Centre for Energy and Environmental Markets

UNSW



The Copenhagen Prediction Market (COPPM)-

Lessons from a Field Experiment to aggregate information on the status of Climate Change Negotiations

Center for Comparative and International Studies (CIS) Colloquium

20th of October 2011

Dr. Regina Betz (co-authors: Johanna Cludius and Paul Twomey)

on Sabbatical at University of Zurich

Centre for Energy and Environmental Markets

UNSW

Outline

- Motivation
- Prediction Markets (PM)
- Copenhagen Climate Conference (COP)
- Prediction Market 5 Step Framework
- Copenhagen Prediction Market (COPPM) Design
- Results:
  - Participants and trading in markets
  - Participants' characteristics
  - Australian Market
  - The Deadline market
  - CER price
  - Negotiation dynamics
- Lessons learnt and conclusions

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Motivation

- The outcome of climate negotiations can
  - trigger billions of Dollars into mitigation and adaptation projects (e.g. turn over of global carbon market was 150$ billions in 2010).
  - influence location decisions of companies
- The aim of Copenhagen was a new international climate treaty, the successor of the Kyoto Protocol.
- Negotiation processes are complex (many issues) and very dynamic as more than 100 governments participate.
- Different sources of information exist on status and likely outcome of negotiations: Which source to trust?
- Research questions: Can prediction markets play a useful role to create transparency and aggregate information on the status of international climate negotiations?

Centre for Energy and Environmental Markets

UNSW

Prediction Markets (PM)

- Wisdom of Crowds: A case in which the information needed to generate a forecast is held collectively, not by any single individual.
  - Aggregation problem: How can the collective information be aggregated into a forecast?
- How does it work?
  - A PM uses a competitive market to aggregate collective information.
  - Participants trade contracts whose payoff depends on the outcome of future events.
  - A specific market design allows share prices to be interpreted as the probability of the event occurring, thus it provides a forecast about the likelihood of an outcome and can change over time.
- Why Does This Work?
  - Markets are belief aggregators by nature.
  - Forecast is based on the marginal trader (the ones well-informed) if motivated to reveal true believes, prices will reflect the unbiased assessments of outcomes. Only few well-informed traders are needed.

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Application and Evidence of PM

- Politics
  - University of Iowa: USA elections
- Sports
  - TradeSports, Betfair: various sporting outcomes.
- Government
  - USA Centres for Disease Control: influenza
  - USA Central Intelligence Agency: terrorism
- Business
  - Google: company milestones.

5

Centre for Energy and Environmental Markets

UNSW

PM 5 Step Framework

1. **Forecasting goals**
2. Contracts
3. Trading mechanism
4. Participation and Incentives
5. Implementation and support

- How many markets?
- Prediction market appropriate and feasible method?
- Will people with relevant information participate?

6

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Copenhagen Climate Conference

- Climate Conference under United Framework Convention of Climate Change (UNFCCC)
- 2 weeks (7-19 December 2009) in Copenhagen
- Around 100 heads of state and 40.000 participants biggest international climate conference ever held
- Main issues to be decided:
  1. By how much would industrialized countries be willing to reduce their emissions of greenhouse gases?
  2. How much were major developing countries such as China and India willing to do in order to limit the growth of their emissions?
  3. How would the efforts of developing countries to reduce their emissions and adapt to the impacts of climate change going to be financed?
  4. How was that money going to be managed?

Centre for Energy and Environmental Markets

UNSW

COPPM: Copenhagen specific Markets

- **Market 1:** Deadline set for achieving a legally binding agreement
- **Market 2**: The long-term stabilization goal in degrees Centigrade of warming and/or parts-per-million of CO_2 concentration.
- **Market 3**: Average annual funding committed by developed country governments to support climate change action (including mitigation and adaptation) in developing countries for the period 2010 through 2012.
- **Market 4**: Aggregate 2020 reduction target for developed nations (Annex I or equivalent, including the US) (1990 base year)
- **Market 7:** Sectoral Crediting included in Copenhagen outcome
- **Market 8-12:** 2020 reduction target (1990 base year) for: Australia, EU, Japan, Russia and US
- **Market 13 & 14:** China or India agrees to some type of binding climate action commitment (e.g. intensity target)
- **Market 17:** Loopholes

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

COPPM: General markets

- **Market 5:** The design of the mechanism for Reducing Emissions from Deforestation in Developing countries (REDD).
- **Market 6:** Over-the-counter (OTC) price issued Certified Emissions Reductions (CERs) reach after Copenhagen Conference.
- **Market 15:** Institution of Adaptation Funding.
- **Market 16:** Mechanism for technology cooperation.

