




Opportunities For Agricultural Biotechnologies in the EU: Policies and Novel Constraints

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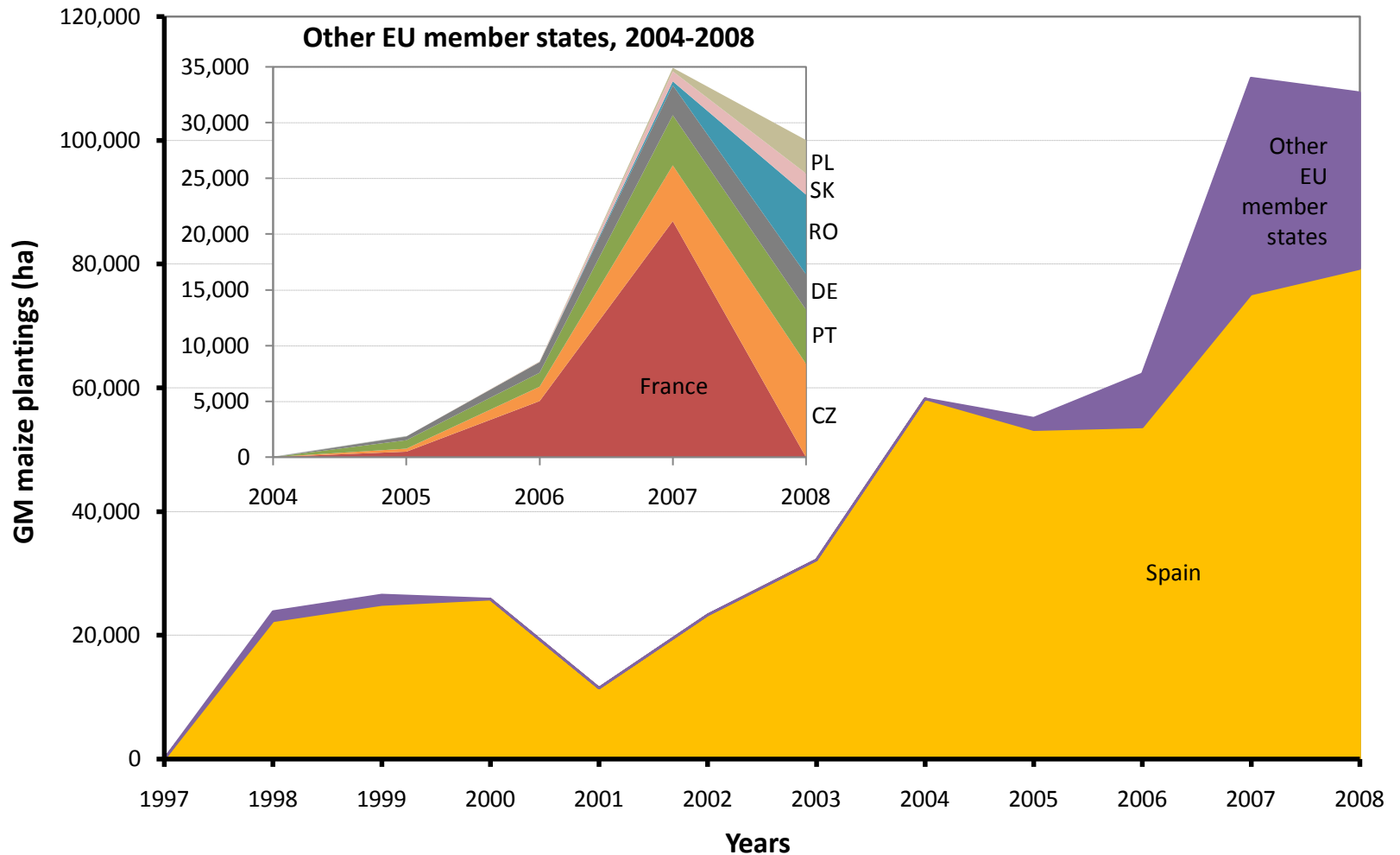
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Overview of the presentation

- GM crops in the EU
 - Socio-Economic *ex ante* impact assessment
 - Case studies:
 - HT sugar beet under changing policies
 - Western corn rootworm infestation Central Europe
 - Conclusions
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GM crops in the EU



GM crops in Europe

- Problems?

