Patent generation in renewable energy by deregulated electric utilities

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Deregulation has significantly influenced the management of R&D in electric utilities

- After deregulation, the determinants of innovation caught the attention of economists following a decline in R&D investment by electric utilities:

  - from the early 1980s the U.S. (Margolis and Kammen, 1999; Sanyal and Cohen, 2009)
  - the U.K. (Jamasb and Pollitt, 2008)
  - other European countries (Salies, 2010).

Deregulation has significantly influenced the management of R&D in electric utilities

- Changes in the selection of innovations by electric utilities
- R&D managers shifted focus away from long-term advanced technology R&D to projects that would provide a competitive edge in the near term (Sanyal, 2007; GAO 1996)

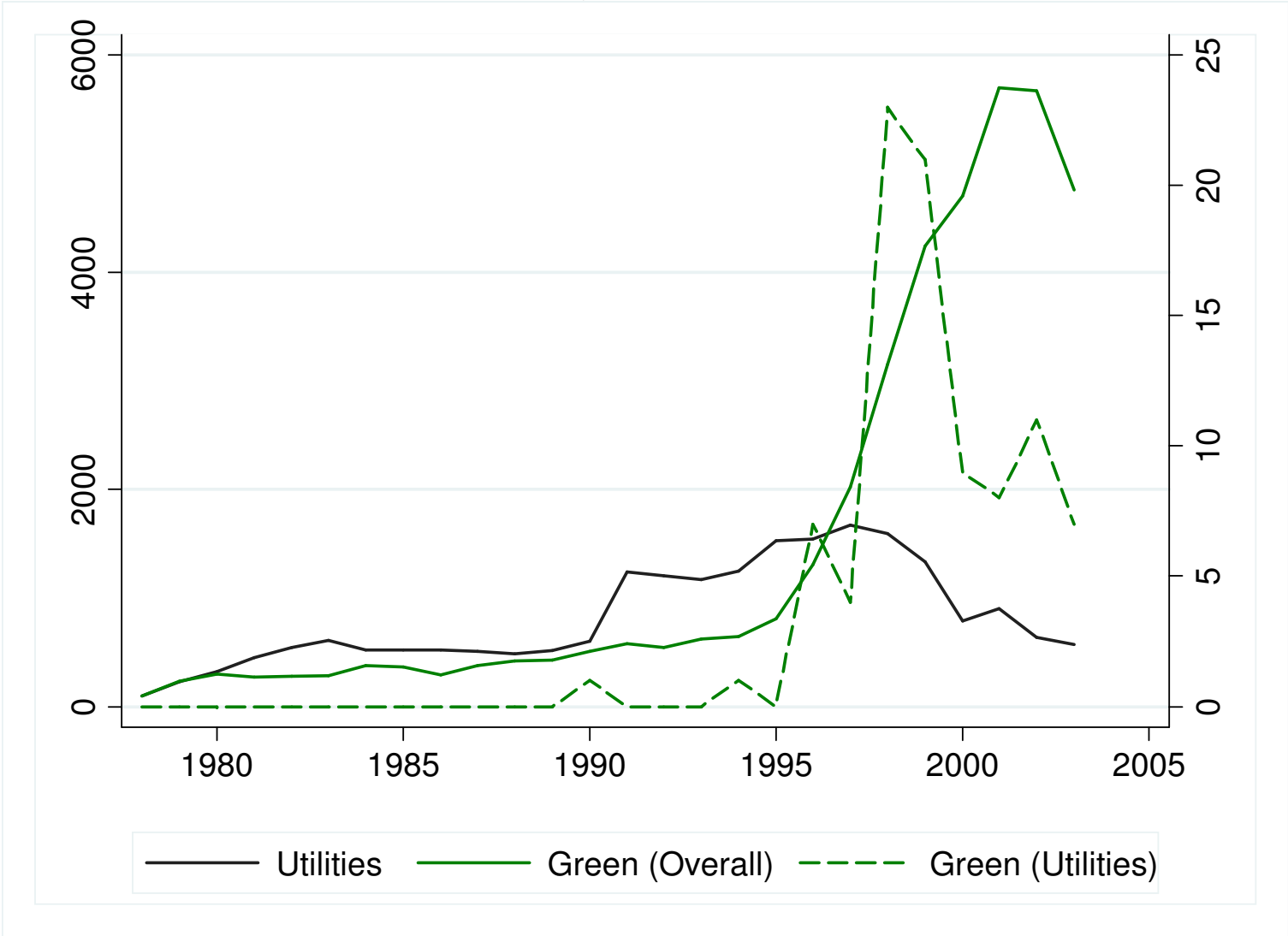
- Main reasons (U.S.A.):

