POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

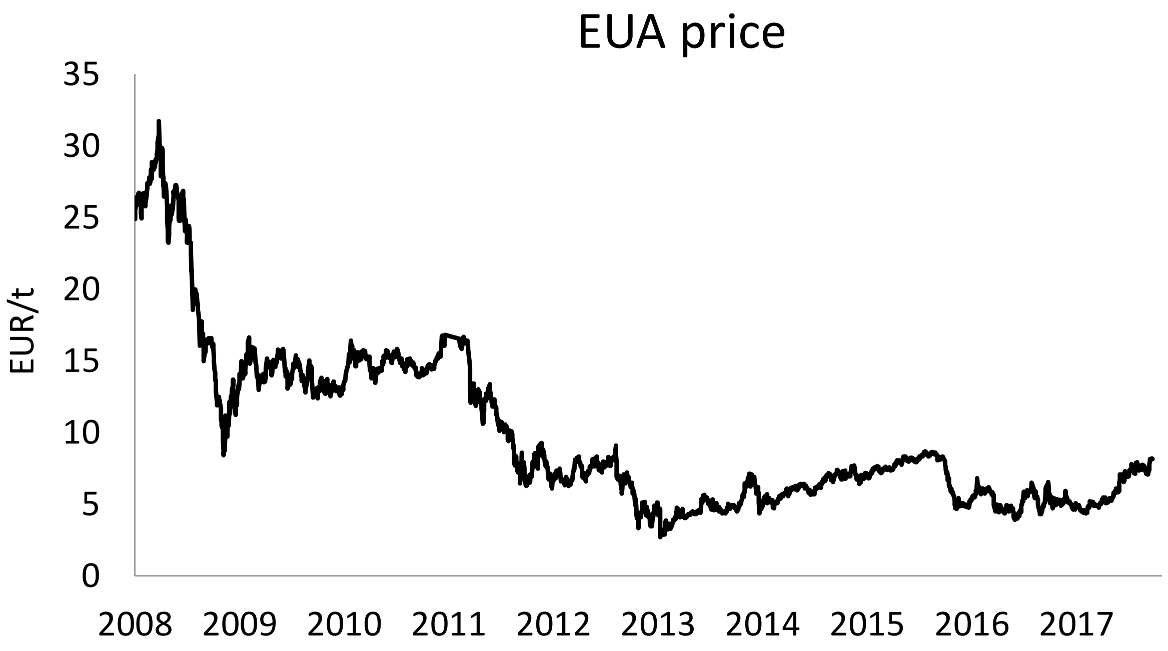
Hedging and the Temporal Permit Issuance in Cap-and-Trade Programs: The Market Stability Reserve under Risk Aversion

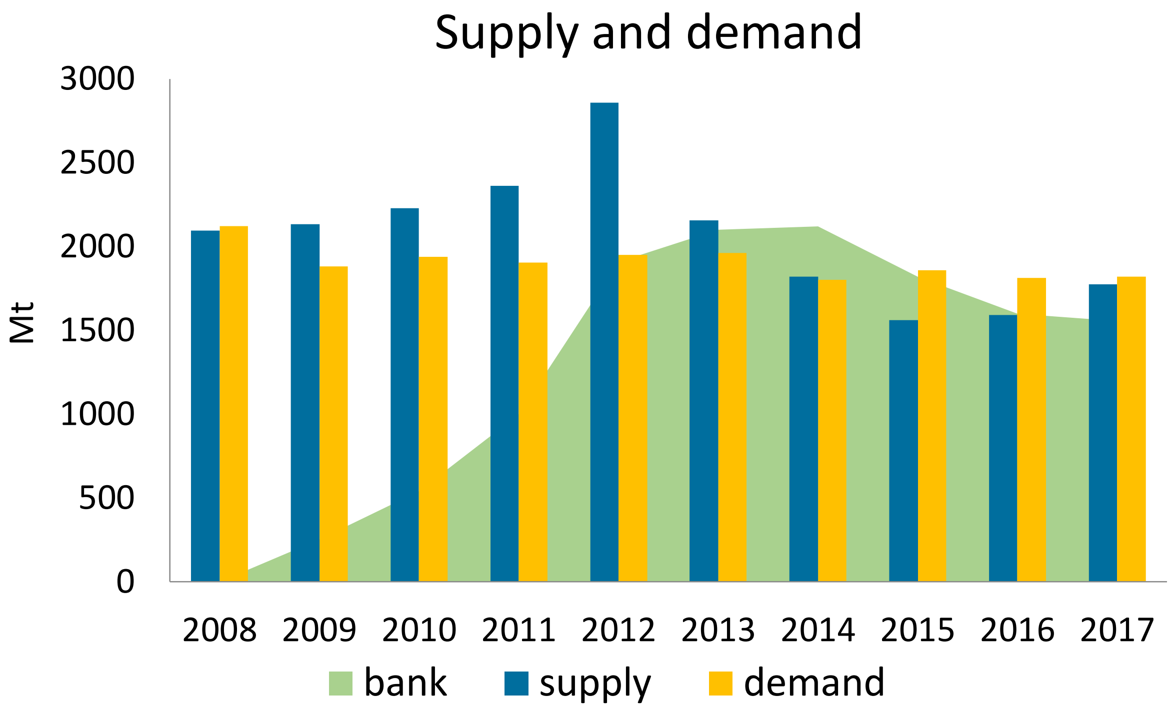
Oliver Tietjen, Kai Lessmann and Michael Pahle

