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The Ausubel auction in the EU ETS

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The motivation...

- Global warming and GHG emissions are *the* problems of the century
- The innovative character of emission permits market (EPM) as a policy instrument to fight a global negative externality
- EU ETS is one of the biggest environmental policy experiments ever

The motivation...

- Grandfathering was the chosen rule for emission permits initial allocation on the 1st and 2nd phases of the EU ETS.
- However, AUCTIONING is the allocation method recommended for the next phases (COM(2008) 16 final, 23.1.2008)

The motivation...

"Auctioning best ensures efficiency of the ETS, transparency and simplicity of the system and avoids undesirable distributional effects.

Auctioning also best complies with the polluter-pays principle and rewards early action to reduce emissions. For these reasons auctioning should be the basic principle for allocation."

(COM(2008) 16 final, 23.1.2008, p.7)

Objective

To experimentally test the performance of an institution that parallels EU ETS but including auction as a rule for the initial allocation of (100%) CO₂ emission permits.

Outline

- Introduction
- Experimental Design
- Benchmarks
- Results
- Conclusion

- Several experimental studies exist on EPM: Godby *et al.* (1997), Cronshaw and Brown-Kruse (1999a), Franciosi *et al.* (1999), Cason *et al.* (1999), Mestelman *et al.* (1999) and Gangadharan *et al.* (2005) are just a few.
- Laboratory experiments on American and Canadian markets for SO₂ were used to test the rules chosen.

- Benz and Ehrhart (2007) experimental study on EU ETS, for instance, is far from being an EU ETS testbeding.
- The main contribution of our work is to include both the rules and the parameters that parallels the EU ETS structure (and test a specific auction type).

An auction type had to be chosen...

- Unique price auctions for multiple units are inefficient as result on demand reduction (ex: Holt (2006); Ausubel e Cramton (1998)).
- Vickrey (1961) static auction and Ausubel (2004) dynamic equivalent version are efficient auctions for multiple units.

- Kagel and Levin (2001), Engelmann and Grimm (2004) and Manelli *et al.* (2006), for example, experimentally test the Ausubel auction.
- However, their laboratorial environment is far from resembling EU ETS or any EPM.

- Holt *et al.* (2007) experimental study represent several characteristics of EPM and test the performance of 5 different auction institutions for CO₂ allocation (unique and discriminative static auctions; English auction; Dutch auction and anglo-dutch auction).
- But DO NOT test the performance of the Ausubel auction.

Each computerized (zTree) experimental session constituted by 3 parts:

- 1. Socioeconomic questionnaire
- 2. Multiple Price List (Holt and Laury, 2002) elicitation of risk aversion attitudes
- 3. EMISSION PERMITS MARKET

Decisão	Forma A	Forma B				
1	Se bola 1 recebe 2.00 Euros Se bola 2 a 10 recebe 1.60 Euros	Se bola 1 recebe 3.85 Euros Se bola 2 a 10 recebe 0.10 Euros				
2	Se bola 1 a 2 recebe 2.00 Euros Se bola 3 a 10 recebe 1.60 Euros	Se bola 1 a 2 recebe 3.85 Euros Se bola 3 a 10 recebe 0.10 Euros				
3	Se bola 1 a 3 recebe 2.00 Euros Se bola 4 a 10 recebe 1.60 Euros	Se bola 1 a 3 recebe 3.85 Euros Se bola 4 a 10 recebe 0.10 Euros				
4	Se bola 1 a 4 recebe 2.00 Euros Se bola 5 a 10 recebe 1.60 Euros	Se bola 1 a 4 recebe 3.85 Euros Se bola 5 a 10 recebe 0.10 Euros				
5	Se bola 1 a 5 recebe 2.00 Euros Se bola 6 a 10 recebe 1.60 Euros	Se bola 1 a 5 recebe 3.85 Euros Se bola 6 a 10 recebe 0.10 Euros				
6	Se bola 1 a 6 recebe 2.00 Euros Se bola 7 a 10 recebe 1.60 Euros	Se bola 1 a 6 recebe 3.85 Euros Se bola 7 a 10 recebe 0.10 Euros				
7	Se bola 1 a 7 recebe 2.00 Euros Se bola 8 a 10 recebe 1.60 Euros	Se bola 1 a 7 recebe 3.85 Euros Se bola 8 a 10 recebe 0.10 Euros				
8	Se bola 1 a 8 recebe 2.00 Euros Se bola 9 a 10 recebe 1.60 Euros	Se bola 1 a 8 recebe 3.85 Euros Se bola 9 a 10 recebe 0.10 Euros				
9	Se bola 1 a 9 recebe 2.00 Euros Se bola 10 recebe 1.60 Euros	Se bola 1 a 9 recebe 3.85 Euros Se bola 10 recebe 0.10 Euros				
10	Se bola 1 a 10 recebe 2.00 Euros	Se bola 1 a 10 recebe 3.85 Euros				

