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Abstract

The number of climate change laws in major economies has grown from less than 40 in 1997 to almost 500 at the end of 2013. The passage of these laws is influenced by both domestic and international factors. This paper reviews the main international factors, drawing on a powerful new dataset of climate legislation in 66 national jurisdictions. We find that the propensity to legislate on climate change is heavily influenced by the passage of similar laws elsewhere, suggesting a strong and so far under-appreciated role for international policy diffusion. International treaties like the Kyoto Protocol work in two ways. The impact of the Kyoto Protocol itself is limited to countries with formal obligations under the treaty. In addition, the prestige of hosting an international climate summit is associated with a subsequent boost in legislation. Legislators seem to respond to the expectations of climate leadership that these events bestow on their host.

Policy relevance: A global solution to climate change will ultimately have to be anchored in domestic legislation, which creates the legal basis for countries to take action. Countries are passing climate legislation in a growing number. This paper asks to what extent they are motivated to do so by international factors, such as existing treaty obligations. We find that the Kyoto Protocol has been a less important factor in explaining climate legislation outside Annex 1 than the passage of similar laws elsewhere. This suggests that international policy diffusion plays an important and so far under-appreciated role in global climate policy, complementing formal treaty obligations.

Keywords: climate change legislation, international policy diffusion, political economy.

1. Introduction

Increasing numbers of countries are passing climate change legislation. Practically all major emitters of greenhouse gases have in place laws to control emissions, conserve energy or promote cleaner forms of energy production, while vulnerable countries are taking steps to prepare for the impacts of climate change (Nachmany et al., 2014). These laws do not add up to a global response that would limit climate change to less than 2°C of global mean warming, but they provide the context in which a new international treaty on climate change is negotiated.

The emergence of climate legislation can be explained by a combination of domestic factors, such as the energy-economic context and the interests of domestic actors, and international factors, such as treaty obligations (Falkner 2013, Never and Betz 2014). Oates and Portney (2005), Congleton (1992) and Hahn (1990) analyse domestic environmental policy and emphasise the crucial role of political institutions and national interest groups (see also Never 2012). But there is also an international dimension. Approaches to environmental policy diffuse across jurisdictions, as policy makers learn from each other and "good practice" spreads (Jordan et al 2000; Jordan and Huitema 2014). The global public good nature of climate change adds a further international dimension in that climate action is subject to international coordination (Kroll and Shogren 2008, Barrett 2007).

The objective of this paper is to identify key international factors that contribute to the emergence of climate change legislation. A parallel paper using the same data also looks at domestic factors (Fankhauser et al., 2014). We contrast the role of policy diffusion – an autonomous, bottom up process through which climate policy may spread – with the effect of formal treaties like the Kyoto Protocol, which offer a more directed approach to policy coordination.

We find statistically that both factors have a positive influence on the emergence of climate change legislation. The effect of policy diffusion is direct and simple. The propensity to pass climate legislation increases with the number of climate laws passed

elsewhere. The effect of international treaties is more complex. International commitments increase legislative action, but only in countries where the obligations bind. Treaties also offer a further incentive: the prospect of global leadership. We find that assuming a global leadership role, by hosting an international summit, can unblock domestic obstacles and lead to more climate legislation

We derive these results from a powerful new dataset, which we helped assemble over a series of climate legislation surveys (Townshend et al., 2013; Townshend et al., 2011). Our analysis is the first to use the extended 2014 version of the data. A distinct feature of the surveys is that they were conducted in close cooperation with legislators from the parliaments concerned (Nachmany et al., 2014).

The data reveal legislative action on climate change since 1990 in 66 jurisdictions – 65 nation states, plus the European Union as a block – which were chosen to cover almost 90% of global greenhouse gas emissions.[1] The surveys adopt a fairly broad interpretation of what constitutes climate change legislation, which includes "relevant laws or regulations of comparable status" (such as executive orders or five-year plans; Nachmany et al., 2014) on energy supply, energy demand, transport and land-use change as well as climate-specific measures like carbon pricing, adaptation, research and new institutions.

