

Climate Policy Uncertainty – Impact on Investment

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Special Session on CO₂ Cost Containment Mechanisms

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Disentangling Climate Policy Risk

- **Before implementation: policy and regulatory uncertainty**
 - Stringency, policy instrument design, commitment and long term stability
 - Difficult to quantify for market players as driven by many complex factors (international negotiation, understanding of climate change dynamics, etc.)
 - Systemic and not diversifiable by market players
- **After implementation of a trading framework: market risk**
 - Dealing with price uncertainty is not new for investors in energy markets...
 - Is CO₂ price risk different from other commodities price risks?
 - How is CO₂ price risk affecting investment decisions?
 - What would be the impact of price caps and price floors?



How much regulatory risk remains after implementation?



Outline – Investors and Climate Risk

- 1. Different investors have different attitudes toward risk**
 - Risk seeking entrepreneurs and technology developers
 - Utilities generally risk averse
- 2. CO2 price risk is one of many risks affecting investment decisions**
 - How significant is CO2 price risk compared to other project / technology / market risks?
 - How does CO2 price risk affect the timing of investment?
 - How does CO2 price risk affect technology choices?
- 3. Quantifying the impact of CO2 price uncertainty and the benefits of price stabilization**
 - Value of waiting and investment risk premium
 - Impact of price cap and price floor



Investors and risk

Attitude toward risk

- **Reliance on short term price signals vs. long term policies**
- **Risk appetite**

- **Utility companies**
 - Typically risk averse
 - Focused on current policy framework and current & forward prices
- **Oil majors**
 - Forward looking and used to carry long term investments under uncertainty
 - Develop internally long term scenarios based on assessment of climate policy
- **Technology manufacturers**
 - Risk appetite depends on maturity of technology
- **Technology developers**
 - Risk seen as generating opportunities
 - Entrepreneur-type investors search for large upside potential

Typical financing

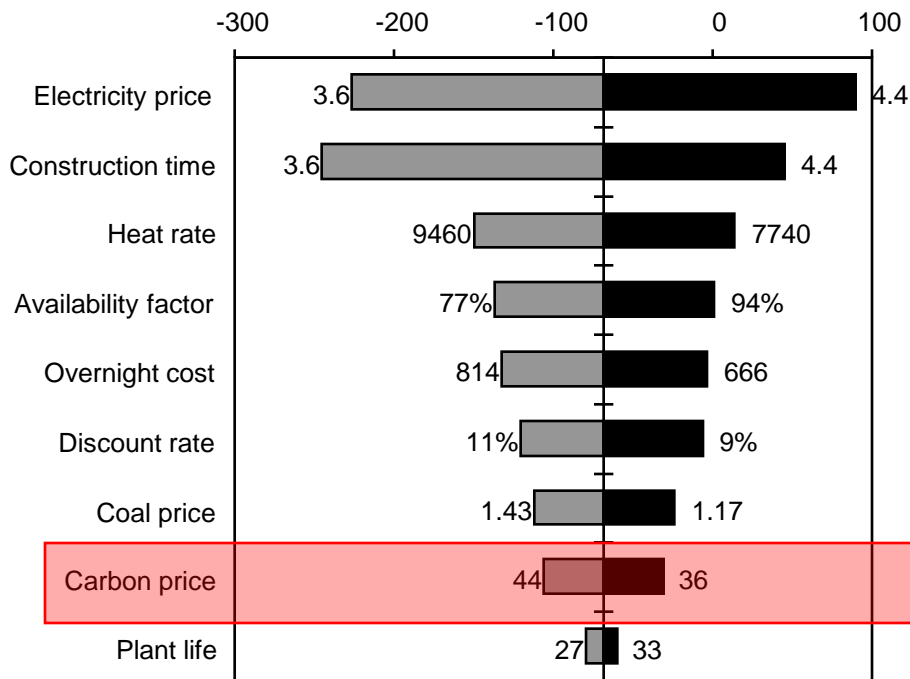
- **Debt from banking services**
- **Equity**
- **Venture capital**



