

European Climate Change Adaptation Conference 2013:

Integrating Climate into Action

March 20, 2013

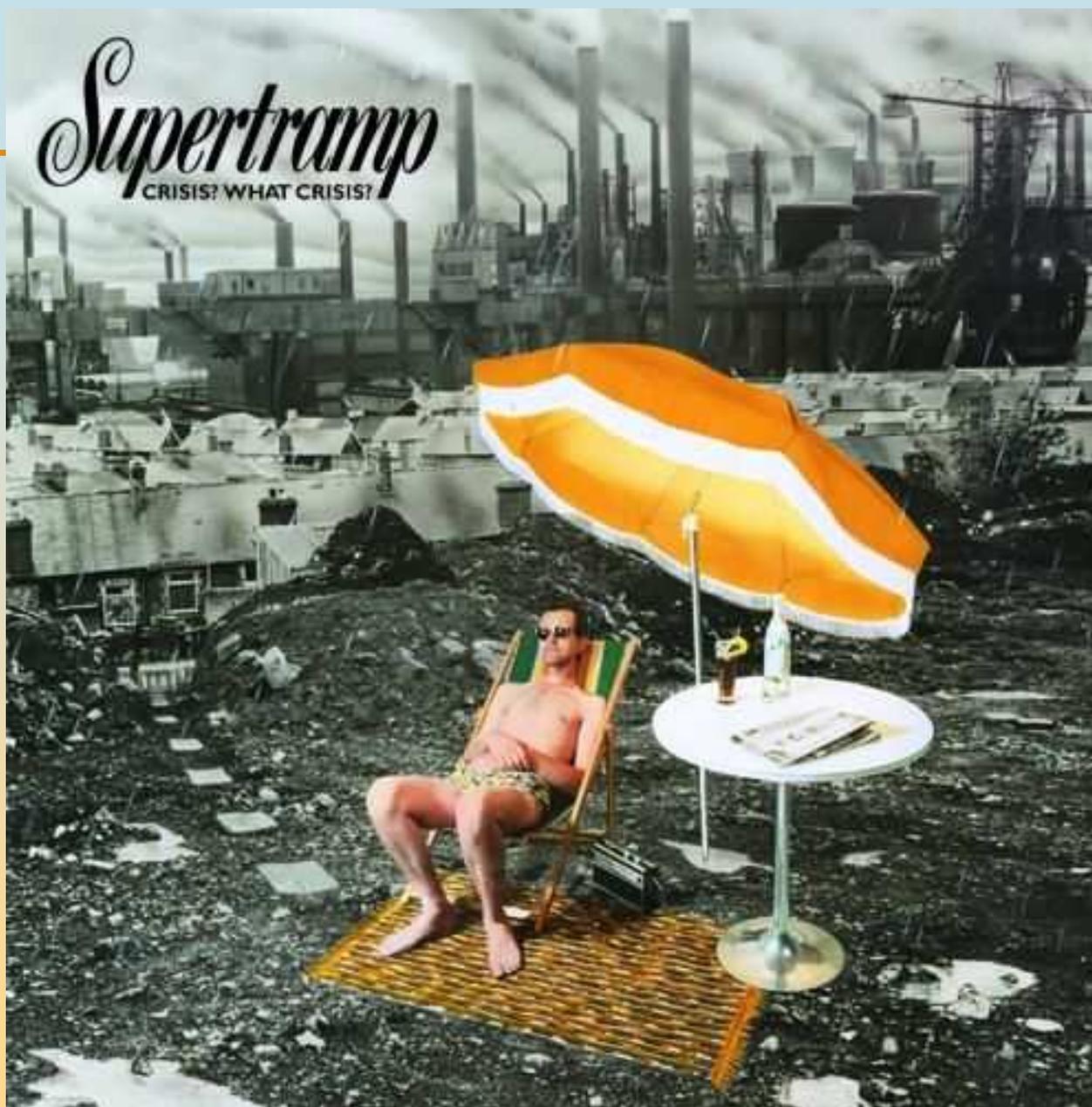
Pricing Innovation in Climate Change Adaptation (CCA): Hedonic Valuation of R&D that can favour CCA