- Consumer rights
- Health
- Environmental effects
- Economic considerations
 - Intellectual property right

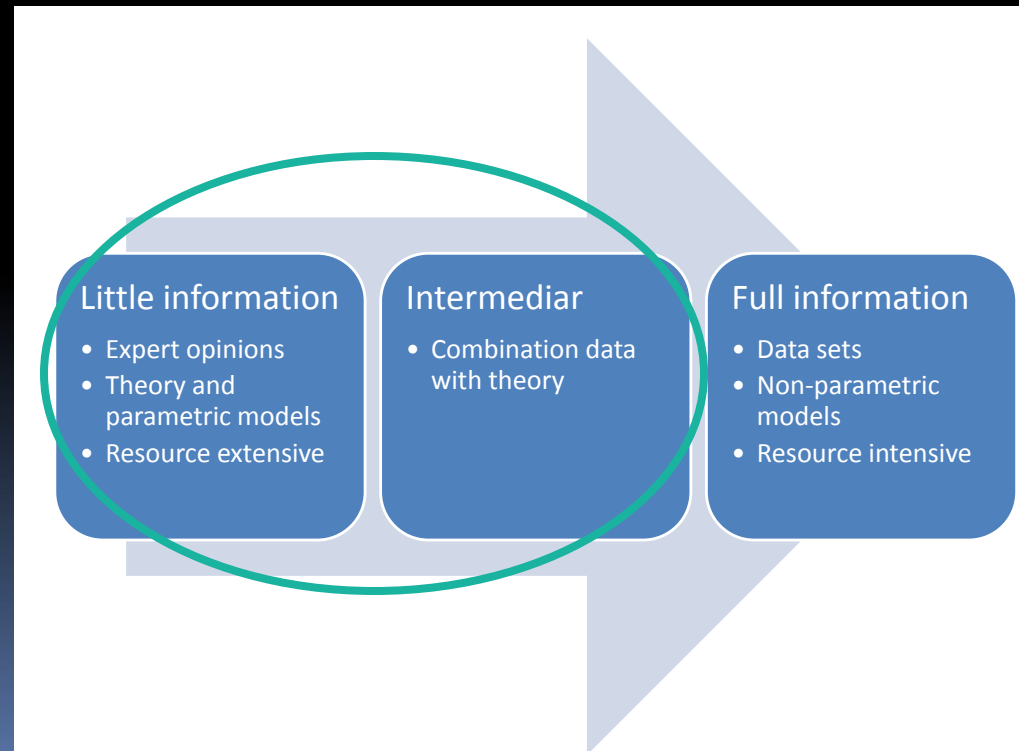
- Uncertainties, Safeguards, Regulatory Authority Existence