There are important caveats about the dataset (Fankhauser et al., 2014): it focuses on action at the national level, that is, it excludes state, province or city-level activities. There is no analysis of the quality or merit of individual laws (for example, the number of exemptions granted to affected industries), the degree to which a law is implemented or enforced, nor the eventual effect it has had.

A particular problem for our research question is that when laws are amended the database only records the latest version, thus omitting earlier activities. Legal provisions are often tightened over time (as for example Switzerland did with its *CO$_2$ Act* in 2013), but there are also cases of reversal (such as the repeal of Canada's *Kyoto Implementation Act* in 2012 and Australia's *Clean Energy Act* in 2014). Neither event is recorded in the

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[1] The data are available on: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/Legislation_Dataset.pdf

data.[2] Similarly, for the 9 EU member states in the sample the database excludes laws that merely implement EU regulations. Only those laws that go beyond EU requirements are included.

Nevertheless, the data constitutes one of the richest sources of information about climate change legislation available to date (see Dubash et al., 2013 for a survey of available data sets). The data include almost 500 climate-relevant laws that were on the statute books of the 66 jurisdictions, although our study is restricted to 419 laws passed in 63 countries before the end of 2012 (see section 4 for details).

The availability of data for over 1,400 country-years (63 countries over 23 years, 1990-2012) allows us to adopt a quantitative, statistical approach. Much of the literature on the transfer and diffusion of environmental policy is qualitative or based on smaller samples, with the European Union a frequent case study (e.g., Jordan et al., 2000, Jordan and Lenschow 2000). Never and Betz (2014) study climate policy performance in seven emerging markets, while Jordan and Huitema (2014) study policy innovation, as well as its subsequent diffusion.

As in our analysis, the main focus of these papers tends to be on policy adoption, rather than the post-adoption dynamics of laws. "Policy" is sometimes unpacked into its constituent parts (e.g., objectives and instruments) to explore whether diffusion differs between these elements. The pertinent literature identifies a broad set of driving forces, which includes international factors (such as international norms, knowledge transfer and pressure to conform), domestic drivers (such as domestic actors, institutions, interests and capacities), as well as the characteristics of the policy at hand (Bernstein and Cashore 2012; Busch et al., 2005; Kern et al., 2001).

Small-N comparative studies offer detailed descriptions of the mechanisms and processes of policy-making. However it is useful to complement their insights with quantitative

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[2] The case of countries with a general tendency to update laws (that is, generally high legislative activity) is captured statistically by the inclusion of a fixed effect (see Technical Annex). If updates are driven by the same factors as the original legislation our results might underestimate the power of these factors, but only slightly. Results would be biased if the tendency to update laws was completely uncorrelated with initial adoption, but this seems unlikely.

results from larger data sets. The econometric analysis of policy diffusion has a long tradition (Graham et al. 2012), often using event history or hazard models (e.g., Berry and Berry 1990, 1992). Krause (2011) studies the adoption of climate policies among US cities, while Matisoff and Edwards (2014) analyse the diffusion of clean energy policies across US states. Bernauer et al. (2010), Fredriksson and Gaston (2000), Sauquet (2014) and von Stein (2008) use statistical methods to analyse the interplay of international and domestic factors that explain the ratification of environmental treaties.

Our analysis is in this mould. It contributes to this body of work by providing new panel-data evidence on the international factors that explain the global adoption of climate change legislation. Understanding the international drivers behind climate change legislation is also important from a practical perspective, as it might help to unlock further climate action. However, our interest is solely in the international dynamics of how climate laws come about. We do not assess their impact, nor indeed judge whether more laws are always desirable.

The paper is structured as follows. Section 2 offers a brief qualitative description of climate change legislation and trends. Section 3 introduces the theoretical framework. Section 4 describes the methodology and main results. Section 5 discusses narrower results focused on particular country contexts (*viz.* Annex 1 vs non-Annex 1 countries, left-wing vs right-wing administrations, strong vs weak democracies). Section 6 concludes. The main paper is complemented by a technical annex with additional information about methods and data.

