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Why do Firms Trade Carbon Emission Permits? Evidence from the European Emission Trading Scheme

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Introduction: Motivation and Research Questions

Motivation:

- The right to emit CO₂ is an input in the production processes of many sectors
- EU ETS as an instrument to internalize the climate externality
- Intertemporal optimization feasible through borrowing und banking
- Firms make participation and amount decisions every year

Research Questions:

- What drives firms' trading behavior in the EU ETS?
- To what extent do the results correspond to theoretical predictions and empirical evidence from the existing literature?



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Introduction: Theoretical Background

- Existing theoretical literature on the permit trade typically addresses cost efficiency via equalization of marginal abatement costs (MAC):
 - Emission trading system with freely traded permits is cost efficient (Montgomery, 1972)
 - Cost efficiency called into question given transaction costs (Stavins, 1995)
- Data on MAC not available, otherwise not many predictions regarding actual firm trading behavior
- New approach in general international trade literature analyzes trade in the context of heterogeneous firms (Melitz, 2003)
 - „Better“ firms more likely to participate in trading and drive out less „good“ firms



Introduction: Existing Empirical Work

- Large existing literature on goods trade at firm level (Bernard et al., 2011)
 - Size, productivity, profitability, ownership structure affect participation and amounts traded
 - Typically significant selection bias found
- Existing literature on determinants of trade in EU ETS rudimentary (Jaraite and Kazukauskas, 2012)

Contribution:

- Compilation of comprehensive dataset
- Application of a flexible two-part model to determinants of trading behavior of CO2-emitters
- Contribution to empirical literature on international trade in a specific market



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Data

Transactions (CITL)

36,917 (2006)

Registry	Acct.-Nr.
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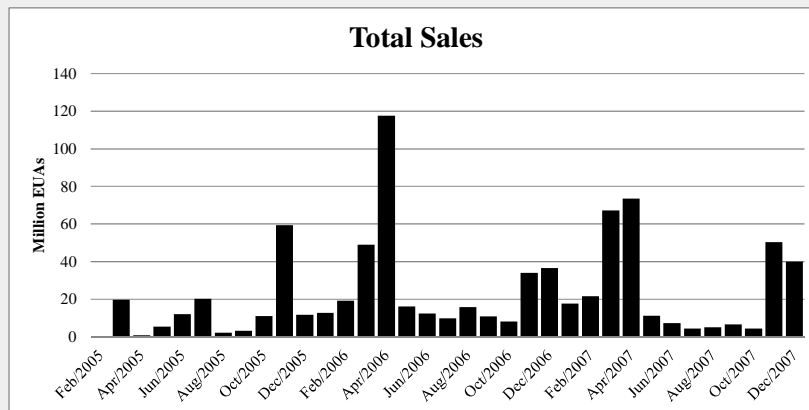
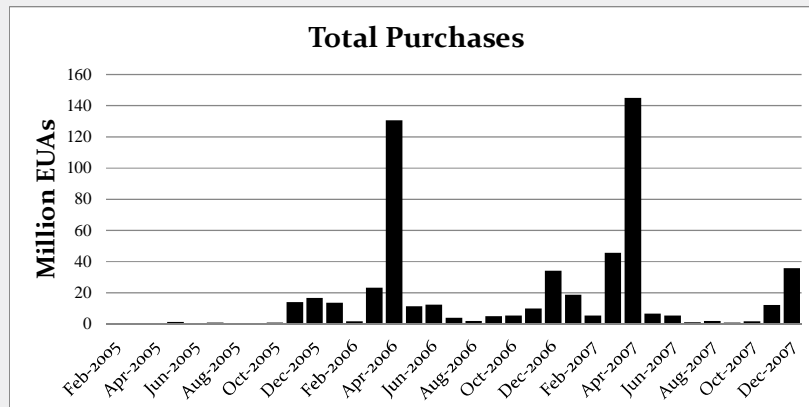
CZ	347
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DE	857
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GB	136
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Descriptive Results: Total Purchases and Sales



