

CHAIR INNOVATION

The logo for CHAIR INNOVATION features the word 'CHAIR' in dark blue and 'INNOVATION' in a gradient of blue and green. A stylized graphic of three green circles connected by lines is positioned above the 'O' in 'INNOVATION'.

CREATION, DEVELOPMENT AND
COMMERCIALISATION OF INNOVATION

Beyond the innovation obstacle paradox - The role of government support in helping firms overcome these obstacles and innovate

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Presentation Plan



Obstacle paradox



Data and Methodology



Results



Conclusion and Future work



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Obstacle paradox (I/II)

- The effect of obstacles on innovation in the empirical literature is not as conclusive as one might expect
 - Non-significant or significantly positive coefficients are often associated with the variable obstacles (Mohnen et al., 2004) → In other words, obstacles are often positively associated with more innovation
 - Literature results interpreted as an indication on how successfully firms can overcome these obstacles (Baldwin & Lin, 2002; Tourigny & Le, 2004)



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Obstacle paradox (II/II)

- This unexpected positive relationship between firm's performance and the probability to face obstacle could also results from two sources of bias:
 - The inclusion of firms that have no intention to innovate
 - The endogeneity of obstacles due to unobserved factors affecting both obstacles and the propensity to innovate
- According to Savignac (2008), the first bias can be eliminated by sampling only firms that "wished" to innovate while the second potential bias can be accounted for by using appropriate econometric techniques (i.e. estimate obstacles and propensity to innovate jointly)



Four probit models (Crépon et al., 1998)

- Model 1: univariate probit model estimating the impact of obstacles Y_{2i} on innovative activities Y_{1i}
 - X_{1i} is a vector of traditional explanatory variables influencing the decision to innovate of firm i : size, market share performance, advanced technology use index, indicator of a subsidiary, long term strategies main focus, government support to innovation and industry dummies
- Model 2: bivariate probit where the decision to innovate Y_{1i} is simultaneously estimated with an indicator of financial constraints Y_{3i}
 - X_{2i} is vector of investment risk

Model 1

$$Y_{1i} = X_{1i}\beta_1 + Y_{2i}\gamma_1 + \varepsilon_{1i}$$

$i \in S0, S1, S1Plus, S1plusRD, S2, S2Plus, S2plusRD$

Model 2

$$Y_{1i} = X_{1i}\beta_1 + Y_{2i}\gamma_1 + Y_{3i}\delta_1 + \varepsilon_{1i}$$
$$Y_{3i} = X_{2i}\beta_2 + Y_{1i}\gamma_2 + \varepsilon_{2i}$$

$i \in S1, S1Plus, S1PlusRD$



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Four probit models (Crépon et al., 1998)

- Model 3: univariate probit estimating the impact of obstacles Y_{2i} on innovative activities Y_{1i}

- For the population of firms that faced each particular obstacle*

- Model 4: univariate probit aimed at estimating success at overcoming an obstacle j $SMITOBS_{ij}$

- Y_{2i} is an obstacle other than that considered
- X_{2i} is a vector of determinants that potentially explain success at overcoming the obstacle