2. The Emergence of Climate Legislation

The basic science of climate change has been known for over a century. Yet, it became an issue of wider policy concern only in the 1990s, after the Intergovernmental Panel on Climate Change had issued its first assessment report and countries started to negotiate what would become the UN Framework Convention on Climate Change (UNFCCC). Few countries followed up their (soft) commitments under the 1992 UNFCCC with domestic legislation. The first law that explicitly features climate change in its title is Japan's *Law Concerning the Promotion of the Measures to Cope with Global Warming* of

1998. There were many efforts to protect forests and conserve energy already at that time, but they were motivated by policy concerns other than climate change.

Figure 1 shows the emergence of climate change laws in the 66 jurisdictions studied by Nachmany et al. (2014). There is a steady increase starting in the late 1990s. At the time of the Kyoto Protocol, in 1997 there were still fewer than 40 relevant laws. By the end of 2013 this had grown to almost 500, following a burst of legislative activity in particular around 2009 and 2010.

Figure 1. Climate change legislation over time
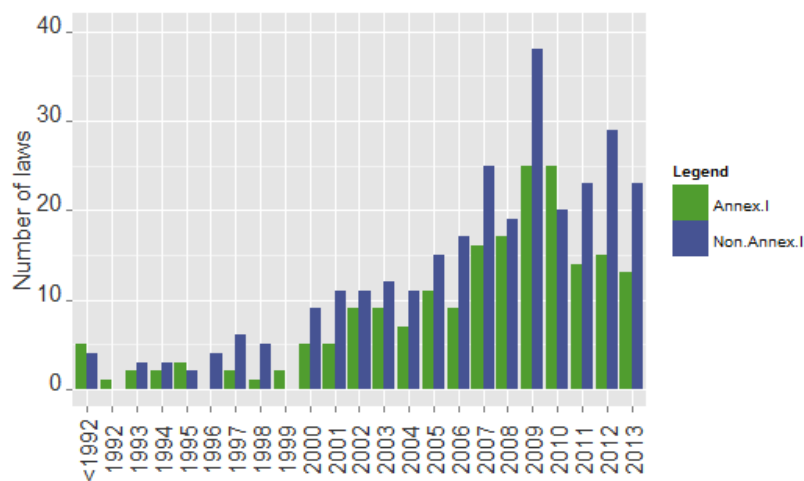
Note: Annex I and non-Annex I as defined in the UN Framework Convention on Climate Change.
Source: Nachmany et al.(2014)

Townshend et al. (2013) observe a change in the nature of climate legislation after 2009/10. Most Annex 1 countries had by that date introduced fairly comprehensive climate laws and subsequent legislation was aimed primarily at the implementation of earlier commitments. For example, in the UK the *Climate Change Act* of 2008 was followed by the *Energy Act* of 2013, which adjusts electricity market arrangements in light of the previously agreed carbon targets. As Annex 1 legislation matured, the momentum shifted to Non-Annex 1 countries, where new laws are still being added to a relatively small stock.

While there are climate change laws addressing all aspects of the problem, the focus is on energy. Almost half of the laws in the database deal with energy supply issues (such as renewable energy), and nearly 40% are concerned at least in part with energy demand (mostly energy efficiency). In Germany, for example, climate policy is driven in no small part by the *Renewable Energy Sources Act* of 2008, which sets the basis for the "Energiewende".

In tropical forest countries, a new suite of legislation has emerged which recognises the importance of sustainable forest management to both mitigation and adaptation. In 2013 Indonesia has been particularly active, issuing a Decree to create a new management agency for REDD+ (*Decree 62/2013*); a Presidential Instruction that created a moratorium on new logging concessions (*Inpres 6/2013* following *Inpres 10/2011*); and also regulations on REDD+ demonstration activities (*P68/Menhut-II/2008*).

In most countries there is also what Townshend et al. (2013) call a "flagship" law – a wide-ranging piece of legislation that fundamentally defines a country's approach to climate change, often setting emissions targets or unifying earlier policies under one umbrella. Good examples are Mexico's *General Law on Climate Change,* passed in 2012, and the French *Grenelle* laws of 2009 and 2010.