**Johann Jacob, Michel Crowley,
Moktar Lamari, Eva Anstett,
Marc Dutil and Charles Nattier**

**Centre de recherche et d'expertise en évaluation
École nationale d'administration publique
Québec, Canada**

Background

- ◆ The **Ouranos Consortium** (a Quebec based consortium on regional climatology and adaptation to climate change) has mandated the ***Centre of research and expertise in evaluation (CREXE)*** of the École nationale d'administration publique (ENAP-Université du Québec) to consider how to develop **indicators reflecting the development of an adaptive capacity to climate change.**
- ◆ **Objective:**
 - ◆ Propose a frame of reference for evaluating climate change adaptation (CCA) capacity



Supertramp (1975). *Crisis? What crisis?*, A&M records.



Université du Québec
École nationale d'administration publique

Photo: <http://cabecadeplaneta.blogspot.com/2010/08/supertramp-crisis-what-crisis.html>

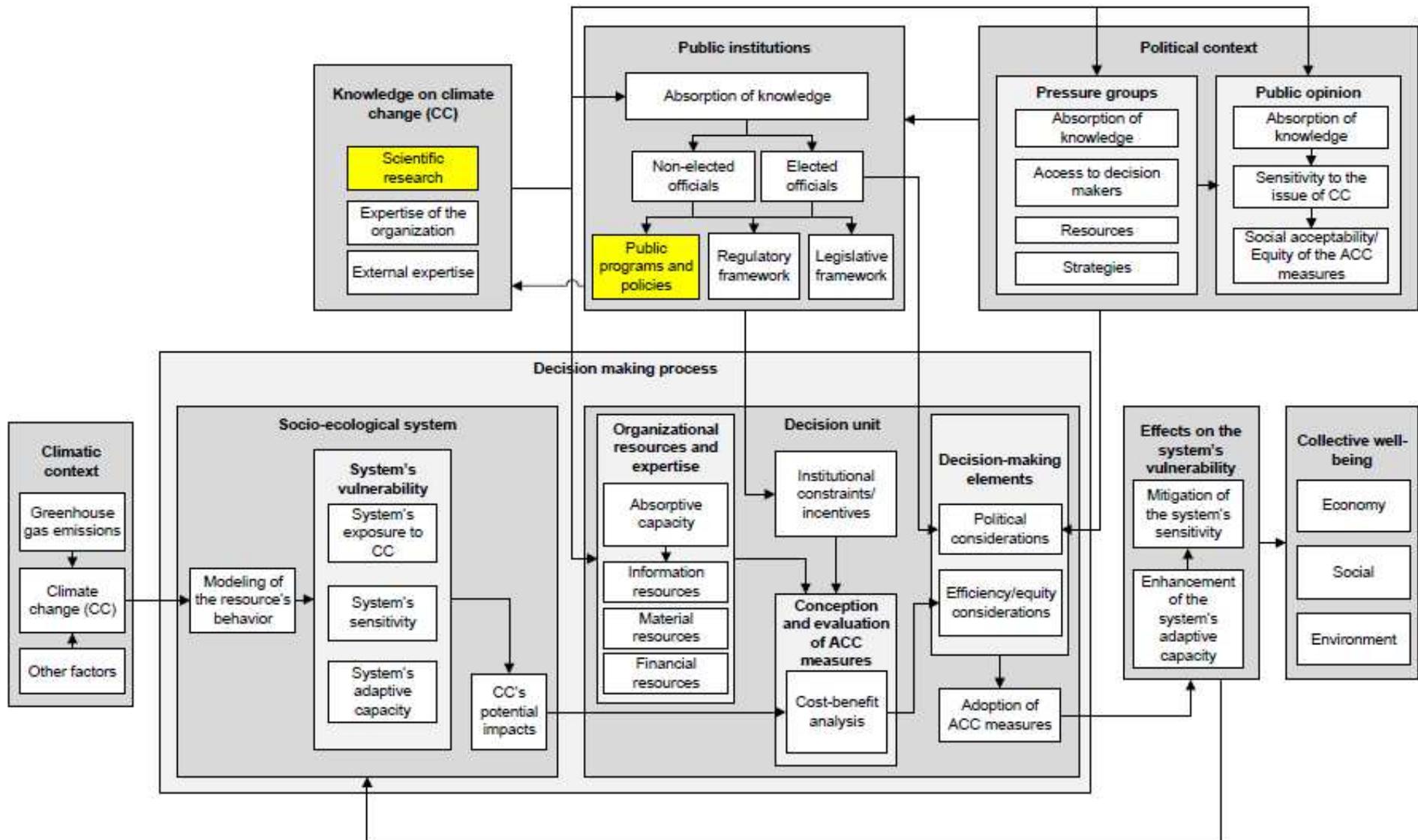
CREXE

CENTRE DE RECHERCHE ET D'EXPERTISE EN ÉVALUATION

Overall methodology

- ◆ **Literature review** (evaluation frameworks and CCA indicators, economics, policy analysis, transfer and knowledge use)
- ◆ Elaboration of a **problem model** of CCA (decision-making process leading to the adoption of a CCA measure)
 - ◆ **Mapping** of the **symptoms** of a social problems that we are trying to solve and their **causes**;
 - ◆ **Graphical representation** of the main **variables** influencing the planning process leading to the definition of CCA measures
- ◆ Analysis of **339 indicators** identified in available CCA evaluation frameworks

CCA Problem Model



Generic indicators on CCA capacity

- ◆ The level of knowledge among stakeholders about vulnerabilities and CC impacts
- ◆ The nature of the decision regarding a CCA measure
- ◆ The change observed in system vulnerability due to the adaptation measure (compared to the overall change in vulnerability due to other factors)
- ◆ The extent of use of scientific/technical knowledge and tools as a support to the CCA decision
- ◆ **Knowledge about**
 - ◆ **Costs to the economic, social and environmental systems if no CCA measure is implemented**
 - ◆ **Costs and benefits of adaptation measures**
 - ◆ **Residual costs of CC and sharing of costs**

