkopf et al. 2017; Hochstetler and Viola 2012; Stadelmann and Castro 2014). Vulnerability to climate change is perhaps the most salient issue for developing countries (Ciplet, Roberts, and Khan 2013; Dubash 2017; Roberts and Parks 2006). The linkage between climate mitigation and adaptation is pursued through strategies of resilience and low-carbon development (Hochstetler and Viola 2012). Carbon offset programs could thus be promoted by actors in developing countries that are sensitive to vulnerability risks as a means to accelerate global efforts or domestic policies (Michaelowa and Michaelowa 2017). NGOs have advanced VCO certifications in the Global South that emphasize community involvement, adaptation, and biodiversity, as illustrated in Table 1. Such initiatives seek to realize co-benefits between mitigation offsets and domestic adaptation through projects focusing on forests, land use, or communities (Hochstetler and Viola 2012). When VCO programs and project developers target the coproduction of sustainability benefits associated with strengthening local resilience to climate risks, the linkage between domestic concerns and mitigation offsets may gain particular salience and interest in VCO projects. Therefore we anticipate in Hypothesis 3 (H3) that in

countries that are more vulnerable to climate change, domestic constituencies will have greater concern and stronger interest to engage in offsetting as a pathway to realize co-benefits and promote stronger climate action:

> H3: The uptake of VCO projects is likely to be higher in developing countries with greater climate vulnerability, all else equal.

Motivation to engage in VCO programs by local actors can also result from national policies in developing countries that link domestic priorities, such as energy innovation, reduced local pollution, or deforestation, to climate governance (Andonova, Hale, and Roger 2017; Cao and Ward 2017; Keohane and Victor 2016; Stadelmann and Castro 2014). Transnational city networks promoting climate mitigation, for instance, have leveraged the public objectives pursued by municipal policies with transnational advocacy and resources (Betsill and Bulkeley 2004; Dolšak and Prakash 2017). Similarly, VCO programs provide opportunities for domestic actors to experiment with market-based mechanisms, particularly when there are regulatory signals that may require actors to invest in low-carbon transitions. For example, China has placed emphasis on expanding renewable energy technologies along with government commitments to national climate targets (Lewis 2013; Hale and Roger 2017). Domestic policies may incentivize investment in particular offset technologies and relevant VCO programs or may create incentives for experimentation with new niche markets that attract domestic and international investors (Pulver and Benney 2013). In sum, policy contexts that establish a positive linkage between domestic priorities and global climate governance are likely to create interest in and political space for voluntary mitigation projects. This expectation is captured by Hypothesis 4 (H4).

> H4: The uptake of VCO projects is likely to be higher in developing countries with stronger national policies that link domestic priorities and climate governance, all else equal.

Transnational Markets and Advocacy

While our main hypotheses rest on a theory of interdependence between public and private governance, we also consider the impact of transnational market-based incentives and advocacy on the diffusion of VCO programs. The literature on private certification highlights the strong pull of transnational markets and commodity chains in the creation of beyond-compliance rules and their diffusion to developing countries, including the ISO14000 series, the FSC, and Responsible Care (Garcia-Johnson 2000; Perkins and Neumayer 2010; Prakash and Potoski 2006, 2007). In the case of VCO certifications, this logic suggests that businesses in jurisdictions with stronger climate regulations may seek to export norms or practices by introducing VCO programs to their partners in unregulated jurisdictions, in order to meet expectations from their home countries and to expand the supply of cost-efficient offsets. Therefore trade with partners

in regulated jurisdictions and foreign direct investment may be mechanisms that increase the awareness, incentives, and ability of actors in the Global South to benefit from transnational VCO programs.

Additionally, industries and actors that have already invested in other forms of sustainability certification (e.g., forestry, eco-efficiency) may be better positioned to benefit from VCO projects due to the lower transaction costs that they face. Forestry, for example, could be a highly indicative sphere for such parallel incentives, given that some 15 percent of offsets are in the same sector (Hamrick and Goldstein 2016).

