"Political Competition, Path Dependence, and the Strategy of Sustainable Energy Transitions"

A Supplementary Appendix

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August 17, 2012

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A1 Overview

This supplementary appendix presents formal extensions, robustness tests, and additional empirical analyses for the article "Political Competition, Path Dependence, and the Strategy of Sustainable Energy Transitions."

A2 Formal Model Extensions

In the main text, we analyzed a simple model with (i) exogenous political replacement and (ii) deterministic exogenous shock. These simplifications allowed us to derive clean equilibrium solutions in closed form, but they may strike some readers as unrealistic. Here we briefly extend the model to cover multiple time periods, endogenous political replacement, uncertain exogenous shocks, varying time preferences, and generalized payoff functions.

Before going any further, we provide graphical illustrations of marginal effects from the main model. In Figure A1, we report here the marginal effects of a change in the incumbent's preferences (A) on the equilibrium public support Q_1^* in period 1, for various values of δ. We also graph the marginal effect of a change in the challenger's preferences (B) on the first period Q_1^*, again for various values of δ.

We also show the marginal effect of a change in δ on the first-period equilibrium public support Q_1^* and the expectation of the support in the second period equilibrium support Q_2^*. The figure is reported in Figure A2.

A2.1 Multiple Time Periods

The model analyzed in the main text has only two periods. This simplification is necessary because the game has a relatively complex payoff structure. Therefore, standard techniques that could be used to solve repeated and simple dynamic games with infinite time horizons are difficult to apply. However, one may wonder whether the insights from the simple two-period model would survive in a similar model with multiple time periods. To address this question, we provide here (i) an algorithm for constructing a dynamic game with an arbitrary number of periods from the fundamentals introduced in the main text and (ii) solve this game for three periods. The solution to these extended games shows that the results are robust.[1]

To extend the game to cover multiple time periods requires a series of discretionary decisions. We assume that there is an exogenous shock parameter Y^t for each period $t = 1, ..., N$. We assume government A is in power in the first period (without loss of generality). In each period government

[1] A Mathematica replication file is included in the replication package.

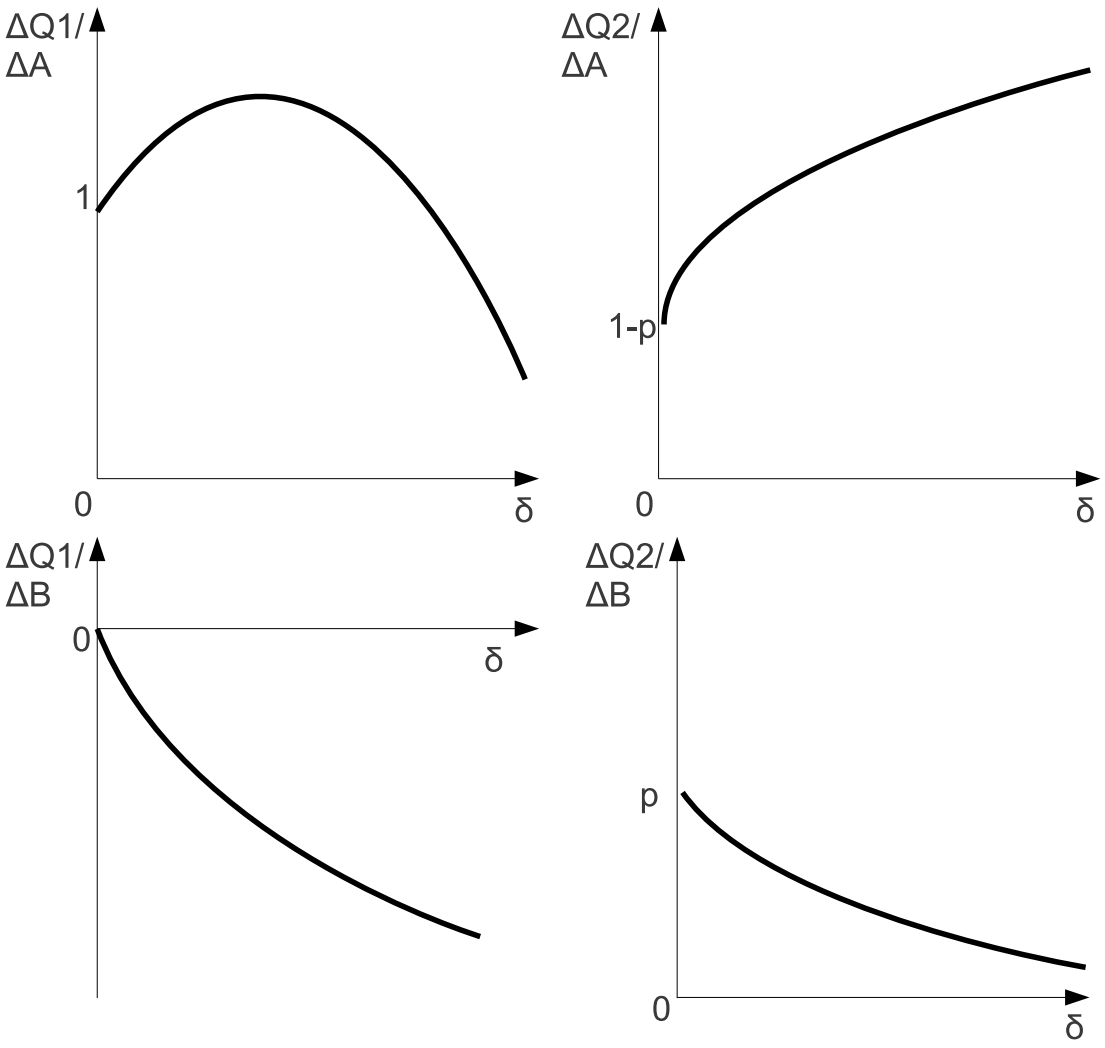

Figure A1: UPPER PANEL: The marginal effect of a change in the incumbent's preferences A on first-period public support Q_1^* and the expectation of second-period public support Q_2^* is positive for any value of positive reinforcement δ. LOWER PANEL: The marginal effect of a change in the challenger's preferences B on first-period public support Q_1^* and the expectation of second-period public support Q_2^* is negative and positive, respectively, for any value of positive reinforcement δ.

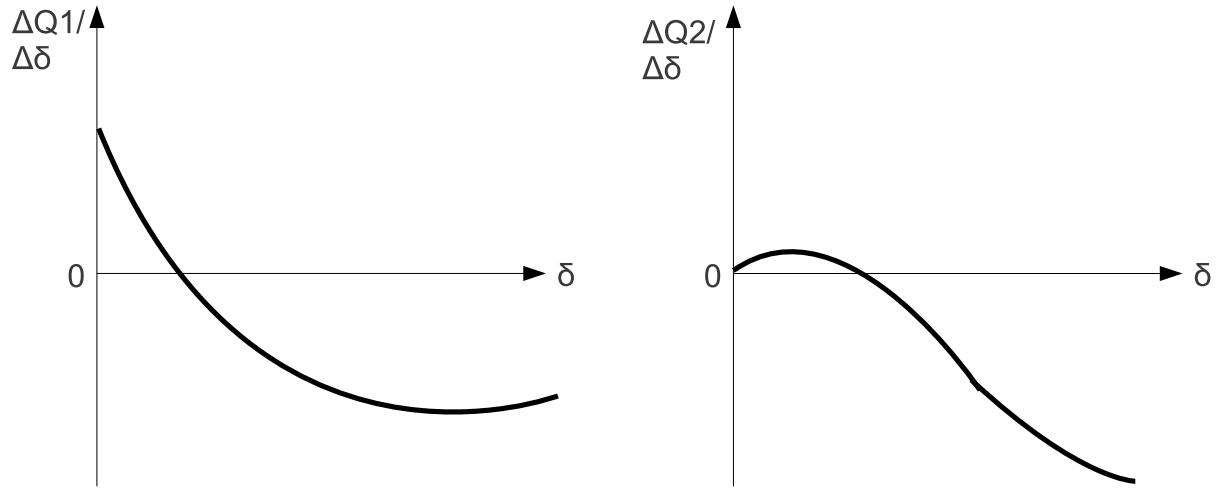

Figure A2: The marginal effect of a change in positive reinforcement δ on first-period public support Q_1^* and the expectation of second-period public support Q_2^*.

B is in power with probability p. We also assume the positive reinforcement parameter δ remains unchanged over time. Finally, we assume that positive reinforcement at time $t+1$ only reflects clean energy policy in the previous period, δQ_t. Thus, the effect only lasts for one period.

To simplify the governments' preferences, we consider an "overlapping generations" payoff structure. When a government is in power at time t, we assume its payoff is the sum of payoffs from times t and $t+1$, as we did in the main model. The only difference is that the t-period government understands that the next government is also forward-looking. Our purpose is to demonstrate that this additional strategic element does not compromise the results.

In general, these assumption allow the following algorithm to produce a dynamic model with any number of periods, denoted by N. Consider the government in the final period of the game. This government's equilibrium strategy is identical to that of the second-period government's in the main model. Let the strategy is denoted by $Q_N^*(i)$ for $i = A, B$.

Consider now the government at time $N-1$. Given the previous period's clean energy policy

Q_{N-2}, this government selects Q_{N-1} to maximize

$$(T + \delta Q_{N-2} + Y^{N-1}) \cdot Q_{N-1} + (T + \delta Q_{N-2} + Y^{N}) \cdot ((1-p) \cdot Q_N^*(A) + p \cdot Q_N^*(B)) \\ -\frac{1}{2}Q_{N-1}^2 - \frac{1}{2}(1-p) \cdot Q_N^*(A)^2 - \frac{1}{2}p \cdot Q_N^*(B)^2. \quad (1)$$

Differentiating with respect to Q_{N-1} and equating to zero yields a unique solution denoted by $Q_{N-1}^*(i)$ for $i = A, B$. The exact value of the solution depends on the number of periods N, so it cannot be written in explicit form here.