FSR Climate Annual Conference - November 2019

Leibniz Association

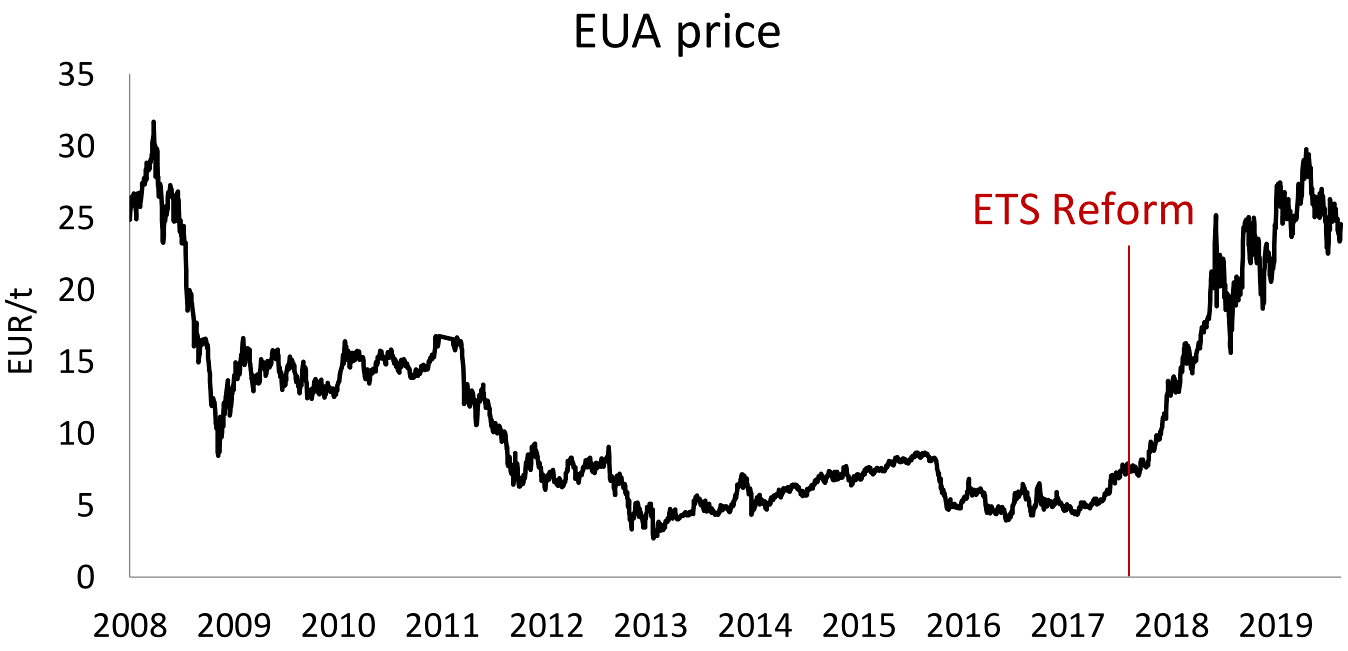
Until 2017: „Supply-Demand-Imbalance“ in the EU ETS





