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International Climate Agreements, Cost Reductions and Convergence of Partisan Politics

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Abstract

In recent years, differences between traditional and green parties have been leveled with respect to climate protection. We show that this partial convergence in party platforms can be explained by international climate agreements, effectively reducing greenhouse gas emissions. We set up a voting model in which political parties differ in their preferences for climate protection and in which (national) climate protection causes both resource costs and distortions in the international allocation of production. International agreements, which reduce greenhouse gas emissions, decrease effective abatement costs. This affects traditional parties in a different way than green parties, since a lower preference for climate protection implies a higher price (cost) elasticity of demand. Thus, climate agreements can lead to more political consensus within countries, even if politicians are partisans. We also point out that increasing flexibility and efficiency in abatement mechanisms is preferable to forming a climate coalition that focuses directly on emission reduction commitments.

JEL-Code: Q540, H410, D720.

Keywords: climate protection, political economy, green parties, platform convergence.

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1 Introduction

There is a puzzle in the dynamics of European politics, in particular in environmental and climate policy: On the one hand, a partial convergence in European politics and party platforms can be observed in the last two decades, being especially the case for climate policy. Green parties had first been located to the (very) left in the political system after having emerged in the late 1970s. Their unique selling property has been environmental policy by putting environmental issues on the political agenda and by calling for a significantly larger level of environmental (climate) protection than all other parties. Nowadays, all other parties put climate policy on their agenda, and green parties are perceived to be moving towards the center ground. A salient example for such a convergence is Germany, revealing a striking continuity in anti-climate change action, though there have been several 'ideological' changes in government. In fact, all governments have not only continued the inherited policy, but also fostered efforts in reducing greenhouse gas emissions (e.g., Blum and Schubert, 2009). The leveling in German climate policy became most prominent when conservative Angela Merkel was celebrated as 'climate chancellor' at the G-8 meeting in Heiligendamm in 2007.[1]

On the other hand, according to recent empirical studies, there should be no convergence in party platforms or in policies at all (as long as preferences are stable over time). These findings strongly support the 'partisan theory' of ideological politicians, which contradicts any form of the 'Downsian paradigm' and implies that considerations of being elected do not matter. Relying on data for the U.S. House, Lee et al. (2004) for example convincingly show that representatives' roll-call voting behavior mirrors their own (ideological) preferences, but not the likelihood of being (re-) elected. Thus, voters only elect a policy, but neither affect party platforms nor behavior of politicians.

The observations above seem to exclude each other. Is it still possible to explain the dynamic convergence in climate policy among ideological parties (i.e., among 'partisan' politicians)? Continuatively, must green parties fear such a potential loss of their unique selling property?

Applying ideological parties, this paper points out that the observed convergence in climate policies over time may be explained by international agreements, both reducing greenhouse gas emissions and decreasing effective abatement costs. 'Green' parties lose their unique green policy position, the more these agreements allow for flexibility and cost reduction, since 'non-green' parties will react more elastically in their ideological party platforms. Thereby, the driving force – namely, reductions in policy implementation costs affecting party platforms asymmetrically – could also be applied to other policy fields. This is a novel contribution to the literature. So far, papers on (dynamic) policy convergence have focused on fiscal and welfare policy in a left-wing/right-wing setting (see, e.g., Tavares, 2004; Lee et al., 2004; Mechtel and Potrafke, 2009; Potrafke, 2010, 2011a; Jensen, 2011). We are – to the best of our knowledge –

[1] Another example is Great Britain, where Prime Minister David Cameron turned the Conservative Party more 'greenish' in the election campaign of 2010.

the first, who examine partial convergence both by endogenizing policy implementation costs and by focusing on environmental policy (and green parties), being a well-suited example.[2] We add a new explanatory channel to the literature on (dynamic) policy convergence of ideological parties over time, focused so far on repeated games and two-level bargaining.

Alesina (1988) analyzes a voting model with two ideological parties, which not only value being elected, but also have preferences on the implemented policies. He points out that neither in one-shot games nor in finitely repeated games any policy convergence will emerge as long as parties cannot be committed to their announcements in the electoral campaign. After being elected, they will always implement their optimal policy.[3] However, in an infinitely repeated election game, parties can coordinate and improve their utility by policy smoothing. To this end, they have to choose identical platforms and policies (and to share offices). Reputational losses (i.e., a loss in credibility) and a return to a one-shot solution (i.e., a trigger strategy), in case of a one-time deviation once from the announced policies, can sustain full convergence in a time-consistent way, if the discount factors for both parties are sufficiently high (i.e., if they are sufficiently far-sighted). By an analogous argument, repeated interaction between two parties can reduce macroeconomic fluctuations in a political business cycle, see Alesina (1987).

Dorussen and Nanou (2006) pick up the approach of two-level games with national veto-players (e.g., Putnam, 1988) and refer to the thesis that policy convergence on the domestic level restricts the government in the international bargaining, improving its bargaining power. The authors extend this idea by arguing that domestic parties strategically converge to a joint policy in order to improve the outcome on the supra-national level. Using the process of European integration as an example, they provide some empirical evidence for their conclusions.

Alesina (1987, 1988) provides a rather static explanation, which cannot really explain the change in platforms (on climate policy) over the last 20 years. Dorussen and Nanou (2006) provide a convincing argument for EU integration, but their results imply that extreme parties even divert and become more radical. This is not what we observe in environmental issues, at least not in European countries. More important, none of the two explanations matches the empirical results in Lee et al. (2004) of purely ideological, partisan politicians. Based on Besley and Case (2003), Lee et al. explain their findings with the lack of credible commitment devices for keeping the election campaign promise by a partisan politician to deviate from its ex-post most preferred policy. Using Swedish data, Dahlberg et al. (2011) back this claim.

[2]There are related papers on environmental policy and political economy. Cremer et al. (2008) analyze political competition in environmental policy, when the concept of 'Party Unanimity Nash Equilibrium' is applied, explaining why two ideological parties still can offer the same low standard in environmental protection and pointing out why it is important to generate support for environmental policies through political compromise. Buchholz et al. (2005) examine international environmental agreements, but focus on strategic voting and the negotiation process, applying a very different approach than we do. Neither paper has endogenized the effective costs of climate protection.

[3]If there is full commitment and if the value of being elected is sufficiently large, the parties will meet at the median voter preference as in the standard model by Downs (1957). See, e.g., Wittman (1977, 1983), Calvert (1985), Persson and Tabellini (2000). However, this is neither convergence in a stricter dynamic sense nor does the result hold if the number of parties increases (e.g., Palfrey, 1984)

Analyzing the example of international climate protection, our findings imply that policies can partially converge because of a decrease in effective abatement costs, even if parties behave like partisans. If climate protection becomes less costly in terms of private consumption and firms' profits, traditional parties (e.g., conservative and social-democratic parties)[4] react more elastically than green parties on these cost reductions and the difference in their most preferred platforms shrinks. Indeed, international agreements such as the Kyoto-Protocol have significantly decreased abatement costs in the last 15 years, by establishing emission trading systems (ETS), installing a Clean Development Mechanism (CDM) and allowing for emission allowances from activities of 'avoided deforestation' (REDD).[5] Therefore, we provide an additional and relevant channel, which can explain the (partial) convergence of environmental party platforms across all types of parties over time, showing the importance of climate change for the political system.

In a one-dimensional voting setting, green parties do not need to fear this development, but this may change if the model is extended to a multi-dimensional approach. Indeed, strategic concerns in policy behavior might explain the failure of the post-Kyoto conference in The Hague in 2000 and the position of the German green party in the debate on the nuclear phaseout. Furthermore, applying our results to an international setting, it follows that investments into and coordination of efficient and flexible abatement mechanisms are preferable as first steps to spending resources on negotiations on more stringent emission reduction commitments.

To derive our results, we set-up a model with $n+1$ countries, in which producing a private good causes greenhouse gas (CO_2) emissions. National governments regulate emissions and, by fulfilling these regulations, costs for price-taking firms are caused, harming their international competitiveness as well as reducing their profits. Households consume the private good and suffer from global emissions ('global warming'), but differ in their preference for climate protection. Ideological parties offer a party platform in each country, defining a level of national climate protection. This model allows to analyze what happens, if some countries form a climate coalition, which either agrees on implementing efficient abatement mechanisms, decreasing resource costs of carbon abatement, or on a common level of emission reduction. Thereby, we focus on effects on party platforms and neglect government action, which can be driven by compromises in governing coalitions.