Experimental Design (EMISSION PERMITS MARKET)

Laboratory rules respected the European Commission choices for the EU ETS implicit at the 2003/87/EC Directive:

- cap-and-trade system
- banking
- double auction with discriminative prices (reflecting rules of exchanges)
- penalty structure for incompliance

Experimental Design (EMISSION PERMITS MARKET)

Instead of the 2003/87/EC Directive initial allocation rule for CO₂ emission permits (grandfathering) we followed the COM(2008)16final recommendation:

• to use auctioning as "the basic principle for allocation."

Also included <u>uncertainty</u> on effective emissions abatement level.

Random variation on emissions drawn from a uniform distribution (-1, 0, +1) – as Godby *et al.* (1997).

To assure comparability of results we used the same uniform distribution for the different experimental sessions.

PARAMETERS chosen for the market intended to parallel EU ETS.

- Marginal abatement costs structure based on Eyckmans et al. (2000)
- Participants' dimension proportional to Belgium (S1), Spain (S2), Germany (S3), Greece (S4), France (S5), Italy (S6), United Kingdom (S7) and Netherlands (S8).
- Emissions targets fixed according to EU Burden Sharing Agreement (BSA).

PARAMETERS:

- Emission permits supply fixed (at the auction) for each of the 10 periods of the session (88 units)
- Penalty for noncompliance: -560 points and one permit less on the period following the infraction.

Imperfect competition characterised our laboratorial market: participants with heterogeneous dimensions, marginal abatement costs and emission targets (under imperfect information about effective emission levels – uncertainty context on the demand side).

Neutral language on Instructions:

emission permits, environmental goals or policy instruments for regulation were never mentioned: <u>an</u> homogeneous good produced at different scales and costs that could be traded in a certain market...

Stages of the third part of our experiments (repeated in the 10 periods of our 4 sessions)