Given this government's behavior, consider now the government at time $N-2$. This government selects Q_{N-2} to maximize

$$(T + \delta Q_{N-3} + Y^{N-2}) \cdot Q_{N-2} + (T + \delta Q_{N-3} + Y^{N-1}) \cdot ((1-p)Q_{N-1}(A) + pQ_{N-1}(B)) \\ -\frac{1}{2}Q_{N-2}^2 - \frac{1}{2}(1-p)Q_{N-1}(A)^2 - \frac{1}{2}pQ_{N-1}(B)^2. \quad (2)$$

This can be solved for a unique $Q_{N-2}^*(i)$ for $i = A, B$. This process can be repeated until the first period, $t = 0$, is reached. At this time, government A is in power and maximizes

$$(T + Y^0) \cdot Q_0 + (T + Y^0) \cdot ((1-p)Q_1(A) + pQ_1(B)) - \frac{1}{2}Q_0^2 - \frac{1}{2}(1-p)Q_1(A)^2 - \frac{1}{2}pQ_1(B)^2. \quad (3)$$

By analyzing Q_0, we can verify that the main insights from the two-period model remain unchanged.

Unfortunately, the equilibrium solutions rapidly become unwieldy and difficult to analyze and present. Due to political competition and each government's time-inconsistent preferences, standard techniques of recursive dynamic programming introduced in Dixit and Pindyck (1994) and Stokey, Lucas, and Prescott (1989) cannot be applied. However, we can present here the solutions for $N = 3$. In the $N = 3$ game, we have Q_0^* set at

$$\frac{(A-B) \cdot (1 + \delta p + 2\delta^2 + \delta^3 + \delta^4) + Y^0 \cdot (1 + 2\delta^2 + \delta^4) + Y^1 \cdot \delta^3}{1 + 3\delta^2 + \delta^4}, \quad (4)$$

as shown in the Mathematica file provided in the replication package.

Differentiating with respect to p shows that whenever $A - B$ is positive (negative), the equilibrium policy is increasing (decreasing) in p, as was also true of the main model. Differentiating with respect to Y^0 shows that the equilibrium policy is increasing in Y^0 but less and less so as δ increases, as was also true of the main model. Therefore, all results continue to hold in the three-period version of the model.

A2.2 Endogenous Political Replacement

To evaluate the consequences of endogenous political replacement, let us suppose that the loss probability p depends on public support Q_1, so that $p = p(Q_1)$. We leave the exact functional form of the loss probability open, but we assume it is a differentiable function.

To analyze this extended model, note first that the second-period Nash equilibrium remains unchanged. Thus, it suffices to consider the first period. Let U^1 denote the payoff from the first period and U^2 the payoff from the second period, as defined in the main text. The expected payoff for the initial government A cannot be written in closed form, but the following expression gives the implicit solution:

$$EU = U^1(Q_1^*) + (1 - p(Q_1^*))U^2(A + Q_1^*) + p(Q_1^*)U^2(B + Q_1^*). \tag{5}$$

Note in particular that U^2 itself is exogenous. The arguments $A + Q_1^*$ and $B + Q_1^*$ follow directly from equation 4 in the main text.

The following is a necessary condition for a subgame-perfect equilibrium (locally optimal Q_1):

$$\frac{\partial U^1(Q_1^*)}{\partial Q_i} + (1 - p(\cdot))\frac{\partial U^2(A + Q_1^*)}{\partial Q_1} + p(\cdot)\frac{\partial U^2(B + Q_1^*)}{\partial Q_1} + \frac{\partial p(\cdot)}{\partial Q_1}\left(U^2(B + Q_1^*) - U^2(A + Q_1^*)\right). \tag{6}$$

The equilibrium is guaranteed to be generically unique given the extensive form, but this necessary condition may hold for a finite set of Q_1. In this case, the highest value is to be chosen.

This expression is otherwise identical to that in the main text, except that the last term – marginal effect of public support on loss probability – is missing from the main model. Endogenous political competition thus adds another dimension to the strategic problem, yet it does not change

the fact that the government continues to consider the effects of current public support on the political competitor's second-period actions. Indeed by continuity of the payoffs it also follows immediately that if p is sufficiently insensitive to Q_1, perhaps due to the high number of items on the political agenda, all comparative statics continue to hold qualitatively (though obviously not quantitatively).

A2.3 Uncertain Exogenous Shocks

Another important simplification that we used was the deterministic nature of the shock. What if the second-period state of the world Y^2 was not fixed at zero but probabilistic instead? Suppose indeed that Y^2 is distributed normally with a mean 0 and a variance σ^2. Again, the second-period equilibrium would remain unchanged because the value of Y^2 would be revealed to the second-period government prior to the choice of Q_2. What about the first period? Now the second-period clean-energy policy Q_2^* would be written as follows:

$$Q_2^*(Q_1) = Y^2 + T + \delta Q_1^*. \tag{7}$$

The expectation would be

$$E(Q_2^*(Q_1)) = E(Y^2) + (1-p)A + pB + \delta Q_1^* = (1-p)A + pB + \delta Q_1^*. \tag{8}$$

Importantly, it does not follow that the first-period choice of Q_1^* would be identical to that in the deterministic main model. Depending on p, δ, B, the original government A could adjust Q_1 downward or upward due to risk-averse preferences. However, the substantive logic of equilibrium behavior remains unchanged, as the original government A considers the effect of first-period public support Q_1 on the expected second-period public support Q_2. As long as the variance parameter σ^2 falls below a certain threshold, all qualitative comparative statics of the main model remain intact by the continuity of the payoffs.

A2.4 Time Preferences

Consider the main model but suppose government A discounts second-period payoffs by some factor $\beta \in (0,1)$. The second-period payoffs remain unchanged but the first-period payoff must now be written as

$$(A+Y)\cdot Q_1 + \beta A \cdot Q_2 - \frac{1}{2}Q_1^2 - \beta\frac{1}{2}Q_2^2. \tag{9}$$

The first-order condition is

$$A + Y - Q_1 + \beta A\delta - \beta(1-p)\delta\left(A + \delta Q_1\right) - \beta p\delta\left(B + \delta Q_1\right) = 0. \tag{10}$$

This yields

$$Q_1^* = \frac{A + Y + \beta p\delta \cdot (A-B)}{\beta\left(1+\delta^2\right).} \tag{11}$$

This condition is otherwise identical expect that the discount factor β weighs one term in the numerator and the entire numerator. Thus, as long as β is high enough, all comparative statics remain identical.

A2.5 Generalized Payoffs

In the main model, payoffs are assumed to be linear-quadratic. For more generality, suppose instead that the second period government maximizes

$$(T + \delta Q_1)\cdot V[Q_2] - C[Q_2], \tag{12}$$

where V is an increasing and strictly concave function while C is an increasing and strictly convex function. Under standard regularity condition, this induces a choice of Q_2 such that

$$(T + \delta Q_1)\cdot V'[Q_2] = C'[Q_2]. \tag{13}$$

Let $Q_2(T)$ denote this scalar and note that, by standard arguments, it is strictly increasing in $T + \delta Q_1$.

In the first period, government A maximizes

$$(A+Y)\cdot V[Q_1]+A\cdot V[Q_2]-C[Q_1]-C[Q_2]. \tag{14}$$

Given probabilistic elections, this yields

$$(A+Y)\cdot V[Q_1]+A\cdot((1-p)\cdot V[Q_2(A)]+p\cdot V[Q_2(B)])-C[Q_1]-p\cdot C[Q_2(B)]-(1-p)\cdot C[Q_2(A)]. \tag{15}$$

Differentiating with respect to Q_1, in equilibrium we must have

$$\begin{aligned}(A+Y)\cdot V'[Q_1]+A\cdot\left((1-p)\cdot V'[Q_2(A)]\frac{\partial V[Q_2(A)]}{\partial Q_1}+p\cdot V'[Q_2(B)]\frac{\partial V[Q_2(B)]}{\partial Q_1}\right) &= \\ C'[Q_1]+p\cdot C'[Q_2(B)]\frac{\partial V[Q_2(B)]}{\partial Q_1}+(1-p)\cdot C'[Q_2(A)]\frac{\partial V[Q_2(A)]}{\partial Q_1} &\quad .\end{aligned} \tag{16}$$

While it is not possible to obtain an explicit solution, this condition shows that the generalized version of the model produces largely similar strategic incentives. Consider first the marginal effect of increasing Y on Q_1. This effect is positive because $V'[Q_1]>0$ and the maximization problem itself is strictly concave. Similarly, the expression shows that an increase in δ tends to dampen the first-period government's incentive to respond to an increase in Y by increasing Q_1. All else constant, a slightly higher δ implies that the value of $\frac{\partial V[Q_2(T)]}{\partial Q_T}$ increase everywhere. Since condition 16 was met prior to the increase in Y, and the maximization problem is strictly concave, $\frac{\partial EU}{\partial Y}$ must decrease in some neighborhood of the equilibrium value Q_1^*. Thus, by the implicit function theorem $\frac{\partial Q_1}{\partial Y}$ must also decrease in some neighborhood of the original equilibrium value Q_1^*.

The conditions 13 and 16 also show that if A increases, both Q_1^* and Q_2^* must increase. The increase in Q_2 for any given Q_2 is immediate, so it suffices to show that Q_1^* increases. Note now that a slight increase in A has a negligible effect on $\frac{\partial V[Q_2(A)]}{\partial Q_A}$ and no effect at all on $\frac{\partial V[Q_2(B)]}{\partial Q_B}$ or $V'[Q_2(B)]$ or $C'[Q_2(B)]$. Also note that $V'[Q_2(A)]$ increases while $C'[Q_2(A)]$ remains unchanged. Finally, note that $(A+Y)\cdot V'[Q_A]$ increases. Thus, the total effect must be positive.