A closer look at costs and benefits

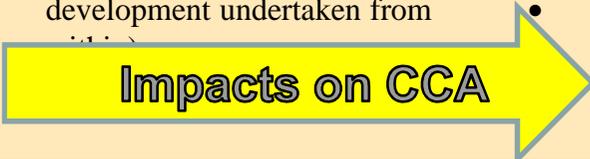
- ◆ Decision makers need to estimate the **costs and benefits** of CCA before they can decide to implement CCA measures in the field.
- ◆ As an illustration, we looked into how public programmes, through **technology transfer organizations (TTO)**, can promote **R&D in the field of CCA** by various firms involved in R&D projects.

Data used and methodology

◆ R&D Cost-benefit analysis methodology

- ◆ Ruegg, R. and I. Feller (2003). A Toolkit for Evaluating Public R&D Investment, National Institute of Standards and Technology.
- ◆ Link, A.N. and J.T. Scott (2012). The Theory and Practice of Public-Sector R&D Economic Impact Analysis, National Institute of Standards and Technology.

	Individual Partners (Companies)	Government	Society
Benefits	<ul style="list-style-type: none"> • Increase in profits • Other benefits from technology transfer • Non-economic benefits 	<ul style="list-style-type: none"> • Tax revenues • Budget capacity (sustainable development undertaken from ...) 	<ul style="list-style-type: none"> • Increase in benefits to society (direct effects) • Spill-over effects (indirect), generated by positive externalities (diffuse and latent benefits)
Costs	<ul style="list-style-type: none"> • Opportunity cost of collaboration • Direct and indirect collaboration costs • Shortfall and reduction of marginal gains from other investments 	<ul style="list-style-type: none"> • Budget costs funded through taxes (marginal costs of public funding) • Reduction of resources available for alternative investments • Project administration and management costs 	<ul style="list-style-type: none"> • Production costs (expenditures and investment) • Opportunity costs (other potential programs)



Source: CREXE (2012) adapted from Polt and Woitech (2002)

Data used and methodology

Matching of data originating from different sources for three TTOs in Quebec (CRIQ, CRIM, CCTT)

◆ Internal data

- ◆ Finance, annual reports, strategic plans,
- ◆ Evaluation frameworks (logic modeling)

◆ Online surveys

- ◆ **Sample** of firms dealing with TTO in Quebec: $n = 289$
- ◆ **Response rate**, around 20%
- ◆ Close-ended questions
- ◆ Data collected via **Survey Gizmo** (november 2012-march 2013)

