

International Modelling Conference, Seoul 2016

Carbon pricing models – overview of different modelling techniques

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Overview

1. Goals in modelling
2. Relevant modelling dimensions
3. Possible market failures to consider
4. Categories of models
5. Multi-model analysis (MSR study)
6. Conclusions

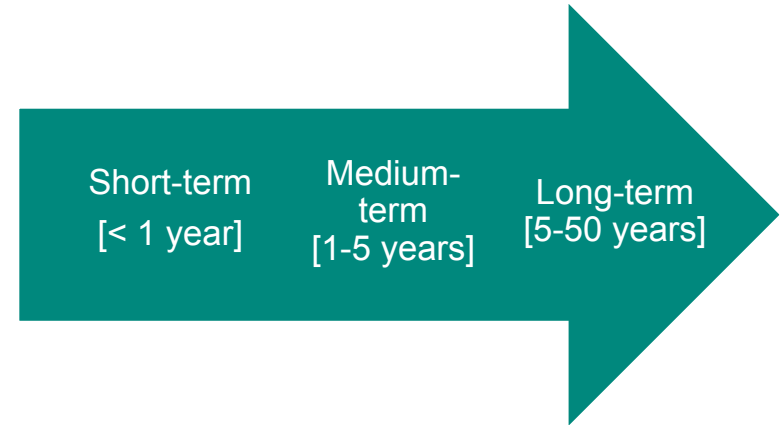
- Ex-post analysis of (price) developments
- Short-term price forecasts
- Long-term price scenarios
- Investigation of price drivers and price dynamics
 - Technological
 - Economic & social
- Evaluation of carbon pricing policies
- Communication & explanation

Dimensions

- Time scale
- Scope (Geog. & sectoral)
- Technological detail
- Actor aggregation & heterogeneity

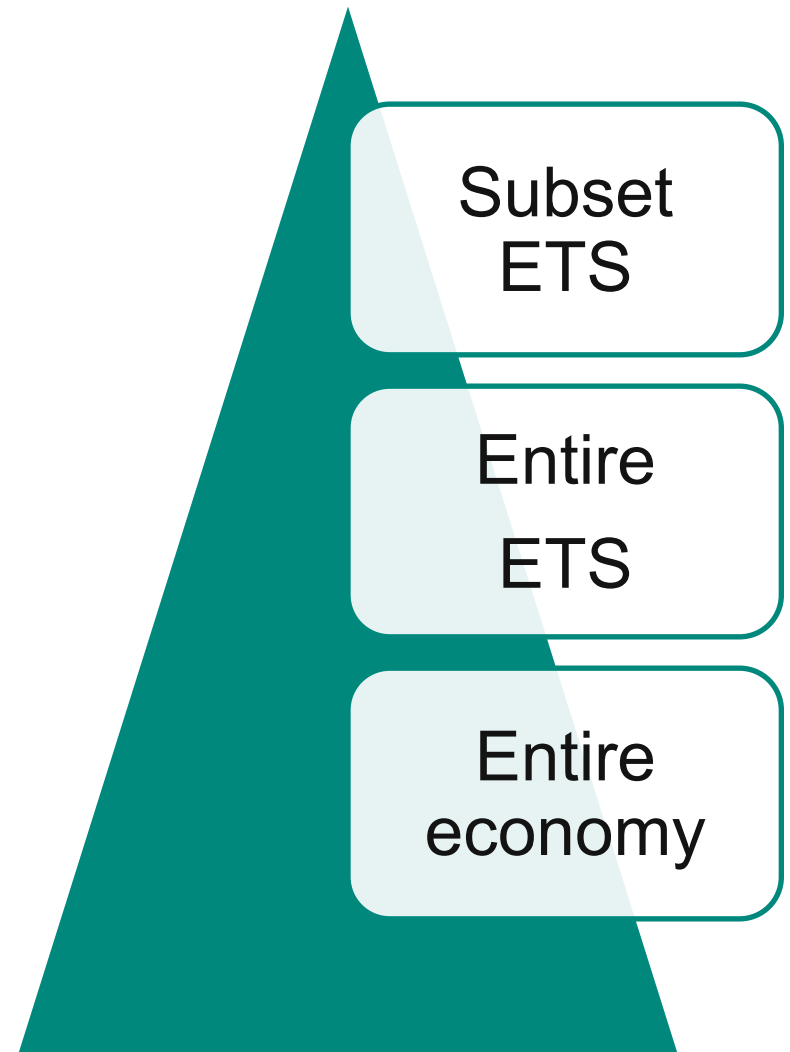
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- **Time scale**
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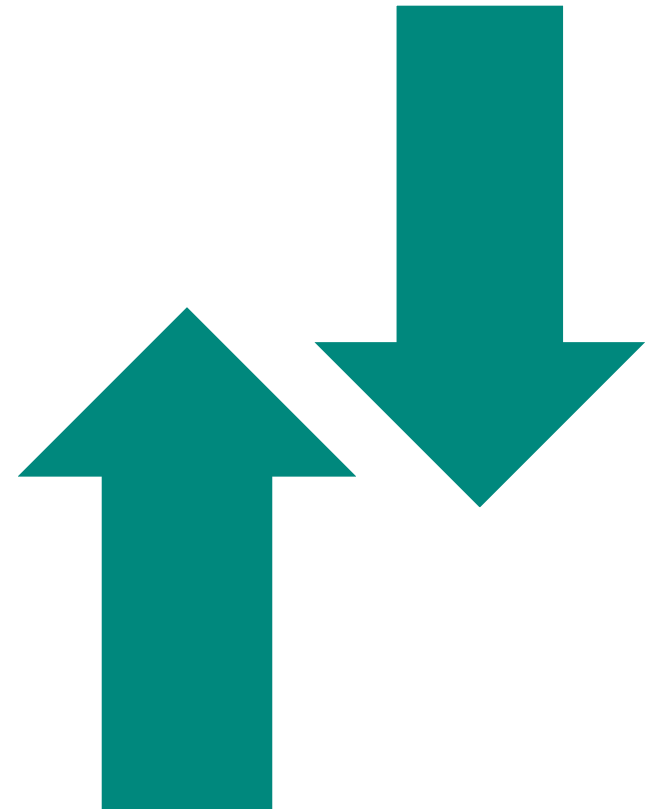
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Representative
actor



