

# Competition, Energy Law and Nuclear Safety Regulation

---

François Lévêque\* and Florent Silve\*\*

\* Professor of Law and Economics, Mines ParisTech

\*\* Sciences-Po Paris

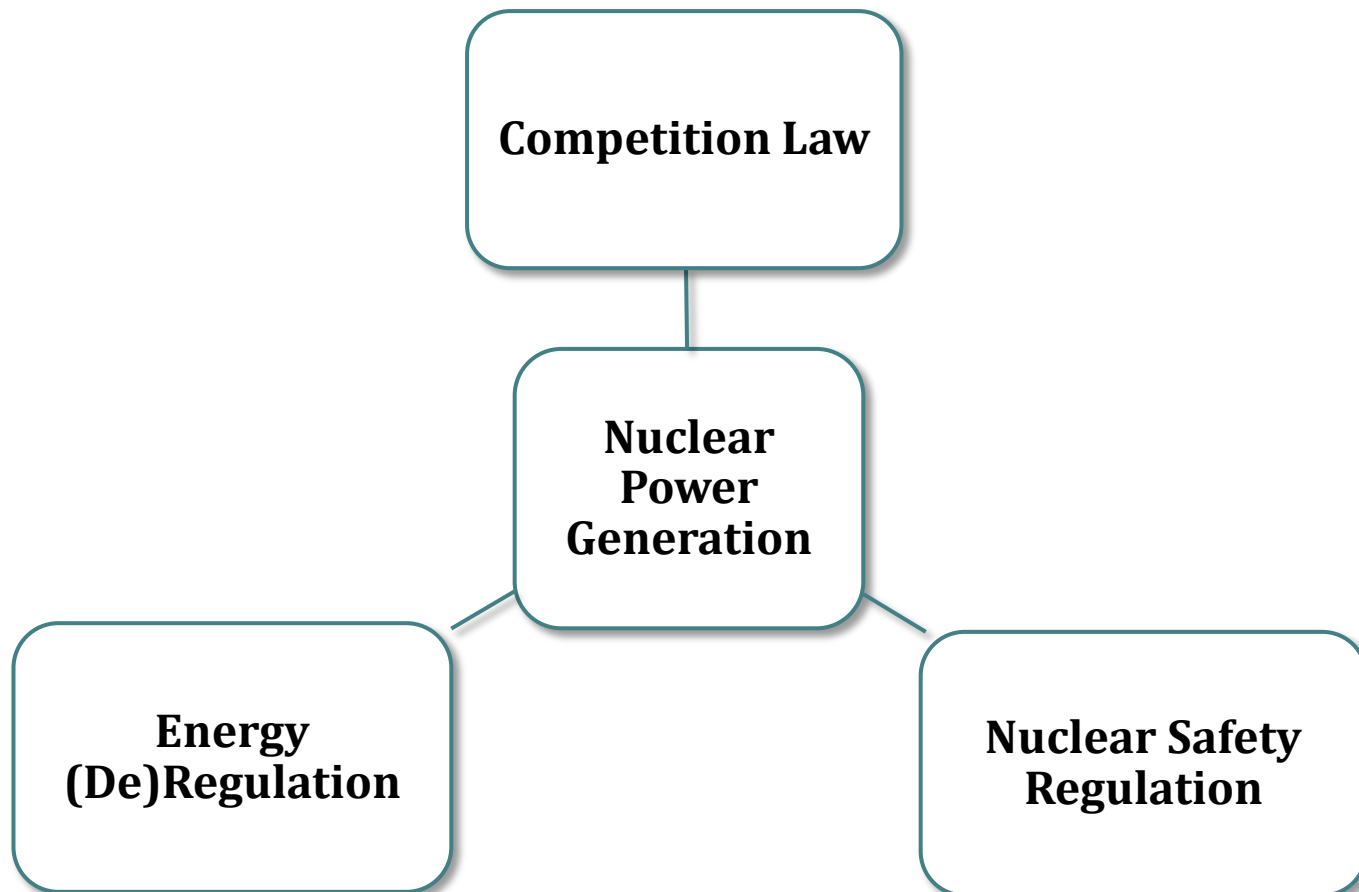
Florence School of Regulation

EU Energy Law & Policy Workshop - 20 May 2011

# Competition, Energy Law and Nuclear Safety Regulation

---

- I. Nuclear energy and deregulated electricity markets
- II. Nuclear safety regulation and competition