- Economic crisis etc., but fundamentals can only party explain ETS prices (e.g. Friedrich et al. 2019)
- Instead: policy and (financial) market failures

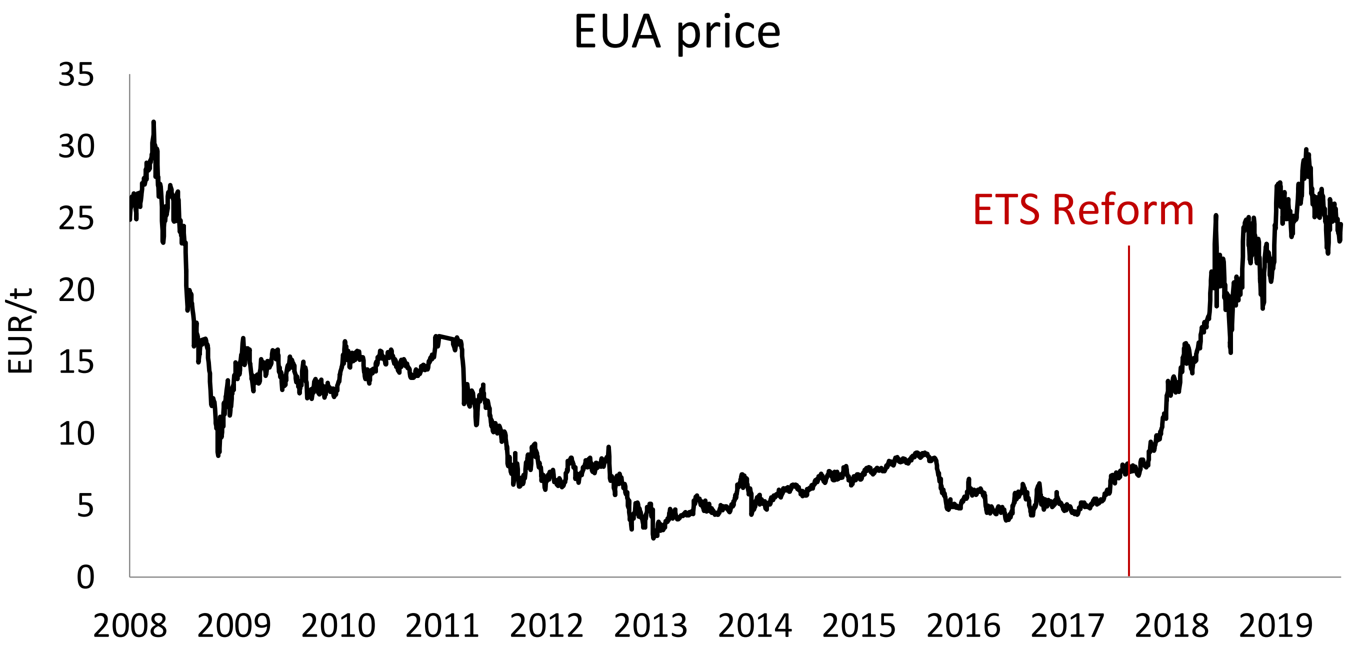
Since 2018: Price Hike



Key points of ETS reform:

1. Higher Linear Reduction Factor (LRF)
2. **Market Stability Reserve (MSR):**
   I. **More permits are shifted to the future**
   II. **Cancellation of permits**

After 2020: ?