Finally, with $A>B$ we have $V'[Q_2(A)]<V'[Q_2(B)]$ and $C'[Q_2(A)]>V'[Q_2(A)]$. This implies that as p increases, Q_1^* must increase.

A3 Case Studies

To illustrate our formal analysis, we now conduct two case studies. We focus on France and Germany because they are wealthy European democracies and neighbors, yet their energy policies diverge. These cases illuminate the strategic logic that we have uncovered: governments exploit positive reinforcement mechanisms for political gain. In the German case, we show how a mix of exogenous shocks and political competition allowed the growth of clean energy. While the importance of positive reinforcement is indisputable, we also find evidence of strategic over- and underinvestment. As a comparison, we consider France. In this country, the domination of nuclear energy undermined the renewables sector and dampened political competition.

A3.1 Germany

The origins of the German energy revolution can be traced to the 1973 oil crisis. The German government, at that time led by the Social Democratic Party (SPD), responded to this shock in two ways. First, it increased spending on coal and nuclear power (Evrard and Saurugger, 2007). Germany has an abundance of coal, and it hoped to reduce national dependence on foreign oil by substitution.[2] Second, the oil crisis also increased spending renewables R&D. By 1982, Germany was the biggest spender on R&D for renewable energy, ahead of such pioneers as Sweden and Denmark (Jacobsson and Lauber, 2006, 261). Nonetheless, the government remained a supporter of nuclear power. Both Chancellor Helmut Schmidt (SPD) and the opposition were in agreement, even though the more leftist wing of the SPD had started militating against nuclear energy.[3] This episode demonstrates how an exogenous shock, high Y, may initiate the growth of the renewables sector even in otherwise unfavorable political-economic circumstances.

In the absence of positive reinforcement, the shock did not have very durable effects. In 1982 the SPD government was replaced by Helmut Kohl's center-right coalition, and party politics superposed the shift in clean energy demand. Public funding for renewables started to dry, and renewables R&D was effectively halved by 1986 (Jacobsson and Lauber, 2006, 261). This reversal

[2]The fact that coal production was mainly located in SPD strongholds might have played a role too.

[3]The opposition was represented by the Christian Democrats (CDU) only, as the Free Liberals (FDP) were part of the coalition government with the SPD.

illustrates the importance of political competition p and partisan preferences B.

In 1986, another major exogenous shock hit Germany. The Chernobyl nuclear catastrophe shifted public opinion against nuclear power. While the country had remained evenly split on nuclear power before the event, polls reported that over 70% of respondents were now against nuclear energy and only 10% supported it (Jahn, 1992). By that time, a small but growing renewables industry had also emerged. Indeed, previous R&D policies had created incentives for universities, entrepreneurs, and the German industry to launch various renewable energy production projects (Jacobsson and Lauber, 2006, 263).[4] Furthermore, these actors organized as interest groups that brought together stakeholders from the private sector, academic institutions, and the civil society. Their influence soon reached the Bundestag. Herman Scheer, the head of Eurosolar (a solar energy interest group), was for instance also a member of the Bundestag for the SPD since 1980 (Scheer, 1999).

Given the growth of the renewables industry, Chernobyl affected German energy politics in a context characterized by higher positive reinforcement δ. Consistent with our model, even the conservative CDU government implemented policies to support renewables.[5] The 'greening' of German politics took place across the political spectrum. The SPD moved away from Schmidt's pro-nuclear stance while the Green Party emerged as a potential rival for center and left votes. Support for renewables increasingly included market tools (Bechberger, 2000). For example, according to Laird and Stefes (2009, 2624) the feed-in tariff "turned out to be a very effective means to promote renewable energy." Positive reinforcement mechanisms had by now allowed the renewable energy industry to pull its weight in the political debate on German energy policies.

By the mid-1990s, a strong renewable industry – especially wind – had emerged in Germany (Michaelowa, 2005). Yet a new struggle was to emerge. With elections looming in 1998, the CDU government started to strategically shift back to conservative energy policies. Major business lobbies, such as the utilities group VDEW, argued for reduced renewables subsidies given their high cost. In fact, the number of wind turbines installed in 1996 for the first time since the early 1980's while the same happened to solar installations in the year of the elections (Jacobsson and Lauber,

[4]The wind and solar energy industries in particular seemed promising.

[5]This change was further encouraged by the emerging worries about climate change.

2006). Hence, after almost two decades of virtually uninterrupted growth, the expansion of the renewable energy sector came to a sudden halt in the years preceding the first shift of power since 1982. Consistent with our theoretical argument, the growth of the renewables advocacy coalition did *not* remove the fundamental political tension surrounding expensive public support to renewables. Equally important, the upcoming elections – high loss probability p – amplified the underinvestment incentive of a conservative government.

The CDU government nevertheless faced internal opposition from its own ranks, showing how renewables had already become 'mainstream' (Salje, 1998; Hustedt, 1998). Additionally, the "political and legal challenge to renewable energy incited massive campaigning by its supporters" (Laird and Stefes, 2009, 2623), such as trade unions and the German Engineering Association, testifying to the increasing strength of the renewables advocacy coalition. In the end, the efforts to undermine the extant renewables policy largely failed. In 1998, the CDU government was replaced by a SPD-Greens coalition. As our model predicts, the rapid shift in the government's preferences produced a substantial increase in renewables support. Consistent with our model, the resolution of a political struggle over renewables ushered in an era of steady growth.

The early period of the SPD-Green coalition was marked by political tension. The two parties had pledged to phase out nuclear energy and the debate soon became highly partisan (Ruedig, 2000). In the opposition, the conservative CDU promised a policy reversal if the party was to regain power in 2002 (it did not), thus underscoring its support to traditional energy sources (Ruedig, 2000, 44). On the other hand, the SPD-Green coalition aggressively encouraged the development of new markets for renewables (Staiss, 2003). Again, the remarkable growth of renewables use has not reduced political tensions.

The partisan rivalry did not dampen when Angela Merkel's CDU regained power in 2005.[6] As Laird and Stefes (2009, 2626) underline, the renewables advocacy coalition had by now grown very powerful. These developments illustrate an important fact about the politics of clean energy: the growing strength of the renewables advocacy coalition may tilt the power balance, but it generally does *not* mitigate the effects of partisan preferences and political competition on energy policy.

[6] In a grand coalition with the SPD until 2009, and with its natural ally the FDP since then.

In sum, the emergence of the renewables sector in Germany highlights many of the important features of our game. Far from simple path dependence, the German renewables history testifies to complex interactions between exogenous shocks, positive reinforcement, partisan preferences, and political competition. First, a 1973 positive exogenous shock $Y > 0$ triggered a structural shift from coal and nuclear energy towards a renewables. While the initial policy response did not have substantial direct effects over time, it laid the foundation for renewables growth. The Chernobyl catastrophe illustrates how a positive exogenous shock $Y > 0$ can have powerful effects given positive reinforcement δ. Second, partisan preferences and political competition exerted powerful influence on the growth of the renewables industry. The early Kohl administration in 1982 scaled back from previous commitment made under the center-Left SPD regime, while the SPD-Green alliance rapidly developed a comprehensive program favorable to renewable energy production in 1998. These policies were partially reversed by the CDU after 2005, but the newly powerful renewables advocacy coalition was able to limit the damage. Perhaps the most intriguing phase is the contest over renewable energy before the upcoming 1998 elections, as the conservative CDU government suddenly began to undermine the renewables industry in view of a possible electoral loss.

A3.2 France

The French case shows that in the absence of constituencies with a direct interest in clean energy and weak positive reinforcement δ for clean energy, exogenous shocks $Y > 0$ may not produce sustained effects. The complete dominance of the nuclear industry prevented renewables growth, so neither the 1973 oil crisis nor the Chernobyl nuclear catastrophe reversed the course of French energy policy.

The roots of current French energy policy are located in the postwar period. Under the influence of General de Gaulle, the country rapidly decided to launch an ambitious nuclear program. This program was to reduce France's dependence on the United States for security and help recover its status as a major power (Finnis, Grisez, and Boyle, 1988). The use of nuclear technology soon helped create a sizable energy industry, mainly centered around *Electricité de France* (EDF) (Hecht, 2009)).

The 1973 oil crisis created a sense of urgency in French energy policy. Extensive negotiations between representatives from industry, political leaders (President Georges Pompidou), and energy producers increased the country's nuclear ambitions (Nelkin and Pollack, 1980). This shift also received broad support across the political spectrum (Puisieux, 1982; Rothman and Lichter, 1987, 613). The influence of EDF was central: alternative solutions such as renewables were quickly discarded. By the end of the 1970's, R&D investments in nuclear power were four times the combined R&D investment in renewables and energy efficiency (Puisieux, 1982, 614). Thus, no renewables advocacy coalition emerged from the 1973 oil crisis.

The Socialist candidate François Mitterrand's victory in the 1981 presidential election did not reduce nuclear dominance. The marginal cost of energy had sunk to record lows, and the production surplus could be sold to neighboring countries, increasing the regional influence of France (Chevènement, 1981). When the Chernobyl catastrophe unfolded, the political consensus was firmly pro-nuclear. The share of nuclear energy in energy consumption had massively increased, while that of oil had fallen (Ikenberry, 1986). The Chernobyl accident could not stimulate a non-existent renewables industry and hence nuclear growth continued unabated throughout the 1980's (Hadjilambrinos, 2000). Thus, the absence of positive reinforcement δ for renewables undermined the potential effect of an exogenous shock $Y > 0$ that should have favored renewables and hurt the nuclear industry. Similarly, partisan preferences A, B were so closely aligned that political competition had virtually no role.

