Emission trading with an endogenous cap: some fundamental/unanticipated problems

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MCC, 20 Nov 2019, Berlin

Sources

Reyer Gerlagh and Roweno Heijmans (2018), Regulating Stock Externalities, CESifo WP 7383 (related to Pizer & Prest JAERE2019))

Reyer Gerlagh and Roweno Heijmans (2019), Climate conscious consumers and the Buy-Bank-Burn Program. Nature Climate Change 9: 431-433.

Reyer Gerlagh, Roweno Heijmans and Knut Einar Rosendahl (2019), Every ETS with endogenous cap causes a green paradox. in progress

Further own thoughts

Preview of main messages

Mirror Properties (two sides of same coin)

- Market Stability Reserve (MSR) stabilizes ETS market against current and past demand volatility.
- MSR punctures the waterbed when considering current climate policies.
- MSR amplifies volatility caused by changing perceptions on future demand, including green innovations.
- MSR causes a green paradox when considering climate policies taking effect with substantial delay (e.g. German coal phase out post 2038).

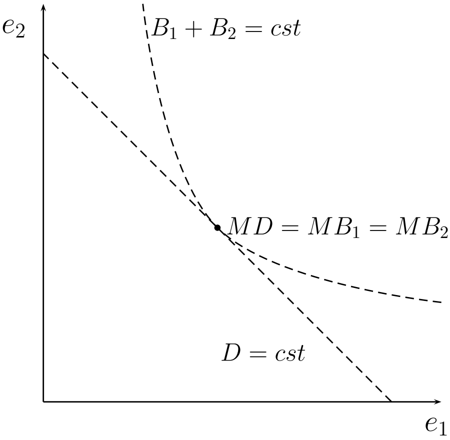
... meaning ...

- Quantity-based ETS modifications always induce strategic exploitation and green paradoxes (mirror).
- ETS has been subject to 'political taboos', but maybe taboos can soften / the 'unspeakable' (price collars) could become politically palatable?

Overview

1. Introduction
2. A Very Simple Model for the ETS-MSR
3. ETS: How to accommodate Short-Run Market Uncertainty
4. ETS: How to accommodate Freedom of Future Climate Policies
5. Any endogenous cap invites to Play the System (Buy-bank-burn)
6. Any endogenous cap creates a Green Paradox!
7. Suggestions for MSR 3.0

ETS benchmark



The ETS is based on 2 premises

- Only cumulative emissions matter for climate damages (diagonal line = constant damages).
- Free banking and borrowing → equal marginal private benefits of allowances over periods.

Level of cumulative quota: marginal damage = marginal benefits.

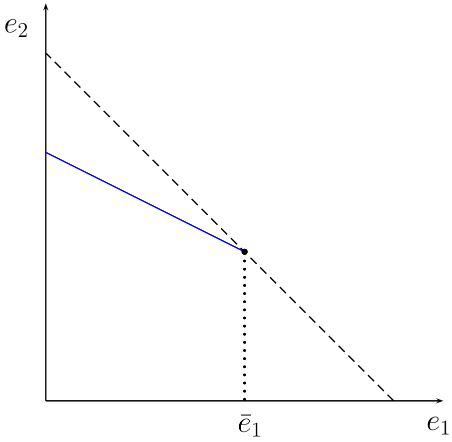
ETS after the 2008 credit crunch

Recall: Level of cumulative quota: marginal climate damage = marginal abatement costs = marginal firms' benefits of emissions.

After 2008 credit crunch, carbon prices dropped, and EC believed that marginal abatement costs $<$ marginal climate damages

... and the MSR entered stage.

Effects of the MSR 1: reduced supply

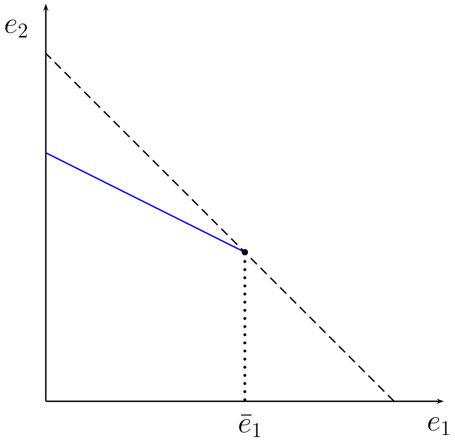


Two periods (present and future)

Benchmark: cumulative emissions are fixed = diagonal dashed line.