3. Theoretical Framework

Econometric techniques can shed further light on the dynamics of climate change legislation described qualitatively above. Our particular interest is in international factors that may have driven the adoption of climate change legislation. In particular, we are interested in two different, but complementary processes.

On the one hand we are interested in policy diffusion as a decentralised, bottom-up process through which climate policy spreads across jurisdictions. On the other hand, there are formal international treaties like the Kyoto Protocol, which offer a more directed, centralised approach to policy coordination. We also seek to unpack the channels through which an international treaty may influence domestic legislation. The most obvious way is through binding commitments, but there may be other incentives. In

particular, Townshend et al. (2011) speculate that the prospect of global leadership under a treaty can change the domestic debate about climate legislation. This gives rise to the following three hypotheses:

Hypothesis 1. *Policy diffusion through learning and other spill-over effects matters and dominates the incentive of countries to free ride. That is, domestic climate legislation is positively correlated with the number of laws already adopted by other countries.*

International policy diffusion takes place "when government policy decisions in a given country are systematically conditioned by prior policy choices made in other countries" (Simmons et al. 2006). In the context of climate policy, econometric studies of diffusion include Bernauer et al. (2010) and Sauquet (2014), who analyses countries' ratification behaviour of environmental treaties. Sauquet (2014) identifies two counteracting effects. On the one hand, action taken by other countries can encourage free-riding. If the problem is addressed by others, countries may feel less of a need to act themselves. On the other hand, policy experience is known to diffuse across countries through knowledge spill-overs, learning effects and peer pressure (Bernstein and Cashore 2012; Busch et al., 2005; Kern et al., 2001). If policy diffusion occurs, the climate action a country undertakes is likely to depend on prior climate legislation by other countries. We therefore test the power of policy diffusion by regressing climate legislation against the number of laws passed in all other countries in the sample.

Hypothesis 2. *Binding obligations under an international treaty are likely to boost the passage of climate change laws. That is, we expect to see an increase in climate legislation after the Kyoto Protocol was signed, at least in Annex 1 countries.*

International treaties like the Kyoto Protocol impose commitments that may need to be implemented through new domestic legislation. Although the sanctions for non-compliance tend to be soft (Barrett 2007), countries face reputational risks if they renege on their international pledges. We test this hypothesis on the Kyoto Protocol and explore whether the passage of climate laws increased in the years after the treaty was signed. We consider the year of signature, rather than ratification, to avoid a potential

endogeneity bias[3]. We do not consider participation in the UNFCCC, since every country in the sample signed it in 1992 so there is not much variation in the data.

Hypothesis 3. *The leadership expectations associated with hosting a climate summit can change the domestic debate in favour of climate legislation. That is, we expect climate legislation to increase after a country hosts the annual Conference of the Parties (COP).*

Governments willing to pass climate change legislation will face opposition from vested interests. The influence of veto players on environmental policy making is a standard feature of political economy models (e.g. Fredriksson et al., 2007; von Stein 2008). Hosting a high-profile international meeting thrusts the host nation into a position of international leadership. It has been argued that this may overcome internal resistance and motivate subsequent climate legislation (Townshend et al., 2011). Lockwood (2013) observes for example how the prominence given to climate change at the G8 Summit in Gleneagles in 2005 contributed to a "groundswell of public interest and concern" in the UK that led to the 2008 *Climate Change Act*. We test the hypothesis by focusing on a different, more regular kind of summit, the annual conference of the parties to the UNFCCC.

4. Methodology and Main Results

The 2014 version of the climate legislation survey (Nachmany et al., 2014) covers legislation activity in 66 jurisdictions between 1990 and 2013. However, we had to exclude three jurisdictions (the EU, Micronesia and the Maldives) as well as laws passed in 2013, as data were not available for all the variables of interest.

Using the remaining up to 1,449 data points (63 countries times 23 years, 1990-2012), we test our hypotheses by estimating different versions of the following equation:

$$y_{it} = a + bI_{it} + gX_{it} + q_i + n_t + e_{it} \quad (1)$$

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[3] The literature on the drivers of Kyoto ratification (Neumayer, 2002; Fredriksson et al. 2007; Von Stein, 2008; Sauquet, 2014) finds that ratification behavior is correlated with domestic legislation activity.