In order to focus on the political economy aspects, party platforms on a national level and the effect of endogenously decreasing abatement costs, we deliberately decided to suppress other important topics. These are the interplay between income redistribution and optimal climate policies in a normative setting (Jacobs and van der Ploeg, 2010); the free-riding problem in forming climate agreements (though we implicitly allow for free-riding in national party

[4]By our definition, traditional parties are primarily interested in private consumption, firms' profits and economic growth and value climate protection less than green parties.

[5]See, e.g., Brandt and Svendsen (2002); Bréchet and Lussis (2006); Anger and Sathaye (2008).

platforms), see, e.g., Carraro and Siniscalco (1998) and Barrett (2005); green paradoxes (e.g., Sinn, 2008; van der Ploeg and Withagen, 2010). Indeed, redistributional concerns might even foster our effect of decreasing abatement costs. Neglecting green paradoxes can be defended by the fact that for climate protection in general, it is more important to offset the effect of green house gases than to avoid them. Offsetting could also be done by improved reafforestation (and avoided deforestation of rain forests) or by separating and storing green house gases (e.g., by carbon-dioxide-capture-and-storage technologies in coal-fired power plants).

The remainder of this paper is structured as follows. Section 2 introduces the model. Then, section 3 discusses the effect of international agreements on the party platforms of national parties. An application of the approach to international negotiations on climate protection is provided in section 4. The paper ends with conclusions in section 5.

2 The Model

We assume a world, which consists of $n+1$ countries, each inhabited by a continuum of households. All households consume an aggregate private good x. Production of this good causes an additive atmosphere externality (Meade, 1952), which we will interpret as CO_2-emissions, causing global warming. Therefore, households suffer from global emissions E, and governments have an incentive to implement national emission reductions G_i. However, this regulation will affect firms' production costs and might suffer from carbon leakage.

Firms All firms are price takers and the world market price for the consumption good x is denoted by p. There is one representative firm per country i, supplying $x_i(p)$ units to the world market and having pure production costs $c(x_i)$.

The government in country i regulates national emissions of CO_2 by enforcing a national carbon abatement of G_i units. Firms must incur resource costs p_G per unit of G_i and fulfilling the climate protection regulation becomes more difficult (costly) the higher the production level is. We capture this by assuming carbon abatement costs to be proportional to production. Hence, the firm in country i faces total abatement costs $c_i^E = p_G \cdot G_i \cdot x_i$. From the point of view of a firm, the unit costs $p_G = p_G(z)$ are exogenous; however, their level depends on the abatement measures z, being implemented by the governments in international agreements.[6]

Profit of firm i is given by

$$\pi_i = p \cdot x_i - c(x_i) - c^E(G_i, x_i) = p \cdot x_i - \frac{x_i^2}{2} - p_G \cdot G_i \cdot x_i. \tag{1}$$

To simplify the analysis without affecting the main results, we assume convex pure production costs $c(x_i) = \frac{c}{2}x_i^2$, and to save notation without loss of generality, we normalize the cost parameter to one, that is $c = 1$.

[6]In order to save notation, we will drop the argument z, whenever this does not cause confusion.

Maximizing profits implies price equal to marginal costs so that optimal production x_i^s in country i is given by

$$x_i^s = p - p_G \cdot G_i, \tag{2}$$

resulting in maximum profits

$$\pi_i^* = \frac{(p - p_G \cdot G_i)^2}{2} = \frac{(x_i^s)^2}{2}. \tag{3}$$

This approach neglects any positive effect of climate protection on production, i.e., innovations and growth in 'green' industries. However, it is straightforward to show that incorporating such spillover effects will even strengthen the results in this paper.

Households Population size in each country i is normalized to one and national households only differ in their preference for climate protection. We assume the utility function of a household h in country i to be

$$u_i = x_i^d - \alpha_{ih} \cdot v_i(E), \tag{4}$$

where x_i^d represents utility from consumption and where $\alpha_{ih} \cdot v_i(E)$ is the disutility derived from global warming and climate change. In this model, global warming is measured by global emissions E. Assuming an increasing marginal disutility from global warming, we have $v_i' > 0$, $v_i'' > 0$. α_{ih} is the perception factor for climate change of household h in country i. The larger is α_{ih} the more household h in country i profits from a CO_2-reduction.

As climate protection by reducing CO_2-emissions is a global public good (or a positive atmosphere externality in the sense of Meade, 1952), the total level of emission E, consumed by households in any country, decreases in all national carbon abatement G_i $\forall$ i. Accordingly, global emissions are given by a function $E = E(G_1, ..., G_{n+1})$, which decreases in any national emission reduction G_i, but at a non-increasing rate. Hence, we have $\frac{\partial E}{\partial G_i} < 0$ and $\frac{\partial^2 E}{\partial G_i^2} \geq 0$. $\frac{\partial E}{\partial G_i}$ measures the effectiveness of (national) CO_2 abatement and not assuming a one-to-one relationship between (claimed) abatement G_i and reduction in global emissions implicitly allows for some 'ineffectiveness' (e.g., due to carbon leakage or a 'green paradox'). Additionally, we assume that a common level of national CO_2 abatement leads to the same reduction in global emissions, viz., $\frac{\partial E}{\partial G_i} = \frac{\partial E}{\partial G_j}$ if $G_i = G_j$. This is sensible in our model since an equal abatement level $G_i = G_j$ implies the same level of production of the private good (i.e., $x_i^s = x_j^s$ from equation (2)) as well as an equal total abatement input $p_G \cdot G_i \cdot x_i^s = p_G \cdot G_j \cdot x_j^s$. Finally, we impose that global emission abatement by a given national emission reduction G_i is independent of the effort in other countries; that is $\frac{\partial^2 E}{\partial G_i \partial G_j} = 0$.

Furthermore, we will assume that $K = 1 + k$ countries can form a climate coalition, which agrees on collective action and which implements the same level of national CO_2 reductions G^c in all member countries. The remaining $n - k$ countries choose their carbon abatement effort independently. Accordingly, worldwide emissions are given by

$$E = E((1+k)\cdot G^c, G_{k+2}, ..., G_{n+1}). \tag{5}$$

The fully non-cooperative case results for $k = 0$ and $G^c = G_1$.[7]

A household in country i is equipped with exogenous income M_i and earns a share in firm's profit π_i^*. Since population size is normalized to one and the price of the private good is given by p, this implies an aggregate demand function for good x in country i according to

$$x_i^d = \frac{M_i + \pi_i^*}{p}. \tag{6}$$

Market Equilibrium The world market equilibrium for the consumption good is determined by equality of aggregate demand and aggregate supply, i.e.,

$$\sum_i x_i^d = \sum_i \frac{M_i + \pi_i^*}{p} = \sum_i x_i^s. \tag{7}$$

Multiplying by p, substituting equation (3) for national profits π_i^* and equation (2) for national supply x_i^s, and rearranging terms, leads to the market clearing condition

$$\begin{aligned} \sum_i M_i + \frac{1+k}{2}(p - p_G G^c)^2 + \frac{1}{2}\sum_{j=k+1}^{n}(p - p_G G_j)^2 & \\ -(1+k)p(p - p_G G^c) - p\sum_{j=k+1}^{n}(p - p_G G_j) &= 0. \end{aligned} \tag{8}$$

Equation (8) implicitly determines the world market price $p = p(p_G, G^c, G_{k+1}, ..., G_n, k)$ as a function of marginal abatement costs p_G, of the levels of national carbon abatement G^c and G_j and of the number of members in the climate coalition $K = 1+k$. Totally differentiating (8) exhibits the marginal effects of abatement costs p_G, of the abatement effort G^c and of the number of coalition members K on the equilibrium price p,

$$(n+1)p\cdot dp = \left[(1+k)(G^c)^2 + \sum_{j=k+1}^{n} G_j^2\right] p_G \cdot dp_G + (1+k)p_G^2 G^c \cdot dG^c + \frac{p_G^2}{2}((G^c)^2 - G_k^2)\cdot dk. \tag{9}$$

The first term on the RHS in equation (9) reveals a positive relation between the world market equilibrium price and abatement costs, since

$$\frac{dp}{dp_G} = \frac{(1+k)(G^c)^2 + \sum_{k+1}^{n} G_j^2}{(n+1)p} p_G > 0. \tag{10}$$

[7] The case of a fully atmospheric externality à la Meade (1952) would result, if we would assume $\frac{\partial E}{\partial G_i} = \frac{\partial E}{\partial G_j}$, $\forall\, i, j$, e.g., by defining $E = E(G)$ in which $G = (1+k)G^c + \sum_{j=k+1}^{n} G_j$.

Higher marginal abatement costs, i.e., higher investment costs for reducing emissions on firm level, increase production costs in all countries. By partially shifting the cost increase to the demand side, the price of the consumption good will increase in the quadrat of the level of national emission reduction.