Stage 1: Auction participation

Stage 2: Banking decision

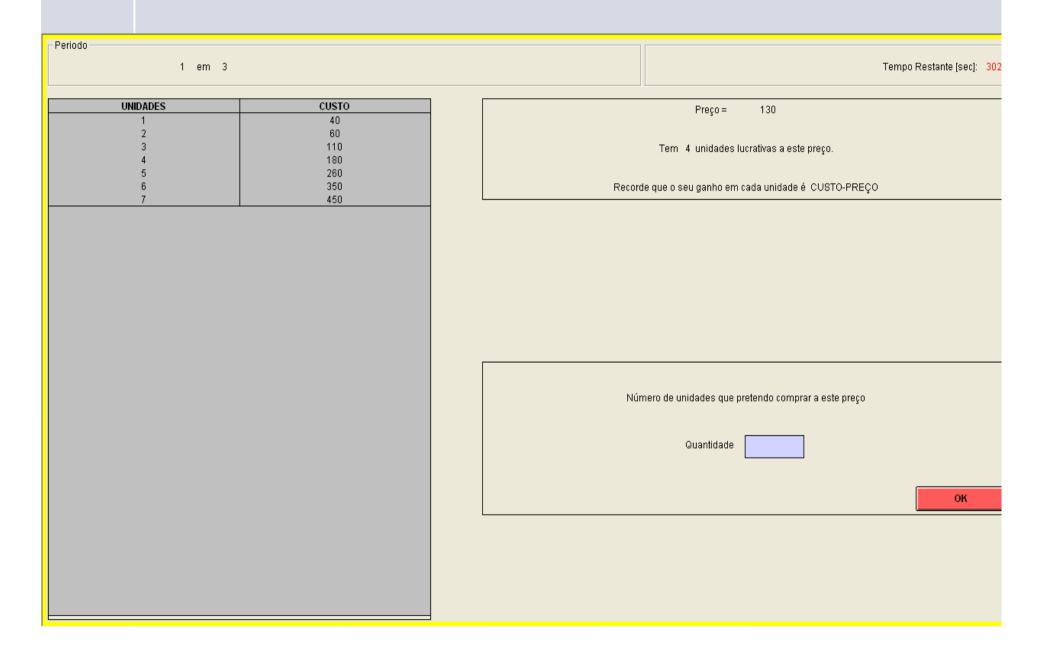
Stage 3: Permit market participation

Stage 4: Information about random shock

Stage 5: Reconciliation market participation

Stage 6: Re-banking.

Stage 1: Auction



Stage 1: Auction

Periodo

1 em 3

Tempo Restante [sec]: 53

UNIDADES	CUSTO	ADQUIRIDA
1	40	
2	60	
3	110	
4	180	
5	260	SIM
6	350	SIM
7	450	SIM

O seu ganho total no leilão é de 490 pontos.

Adquiriu um total de 3 unidades aos seguintes preços:

QUANTIDADES	PREÇOS
0	130
0	160
3	190

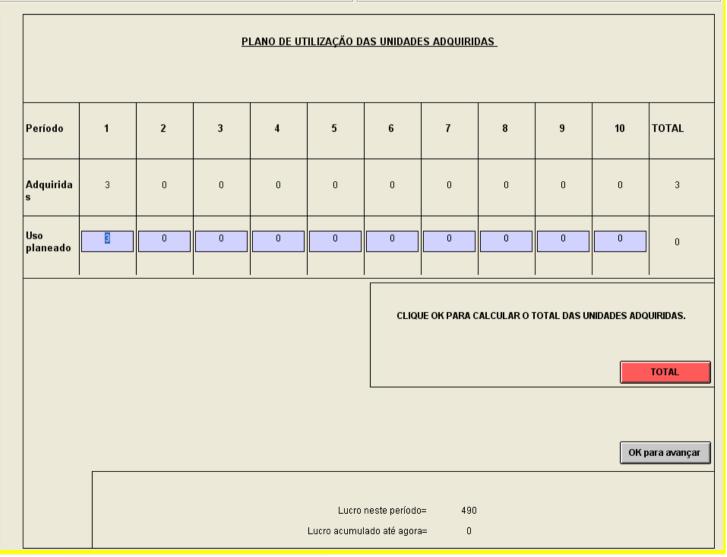
Stage 2: Banking

Periodo

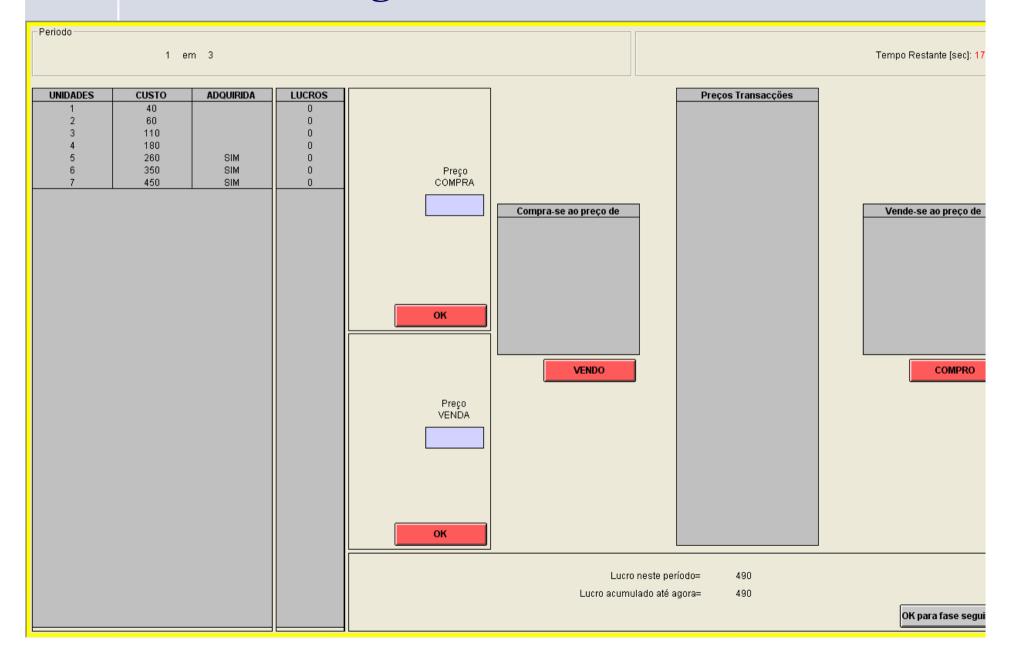
1 em 3

Tempo Restante [sec]: 594

UNIDADES	CUSTO	ADQUIRIDA
1	40	
2	60	
3	110	
4	180	
5	260	SIM
6	350	SIM
7	450	SIM



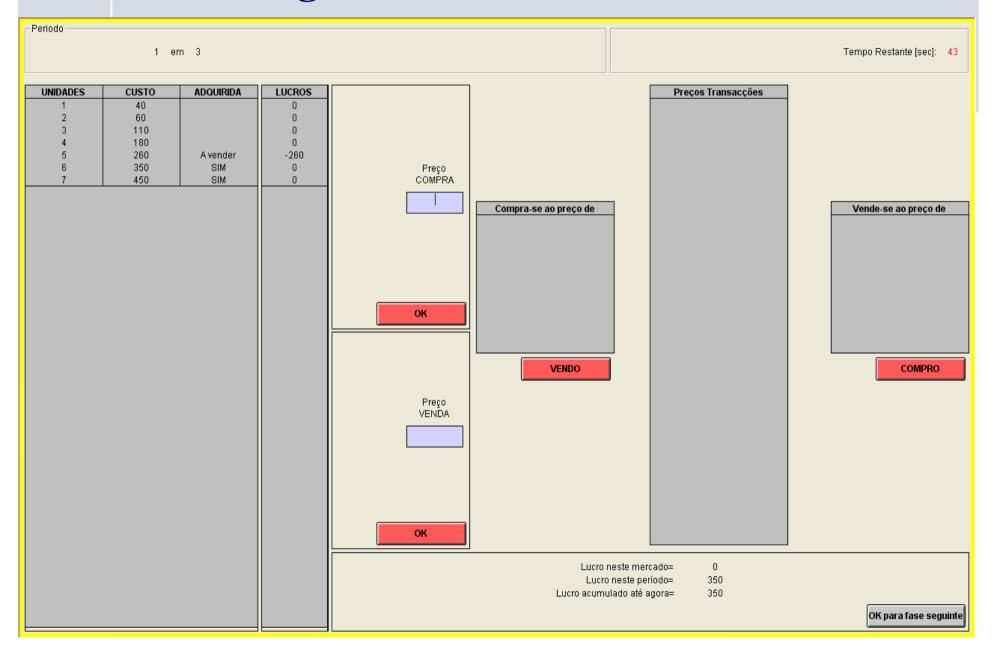
Stage 3: Permits Market



Stage 4: Information about random shock

- Periodo							
	1 em 3			Tempo Restante [sec]: 36			
UNIDADES	CUSTO	ADQUIRIDA	LUCROS				
1 2	40 60		0	Resolução da Incerteza			
3 4	110 180		0				
5 6	260 350	SIM SIM	-260 0				
7	450	SIM	0				
				Variação nas Unidades detidas: 1			
				Detém mais uma unidade do que o previsto. Foi suportado desnecessariamente o custo da unidade número:			
				5			
				Pode, porém, tentar ainda vendê-la no mercado que abre de seguida ou então guardá-la para períodos futuros.			
				Se VENDER, o seu ganho será de Preço de Venda - Custo dessa unidade.			
				Se GUARDAR, os ganhos actuais diminuem no valor do seu custo mas num momento futuro aumentam pelo valor do custo que evitar então suportar.			
				Se nada fizer, essa unidade terá um impacto negativo nos seus ganhos, correspondente ao valor do seu custo.			
				Impacto da Incerteza no Lucro= -260			
				Lucro neste período= 350			
				Lucro acumulado até agora= 350			