MSR takes allowances out of market, and destroys part of these.
⇒ cumulative supply with MSR (blue line) is below dashed line
⇒ explains rise in carbon price Spring 2018 from 5 to 20 €/tCO_2.

Effects of the MSR 2: changing aggregate substitution

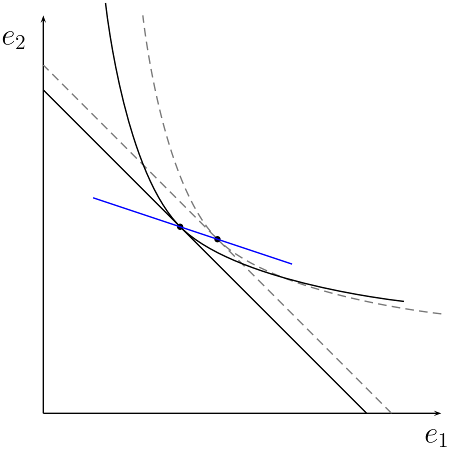


Benchmark: cumulative emissions are fixed = diagonal line.

If firms emit less in early periods ⇒ they bank more allowances ⇒ larger MSR ⇒ more cancelling ⇒ fewer cumulative emissions.

Slope of ETS supply declines (straight blue line)

Effects of the MSR 3: no changing firms substitution



- MSR does not change the rights of individual firms to save allowances 1-to-1.
- If demand shifts (captured by change in profit-maximizing iso-curves) then new equilibrium is where iso-profits and 45-degree line are tangent
- but equilibrium allocation adjusts along the blue line (previous slide)

3 Effects of the MSR (summary)

Changes

- Reduced aggregate supply
- Decreased substitution of allowances at aggregate level

No change:

- Free banking of allowances (no change)
- Competitive markets for allowances (abstract from market power)

Describing the MSR through 4 equations

- Competitive markets for allowances (no change):

$$p_t = B'(q_t; \theta_t, \lambda_t) \tag{1}$$

with $B(.)$ firms profits, θ_t market uncertainty, and λ_t climate policy.

- MSR stabilization mechanism at aggregate level (MSR change)

$$q_1 + \delta q_2 = Q \tag{2}$$

with periods $t \in \{1, 2\}$, q_t aggregate use of allowances, $\delta < 1$

- Free banking of allowances (no change)

$$p_1 = \mathbb{E}_1[p_2] \tag{3}$$

with p_t market prices.

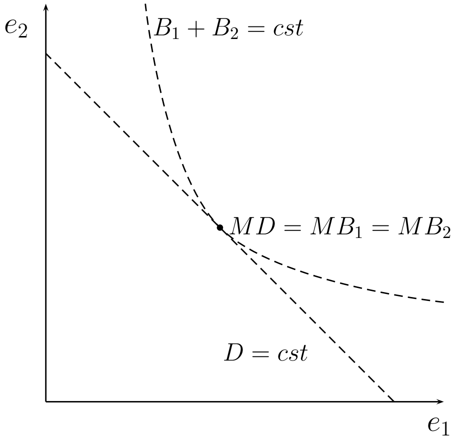
- Note: 4 equations determine 4 variables (p_t, q_t)

ETS: How to accommodate Short-Run Market Uncertainty

Question: if we have an ETS, how should it optimally deal with market uncertainty (θ_t)?

- define ex-ante expected equilibrium allocation
- describe demand shock (decrease) at $t = 1$
- derive welfare optimal cap adjustment
- derive optimal aggregate supply curve
- describe the problem with formulas

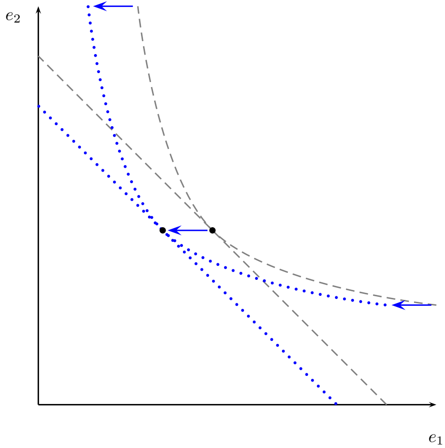
Ideal response to Market Uncertainty 1. Define ex-ante



Before opening the ETS

- Only cumulative emissions matter for climate damages (diagonal line = constant damages).
- Economic profits are maximized when allocating emissions to both periods (curvature = constant profits).
- Ex-ante optimum where two lines are tangent.