In the main specification y_{it} represents the total number of climate laws adopted in country i at year t, although we also run regressions for particular types of laws (e.g. energy supply laws). The vector $\boldsymbol{I}_{it}$ indicates the international factors of interest, while vector $\boldsymbol{X}_{it}$ contains domestic control variables, such as the level of democracy and GDP per capita (see Technical Annex). We also include a full set of country and year fixed effects (which pick up country-specific features and evolving global factors such as an increased scientific consensus) and a random error term. The international variables of interest are:

- *Diffusion*: number of climate laws (of each type) adopted by all other countries until time t-1.

- *Kyoto*: lagged dummy for the 4 years after the Kyoto Protocol (1998-2001).

- *Host*: hosting a COP, dummy for the year of the meeting and subsequent two years.

We estimate equation (1) using a negative binomial fixed effects model where the log of the expected count is a function of the predictor variables. The count model is suitable since we are dealing with a count dependent variable characterized by over-dispersion (i.e. the mean is lower than the variance) and events (e.g. law adoptions) that a country can experience more than once (Allison and Waterman 2002; Cameron and Trivedi 1998, 2010). These features prevent the use of hazard models, which have been employed to study policy adoption elsewhere (e.g., Berry and Berry 1990, 1992). The negative binomial is also best suited to deal with the large number of zero entries (i.e. country-years without legislative action), which represent about 80 per cent of all observations.

Table 1 reports the results based on the full sample of ca. 1,400 country-years. For the main results (column 1) the dependent variable is the total number of climate laws. Columns (2) to (8) display the same calculations for specific types of legislation. That is, they only count laws dealing with energy supply, energy demand, new climate

institutions, adaptation, transportation, low-carbon research and development or deforestation (REDD).[4]

We find strong evidence of policy diffusion. Countries are encouraged to pass climate legislation by the legislative activities of other countries. Diffusion clearly dominates any temptation to free-ride. Consistent with hypothesis 1, the stock of laws adopted previously by all other nations is a very powerful predictor of additional legislative activity.

In contrast, the observed impact of the Kyoto Protocol is unexpected. The post-Kyoto period of 1998 to 2001 was characterized by lower legislative activity than normal across the full sample of countries. This counter-intuitive result is inconsistent with hypothesis 2 and will require further exploration. As we will see below, it could be due to the fact that Kyoto imposed commitments only on a small number of countries or because the Kyoto effect takes longer to materialise.

Table 1. Analysis of the Number of Laws Passed (years: 1990-2010). Model: Negative Binomial Fixed Effects.

VARIABLES	(1) All_laws	(2) Energy_Supply	(3) Energy_Demand	(4) Institutions	(5) Adaptation	(6) Transportation	(7) R&D	(8) REDD
Diffusion	0.159***	0.578***	0.518***	0.582***	2.804***	1.680***	1.463***	1.148**
	(0.061)	(0.136)	(0.182)	(0.126)	(0.550)	(0.282)	(0.343)	(0.483)
Host	0.680***	0.301	0.841**	0.433	1.270	1.533**	1.238*	1.803***
	(0.237)	(0.236)	(0.420)	(0.324)	(1.087)	(0.595)	(0.689)	(0.550)
Kyoto	-5.601*	-7.301***	8.433***	-3.656	0.054	-12.393***	-12.598***	-2.469
	(3.250)	(2.416)	(2.988)	(4.050)	(3.239)	(3.351)	(2.918)	(7.624)
Other controls	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383

Clustered standard errors at the country level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Consistent with hypothesis 3, the international negotiations appear to have a galvanising effect on the countries that host the annual conference of the parties. While this establishes correlation, we cannot completely preclude a reverse causality. The UNFCCC

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[4] Note that many laws address more than one issue and therefore feature in several of the narrower specifications. For example, renewable energy, energy efficiency and carbon pricing may all be addressed in the same law.

might prefer host countries with legislation in the pipeline and/or countries might volunteer to host a COP to showcase their domestic achievements. To test this alternative, we ran the model with an additional dummy for the two years before a COP. We do not find a significant effect for the new variable, which lends support to the original hypothesis. The hypothesis is supported by anecdotal evidence. Officials from host countries often emphasise how hosting the COP changed political dynamics and facilitated the passage of legislation (Townshend et al., 2013; Nachmany et al., 2014). Japan and Mexico are prominent countries which passed major climate change laws within a few years of hosting a COP.