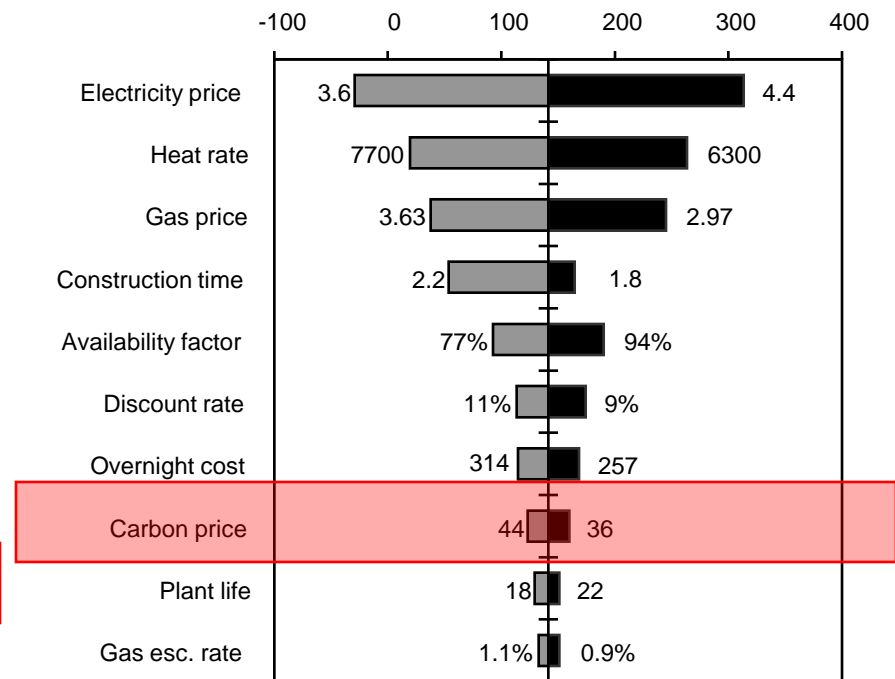
How significant is CO2 price risk compared to other project risks?

Power plant NPV sensitivity to CO2 price risk

Impact of 10% change on coal plant NPV



Impact of 10% change on CCGT NPV



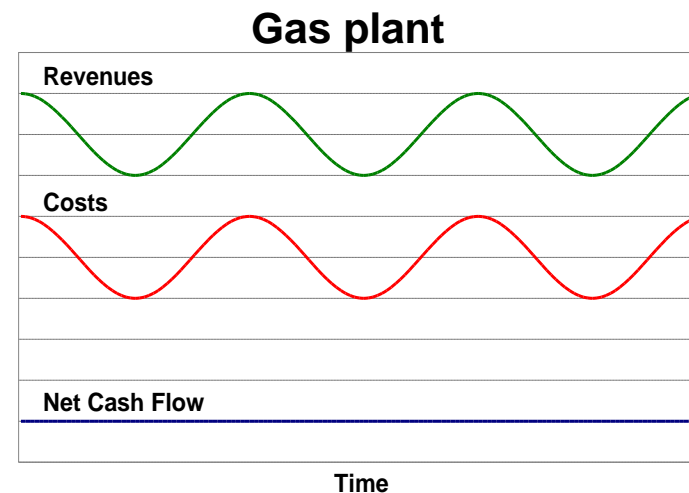
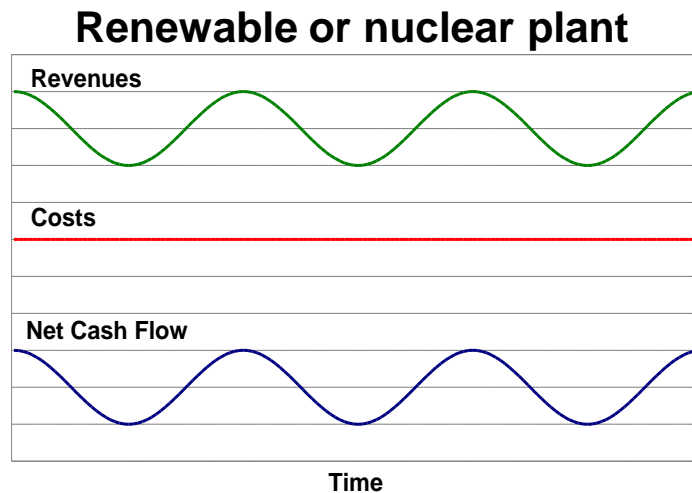
CO2 price risk seems at first sight relatively small compared to other risks...