# Nuclear energy and deregulated electricity markets

---

## ❑ Competitiveness

- Challenges for nuclear power in liberalized electricity markets which could impede its competitiveness:
    - Long lead time
    - Large upfront minimal capital investment
    - Lack of recent experience with new build
    - Redistribution of risk among the different stakeholders
    - Political and regulatory challenges to obtain license to build and operate a plant
    - Greater size of nuclear plant exposes investors to greater risks
  - Ex:
    - Roques et al. (2006):
      - Analysis starts from the idea that the liberalisation of the energy markets makes it more difficult to invest in nuclear
      - Estimate option value of nuclear in order to analyse whether this value can enable the nuclear to be competitive in a liberalized market
      - Show notably that nuclear is not generating any option value for electricity producers, given the correlation between carbon, natural gas and electricity prices
    - Lester and McCabe (1993):
      - Study suggesting that nuclear industry might not be adapted to fragmented structure of a liberalized industry, which would lower learning
-

# Nuclear energy and deregulated electricity markets

---

## ❑ Financing

- ❑ Challenges of financing nuclear new build:
  - Nuclear characterised by high fixed costs of construction
  - Deregulation and privatization has led to financial risks transfer towards the electricity producers
  
- ❑ Literature on financial set-ups and public support schemes favorable to the emergence of nuclear power in competitive electricity markets
  - Example: Finon et Roques (2008) study the different forms of contracts and organizations which enable to share the various risks of nuclear programs

# Nuclear energy and deregulated electricity markets

---

## ❑ Competition

### ❑ Main issue from a competition perspective arises when:

- There is a single nuclear power operator
- The share of nuclear power in the total electricity production is large
- Nuclear generation from the existing fleet is cost efficient;

Then entry is difficult for potential new entrants and competition in base load generation is weak, both on the short term and on the long term

### ❑ Possible policy or regulatory remedies:

- Regulating access: ex. NOME in France (Lévêque, 2011)
  - Regulating wholesale price: ex. in South Korea (Berthélemy & Lévêque, 2011)
  - Divestiture of part of the nuclear generating assets (selling of reactors or sections of reactors while maintaining a unique operator)
-

# Nuclear safety regulation and competition

---

I. Nuclear energy and deregulated electricity markets

II. Nuclear safety regulation and competition

---

# Nuclear safety regulation and competition

---

## □ Main preoccupations:

- What market failures and externalities can arise in a competitive setting and how can they lead to under-provision of safety?
- How can safety be regulated?
- What are the consequences of imperfect regulation in terms of safety provision incentives and nuclear power competitiveness?
- What are the possible consequences of imperfect regulation from a competition law perspective?

## □ These questions will be all the more important in the post-Fukushima period as this period is likely to be characterised by:

- An enhanced competition between NPPs' vendors because of the cancellation or postponing of some projects
  - A greater importance given to safety standards
-

# Nuclear safety regulation and competition

---

- ❑ **Unregulated setting:** externalities and market failures
    1. Problem of heterogeneous safety and quality standards
    2. Externalities in a competitive setting with several nuclear power operators
  
  - ❑ **Regulated setting:** Incentive system combining *ex ante* safety standards and *ex post* liability rules
    1. The balance between *ex ante* regulation (i.e., standards) and *ex post* regulation (i.e., liability rules)
    2. Imperfections and challenges raised by *ex ante* regulation
    3. Imperfections and challenges raised by limited *ex post* liability
-



# Heterogeneous quality and safety standards

---

- ❑ Without regulation, a problem for the provision of safety may arise when there are:
    - Heterogeneous products (different safety levels)
    - Asymmetric information
    - Competition
  - ❑ If the buyer/owner of a power plant values quality and safety features but cannot observe the level of quality and safety provided – or can only observe it *ex post* –, in a competitive setting, this may drive down the average level of quality
  - ❑ Akerlof (1970): market for ‘lemons’
  - ❑ Problem may be all the more important in the nuclear industry as:
    - It involves complex technologies
    - Some of the quality/safety features can only be observed/assessed *ex post*, when an accident or a failure actually occurs
-