The results for specific types of climate legislation (columns 2-8) are broadly similar. Policy diffusion and hosting a COP are strongly associated with additional climate legislation in all regressions. However, a note of caution is required in interpreting the results in columns (2)-(8): given the smaller number of non-zero observations when considering specific types of law, the evidence becomes less robust that the analysis of all climate laws in column (1).

5. Evidence Related to Particular Country Contexts

We then repeat the same analysis for a series of restricted data sets. This can shed light on legislative dynamics in particular political contexts or for particular groups of countries. Table 2 reports on six such regressions. In smaller datasets the number of zero observations (that is country-years without legal activity) becomes more pertinent statistically. To maintain a sufficient number of non-zero observations, the restricted sample estimations are carried out only for the total number of climate laws.

In the first set of regressions (columns 1 and 2) we explore whether different dynamics are at play depending on the political orientation of the government (which in turn is a reflection of voter preferences, Lee et al. 2004). To do so, we split the sample into periods of left-wing and right-wing administrations. Left-wing governments are less frequent; that sample is considerably smaller, and the results correspondingly weaker.

Table 2. Analysis of the Number of Laws Passed (years: 1990-2010). Model: Negative Binomial Fixed Effects

VARIABLES	Political orientation of the executive		Status under the UNFCCC		Quality of democracy	
	(1) Left-wing	(2) Right-wing	(3) Annex 1	(4) Non-Annex 1	(5) High	(6) Low
Diffusion	0.185***	0.180**	0.190***	0.142	0.115***	0.812***
	(0.047)	(0.082)	(0.059)	(0.093)	(0.043)	(0.190)
Host	0.124	0.642*	0.815*	0.590*	0.597**	0.150
	(0.636)	(0.349)	(0.444)	(0.308)	(0.251)	(0.755)
Kyoto	5.032*	-7.254*	4.673	-5.137	9.540***	-38.369***
	(2.591)	(4.194)	(3.237)	(4.733)	(2.219)	(9.637)
Other controls	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Obs.	471	912	418	967	762	645

Clustered standard errors at the country level in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

(a)   We were unable to account for the business cycle and the level of GDP, as the negative binomial model failed to converge when including these variables.

There is evidence that left-wing governments are more inclined to pass environmental legislation (Neumayer 2003), although the link between party politics and environmental policy can be complex (Folke 2014). Table 2 suggests that there are also differences in the way right-wing and left-wing governments are influenced by international factors. Policy diffusion is strong under both types of government. However, each responds differently to international treaties. Under right-wing governments the galvanising effect of hosting an international summit is much stronger, while left-wing governments are more likely to follow up on international commitments. Left-wing governments were more inclined to pass climate legislation in the aftermath of Kyoto, while the opposite happened under right-wing governments.

Columns 3 and 4 report separate results for Annex 1 and non-Annex 1 countries. The results on policy diffusion and hosting a COP are broadly consistent with the main findings, although policy diffusion in non-Annex 1 countries is no longer statistically significant. We assign this to the diverse nature of the non-Annex 1 grouping. This makes it more difficult to capture diffusion effects, which are strongest among countries with similar histories and backgrounds.

Perhaps of more interest is the difference in sign for the Kyoto dummy. For Annex I countries the coefficient is positive (although not statistically significant, probably due to the small number of observations), while it is negative outside Annex 1. This suggests that the low level of climate legislation following Kyoto that we observed in the full sample (Table 1) is due to the trend in non-Annex I countries, which represent 70 per cent of our sample. For Annex 1 countries, which have binding obligations under Kyoto, the Protocol has led to the expected increase in legislative activity.