On the contrary, both government interest in and positive reinforcement for nuclear energy were strong in France. Given that France had initially built a large nuclear industry, the energy utilities had a vested interest in nuclear power. Additionally, positive reinforcement was strong because nuclear installations have very long life spans. Therefore, French responses to exogenous shocks were almost exclusively centered on nuclear energy. This contrast shows the importance of technology competition for political-economic outcomes under salient exogenous shocks.

A comparison of outcomes with Germany is striking. By 1990, Germany produced 1% of its electricity from (non-hydro) renewables. France was slightly behind at 0.4%. By 2000 and 2007 respectively, Germany saw an increase to 3% and 11% while France remained relatively stable at

0.8% and 1.7%.[7] By contrast, French nuclear power had steadily increased to just below 70% by 1986 (the year of the Chernobyl accident) and continued to increase to just below 80% in the early 2000's. Figure A3 shows the development of renewable and nuclear energy in France and Germany.

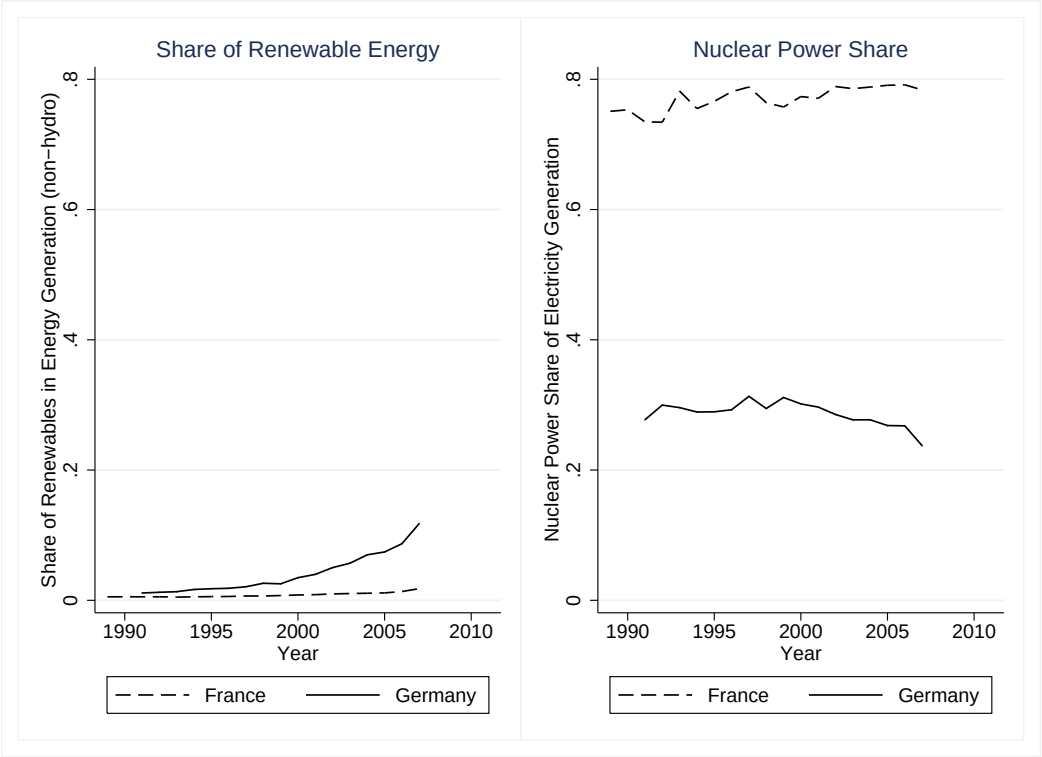

Figure A3: Renewable Energy Share of Energy Generation.

In sum, our model fits the French case well. The lack of positive reinforcement prevented growth in response to the 1973 oil crisis. Similarly, the political competitor Mitterrand's is explained. Although leftist governments are generally more supportive of renewables, the enormous influence of the EDF made renewables support a politically very costly strategy.

Comparing France and Germany, we note the following facts. For historical (perhaps accidental) reasons, France embarked on a path of aggressive nuclear expansion whereas Germany exercised more restraint. This largely accidental difference created diverging trajectories, or path dependence. However, the German emphasis on clean energy emerged from an intense political struggle on energy policy.

[7]Data from the United States Energy Information Administration at `http://www.eia.doe.gov/international`, accessed August 27, 2010.

A4 Robustness Overview

We subjected our results to a battery of robustness tests, which we detail here and report below.

- Table A1: summary statistics.
- Table A2: original results.
- Table A3: replacing the patents variable by data from the European Patent Office (EPO). This data will inevitably be more eurocentric, but is still relatively highly correlated to our main innovation variable ($\rho = 0.9$).
- Table A4: oil prices are replaced by a three year moving average of oil prices (between $t-3$ and t). replaced the price of oil in constant dollar by a moving average (between $t-3$ and t) of oil prices (in constant prices). It is plausible that political reactions to oil prices (i) are more likely to respond to some longer period of high (or low) oil prices, and (ii) the political reaction is lagged.
- Table A5: replacing renewable energy capacity as the dependent variable by energy generation.
- Table A6: using the log of the innovation variable (independent variable).
- Table A7: using the log of renewable energy capacity (dependent variable).
- Table A8: using post-1995 data only.
- Table A9: using traditional OECD countries only (i.e. dropping Chile, Czech Republic, Hungary, Mexico, Poland, Slovakia, and Turkey).
- Table A10: reporting clustered standard errors by years
- Table A11: including country fixed effects.
- Table A12: assuming that the error term follows an AR(1) process. Notice that the Wooldridge tests never rejected the null of no serial correlation (with p values generally greater than 0.9).

- Table A13: replacing traditional energy share by its three year moving average (from $t-3$ until $t-1$).
- Table A14-A16: see below.

A5 Renewable Energy Growth and Policies

Since our dependent variable is not a direct measure of policy, we explored the extent to which renewables growth is correlated to policies. Unfortunately, as we state in the main article, few such measures exist, and the time series for the ones that do exist are short. Nevertheless, we verified that renewable energy growth is correlated to feed-in tariffs. The data are from Johnstone, Hascic, and Popp (2010) and covers 25 OECD countries between 1989 and 2005.

The bivariate correlation coefficient between the mean feed-in tariff, summed across several sources of renewable energy and lagged by one year (the results are virtually identical when not lagged), and renewable energy growth is positive ($\rho = 0.3$) and highly significant (significant at the 0.0000 level). We illustrate the bivariate relation in Figure A4.

We verify the robustness of these findings in a regression setting. The results are reported in Table A14, where we use feed-in tariffs to explain renewable energy capacity. We find that the effect is positive and highly significant in all models, even though the sample size is much smaller than in our other analyses. These findings emphasize the strong association between renewable energy growth and policy.

A6 Positive Reinforcement: An Alternative Measure

We replaced our measure of positive reinforcement – the number of patents applications by capita – by two alternative variables to ensure that we capture the political dimension of reinforcement. First, we replace our original measure of reinforcement by the share of labor working in the high-technology sector (measured on the $[0, 1]$ interval). The data are available for 22 members of the European Union between 1994 and 2008.[8] Figure A5 shows the bivariate relation between high tech employment share and patents per capita, underlying their relationship. The correlation coefficient between these two variables is $\rho = 0.49$ and the estimate is highly significant.

Having established the link between high-tech employment share and patents per capita, we further verified that the former is a good determinant of renewable energy growth. Table A15 reports the results for the reduced form analysis, in which we replaced patents per capita by the share of workers in the high tech sector. The results are qualitatively identical to our initial findings.

Finally, we estimated a two-step model with 2-stage least squares (2-SLS), in which the initial reinforcement variable and its interaction with oil are instrumented by the high tech employment share and its interaction with oil. The results of the second stage are reported in Table A16. We find that the results are similar to the initial results, although the smaller sample size leads to larger standard errors. The two main assumptions of 2-SLS are (i) that the instrument only affects the dependent variable through the variable to be instrumented (exclusion restriction) and the instrument is uncorrelated with the error term (in the limit as $n \to \infty$) in the main equation to be estimated; (ii) the instrument is correlated with the variable to be instrumented (Sovey and Green, 2011). Regarding the latter, the F statistic of the first stage is between 4 and 6, depending on the specification, pointing to a potential weak instrument issue. However, the bivariate relation between positive reinforcement and the share of workers in high technology employment is highly positive and significant with F statistics above 30. Hence, the increase in standard errors is due jointly to the decreasing number of observations and the statistical noise.

Second, we examined whether the number of high tech firms is a good predictor of total patents.[9]

[8] Data available at `http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database` (accessed on November 1, 2011).

[9] Data available at `http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database`

(Since analyzing firms per capita has no clear meaning, we only use absolute values.) We relate the absolute number of high tech firms in any country-year to the absolute number of patents. The correlation is positive ($\rho = 0.47$) and highly significant. Figure A6 illustrates this relation.

(accessed on November 1, 2011).