Multiple,
heterogeneous
actors

Potential market failures

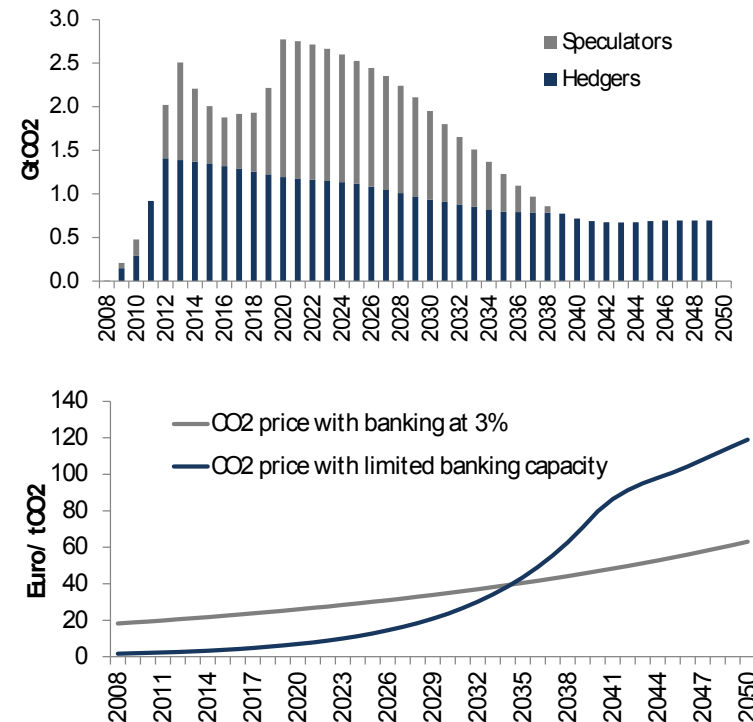
- Limited banking capabilities
- Regulatory credibility (& myopia)
- Bounded rationality (uncertainty & complexity)
- Market power

Based on MSR Comparison (Neuhoff et al., 2015)

Potential market failures

- **Limited banking capabilities**
- Regulatory credibility (& myopia)
- Bounded rationality (uncertainty & complexity)
- Market power

Linked to Actor aggregation & heterogeneity



Based on MSR Comparison (Neuhoff et al., 2015)

Difference between Hedgers (3-5%) and speculators (10-15%)

Potential market failures

- Limited banking capabilities
 - **Regulatory credibility (& myopia)**
 - Bounded rationality (uncertainty & complexity)
 - Market power
- Companies face regulatory uncertainty
 - Companies are concerned about returns in time-frames that can be observed and on which they are judged by the markets.
 - The longer the time horizon considered, the higher the uncertainties and the more difficult it is to characterize possible outcomes.