How big is CO2 price risk compared to other project risks?

Indirect effects of CO2 price risk are significant

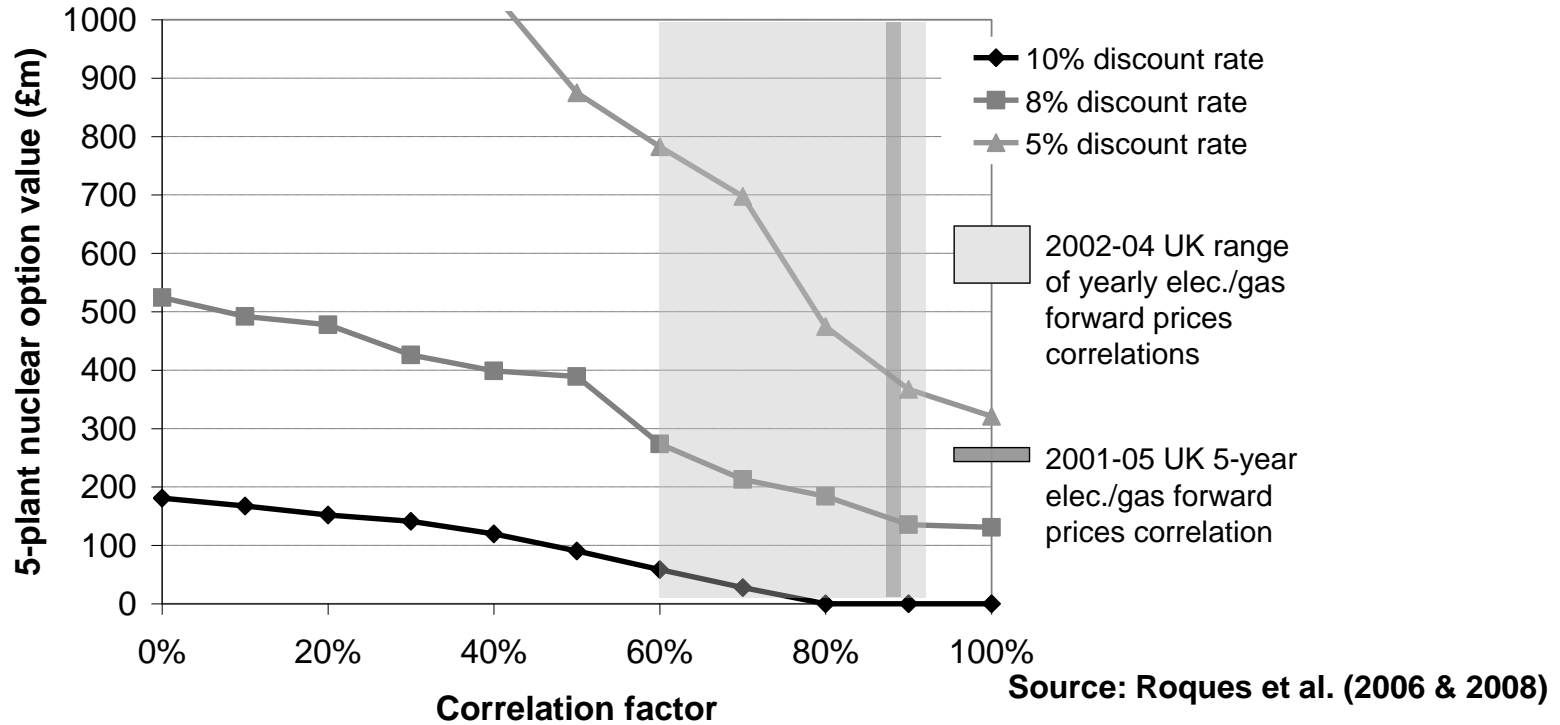
- **Liberalised electricity markets reduce revenue risk of price setting technologies**
 - Fossil fuel generation technologies revenue (electricity price) and cost (gas, coal, CO2 prices) streams highly correlated
 - EU ETS has reinforced correlation btw. gas (coal) and power prices



- ⇒ **Capital intensive renewable & nuclear face high cash flow volatility**
- ⇒ **CO2 price stabilisation has potentially important 2nd order effects on power and gas markets**



Nuclear value as a hedge against CO2 & fossil fuel price volatility decreases with increasing correlation



- Investment incentives in CO2 free technologies can be improved through:
 - Reduced correlation btw CO2 / power / fuel prices
 - Long-term fixed price power purchase agreements
 - Lower required return on investment by reducing regulatory risks



How does CO2 policy uncertainty affect investment decisions?