- Safeguard clause
- Introduction socio-economics in deregulation procedure

Socio-Economic *ex ante* impact assessment


- Uncertainties
- Irreversibilities
- Imperfect data

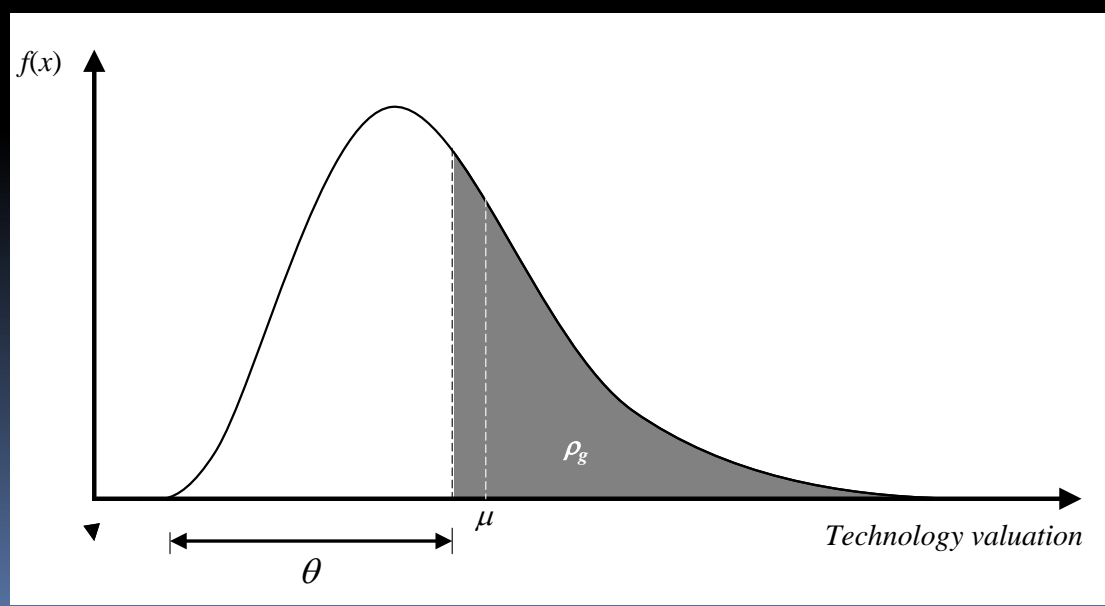
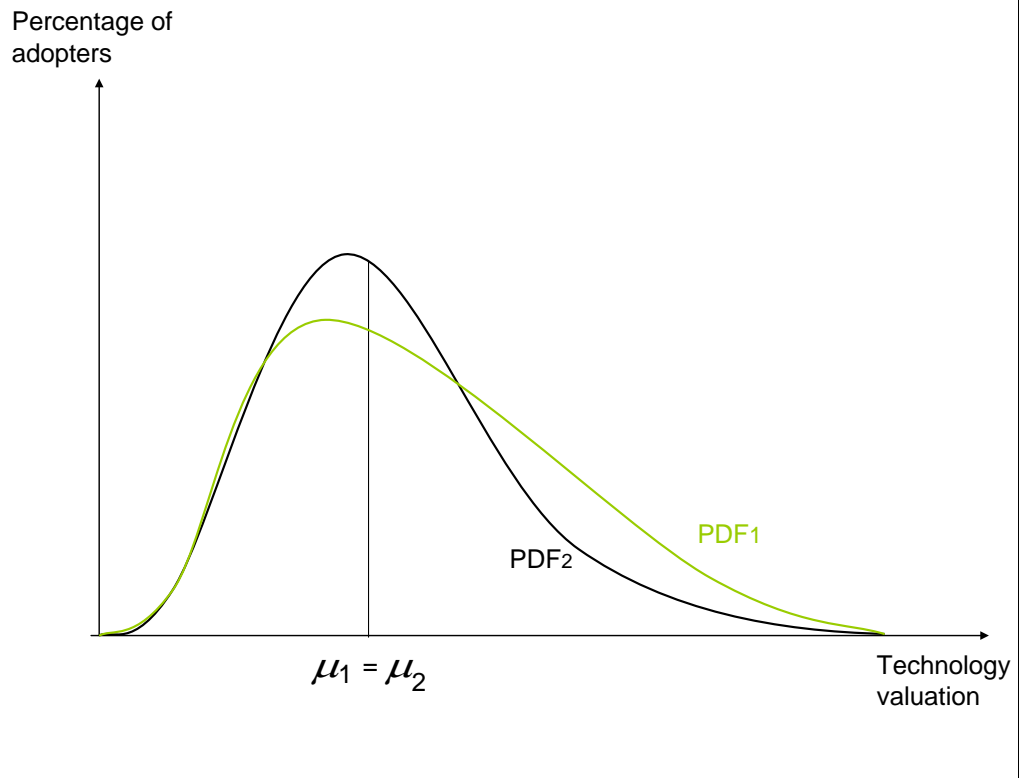
Appropriate methodologies





Heterogeneity among farmers

- Recognised in literature as important factor
 - Sources:
 - Geophysical differences
 - Climatic differences
 - Production systems
 - Managerial capacities
 - Differential technology pay-off
- 



Case study HT sugar beet in EU-27

- Replacement of herbicide regime
- Buying package: seed+ glyphosate
- Calibration of PDF on both data and expert opinions

Results HT sugar beet

Member State	Price discrimination					Uniform pricing				
	Technology fee (€/ha)	Farmer incremental profits (€/ha)	Adoption (%)	Corporate revenue (million €)	Total value (€/ha)	Technology fee (€/ha)	Farmer incremental profits (€/ha)	Adoption (%)	Corporate revenue (million €)	Total value (€/ha)
Austria	147	123	74	4.9	270	95	188	84	3.8	283
Belgium	123	131	76	8.1	254	95	174	98	7.2	269
Germany	94	99	69	26.5	193	95	108	63	26.3	203
Spain	145	135	97	12.9	280	95	192	99	9.0	287
Czech Republic	98	87	88	5.6	185	95	101	91	5.6	196
France	87	133	90	27.0	220	95	131	78	26.9	226
Finland	125	68	79	3.5	193	95	102	97	2.7	197
Greece	75	95	90	2.2	170	95	63	43	1.8	158
Italy	77	59	79	9.7	136	95	45	43	8.6	140
Ireland	50	32	51	0.7	82	95	1	5	0.003	96
Netherlands	121	92	92	11.2	239	95	151	97	8.6	246
Poland	102	79	80	22.4	181	95	96	85	22.0	191
Sweden	86	74	65	2.5	160	95	71	47	2.5	166
UK	78	117	86	8.8	195	95	99	59	8.5	194
Denmark	106	122	80	4.3	228	95	145	82	4.0	240
Portugal	145	135	97	1.2	280	95	192	99	0.7	287
Hungary	108	63	84	2.6	171	95	78	92	2.4	173
EU-27 area-weighted average (total)	98	99		(154)	204	95	116		(141)	218

HT sugar beet

- Introduction does not happen in vacuum
- Policy measures influence innovation
- Trade flows
- Spill-over