Stage 5: Reconciliation market



Stage 6: Rebanking

Periodo	
1 em 3	Tempo Restante [sec]: 51
Se preferir, pode guardar a unidade para o próximo p	eríodo.
Quer guardar uma unidade agora?	
○ SIM	
C NÃO	
NOTA:	
Se escolher NÃO, suporta o custo desta unidade, afectando assim os seus resultados de forma negativa.	
Se escolher SIM, fica com mais uma unidade guardada para o próximo período.	
oe esculler oliw, lica culti triais utria utriuaue guaruaua para u proximo periodo.	
Depois de assinalar a sua escolha, clique em OK para contir	ouar.
<mark>ок</mark>	
	OK para avançar
Lucro neste período= 350	
Lucro acumulado até agora= 350	

Supply and demand conditions are NOT the same on the 10 periods of the sessions, although marginal abatement costs and participants' dimensions are fixed, as well as the supply in each period (88).

Random fluctuations on emissions, the penalty imposed and the possibility of banking change supply and demand conditions on the 10 periods.

Ex-ante determination of equilibrium price and quantity benchmarks' considered the **uncertainty matrix** resultant from the uniform distribution used for all sessions.

Following Godby *et al.* (1997) we determined all benchmarks considering two cases:

- 1) Use of all permits bought in the auction for the period System Optimum Benchmarks;
- 2) Retention (banking) of one permit in each period, for precautionary reasons Market Equilibrium Benchmarks.

• 4 sessions run on the 12th, 18th, 19th and 20th of May 2009 at Minho University – Braga, Portugal (after a pilot session on the 21st of March 2009).

€22.15 average earnings on the 4 sessions (including a
5€ participation fee).

- Risk neutral or risk averse subjects did not bank one unit each period (0.65 units on average).
- Excessive banking in one of the sessions resulted in excess supply at the first price of the auction (therefore, more restrictive abatement target).

- Significant differences between our auction permits allocation and the Ausubel auction predictions (abatement costs statistically different from benchmarks)
- Secondary market efficiently reallocated emission permits (realized gains superior to potential ones).

Efficiency Index

Period	Sess	Session 5		Session 6		Session 7		Session 8		TOTAL		TOT_ses5	
Period	Is ₅	Im ₅	Is ₆	Im ₆	Is ₇	Im ₇	Is_8	Im_8	Is	Im	Is	Im	
1	-8.74	-3.16	-0.89	1.14	-0.50	1.36	-3.35	-0.21	-3.37	-0.22	-1.58	0.76	
2	-2.42	-2.42	1.24	1.24	0.78	0.78	1.02	1.02	0.16	0.16	1.02	1.02	
3	-0.23	-0.23	0.56	0.56	0.99	0.99	1.31	1.31	0.66	0.66	0.95	0.95	
4	1.19	1.19	1.10	1.10	0.86	0.86	0.81	0.81	0.99	0.99	0.92	0.92	
5	1.73	1.73	1.28	1.28	1.12	1.12	1.45	1.45	1.40	1.40	1.28	1.28	
6	-1.87	-1.87	1.21	1.21	0.57	0.57	0.92	0.92	0.21	0.21	0.90	0.90	
7	-0.72	-0.72	0.75	0.75	1.01	1.01	0.56	0.56	0.40	0.40	0.77	0.77	
8	1.74	1.74	0.63	0.63	1.02	1.02	1.12	1.12	1.13	1.13	0.93	0.93	
9	-0.91	-0.91	0.85	0.85	1.28	1.28	1.02	1.02	0.56	0.56	1.05	1.05	
10	3.01	1.66	2.34	1.15	2.10	0.97	1.99	0.88	2.36	1.17	2.14	1.00	
Average	-0.72	-0.30	0.91	0.99	0.92	1.00	0.68	0.89	0.45	0.64	0.84	0.96	

Conclusion

- The institution represented was efficient (excluding outlier session 5) the market worked.
- The Ausubel (2004) auction was not efficient when implemented in a more complex environment.
- Excessive banking results in more restrictive environmental targets and higher abatement costs, when auctioning is the initial allocation rule (not possible in the grandfathering treatment).

Thank you for your attention!

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Efficiency Index:

$$Is_{i} = \frac{(CCU_{S} - CostAbat_{i})}{(CCU_{S} - BTU_{S})}$$
, $i = 5, 6, 7, 8$

$$\operatorname{Im}_{i} = \frac{(CCU_{m} - CostAbat_{i})}{(CCU_{m} - BTU_{m})} , i = 5, 6, 7, 8$$