Forecasting goals: started with 16 markets and added 1 market during the conference

9

Centre for Energy and Environmental Markets

UNSW

PM 5 step Framework

1. Forecasting goals
2. **Contracts**
   - Contract type?
   - Number of shares per market?
   - Headline definition?
   - How to settle disputes?
3. Trading mechanism
4. Participation and Incentives
5. Implementation and support

10

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Possbile contract types

1. Forecasting goals
2. **Contracts**
3. Trading mechanism
4. Participation and Incentives
5. Implementation and support

Contract	Example	Details	Share prices interpretable as the...
Winner-take-all	Binary Event (e.g., win or loss): China agrees to some type of binding target	Contract pays $100 if the Event occurs, $0 otherwise.	probability of the Event occurring.
Index (Percentage Share market)	Contract pays $1 for every percentage point (y) of vote won by candidate x	Contract pays y$	mean value of outcome
Spreads	Contract pays even money if candidate x wins more than y% of vote	Contract costs $1 and pays $2 if outcome >y, E$0 otherwise.	median value of outcome

11

Centre for Energy and Environmental Markets

UNSW

COPPM contract example

Market 9: 2020 reduction target for the EU27 (1990 base year)*

Shares: Headline definition	Final Value
EU-20	• E$100 if the agreed-upon aggregate 2020 reduction target is less than 20%. • E$0 otherwise.
EU-2024	• E$100 if the agreed-upon aggregate 2020 reduction target is at least 20% but less than 25%. • E$0 otherwise.
EU-2529	• E$100 if the agreed-upon aggregate 2020 reduction target is at least 25% but less than 30%. • E$0 otherwise.
EU-3034	• E$100 if the agreed-upon aggregate 2020 reduction target is at least 30% but less than 35%. • E$0 otherwise.
EU-35	• E$100 if the agreed-upon aggregate 2020 reduction target is at least 35%. • E$0 otherwise

*If the base years between the prediction-market share and the decision of the COP plenary differ, the plenary decision will be converted to a 1990 base year using UNFCCC conversion rates and data. If a range is given in the decision, the upper end of the range will be used. The target may be conditional on future developments, such as dependent on legislation

Independent Committee of experts established to make final decision in case outcome is ambiguous and need interpretation

12

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

PM 5 step Framework

1. Forecasting goals
2. Contracts
3. **Trading mechanism**
4. Participation and Incentives
5. Implementation and support

- Mechanism?
- Limits?
- Duration of markets?
- Trading hours?
- Information to be disclosed?

13

Centre for Energy and Environmental Markets

UNSW

Trading mechanism options

1. Forecasting goals
2. Contracts
3. **Trading mechanism**
4. Participation and Incentives
5. Implementation and support

	Continuous Double Auction	**Pari-mutuel**
Function	Buyers and sellers submit bids/offers and if there is a matching the transaction is executed	Winning shares split the total market equity in a proportion to input (like racetrack betting)
Advantages	Well known as used in financial markets	Less likely to have liquidity problems as no matching of trades
Disadvantages	Liquidity problems (solution might be market maker)	Wait and see strategy for investments in order not to reveal information advantage

14

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

COOPM Trading Mechanism and Rules

- Continuous Double Auction (CDA)
  - Bid/offer contains: price, number of units, optional expiration time
  - Five highest bids (buy) and lowest offers (sell) are posted
  - Partial execution of trades possible
  - Older offer determines the price
- No limits on amount of shares that could be traded
- No market maker
- Markets open 24 hours during COP 15
- Markets end: Final statement read by secretary (morning of 19/12/09)

15

Centre for Energy and Environmental Markets

UNSW

PM 5 step Framework

1. Forecasting goals
2. Contracts
3. Trading mechanism
4. **Participation and Incentives**
   - Participants?
   - Promotion?
   - Real money vs. play money?
   - Risk of market manipulation?
5. Implementation and support

16

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

COPPM Participation

1. Forecasting goals
2. Contracts
3. Trading mechanism
4. **Participation and Incentives**
5. Implementation and support

- Open to general public (decided that splitting would reduce liquidity)
- Promotion at COP 15 in Copenhagen (1000 flyers and stall, internet, emails, press releases)
- Manipulation risk: assumed to be low as people were only able to sign in once, play money restricted