Finally, transnational advocacy networks are conduits of norms and pressure for the adoption of private environmental standards (Auld, Bernstein, and Cashore 2008; Pattberg 2007). Although historically, the NGO community has been split on the issue of carbon offsets as an instrument of climate governance, transnational NGOs that actively promote VCOs have designed certifications with stronger social and sustainability orientation, as illustrated by Table 1. Hence our model will test the effects of international market-based incentives and NGO networks, respectively, as summarized in the following two hypotheses:

> H5: The uptake of VCO projects is likely to be higher in developing countries that are highly embedded in international markets, and particularly those with stronger climate regulation, all else equal.

> H6: The uptake of VCO projects is likely to be higher in developing countries that are highly embedded in transnational NGO networks, all else equal.

Statistical Model and Data

Using cross-sectional data, our analysis explores the forces that can influence the supply of VCOs in developing countries. The empirical model specifies the dependent variable—*VCO projects*—as the total number of VCS- and GS-certified projects registered in each developing country as of 2016.[4] In specifications 4–6 of the baseline model, we further examine the differences in uptake between

4. This specification of the dependent variable best captures the main phenomenon that we seek to explain, namely, the variable participation in VCO programs across developing countries. The VCS began to register projects in March 2009, and the majority of GS-certified projects have been registered since 2009. We do not use panel data because of the short time period since the operation of the two programs and the impossibility to identify projects' starting years from publicly available sources. It is also not plausible to standardize the dependent variable measure because of the tendency toward large numbers of zeros in the sample. However, as elaborated later in the specification of the model and of the robustness checks, we use several controls for the size of the economy and greenhouse gas emissions, which capture characteristics of the economies that could potentially scale the effect of the explanatory variables highlighted by the core hypotheses, in order to address the possibility of spurious correlation. Finally, Figure A3 in the online Appendix provides a summary perspective on the average size of projects, showing that most projects are of small or medium size in terms of mitigation potential and that there is a relatively small variance in the overall sample. This increases our confidence in the compatibility and consistency of our measure across countries.

these two leading programs, defining the dependent variable as participation in VCS- and GS-certified projects, respectively. These models explore how the design features of the programs, in particular, the greater emphasis by the GS on sustainability co-benefits, affect the politics of participation in developing countries.

As Figure 1 illustrates, the uptake of these two programs is highly uneven in the Global South, with the number of projects for many developing countries remaining very small or even zero. In other words, the dependent variable is overspread count data with standard deviation bigger than the mean. Hence the negative binomial regression model is appropriate to generate accurate estimation; its coefficient shows the difference in the logs of expected counts of the response variable for one unit change in the predictor variable, given other variables held constant. The sample includes observations of VCS- and GS-certified projects in 101 countries that are not in Annex I of the Kyoto Protocol.

The explanatory variables are specified as follows. The variable *CDM* measures the number of CDM projects registered in each country as of 2016,[5] to test the hypothesized influence of market-based institutions under the UNFCCC (H1) on parallel incentives and capacity for participation in voluntary markets. We use the aggregate number of CDM projects as of 2016, because the approval and registration of CDM projects can take several years, and relatively few CDM projects were implemented in low-income countries early on (Castro and Michaelowa 2011). This approach therefore provides the most reliable measure of the *overall* impact of the CDM institution across our full sample. The risk of endogeneity for this measure is low, because of the late start of the VCO programs examined (2009) and the long pipeline time of CDM registration. A more limited measure of CDM projects registered before 2009 (*CDM 2008*) is used as a robustness check for endogeneity.

The variable *Climate Aid* measures the natural logarithm of the ten-year average (1999–2008) of official development aid with a priority of climate mitigation, received by each country.[6] We limit the data to 2008 for most explanatory variables to reduce the risk of endogeneity, given that the vast majority of VCO projects have been registered after that date. The variable *Green Aid* uses broader data on environmental assistance developed by Hicks et al. (2008) as a robustness check for the influence of foreign assistance.