The second term in (9) implies

$$\frac{dp}{dG^c} = \frac{(1+k)p_G G^c}{(n+1)p} p_G > 0. \tag{11}$$

Higher emission reduction G^c within the climate coalition (in country i), increases effective production costs in the firms of these countries. Ceteris paribus the affected firms will decrease their production, which will raise the world market price. The price increase is the higher the more firms are affected, i.e., the larger is the climate coalition, and the higher the carbon abatement aim.

Finally, from (9), it follows a reduced form of the effect of a discrete change of the coalition size:

$$\frac{dp}{dk} = \frac{1}{2}\frac{p_G((G^c)^2 - G_k^2)}{(n+1)p} p_G. \tag{12}$$

A marginal increase in the number of member countries in the climate coalition will increase the world market price, if the new member country k has to increase its effort of carbon abatement ($G^c > G_k$). If so, the mechanism is the same as when the climate coalition increases its abatement effort G^c.

Party Platforms As it is standard in the political economy literature, we simplify the voting problem and assume that voters have to decide on the national level of emission reduction only. The climate preference parameter $\alpha_{ih} \geq 0$ (i.e., the perception of costs from climate change) is continuously distributed over households in each country i and the median voter m in country i has a preference parameter $\alpha_{im} = 1$. Note that α_{ih} can be uniformly distributed, implying $\alpha_{ih} \in [0,2]$, but this does not have to be the case.

Following Wittman (1977, 1983) and the findings in Lee et al. (2004), we assume ideological parties. There are at least $R \geq 2$ parties in country i, which differ in their preferences for climate protection. We denote the climate preference parameter of a party r by α_i^r. $\alpha_i^r < 1$ characterizes 'traditional parties', being primarily interested in firm profits and private consumption, whereas 'green parties' are characterized by a high concern about climate change, $\alpha_i^r > 1$.[8]

A party platform G_i^r is defined as the level of national emission reduction announced by a

[8] The analysis to follow and all results would be identical, if we alternatively assume a standard median voter model in the tradition of Downs (1957), in which $R \geq 4$ opportunistic parties maximize their voting shares. For $R = 2$ parties, convergence became trivial, since both would pick the median voter position. For $R = 3$, it is well-known that a political equilibrium does not exist in such a setting. See, e.g., Persson and Tabellini (2000). In the simplest case, therefore, voters were uniformly and continuously distributed on the interval $\alpha_{ih} \in [0,2]$ and there were $R = 4$ parties. Then, parties 1 and 2 would pick the position of the voter at 0.5, viz., $\alpha_{i0.5}$, whilst parties 3 and 4 would pick position 1.5 and $\alpha_{i1,5}$. In both settings, time inconsistency is not an issue.

party r_i in country i, given the abatement costs $p_G(z)$ and with it the implemented abatement measures z, the number of member countries in the climate coalition, $K = 1+k$, and the abatement effort in non-member countries, G_j. Party r_i will derive its party platform by maximizing the utility function in equation (4), given its preference parameter α_i^r and taking into account the effects on national profits and the world market price.

Consequently, the national carbon abatement G_i^r announced by party r_i follows from

$$\max_{G_i^r} u_i^r = \frac{M_i + \pi_i^*}{p(p_G, G_i^r, k)} - \alpha_i^r \cdot v_i(E) \quad \text{s.t.} \quad (3) \quad \text{and} \quad E = E((1+k)\cdot G_i^r, G_{k+1}, ..., G_{n+1}), \tag{13}$$

where we already made use of the national demand function (6). Hence, G_i^r is determined by the first order condition

$$H = -\frac{x_i^d}{p} \cdot \frac{dp}{dG_i^r} - \frac{p_G}{p^2} \cdot \left[p - \frac{1+k}{n+1} p_G G_i^r \right] \cdot x_i^s - (1+k) \cdot \alpha_i^r \cdot v_i'(E) \cdot \frac{\partial E}{\partial G_i^r} = 0. \tag{14}$$

The last term on the left hand side represents the increase in utility if the countries in the climate coalition marginally increase their CO_2 abatement, leading to a marginal decrease in global emissions by $(1+k)\frac{\partial E}{\partial G_i^r}$. The effect is the larger, the stronger the perception of climate change α_i^r is. The effect increases also with the number of member countries in the union, viz., with k. The reason is that multilateral action within the union mitigates the standard underinvestment problem for public goods, where free-riding is always an option.

The total level of emissions E is determined by the sum of CO_2 abatement within the climate coalition and the unilaterally chosen climate protection efforts in all countries outside the climate coalition.[9] Reducing emissions, however, causes two kinds of costs. *First*, an increase in national abatement effort G_i^r decreases profits of the national firm, since the increase in costs is larger than the increase in the world market price. This can be taken from the second term on the left hand side of (14), where $p - \frac{1+k}{n+1} p_G G_i^r \geq x_i^s > 0$ because $n+1 \geq 1+k$. Decreasing profits decrease disposable income and with it private consumption. *Second*, an increase in G_i increases the world market price, see equation (11). This leads to a further decrease in private consumption. The latter effect is represented by the first term on the left hand side of (14), where $x_i^d = \frac{M_i + \pi_i^*}{p}$. If there were no resource costs, $p_G = 0$, we had $\frac{dp}{dG_i^r} = 0$, and both cost terms dropped to zero. In this case, all parties in all countries would be willing to avoid all emissions and we would end up with $G_i^r = G_i^{max}$ $\forall$ r and with $E = 0$.

Inserting maximum profits from equation (3) as well as the supply function (2), the second

[9]For $k = 0$, we have the non-cooperative case, where all countries choose their abatement effort unilaterally. The advantage of our chosen setting is that the effect of writing bilateral or multilateral contracts on the party platform G_i^r can easily be derived by varying the number of coalition members k (e.g., from $k = 0$ to $k = 1$).

order condition reads after rearrangements

$$\begin{aligned} SOC &= -\frac{1}{p}\frac{dx_i^d}{dG_i^r}\frac{dp}{dG_i^r} + \frac{x_i^d}{p^2}\left(\frac{dp}{dG_i^r}\right)^2 - \frac{x_i^d}{p}\frac{d^2p}{d(G_i^r)^2} \\ &- \frac{p_G^2}{p^4(n+1)}\left[(n+k+2)x_i^s + (n-k)p_G G_i^r\right]\left(p^2 - \frac{1+k}{n+1}p_G^2(G_i^r)^2\right) \\ &- (1+k)\alpha_i^r \cdot v_i'(E) \cdot \left[\frac{v_i''(E)}{v_i'(E)} \cdot \left(\frac{\partial E}{\partial G_i^r}\right)^2 (1+k) + \frac{\partial^2 E}{\partial (G_i^r)^2}\right] < 0, \end{aligned} \tag{15}$$

which is fulfilled at least as long as the 'absolute harm aversion' $AHA(E) = v''/v'(E) > 0$ against damage from global warming is sufficiently large; that is if the subutility function over climate change $v_i(E)$ is sufficiently convex.

Climate Coalitions There are two possibilities for forming a climate coalition in this paper. Either a union of K countries, having an identical production at the outset (i.e., for $G_i = 0\ \forall i \in K$), commits to a common level G^c of national carbon abatement in all member countries i (i.e., $G_i = G^c\ \forall i = 1,\ldots 1+k$) or a union of Z countries agrees on establishing a set of international abatement mechanisms z, affecting resource costs $p_G(z)$ of reducing CO_2-emissions.

In the following, we will draw on

Definition 1. *A successful climate coalition is a union, in which*

(i) either any new member country k has to increase its primal abatement effort to $G^c > G_k$ and where this increase leads to a reduction in emissions; that is $\frac{\partial E}{\partial G^c} \cdot G^c - \frac{\partial E}{\partial G_k} \cdot G_k < 0$,

(ii) or implementing an improved set of abatement mechanisms z decreases resource costs in abatement $(\partial p_G(z)/\partial z < 0)$ leading to an increase of national carbon abatement in all member countries; that is $\frac{\partial G_i}{\partial p_G}\frac{\partial p_g}{\partial z} > 0\ \forall i \in Z$.