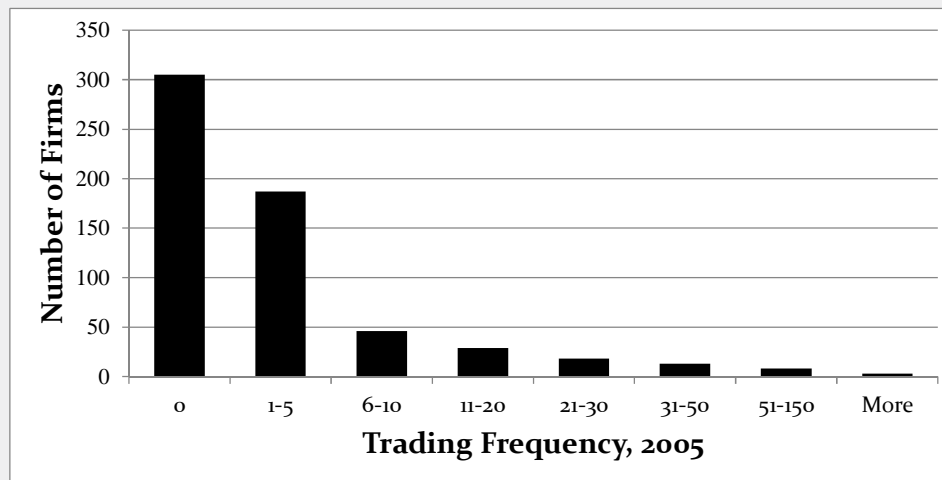
- **Note:** CITL transaction data only capture final transfer of allowances
- Year-end clustering of transactions on demand side
- Smoother pattern on supply side



Descriptive Results: Participation and Trading Frequency

Participation: Inter-Firm Sales vs. Inter-Firm Purchases, 2005

		Inter-firm purchases		Total
		0	1	
Inter-firm sales	0	300	58	358
	1	143	108	251
Total		443	166	609



- High degree of non-participation in trading
- When participation occurs, only few transactions per firm and trading year



Descriptive Results: EUA Flows by Compliance Position and Activity Level

			Number of firms	Allocation	Surplus allocation	Volume inter-firm sales	Volume inter-firm purchases	Net inter-firm trade
2005	Long	Active	74	286.3	41.5	67.8	16.5	51.2
		Not active	367	283.7	38.1	19.3	0.2	19.1
	Short	Active	34	684.8	-59.0	167.4	126.0	41.4
		Not active	134	175.3	-30.2	0.0	12.0	-12.0
	Sum		609	1,430.1	-9.7	254.5	154.8	99.8
2006	Long	Active	112	447.5	47.7	85.8	23.7	62.1
		Not active	360	283.4	39.1	32.4	0.3	32.1
	Short	Active	44	652.1	-82.0	112.5	187.2	-74.7
		Not active	151	130.6	-26.6	0.4	16.5	-16.1
	Sum		667	1,514	-21.8	231.2	227.7	3.5

- Fewer firms in active groups
- Active long firms realized their profit opportunities from selling EUAs more fully during the 2005 compliance year
- Active short firms include the big players by allocation size
 - Exhibit net sales on aggregate in 2005 compliance year, i.e. they borrowed
 - Became major buyers during the 2006 compliance year



Method

- Flexible two-part corner solution model, to allow for connection between participation and amount decisions
 - „Exponential Type II Tobit“ (Wooldridge, 2010)
 - Estimator equivalent to Heckman (1979) two-step selection model with dependent variable in amount equation in logs

- System of equations:

Amount: $y_{i1} = x_{i1}\beta_1 + \varepsilon_{i1}$

Participation: $y_{i2} = x_{i2}\beta_2 + \varepsilon_{i2}$

- Effect of selection:

$$E(y_{i1} | x_{i1}, y_{i2} = 1) = x_{i1}\beta_1 + \gamma_1\lambda(x_{i2}\delta_2)$$

- For identification exclusion restrictions are desired



Results: Inter-Firm Acquisitions

	2005	2006
	ln(Value of inter-firm acquisitions)	
ln(Value of EUA stock)	0.752*** (0.000)	0.762*** (0.000)
EUA position: long	-3.004*** (0.000)	-2.129*** (0.003)
Return on assets	0.061* (0.063)	0.037* (0.056)
Inverse Mills Ratio	0.754 (0.494)	0.269 (0.801)
	Participation: inter-firm acquisitions	
ln(Turnover)	0.041*** (0.000)	0.038*** (0.001)
ln(Value of EUA stock)	0.043*** (0.000)	0.038*** (0.000)
EUA position: long	-0.302*** (0.000)	-0.431*** (0.000)
Government-owned	0.129** (0.027)	-0.027 (0.632)
Family-owned	-0.145** (0.016)	-0.090 (0.227)
Industry	-0.135*** (0.001)	-0.147*** (0.002)
Observations	609	667
Censored Observations	443	406

Bootstrap p-values in parentheses, with *, **, *** indicating significance at the 10%, 5% and 1% levels, respectively.

