What does it take for an R&D tax incentive policy to be effective?

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Montevideo-April 2009

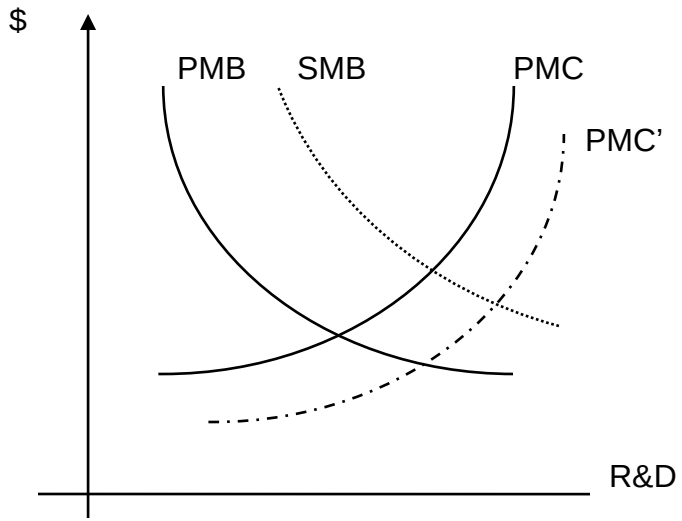
Outline

- reconcile notions and evaluation methods

- Evaluation of Dutch tax incentive system

Market failure

- Optimal social amount of R&D



Policies in support for R&D

Country	Cost of fiscal R&D incentives as a % of GDP	Magnitude of R&D tax incentives in 2005 (Millions US$ in PPP)	Magnitude of direct government funding for R&D as a % of GDP	Type of indirect support for R&D 2008
Australia	0.05 (2004)	356	0.04 (2003)	V, I, SL, R
Canada	0.15 (2004)	2 990.4	0.03 (2004)	V, SL, R
France	0.03 (2002)	1 009.9	0.15 (2002)	V, SL, S
Japan	0.01 (2003)	3.3	0.02 (2003)	I
Netherlands	0.09 (2005)	419.3	0.04 (2003)	V, SL, S, R
Norway	0.01 (2004)	137.0	0.10 (2003)	V, SL, R
United Kingdom	0.05 (2004)	937.3	0.13 (2003)	V, SL, R
United States	0.06 (2001)	5 110.0	0.17 (2001)	I (mostly), R

Reconciling notions

Additionality

Cost-effectiveness ratio
Incrementality ratio
Tax sensitivity ratio

Full
Cost benefit analysis

Spillovers
Administration costs
Compliance costs
Opportunity costs

General equilibrium analysis

Wage effects
Balanced budget
Open trade

Second-order effects
Third-order effects

Additionality: denominator

- Additionality: How much additional R&D/ Euro of tax expenditure?

- Tax expenditures:
  - Include all taxes (level, incremental, …)
  - Allow for changes in tax position

  - Calculate it (statutory rates)
  - Observe it (administrative data)

How to measure additional R&D?

- Ask firms
  - Do they really know?
  - Self-interest to respond positively
- Estimate econometrically
  - Structural models
  - Treatment evaluation methods

Structural models

- Demand for R&D equation
  - With R&D tax credit dummies
  - With user cost including B-index

  - Endogeneity of dummy or user cost
  - Time effects (adjust. Costs, delays in credit)
  - For comparisons: stocks or flows, absolute or relative levels, elasticities or semi-elasticities?

Treatment evaluation methods

- Matching estimators
- Difference in difference
- Regression discontinuity design

Switzer (1988)				
Finance Canada and Revenue Canada (1997)	Canada	survey	1.38	
Bernstein	Canada	Structural model	0.80 (exogenous output) 1.05-1.70 (induced output)	
Dagenais, Mohnen, Therrien (2004)	Canada	Stuctural model	0.98-1.04	
Russo (2004)	Canada	CGE model[$]	Higher for incremental than for level-based R&D tax credits	
Parsons and Phillips (2007)*	Canada	Cost/benefit analysis		10.9%
Mairesse and Mulkay (2007)	France	Structural model	4.00	
Lokshin and Mohnen (2007)	Netherlands	Structural model	0.80-1.40 in short run 0.31-0.75 in long run	
Czarnitzki, Hanel and Rosa (2004)	Canada	Evaluation treatment	R&D tax credit receivers have higher innovative, but not higher economic performance	
Duguet (2007)	France	Evaluation treatment	1.00-3.30	
Haegeland and	Norway	Evaluation	2.00	