Strategy (i) mirrors the idea behind agreements like the Kyoto-Protocol. However, this strategy revealed some problems in the process of renegotiating Kyoto II, culminating in the failure of the Copenhagen climate summit in December 2009. The latter strategy (ii) features the focus of cooperative agreements on cost-reducing, economically efficient flexibility mechanisms. Examples are the Clean Development Mechanism (CDM), where countries are allowed to fulfill their emission reduction by investing in developing countries, which have a lower standard of energy efficiency and therefore lower marginal abatement costs (see, e.g., Bréchet and Lussis, 2006; Haites and Yamin, 2000, Partridge and Gamkhar, 2010), or the establishment of international emission trading systems (Buchner and Carraro, 2006; Carbone et al., 2009).[10] More

[10]In fact, the International Energy Agency (2000, p. 234f) argued very early that fulfilling the Kyoto-commitments necessarily requires implementing an international emission trading system, since domestic measures alone would carry too high economic costs. Furthermore, the abatement costs would decrease with the number of participating countries.

recently, economic flexibility has been increased by including ‘avoided deforestation and forest degradation’ (REDD) in a post-Kyoto agreement as negotiated at the Copenhagen climate summit (see Copenhagen Accord, paragraph 6) and expanded at the climate summit in Cancún in December 2010.

Note that ‘successful’ in our terms only implies a reduction in national CO_2-emissions and a decrease in effective abatement costs; it does not need to imply an optimal solution for climate protection. Hence, even if regime-effectiveness is violated and all countries in a coalition do not reduce emissions of CO_2 more than they would do in a unilateral setting, such a coalition would be ‘successful,’ as long as effective abatement costs decrease. Furthermore, we are modeling flexible abatement mechanisms in an ideal world. In reality, these mechanisms have to be designed soundly in order to avoid situations, where, e.g., CDM-measures represent pure windfall gains, since they would have been implemented by host-countries anyway, or where they even are counterproductive and increase global emissions. See, e.g., Flues et al. (2010) and Partridge and Gamkhar (2010).

3 Policy Convergence

We are now going to show that both international agreements on implementing (economically efficient) flexible abatement mechanisms and on collectively reducing CO_2-emissions can explain partial convergence in party platforms G_i^r in a country i. The same holds true for cost-saving progress, improving abatement technologies.

3.1 Introducing Flexible Abatement Mechanisms

A climate coalition Z can agree on improving the set of (international) abatement mechanisms z to reduce resource costs of carbon abatement. One example is the designated possibility of purchasing emission allowances from activities of ‘avoided deforestation’ in regions with rainforests within the framework of a post-Kyoto climate agreement. Investments in reducing emissions from deforestation and forest degradation grant emission allowances, which can be traded in the European Emission Trading System (ETS); see Schlamadinger et al. (2005) for the so-called REDD-mechanism. Such flexibility in abatement mechanisms is considered as decreasing marginal abatement costs $p_G(z)$, since, e.g., a REDD measure is less costly than traditional abatement measures in industrial countries (see Anger and Sathaye, 2008).

Hence, the effect, which such agreements on efficient abatement mechanisms have on party platforms, corresponds to the effects of cost-saving technological progress in abatement mechanisms. Thus, we are able to deal with both issues by analyzing a decrease in (marginal) resource costs p_G for reducing CO_2-emissions. To save notation, we will drop $\partial p_G/\partial z < 0$ and focus on the change in p_G directly.

Let us start with analyzing the effect of a decrease of resource costs p_G at a given carbon abatement G_i on the economic activity in a coalition country i.

Lemma 1. *A reduction in resource costs p_G of climate protection increases production x_i^s, profits π_i^* and consumption x_i^d in a member country i of a successful climate coalition, if its initially given carbon abatement level G_i is higher than an adjusted average $\bar{G}_j^a$ in non-member countries.*

Proof. See Appendix A.1. □

Thereby, $\bar{G}_j^a = \sqrt{n-k}\,\sqrt{\sum_{k+1}^{n} \frac{G_j^2}{(n-k)^2}} < G_k$. Thus, improving abatement mechanisms enhances the economic activity in a country under mild conditions.

Simple intuition would then tell us that the abatement effort G_i^r, offered by any party p_i, should increase when resource costs p_G of climate protection and with it the world market price p of the consumption good decrease. However, first intuition may fail, since there are opposing price and quantity effects, and we cannot sign the change in abatement efforts offered in reaction to a reduction of resource costs p_G. Lower resource costs make climate protection per unit produced of the private good cheaper, but at the same time lower resource costs increase total production of the consumption good. Hence, the combined marginal effect on firms' profits is ambiguous. A similar argument applies to private consumption: the increase in the world market price is lower for lower resource costs, but as households consume more units, they have to pay the increased price on more units. Accordingly, the marginal effect on utility in private consumption is also ambiguous. See appendix A.2 for a formal analysis. We are left with

$$\frac{\partial G_i^r}{\partial p_G} = -\frac{\partial H}{\partial p_G} \Big/ \frac{\partial H}{\partial G_i^r} \gtrless 0 \tag{16}$$

from implicitly differentiating the first order condition (14). Note that $\frac{\partial H}{\partial G_i^r} = SOC < 0$.

Our main interest, however, is in comparing the magnitude of this change across different parties in member countries of a successful climate coalition. Fortunately, the effect of the preference parameter α_i on the change in equation (16) can be signed and we find

$$\frac{\partial \left(\frac{\partial G_i^r}{\partial p_G}\right)}{\partial \alpha_i} = -\frac{v_i''(G)(1+k)}{SOC^2} \cdot \frac{\partial H}{\partial p_G} > 0, \quad \text{if} \quad \frac{\partial G_i^r}{\partial p_G} < 0. \tag{17}$$

From Definition 1, a successful climate coalition implies $\frac{\partial G_i^r}{\partial p_G} < 0$, and the interpretation of equation (17) can be summarized as

Proposition 1. *When a successful climate coalition reduces resource costs of climate protection by implementing a flexible (international) abatement mechanism, this decrease will lead to a partial convergence in carbon abatement offered by parties in a coalition country.*

Proof. See Appendix A.2. □

A decrease in marginal resource costs p_G will always have a stronger positive impact on parties with lower preference for climate protection, since the reduction in private consumption, which is necessary for increasing climate protection, is smaller the more abatement costs decrease. As traditional parties are more concerned about private consumption and firms' profits, they react more strongly on this cost decrease. Hence, the increase in carbon abatement offered in their party platforms will be higher than for green parties, as the latter attach less value to private consumption (and demand climate protection less elastically, respectively). No matter whether marginal abatement costs decrease due to implementing more efficient mechanisms by an international agreement or by cost-saving technological progress, there will be a partial convergence in party platforms as long as a cost decrease fosters the carbon abatement effort.

Improving the efficiency of abatement mechanisms as an explanatory variable should be of relevance. Such improvements were already embedded in the Kyoto-Protocol, in which (i) a group of countries (e.g., the EU) can assign emission reductions differently across member countries as long as the group fulfills its aggregate reduction ('EU emission bubble'); in which (ii) countries can invest in emission abatement in other (treaty) countries and claim the achieved reductions ('joint implementation'); and in which (iii) special rules for investments in developing countries are introduced ('clean development mechanism' CDM), leading to a similar effect like joint implementation. Since then, efficiency has increased by more flexibility in CDM measures (see EU linking-directive 2004/101/EG) and by implementing the REDD approach on avoided deforestation. Furthermore, a global linking of different, regional Emission Trading Systems (Anger, 2008) and including the transportation sector or households in the Emission Trading System (Endres and Ohl, 2005) are under discussion at the moment.[11]

Note, however, that the effect described in Proposition 1 does not change voting shares in a one-dimensional voting decision. We observe a shift in optimal climate protection for each voter, but the distribution of voters remains the same. Thus, the outcome of an election will not change as long as all party platforms are adjusted accordingly. This may change if there are more dimensions besides climate protection, as will be shortly discussed in subsection 3.3.

3.2 Forming A Climate Coalition With Common Abatement Levels

In this subsection, we analyze the effect of a climate coalition, in which all members agree on a common level of emission reduction. Though highly stylized, this setting features, e.g., the Kyoto-Protocol. The major difference here is that we assume an agreement on identical carbon abatement efforts, whereas in the Kyoto-Protocol countries committed themselves to distinct abatement levels. However, our analysis can furthermore capture the effect of a bilateral climate treaty by evaluating all results at $k = 0$.

Again, we are interested in the effect of such agreements on the different party platforms within one country, i.e., on the reaction functions of national parties. Therefore, we do not

[11] Both amendments would balance abatement costs between economies and sectors.

solve for the equilibrium outcome of climate protection and we do not examine under which conditions such a coalition is stable and incentive-compatible. See, e.g., Besley and Coate (2003, section 5) for an optimal cooperative solution (and its justification) in a centralized setting of providing local public goods with spillover effects.

Focusing on a successful climate coalition, country k, newly entering the coalition, has a primal abatement effort being lower than the commitment level in the coalition (i.e., $G^c > G_k$) and less emission reduction (viz., $\frac{\partial E}{\partial G^c} \cdot G^c - \frac{\partial E}{\partial G_k} \cdot G_k < 0$).[12] Hence, from equation (12), the world market price for good x increases and we can state for the economic activity in a coalition country i with initially given carbon abatement G^c.