- Partial equilibrium model (EUWABSIM)
 - 1996-2014
 - Change in sugar policy (2006)
 - Accession of new Member States

Change innovation incentive

	2006	2007	2008	2009	2010
Belgium	(-21.9; 88.5)	(-20.2; 83.1)	(-22.1; 88.8)	(-23.1; 92.3)	(-23.3; 93.2)
Denmark	(10.6; 137.8)	(2.2; 111.9)	(-7.2; 102.0)	(-15.3; 93.8)	(-15.4; 94.8)
Germany	(-23.7; 97.0)	(-21.9; 91.7)	(-24.0; 97.5)	(-25.1; 101.2)	(-25.4; 102.3)
Greece	(-44.6; 3.9)	(-64.4; 1.4)	(-76.7; 0.93)	(-86.4; 0.31)	(-86.4; 0.34)
Spain	(15.4; 94.1)	(9.6; 59.3)	(4.7; 41.4)	(-0.19; 28.7)	(-0.19; 29.0)
France	(-27.7; 110.0)	(-25.6; 103.6)	(-28.1; 110.2)	(-29.3; 114.3)	(-29.6; 115.5)
Italy	(-35.0; 2.5)	(-48.5; 0.41)	(-57.3; -0.24)	(-64.4; -0.79)	(-65.0; -0.77)
Netherlands	(-19.0; 94.5)	(-40.4; 70.8)	(-59.4; 65.4)	(-75.1; 62.3)	(-75.7; 62.9)
Austria	(-20.7; 87.0)	(-19.1; 81.9)	(-21.0; 87.3)	(-21.9; 90.8)	(-22.1; 91.9)
Portugal	(-119.4; -5.9)	(-151.0; -10.8)	(-171.0; -13.0)	(-187.4; -14.5)	(-189.0; -14.9)
Finland	(-41.6; -1.1)	(-58.1; -3.7)	(-69.1; -5.0)	(-78.3; -6.0)	(-79.3; -6.0)
Sweden	(13.5; 81.1)	(10.5; 64.2)	(7.8; 55.2)	(5.4; 49.2)	(5.5; 49.6)
United Kingdom	(-14.0; 54.6)	(-12.8; 51.0)	(-14.2; 54.8)	(-14.9; 57.0)	(-15.1; 57.7)
Czech Republic	(10.0; 71.2)	(6.3; 46.7)	(3.9; 32.7)	(1.4; 22.7)	(1.5; 22.9)
Hungary	(2.8; 35.2)	(0.70; 22.7)	(-1.4; 16.0)	(-3.8; 10.9)	(-3.8; 11.1)
Poland	(9.8; 61.6)	(6.4; 41.9)	(3.6; 31.6)	(0.42; 24.2)	(0.40; 24.5)
Input suppliers revenue	(-4.3; -8.1)	(-10.9; -17.6)	(-10.6; -17.2)	(-10.4; -16.9)	(-10.6; -17.4)
	2011	2012	2013	2014	
Belgium	(-23.7; 94.7)	(-24.3; 96.5)	(-24.7; 97.9)	(-25.3; 99.8)	
Denmark	(-15.8; 96.1)	(-16.3; 97.7)	(-16.7; 99.0)	(-17.2; 100.6)	
Germany	(-25.8; 103.8)	(-26.5; 105.8)	(-26.9; 107.3)	(-27.5; 109.3)	
Greece	(-86.3; 0.40)	(-86.2; 0.51)	(-86.2; 0.59)	(-86.1; 0.70)	
Spain	(-0.24; 29.3)	(-0.32; 29.8)	(-0.42; 30.1)	(-0.56; 30.6)	
France	(-30.1; 117.1)	(-30.8; 119.2)	(-31.3; 120.8)	(-32.0; 123.0)	
Italy	(-65.7; -0.73)	(-66.3; -0.65)	(-67.0; -0.60)	(-67.7; -0.49)	
Netherlands	(-76.5; 63.8)	(-77.4; 65.0)	(-78.2; 66.0)	(-79.4; 67.2)	
Austria	(-22.6; 93.3)	(-23.1; 95.1)	(-23.5; 96.6)	(-24.0; 98.5)	
Portugal	(-190.2; -14.9)	(-191.3; -15.0)	(-192.6; -14.9)	(-193.8; -14.9)	
Finland	(-80.4; -6.1)	(-81.4; -6.1)	(-82.5; -6.1)	(-83.5; -6.1)	
Sweden	(5.5; 50.2)	(5.5; 50.8)	(5.5; 51.4)	(5.4; 52.1)	
United Kingdom	(-15.3; 58.7)	(-15.7; 59.9)	(-16.0; 60.8)	(-16.4; 62.1)	
Czech Republic	(1.5; 23.2)	(1.5; 23.6)	(1.5; 23.9)	(1.5; 24.3)	
Hungary	(-3.9; 11.2)	(-4.0; 11.4)	(-4.1; 11.5)	(-4.2; 11.7)	
Poland	(0.38; 24.8)	(0.34; 25.2)	(0.32; 25.6)	(0.29; 26.0)	
Input suppliers revenue	(-10.2; -16.6)	(-10.1; -16.4)	(-10.1; -16.3)	(-10.0; -16.2)	