Model 3

$$Y_{1i} = X_{1i}\beta_1 + Y_{2i}\gamma_1 + \varepsilon_{1i}$$

$i \in S0, S1Plus, S1plusRD$

$i \in$ Firms that faced each particular obstacle,

Model 4

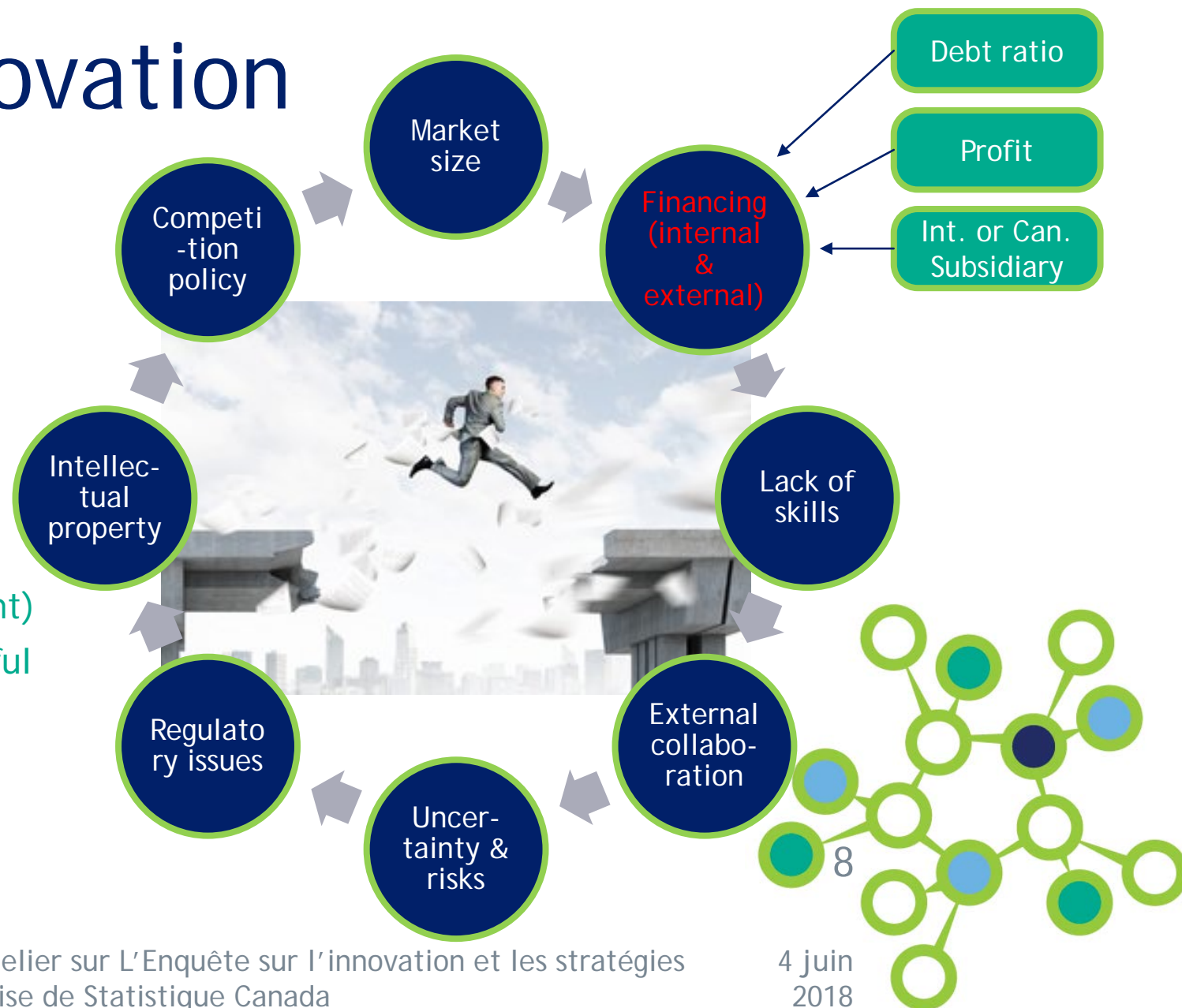
$$SMITOBS_{ij} = Y_{2i}\beta_{\neq j} + X_{1i}\gamma_j + \varepsilon_{ij}$$