Full cost-benefit analysis (1)

Study by Parsons and Phillips (2007)

- Inclusion of
  - Spillovers (0.56)
  - Administration costs (0.02)
  - Compliance costs (0.08)
  - Opportunity costs (0.27)

- Net welfare effect: 10.9%

Full cost-benefit analysis (2)

- Behavioral additionality (2nd order effects)
  - Innovation incidence
  - Innovation intensity
  - patenting
- Returns to marginal R&D (3rd order effects)
  - Productivity or profitability

Full cost-benefit analysis (3)

- General equilibrium effects
  - Wage effects
  - Balanced budget
  - Credit constraints
  - Open economy

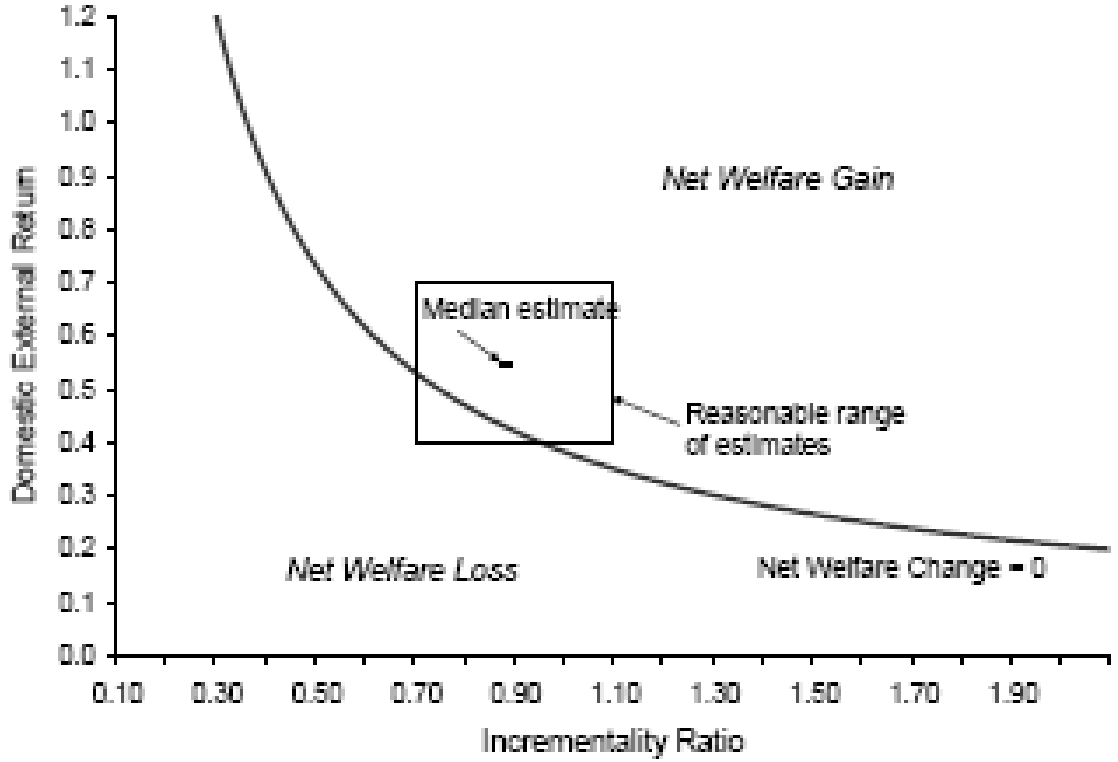
  - Study by Russo (2004)

Sensitivity analysis

- Parsons and Phillips (2007)
  - Range of values
  - Example: net welfare = 0 if
    - Spillover = 0.45
    - Incrementality = 0.71
  - Imprecise estimates

Externalities vs. incrementality ratio (Parsons and Phillips, 2007)

Figure 2: Welfare Effects of the Federal SR&ED Tax Credit



Assumes MRR = 0.27, r = 0.3, s = 0.043

Lokshin and Mohnen (2007)