Irreversibilities

- Value in waiting due to irreversibilities and uncertainty
 - Real options quantifies this waiting value
 - Restructuring: maximal incremental social tolerable irreversible costs that justify an immediate release
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MISTICS

Member State	ρ_{\max}	W_{\max}	W_a (€/ha)	R_a (€/ha)	Hurdle Rate	I_a^* (€/ha)	I_a^* (€)	Coefficient of variation	I_a^*/farm (€)
Old CMO sugar									
Belgium	98%	161	103	0.97	1.077613	97	8 107 383	4.79E-02	605
Denmark	82%	158	102	0.19	4.841197	21.3	857 356	6.76E-01	200
Germany	63%	84	51	0.22	3.836102	13.6	5 346 466	5.85E-01	131
Greece	43%	122	83	0.94	1.05967	79.4	2 933 103	3.82E-02	204
Spain	99%	245	164	5.10	1.000273	169.1	15 088 785	1.83E-04	978
France	78%	104	66	1.09	1.448304	46.5	15 859 971	1.97E-01	530
Italy	43%	97	64	-0.22	1.23248	51.9	9 860 526	1.28E-01	274
Netherland	97%	218	142	1.4	1.363038	105.9	9 283 404	1.75E-01	705
Austria	84%	176	113	-0.36	1.135054	99.6	4 680 685	7.97E-02	522
Portugal	99%	382	254	-0.07	1.000081	253.7	1 698 012	5.27E-05	2534
Finland	97%	182	121	0.91	1.000105	122.1	3 000 929	6.75E-05	1409
Sweden	47%	75	49	0.04	1.047497	47	2 375 252	3.11E-02	673
United Kingdom	59%	91	59	0.85	2.747777	22.2	2 557 346	4.54E-01	337
Czech Republic	91%	135	91	1.3	1.000665	92.6	4 872 339	4.41E-04	4640
Hungary	92%	90	60	1.32	1.000254	61.5	3 003 420	1.65E-04	1206
Poland	85%	123	82	0.56	1.004259	82.4	18 504 185	2.95E-03	229
New CMO sugar									
Belgium	98%	198	132	0.97	1.009099	131.9	11 031 382	3.44E-03	823
Denmark	82%	229	145	0.19	1.001713	144.8	5 076 405	6.40E-04	1186
Germany	63%	124	83	0.22	1.010634	82.2	32 244 302	3.79E-03	789
Greece	43%	105	65	0.94	1.002209	66.2	1 315 412	5.06E-04	91
Spain	99%	292	185	5.10	1.001611	189.7	13 470 372	6.05E-04	874
France	78%	150	102	1.09	1.014367	101.3	34 613 129	4.69E-03	1158
Italy	43%	77	48	-0.22	1.002026	48.1	5 509 687	6.77E-04	153
Netherland	97%	248	155	1.4	1.001956	156.4	10 583 648	7.08E-04	804
Austria	84%	212	141	-0.36	1.008735	139.7	6 572 343	3.62E-03	733
Portugal	99%	309	199	-0.07	1.001111	198.3	506 231	4.26E-04	756
Finland	97%	148	95	0.91	1.001445	96.2	1 617 853	5.80E-04	760
Sweden	47%	115	73	0.04	1.001841	72.8	2 538 996	6.37E-04	719
United Kingdom	59%	114	77	0.85	1.012847	76.6	8 838 270	4.57E-03	1164
Czech Republic	91%	167	106	1.3	1.00217	107.5	4 029 889	7.12E-04	3838
Hungary	92%	105	67	1.32	1.001456	67.9	2 255 003	5.58E-04	906
Poland	85%	152	97	0.56	1.001884	97.2	18 719 120	7.01E-04	231