To further test this hypothesis we perform a t-test to compare the average number of laws passed in different time periods (Table 3) . We find statistically higher legislation activity in Annex I countries after 2001, that is, a few years after the protocol was signed in December 1997 and the ratification wave began. The difference persists until 2009, a year after the Kyoto compliance period began. After that point the effect levels off, perhaps because climate action is increasingly expected from all countries.

Table 3. T-test of the difference in legislation activity between Annex I and Non-Annex I countries in different time periods (average laws per country and year).

	Number of Laws Passed Non-Annex I	Number of Laws Passed Annex I	Mean Difference	P-value
Period: 1990-1993	0.039	0.039	0	0.991
Period: 1994-1997	0.096	0.065	0.030	0.487
Period: 1998-2001	0.119	0.197	-0.078	0.138
Period: 2002-2005	0.238	0.434	-0.195	0.020
Period: 2006-2009	0.5	0.868	-0.368	0.005
Period: 2010-2012	0.681	0.561	0.120	0.401

The last two regressions (columns 5 and 6) split the sample into countries with more or less advanced democracies (where the latter are defined as having a Polity2 score of less than 8, Fankhauser et al., 2014). The two sub-samples are more balanced than for the other split regressions, with a similar number of observations in each. The most striking result is the significant increase in climate legislation after Kyoto among advanced democracies. The opposite holds for less democratic regimes. The former grouping

includes the majority of Annex 1 countries, but it is also possible that advanced democracies are more concerned about reputation effects. This is consistent with Neumayer (2002), who found that democracies exhibit a stronger international environmental commitment.

The host country effect is positive only for advanced democracies, but since 17 out of 19 COP meetings until 2013 have taken place in advanced democracies, the absence of an effect in weaker democracies is not surprising. As before, we find evidence of a diffusion effect in both sub-samples.

6. Conclusions

Despite slow progress in the international negotiations, governments around the world have started to legislate on climate change. They enact provisions not just to prepare for the impacts of a changing climate (where there are clear domestic incentives to act) but also to reduce greenhouse gas emissions (where there might have been temptation to await a new global treaty). A key concern of legislators is the cleaner production and more efficient use of energy, but climate laws also cover transport, agriculture, forestry and a host of other activities.

Many laws are couched in terms of domestic objectives like green growth, energy security or air pollution, rather than climate change *per se.* For example, South Korea's main climate law is the 2009 *Framework Act on Low Carbon Green Growth.* In the US, the main legislative (as opposed to regulatory) response at the federal level is the 2009 *American Recovery and Reinvestment Act,* which promoted low-carbon investment as a way to stimulate an ailing economy. Yet countries like Germany, France, Mexico, New Zealand, Switzerland and the UK have all passed laws that are explicitly aimed at climate change, establishing new policies, processes and institutions (such as independent agencies and oversight bodies) to deal with the problem.

This paper analyses the international driving forces behind the adoption of such legislation, using a powerful data set of climate legislation since 1990. The paper is not interested in the detailed workings or the technical content of these laws, although this is

clearly an important area of research and policy practice. Our interest is how international drivers may have contributed to the passage of the laws. We contrast the autonomous process of policy diffusion across countries with the more formal incentives provided by international treaties.

The debate so far, both practical and theoretical, has focused heavily on the importance of international treaties. We find some evidence of a commitment effect arising from the Kyoto Protocol, but only in countries with binding treaty obligations. . Legislative activity in Annex 1 countries has been significantly higher than in non-Annex 1 countries in the years following Kyoto, but there is no evidence that the Kyoto Protocol has increased overall legislative activities across all countries. This points to the need for a more comprehensive treaty that binds in all major emitters.

International treaties also have another effect. Hosting a climate summit – which catapults the host into a position of environmental leadership – is associated with additional domestic legislation in subsequent years. It appears that international media presence and pressure to lead by example can change the domestic discourse and push climate change up the political agenda. The effect is very strong statistically, and as such important, but it is of less significance in terms of the global number of laws, given the relatively small number of countries that have hosted a summit.