$i \in S1PlusRD, j = 1, \dots, 9$



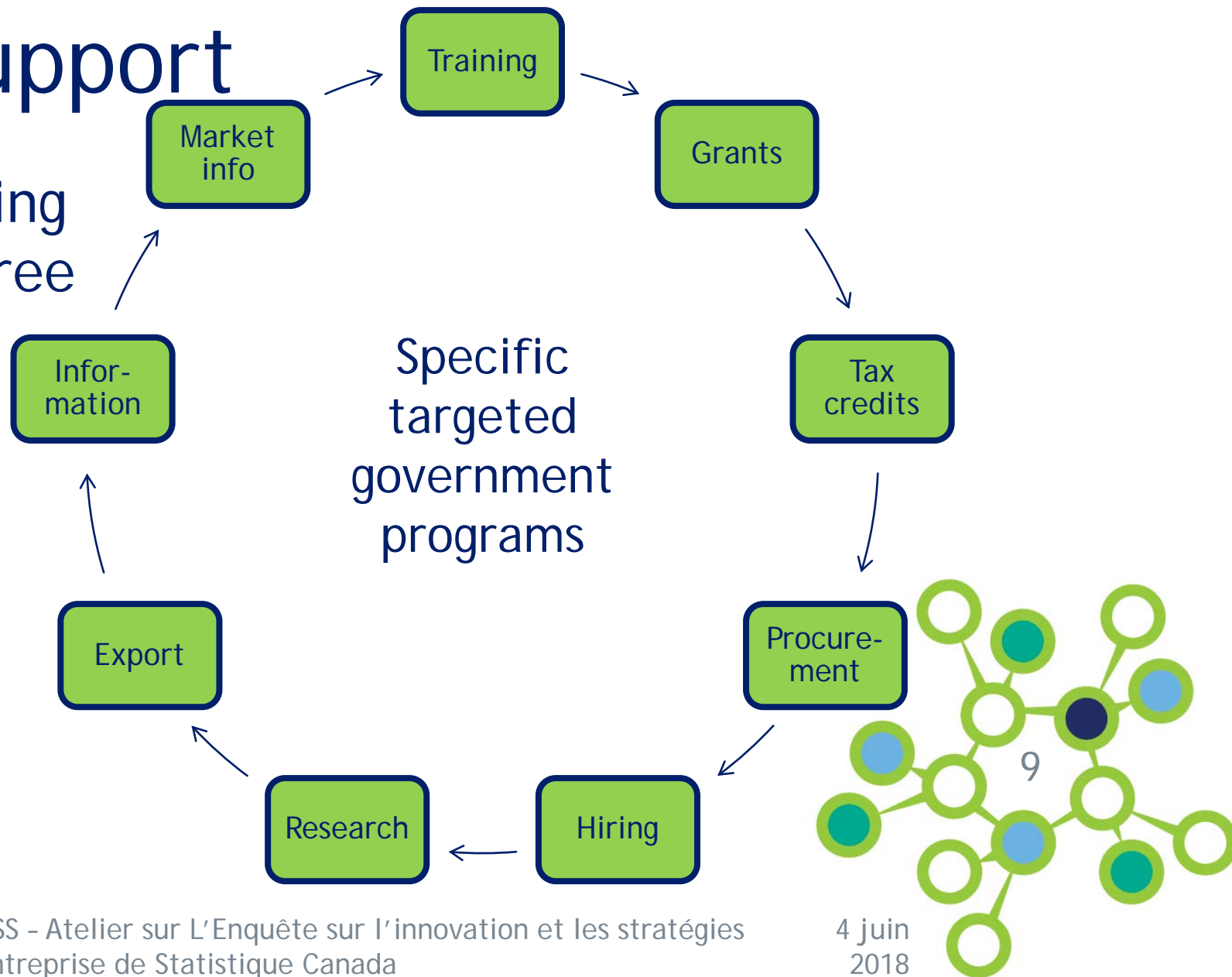
Obstacles to innovation

- Financial obstacles to innovation are our measure of financial constraints (i.e. specific to innovation)
 - Internal
 - External
 - Both
- Actions taken by firms:
 - Nothing, i.e. no measures taken (nmt)
 - Measures taken but were unsuccessful (mtu)
 - Measures taken and successful (mts)
 - Government measures used



Government support

- One variable combining programs from all three levels of government
 - Federal
 - Provincial
 - Municipal
- Most used are grants and tax credits

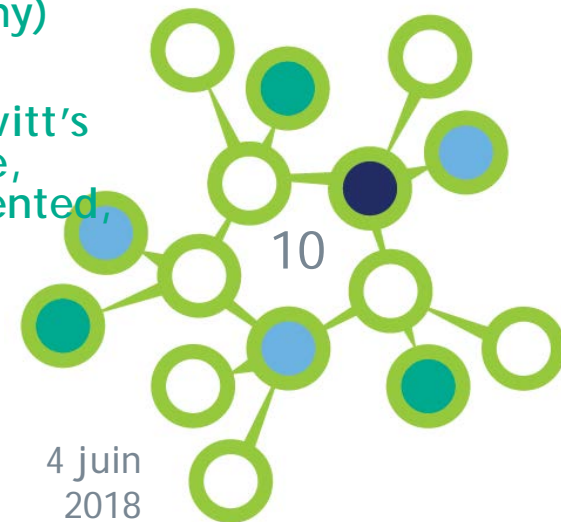


Control variables

Survey of Innovation and Business Strategy (SIBS 2009 and 2012)

General Index of Financial Information (GIFI 2009 and 2011)