Data used and methodology

Two questions

- ◆ What are the main **attributes** of Quebec firms collaborating with TTOs on research related to CCA?
 - Descriptive analysis
 - Chi squared Test and T-test
- ◆ What is the **value (price)** attributed by actors doing R&D that help innovation on **CCA**?
 - Hedonic pricing : valuating intangible attributes to new ideas in CCA
 - Correlational and regression analyses

Data used and methodology

Online surveys

- ◆ Estimate of costs and benefits using questions designed to obtain **continuous metrics (numbers)**
 - ◆ *For the period from April 1, 2010, to September 30, 2012, please estimate the average annual **spin-off benefits** for your firm or organization following your collaboration with [the TTO organization]. A spin-off benefit is any profit or benefit generated for your firm or organization that would not have been generated if not for your collaboration with [the TTO organization].*
 1. \$_____
 97. Do not know
 99. Refuse to answer

Data used and methodology

Online surveys

- ◆ **For a quantity that is difficult to estimate, use of intervals or other proxies**

- ◆ *For the period from April 1, 2010, to September 30, 2012, please estimate the impact of your collaboration with [the TTO organization] on the following indicators on a scale from 0 to 10, where 0 is no impact and 10 is a major impact.*

- a. Access to the expertise of a network of companies and partners in your activity sector*

- b. Increase in your employees' knowledge and expertise*

- c. Intellectual property available to your company or organization*

- d. Workplace health and safety*

- e. Climate change adaptation** 

- f. Reduction of greenhouse gas emissions*

...

Results

Characterization of Quebec firms producing impacts on CCA

	Respondents seeing impacts of the collaboration with the TTO on CCA (n=30)	Respondents <u>NOT</u> seeing impacts of the collaboration with the TTO on CCA (n =216)
	n (%)	n (%)
Sector		
Public administration	3/29 (10 %)	23/204 (11 %)
Primary sector	3/29 (10 %)	25/204 (12 %)
Secondary sector	13/29 (45 %)	86/204 (42 %)
Tertiary sector	13/29 (45 %)	93/204 (46 %)

Results

Characterization of Quebec firms producing impacts on ACC

	Respondents seeing impacts of the collaboration with the TTO on CCA (n=30)	Respondents <u>NOT</u> seeing impacts of the collaboration with the TTO on CCA (n =216)	Chi sq
	n (%)	n (%)	
<i>Collaboration with the TTO led to investments in...</i>			
Internal R&D in the firm or organization	20/28 (71 %)	95/209 (45 %)	0,01**
External R&D	19/27 (70 %)	55/208 (26 %)	0,000**
Acquisition machines, equipment and software	17/30 (57 %)	70/209 (33 %)	0,014**
Acquisition of immovable property	1/28(4 %)	18/206 (9 %)	0,348
Acquisition of other exterior knowledge (except hiring specialized HR)	11/28 (39 %)	39/205 (19 %)	0,014**
Hiring of specialized HR	11/30 (37 %)	33/209 (16 %)	0,006**
Training	14/29 (48 %)	94/209 (45 %)	0,738
Marketing activities	11/28 (39 %)	63/208 (30 %)	0,335
Other innovation related activities	19/28 (68 %)	96/207 (46 %)	0,033**
Firm is eligible to a tax credit for R&D	16/23 (70 %)	98/150 (65 %)	0,690

Results

Characterization of firms investing on R-D impacting on ACC

	Respondents seeing impacts of the collaboration with the TTO on CCA			Respondents <u>NOT</u> seeing impacts of the collaboration with the TTO on CCA		
	Mean (SD)	Med	n	Mean (SD)	Med	n
Description of the respondent						
- Number of employees of the firm	1 028 (3 390)	40	23	596 (1 814)	55	191
- Earnings (\$) (annual)	17,3 M \$ (26,8 M \$)	7,9 M \$	26	81,3 M \$ (332,5 M \$)	8 M \$	195
- Benefits (\$) (annual)	906 577 \$ (2,03 M \$)	191 326 \$	18	3,9 M \$ (22 M \$)	391 000 \$	143
- Estimate of the impact (\$) of the collaboration with the TTO	183 662 \$ (312 643 \$)	50 000 \$	19	215 740 \$ (652 189 \$)	10 000 \$	127
- Spin-off benefits (\$) due to collaboration	100 834 \$ (248 510 \$)	22 843 \$	22	355 835 \$ (2,6 M \$)	-	177
- Contract amount with the TTO (for 1 year)	29 358 \$ (70 157 \$)	17 500 \$	27	16 676 \$ (31 283 \$)	6 644 \$	184