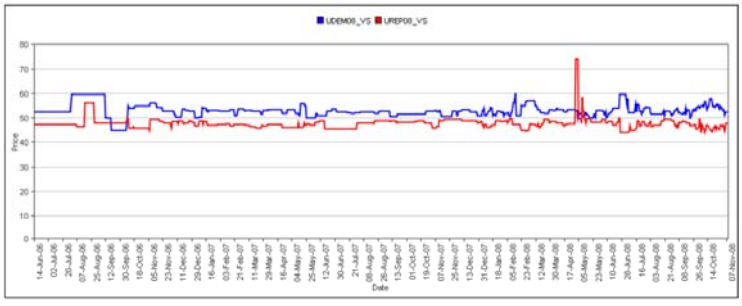
17

Centre for Energy and Environmental Markets

UNSW

Manipulation example

2008 USA Presidential "Percentage Share" Market



Source:
http://iemweb.biz.uiowa.edu/quotes/Pres08_Quotes.html.

18

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Incentives: Real money versus play money

	Real money	Play money
Options	• Own money • Endowment with real money	Endowment with play money AND cash prizes or non-monetary awards
Advantages	• Putting your money where your mouth is • Well-informed traders enter the market • Active trading	• Likely more participants • Less legal and ethical committee problems • No problem with fraud • Lower security of trading plattform neccessary • No transaction fees, no short trading possible

19

Centre for Energy and Environmental Markets

UNSW

COPPM Incentives

1. Forecasting goals
2. Contracts
3. Trading mechanism
4. **Participation and Incentives**
5. Implementation and support

- Play money and no participation fee
- Endowment: mix of play money and market bundles
- Markets were kept separate (no shares and money could be transferred between markets)
- Rank-order tournament payment scheme: prizes for three top traders for each market
- Prizes: offsetting of own emissions with gold standard Certified Emission Reductions sponsored by Baker&McKenzie (a public good) for 12, 4, 2 months

20

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

COPPM Process

21

Centre for Energy and Environmental Markets

UNSW

PM 5 step Framework

1. Forecasting goals
2. Contracts
3. Trading mechanism
4. Participation and Incentives
5. **Implementation and support**

- Which software?
- What level of security?
- Which server, what back-up?
- On-going support?

22

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Implementation and support COPPM

1. Forecasting goals
2. Contracts
3. Trading mechanism
4. Participation and Incentives
5. **Implementation and support**

- Adaptation of existing prediction market software for sporting events
- Employed in-house programmer
- Hiring of server and web-address
- Contact via email or at stall at COP15 in Copenhagen

23

Centre for Energy and Environmental Markets

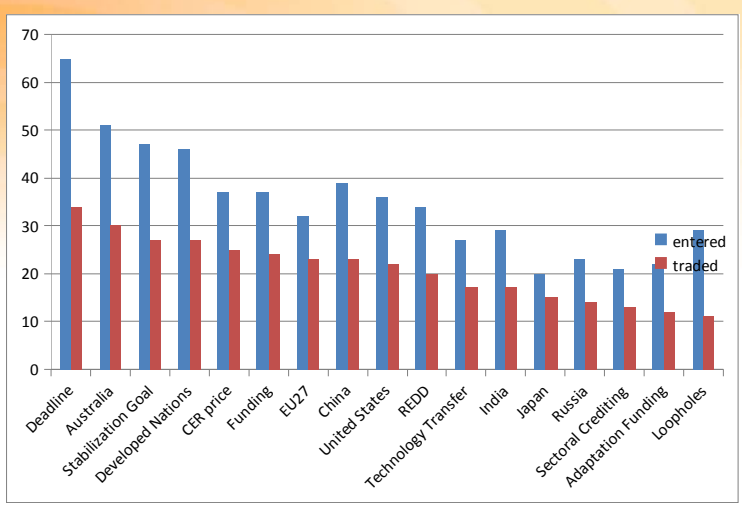
UNSW

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Number of traders on each market



Centre for Energy and Environmental Markets

UNSW

Participation characteristics (%)