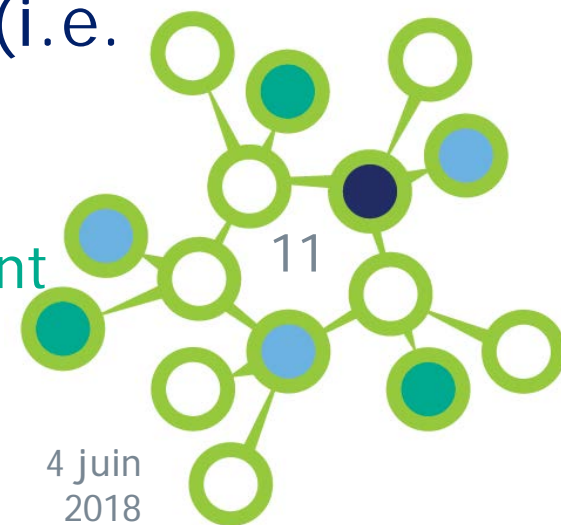
- Firm size: number of employees (natural log)
- Firm strategy on low price (rather than on goods and services positioning): dummy
- Age of the long term strategy (natural log)
- Strategy focused on new products and services (dummy)
- Strategy focused on new processes (dummy)
- Used any of nine advanced technologies (dummy)
- Introduced new open organisational innovation (dummy)
- Outsourced R&D (dummy)
- Relocated R&D activities outside Canada (dummy)
- Market share (natural log) [*from GIFI*]
- Gained market share (dummy)
- Possesses intangible capital (dummy) [*from GIFI*]
- Sectoral fixed effects based on Pavitt's (1984) taxonomy - Resource, Scale, Labour, Specialized, Scientific oriented, plus KIBS (services)
- Regional fixed effects



Sample - 2009 only **incomplete**

	S0	S1	S1Plus	S1PlusR&D
Who is included in the target population	All	Product & process innovators + Faced any obstacle to innovation + Yes to Q5 (prod) & Q7 (proc) + performed R&D		
N	4248	3521	3712	
Non innovators ($Y_i=0$)	1364	637	828	
Innovators ($Y_i=1$)	2884	2884	2884	
Excluded N	0	727	536	

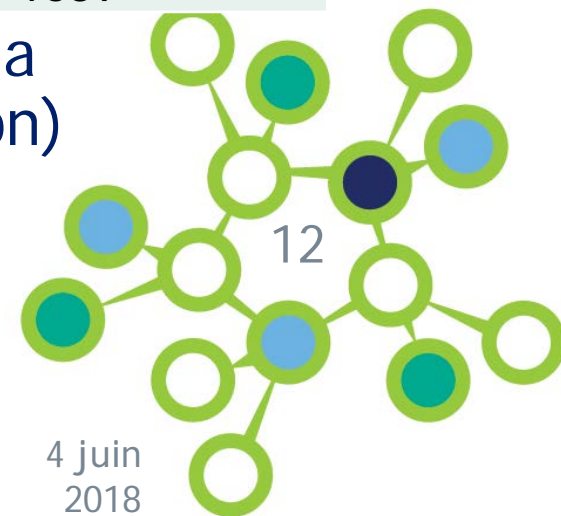
- Only for the sample S0 is the obstacle paradox present (i.e. a positive and significant sign for facing obstacles to innovation)
 - For all other samples, S1, etc. the sign is negative and significant



Sample - 2009 & 2012 combined

	S0	S1	S1Plus	S1PlusR&D
Who is included in the target population	All	Product & process innovators + Faced any obstacle to innovation + Yes to Q5 (prod) & Q7 (proc) + performed R&D		
N	8731	6588	7349	7092
N clusters	7445	5720	6340	6085
Non innovators ($Y_i=0$)				
Innovators ($Y_i=1$)				
Excluded N	0	2143	1382	1639

- Only for the sample S0 is the obstacle paradox present (i.e. a positive and significant sign for facing obstacles to innovation)
 - For all other samples, S1, etc. the sign is negative and significant



Regression results – Model 1 & 2

- Controls robust across models 1 and 2

NS Firm size: number of employees (natural log)

-- Firm strategy on low price (rather than on goods and services positioning): dummy

NS Age of the long term strategy (natural log)

+++ Strategy focused on new products and services (dummy)

+++ Strategy focused on new processes (dummy)

+++ Used any of nine advanced technologies (dummy)

+++ Introduced new open organisational innovation (dummy)

+ Outsourced R&D (dummy)

NS Relocated R&D activities outside Canada (dummy)

++ Market share (natural log)

+++ Gained market share (dummy)

++ Possesses intangible capital (dummy)

- Instruments for model 2

-- Subsidiary of a Canadian firm (dummy)

--- Subsidiary of a foreign firm (dummy)

--- Profit (natural log)

+++ Debt ratio (natural log)