Lemma 2. *Enlarging a successful climate coalition increases both production and profits in all former coalition countries. Consumption in an old member country i increases (decreases), if it is a net exporter (importer).*

Proof. See Appendix A.3. □

Obviously, the restrictions for a positive effect on private consumption in country i are stricter than for a decrease in resource costs as analyzed in the previous subsection, and enlargement of a climate coalition benefits private consumption only in those countries, producing more than they consume so that the increase in profits dominates the decrease in purchasing power.

The effect of expanding the climate coalition on the party platform G_i^r of a party with preference α_i^r in a coalition country i can in our model be derived from implicitly differentiating the first order condition (14). Thereby, we will implicitly impose the assumption that any party r in country i can dictate the coalition's level of carbon abatement G^c. This is a rather weak assumption if country i is newly forming a coalition with a second country; that is if evaluating a change from $k = 0$ to $k = 1$. However, it becomes a (very) strong assumption for the case of an existing or a large coalition.

The effect on the desired level of abatement effort G_i^r is ambiguous once more:

$$\frac{\partial G_i^r}{\partial k} = -\frac{\partial H}{\partial k} \Big/ \frac{\partial H}{\partial G_i^r} \gtrless 0. \tag{18}$$

As pointed out in Lemma 2, a price increase ceteris paribus has a negative effect on consumption and it depends on whether country i is a net exporter or a net importer of good x, whether utility in private consumption increases or decreases. Furthermore, there is a negative effect on the marginal willingness to pay, which decreases due to diminishing marginal utility, when country k increases its abatement effort. The latter implicitly mirrors the free-riding incentive inherent in a climate coalition. See the appendix to Proposition 2 for the formal effects in detail.

[12]This is also the most reasonable assumption, because it is hardly realistic that a country with a high abatement effort voluntarily joins a climate coalition, where it has to decrease its standard.

A sufficient condition for an increase in carbon abatement G_i^r due to enlarging a climate coalition (and for sustaining definition 1) is that the previous abatement effort in the joining country is sufficiently close to the abatement effort in country i and that country i is an exporting country. See also appendix A.4 for a formal analysis.

The result we are interested in, however, is the effect on the difference between abatement efforts offered by different parties in country i. Indeed, there will be a platform convergence, when enlarging the climate coalition raises the desired abatement effort for all parties (i.e., for any preference parameter α_i^r), and if absolute harm aversion $AHA(E) = \frac{v_i''(E)}{v_i'(E)} > 0$ is sufficiently large; that is if there is enough concern about global warming in country i, or if the coalition size $K = 1+k$ is sufficiently large. This follows from

$$\begin{aligned}\frac{\partial\left(\frac{\partial G_i^r}{\partial k}\right)}{\partial \alpha_i^r} &= \frac{\frac{\partial E}{\partial G_i^r} + (1+k)\frac{v_i''(E)}{v_i'(E)}\frac{\partial E}{\partial G_i^r}\cdot\left(\frac{\partial E}{\partial G_i^r}\cdot G_i^r - \frac{\partial E}{\partial G_k}\cdot G_k\right)}{SOC}\cdot v_i'(E) \\ &- \frac{(1+k)\frac{\partial H}{\partial k}\left[\frac{v_i''(E)}{v_i'(E)}\left(\frac{\partial E}{\partial G_i^r}\right)^2(1+k) + \frac{\partial^2 E}{\partial (G_i^r)^2}\right]}{SOC^2}\cdot v_i'(E) < 0, \quad \text{if} \quad \frac{\partial G_i^r}{\partial k} > 0,\end{aligned} \tag{19}$$

for sufficient $AHA(E)$. $SOC < 0$ is given by equation (15), and $\text{sign}\{\frac{\partial H}{\partial k}\} = \text{sign}\{\frac{\partial G_i^r}{\partial k}\}$ as well as $\left(\frac{\partial E}{\partial G_i^r}\cdot G_i^r - \frac{\partial E}{\partial G_k}\cdot G_k\right) < 0$ follow from focusing on a successful climate coalition.

Proposition 2. *Enlarging a successful climate coalition leads to partial platform convergence in the sense that the announced abatement efforts across parties are converging towards a common value, if either absolute harm aversion against global warming or coalition size are sufficiently large.*

Proof. See Appendix A.4 □

The intuition behind this result is as follows: If more countries join a successful climate coalition, their firms face higher production costs due to an increase in their abatement investments, and the world market price for the consumption good increases. Therefore, increased national emission reduction effort in any country i is less harmful to the competitiveness of the industry in the country under consideration. In other words, the more countries form a successful climate coalition, the less distortive national climate protection requirements will be, with respect to the international allocation of production. Though the increase in price p for good x has ceteris paribus a negative effect on consumption, the total effect can reduce effective abatement costs by reducing the indirect 'economic' costs for any given resource cost p_G of reducing CO_2-emissions. However, the reduction in effective abatement costs matters more for traditional parties, having a smaller preference parameter α_i^r, than for green parties, since the former are relatively more interested in profits and private consumption. Consequently, traditional parties will catch up and the level of climate protection offered in their party platform will approach the level offered by green parties: we observe a (partial) convergence in policy platforms defined over environmental policy (i.e., climate protection).

When enlarging the coalition, there is an offsetting effect on convergence, stemming from overcoming the free-riding problem by partial coordination. Ceteris paribus, this effect would increase abatement efforts for green parties more than for traditional ones. However, this effect becomes less relevant, the larger the climate coalition is or the larger general concern about global warming is. Still, the required assumptions for deriving Proposition 2 are surprisingly strong. This is not to say that a successful climate agreement will not lead to partial convergence, but signing such an agreement which leads all parties to increase their climate protection offer might be difficult. Indeed, the negative effect of a price increase on private consumption (all else equal) might provide an additional explanation for the failure in negotiating a post-Kyoto agreement, besides free-riding in coalitions (e.g., Barrett and Stavins, 2003). If optimal carbon abatement does not increase for all parties within a country, an agreement with commitments on abatement levels could also lead to further divergence. The clash in climate policy between Republicans and Democrats in the U.S. might partially be explained along these lines.

Focusing on a successful agreement and having in mind the Kyoto-Protocol, the size of this climate coalition should be sufficiently large and absolute harm aversion with respect to global warming should be large at least in Europe. Therefore, Proposition 2 should hold for European countries as long as forming a climate coalition (and signing a treaty on environmental protection respectively) reduces emissions. For the latter, there is some supporting evidence, though the Kyoto-Protocol is less dynamic than other examples and though there are some problems in its institutional design. The European Environment Agency calculated for the EU-15 that the Kyoto-induced additional effort – neglecting additional flexibility instruments – has led to an emission reduction of 6.2 percent by 2008 compared with a projected augmentation of emissions in a business-as-usual-scenario (European Environmental Agency 2006, p. 5; 2009, p. 9). Incorporating further flexibility mechanisms should add an additional reduction of 4.6 percent (European Environmental Agency, 2009, p. 11). In total, the EU would easily fulfill the 8 percent reduction as required by the Kyoto-Protocol and most emission reductions are attributed to EU-policy regulations.[13]

Besides the Kyoto-Protocol, there are many examples of international environmental agreements, e.g., the 'Montreal Protocol on Substances that Deplete the Ozone Layer' or the 'International Convention for the Prevention of Pollution From Ships' (MARPOL 73/78), which – in accordance with rationalist regime-theory in the field of international relations – actually caused a gradual enhancement of national environmental protection standards over time and which were backed by a broad consensus among member countries.[14] These agreements and the necessary national regulations were widely supported by all national parties in the member countries.

Again, in a one-dimensional setting, there will be a shift in optimal national reduction levels

[13]About 82 percent of the emission savings in the EU-27 in 2010 are expected to be driven by EU-Commission directives aiming to implement the Kyoto-Protocol. See European Environmental Agency (2009, p. 48f).

[14]See, e.g., Gehring (1994; ch.4), Victor (1995) and Zürn (1997, pp. 48) for an overview and summary of the effectiveness of older agreements.

for each voter, but the distribution of voters remains constant.

3.3 Discussion

From our analysis, it follows that, at least for a policy of internalizing additive atmosphere externalities (i.e., for providing global public goods) and for environmental policy, there can be other reasons for policy convergence besides repeated games and time consistency issues (Alesina, 1987, 1988) and two-level games (e.g., Dorussen and Nanou, 2006). International agreements on reducing CO_2-emissions or on improving abatement mechanisms can lead to partial platform convergence in member countries, if national parties (and voters) put different weights on, e.g., climate protection. These agreements will reduce effective economic costs of internalization and since parties with lower weights on climate protection value private consumption more, they will respond more strongly to a cost decrease, implying a larger increase in offered climate protection efforts compared to the increase in party platforms of green parties.