	Participants	Winners		Participants	Winners
Female	0.21	0.18	Australia	0.39	0.65
Male	0.68	0.76	USA	0.11	0.00
Not stated	0.11	0.06	Germany	0.09	0.06
Not at COP	0.65	0.94	Working	0.67	0.82
At COP	0.35	0.06	Student	0.16	0.06
Of which:			Not stated	0.17	0.12
Governmental	*0.15*	*1.00*			
Non-Gov.	*0.68*	*0.00*			

Characteristics of participants and traders of the COPPM in percent

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Correct predictions of the COPPM

Market name (number of shares and volume)		Outcome	Share traded highest at end of market
Market 1	Deadline for legally binding agreement (5, 100k)	no deadline set	no deadline set
Market 7	Sectoral Crediting included in outcome (2, 49k)	not included	not included
Market 8	2020 reduction target for Australia (5, 103k)	< 10%	< 10%
Market 9	2020 reduction target for the EU27 (5, 67k)	20% - 24%	20% - 24%
Market 11	2020 reduction target for Russia (5, 39k)	15% - 19%	15% - 19%
Market 12	2020 reduction target for the US (5, 59k)	0% - 4%	0% - 4%
Market 14	India agrees to some type of binding climate action commitment (2, 44k)	no	no
Market 15	Institution of Adaptation Funding (3, 32k)	new + existing fund	new + existing fund

Centre for Energy and Environmental Markets

UNSW

Incorrect predictions of the COPPM

Market name (number of shares and volume)		Outcome	Share traded highest at end of market
Market 2	Long-term stabilization goal (3, 84k)	< 2 degrees	≥ 2 degrees
Market 3	Average annual funding through 2012 (5, 67k)	< USD 10 billion	10-14 USD 10 billion
Market 4	2020 reduction target for developed nations (5, 82k)	10% -14%	15% -19%
Market 5	Design of REDD mechanism (3, 57k)	no conclusive decision	mix of public and private funding
Market 6	CER price (5, 77k)	11.15 Euro	≥ 14 Euro
Market 10	2020 reduction target for the Japan (5, 57k)	25% - 29%	20% - 24%
Market 16	Mechanism for technology cooperation (3, 39k)	technology action plans	no technology action plans

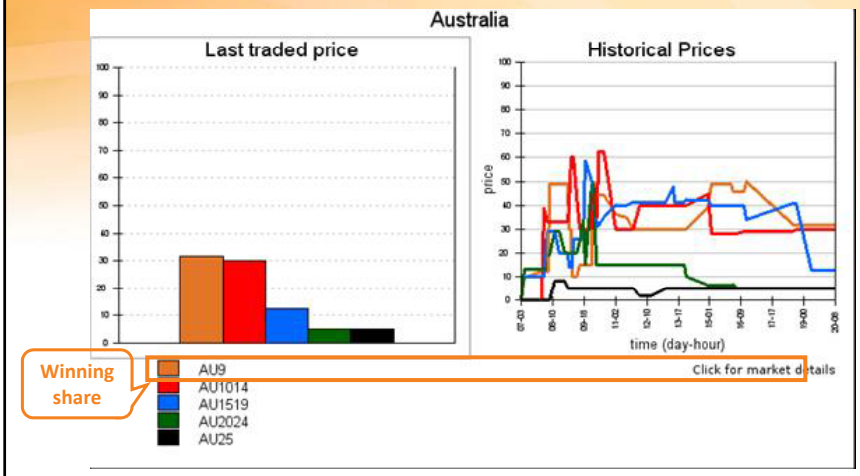
13 out of 17 markets decided by Independent Committee of experts
One Market was undecided and one market decided by lottery

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Results market 8: Australian target