- Firm-specific factors are significant, especially in participation decision
- Market-specific factors determine participation and amounts
- Exclusion restriction significant
- No evidence of selection bias



Results: Inter-Firm Transfers

	2005	2006
	ln(Value of inter-firm transfers)	
ln(Value of EUA stock)	1.186*** (0.000)	0.665*** (0.002)
EUA position: long	2.103* (0.060)	0.121 (0.877)
Inverse Mills Ratio	1.730 (0.253)	-1.430 (0.324)
	Participation: inter-firm transfers	
ln(Turnover)	0.005 (0.702)	0.004 (0.711)
ln(Value of EUA stock)	0.095*** (0.000)	0.103*** (0.000)
EUA position: long	0.278*** (0.000)	0.306*** (0.000)
Government-owned	0.185*** (0.008)	0.076 (0.235)
Family-owned	-0.169** (0.025)	-0.101 (0.211)
Industry	-0.162*** (0.001)	-0.191*** (0.000)
Observations	609	667
Censored Observations	358	351

Bootstrap p-values in parentheses, with *, **, *** indicating significance at the 10%, 5% and 1% levels, respectively.

- Results similar to those on demand side
- Main differences:
 - Firm size not significant in participation decision
 - Result on EUA position weaker in amount decision



Conclusions

- Main drivers of trade in EUAs:

	Firm-specific factors	Market-specific factors
Participation	Firm size (acquisitions only) Sector Ownership structure	Allocation size EUA position
Amount		Allocation size EUA position (acquisitions only)

- EU ETS flexible mechanisms allow firms significant discretion
- Notable departures from general trade literature
- Further improving data situation will allow for consideration of unobserved heterogeneity and panel dynamics



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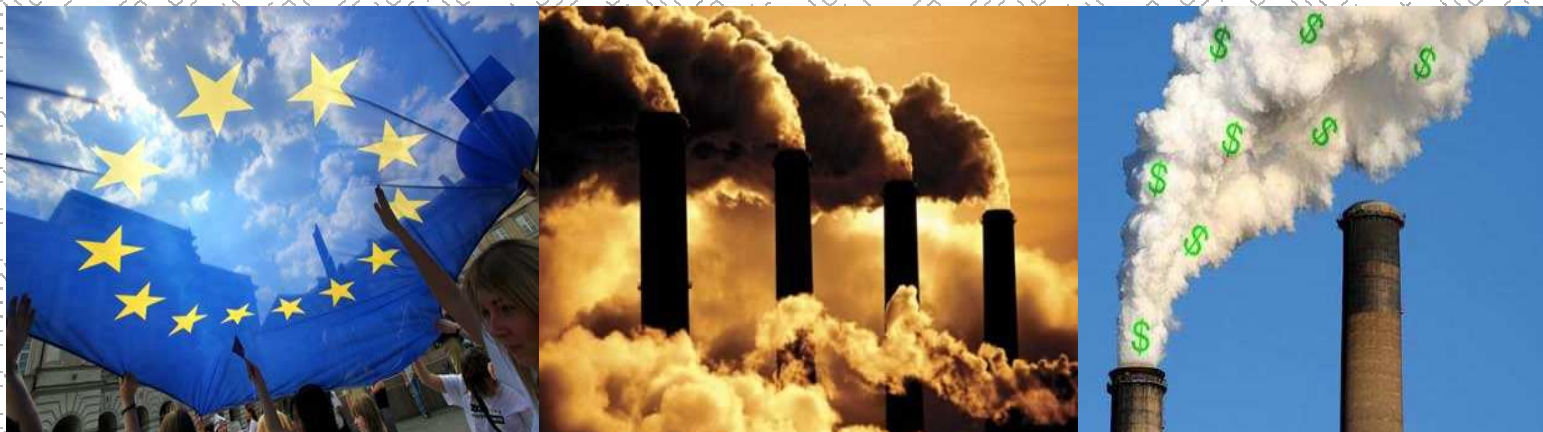
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Thank you very much for your attention.

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