A7 Tables

Table A1: Summary Statistics

	count	mean	sd	min	max
Δ Renewable Capacity	520	0.48	1.02	-3.95	9.36
Pos. Reinforcement (t-1)	520	0.44	0.96	0.00	10.60
Oil Prices (2009 USD)	520	38.65	20.62	16.74	96.91
Pos. Reinforcement (t-1) * Oil	520	23.21	71.23	0.00	1027.33
Left Government	520	0.45	0.50	0.00	1.00
Right Government	520	0.44	0.50	0.00	1.00
Left to Right Exec.	520	0.04	0.21	0.00	1.00
Right to Left Exec.	520	0.04	0.20	0.00	1.00
Election Year	520	0.30	0.46	0.00	1.00
Renewable Capacity (3 year average)	520	1.65	3.86	0.00	27.29
Hydro + Nuclear Share (3 year average)	520	0.42	0.30	0.00	1.00
Traditional Electricity Share	520	0.55	0.30	0.00	0.99
Income Growth	520	0.02	0.03	-0.13	0.13
GDP per capita (K$)	520	25.76	9.51	5.65	51.09
Gov. Share of Income	520	9.23	2.64	2.58	16.53
Investment Share of Income	520	22.63	5.26	10.39	47.79
Trade Openness	520	65.47	31.91	16.10	177.92

Table A2: Explaining Growth of Renewable Energy Share

	(1) Model	(2) Model	(3) Model	(4) Model	(5) Model	(6) Model
Pos. Reinforcement (t-1) * Oil	-0.006**	-0.005*	-0.006**	-0.005*	-0.005**	-0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Oil Prices (2009 USD)	0.016***	0.012***	0.012***	0.014***	0.011***	0.013***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Pos. Reinforcement (t-1)	0.542**	0.498**	0.439**	0.424*	0.375*	0.358
	(0.214)	(0.227)	(0.217)	(0.223)	(0.218)	(0.224)
Left to Right Exec.	-0.209*	-0.216*	-0.239**	-0.243**	-0.212**	-0.219**
	(0.116)	(0.116)	(0.112)	(0.114)	(0.101)	(0.100)
Right to Left Exec.	0.250**	0.307***	0.255**	0.305***	0.243**	0.288**
	(0.106)	(0.113)	(0.104)	(0.111)	(0.116)	(0.124)
Left Government	-0.053	-0.047	-0.007	0.002	0.200	0.196
	(0.108)	(0.100)	(0.111)	(0.108)	(0.132)	(0.132)
Right Government	-0.139	-0.112	-0.077	-0.056	0.059	0.068
	(0.131)	(0.126)	(0.149)	(0.146)	(0.168)	(0.168)
Election Year	-0.122*	-0.163**	-0.135**	-0.173***	-0.132**	-0.174***
	(0.064)	(0.070)	(0.060)	(0.066)	(0.059)	(0.065)
Renewable Capacity (3 year average)			0.014***	0.015***	0.023***	0.024***
			(0.004)	(0.004)	(0.007)	(0.007)
Hydro + Nuclear Share (3 year average)			-2.418**	-2.364**	-2.624**	-2.553**
			(1.176)	(1.179)	(1.241)	(1.250)
Year			0.010	-0.025***	-0.008	-0.044***
			(0.010)	(0.003)	(0.008)	(0.004)
Traditional Electricity Share			-2.195*	-2.157*	-2.312*	-2.265*
			(1.233)	(1.235)	(1.288)	(1.295)
GDP per capita (K$)					0.007**	0.006*
					(0.003)	(0.003)
Gov. Share of Income					0.009	0.010
					(0.012)	(0.012)
Investment Share of Income					0.029***	0.028***
					(0.010)	(0.010)
Trade Openness					0.005***	0.005***
					(0.001)	(0.001)
Income Growth					-3.195**	-3.558**
					(1.335)	(1.426)
Constant	-0.103	0.191	-17.173	53.184***	16.516	90.073***
	(0.131)	(0.119)	(19.012)	(6.755)	(14.886)	(8.462)
Year FE	No	Yes	No	Yes	No	Yes
Observations	521	521	520	520	520	520
R^2	0.135	0.173	0.157	0.192	0.193	0.226
$\hat{\sigma}$	0.952	0.947	0.945	0.940	0.929	0.924

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: EU Patents

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (EU, t-1)	0.534**	0.517**	0.333	0.309
	(0.220)	(0.226)	(0.209)	(0.217)
Oil Prices (2009 USD)	0.012***	0.014***	0.009***	0.012***
	(0.003)	(0.001)	(0.003)	(0.002)
Pos. Reinforcement (EU, t-1) * Oil	-0.005*	-0.005*	-0.004	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Left Government	-0.059	-0.045	0.183	0.184
	(0.107)	(0.103)	(0.131)	(0.131)
Right Government	-0.141	-0.117	0.045	0.060
	(0.136)	(0.132)	(0.167)	(0.167)
Left to Right Exec.	-0.202*	-0.206*	-0.197**	-0.208**
	(0.108)	(0.109)	(0.099)	(0.099)
Right to Left Exec.	0.255**	0.304***	0.241**	0.288**
	(0.101)	(0.108)	(0.114)	(0.121)
Election Year	-0.123**	-0.163**	-0.124**	-0.168***
	(0.062)	(0.068)	(0.058)	(0.064)
Renewable Capacity (3 year average)	0.012***	0.013***	0.021***	0.022***
	(0.004)	(0.004)	(0.007)	(0.007)
Hydro + Nuclear Share (3 year average)	-0.183**	-0.168*	-2.434**	-2.406**
	(0.092)	(0.089)	(1.208)	(1.215)
Year	0.010	-0.027***	-0.005	-0.046***
	(0.010)	(0.003)	(0.007)	(0.004)
GDP per capita (K$)			0.007**	0.006**
			(0.003)	(0.003)
Gov. Share of Income			0.009	0.010
			(0.012)	(0.012)
Investment Share of Income			0.028***	0.027***
			(0.010)	(0.010)
Trade Openness			0.005***	0.005***
			(0.001)	(0.001)
Traditional Electricity Share			-2.156*	-2.151*
			(1.254)	(1.260)
Income Growth			-2.892**	-3.311**
			(1.298)	(1.416)
Constant	-19.536	54.339***	12.033	92.765***
	(19.065)	(5.923)	(14.072)	(8.274)
Observations	520	520	520	520
R^2	0.146	0.181	0.186	0.221

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Oil Moving Average

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.531**	0.523**	0.356	0.358
	(0.241)	(0.250)	(0.232)	(0.242)
Oil Price (3 year average)	0.013***	0.023***	0.009**	0.019***
	(0.004)	(0.004)	(0.004)	(0.004)
Pos. Reinforcement (t-1) * Oil (3 yrs)	-0.008*	-0.008*	-0.007*	-0.007
	(0.004)	(0.005)	(0.004)	(0.004)
Left Government	-0.073	-0.042	0.191	0.195
	(0.104)	(0.105)	(0.131)	(0.131)
Right Government	-0.145	-0.114	0.060	0.066
	(0.132)	(0.132)	(0.166)	(0.167)
Left to Right Exec.	-0.211*	-0.207*	-0.212**	-0.210**
	(0.109)	(0.112)	(0.097)	(0.099)
Right to Left Exec.	0.248**	0.296***	0.242**	0.284**
	(0.101)	(0.109)	(0.116)	(0.122)
Election Year	-0.129**	-0.165**	-0.137**	-0.170***
	(0.065)	(0.069)	(0.060)	(0.064)
Renewable Capacity (3 year average)	0.016***	0.015***	0.024***	0.024***
	(0.004)	(0.004)	(0.007)	(0.007)
Hydro + Nuclear Share (3 year average)	-0.229***	-0.216***	-2.797**	-2.545**
	(0.086)	(0.083)	(1.222)	(1.247)
Year	0.028***	-0.026***	0.009*	-0.043***
	(0.006)	(0.003)	(0.005)	(0.003)
GDP per capita (K$)			0.008**	0.006**
			(0.003)	(0.003)
Gov. Share of Income			0.009	0.011
			(0.012)	(0.012)
Investment Share of Income			0.030***	0.028***
			(0.010)	(0.010)
Trade Openness			0.005***	0.005***
			(0.001)	(0.001)
Traditional Electricity Share			-2.492**	-2.260*
			(1.269)	(1.292)
Income Growth			-3.282**	-3.517**
			(1.277)	(1.409)
Constant	-55.772***	51.596***	-16.378*	86.796***
	(11.325)	(6.046)	(9.484)	(7.176)
Observations	520	520	520	520
R^2	0.129	0.178	0.180	0.224

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Energy Generation as Dep. Var.

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.008**	0.008**	0.006**	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)
Oil Prices (2009 USD)	0.000***	0.000**	0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Pos. Reinforcement (t-1) * Oil	-0.000	-0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Left Government	-0.003*	-0.003*	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Right Government	-0.003*	-0.003*	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Left to Right Exec.	-0.001	-0.001	-0.002	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Right to Left Exec.	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.002)
Election Year	-0.001	-0.001	-0.001*	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Renewable Capacity (3 year average)	0.000*	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Hydro + Nuclear Share (3 year average)	-0.000	-0.001	-0.043***	-0.043***
	(0.001)	(0.001)	(0.014)	(0.015)
Year	0.000	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
GDP per capita (K$)			-0.000	-0.000
			(0.000)	(0.000)
Gov. Share of Income			0.000***	0.000***
			(0.000)	(0.000)
Investment Share of Income			0.000***	0.000***
			(0.000)	(0.000)
Trade Openness			0.000**	0.000**
			(0.000)	(0.000)
Traditional Electricity Share			-0.043***	-0.043***
			(0.014)	(0.015)
Income Growth			-0.018	-0.026
			(0.018)	(0.017)
Constant	-0.145	-0.771***	-0.064	-0.675***
	(0.269)	(0.097)	(0.242)	(0.112)
Observations	493	493	493	493
R^2	0.119	0.155	0.173	0.210

Standard errors in parentheses
Dependent Variable: Δ Renewable Generation (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Log (Innovation)