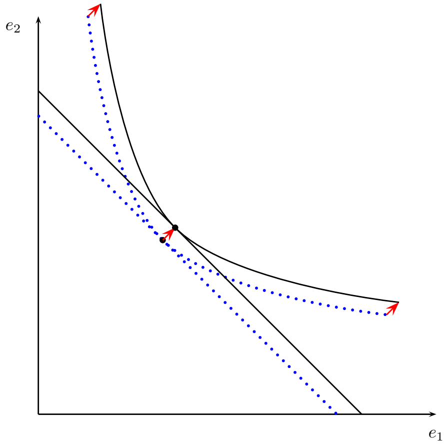
Market uncertainty 2. Period-1 demand shock



After opening the ETS

- Demand in period 1 drops (recession)
- Suppose cap drops equally, equilibrium moves left

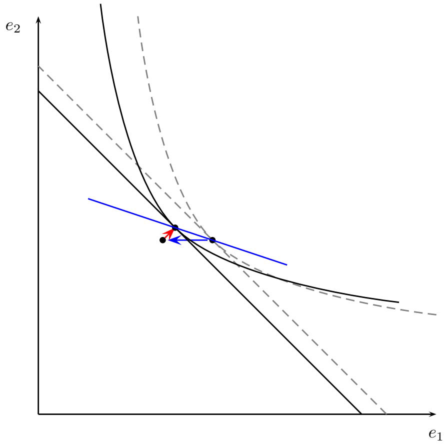
Market uncertainty 3. Cap adjusts optimally



But if cumulative emissions drop, marginal damages decrease

- Optimal cap increases compared to previous slide (cap drops only partly compared to original)
- optimum is right-up (compared to previous slide)

Market uncertainty: 1+2+3 = Optimal response



The optimal responding ETS, takes both together

- a drop in period 1 demand moves the allocation up-left.

MSR implements the principles of optimally adjusting caps (Gerlagh and Heijmans 2018).

- An optimal endogenous cap sets the contract curve along the the blue line

Optimal response to Market Uncertainty: formulas

- max economics profits minus climate damages

$$\max B_1(q_1;\theta_1,\lambda_1) + B_1(q_2;\theta_2,\lambda_2) - C(q_1+q_2) \tag{4}$$

- Context. The market observes θ_1 (recession), and shocks are AR1

$$\theta_2 = \rho\theta_1 + \mu \tag{5}$$

- FOCs

$$B'(q_1;\theta_1,\lambda_1) = \mathbb{E}[B'(q_2;\theta_2,\lambda_2)|\theta_1] \tag{6}$$
$$B'(q_1;\theta_1,\lambda_1) = C'(q_1+q_2)| \tag{7}$$

- 2 equations conditional on θ_1 define implicitly the regulator's optimal response policy $q_2^*(\theta_1) = R(q_1^*(\theta_1))$ with

$$-1 < R' < 0 \tag{8}$$

ETS: How to accommodate Freedom of Climate Policies

Question: if we have an ETS, how should it optimally deal with policies that may affect future demand, and that may change due to new moral/social/economic insights?