Based on MSR Comparison (Neuhoff et al., 2015)

Potential market failures

- Limited banking capabilities
- Regulatory credibility (& myopia)
- **Bounded rationality (uncertainty & complexity)**
- Market power
- Decision makers in companies might have only incomplete information about other companies and future developments.
- Decision processes (of individuals and companies) might be based on simplified representations of complex situations and instruments.

Based on MSR Comparison (Neuhoff et al., 2015)

Potential market failures

- Limited banking capabilities
 - Regulatory credibility (& myopia)
 - Bounded rationality (uncertainty & complexity)
 - **Market power**
- Relatively few companies may produce a large share of emissions in an ETS
 - This may create potential for exercise of market power

Based on MSR Comparison (Neuhoff et al., 2015)

- Econometric
- General equilibrium models (CGE & DSGE)
- Partial equilibrium models (PE)*
- Cost-minimizing models
- Simulations (agent-based & others)*
- Analytical*

* incl. in MSR comparison

- **Econometric**

- General equilibrium models (CGE & DSGE)
- Partial equilibrium models (PE)*
- Cost-minimizing models

- Simulations (agent-based & others)*

- Analytical*

* incl. in MSR comparison

Timescale: Short-/medium-term

Scope: Flexible (depends on data)

Tech. detail: /

Actor aggregation &

heterogeneity: /

Statistical analysis of (historic) economic data related to carbon prices.

- Econometric
- **General equilibrium models (CGE & DSGE)**
- Partial equilibrium models (PE)*
- Cost-minimizing models
- Simulations (agent-based & others)*
- Analytical*

* incl. in MSR comparison

Timescale: Up to long-term

Scope: High (entire economy)

Tech. detail: Low to medium

Actor aggregation: High (few representative agents)

Equation based models covering the whole economy, usually equal (or close) to perfectly functioning (optimal) markets.

- Econometric
- General equilibrium models (CGE & DSGE)
- **Partial equilibrium models (PE)***
- Cost-minimizing models
- Simulations (agent-based & others)*
- Analytical*

* incl. in MSR comparison

Timescale: Up to long-term

Scope: Limited (to (sub-)ETS)

Tech. detail: Medium to high

Actor aggregation: High to medium

Equation-based model limited to a part (ETS) of the economy. Due to smaller scope better tractable and can more easily incorporate market failures.

- Econometric
- General equilibrium models (CGE & DSGE)
- Partial equilibrium models (PE)*
- **Cost-minimizing models**
- Simulations (agent-based & others)*
- Analytical*

* incl. in MSR comparison

Timescale: Up to long-term

Scope: Limited ((sub-)ETS supply side)

Tech. detail: High

Actor aggregation: /

Optimisation model limited supply side of the ETS. Difficult to incorporate market failure, since technology based. Ignores demand side.

- Econometric
- General equilibrium models (CGE & DSGE)
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- Cost-minimizing models
- **Simulations (agent-based & others)***
- Analytical*

* incl. in MSR comparison

Timescale: Up to long-term

Scope: Limited

Tech. detail: Low to High

Actor aggregation: Medium to low

Bottom-up algorithmic description of actor behaviour. Usually actors are boundedly rational. Computationally “cheap” to run, lends itself to sensitivity analysis / monte-carlo. Limited tractability.

- Econometric
- General equilibrium models (CGE & DSGE)
- Partial equilibrium models (PE)*
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- Simulations (agent-based & others)*
- **Analytical***

* incl. in MSR comparison

Timescale: /

Scope: Limited

Tech. detail: Low

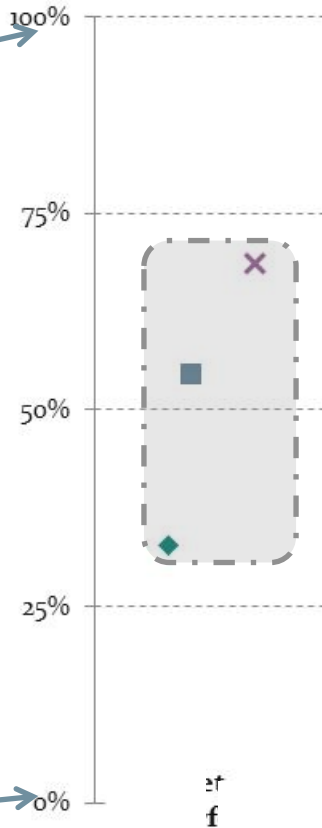
Actor aggregation: low-high

Equation-based (pen & paper) model, extremely tractable. For generating theory and explaining policy implications.