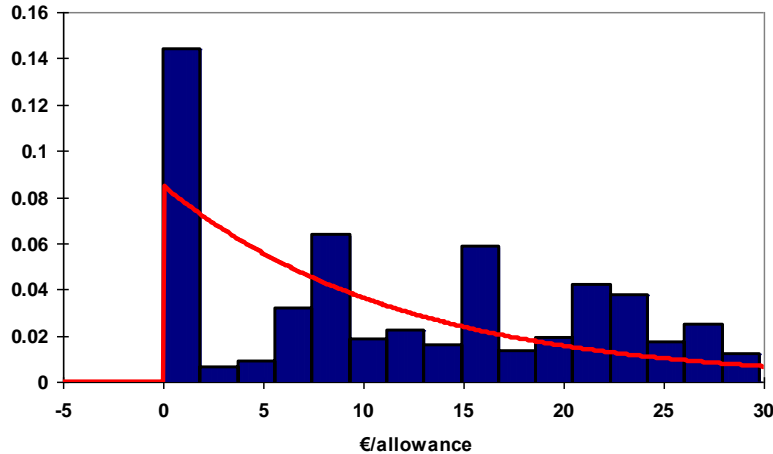
- **Timing: utilities delay investment decision**
 - Real options: return uncertainty creates *value of waiting* for irreversible investment (assuming perfect competition)
 - **Risk premium**: return uncertainty makes access to capital more difficult (CAPM)
 - But risk seeking entrepreneur or strategic behavior may lead to “*race to be first*”
- **Technology choice: bias against capital intensive / long lead time technologies**
 - Uncertainty on allowances allocation affects fossil fuel plants
 - CO2 price uncertainty affects both fossil fuel plants and carbon free technologies through fuel and power prices
 - Technologies with short lead times favored
 - Capital intensive technologies face high cash flow volatility and are more affected by higher risk premium



Impact of Price Cap and Price Floor

Example of plant generating cost

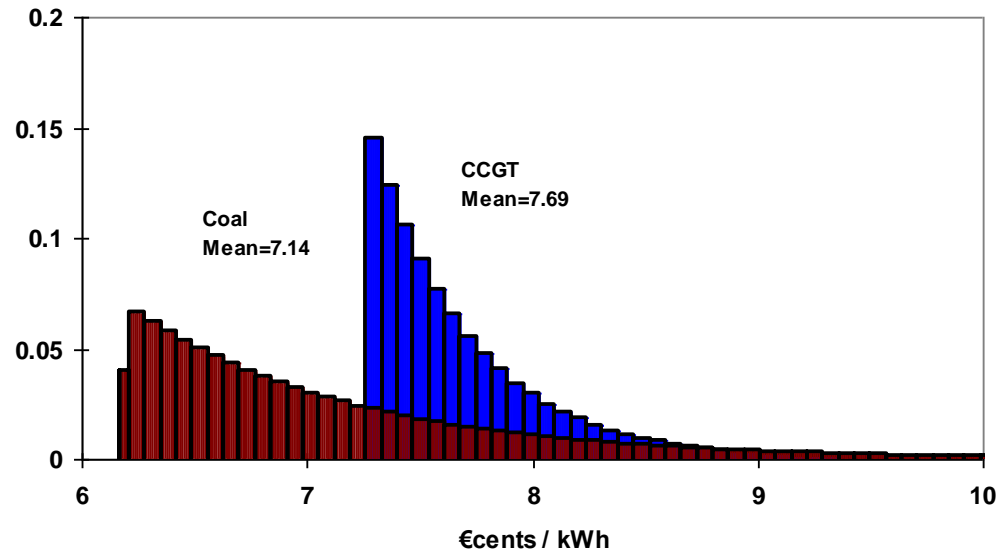
EU ETS allowance price spot distribution - Phase 1 (2005-07)



- EU ETS 1st Phase daily allowance spot price fitted with exponential distribution