Vulnerability is operationalized as the ten-year average of the vulnerability indicator constructed by the Notre Dame Global Adaptation Initiative, which measures a country's exposure, sensitivity, and capacity to adapt to climate change (higher scores mean greater vulnerability).[7] This variable tests whether

5. Data from the CDM portal at https://cdm.unfccc.int/Projects/projsearch.html, last accessed December 21, 2018.
6. Data from http://stats.oecd.org/Index.aspx?DataSetCode=RIOMARKERS#, last accessed December 21, 2018.
7. Data from http://index.gain.org/about/download, last accessed December 21, 2018.

domestic vulnerability and local concerns stimulate greater participation in VCO programs as a means of promoting stronger mitigation efforts (H3). In the robustness checks, we use the variable Gross domestic product per capita (*GDPpc*) as an alternative measure of vulnerability, reflecting that poor countries have fewer resources to adapt to climate change.[8]

We examine the effect of national policies related to climate change (H4) on the political scope for uptake of VCO programs by using two different proxies of support for renewable energy deployment. The variable *Renewables* is the natural logarithm of each country's renewable electricity installed capacity (1999–2008), drawing from the US Energy Information Administration International Energy Statistics.[9] It provides a continuous measure of the scale of domestic prioritization of investment in renewable technologies during the period shortly after the adoption of the Kyoto Protocol and before the implementation of the two VCO programs. Moreover, we build an ordinal variable (*Policies Targets*) using REN21 data on the existence of policies and targets on renewable energy as of 2008.[10] These two variables are good proxies of the linkage between domestic priorities and global climate change and how such policies might create incentives for actors to engage in VCO programs. The Environmental Performance Index (EPI) score for climate change policy in 2008 (*EPI2008*) is an additional policy proxy used in the robustness checks.[11]

The model takes into account countries' connectivity to transnational markets and advocacy networks, which could partake in the diffusion of transnational climate regulation (H5 and H6). *Trade EU* measures the natural logarithm of countries' trade flows with the European Union (EU) (2003–2008), drawing from the European Commission Market Access Database.[12] The EU is the market with the strongest climate regulations, including mandatory and voluntary carbon trading, leading us to expect that greater trade engagement with the EU could facilitate awareness of and incentives for engagement in VCO programs (Biedenkopf et al. 2017; Meckling 2011). The amount of foreign direct investment (*FDI*)[13] is a robustness-check variable for the impact of economic interconnectedness on the diffusion of private regulation to developing countries (Prakash and Potoski 2007). The numbers of ISO14001-certified facilities (*ISO14001*) and FSC-certified projects (*FSC*) in each developing country by 2008 provide additional robustness checks to assess how industrial actors that benefit from market-based certification in areas related to climate change may affect the incentives for developing VCO projects.

8. Data from https://tinyurl.com/y8yo2ng5, last accessed December 21, 2018.
9. Data from https://tinyurl.com/ycjpwqmr, last accessed December 21, 2018.
10. Data from https://tinyurl.com/y9cwh2yo, accessed December 21, 2018.
11. Data from http://epi.yale.edu/downloads, last accessed December 21, 2018.
12. Data from http://madb.europa.eu/madb/statistical_form.htm, last accessed December 21, 2018.
13. Data from https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD, last accessed December 21, 2018.

The variable *ENGOs* takes the number of members of the International Union for Conservation of Nature (IUCN) in a country[14] to test the influence of transnational advocacy networks on the uptake of VCO programs. The IUCN is one of the oldest networks of environmental advocacy and science-based expertise, with programs on climate change and the widest global participation by domestic organizations, including in developing countries. The network includes relatively mainstream environmental NGOs likely to support market-based instruments. It is thus the most appropriate available indicator of transnational advocacy that can claim any degree of representativeness in the Global South (Andonova 2014; Bernauer, Bohmelt, and Koubi 2013).

Our baseline analysis includes two additional variables—countries' greenhouse gas emissions (GHG) and *Civil Liberties*—that are appropriate overall controls for country-specific characteristics. *GHG* is the natural logarithm of each country's total emission level (1999–2008), using data from the World Bank.[15] It controls broadly for the size and structure of the economy, which could affect a range of political factors and the relative cost and attractiveness of VCO projects. While we do not standardize the measure of the dependent variable, the variables *GHG* and *GDPpc* control for a range of structural characteristics of the economy, which may affect the industrial interest and potential across countries to implement both VCO and CDM projects. The variable *Civil Liberties* uses data from Freedom House to control broadly for domestic institutional and political structure, taking into account that a free society with greater opportunities for bottom-up associations is likely to provide enabling conditions for nonstate actors to join transnational governance (Andonova, Hale, and Roger 2017; Bernauer, Bohmelt, and Koubi 2013).[16]