- Allow for lags, dynamics, SR vs LR
  - in structural model
  - in bang for the buck
- CES production function

$$k_{it}^{*} = a + \phi v_{it} - \sigma(u_{R,it} - p_{I,it}) + \gamma q_{I,it}$$

- Partial adjustment

$$\frac{R_{it}}{K_{i,t-1}} = \frac{R_{it}^{r} + R_{it}^{n}}{K_{i,t-1}} = \delta + (\frac{K_{it}}{K_{i,t-1}} - 1) \cong \delta + d \log K_{t}$$

Estimating equation

$$k_t - k_{t-1} = \lambda(k_t^* - k_{t-1}^*) + (1-\lambda)\lambda(k_{t-1}^* - k_{t-2}^*) + (1-\lambda)^2\lambda(k_{t-2}^* - k_{t-3}^*) + \ldots$$

$$\frac{R_{it}}{K_{i,t-1}} = \lambda\delta + (1-\lambda)\frac{R_{i,t-1}}{K_{i,t-2}} + \varphi\lambda\, dv_{it} - \sigma\lambda\,(du_{Rit} - dp_{I,it}) + \gamma\lambda dq_{I,it} + (\varepsilon_{it} - (1-\lambda)\varepsilon_{i,t-1})$$

Measuring cost effectiveness

time	Change in R&D expenditures ($\tilde{R}_t - R_t$)	Change in foregone tax revenues ($\tilde{W}_t - W_t$)
1	$(\partial K_1 / \partial u_R^1)\Delta u_R^1$	$(1-\tau)w^L[\tilde{\gamma}(\tilde{R}_1)\tilde{R}_1 - \gamma(R_1)R_1] - \tau\kappa(\tilde{R}_1 - R_1)$
2	$\delta(\partial K_1 / \partial u_R^1)\Delta u_R^1 + (\partial K_2 / \partial u_R^1)\Delta u_R^1$	$(1-\tau)w^L[\tilde{\gamma}(\tilde{R}_2)\tilde{R}_2 - \gamma(R_2)R_2] - \tau\kappa(\tilde{R}_2 - R_2)$
t	$\delta(\partial K_1 / \partial u_R^1 + \partial K_2 / \partial u_R^1 + ... + \partial K_{t-1} / \partial u_R^1)\Delta u_R^1 + (\partial K_t / \partial u_R^1)\Delta u_R^1$	$(1-\tau)w^L[\tilde{\gamma}(\tilde{R}_t)\tilde{R}_t - \gamma(R_t)R_t] - \tau\kappa(\tilde{R}_t - R_t)$

Calculation of BFTB

$$BFTB = \frac{\sum_{i}\sum_{t=1}^{\infty}(\tilde{R}_{it} - R_{it})/(1+r)^{t-1}}{\sum_{t=1}^{\infty}(\tilde{W}_{t} - W_{t})/(1+r)^{t-1}}.$$

Data

- Generated random sample of 1000 observations
- Reproducing composition of Dutch population of firms
- 75% small firms (R&D< €110,000)
- 25% large firms (€110,000<R&D<€ 50ML)