- Plant generation cost simulated using Monte Carlo simulation
- Simple example does not account for 2nd order effect through fuel prices correlation with CO₂ prices

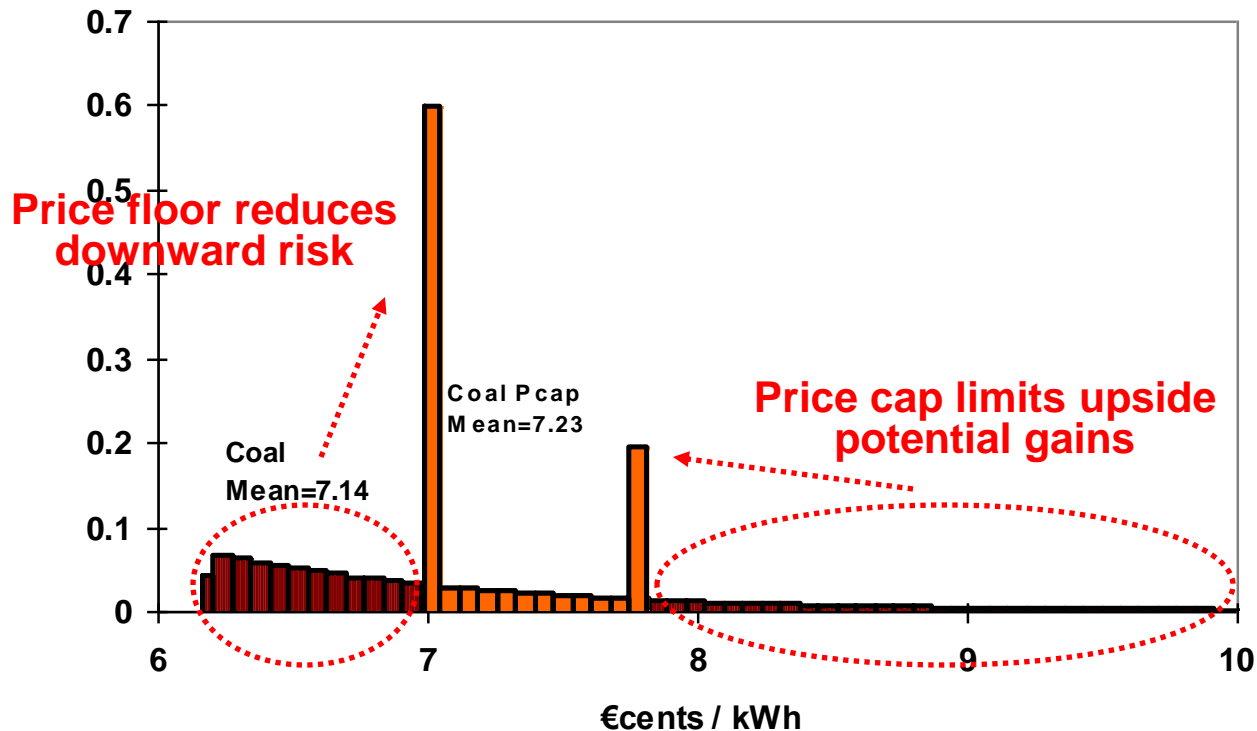
Distribution for Generating cost
10% d.r., gas 8€/mmBTU, coal 4€/mmBTU