	(1) Model	(2) Model
Pos. Reinforcement (total) (log)	1.280***	1.092**
	(0.388)	(0.432)
Oil Prices (2009 USD)	0.015***	0.013***
	(0.004)	(0.004)
Pos. Reinforcement (log) * Oil	-0.015**	-0.015**
	(0.006)	(0.006)
Left Government	-0.063	0.181
	(0.146)	(0.167)
Right Government	-0.136	0.047
	(0.155)	(0.170)
Left to Right Exec.	-0.223	-0.216
	(0.162)	(0.158)
Right to Left Exec.	0.250	0.258
	(0.190)	(0.188)
Election Year	-0.134	-0.141
	(0.095)	(0.090)
Renewable Capacity (3 year average)	0.013*	0.025***
	(0.007)	(0.010)
Hydro + Nuclear Share (3 year average)	-0.274*	-2.448**
	(0.140)	(1.186)
Year	0.004	-0.010
	(0.012)	(0.012)
GDP per capita (K$)		0.004
		(0.006)
Gov. Share of Income		0.008
		(0.015)
Investment Share of Income		0.031***
		(0.007)
Trade Openness		0.005***
		(0.001)
Traditional Electricity Share		-2.141*
		(1.233)
Income Growth		-3.333**
		(1.635)
Constant	-8.271	21.858
	(24.225)	(22.991)
Observations	520	520
R^2	0.157	0.200

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Log (Dependent Variable)

	(1) Model	(2) Model
Pos. Reinforcement (t-1)	0.005	0.005
	(0.031)	(0.036)
Oil Prices (2009 USD)	0.003*	0.004**
	(0.002)	(0.002)
Pos. Reinforcement (t-1) * Oil	-0.000	-0.000
	(0.000)	(0.000)
Left Government	0.132**	0.156**
	(0.056)	(0.072)
Right Government	0.124**	0.152**
	(0.060)	(0.068)
Left to Right Exec.	-0.032	-0.016
	(0.068)	(0.067)
Right to Left Exec.	-0.064	-0.065
	(0.106)	(0.104)
Election Year	-0.002	-0.006
	(0.040)	(0.039)
Renewable Capacity (3 year average)	-0.011***	-0.006
	(0.003)	(0.004)
Hydro + Nuclear Share (3 year average)	-0.164***	0.169
	(0.038)	(0.369)
Year	-0.006	-0.011
	(0.007)	(0.008)
GDP per capita (K$)		-0.001
		(0.003)
Gov. Share of Income		0.011
		(0.009)
Investment Share of Income		0.005
		(0.006)
Trade Openness		0.001*
		(0.001)
Traditional Electricity Share		0.327
		(0.371)
Income Growth		1.236
		(0.782)
Constant	12.566	21.210
	(14.321)	(15.201)
Observations	485	485
R^2	0.040	0.060

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro) (log).
All models estimated with panel-corrected standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A8: Post 1995 Data

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.475**	0.496**	0.286	0.306
	(0.234)	(0.237)	(0.229)	(0.232)
Oil Prices (2009 USD)	0.008**	0.009**	0.006	0.005
	(0.004)	(0.003)	(0.003)	(0.003)
Pos. Reinforcement (t-1) * Oil	-0.005*	-0.006*	-0.004	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Left Government	-0.176	-0.156	0.173	0.202
	(0.111)	(0.108)	(0.171)	(0.170)
Right Government	-0.306*	-0.298*	-0.007	0.005
	(0.166)	(0.165)	(0.213)	(0.213)
Left to Right Exec.	-0.237*	-0.231*	-0.266**	-0.258**
	(0.132)	(0.136)	(0.123)	(0.125)
Right to Left Exec.	0.428***	0.424***	0.408***	0.404**
	(0.114)	(0.126)	(0.147)	(0.160)
Election Year	-0.151*	-0.188**	-0.157**	-0.193**
	(0.077)	(0.086)	(0.072)	(0.079)
Renewable Capacity (3 year average)	0.021***	0.021***	0.026***	0.027***
	(0.005)	(0.005)	(0.007)	(0.007)
Hydro + Nuclear Share (3 year average)	-0.271***	-0.269***	-3.160**	-3.008**
	(0.097)	(0.096)	(1.443)	(1.449)
Year	0.036**	0.037***	0.013	0.017**
	(0.016)	(0.007)	(0.012)	(0.007)
GDP per capita (K$)			0.010**	0.010**
			(0.004)	(0.004)
Gov. Share of Income			-0.002	-0.003
			(0.011)	(0.012)
Investment Share of Income			0.028**	0.029**
			(0.012)	(0.012)
Trade Openness			0.005***	0.005***
			(0.001)	(0.001)
Traditional Electricity Share			-2.814*	-2.666*
			(1.507)	(1.512)
Income Growth			-3.016	-3.333
			(1.956)	(2.155)
Constant	-71.118**	-73.965***	-24.510	-32.411**
	(31.652)	(14.154)	(24.164)	(14.403)
Observations	389	389	389	389
R^2	0.146	0.167	0.199	0.218

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A9: Traditional OECD Members

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.475**	0.459**	0.410*	0.390
	(0.218)	(0.226)	(0.237)	(0.247)
Oil Prices (2009 USD)	0.017***	0.019***	0.015***	0.017***
	(0.004)	(0.002)	(0.004)	(0.003)
Pos. Reinforcement (t-1) * Oil	-0.006**	-0.006*	-0.006**	-0.006*
	(0.003)	(0.003)	(0.003)	(0.003)
Left Government	0.117	0.133	0.387**	0.396**
	(0.141)	(0.140)	(0.173)	(0.173)
Right Government	-0.048	-0.028	0.160	0.174
	(0.156)	(0.153)	(0.178)	(0.177)
Left to Right Exec.	-0.202	-0.194	-0.184	-0.191
	(0.186)	(0.191)	(0.181)	(0.187)
Right to Left Exec.	0.190	0.250	0.209	0.267
	(0.213)	(0.217)	(0.208)	(0.211)
Election Year	-0.116	-0.154	-0.108	-0.147
	(0.105)	(0.111)	(0.101)	(0.107)
Renewable Capacity (3 year average)	0.002	0.003	0.026**	0.027***
	(0.008)	(0.008)	(0.010)	(0.010)
Hydro + Nuclear Share (3 year average)	-0.386**	-0.384**	-2.650*	-2.535*
	(0.156)	(0.155)	(1.493)	(1.520)
Year	0.011	-0.030***	0.001	-0.044***
	(0.012)	(0.007)	(0.012)	(0.008)
GDP per capita (K$)			-0.013	-0.016*
			(0.009)	(0.009)
Gov. Share of Income			0.013	0.013
			(0.029)	(0.029)
Investment Share of Income			0.027***	0.026**
			(0.010)	(0.010)
Trade Openness			0.007***	0.007***
			(0.002)	(0.002)
Traditional Electricity Share			-2.341	-2.235
			(1.532)	(1.560)
Income Growth			-3.013	-4.146
			(2.480)	(2.778)
Constant	-22.046	59.629***	-1.249	90.262***
	(24.844)	(13.323)	(23.167)	(15.415)
Observations	416	416	416	416
R^2	0.151	0.192	0.200	0.242

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A10: Clustered Standard Errors

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.524**	0.509**	0.375	0.358
	(0.188)	(0.189)	(0.218)	(0.221)
Oil Prices (2009 USD)	0.013**	0.015***	0.011*	0.013***
	(0.005)	(0.003)	(0.005)	(0.003)
Pos. Reinforcement (t-1) * Oil	-0.006*	-0.006	-0.005	-0.005
	(0.003)	(0.003)	(0.003)	(0.003)
Left Government	-0.054	-0.042	0.200	0.196
	(0.179)	(0.179)	(0.127)	(0.127)
Right Government	-0.134	-0.113	0.059	0.068
	(0.208)	(0.215)	(0.169)	(0.176)
Left to Right Exec.	-0.215	-0.217	-0.212	-0.219
	(0.154)	(0.157)	(0.144)	(0.144)
Right to Left Exec.	0.252	0.300	0.243	0.288
	(0.252)	(0.277)	(0.249)	(0.275)
Election Year	-0.128**	-0.169***	-0.132**	-0.174***
	(0.047)	(0.053)	(0.053)	(0.059)
Renewable Capacity (3 year average)	0.015*	0.015**	0.023**	0.024**
	(0.007)	(0.007)	(0.009)	(0.010)
Hydro + Nuclear Share (3 year average)	-0.236	-0.221	-2.624*	-2.553*
	(0.142)	(0.146)	(1.261)	(1.304)
Year	0.009	-0.025***	-0.008	-0.044***
	(0.019)	(0.006)	(0.021)	(0.007)
GDP per capita (K$)			0.007	0.006
			(0.004)	(0.004)
Gov. Share of Income			0.009	0.010
			(0.013)	(0.014)
Investment Share of Income			0.029**	0.028*
			(0.014)	(0.014)
Trade Openness			0.005***	0.005***
			(0.002)	(0.002)
Traditional Electricity Share			-2.312*	-2.265
			(1.328)	(1.371)
Income Growth			-3.195**	-3.558**
			(1.399)	(1.652)
Constant	-17.171	50.967***	16.516	90.073***
	(38.543)	(11.013)	(41.366)	(14.723)
Observations	520	520	520	520
R^2	0.145	0.181	0.193	0.226

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with clustered standard errors (by year).
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A11: Country FE