Table A1 in the online Appendix presents the summary statistics of the dependent and explanatory variables. We pay special attention to potential endogeneity concerns about the direction of impacts between our independent and dependent variables. Hence, unless otherwise specified, the independent and control variables are constructed using the data of ten-year averages, 1999 to 2008, the time period prior to the beginning of the registration of most VCS and GS projects in developing countries. The correlation matrix and variance influence factors test for multicollinearity (Tables A2 and A3 in the Appendix), showing that the independent variables of our main models are not highly correlated.[17]

Results

The statistical analysis provides robust support for the argument that public institutions and local concerns and policies are likely to be key political factors

14. Data constructed by Bernauer et al. (2013); see https://tinyurl.com/y7ab3szm, last accessed December 21, 2018.
15. Data from https://tinyurl.com/q56nd8o, last accessed December 21, 2018.
16. Data from https://tinyurl.com/hqd5zsc, last accessed December 21, 2018.
17. The Appendices are available at: https://www.mitpressjournals.org/doi/suppl/10.1162/glep_a_00496/suppl_file/Andonova_onlineAppendix.pdf

in shaping the participation in VCO programs in developing countries. Table 2 presents the baseline model (1) with five alternative specifications. Specification 2 tests the model without China and India to take into account the high shares of CDM and VCO projects implemented in these countries. Specifications 3–6 split the sample to test the explanatory leverage of the model with respect to the uptake of VCS and GS projects, respectively.

The coefficients of the *CDM* and *Climate Aid* variables are positive and, in large part, statistically significant in the baseline specifications, supporting the argument that targeted assistance for climate change and CDM institutions can play an important role in creating domestic capacity and interest for participation in VCO programs. The significance of the variable *CDM* can be also accounted for by the fact that some VCO programs, such as the GS, seek to indirectly influence CDM rules, providing additional leverage to private actors who are simultaneously interested in the voluntary and mandatory markets (Green 2013). Specification 2 confirms the significance of our results even when China and India, the two largest suppliers of the VCO markets, are excluded.

While the variables measuring the influence of international institutions remain largely significant across the specifications, the significance of *Climate Aid* is reduced in explaining the uptake of VCS projects (model 3 and 5). This implies that in the business-driven VCS program, its transnational private constituency may bring greater resources to VCO projects, making participation less sensitive to internationally assisted capacity.

Turning to linkages with domestic concerns, the variable *Vulnerability* is positive and significant (10 percent level) in the baseline specification 1, indicating that greater vulnerability suggests stronger participation in VCO programs in developing countries (H3). However, the variable exhibits greater sensitivity to the sample in which the model is tested. The statistical significance of vulnerability increases in specification 2 (without China and India) to the 1 percent level, and to the 5 percent level in the models of the uptake of GS projects (specifications 4 and 6). These findings introduce an important refinement to our argument on the linkage between domestic concerns about *Vulnerability* and support for transnational voluntary action. The linkage appears to be particularly significant in developing countries that do not have the market power of emerging economies like China and India. Furthermore, the large and significant coefficients of *Vulnerability* for the uptake of GS projects suggests that the design of private market-based instruments matters. When VCO programs explicitly leverage sustainable development co-benefits like the GS, they are more likely to stimulate linkages between domestic concerns about vulnerability and participation in beyond-compliance action. On the contrary, vulnerability does not appear to be a significant predictor for the uptake of VCS projects, which are more strongly driven by business interests that tend to prioritize cost-effectiveness and reduced transaction cost.