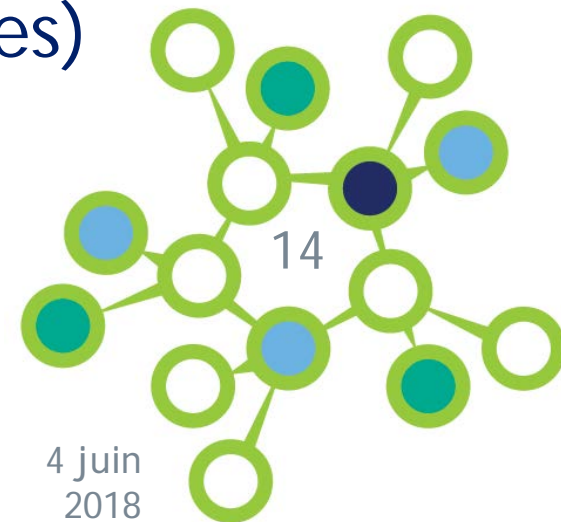


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Regression results - Model 1 - obstacles

	All	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ObsMktSize	-0.0399	-0.0928**									
ObsIntFin	-0.043		-0.1042***								
ObsExtFin	-0.0344			-0.1047**							
ObsFin					-0.1153***						
ObsSkills	-0.0841**					-0.1154***					
ObsCollab	0.069						-0.0232				
ObsRisks	-0.1106***							-0.1446***			
ObsRegu	-0.0524								-0.0957**		
ObsIP	0.2664***									0.1602**	
ObsCompPol	-0.1057										-0.1186*

- All firms that faced obstacles (except for IP obstacles) were less innovative (fewer product or process innovation)



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Regression results - Model 2 - obstacles

	(1)	(2)	(5)	(6)	(7)	(8)	(9)	(10)
ObsExtFin (endogenous)	-0.9743***	-0.9516***	-1.0222***	-0.9404***	-1.0059***	-1.0036***	-1.0296***	-1.0280***
MTUObsExtFin	0.0275	0.0211	0.0196	0.0266	0.0250	0.0209	0.0201	0.0174
MTSObsExtFin	0.2216**	0.2127**	0.2112**	0.2169**	0.2215**	0.2044*	0.2162**	0.2077**
ObsMktSize	-0.0745*							
ObsIntFin		-0.0609						
ObsSkills			-0.0975**					
ObsCollab				0.0007				
ObsRisks					-0.1147***			
ObsRegu						-0.0753*		
ObsIP							0.1796**	
ObsCompPol								-0.0960

Successful measures

- Taking successful measures to alleviate external (but also internal) finance obstacles to innovation are more innovative



Regression results - Model 1 - measures taken

Obstacles:	MktSize	IntFin	ExtFin	I&E Fin	Skills	Collab	Risks	Regu	IP	CompPol
No measures taken	-0.3849***	-0.4216***	-0.2146**	-0.3517***	-0.3630***	-0.3633**	-0.3855***	-0.2292***	-0.1461	-0.2419**
Gov't prog. & Measures successful	0.4860***	0.3066***	0.2833*	0.1774*	0.1563	0.4980	0.155	0.3948	0.3907	-0.3475
Gov't prog. & Measures unsuccessful	0.4252**	0.5313***	0.356**	0.4306***	0.0045	0.2754	0.3347**	0.1714	0	0
No gov't prog. & Measures successful	0.1527	0.0433	-0.0304	0.0661	0.0745	0.2851***	0.1000	0.0305	0.2433**	-0.1776
No gov't prog. & Measures unsuccessful	-0.1864***	-0.2704***	-0.2801***	-0.2495***	-0.1997***	-0.2152**	-0.1996***	-0.1405**	0.2305*	-0.0217

- Compared with not facing these obstacles to innovation
 - Taking no measures was worse
 - Using government programs to alleviate market size and financial obstacles had a positive effect
 - Not using government programs and the measures taken were unsuccessful had a negative effect on innovation (except for IP!)
 - Government programs are not useful to alleviate collaboration or IP obstacles to innovation



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Regression results - Model 2 - measures taken

Obstacles:	MktSize	IntFin	Skills	Collab	Risks	Regu	IP	CompPol
ObsExtFin (endogenous)	-0.9165***	-0.7911***	-0.9621***	-0.9770***	-0.8972***	-0.9663***	-0.9732***	-1.0161***
No measures taken	-0.3333***	-0.3460***	-0.3293***	-0.3058**	-0.3306***	-0.2143***	-0.0864	-0.1863*
Gov't prog. & Measures successful	0.4778***	0.3184***	0.1519	0.4640	0.1558	0.3574	0.3311	-0.3689
Gov't prog. & Measures unsuccessful	0.4234***	0.5236***	-0.0105	0.2899	0.3701***	0.1893	4.6318***	5.6075***
No gov't prog. & Measures successful	0.1732*	0.0676	0.0809	0.2951***	0.1288**	0.0907	0.2747***	-0.0710
No gov't prog. & Measures unsuccessful	-0.1588***	-0.2146***	-0.1590***	-0.1595*	-0.1605***	-0.1167**	0.2406**	-0.0258