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Multi-model analysis (MSR study)

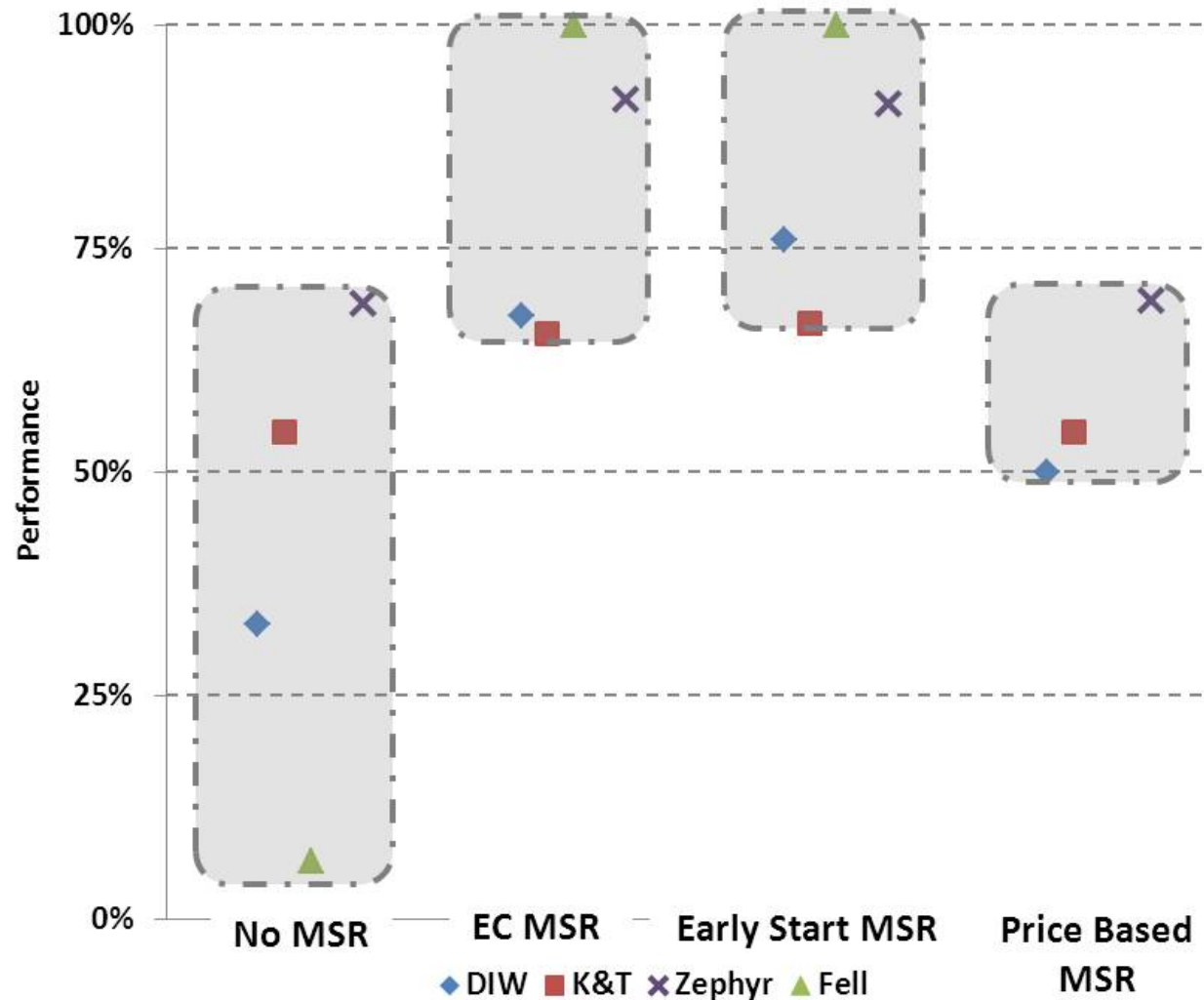
Value of indicator
modelling efficient
abatement pathway
(assuming banking
without market
imperfections)



Value of indicator
modelling no inter-
temporal flexibility
(assuming no banking)

Result of indicator from
different models
assuming market
imperfection

	Limited capacity	Myopia	Information
DIW	X		
LSE / K&T		X	
CEC/ Zephyr		X	X
Holt/Shobe			X
Salant/Fell	X		Stoch.



Efficiency criterion. From Neuhoﬀ et al., 2015

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- Different modelling goals lead to different models → No one-size fits it all.
 - For economy wide-effects, general equilibrium models cannot be substituted.
 - Sector specific models lead to deeper insights into market failures and sector transitions.
- Several potential market failures can exist in carbon markets → analysis of markets necessary to determine which one
- If possible, use a family of different model types to analyse a given (policy) problem.

Thank you for your attention!



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