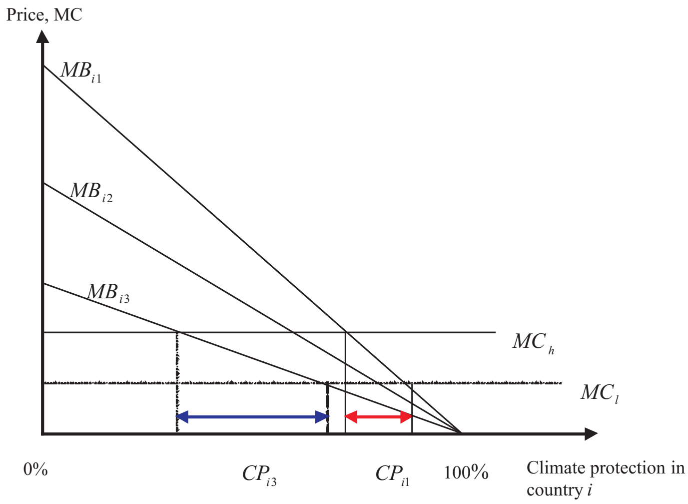

Figure 1: Party platform changes in climate protection

This effect can be illustrated in a simplified diagram, see Figure 1. Assume that effective marginal abatement costs (MC) are linear and that there are 'linear demand functions' (MB) for carbon abatement, reflecting reaction functions of different parties in country i. The demand functions are drawn for different preference parameters α_i^r, where $\alpha_i^1 > \alpha_i^2 > \alpha_i^3$. Optimal party platforms for each party r_i in country i are found by the intersection of its demand function MB_{ir} with the marginal cost curve MC. Then, the analysis can be summarized in Figure 1 by examining the effect of a downward shift in marginal costs from MC_h to MC_l.

For all parties, a reduction in effective abatement costs will increase the offered level of abatement effort. However, the increase is larger for traditional parties than for green parties ($\Delta CP_{i3} > \Delta CP_{i1}$), since the latter demand climate protection less elastically. Indeed, if the price (i.e., effective costs) of reducing emissions dropped to zero, all parties would offer a full reduction in emission, viz., a protection level (an abatement effort) of 100%.

The asymmetric effect of endogenous implementation costs can be applied to other policy fields as well, as long as costless policy implementation implies that all parties will choose the same policy. For these cases, empirical findings that ideology hardly affects budgetary affairs (e.g., Potrafke, 2011b), could also be explained by cost reductions leveling the difference in partisans' optimal spending. Furthermore, the new German consensus on a rapid nuclear phaseout after the Fukushima disaster could be explained along our lines: Nobody wants to run the nuclear risk if costs are too high. Now, the accident in Fukushima has proven that the effective costs of nuclear energy can be extremely high. Hence, the net costs of a phaseout dropped significantly – and the traditional parties reacted more elastically on this cost change.

Can one infer from our findings, however, that green parties should fear successful climate agreements? Our model shows that they do not have to in a one-dimensional world, when the level of desired abatement effort and climate protection is shifted for the entire distribution of voters. Though green parties will lose their unique green policy position (i.e., their unique selling proposition), their share of votes can still remain very stable in election outcomes.

However, the picture changes if one allows for multi-dimensional settings. Assume that voters consider two issues: climate protection and crime prevention. For simplicity presume that both issues are independent of each other and that green parties have a unique selling proposition in climate protection, whereas traditional parties are rather seen as competent in providing crime prevention. In such a world, a policy convergence in climate protection can have disastrous effects for green parties. Since the difference in carbon abatement efforts shrinks or even becomes marginal, crime prevention becomes the focal point for voters. Consequently, green parties might be marginalized, if they stick to their original party platform (e.g., in the case of ideological parties). Alternatively, green parties have to adjust to the stricter crime-prevention regime of traditional parties. Dismissing their ideology (in non-environmental issues) would then be rewarded by preserving or even significantly extending their voting shares.[15] As an example might serve the secession of the so-called 'realo-fraction' from the Swiss green party and the foundation of the (nation-wide) green liberal party in 2007. Whilst the Swiss 'greens' are still very left-wing relative to European average, the Swiss 'green-liberals' clearly moved into the political center – and, for a newly founded party, have been relatively successful in their first election campaign (see, e.g., Baer and Seitz, 2008).[16] In this sense, really ideological green parties should fear successful international agreements on climate protection, though these agreements lead to a higher reduction of CO_2-Emissions.

In fact, there is anecdotal evidence that green parties have tried to prevent too efficient international agreements and in particular have opposed to implement flexible market mechanisms.

[15]Furthermore, the space for governing coalitions increases for green parties, since the largest leveling of 'ideological differences' is achieved between the greens and the most traditional party (e.g., the conservatives).

[16]Another example might be the German 'greens,' becoming more an more a mainstream party, if their share in the latest opinion polls should materialize as votes in the next election.

A salient example is the 6^{th} Conference of the Parties to the Framework Convention on Climate Change in The Hague in November 2000, where the French and German environmental ministers, being negotiators on behalf of the EU, prevented a compromise with the U.S. administration.[17] The U.S. government preferred a market-based solution, including an extended consideration of carbon sinks and emission trading, and credibly threatened with a withdrawal from their Kyoto-commitments, if their claims should not be fulfilled. In the end, the U.S. stepped back from the Kyoto-Protocol due to the opposition of the EU against a further extension of economic flexibility. The failure of this conference turned out to be a major setback for climate protection.[18] Afterwards, many observers mainly blamed green party members or supporters from the environmental ministries – especially the German Jürgen Trittin – to have strategically prevented a market-driven compromise solution (see, e.g., Jacoby and Reiner, 2001, p. 301f; Vrolijk, 2001, p.167f; and Grubb and Yamin, 2001, p. 275).

More recently, the German green party pled for a maximum of 'home-made' emission reductions by the national enterprises and argued for limiting the generation of emission certificates by cost-saving abatement mechanisms, e.g., the CDM, and their trade in the European Emission Trading System (ETS). Flexibility mechanisms should only by ancillary measures.[19]

Another example might be the strong defense of the agreement on nuclear phaseout in Germany in the pre-Fukushima era. Postponing the phaseout could eventually smooth the costs of changing the energy mix, until sufficient renewable energy is available, but the German 'greens' were not willing to discuss this issue at all. Following our analysis, this might have not been due to the fact that the nuclear phaseout is one of their foundation principles (as often declared), but driven by the desire to keep the costs of emission reductions rather high.

Put together, the observed behavior of 'green' politicians might be explained by strategic concerns in policy making in order to sustain their unique selling proposition. Clearly, this issue deserves further analysis, but this topic is left for further research, since it is beyond the scope of the present paper.

4 An International Application

Our analysis can also be transferred to an international setting, by interpreting differences in the preference parameter α_i^r as differences in the national priorities of climate protection.

Some years ago, the focus of both politicians and political scientists was lying on implementing 'command-and-control regulations', establishing a kind of 'international government'

[17] At that time, both ministers, Dominique Voynet and Jürgen Trittin, were members of the green party in the respective country.

[18] Even compared to a situation, where the desired flexibility mechanisms would have been callow and less effective in reducing emissions, the withdrawal of the U.S. from the Kyoto-Protocol created umpteen times more emissions. See Brandt and Svendsen (2002, p. 1191f) and Jacoby and Reiner (2001, p. 302).

[19] See the petition no. 17/120 from December 02, 2009 of the German green party in the German Bundestag. Note that the conservative-liberal majority in the Bundestag exactly favors the opposite. See petition no. 17/100 from December 01, 2009.

and enforcing commitments on emission reduction. However, the negotiating history of the international climate protection regime clearly shows that this kind of policy approach created too many conflicts with other international laws and institutionalized normative principles. Examples are the right to 'catch up,' being guaranteed to developing countries in the Johannesburg Declaration of 2002, which then served as further justification for developing countries not to engage in national abatement obligations (Pohlmann, 2004), and the ban of carbon taxes on imports (from countries with lax climate protection), since these taxes are at odds with the free trade regulation of the WTO (Pitschas, 1995, Whalley and Walsh, 2009). Furthermore, the 'command-and-control' approach turned out to be ineffective (Nordhaus, 2006). Its failure became most obvious during the climate summit in Copenhagen in December 2009, having raised doubts that successful climate agreements on protection levels (i.e., on national reductions in emissions) can internationally be implemented at the moment. One reason should be that countries are still willing to avoid losses in production (stemming from costly climate requirements) and in national purchasing power (due to an increased world market price).