- describe the problem with formulas
- describe demand shock (decrease) at $t = 2$
- derive welfare optimal cap adjustment
- derive optimal aggregate supply curve

Climate policies

- Government needs to be free to develop complementary new policy measures that reduce demand: immediate effects in λ_1 and future effects in λ_2). This freedom implies uncertainty at the stage of the set up of the ETS. ETS rules should optimally adjust to new policies. FOCS:

$$B'(q_1; \theta_1, \lambda_1) = \mathbb{E}[B'(q_2; \theta_2, \lambda_2)|\theta_1] \quad (9)$$

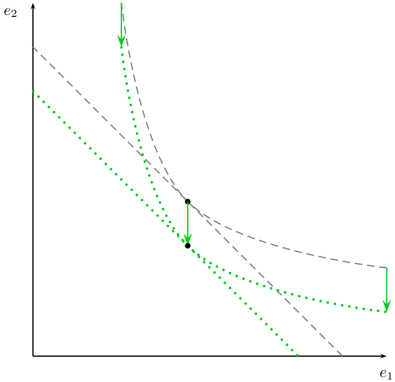
$$B'(q_1; \theta_1, \lambda_1) = C'(q_1 + q_2)| \quad (10)$$

- 2 equations. When conditional on λ_1 same result as for θ_1.
- When conditional on λ_2, we get optimal response $q_2^*(\lambda_2) = R(q_1^*(\lambda_2))$ with

$$R' < -1 \quad (11)$$

- A MRS that is good for uncertainty is bad for policy response, and vice versa!

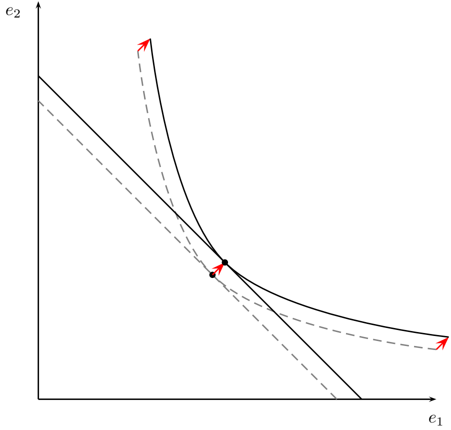
Policies: period-2 demand reduction



Policy maker announces to shut down all coal power plants per 2035

- Demand in period 2 drops (policies!)
- Suppose cap drops equally, equilibrium moves down

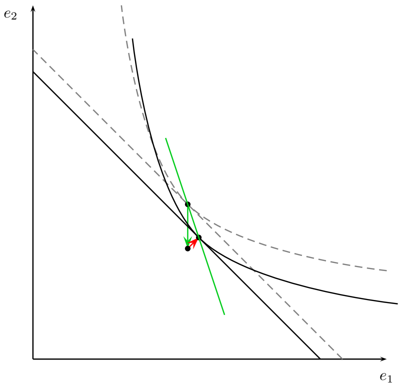
Policies: Cap adjusts optimally



But if cumulative emissions drop, marginal damages decrease

- Optimal cap increases compared to previous slide (cap drops only partly compared to original)
- equilibrium moves right-up (compared to previous slide)

Policies: Optimal response



The optimal responding ETS, takes both together

- a drop in period 2 demand moves the allocation down-right.
- An optimal endogenous cap sets the contract curve along the the green line

MSR changes the Aggregate Marginal Rate of Substitution in the wrong direction.

Summary of Optimal Endogenous Caps

An optimal endogenous cap would have to respond differently in case of market uncertainty in early periods (decreased slope), as compared to political freedom for later periods (increased slope).

New MSR rules are consistent with optimal response to market uncertainty (reason for its set up), not with freedom of demand policies (not considered when set up)!

Note that policy changes for the future are technicaly equivalent to changing technology expectations about future. Thus, MSR also leads to more cumulative emissions if we become more optimistic about future cheap abatement (Bruninx, Ovaere, Gillingham, Delarue 2019)!

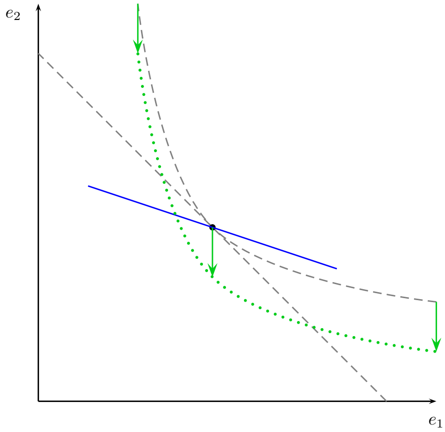
Another problem: Buy-bank-burn

Simple logic: You take a flight to New York, you buy allowances that offset the flight, but the effect on cumulative emissions in the ETS depends on the period in which you retire the allowances!