# Externalities and Free-riding

---

- ❑ Safety provision is subject to potential free-riding behaviour
    - Any localized accident or failure in one power plant results in large negative externalities on other players and on the industry as a whole, notably in terms of reputation and future demand for new reactors and services
    - This impact is not internalized by manufacturers and operators in their choices of safety investment and improvement. It leads to under-provision of safety
  
  - ❑ Impact of competition on externalities and free-riding?
    - Intuitively, we would expect that the greater the competition, i.e. the larger the number of players and the smaller the individual market shares, the largest the externalities and free-riding potential and the lower the incentive to provide safety
-

# Nuclear safety regulation and competition

---

- ❑ **Unregulated setting:** externalities and market failures
    1. Problem of heterogeneous safety and quality standards
    2. Externalities in a competitive setting with several operators
  
  - ❑ **Regulated setting:** Incentive system combining *ex ante* safety standards and *ex post* liability rules
    1. The balance between *ex ante* regulation (i.e., standards) and *ex post* regulation (i.e., liability rules)
    2. Imperfections and challenges raised by *ex ante* regulation
    3. Imperfections and challenges raised by limited *ex post* liability
-

# Incentive systems: mix of *ex ante* regulation and *ex post* liability rules

---

- ❑ Design of incentive systems which combine:
    - *Ex ante* regulation (ex: safety standards, Pigouvian fees)
    - *Ex post* regulation (tort liability)
  
  - ❑ Potential injurer minimizes expected total cost of safety, where total cost is a combination of the actual cost of safety/care and expected liability in the event of an accident
  
  - ❑ The literature recognises that the combination of the 2 instruments can be necessary to achieve an efficient level of safety since both types of regulations have imperfections (See for instance: Kolstad et al., (1990); Shavell (1984a, 1984b, 1987); Wittman (1977))
-

## Question of the optimal mix of *ex ante* regulation and *ex post* liability rules

---

- In general, both *ex ante* and *ex post* regulations have imperfections, notably:

<u><i>Ex ante</i> regulation</u>	<u><i>Ex post</i> regulation</u>
Heterogeneity of technologies, reactors, damages	Limited assets and possibility of bankruptcy of injurer
Asymmetric info. on level of effort	Uncertainty of suit by victims
Imperfect info. on accident costs and damages	Difficult estimation of risks
...	...

- Shavell (1984a) recognizes that *ex ante* regulation and *ex post* liability rules can complement each other in that their joint use can correct the inefficiencies of using either alone to correct an externality
  - Kolstad et al. (1990) have shown that exclusive use of negligence liability leads to suboptimal choice of precaution in the presence of uncertainty and that *ex ante* regulation can correct these inefficiencies
-

# Nuclear safety regulation and competition

---

- ❑ **Unregulated setting:** externalities and market failures
    1. Problem of heterogeneous safety and quality standards
    2. Externalities in a competitive setting with several operators
  
  - ❑ **Regulated setting:** Incentive system combining *ex ante* safety standards and *ex post* liability rules
    1. The balance between *ex ante* regulation (i.e., standards) and *ex post* regulation (i.e., liability rules)
    2. Imperfections and challenges raised by *ex ante* regulation
    3. Imperfections and challenges raised by limited *ex post* liability
-

# Problems of incentives to respect safety regulation standards

---

- ❑ *Ex ante* regulation (in general):
    - ❑ The regulator sets rules and standards and tries to enforce them and to monitor regulated entities
    - ❑ Challenges:
      - Regulator may be in a situation of asymmetric information;
      - Need to design an incentive-compatible regulatory framework to give the regulated company appropriate incentives to comply with the safety standards imposed
    - Potential under-compliance
-