  - higher competition expected from the deregulation of the utilities increases uncertainty in the value of future revenues (Sanyal and Cohen 2008; Sanyal 2007; Margolis and Kammen 1999)
  - overall reduction in federal and state funding, notably in environmental R&D (GAO 1996)

But it may be too early to conclude about its effect on patent generation in Europe

- In the U.S.A., the share (and the absolute number) of EEM electric technology patents in total USPTO patents has been decreasing since the early 1990s to 2000.:
  - increasing role for the upstream heavy EEMs relative to electric utilities in terms of patents (Jamasb and Pollitt, 2009)
  - negative effect of the reforms on patenting activities by EEMs (Sanyal and Gosh, 2008)

Patent generation by electric utilities, and all firms, 1978–2003



Changes in patent generation by electric utilities before and after deregulation

Firm	Year of first piece of legislation	All[1]			Green[2]
		Before	After	Change (%)	After
AEM	1999		0.333		0
ASM	1999		1.400		0
Bewag	1998	0.250	0	–100	0
EDF	2000	20	14	–30	1.166
Edison	1999	0.600	1.571	161.904	0.142
Enbw	1998	2	1.250	–37.500	0.125
Enel	1999	3.625	1.571	–56.650	0
Eon	1998	0.167	0.375	125	0
Evn	1998	0.250	0	–100	0
Fortum	1995		6.700		1.800
Hafslund	1990		0.200		0
Iberdrola	1994		0.667		0
Innogy	1989		3		0.714
Int. Power	1989		0.363		0
London E.	1989		0.272		0
Meta	1999		0.333		0
Nesa	1996		0.428		0
Powergen	1989	0.250	0.176	–29.411	0
Red Electrica de E.	1994		0.333		0
RWE	1998	3.800	1.750	–53.947	0.250
Sydkraft	1995	0.461	1.090	136.363	0
TXU	1989		0.250		0
Union Fenosa	1994		0.428		0
Vattenfall	1995	6.400	4.090	–36.079	0.090

The knowledge production function

- firm i, country c, year t=1980,…,2003

Number of patents $Y_{ict} = f(K_{ict-1}, D_{ict-1}, Z_{t-1})$

Knowledge capital

Technological diversification

Control variables:
- deregulation
- R&D
- technological opportunities
- fossil fuel intensity
- economic growth opportunities

Regression results

Variables	All		Non-green		Green	
Electricity act*	–0.171		–0.321	*	4.225	***
	(0.175)		(0.176)		(1.431)	
R&D	0.132	*	0.105		0.624	*
	(0.070)		(0.070)		(0.344)	
Technological Opp.	0.511	**	0.409	*	1.666	*
	(0.021)		(0.225)		(0.935)	
Knowledge capital	0.917	***	0.903	***	1.714	**
	(0.198)		(0.199)		(0.812)	
Diversity	–0.371		–0.338		–1.276	
	(0.228)		(0.229)		(0.911)	
Market Opp.	–1.875	***	–1.748	***	–3.607	
	(0.635)		(0.626)		(4.288)	
Fuel ratio	–0.060	***	–0.056	***	–0.019	
	(0.021)		(0.020)		(0.0614)	
Constant	15.592	**	14.822	**	34.32	
	(6.144)		(6.051)		(1797.884)	
No obs.	193		193		193	

Conclusion: future research

- Complete the model with additional variables and increase the sample to EEMs
- Environmental measures for encouraging technological innovation (Johnstone et al., 2008)
- A variable on national public sector expenditures on R&D for renewable energy (Johnstone et al., 2008)
- ‘Induced innovation’ effect
- Patent characteristics rather than simply magnitude