In the EU-ETS-MSR system, immediate retirement reduces cumulative emissions by only 30%. But a buy-bank-burn program (retire allowances after 2040) can reduce emissions by 170% (Gerlagh and Heijmans NCC 2019)

MSR enables parties external to ETS to offset emissions at lower costs if they act strategically.

The green paradox!

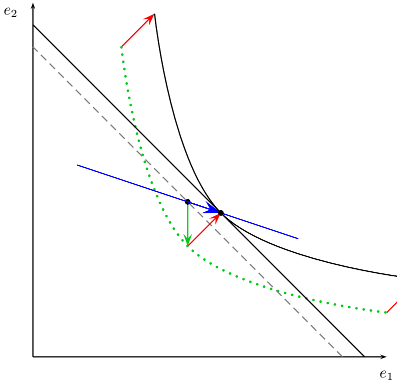


Now assume we have implemented the MSR that is optimal for market uncertainty (blue line).

Initial allocation is on the blue line where iso-profit curve is 45-degrees.

Then policy implements a demand reduction in the future.

The green paradox through the MSR



The MSR rebalances the equilibrium, such that prices of allowances in first period equal those in second period.

Future demand goes down → prices go down → current demand goes up → banking goes down → canceling goes down → cumulative emissions go up (diagonal shifts outwards)

A Green Paradox results (GHR 2019)

Green Paradox through Formulas

- ETS (3 equations determine 3 variables (p_1, q_1, q_2))

$$p_1 = B_1'(q_1; \theta_1, \lambda_1) \tag{12}$$
$$p_1 = \mathbb{E}B_2'(q_2; \theta_2, \lambda_2) \tag{13}$$
$$q_1 + \delta q_2 = Q \tag{14}$$

- define $dq_t/d\lambda_t = 1$ for constant price, so $B_\lambda' = -B''$, and take full derivatives for policy $d\lambda_2 < 0$

$$B_1'' dq_1 = \mathbb{E}B_2''(dq_2 - d\lambda_2) \tag{15}$$
$$dq_1 + \delta dq_2 = 0 \tag{16}$$

- which gives the green paradox

$$\frac{d(q_1 + q_2)}{d\lambda_2} = \frac{\delta - 1}{\frac{B_1''}{\mathbb{E}B_2''} + \delta} < 0 \tag{17}$$

ETS-MSR: a fundamental problem by construction

- ETS Fase IV ends 2030. We have since 2018 new MSR rules
- Further revisions must respect existing rules

Is politics still stuck to 'pure quantity' measures?

- Quantity only is by construction half-blind for market information. GHR2019 show that quantity only always result in green paradoxes.

Revising the ETS-MSR

Alternative 1.

- Re-interpret the MSR as stabilizer of financial assets balances, rather than as price stabilizer!
- Use price rules for price-stabilization...
  taking effect after 2030 may make it politically acceptable?

EC can propose that

- allowances are not auctioned below a certain price level, but put in the MSR instead (French proposal?)
- allowances from the MSR are faster returned to the market if prices exceed a certain level
- Note 1: a price policy will let the MSR endogenously cancel allowances (complicated variation of collar).
- Note 2: An announcement of a price policy by 2030 will immediately affect present prices!

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Looking further ahead

World will almost surely overshoot CO_2 levels consistent with 2 degrees Celsius.

Europe's potential contribution to damage control:

- Prepare infrastructure knowledge for large-scale clean energy to be available to other countries when their citizen and polity are ready.
- Prepare and test Carbon Capture (from air) and Sequestration technologies.
- Prepare and test Solar Radiation Management.

Soft power

- Test supporting institutions for use by other countries when their citizen and polity are ready.
- Target beliefs. By serious planning, signal that climate policies are the future.

Extending the scope of the ETS: remove carbon!

Alternative 2. Look further ahead.

EC can respond to CO_2 overshooting by explicitly aiming at atmospheric carbon capture post 2050

- After 2050, ETS will continue
- Extra allowances can (only) be produced by specified Carbon Capture and Sequestration technologies
- Some of these allowances are canceled; the remaining allowances are for firms to buy and trade.
- This will set the current ETS market price equal to the long-run marginal costs of carbon removal.