This work:

1. Does the bank affects prices ?

➢ yes, if permits have hedging value

2. Does the MSR lead to a sustainable price increase ?

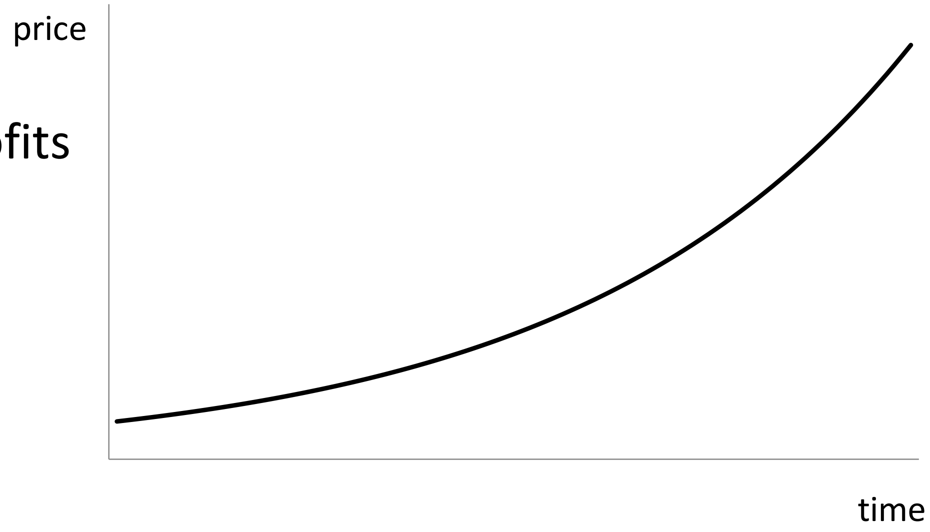
➢ Cancellation: yes

➢ Shifting of permits: no.

Theoretical Approach

Standard ETS model (e.g. Rubin 1996):

- Representative firm maximizes expected discounted profits
- Price growth at discount rate



This work:

- Dirty (coal) and (relative) clean (gas, renewables) firms produce good (electricity)
- Electricity market is regulated by an ETS with banking
- (regulatory) uncertainty about future permit supply creates demand for hedging
- risk counterparties (speculators) require risk premium for trading with regulated firms

Theoretical Model: Permit Trading under Risk Aversion

Theoretical Model

Firm problem

$$\max_{\zeta_{it}, y_{it}, I_{Kit}, I_{Lit}} \sum_{t=1}^{T} \frac{1}{(1+r)^{t-1}} E\left[U_{it}\left(\pi_{it}\right)\right]$$

subject to

$$1 \geq \zeta_{it} \geq 0 \quad I_{Kit} \geq 0 \quad b_{it} \geq 0$$

$k_{it} = (1-\delta)\, k_{it-1} + I_{Kit-1}$ ⟶ Plant capacity

$b_{it} = b_{it-1} + y_{it} - k_{it}\zeta_{it}\phi_i$ ⟶ Permit banking

$l_{it} = (1+r)\, l_{it-1} + I_{Lit}$ ⟶ Risk-free asset

Theoretical Model

Assuming a simplified two-period model, firms bank as follows:

$$b_{i,1} = \underbrace{\frac{E\left[p_2\right] - p_1\left(1+r\right)}{\lambda_i Var\left[p_2\right]}}_{\text{speculation}} - \underbrace{\frac{Cov\left[\pi_{i,2}^{plant}, p_2\right]}{Var\left[p_2\right]}}_{\text{hedging}}$$

In equilibrium, the growth rate of the ETS price is:

$$\frac{E\left[p_2\right] - p_1}{p_1} = r + \underbrace{q_1}_{\text{time-dependent risk premium}}$$

Theoretical Model

The risk premium:

$$q_1 = \frac{\Lambda}{p_1}\left(\underbrace{Cov\left[\pi_{d,2}^{plant}, p_2\right] + Cov\left[\pi_{c,2}^{plant}, p_2\right]}_{\text{Hedging demand of firms}} + \underbrace{Var\left[p_2\right]}_{\text{price risk}}\underbrace{B_1}_{\text{ETS permit bank}}\right)$$

- Hedging demand of dirty firms decreases over time: risk premium increases
- Regulator affects price level and growth rate by temporal allocation of permits

Numerical Application: The EU ETS and the Reformed MSR

Numerical Simulation

Electricity sector of EU ETS:

- One representative dirty coal and one relative clean gas firm
- 2020 to 2100 in five year steps
- MSR adjusts (annual) supply:

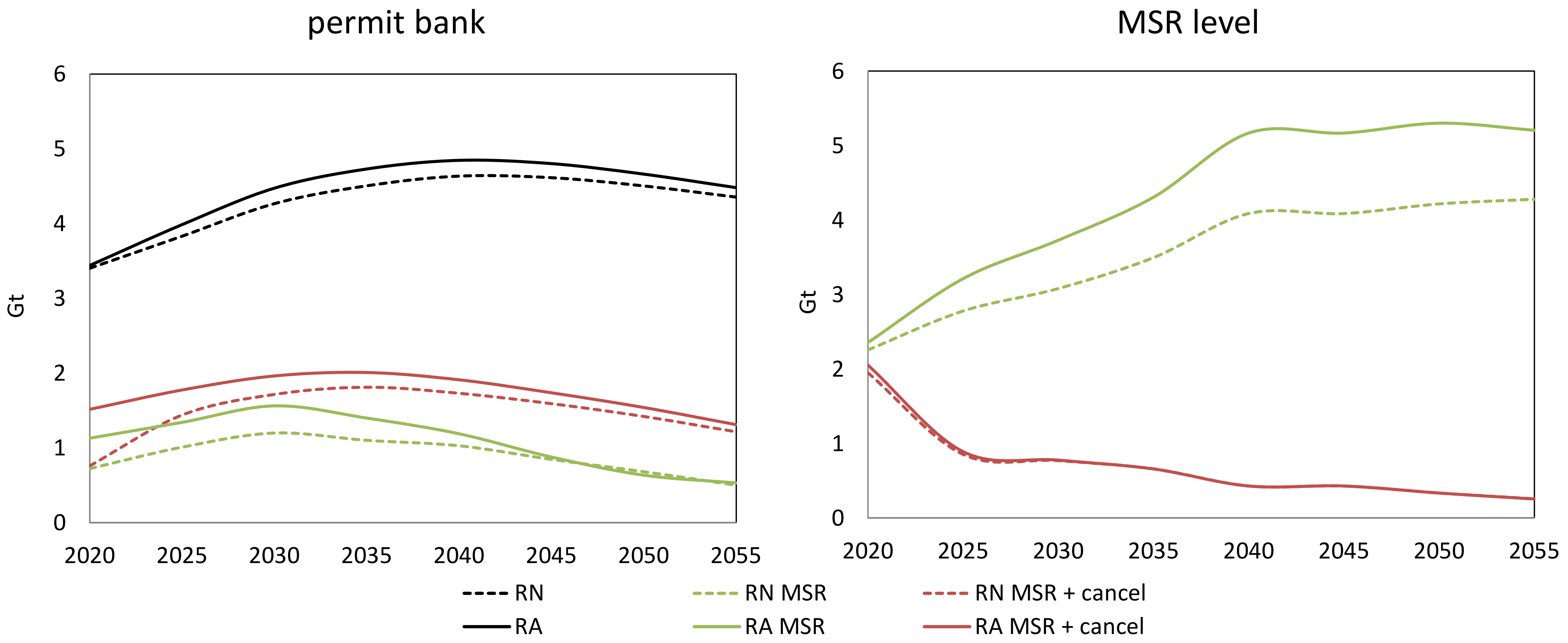
$$S_y^M = \begin{cases} S_y - \min\left(\gamma_y B_{y-1}; S_y\right) & if\ B_{y-1} > 0.833\,Gt \\ S_y + \min\left(0.1; M_{y-1}\right) & if\ B_{y-1} < 0.400\,Gt \\ S_y & otherwise, \end{cases}$$

- MSR level:

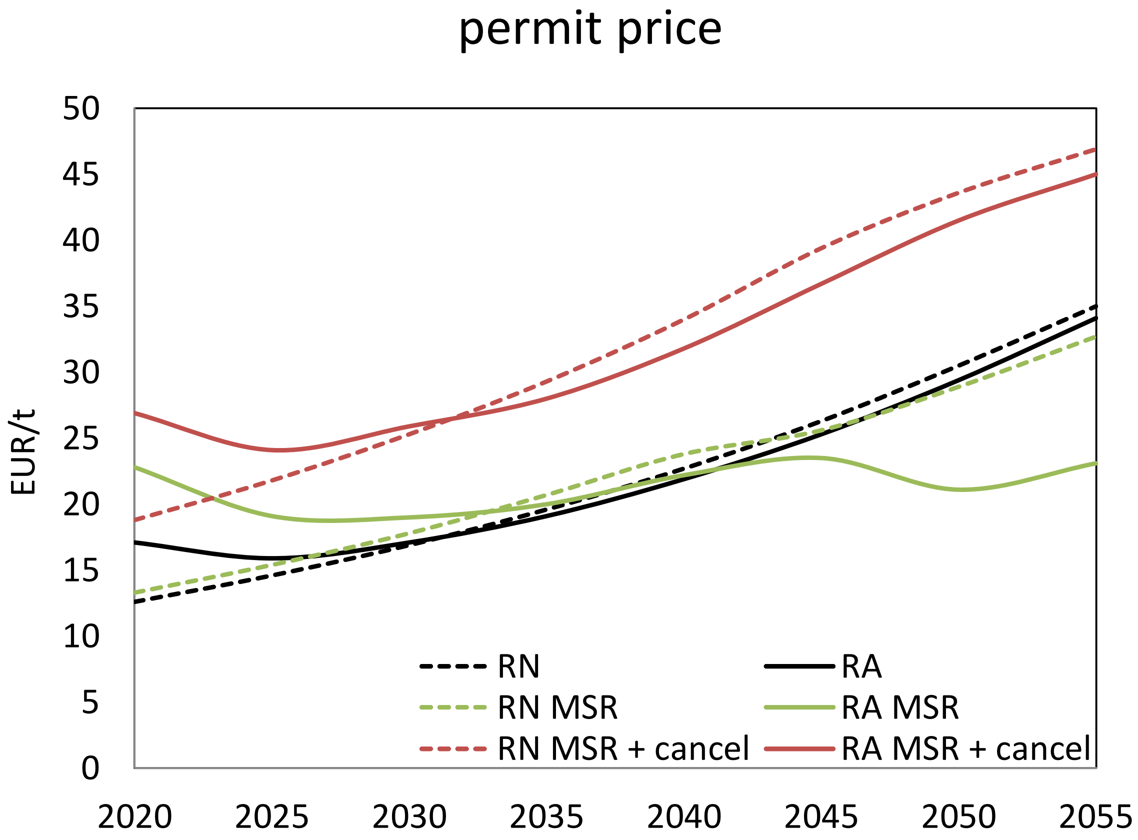
$$M_y = M_{y-1} + M_y^{in} - M_y^{out} - \max\left(M_y - S_{y-1}^M; 0\right)$$