- Very similar results
- Same anomaly for IP
- Government programs that have a positive impact:
 - Training, grants, tax credits, research facilities, export, hiring, information



Model 3 - Firms that faced specific obstacles (gov't prog. & measures)

Firms that faced these obstacles:	Market size	Internal finance	External finance	Int or Ext finance	Lack of skills
Gov. programs used & Measures successful	0.8742***	0.6894***	0.4625***	0.4500***	0.4270***
Gov. programs used & Measures unsuccessful	0.7110***	0.9168***	0.5978***	0.7192***	0.3002*
No gov. programs used & Measures successful	0.5159***	0.4463***	0.2499**	0.3828***	0.4392***
No gov. programs used & Measures unsuccessful	0.1878*	0.1274	-0.0605	0.0623	0.1238
Number of observations	1576	2384	1545	2609	2162

- Firms that faced these obstacles were more innovative if they used government programs and when they did not, if their measures were successful



Model 3 - Firms that faced specific obstacles (gov't prog. & measures)

Firms that faced these obstacles:	Collabo-ration	Risks	Regu-lation	IP	Competition policy
Gov. programs used & Measures successful	1.0650***	0.4501***	0.5118*	0.4613	-0.5218
Gov. programs used & Measures unsuccessful	0.7534**	0.6843***	0.2699		
No gov. programs used & Measures successful	0.8306***	0.5112***	0.1903*	0.3870**	-0.2506
No gov. programs used & Measures unsuccessful	0.3174	0.1822***	0.0262	0.3871*	0.0935
Number of observations	656	3190	1560	602	433

- Firms that faced collaboration and risks obstacles were more innovative if they used government programs and when they did not, if their measures were successful
- Firms that faced regulation obstacles were more innovative if the measures taken were successful
- Firms that faced IP obstacles were more innovative if they did not use government programs...



Firms that face market size obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1320***									
Training		0.0674								
Grants			0.3509***							
Tax credits				0.3493***						
Procurement					0.0831					
Hiring						0.3168**				
Research							0.5474***			
Export								0.3074*		
Information									0.2867*	
Market info										0.2628*

- Beside grants and tax credits that contribute directly to innovation, hiring and research facilities have a strong positive impact
 - Hiring for expansion
 - Research facilities for collaboration?



Firms that face internal finance obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1070***									
Training		0.0406								
Grants			0.2466***							
Tax credits				0.3871***						
Procurement					0.1652					
Hiring						0.0612				
Research							0.2079*			
Export								0.1762		
Information									0.1277	
Market info										0.2564**

- Beside grants and tax credits that contribute directly to innovation, only market information has a strong positive impact
 - Market information useful to justify internal investment?



Firms that face external finance obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1321***									
Training		0.0600								
Grants			0.4220***							
Tax credits				0.3615***						
Procurement					0.1090					
Hiring						0.1252				
Research							0.3752**			
Export								0.2999**		
Information									0.2842*	
Market info										0.3021**

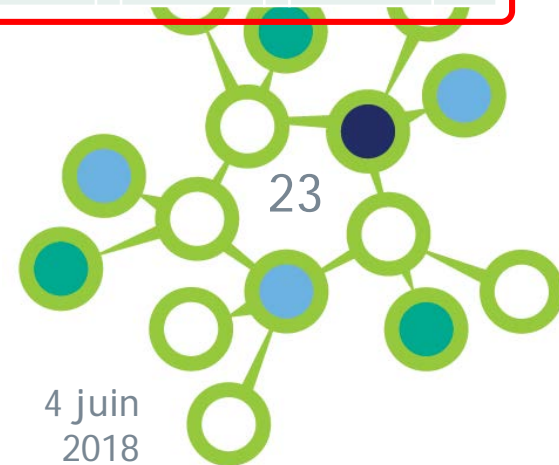
- Beside grants and tax credits that contribute directly to innovation, research facilities and export incentives and services have a strong positive impact
 - Help to reach foreign markets beneficial?



Firms that face financial obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1066***									
Training		0.0430								
Grants			0.2743***							
Tax credits				0.3604***						
Procurement					0.1148					
Hiring						0.0385				
Research							0.1752			
Export								0.1947*		
Information									0.1771	
Market info										0.3122***

- Same as internal finance obstacles



Firms that face skills obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1084***									
Training		0.0904 ?								
Grants			0.3267***							
Tax credits				0.3194***						
Procurement					0.1862					
Hiring						0.2269**				
Research							0.1941			
Export								0.2035		
Information									0.0988	
Market info										0.0411

- Beside grants and tax credits that contribute directly to innovation, hiring programs of recent graduates have a strong positive impact
 - Hiring of recent graduates to benefit from the newest skills
 - BUT WHY NOT TRAINING OF CURRENT STAFF???