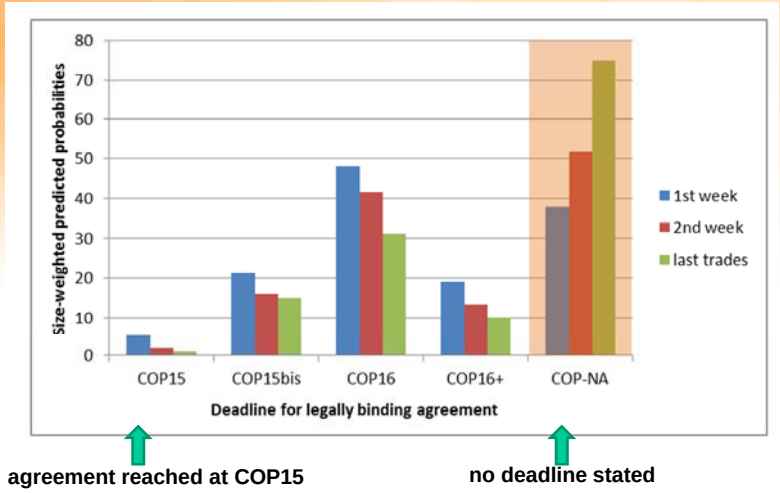


CEEM Research Day, 24 Nov 2009 29

Centre for Energy and Environmental Markets

UNSW

Results market 1: Deadline market



agreement reached at COP15

Participants entered: 65

no deadline stated

Participants traded: 34

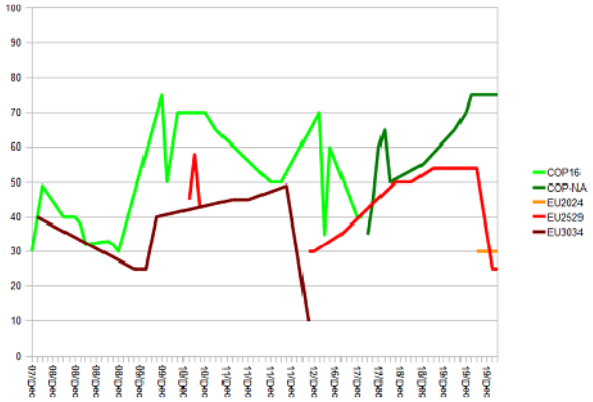
© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Negotiations dynamics

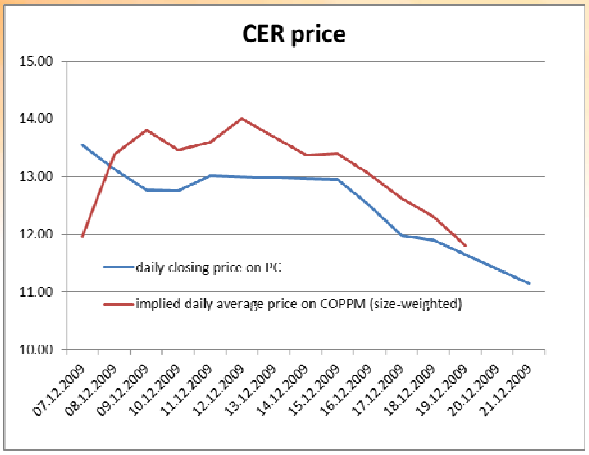
Highest traded shares on the Deadline and EU27 markets



Centre for Energy and Environmental Markets

UNSW

Certified Emissions Reduction Price



CER price as published by Point Carbon vs. size-weighted daily average price as traded on COPPM (Source: www.pointcarbon.com; own illustration)

32

© CEEM, 2011

Centre for Energy and Environmental Markets

UNSW

Lessons learnt

- Definition of shares
  LONG2-450 (≥2) not equivalent to "2 degree target" (<2)
  → pay attention on abbreviations
- Determining of outcomes
  → Many markets do not have a clear-cut outcome
  therefore establish committee of experts and make this decision methodology public
- Long time horizon
  → intrade and Leonardo had very little or zero trading,
  therefore to achieve long forecasts continuous advertising, and continuous payouts are important
- Acceptance "Betting on the future of our planet"
  → Explain that PM is only an information aggregation tool

Centre for Energy and Environmental Markets

UNSW

Reflection

- Participation: Some markets had little active traders (8 markets less than 20 traders)
  → Recruit more active traders or reduce number of markets
- Recruiting: People at COP too busy, media stories worked well
  → Focus on outside recruiting or longer time horizon for negotiators necessary
- Predictive power:
  - People with general interest perform well, number of shares or trading volume seem not to have an impact on accuracy, incoming new information was generally well reflected, some positive feedback on transparency
    → awareness of challenges on how to interprete and illustrate the results
  - Open arbitrage positions
    → not enough market makers took part, but may be linked to incentive scheme
- Incentive scheme: Tournament prizes seem not to encourage extreme trading behaviour, people have intrinsic motivation

34

© CEEM, 2011

Regina Betz
r.betz@unsw.edu.au

Comments &
Suggestions welcome

Centre for Energy and Environmental Markets

UNSW

Many of our publications are available at:
www.ceem.unsw.edu.au

www.ceem.unsw.edu.au

© CEEM, 2011