Therefore, most of the recent contributions to international climate policy clearly favor market-based solutions. The majority of these authors recommends higher economic flexibility, improving the efficiency of abatement mechanisms, e.g., by connecting emission trading systems and by implementing CDM and REDD, in order to decrease marginal abatement costs as much as possible. See Endres (2010, part 5) and Whalley and Walsh (2009) for an overview. Others include mechanisms for technological cooperation (Buchner and Carraro, 2006) or carbon taxes as a hybrid price-quantity solution (e.g., Aldy et al., 2003; Nordhaus, 2006). According to Brandt and Svendsen (2002) and Stavins (2008), making global abatement measures more efficient by ameliorating flexibility-mechanisms appears to be the only way of advancing international cooperation in this field at this stage. Indeed, findings from numerical simulations in Carbone et al. (2009) show that decreasing abatement costs by establishing international emission trading systems leads to significant emission reductions, even if governments behave non-cooperatively in setting the (national) level of emission permits.

Our results support this view. Implementing efficient abatement mechanisms and improving abatement technologies seem to be advantageous. First, production costs and the world market price are decreased. Under mild conditions, this increases firms' profits as well as households' consumption. This is the major difference to forming a climate coalition and committing to abatement effort levels, where an increasing world market price always has a negative effect on consumption all else equal. In that sense, a strategy for more flexibility and efficiency would take into account the worries about the economic development of countries (as, e.g., being present in reluctant countries like China, India and the U.S.). Consequently, countries are more willing to increase their voluntary abatement effort. Second, if improving abatement mechanisms leads to higher abatement efforts in all countries, we can conclude from transferring Proposition 1 to an international level that there will be at least partial convergence in desired levels of emission reductions across countries. Countries with less emphasis on climate protection will increase their voluntary reduction effort more than those countries which are highly concerned about global warming. Accordingly, it should also be easier to sign agreements with commitments on abatement efforts in a second step, since the difference between national objectives is leveled. Hence, our findings support the view in Endres and Ohl (2002) that the 'cooperative push' of an international environmental agreement significantly depends on the (correct) choice of abatement instruments and the call in Hoel and de Zeeuw (2010) for cost-reducing R&D investment as part of such agreements.

In a nutshell, one policy relevant interpretation of our results is that the priority of climate policy should be investing resources and effort into improving and implementing efficient abatement mechanisms and providing (free) access to these mechanisms. Such a strategy should foster international climate protection in various ways and prove more efficient than spending resources on climate conferences (as, e.g., the Copenhagen summit 2009), if climate agendas of countries differ a lot.

5 Conclusions

Analyzing a model of international climate protection, we have shown that the convergence in environmental party platforms across parties can be explained by international agreements, even if parties behave as partisans according to recent empirical evidence. If these agreements decrease the effective abatement costs, the optimal level of climate protection increases more for traditional parties than for green parties and the difference shrinks. This is driven by the fact that traditional parties react more elastically on reductions in abatement costs, since they are primarily interested in firms' profits and purchasing power and appreciate cost reductions strongly. Our result, using climate policy as an example, applies also to other policy fields, where endogenous policy implementation costs decrease due to, e.g., (international) agreements or technological progress.

Green parties do not need to fear the resulting loss of their unique selling proposition as long as there is only a one-dimensional voting problem. However, in a multi-dimensional setting, the effect can be disastrous – or requires forsaking ideological positions in other policy fields. Further research should clarify whether green parties are well aware of this problem and strategically try to prevent market-based abatement mechanisms and too efficient climate agreements, as indicated by some anecdotal evidence. If so, their guideline would be that 'more climate protection is fine, but at rather high costs, please.'

With respect to designing an international climate policy, it can be taken from our model that investing into efficient abatement mechanisms is preferable to climate summits which fail because the objectives of countries are too divergent. Reducing abatement costs first by establishing efficient and flexible mechanisms should lead to a convergence in national interests and should facilitate signing a post-Kyoto agreement on emission reductions in a second step.

A Appendix

A.1 Proof of Lemma 1

In order to derive a sufficient condition for the effect on production and profits, we differentiate the profit function (3) for p_G and utilize the effect in equation (10) to find

$$\begin{aligned} \frac{d\pi_i}{dp_G} &= \frac{dx_i^s}{dp_G} \cdot x_i^s = \left[\frac{dp}{dp_G} - G_i\right] \cdot x_i^s = -\frac{x_i^s}{p}\left[pG_i - p_G \frac{(1+k)G_i^2 + \sum_{j=k+1}^n G_j^2}{n+1}\right] \\ &< -\frac{x_i^s}{p}\left[pG_i - p_G G_i^2\right] = -\frac{G_i}{p}(x_i^s)^2 < 0, \end{aligned} \tag{20}$$

if $G_i \geq \sqrt{n-k}\sqrt{\sum_{k+1}^n \frac{G_j^2}{(n-k)^2}} = \bar{G}_j^a$, and where $x_i^s = p - p_G G_i$. Sufficient conditions for an increase of consumption $x_i^d = \frac{M_i + \pi_i^*}{p}$ in country i with a decrease in p_G, i.e.,

$$\frac{dx_i^d}{dp_G} = -\frac{x_i^d}{p}\frac{dp}{dp_G} + \frac{1}{p}\frac{d\pi_i^*}{dp_G} = \frac{x_i^s - x_i^d}{p} - G_i x_i^s < 0, \tag{21}$$

are either that profits increase, $\frac{d\pi_i}{dp_G} < 0$, or that the country is a net importer $x_i^d > x_i^s$.

A.2 Proof of Proposition 1

The FOC (14) for the optimal policy platform G_i^* can be rewritten as

$$H = -\frac{x_i^d}{p} \cdot \frac{dp}{dG_i^r} - \frac{1}{p} \cdot \frac{\partial \pi_i}{\partial G_i} + (1+k) \cdot \alpha_i^r \cdot v_i'(E) \cdot \frac{\partial E}{\partial G_i^r} \equiv 0, \tag{22}$$

and from applying comparative statics and $SOC < 0$, it follows that $\text{sign}\{\frac{\partial G_i^*}{\partial p_G}\} = \text{sign}\{\frac{\partial H}{\partial p_G}\}$; see equation (16). Unfortunately, this effect

$$\begin{aligned} \frac{\partial H}{\partial p_G} &= \frac{x_i^d}{p^2}\frac{dp}{dp_G}\frac{dp}{dG_i^r} - \frac{1}{p}\frac{dx_i^d}{dp_G}\frac{dp}{dG_i^r} - \frac{x_i^d}{p}\frac{d^2 p}{dG_i^r dp_G} \\ &+ \frac{x_i^s}{n+1}\frac{p_G}{p^3}\left(\frac{dp}{dp_G} - \frac{p}{p_G}\right)\left[(n+1)x_i^s + (n-2k-1)p_G G_i^r\right] \gtrless 0 \end{aligned}$$

cannot be signed in general. The reason is that a decrease in resource costs p_G reduces abatement costs per unit of production, but at the same time total production increases, implying that marginal abatement costs are increased ceteris paribus. See

$$\frac{\partial\left(\frac{\partial \pi_i}{\partial G_i}\right)}{\partial p_G} = \underbrace{\frac{\partial x_i^s}{\partial p_G} \cdot \left[\frac{\partial p}{\partial G_i} - p_G\right]}_{(+)} + \underbrace{x_i^s \cdot \left[\frac{\partial\left(\frac{\partial p}{\partial G_i}\right)}{\partial p_G} - 1\right]}_{(+/-)} \gtrless 0. \tag{23}$$

The analogous argument holds true for the effect on marginal abatement costs in private consumption. A decrease in p_G fosters income and reduces the increase in the world market price, but the still increasing world market price must be paid on more units, because consumption has increased ceteris paribus. Again, the total effect on the margin is ambiguous, because

$$\frac{\partial\left(\frac{x_i^d}{p}\cdot\frac{dp}{dG_i^r}\right)}{\partial p_G} = \underbrace{\frac{\partial x_i^d}{\partial p_G}\frac{1}{p}\frac{\partial p}{\partial G_i^r}}_{(-)} - \underbrace{\frac{x_i^d}{p}\frac{dp}{dp_G}\frac{dp}{dG_i^r}}_{(+)} + \underbrace{\frac{x_i^d}{p}\frac{\partial\left(\frac{dp}{dG_i^r}\right)}{\partial p_G}}_{(+)} \gtrless 0. \tag{24}$$

However, from applying Definition 1, for a successful climate coalition a decrease in resource costs p_G increases abatement effort G_i and we have $\frac{\partial H}{\partial p_G} < 0$ from equation (16).