Firms that face collaboration obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.2421***									
Training		0.2387								
Grants			0.3486**							
Tax credits				0.4508***						
Procurement					0.7022***					
Hiring						0.5048**				
Research							0.5410**			
Export								0.9533***		
Information									0.7159***	
Market info										0.8588***

- Beside grants and tax credits that contribute directly to innovation, everything except training has a strong positive impact
- Does external collaboration lessen the need for government training programs and is replaced by peer training?



Firms that face risks obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1110 ^{***}									
Training		0.1249 [*]								
Grants			0.2033 ^{***}							
Tax credits				0.3157 ^{***}						
Procurement					0.0849					
Hiring						0.1907 ^{**}				
Research							0.3173 ^{***}			
Export								0.1770 [*]		
Information									0.1717	
Market info										0.2620 ^{**}

- Beside grants and tax credits that contribute directly to innovation, hiring of recent graduates, access to research facilities and market information have a strong positive impact



Firms that face regulation obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1211***									
Training		0.1506								
Grants			0.2753***							
Tax credits				0.3544***						
Procurement					0.1441					
Hiring						0.2309*				
Research							0.4829***			
Export								0.3103*		
Information									0.2507*	
Market info										0.1933

- Beside grants and tax credits that contribute directly to innovation, access to research facilities have a strong positive impact
 - Are research facilities focused on industry problem solving that help surmount regulatory hurdles?

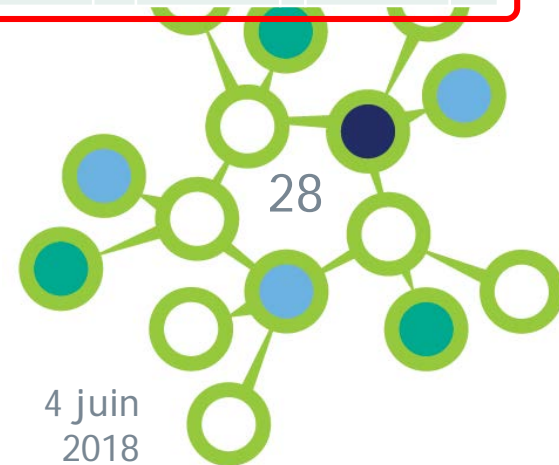


Firms that face IP obstacles

An international issue?

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gov't programs										
Index of 10 prog.	0.1045**									
Training		-0.1315								
Grants			0.1771							
Tax credits				0.4636***						
Procurement					0.8922***					
Hiring						0.2283				
Research							0.0380			
Export								0.5281**		
Information									0.0092	
Market info										0.6075**

- Grants have no impact on the propensity to innovate
- Role of procurement clearly identified here as linked with innovation
 - Technology testing prior to commercialisation?
- Government programs on export and market information have a positive impact



Firms that face competition policy obstacles

Gov't programs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Index of 10 prog.	0.1248**									
Training		0.1417								
Grants			0.1006							
Tax credits				0.4391***						
Procurement					0.0856					
Hiring						0.6199**				
Research							0.5519**			
Export								0.3668		
Information									0.5225*	
Market info										0.4039*

- Grants have no impact
- Hiring support and access to government research facilities

Small sample



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Discussion

- Models 1 and 2 yield similar results
- Controls
 - Firms that compete on price leadership have less chances to innovate
 - Firms using advanced technologies have more chances to innovate than non-using firms
 - Firms outsourcing R&D activities have a weak but positive chance to innovate
 - Firms gaining market share have more chances to innovate



Discussion

- ◉ Models 1 & 2
 - ◉ Only IP does not yield the expected outcome
 - ◉ Government does not help in patent litigations
 - ◉ Non interesting patents are not sought after and therefore not infringed?
 - ◉ Risks and uncertainties is not a good category of obstacle
- ◉ Government support
 - ◉ The usual suspects (grants and tax credits) have the most impact
- ◉ Model 3 (regression for each sample of firms that faced a particular obstacle to innovation) yields focused results on the impact of specific government programs



Conclusion

- Doing nothing to surmount obstacles to innovation is the worst strategy
- Collaboration and IP obstacles are not helped by government programs
 - To a lesser extent, competition policy obstacles
- Future work
 - Identify which programs are truly useful for which innovation obstacles (challenge without a longitudinal study)



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Future work

- SIBS only allows to scratch the surface
 - SIBS 2017 will help have a third data point
 - But only very few firms have responded to SIBS2009 and SIBS2012
- Identify which programs are truly useful for which innovation obstacles (challenge without a longitudinal study)
- Map their impact on innovation and firm performance
- Link with the horizontal review of government programs?