Results

Characterization of Quebec firms producing impacts on CCA

	Respondents seeing impacts of the collaboration with the TTO on CCA			Respondents <u>NOT</u> seeing impacts of the collaboration with the TTO on CCA		
	Mean (SD)	Med	n	Mean (SD)	Med	n
Induced investments (\$) by the collaboration with the TTO						
Non-infrastructure	207 265 \$ (256 168 \$)	90 000 \$	17	163 520 \$ (311 334)	50 000 \$	75
Infrastructure	301 875 \$ (690 517 \$)	32 500 \$	8	286 133 \$ (1,2 M \$)	-	45

Results

Key messages from descriptive statistics

- ◆ Firms that produce impacts on CCA are **highly valuing innovation**:
 - ◆ More intensive in **R&D** (internal and external)
 - ◆ Investors on capital : machines, equipment, softwares, etc.
 - ◆ More open to **external skills and knowledge** (open innovation)
- ◆ Contrary to our expectations, **no statistically significant difference** on other parameters (number of employees, earnings, profit, etc.), however:
 - Firms do not necessarily have huge **earnings**, but nevertheless require an **important workforce**.
- ◆ Further analysis is required

Results

Price attributed by actors from the R&D sector to research on ACC

- ◆ **Hedonic evaluation** to estimate the value for a good, which value can not be fixed by the market
- ◆ **Correlations** between monetary variables and our impact variable
- ◆ **Regression Lin-Lin** (linear-linear)
 - **Dependant variable:** Contract amount with the TTO for 1 year (**CA**)
 - **Independent variable:** impact of the firm's collaboration with the TTO on CCA (*likert scale from 0 to 10, where 0 is no impact and 10 is a major impact*) (**ACC**)

Results

Pricing the R&D impacting on CCA

- ◆ Firms attribute, on average, **2 562 \$** for each level of impacts on CCA
- ◆ Firms which do not show interest for CCA execute research collaboration projects averaging **16 501 \$** (constant). If these firms invest 0 \$ for research on CCA, they will still invest 16 501 \$ for other research.
- ◆ Conversely, firms that do invest some money for research in CCA will add this extra amount to 16 501 \$.

◆ $CA = 16\ 501 + 2\ 562 * CCA$

	Non standardized coefficients		Standardized coefficients	t	Sig.
	A	SE	Beta		
Model					
(Constant)	16501,436	2768,018		5,961	,000
Climate change adaptation (CCA)	2561,898	1238,482	,142	2,069	,040

Conclusion

- ◆ Our research advances knowledge in **putting a value of R&D that impacts CCA** (at the firm level)
- ◆ Our evidence suggests that **TTOs can play an important role on innovation related to CCA**
- ◆ Our results suggest a benchmark of **25 562 \$** (about **19 200 euros**) as a government **incentive** to firms (tax credits, grants, etc.), that is likely to stimulate private firms to invest on R&D that can be useful in CCA

Conclusion

- ◆ **Future research areas that can improve the validity, reliability and credibility of return measurements obtained here:**
 - ◆ Quantitative and qualitative survey (\$\$\$)
 - ◆ More investigation of intangible attributes of research and innovation on CCA
 - ◆ Access to chronological data from Statistics Canada to track the impacts of public knowledge transfer programs impacting on innovation in CCA

Thank you!

Johann Jacob
555 Charest Boulevard East
Quebec City, Quebec
G1K 9E5
Tel.: 418-641-3000, ext. 6282
johann.jacob@enap.ca

Michel Crowley
555 Charest Boulevard East
Quebec City, Quebec
G1K 9E5
Tel.: 418-641-3000, ext. 6268
michel.crowley@enap.ca



CENTRE DE RECHERCHE ET D'EXPERTISE EN ÉVALUATION

www.crexe.enap.ca