The coefficient of the variable *Renewables* is positive and statistically significant across all models, supporting the expectations of H4 on the importance of

Table 2
Determinants of Participation in VCO Programs in Developing Countries

	(1)	(2)	(3)	(4)	(5)	(6)
	VCO projects	*VCO projects without China/India*	*VCS*	*GS*	*VCS*	*GS*
CDM	0.000868**	0.0137*	0.000853*	0.00103*	0.000931*	0.00105**
	(2.58)	(2.56)	(2.27)	(2.57)	(2.50)	(2.58)
Climate aid	0.282***	0.275***	0.217*	0.359***	0.166	0.358**
	(3.71)	(3.64)	(2.32)	(3.52)	(1.69)	(3.15)
Vulnerability	6.332*	8.819***	5.780	11.29**	2.949	9.998**
	(2.54)	(3.34)	(1.81)	(3.26)	(1.03)	(2.97)
Renewables	0.243**	0.223**	0.316*	0.183*		
	(3.15)	(3.01)	(2.55)	(2.03)		
ENGOs	0.0144	0.0384	0.0176	0.0121	0.0419	0.0267
	(0.32)	(0.82)	(0.34)	(0.20)	(0.87)	(0.44)

Trade EU	−0.127	−0.222	0.176	−0.242	0.0970	−0.159
	(−0.90)	(−1.53)	(0.97)	(−1.40)	(0.54)	(−0.93)
GHG	0.478**	0.398*	0.240	0.504*	0.366*	0.511*
	(2.97)	(2.52)	(1.27)	(2.37)	(2.15)	(2.49)
Civil liberties	0.670***	0.647***	0.707***	0.633**	0.595***	0.528*
	(4.43)	(4.25)	(4.16)	(2.86)	(3.60)	(2.56)
Policy targets					0.527**	0.0667
					(2.76)	(0.33)
_cons	−14.74***	−13.14***	−18.80***	−16.44***	−13.08**	−15.10***
	(−4.63)	(−4.05)	(−4.45)	(−4.04)	(−3.19)	(−3.54)
lnalpha_cons	0.185	0.156	0.310	0.609*	0.267	0.633*
	(0.84)	(0.71)	(1.17)	(2.29)	(0.98)	(2.33)
N	101	99	101	101	101	101

Note. *t*-Statistics in parentheses.
*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

policies and actions that link domestic priorities and global concerns. Greater installation of additional capacity in renewables, after the adoption of the Kyoto Protocol and during a critical period of stagnating international cooperation, provides a concrete signal of policy support and opportunities for low-carbon development.

Figures A1 and A2 in the online Appendix (available at https://www.mitpressjournals.org/doi/suppl/10.1162/glep_a_00496/suppl_file/Andonova_onlineAppendix.pdf) illustrate the marginal effects of some of our core explanatory variables. They show that if we increase the value of *Renewables* and *Climate Aid* from one standard deviation below its mean to one standard deviation above its mean, holding other variables at their mean, VCO projects would be increased by 4 and 3, respectively. These effects are not only statistically significant but also substantively strong, given that the average VCO project number in our sample is less than 14.

The variable *Policies Targets* (specifications 5 and 6) provide an alternative categorical measure of policy support for advancing renewable energy. Somewhat surprisingly, this measure is significant for the uptake of the business-driven VCS program and not significant for the GS sample. This result may be interpreted by noting that the GS prioritizes greener projects, including on clean energy, and seeks strong evidence of additionality. Thus the program itself may shape the selection of renewable energy projects independent of domestic policies. By contrast, for the business-driven VCS program, a credible policy signal may be important for both transnational and local actors to invest in VCO projects, as it creates more stable expectations, particularly when no binding international commitment existed for developing countries.

International diffusion variables such as *ENGOs* and *Trade EU* are insignificant across all models, which is unexpected given the role of these factors in the diffusion of other private standards (Prakash and Potoski 2006; Schleifer 2017; van Kooten, Nelson, and Vertinsky 2005). The literature on the market drivers of private regulation has focused primarily on certification schemes that directly affect commodity chains (e.g., timber, chemicals, textiles, food products). Advocacy and market pressure for the adoption of such certifications by transnational corporations and their suppliers can take very direct forms through contracts and building of expertise along the supply chain. By contrast, carbon offsets are less directly implicated in existing commodity chains, which could explain the limited pull of regulated trade partners and ENGOs. The demand for VCO programs has been established in industrialized countries in reaction to broad social responsibility concerns and the parallel creation of public platforms for offset trading. To the extent that global actors, such as project developers, certifiers, or companies, are interested in promoting VCOs in developing countries, they cannot leverage preexisting market-based contracts or normative pressure. Rather, VCO programs are more likely to be incentivized by local interests, by targeted climate aid and enlarging existing offsets portfolios, and by linkages to domestic concerns and policy signals.