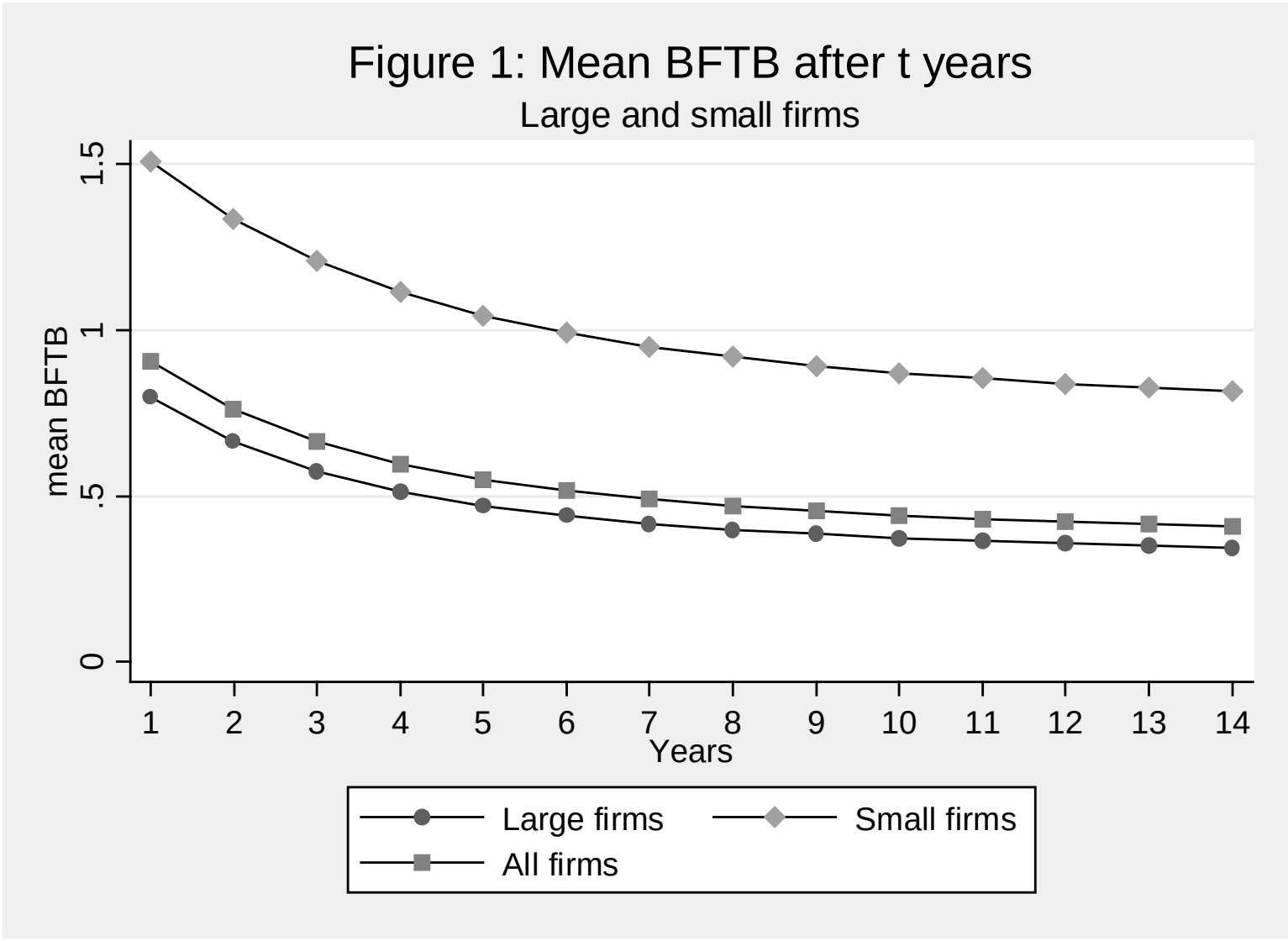
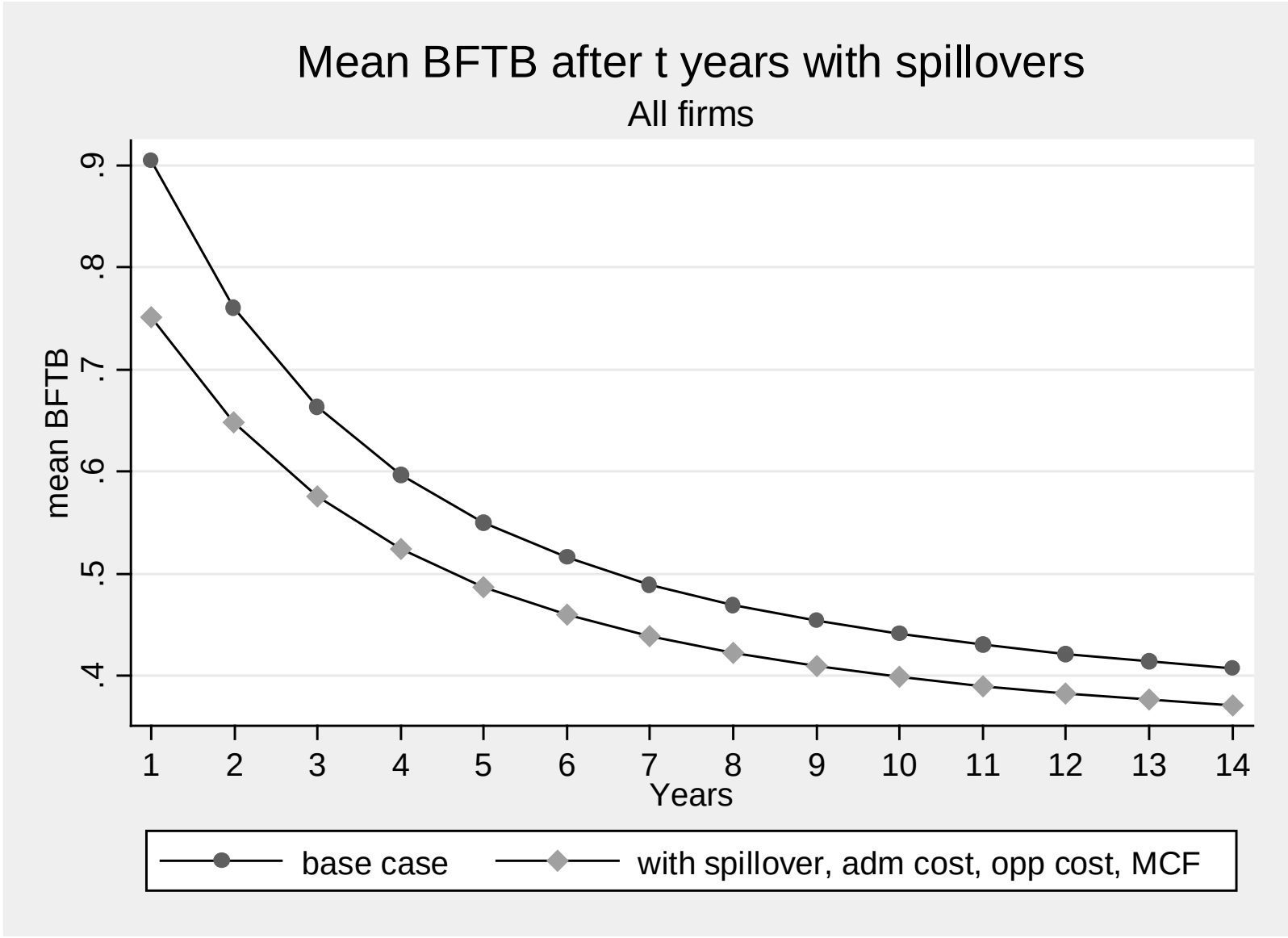