Member State	Population over 18 years	I_a^*/voting person new CMO, $I_{\text{vote},i}^*,\text{new}$ (€year)	I_a^*/voting person old CMO, $I_{\text{vote},I,\text{old}}^*$ (€year)	Voting weight under Nice Treaty	Voting weight under Lisbon Treaty
Belgium	8331936	1.32	0.97	12	11
Denmark	4216893	1.20	0.20	7	5.5
Germany	67725607	0.48	0.08	29	82
Greece	9178742	0.14	0.32	12	11
Spain	36017564	0.37	0.42	27	46
France	49006703	0.71	0.32	29	64
Italy	48608776	0.11	0.20	29	60
The Netherlands	12752453	0.83	0.73	13	17
Austria	6647030	0.99	0.70	10	8.3
Portugal	8567879	0.06	0.20	12	11
Finland	4151882	0.39	0.72	7	5.3
Sweden	7113513	0.36	0.33	10	9.2
United Kingdom	46799543	0.19	0.05	29	62
Czech Republic	8359568	0.48	0.58	12	10
Hungary	8108480	0.28	0.37	12	10
Poland	30293256	0.62	0.61	27	38
Total				277	450.3

Barroso vs EU treaties

- Qualified majority

- Nice Treaty

- Lisbon Treaty



- National Authority

- Barroso Proposal

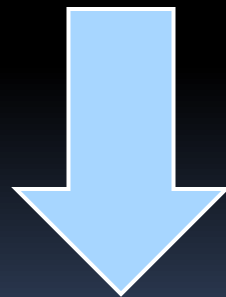


Western corn rootworm



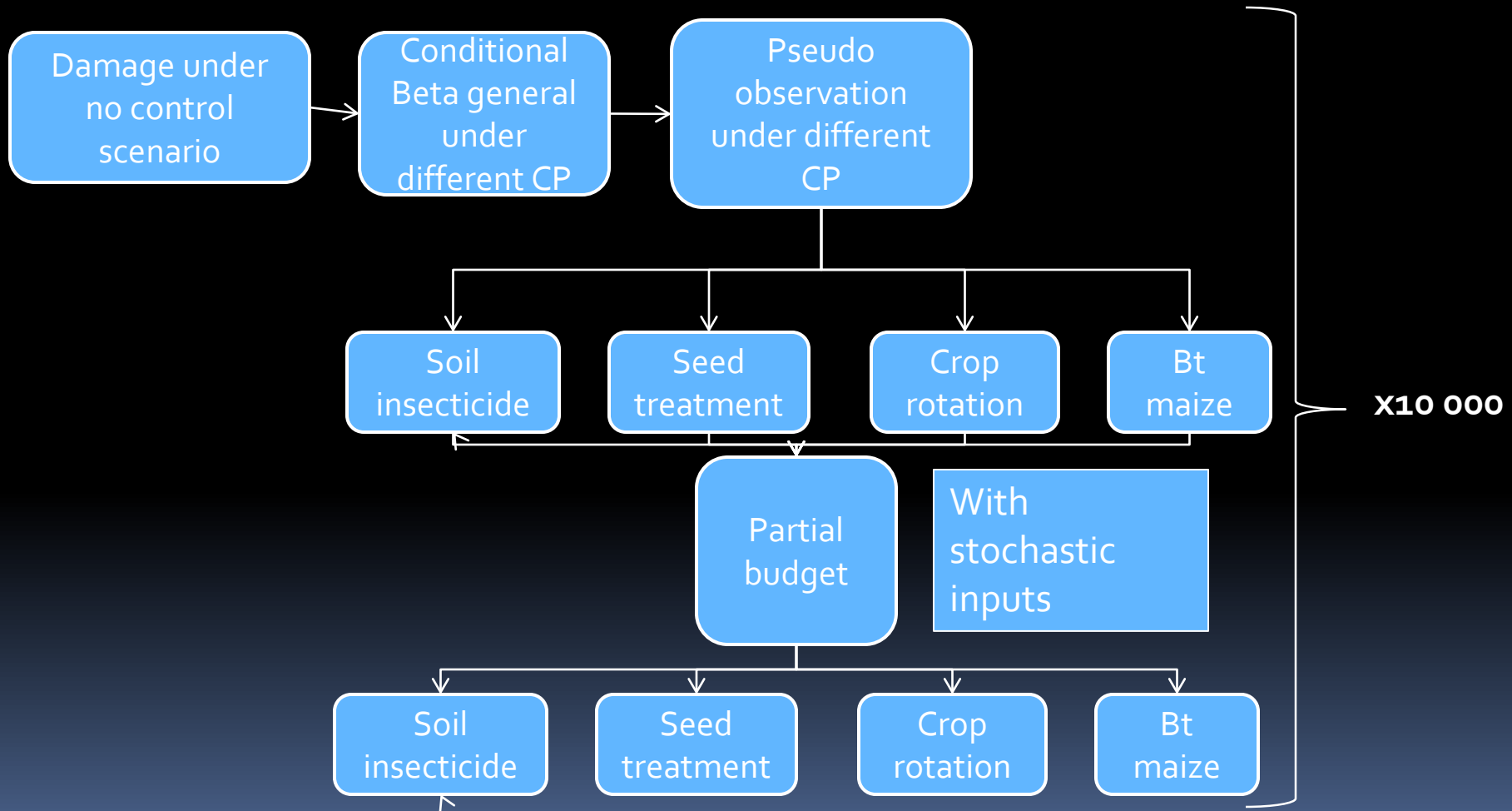
WCR- Economic threat?