Thank you

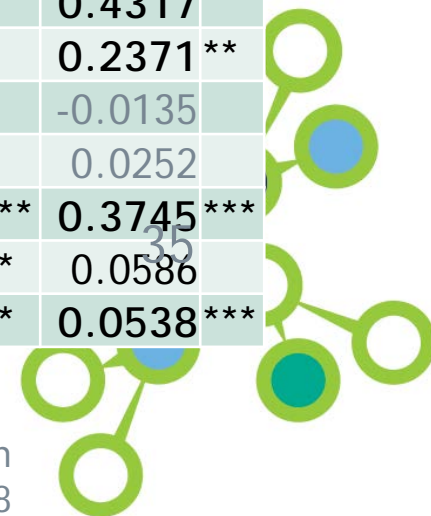


CIQSS - Atelier sur L'Enquête sur l'innovation et les stratégies d'entreprise de Statistique Canada



Model 3 - Firms that faced specific obstacles (controls)

Firms that faced these obstacles:	Market size	Internal finance	External finance	Int or Ext finance	Lack of skills
Nb Employees (natural log)	0.0509	0.0003	-0.0176	0.0070	0.0236
Strat. focused on low price (dummy)	-0.0958	-0.1876**	-0.1012	-0.1663*	-0.0570
Age of long term strategy (natural log)	0.0089	0.0031	-0.0999	-0.0339	-0.0249
Strat. focused on new products & services (dummy)	0.3066***	0.3566***	0.2849***	0.3346***	0.4402***
Strat. focused on new processes (dummy)	0.2603***	0.2803***	0.2995***	0.285***	0.2026***
Used any of 9 advanced technologies (dummy)	0.4974***	0.4958***	0.5473***	0.5228***	0.4986***
Introduced new open organisational innov. (dummy)	0.3406***	0.3190***	0.2727***	0.3232***	0.4317***
Outsourced R&D (dummy)	0.2470*	0.1594	0.1085	0.1471	0.2371**
Relocated R&D activities outside Canada (dummy)	-0.1104	-0.0435	-0.2778	-0.1128	-0.0135
Market share (natural log)	0.0134	0.0023	0.0306	0.0037	0.0252
Gained market share (dummy)	0.4402***	0.4933***	0.4286***	0.5046***	0.3745***
Possesses intangible capital (dummy)	0.1145	0.1612**	0.1984**	0.1582**	0.0586
Obstacles others than those identified	0.0685***	0.0325*	0.0477**	0.0445**	0.0538***



Model 3 - Firms that faced specific obstacles (controls)

Firms that faced these obstacles:	Collabo-ration	Risks	Regu-lation	IP	Competition policy
Nb Employees (natural log)	0.1081 *	-0.0011	0.0204	-0.0196	-0.0062
Strategy focused on low price (dummy)	-0.1468	-0.1580 **	-0.2983 ***	0.2676	-0.1212
Age of long term strategy (natural log)	-0.0071	-0.0194	0.0071	-0.0329	-0.1604
Strat. focused on new products & services (dummy)	0.3952 **	0.4369 ***	0.4528 ***	0.5178 ***	0.2807
Strat. focused on new processes (dummy)	0.3300 **	0.2456 ***	0.2618 ***	0.1758	0.3170 *
Used any of 9 advanced technologies (dummy)	0.5862 ***	0.4929 ***	0.5753 ***	0.4950 ***	0.6431 ***
Introduced new open organisational innov. (dummy)	0.0977	0.3839 ***	0.5270 ***	0.1221	0.4513 **
Outsourced R&D (dummy)	0.4128 *	0.3012 ***	0.2866 **	0.3104	0.6562 **
Relocated R&D activities outside Canada (dummy)		-0.0817			
Market share (natural log)	0.0383	0.0079	0.0199	0.0231	0.1450 **
Gained market share (dummy)	0.5202 ***	0.4225 ***	0.4074 ***	0.5317 ***	0.4510 **
Possesses intangible capital (dummy)	0.1105	0.0734	0.1131	0.2077	0.3667 **
Obstacles others than those identified	-0.0061	0.0379 **	0.0219	-0.0084	0.0329 **