# Problems of incentives to respect safety regulation standards

---

- ❑ *Ex ante* nuclear safety regulation:
    - ❑ Question: What may be the impact of the opening to competition on the compliance to *ex ante* safety regulation?
    - ❑ Complex question which is difficult to assess empirically
      - MacAvoy and Rosenthal (2005) '*Corporate Strategy and Nuclear Safety – Strategy at Northeast Utilities in the 1990s*':  
Give a good example of the trade-off between profit maximisation and safety provision, as well as of the limited enforcement power of the regulator
      - Fukushima (public regional monopoly) vs. Chernobyl (state-owned monopoly)
  
  - ❑ In theory, does the energy liberalization reinforces incentives for non-compliance to safety standards?
    - ❑ Maybe, notably:
      - If we consider that Cost + regulation facilitates investment in safety and facilitates the pass through of the cost onto consumers
      - If we associate deregulation with shareholders who have short term interests
-



# Nuclear safety regulation and competition

---

- ❑ **Unregulated setting:** externalities and market failures
  1. Problem of heterogeneous safety and quality standards
  2. Externalities in a competitive setting with several operators
  
- ❑ **Regulated setting:** Incentive system combining *ex ante* safety standards and *ex post* liability rules
  1. The balance between *ex ante* regulation (i.e., standards) and *ex post* regulation (i.e., liability rules)
  2. Imperfections and challenges raised by *ex ante* regulation
  3. Imperfections and challenges raised by limited *ex post* liability

# Limited liability and heterogeneous rules

---

## ❑ Nuclear liability is limited

Nuclear plants vendors and operators benefit from a limited liability by which they do not have to bear the full cost of a severe accident. This implies that they do not assume all risk they generate through the internalization of the resulting costs of damages (Trebilcock and Winter, 1997 ; Faure and Fiore, 2009)

## ❑ Liability rules differ across Member States (Gomez-Acebo & Pombo, 2005; Handrlica, 2010): see slides 19 and 20

## ❑ Discussion : What impact does it have? In terms of

- Safety provision
  - Competitiveness of nuclear
  - Competition law
  - Equity
-