Impact of Price Cap and Price Floor

Example of plant generating cost

Distribution for coal plant generating cost
10% d.r., coal 4€/mmBTU



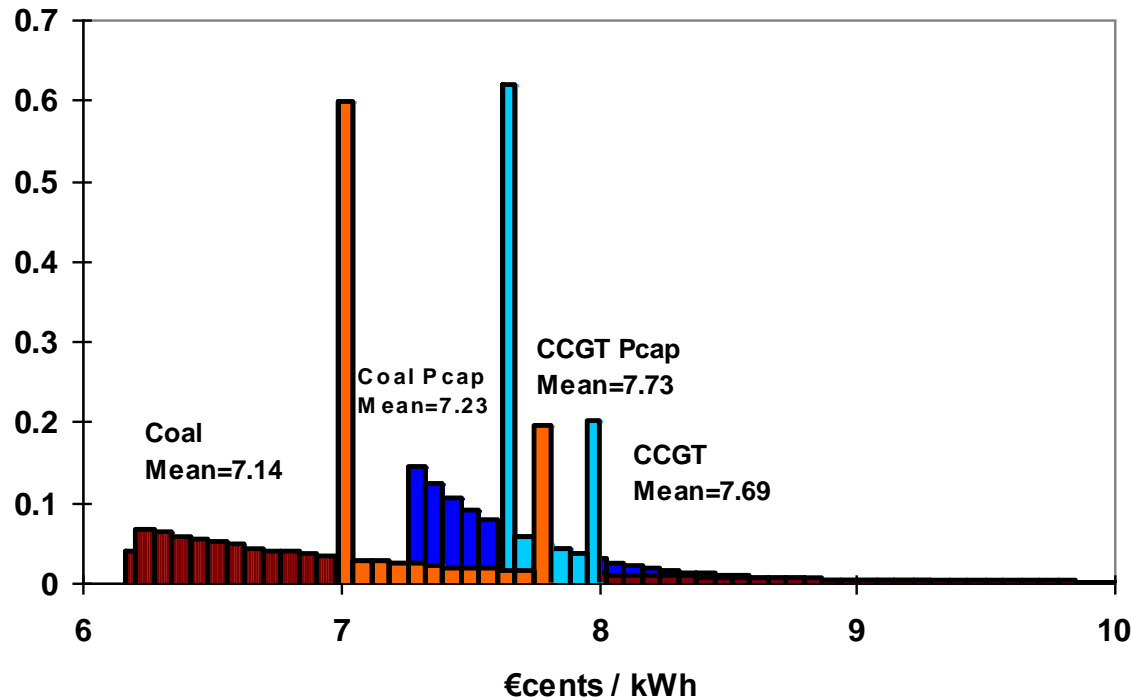
- €10/tCO₂ price floor and €20/tCO₂ price cap constrain range of generating costs



Impact of Price Cap and Price Floor

Example of plant generating cost

Distribution for Generating cost
10% d.r., gas 8€/mmBTU, coal 4€/mmBTU

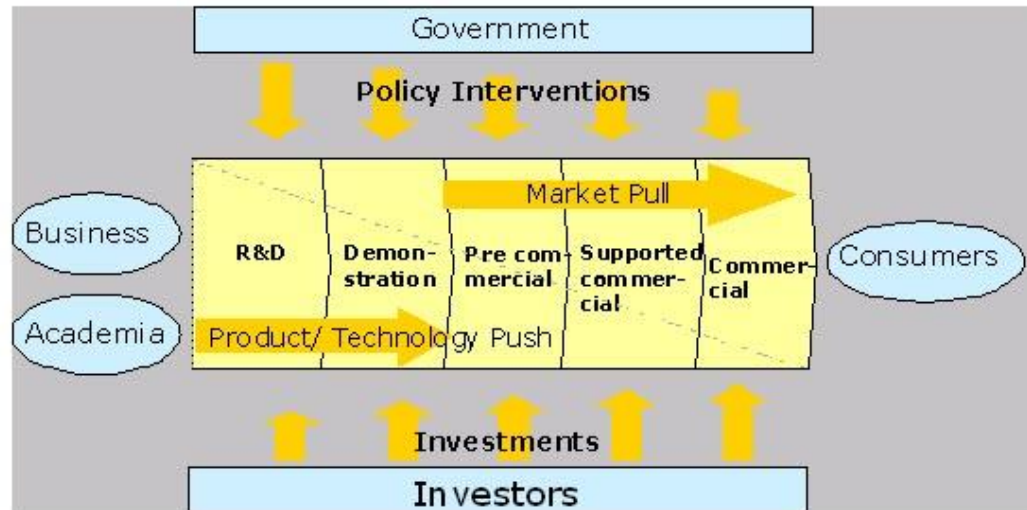


- Combination of price cap and price floor can be chosen so as to leave expected generating cost / NPV unchanged
- But impact on investment risk profile depends on technology and 2nd order effects on fossil fuel prices



Impact of Price Cap and Price Floor Technology Innovation and Deployment

Technology innovation and deployment chain



- **Price cap**
 - Will affect risk seeking entrepreneurs attracted by upside potential
 - Potentially adverse effect on investment in R&D and most risky / least mature technologies
- **Price floor**
 - May boost investment from risk averse utilities in mature clean technologies
 - Likely to speed deployment and learning