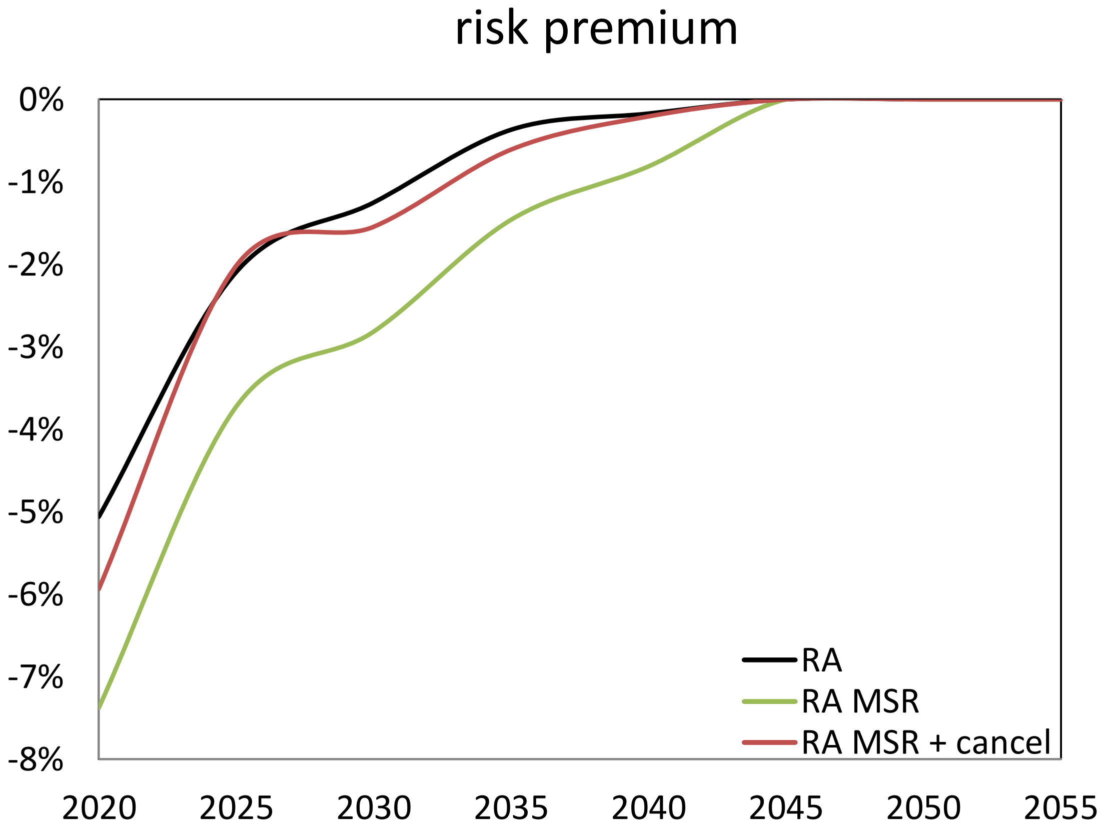
PIK

Numerical Simulation

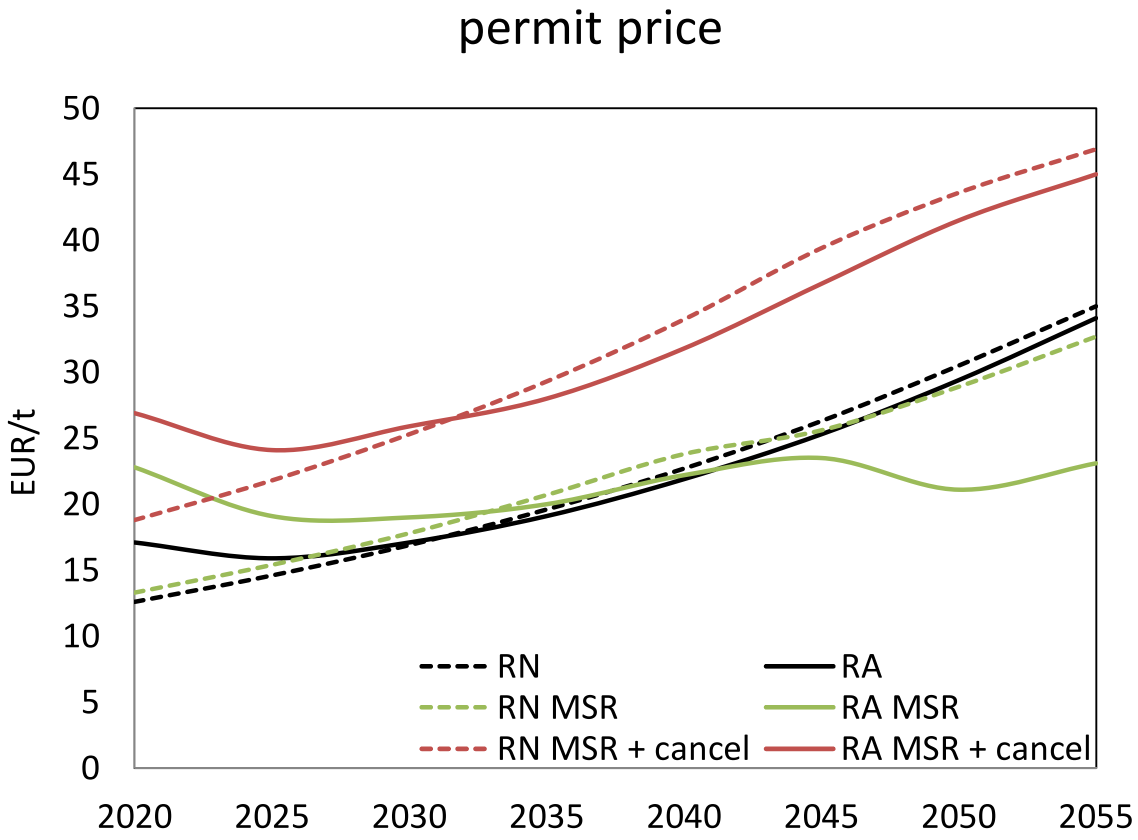


Numerical Simulation





Numerical Simulation



Cancellations

- In general, lower discount rate, more cancellations
- Assumed risk-free rate: 3%
- Cancellations in RN case: 7.6 Gt
- Cancellations in RA case: 8.59 Gt
- hedging of permits reinforces cancellation