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.159	0.139	0.138	0.116
	(0.228)	(0.229)	(0.220)	(0.227)
Oil Prices (2009 USD)	0.013***	0.015***	0.010***	0.014***
	(0.002)	(0.001)	(0.002)	(0.001)
Pos. Reinforcement (t-1) * Oil	-0.003	-0.003	-0.004*	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Left Government	0.012	0.050	0.103	0.122
	(0.210)	(0.209)	(0.225)	(0.228)
Right Government	-0.125	-0.075	-0.026	0.001
	(0.231)	(0.231)	(0.239)	(0.242)
Left to Right Exec.	-0.207**	-0.209**	-0.231***	-0.226**
	(0.083)	(0.088)	(0.086)	(0.090)
Right to Left Exec.	0.163*	0.226**	0.174*	0.229**
	(0.096)	(0.103)	(0.103)	(0.111)
Election Year	-0.123**	-0.164**	-0.121*	-0.162**
	(0.059)	(0.065)	(0.064)	(0.069)
Renewable Capacity (3 year average)	0.038***	0.039***	0.056***	0.056***
	(0.011)	(0.012)	(0.009)	(0.009)
Hydro + Nuclear Share (3 year average)	0.577	0.796	0.652	0.864
	(1.169)	(1.149)	(1.125)	(1.120)
Year	0.018*	-0.022***	-0.018	-0.055***
	(0.009)	(0.003)	(0.011)	(0.008)
Traditional Electricity Share	-0.041	-0.078	-0.187	-0.229
	(0.900)	(0.933)	(0.938)	(0.980)
GDP per capita (K$)			0.034**	0.029**
			(0.014)	(0.014)
Gov. Share of Income			0.305***	0.317***
			(0.058)	(0.058)
Investment Share of Income			0.082***	0.079***
			(0.024)	(0.025)
Trade Openness			0.011***	0.011***
			(0.003)	(0.002)
Income Growth			-2.087*	-2.347*
			(1.137)	(1.249)
Constant	-35.804*	43.012***	28.181	102.881***
	(18.324)	(6.380)	(21.976)	(15.045)
Observations	520	520	520	520
R^2	0.304	0.340	0.343	0.376
$\hat{\sigma}$	0.883	0.875	0.862	0.855

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A12: AR(1)

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	0.148	0.231	0.092	0.167
	(0.253)	(0.254)	(0.237)	(0.243)
Oil Prices (2009 USD)	0.013***	0.009***	0.011***	0.006***
	(0.003)	(0.002)	(0.003)	(0.002)
Pos. Reinforcement (t-1) * Oil	-0.001	-0.002	-0.001	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Left Government	-0.128	-0.094	0.102	0.129
	(0.164)	(0.147)	(0.172)	(0.161)
Right Government	-0.201	-0.154	-0.046	0.000
	(0.203)	(0.183)	(0.220)	(0.204)
Left to Right Exec.	-0.249***	-0.236**	-0.229**	-0.217**
	(0.096)	(0.103)	(0.092)	(0.095)
Right to Left Exec.	0.098	0.144	0.062	0.124
	(0.090)	(0.099)	(0.097)	(0.108)
Election Year	-0.108**	-0.144***	-0.110**	-0.144***
	(0.048)	(0.055)	(0.045)	(0.052)
Renewable Capacity (3 year average)	0.012**	0.014***	0.020**	0.023**
	(0.005)	(0.005)	(0.009)	(0.009)
Hydro + Nuclear Share (3 year average)	-0.182	-0.174	-1.675*	-1.823*
	(0.139)	(0.121)	(0.976)	(1.102)
Year	0.002	0.000**	-0.020*	0.000
	(0.013)	(0.000)	(0.011)	(0.001)
GDP per capita (K$)			0.012***	0.009**
			(0.005)	(0.004)
Gov. Share of Income			0.022	0.020
			(0.016)	(0.015)
Investment Share of Income			0.041***	0.034***
			(0.014)	(0.013)
Trade Openness			0.004***	0.005***
			(0.001)	(0.001)
Traditional Electricity Share			-1.366	-1.547
			(1.050)	(1.167)
Income Growth			-1.718	-2.205
			(1.283)	(1.396)
Constant	-3.386		40.240*	
	(26.378)		(21.641)	
Observations	520	520	520	520
R^2	0.071	0.124	0.098	0.155

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors and an AR(1).
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A13: Traditional Energy Share: 3 Year Moving Average

	(1) Model	(2) Model	(3) Model	(4) Model	(5) Model	(6) Model
Left to Right Exec.	-0.209*	-0.216*	-0.211**	-0.212**	-0.181*	-0.184*
	(0.116)	(0.116)	(0.106)	(0.108)	(0.096)	(0.095)
Right to Left Exec.	0.250**	0.307***	0.273***	0.324***	0.261**	0.309***
	(0.106)	(0.113)	(0.102)	(0.110)	(0.110)	(0.118)
Pos. Reinforcement (t-1) * Oil	-0.006**	-0.005*	-0.006**	-0.005*	-0.005**	-0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Oil Prices (2009 USD)	0.016***	0.012***	0.013***	0.014***	0.012***	0.014***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Pos. Reinforcement (t-1)	0.542**	0.498**	0.432*	0.416*	0.354	0.337
	(0.214)	(0.227)	(0.222)	(0.227)	(0.221)	(0.228)
Left Government	-0.053	-0.047	-0.029	-0.018	0.173	0.172
	(0.108)	(0.100)	(0.107)	(0.105)	(0.118)	(0.119)
Right Government	-0.139	-0.112	-0.108	-0.086	0.026	0.036
	(0.131)	(0.126)	(0.139)	(0.136)	(0.151)	(0.150)
Election Year	-0.122*	-0.163**	-0.136**	-0.176***	-0.131**	-0.175***
	(0.064)	(0.070)	(0.061)	(0.068)	(0.059)	(0.066)
Renewable Capacity (3 year average)			0.014***	0.014***	0.022***	0.023***
			(0.004)	(0.004)	(0.007)	(0.008)
Hydro + Nuclear Share (3 year average)			-4.101*	-4.065*	-4.436*	-4.378*
			(2.281)	(2.264)	(2.341)	(2.338)
Year			0.004	-0.030***	-0.014*	-0.050***
			(0.009)	(0.005)	(0.008)	(0.006)
Traditional Electr. Generation Share (3 yr average)			-3.838*	-3.816*	-4.072*	-4.039*
			(2.318)	(2.301)	(2.360)	(2.355)
GDP per capita (K$)					0.009**	0.007**
					(0.004)	(0.004)
Gov. Share of Income					0.011	0.012
					(0.011)	(0.011)
Investment Share of Income					0.027***	0.026***
					(0.009)	(0.009)
Trade Openness					0.005***	0.005***
					(0.001)	(0.001)
Income Growth					-2.834**	-3.145**
					(1.261)	(1.323)
Constant	-0.103	0.191	-4.920	63.878***	30.951*	102.631***
	(0.131)	(0.119)	(18.270)	(11.631)	(15.965)	(13.973)
Observations	521	521	520	520	520	520
R^2	0.135	0.173	0.161	0.196	0.198	0.232
$\hat{\sigma}$	0.952	0.947	0.942	0.937	0.926	0.921

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) (4) and (6) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A14: Feed-in Policies and Renewable Capcity

	(1) Model	(2) Model	(3) Model	(4) Model
Mean Feed-In Tariff (t-1)	7.731***	5.343***	7.500***	6.605***
	(1.172)	(1.288)	(1.422)	(1.397)
GDP per capita			0.000***	0.000**
			(0.000)	(0.000)
Gov. Share of Income			0.174**	0.175**
			(0.081)	(0.079)
Investment Share of Income			0.073***	0.058***
			(0.019)	(0.018)
Trade Openness			0.002	0.002
			(0.004)	(0.004)
Income Growth			-2.361	-2.361
			(1.631)	(1.721)
Renewable Capacity (3 year average)			0.099***	0.078***
			(0.025)	(0.025)
Hydro + Nuclear Share (3 year average)			2.321*	2.844**
			(1.307)	(1.280)
Year			-0.040**	-0.066***
			(0.018)	(0.020)
Traditional Electricity Share			1.048	1.333
			(0.962)	(0.937)
Constant	0.231***	0.943***	72.413**	126.897***
	(0.045)	(0.137)	(36.289)	(40.079)
Observations	412	412	411	411
R^2	0.101	0.238	0.216	0.298
$\hat{\sigma}$	0.697	0.655	0.657	0.635

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with country fixed effects.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A15: High Tech Employment

	(1) Model	(2) Model
Share Empl. High Tech (t-1)	5.553***	5.049**
	(1.588)	(2.244)
Oil Prices (2009 USD)	0.016*	0.018**
	(0.009)	(0.009)
High Tech Empl * Oil (t-1)	-0.042*	-0.049*
	(0.025)	(0.025)
Left Government	-0.364*	-0.055
	(0.219)	(0.284)
Right Government	-0.384	-0.232
	(0.267)	(0.277)
Left to Right Exec.	-0.381	-0.281
	(0.306)	(0.317)
Right to Left Exec.	0.501*	0.371
	(0.290)	(0.299)
Election Year	-0.127	-0.136
	(0.154)	(0.151)
Renewable Capacity (3 year average)	0.076***	0.086***
	(0.021)	(0.022)
Hydro + Nuclear Share (3 year average)	-1.292	-0.858
	(1.725)	(1.686)
Year	0.033	0.019
	(0.029)	(0.030)
Traditional Electricity Share	-0.862	-0.343
	(1.775)	(1.684)
GDP per capita (K$)		0.008
		(0.013)
Gov. Share of Income		-0.020
		(0.041)
Investment Share of Income		0.069***
		(0.026)
Trade Openness		0.001
		(0.003)
Income Growth		-2.547
		(4.208)
Constant	-67.228	-40.116
	(56.893)	(59.852)
Observations	253	253
R^2	0.200	0.240
$\hat{\sigma}$	1.141	1.124

Standard errors in parentheses
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A16: High Tech Employment: 2-SLS