In contrast, we find clear evidence of the power of international policy diffusion. The propensity to legislate is heavily influenced by the passage of climate change laws elsewhere. The effect is significant and positive for all types of climate legislation and in all the country groupings we analyse. This diffusion mechanism, which is at work outside the formal architecture of the UNFCCC, has perhaps been under-appreciated so far, although the debate is increasingly about more diverse forms of global governance (Stavins and Ji, 2014).

More work is needed to unpack and understand this diffusion effect. For example, our analysis does not tell us whether the process works through peer pressure or intergovernmental learning, although the literature is beginning to shed light on this question (e.g., Jordan and Huitema, 2014). It would also be fruitful to differentiate further

between different peer groups and address questions of country interdependency (sometimes referred to as Galton's problem, Braun and Gilardi, 2006). We measure the diffusion effect by the number of laws passed in all other countries, but it is reasonable to assume that it will differ depending on the cultural and economic ties between countries. This may be worth exploring further (see also Sauquet, 2014).

It is worth recalling that we do not assess the quality of laws or progress in their implementation. Our approach is purely enumerative, based on the number of laws that have been passed, and of course more laws do not necessarily equate to stronger climate policy. Individual laws will differ in their ambition (e.g. their carbon targets), stringency (e.g. the number of exemptions) and scope (e.g. sector coverage) as well as in and the degree to which they are implemented.. The number of laws also depends on legislative strategy, in terms of what is deemed to require primary legislation and what is left to policies and regulation. For example, Indonesia has no fewer than 27 climate laws, while China's climate provisions are concentrated in a few powerful legal acts, including the *12th Five-year Plan* of 2011.

Nevertheless, we believe our results put the spotlight on an important set of international drivers that is wider than just the commitment effect of global treaties. While a new climate treaty is essential, our results caution against focusing exclusively on formal international commitments as the sole solution to the climate problem. Climate change is a global collective action problem that requires international coordination. However, it appears that legislative action at the country level could be equally important in creating momentum through the international diffusion of policy, and that this might be a possible route to unlock the stalemate in the international negotiations.

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Technical Annex

We use a negative binomial fixed effects model to estimate different versions of the following equation:

$$y_{it} = \alpha + \beta \mathbf{I}_{it} + \gamma \mathbf{X}_{it} + \theta_i + \nu_t + \varepsilon_{it} \qquad (1)$$

Where y_{it} represents the number of climate laws adopted in country i at year t. The vector $\mathbf{I}_{it}$ indicates the international factors of interest (discussed in the main text), while vector $\mathbf{X}_{it}$ contains control variables. We also include a full set of country and year fixed effects (and a random error term). The vector of controls includes the following economic and political economy variables (see Fankhauser et al., 2014 for further detail):

- The presence of a flagship law, which sets the basis of subsequent legislative activity.

- GDP per capita as an indicator of the socio-economic context, taken from the IMF's statistics database.

- The cyclical component of GDP as a measure of the business cycle, computed through a Hodrick-Prescott filter (Doda 2014).

- Political institutions variables from Beck et al. (2001, updated in 2012), including dummies for presidential systems, for the political orientation of the executive and for the electoral cycle (year of election and year before an election).

- Democracy variables from the Polity IV dataset, including the strength of democracy (using the polity2 index) and constraints on the executive (i.e. whether the party of the executive has an absolute majority in the legislative).

As a robustness check we also estimate the model using logit fixed effects, which measures the (binary) probability of passing at least one law in a particular country and year. That is, rather than counting the number of laws passed each year, the dependent variable is binary, taking a value of 1 if at least one law was passed in a country-year and 0 otherwise. The results are broadly consistent and therefore not reported here.

Another alternative specification concerns the use of fixed effects. The main model includes separate country and year fixed effects. One might be concerned that under this structure the policy diffusion variable could capture no more than a general increase in adoption (or in any unobservable correlated with adoption). To explore this issue we experiment with an alternative to equation (1), which also includes a country-specific linear time trend. The additional variable accounts for any unobservable changes over time at the country level. The drawback of this model is that it is less likely to converge for runs that are limited to particular kinds of laws (i.e. those related to energy, transportation, adaptation, etc.). However, for the total number of laws it delivers results very similar to the ones obtained from the main specification.