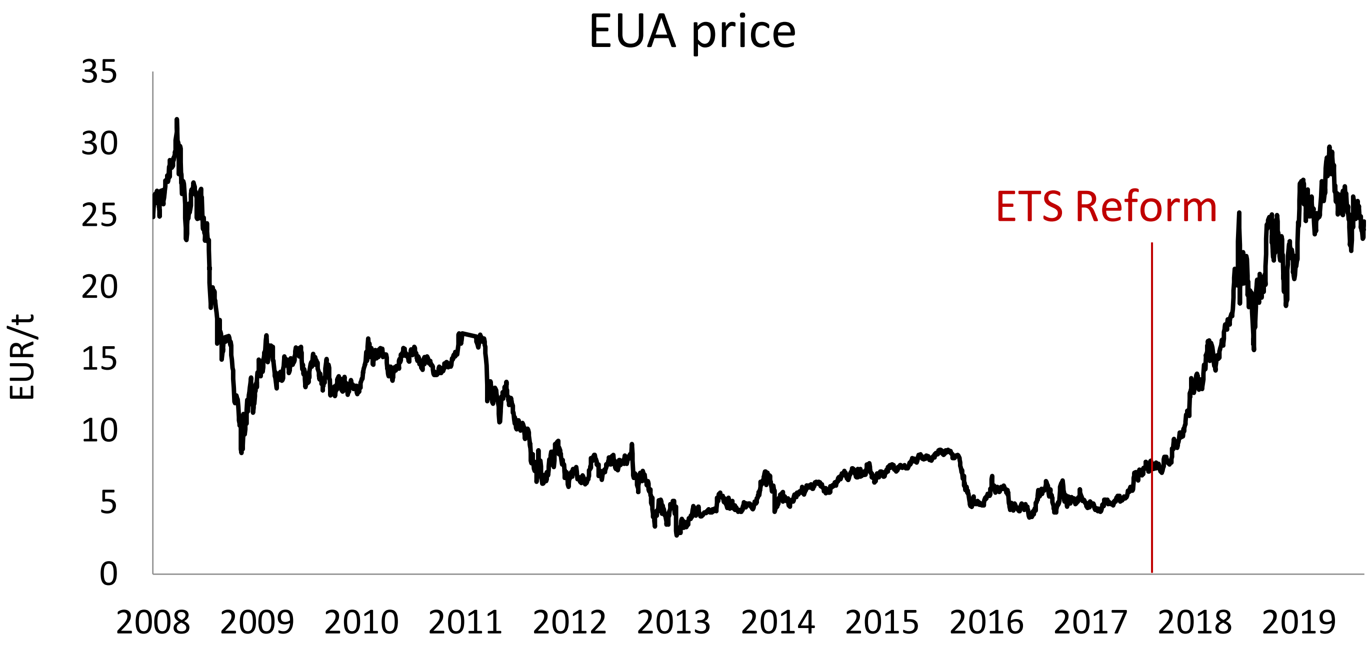
Conclusion

If firms are risk averse, and risk allocation is inefficient (regulatory risk)…

… permits have hedging value that depends on bank level

… hedging and permit shifting to future (MSR) leads to

1. higher short-term price
2. lower growth rate of permit price
3. more MSR cancellation



Thank you!

oliver.tietjen@pik-potsdam.de

References

Friedrich, M., Mauer, E., Pahle, M., Tietjen, O. (2019): From fundamentals to financial assets: the evolution of understanding price formation in the EU ETS. EconStor working paper.

Rubin, J. (1996): A Model of Intertemporal Emission Trading, Banking, and Borrowing. Journal of Environmental Economics and Management 31 (3), 269 – 286.