	(1) Model	(2) Model	(3) Model	(4) Model
Pos. Reinforcement (t-1)	1.592**	1.057***	3.172	0.218
	(0.647)	(0.399)	(4.219)	(1.815)
Pos. Reinforcement (t-1) * Oil	-0.021*	-0.011*	-0.027	-0.008
	(0.011)	(0.006)	(0.018)	(0.011)
Oil Prices (2009 USD)	0.025	0.021	0.031	0.021
	(0.016)	(0.018)	(0.023)	(0.019)
Left Government	-0.469	-0.416	-1.431	0.340
	(0.291)	(0.277)	(3.447)	(1.181)
Right Government	-0.584*	-0.586**	-1.742	0.085
	(0.311)	(0.297)	(3.636)	(1.272)
Left to Right Exec.	-0.457	-0.357	0.028	-0.427
	(0.418)	(0.381)	(1.401)	(0.487)
Right to Left Exec.	0.602	0.566	0.689	0.277
	(0.401)	(0.392)	(0.981)	(0.480)
Election Year	-0.145	-0.105	-0.144	-0.130
	(0.191)	(0.179)	(0.316)	(0.169)
Renewable Capacity (3 year average)	0.061**	0.057**	0.047	0.088**
	(0.027)	(0.025)	(0.099)	(0.037)
Hydro + Nuclear Share (3 year average)	-0.450*	-0.345	12.161	-4.190
	(0.273)	(0.246)	(33.910)	(11.402)
Year	-0.008	-0.000	-0.014	0.000
	(0.052)	(0.001)	(0.107)	(0.005)
GDP per capita (K$)			-0.069	0.032
			(0.195)	(0.067)
Gov. Share of Income			0.120	-0.043
			(0.323)	(0.117)
Investment Share of Income			0.134	0.073
			(0.103)	(0.048)
Trade Openness			-0.005	0.002
			(0.014)	(0.005)
Traditional Electricity Share			12.137	-3.502
			(32.248)	(10.885)
Income Growth			-1.633	-5.480
			(16.063)	(5.796)
Constant	15.813	0.000	15.134	0.000
	(103.624)	(.)	(235.473)	(.)
Observations	253	253	253	253
R^2	.	0.082	.	0.191
$\hat{\sigma}$	1.256	1.191	1.837	1.118

Standard errors in parentheses
2-stage least squares estimate; innovation is instrumented by high tech employment.
Dependent Variable: Δ Renewable Capacity (excluding hydro).
All models estimated with panel-corrected standard errors.
Models (2) and (4) estimated with year fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

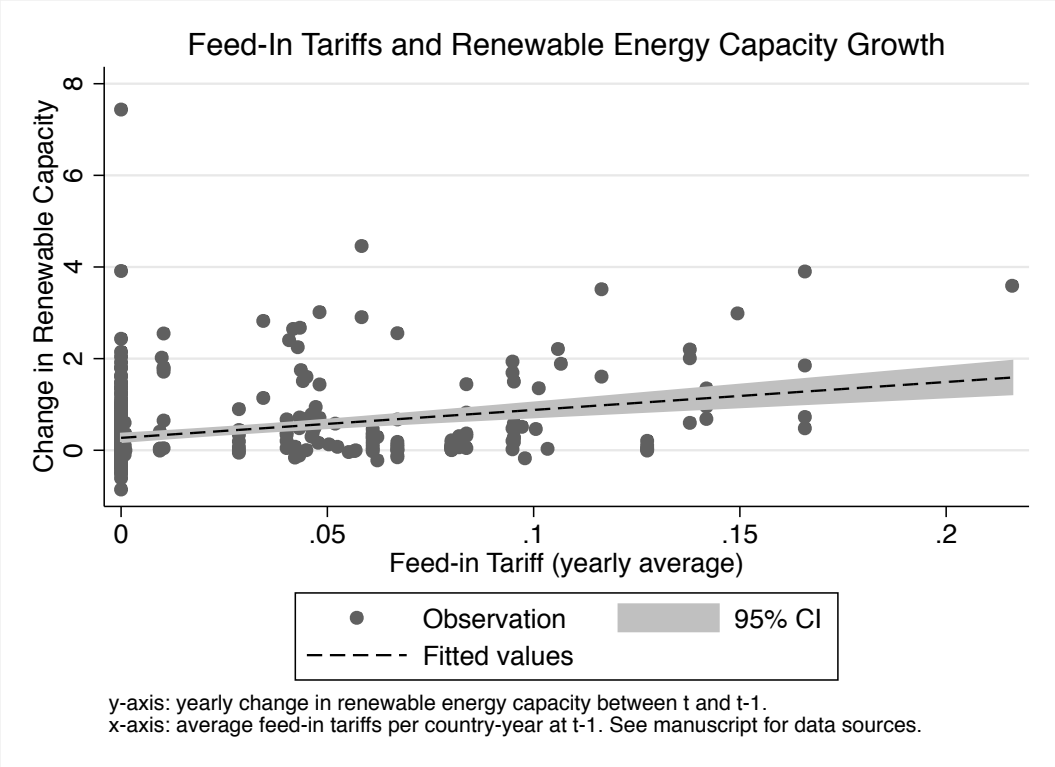

Figure A4: Feed-In Tariffs and Renewable Energy Capacity Growth.

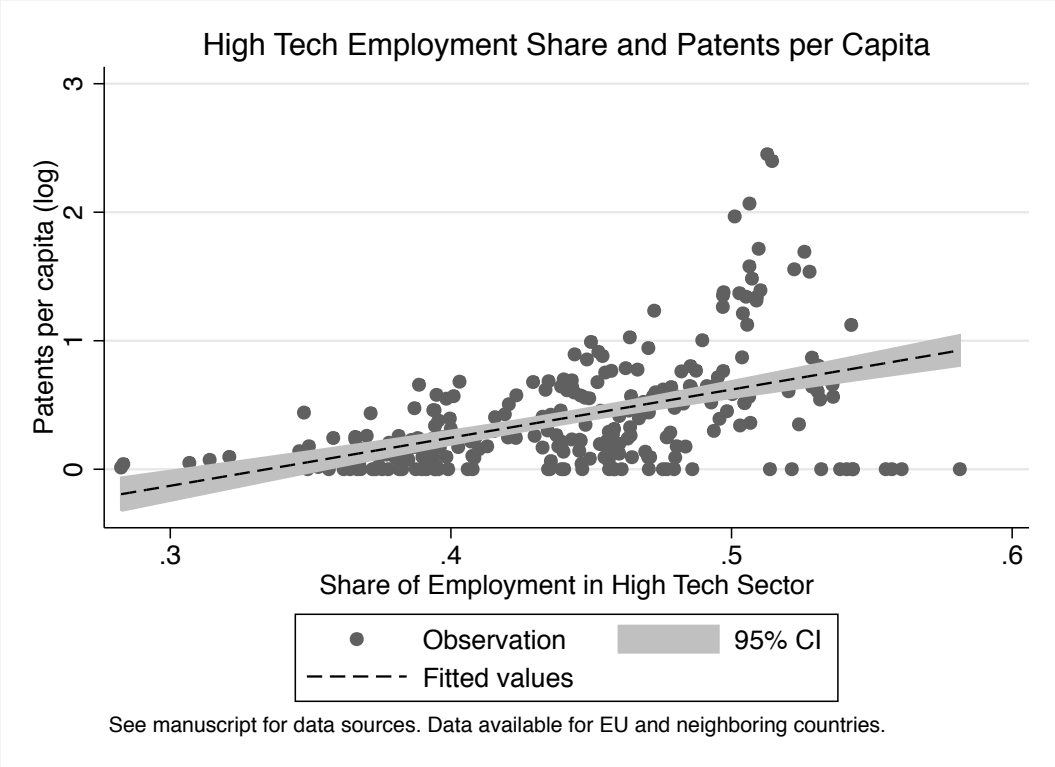

Figure A5: High Tech Employment Share and Patents per Capita.

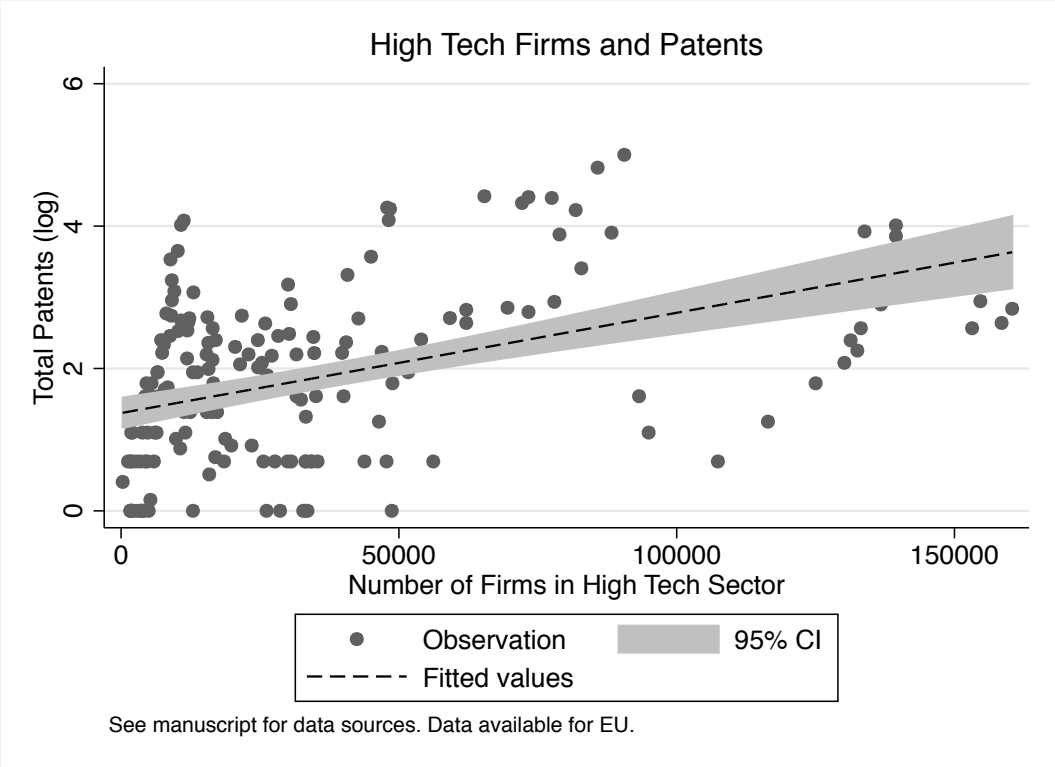

Figure A6: High Tech Firms and Patents.

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