- Heterogeneity
- High unpredictability yield losses
- High unpredictability effect of different crop protection strategies
- Very low data availability



Bio-economic model

Bio-economic model WCR



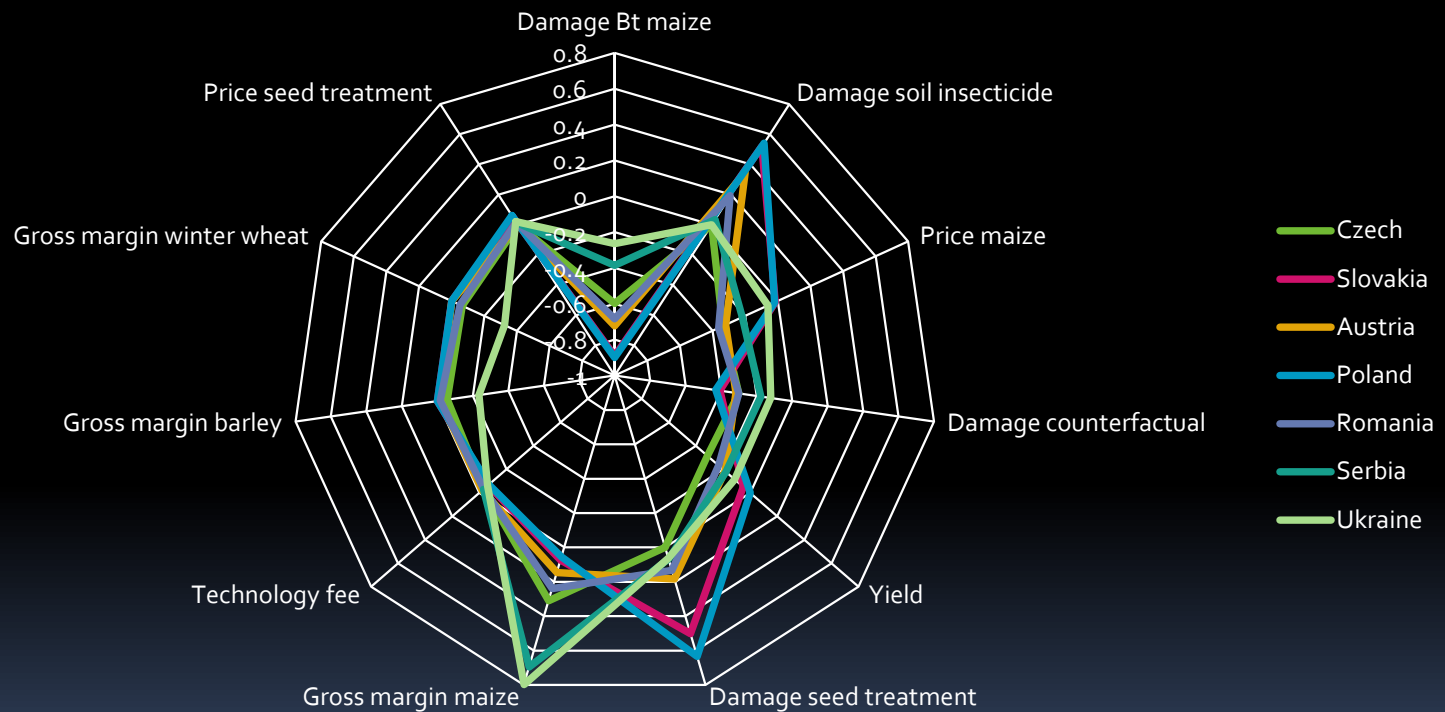
Results WCR case study

		Austria		Czech Republic		Poland		Serbia		Slovakia		Romania		Ukraine	
Grain	Net Benefit	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
	Bt maize	100.7	1.0	71.9	1.0	37.8	1.1	28.2	1.3	47.2	1.0	99.8	0.9	0.4	33.8
	Seed treatment	22.0	3.0	5.2	8.6	-13.9	-1.9	-19.4	-1.3	-8.8	-3.5	20.9	3.0	-35.1	-0.3
	Soil insecticide	48.3	2.1	20.4	3.5	-13.7	-3.0	-23.3	-1.7	-4.7	-10.2	48.2	2.0	-50.9	-0.3
	Crop rotation	16.4	9.6	136.4	0.8	-89.3	-0.8	25.9	3.0	-55.4	-1.3	62.9	2.4	-6.2	-5.9
Surplus created by Bt maize															
	Land constrained	48.3	0.6	10.5	0.7	44.4	0.5	30.6	0.6	45.0	0.5	33.1	0.6	23.4	0.6
	Continuous	58.5	0.7	52.0	0.6	45.5	0.5	44.8	0.4	47.2	0.5	36.5	0.7	40.5	0.3
Silage	Net Benefit														
	Bt maize	103.9	0.8	54.9	0.9	46.9	0.9	----	----	34.1	1.1	103.7	0.8	-5.9	-1.5
	Seed treatment	19.1	-3.1	-8.2	3.9	-13.3	2.1	----	----	-18.5	1.3	18.0	-3.1	-39.5	0.2
	Soil insecticide	43.2	-2.0	-3.2	15.6	-12.3	3.6	----	----	-21.9	1.7	42.8	-2.0	-58.7	0.1
	Crop rotation	7.3	18.8	95.2	0.8	-86.7	-0.9	----	----	-85.6	-0.7	54.3	2.5	-19.8	-1.6
Surplus created by Bt maize															
	Land constrained	52.4	0.5	12.1	0.5	49.7	0.5	----	----	46.5	0.4	30.8	0.4	24.2	0.5
	Continuous	61.7	0.6	51.3	0.5	51.0	0.6	----	----	47.3	0.4	31.4	0.4	44.6	0.4

Results WCR case study

Crop Protection	Austria		Czech Republic		Poland		Serbia		Slovakia		Romania		Ukraine	
	LC	C	LC	C	LC	C	LC	C	LC	C	LC	C	LC	C
Grain														
Bt maize	72%	79%	7%	81%	81%	81%	38%	74%	81%	83%	71%	72%	22%	42%
Seed treatment	2%	3%	0%	2%	1%	1%	0%	1%	1%	2%	16%	16%	0%	0%
Soil insecticide	10%	13%	0%	10%	3%	3%	1%	3%	5%	5%	0%	0%	0%	0%