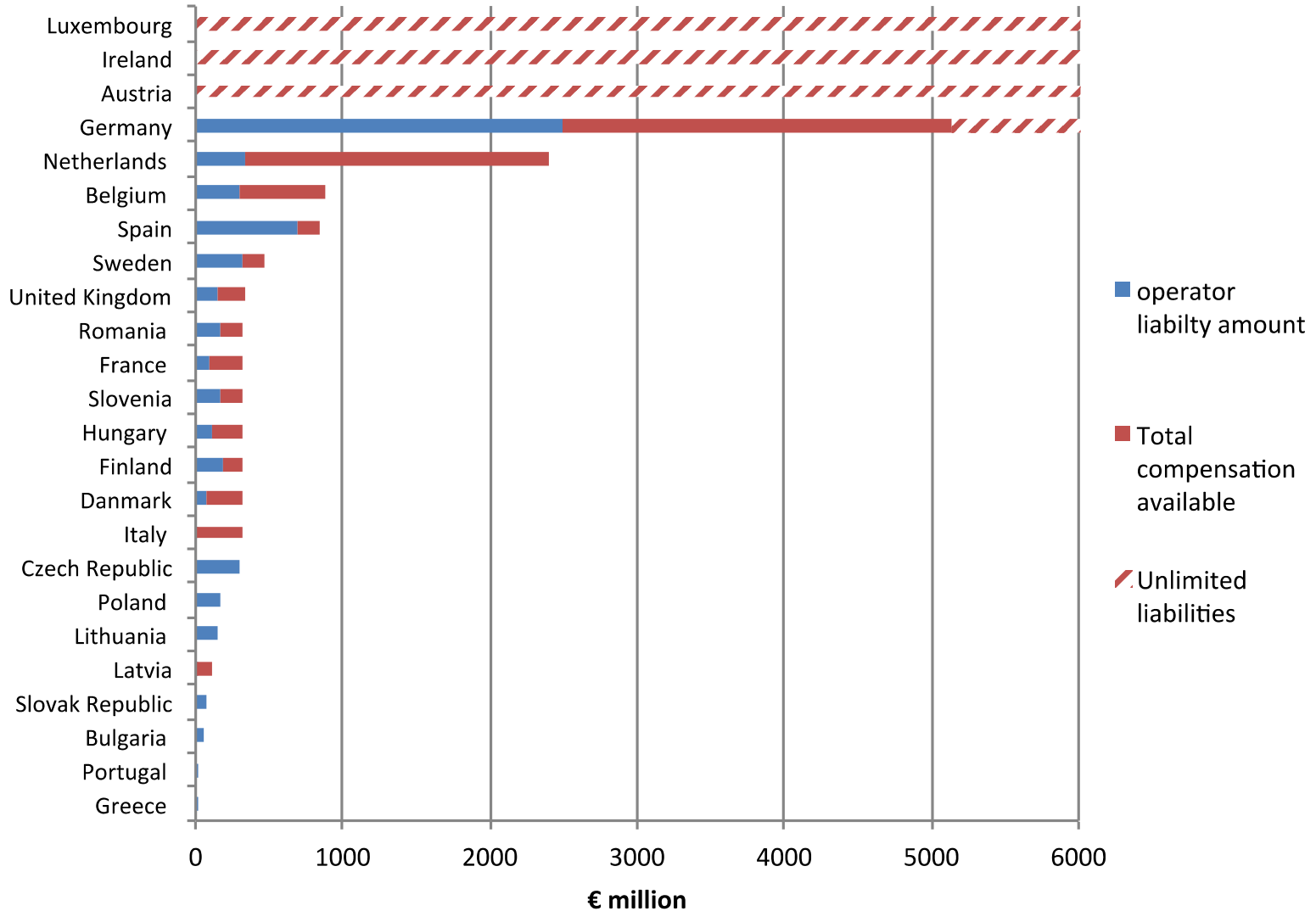
# The EU Nuclear Liability Patchwork

International Regimes		Member States	
Paris regime (NEA)	Paris (1960) and Brussels (1963) <sup>a</sup>	Belgium, Denmark, Finland, France, the Netherlands, Germany, Sweden, Italy, the UK, Spain, Slovenia	
		<i>Ratified</i> Joint Protocol (1988)	Denmark, Finland, the Netherlands, Germany, Sweden, Italy, the UK, Spain, Slovenia*
		<i>Signed</i> Joint Protocol (1988)	Belgium, France, the UK
	Paris (1960) <sup>a</sup> only	Portugal & Greece	
	Paris (2004) <sup>b</sup>	none	
Vienna Regime (IAEA)	Vienna (1963) <sup>a</sup>	Bulgaria, the Czech Republic, Estonia, Lithuania, Hungary, Poland and Slovakia, Latvia, Romania	
		Join Protocol (1988)	All
	Vienna (1997) <sup>b</sup>	<i>Signed</i> Vienna (1997)	Czech Republic, Lithuania, Hungary and Poland
		<i>Ratified</i> Vienna (1997)	Latvia, Romania
Convention on Supplementary Compensation for Nuclear Damages (1997)	<i>Signed</i>	Lithuania & Czech Republic	
	<i>Ratified</i>	Romania	
Nothing		Austria, Luxembourg, Ireland, Cyprus, Malta	

<sup>a</sup>: First generation

<sup>b</sup>: Second generation

# Liability amounts available in EU Member States



# Limited liability and heterogeneous rules

---

## ❑ Nuclear liability is limited

Nuclear plants vendors and operators benefit from a limited liability by which they do not have to bear the full cost of a severe accident. This implies that they do not assume all risk they generate through the internalization of the resulting costs of damages (Trebilcock and Winter, 1997 ; Faure and Fiore, 2009)

## ❑ Liability rules differ across Member States (Gomez-Acebo & Pombo, 2005; Handrlica, 2010): see slides 19 and 20

## ❑ Discussion : What impact does it have? In terms of

- Safety provision
  - Competitiveness of nuclear
  - Competition law
  - Equity
-