Applying this in equation (17), it follows immediately that $\partial\left(\frac{\partial G_i^r}{\partial p_G}\right)/\partial\alpha_i^r > 0$ from $v_i''(E) > 0$, $\frac{\partial E}{\partial G_i^r} < 0$ and $\frac{\partial H}{\partial p_G} < 0$. Since all parties r_i want to avoid all national emissions when effective abatement costs are zero (evaluate (14) for $p_G = 0$), all party platforms G_i^r converge to the same level of national emission reduction $G_i \;\forall\; r$. Therefore, $\partial\left(\frac{\partial G_i^r}{\partial p_G}\right)/\partial\alpha_i^r > 0$ proves Proposition 1.

A.3 Proof of Lemma 2

From Definition 1, we have $G^c > G^k$ for a successful climate coalition; consequently, $\frac{dp}{dk} > 0$ from (12). For a given abatement level G^c, this then implies for firms' profits in all coalition countries i that $\frac{d\pi_i}{dk} = \frac{\partial \pi_i}{\partial p}\frac{dp}{dk} = x_i^s\frac{dp}{dk} > 0 \forall\; i \neq k$ and for production in a country i that $\frac{dx_i^s}{dk} = \frac{\partial x_i^s}{\partial p}\frac{dp}{dk} = \frac{dp}{dk} > 0 \forall\; i \neq k$.

The effect on private consumption in country i, $x_i^d = \frac{M_i + \pi_i^*}{p}$, can be displayed as

$$\frac{dx_i^d}{dk} = \frac{\partial x_i^s}{\partial p}\frac{dp}{dk} = \frac{x_i^s - x_i^d}{p}\frac{dp}{dk} > (<)\; 0, \quad \text{if} \quad x_i^s > (<)\; x_i^d, \tag{25}$$

that is if country i is a net exporter (importer).

A.4 Proof of Proposition 2

Evaluating the first order condition (14) for the optimal abatement effort G_i^*, we define

$$H = -\frac{x_i^d}{p}\cdot\frac{dp}{dG_i^r} - \frac{p_G}{p^2}\cdot\left[p - \frac{1+k}{n+1}p_G G_i^r\right]\cdot x_i^s - (1+k)\cdot\alpha_i^r\cdot v_i'(E)\cdot\frac{\partial E}{\partial G_i^r} \equiv 0. \tag{26}$$

The effect of enlarging the climate coalition by country k on the party platform of a party (and the desired abatement effort of a voter, respectively) with preference parameter α_i^r is found by implicitly differentiating equation (26):

$$\frac{\partial G_i^r}{\partial k} = -\frac{\partial H}{\partial k}\Big/\frac{\partial H}{\partial G_i^r} = -\frac{\frac{\partial H}{\partial k}}{SOC}. \tag{27}$$

Since $SOC < 0$ from equation (15), we are left with $\text{sign}\{\frac{\partial G_i^r}{\partial k}\} = \text{sign}\{\frac{\partial H}{\partial k}\}$.

Partially differentiating equation (26) leads to

$$\begin{aligned}
\frac{\partial H}{\partial k} &= \left(\frac{x_i^d}{p} - \frac{1}{p}\frac{\partial \pi_i^*}{\partial p}\right)\frac{dp}{dk}\frac{dp}{dG_i^r} - \frac{x_i^d}{p}\frac{d^2 p}{dG_i^r dk} \\
&+ \left[2\frac{p_G}{p^3}\left(p - \frac{1+k}{n+1}p_G G_i^r\right)x_i^s - \frac{p_G}{p^2}x_i^s - \frac{p_G}{p^2}\left(p - \frac{1+k}{n+1}p_G G_i^r\right)\right]\frac{dp}{dk} + \frac{p_G^2}{p^2}G_i^r\frac{x_i^s}{n+1} \\
&- \alpha_i^r \cdot v_i'(E)\left[\frac{\partial E}{\partial G_i^r} + (1+k)\frac{v_i''(E)}{v_i'(E)}\left(\frac{\partial E}{\partial G_i^r}\right)^2\left(\frac{\partial E}{\partial G_i^r}\cdot G_i^r - \frac{\partial E}{\partial G_k}\cdot G_k\right)\right] \\
&= \left[\frac{x_i^d - x_i^s}{p}\frac{dp}{dG_i^r} - \frac{p_G^2}{p^3}\frac{G_i^r}{n+1}\left(2(1+k)x_i^s + (n-k)p\right)\right]\frac{dp}{dk} + \frac{x_i^s - x_i^d}{p}\frac{d^2 p}{dG_i^r dk} \qquad (28) \\
&- \alpha_i^r \cdot v_i'(E)\left[\frac{\partial E}{\partial G_i^r} + (1+k)\cdot AHA(E)\left(\frac{\partial E}{\partial G_i^r}\right)^2\left(\frac{\partial E}{\partial G_i^r}\cdot G_i^r - \frac{\partial E}{\partial G_k}\cdot G_k\right)\right] \gtreqless 0,
\end{aligned}$$

where $\frac{d^2 p}{dG_i^r dk} = \frac{p_G^2}{p}\frac{G_i^r}{n+1} > 0$ from differentiating equation (11), and where $AHA(E) = \frac{v_i''(E)}{v_i'(E)} > 0$.

In general, all terms in (28) are ambiguous for a successful climate coalition with $G_i^r = G^c > G_k$ and $\frac{\partial E}{\partial G_i^r}\cdot G_i^r - \frac{\partial E}{\partial G_k}\cdot G_k < 0$. For a sufficient condition guaranteeing an increase in carbon abatement, assume that the difference between the abatement effort in the coalition and the original level in country k is sufficiently small, $G^c - G_k \to 0$. Then, we can utilize $\frac{dp}{dk} \to 0$ as well as $\frac{\partial E}{\partial G^c} - \frac{\partial E}{\partial G_k} \to 0$ and equation (28) simplifies to

$$\frac{\partial H}{\partial k} = \frac{x_i^s - x_i^d}{p}\frac{d^2 p}{dG_i^r dk} - \alpha_i^r v_i'(E)\frac{\partial E}{\partial G_i^r} > 0, \qquad (29)$$

for an exporting country implying $x_i^s > x_i^d$.

To prove Proposition 2, we have to differentiate equation (27) for the preference parameter α_i^r. This leads to

$$\begin{aligned}
\frac{\partial\left(\frac{\partial G_i^r}{\partial k}\right)}{\partial \alpha_i^r} &= \frac{\frac{\partial E}{\partial G_i^r} + (1+k)\cdot AHA(E)\cdot\frac{\partial E}{\partial G_i^r}\cdot\left(\frac{\partial E}{\partial G_i^r}\cdot G_i^r - \frac{\partial E}{\partial G_k}\cdot G_k\right)}{SOC}\cdot v_i'(E) \qquad (30) \\
&- \frac{(1+k)\frac{\partial H}{\partial k}}{SOC^2}\left[(1+k)\cdot AHA(E)\left(\frac{\partial E}{\partial G_i^r}\right)^2 + \frac{\partial^2 E}{\partial (G_i^r)^2}\right]\cdot v_i'(E)
\end{aligned}$$

Assuming that party r can set the carbon abatement level in a successful climate coalition, $G_i^r > G_k$, $\frac{\partial E}{\partial G_i^r}\cdot G_i^r < \frac{\partial E}{\partial G_k}\cdot G_k$ and $\frac{\partial G_i^r}{\partial k} > 0$ from Definition 1. Utilizing that the second order condition is negative, $SOC < 0$, and recognizing from equation (27) that $\text{sign}\{\frac{\partial H}{\partial k}\} = \text{sign}\{\frac{\partial G_i^r}{\partial k}\}$, we find

$$\frac{\partial\left(\frac{\partial G_i^r}{\partial k}\right)}{\partial \alpha_i^r} < 0 \qquad (31)$$

in equation (19), if there is sufficient harm aversion against global warming (i.e., if $AHA(E) = v_i''/v_i'$ is high) or if the coalition size $K = 1 + k$ is large enough. Then, the increase in the offered abatement effort decreases in the preference parameter α_i^r for climate protection. Since a high preference parameter implies originally a high abatement effort in the party platform, the distance between abatement efforts is reduced across platforms. Moreover, since all parties r_i want to avoid all national emissions when effective abatement costs are zero, all party platforms G_i^r converge towards the same level of national emission reduction $G_i \; \forall \; r$, and we have a (partial) convergence in party platforms.

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