Crop rotation	10%	n.a.	91%	n.a.	0%	n.a.	46%	n.a.	2%	n.a.	0%	n.a.	37%	n.a.
No control	5%	5%	2%	7%	14%	14%	15%	22%	11%	11%	12%	12%	41%	58%
Silage														
Bt maize	79%	84%	13%	88%	89%	89%	n.a.	n.a.	83%	88%	18%	18%	12%	20%
Seed treatment	2%	2%	0%	1%	0%	2%	n.a.	n.a.	1%	1%	1%	1%	0%	0%
Soil insecticide	8%	10%	0%	4%	2%	0%	n.a.	n.a.	1%	4%	0%	0%	0%	0%
Crop rotation	8%	n.a.	85%	n.a.	1%	n.a.	n.a.	n.a.	1%	n.a.	0%	n.a.	26%	n.a.
No control	3%	3%	2%	7%	8%	8%	n.a.	n.a.	14%	7%	82%	82%	62%	80%
Grain (Bt maize not commercialized)														
Seed treatment	13%	20%	1%	38%	11%	12%	1%	9%	12%	14%	46%	51%	42%	1%
Soil insecticide	36%	52%	0%	52%	23%	26%	3%	18%	27%	32%	0%	0%	0%	1%
Crop rotation	23%	n.a.	96%	n.a.	4%	n.a.	59%	n.a.	9%	n.a.	8%	n.a.	0%	n.a.
No control	28%	29%	3%	10%	62%	62%	38%	73%	52%	53%	46%	49%	58%	99%
Silage (Bt maize not commercialized)														
Seed treatment	14%	20%	1%	46%	11%	12%	2%	14%	8%	9%	2%	2%	0%	0%
Soil insecticide	37%	51%	0%	48%	23%	26%	5%	34%	17%	19%	0%	0%	0%	0%
Crop rotation	23%	n.a.	96%	n.a.	5%	n.a.	71%	n.a.	3%	n.a.	0%	n.a.	28%	n.a.
No control	27%	28%	3%	6%	61%	62%	23%	52%	71%	72%	98%	98%	72%	100%

Results WCR case study



WTP for the Bt variety

- Dicothomous choice experiment
- Total valuation of technology
 - Monetary
 - Easiness of management
 - Impact environment/health
 - ...
- €16-49/ha surplus Bt maize => non pecuniar value €21-54/ha

Conclusions

- Theoretical:
 - Inclusion of heterogeneity essential
 - Parametric models under data constraints
 - Indirect policy changes affect innovation incentives
- Empirical:
 - HT sugar beet high value, potentially increasing competitiveness of the sector
 - WCR economic risk for EU maize production
 - Added value (pecuniary and non-pecuniary) of Bt maize resistant against WCR damage

Thank you all for your attention



Field test drought resistant wheat, Australia, 2009