The statistical significance of the two control variables, *GHG* and *Civil Liberties*, confirms the expectation that large developing emitters, on balance, attract more participation in VCO programs and that stronger civil institution and freer society likely enable the agency of private actors to engage in VCO programs. They increase the confidence in our main results as critical controls.

Tables A4 and A5 in the online Appendix report the results of the robustness checks, as elaborated in the section on model specification. They largely confirm the significance of domestic policies (*EPI 2008*), a broader measure of environmental aid (*Green Aid*), and vulnerability (*GDPpc*) as key political factors that influence participation in VCO programs in developing countries. The differences in what shapes the uptake of GS and VCS projects are also consistent across the robustness-check models, with countries' climate vulnerability representing a more likely determinant of participation in GS-certified projects, while domestic climate policy (*EPI 2008*) remains a more consistent predictor of VCS projects. *CDM 2008* confirms the significance of the CDM variable in the full model; it becomes insignificant only in the sample without China and India, reflecting precisely our concern that by 2008, the scope of CDM influence was hard to measure accurately, given that many projects were delayed in the pipeline and participation by low-income countries was limited. The variables *FDI*, *FSC*, and *ISO14001*, providing alternative measures of transnational integration and market-based motivations, remain insignificant, suggesting that further research is needed on the structure of economic incentives for the diffusion of VCO projects in developing countries.

In summary, our empirical analysis reveals an important interdependence between public institutions and private governance for climate change. VCO programs do not take root in developing countries largely through the invisible hand of the market. Rather, institutions like the CDM and targeted foreign aid, as well as linkages with domestic concerns and priorities, shape to a considerable degree the differential capacity and societal incentives to engage in voluntary offsets and certification.

Conclusions

Global governance has evolved toward a system of complex and overlapping instruments. This article makes several novel contributions to the study of the interface between public and private institutions, and the implications for pressing global issues. With respect to climate governance, our research moves beyond studies of aggregate trends in transnational collaboration to focus on the spread of VCO programs in the Global South. It reveals in the first instance a relatively limited uptake, compared to the potential of this instrument to support climate mitigation. However, the considerable variance in uptake allows us to gain important insights into the factors that may block or unlock opportunities for emission reductions in developing country contexts.

Our theoretical framework advances the literature that emphasizes the interdependence of public and private rules. We argue that not only domestic

but also international institutions can play an important role in shaping the opportunities and capacity of actors in developing countries to partake in voluntary beyond-compliance governance. This insight highlights how different elements of complex governance systems interact and through what mechanisms, such as creating capacity and reducing knowledge asymmetries, they may result in positive reinforcement across levels of governance. The empirical analysis, furthermore, reveals that the design of private regulations matters. Their internal rules and prioritization can be fine-tuned to better capture linkages between local priorities, such as vulnerability, clean air, or technological innovation, and investment through VCO projects.

These findings have important policy implications for the future of climate governance. The Paris Agreement builds on a new premise of linking national priorities and international commitments and on catalyzing action through nonstate initiatives. We show that such linkages can provide promising pathways toward decarbonization and resilient development. However, a productive layering of public commitments and private action in developing contexts is likely to require long-term institutional support, through a variety of instruments, such as the CDM, the Green Climate Fund, and donor and partnership initiatives.

As a first step to examine the dynamics in voluntary carbon offsetting across developing countries, our study opens a new research agenda for students of environmental politics. While our exploratory work sheds light on the conditions for VCO uptake across jurisdictions, the micro-level incentives of the suppliers of carbon offsets, as well of international investors and buyers, remain an important subject for more detailed research. Further studies are warranted to investigate such dynamics and to explain why carbon markets may be different from other commodity chains where transnational markets and NGO networks play a stronger diffusion role. While we do not disaggregate different types of projects across the sectors in which they are implemented, we see this as a limitation. Domestic industrial and interest group dynamics may favor certain types of projects over others. Further research is needed to examine with greater scrutiny the variation in size and environmental quality of VCO projects. Finally, the present study implies the need for new data to examine the on-the-ground impacts of VCO projects and thus their actual potential to support NDC commitments in developing contexts.

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