Impact of Price Cap and Price Floor

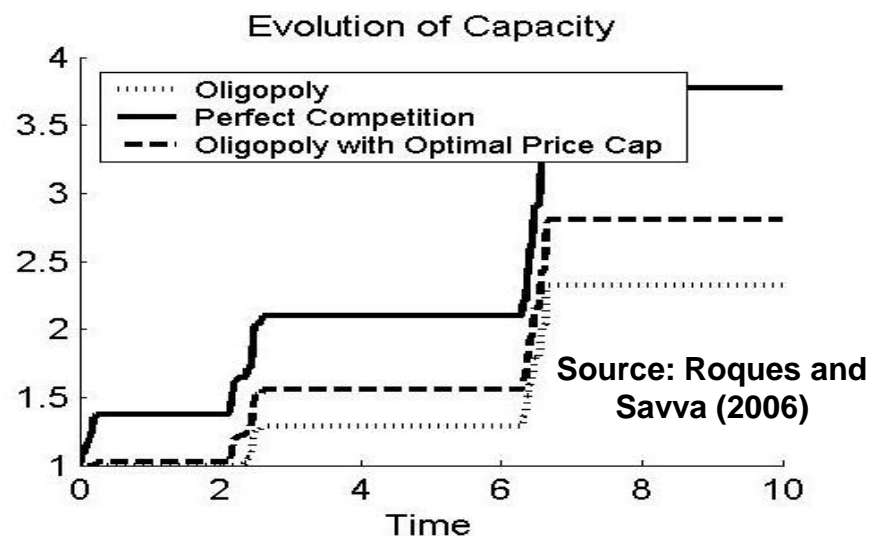
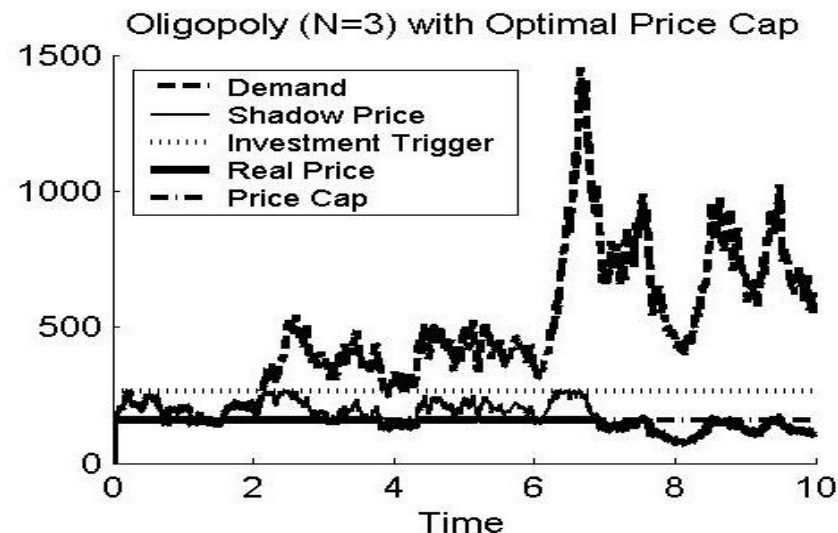
Impact of market power

- Under perfect competition, the higher the price cap the better for investment
- But “reasonably low” price cap can be beneficial to mitigate market power and speed up investment

⇒ **Optimal price cap :**

- increases with volatility
- Increases with construction time lag

⇒ Price cap can be counterproductive if not optimally set



Conclusions

- **Investors in energy markets are used to dealing with market risk; regulatory risk is more problematic**
- **Once a stable and credible trading framework is established, CO2 market price risk volatility can be dealt with insurance, hedging, and long term contracts**
- **Price cap and price floor can be defined so as not to affect the expected value of an investment project, while reducing project risk**
- **Such risk reduction could be leveraged politically to build private sector support for more ambitious mitigation targets**
- **Price cap and price floor are likely to affect both investment timing and the technology mix**
- **Price cap should be set high enough to limit negative effect on R&D and innovation**
- **Price floor could speed up the deployment and learning of mature clean technologies**
- **Potentially large 2nd order benefits in stabilizing CO2 prices through correlation with fossil fuel and power markets**



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