Figure 1: Mean BFTB after t years
Large and small firms
mean BFTB
0
.5
1
1.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Years
Large firms
Small firms
All firms


Mean BFTB after t years with spillovers
All firms
mean BFTB
.4
.5
.6
.7
.8
.9
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Years
base case
with spillover, adm cost, opp cost, MCF

Lokshin and Mohnen (2008)

- Is there a price effect? (Goolsbee, 1997 QJE; Goolsbee, 1998) AER

- Our hypothesis:

  Additional R&D expenditures stimulated by fiscal incentives program are split in quantity and price effects

Is there a wage effect?

- Approach: Nash bargaining model with risk-neutral preferences
- Solving the f.o.c. $w \cong (1-\beta)\overline{w} + \beta(d/L)$
- Empirical specification:

$$\ln W_{it} = b_1 \ln d_{R,it} + b_2 (K/L)_{it} + b_3 \ln Size_{it} + b_4 \ln \overline{w}_{jt}$$

$$+ \mathbf{d}Z_{jt} + \varepsilon_{it}$$

Results

	R&D tax credits treated as exog	GMM, first difference	GMM (A-B)
Wage rate$_{-1}$			0.164*** (0.043)
Tax credit disbursements	0.066*** (0.08)	0.124*** (0.014)	0.112*** (0.028)
Cap-labor ratio * 10^{-2}	0.141*** (0.220)	0.491*** (0.036)	0.005 (0.003)
Size (logs)	0.048*** (0.006)	0.031 (0.020)	0.042 (0.029)
Altern. wage	0.187*** (0.049)	0.081* (0.046)	0.083 (0.060)
Sargan test	-	0.10(0.95)	38.38 (0.36)
# of firms	1286	1286	798
# obs	3485	3485	2121

Further work?

- What does it take to turn firms into R&D performers?
- R&D tax competition – R&D location
- Less emphasis on the BFTB, more on net welfare gain (how big spillovers?)
- What is more effective: direct-indirect?
- Complementarity direct-indirect R&D support

Further work? (2)

- Any wage effect?
- Willingness to apply for R&D tax incentives?
- Level based or incremental R&D tax credits?
- Productivity of additional R&D emanating from government support (2nd and 3rd order effects)?