# Potential impacts of limited liability and heterogeneous rules

---

<b>Liability amounts</b>	<b>Safety provision</b>	<b>Competitiveness</b>
	Low amounts of limited liability may lower incentives to invest in safety (Trebilcock and Winter, 1997)	Low amounts of limited liability may distort competitiveness of, and investment decisions in, different technologies (Heyes and Liston Heyes, 1998)
<b>Heterogeneity in liability regimes</b>	<b>Competition</b>	<b>Equity</b>
	Implicit subsidy to nuclear industry (Dubin and Rothwell, 1990 ; Faure and Fiore, 2009) may vary depending on countries and might raise a State aid concern (Handrlica, 2010)	For an accident happening close to a border, victims on each side of the border might not perceive the same compensation (Gomez-Acebo & Pombo, 2005)

# Conclusion

---

- Deregulation of electricity markets has led to difficulties to finance nuclear new-build
  - In principle deregulation implies that cost of safety provision and expected costs of damages in the event of a severe nuclear accident have to be internalized in costs
  - Imperfect safety regulation (*ex ante* and *ex post*) may distort technology competitiveness and market competition
-

# References

---

- Akerlof, George A. (1970), The Market for 'Lemons': Quality Uncertainty and the Market Mechanism. *Quarterly Journal of Economics* (The MIT Press) 84 (3): 488-500
  - Berthélémy, M. and F. Lévêque (2011) Korea nuclear exports: Why did the Koreans win the UAE tender? Will Korea achieve its goal of exporting 80 nuclear reactors by 2030?, Cerna Working Papers Series, 2011-04
  - Dubin J.A. and G. S. Rothwell (1973), Subsidy to nuclear power through Price-Anderson liability limit, 8 CONTEMP. ECON. POLICY 73.
  - Faure, M. and K. Fiore (2009), An Economic Analysis Of The Nuclear Liability Subsidy, *Pace Environmental Law Review*, Volume 26, Issue 2 Summer 2009, Article 5
  - Finon, D. and Roques, F. (2008), Financing arrangements and industrial organisation for new nuclear build in electricity markets, *Cambridge Working Paper in Economics no.0826*
  - Gomez-Acebo & Pombo, (2005), Legal Study for the Accession of Euratom to the Paris Convention on third party liability in the field of nuclear energy, Legal Study for DG TREN
  - Handrlica, J. (2010), Euratom Powers In the Field of Nuclear Liability Revisited, *International Journal of Nuclear Law*, Vol. 3, No. 1, 2010, pp. 1 – 18
  - Heyes, A.G. and C. Liston-Heyes (1998). Subsidy to Nuclear Power through Price-Anderson Liability Limit: Comment, 16 CONTEMP. ECON. POLICY 122.
  - Kolstad, C., Ulen, T., and G.V. Johnson (1990). Ex post Liability for Harm vs. Ex ante Safety Regulation: Substitutes or Complements? *American Economic Review*. **80** (4):888-901
  - Lester, R.K. and McCabe, M.J. (1993), The effect of industrial structure on learning by doing in nuclear power plant operation, *RAND Journal of Economics* 24 (3)
  - Lévêque F. (2011), France's New Electricity Act: A potential Windfall Profit for Electricity Suppliers and a Potential Incompatibility with the EU Law, *The Electricity Journal*, Vol. 24, Issue 2, March 2011
  - MacAvoy, P. W. and J. W. Rosenthal, 2005. Corporate profit and nuclear safety: Strategy at Northeast Utilities in the 1990s. Princeton: Princeton University Press
  - Roques, F.A., Nuttall, W.J., Newbery, D.M., de Neufville, R. and Connors, S. (2006), Nuclear Power : a Hedge against Uncertain Gas and carbon Prices?, *The Energy Journal* 27 (4), 1-24
  - Shavell, S. (1984a). Liability for Harm versus Regulation of Safety. *Journal of Legal Studies*. **13**:357-374
  - Shavell, S. (1984b). A model of the optimal use of liability and safety regulation. *Rand Journal of Economics*. **15** (Summer): 271-280
  - Shavell, S. (1987). *Economic Analysis of Accident Law*, Harvard University Press, Cambridge, Massachusetts
  - Trebilock, M. and Winter, R. (1997), The economics of nuclear accident law, *International Review of Law and Economics*, Vol.17 p.215-243
  - Wittman, D. (1977). Prior regulation versus post liability: The choice between input and output monitoring. *Journal of Legal Studies*. **6**:13
-