The Effectiveness of Tax Incentives for R&D+i in Developing Countries: The case of Argentina

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Motivation: diagnosis

R&D made up 40 per cent of the productivity growth during the post-war era in US (Reikard, 2011). However,

- The Investment in R&D in Latin America remained stubbornly low over time, less than 1 % of the GDP, (exception Brazil)
- This percentage is much lower compared to countries such as Israel (4.3 %), Finland (3.9 %), and South Korea (3.7 %). Or the mean of the OECD countries (2.3 %)

Motivation: diagnosis

Argentina is not the exception.

- Only 25 % comes from the private sector.
- Important deficit in R&D investment in the private sector.
- Spend on innovation: Developed country more 4 % of sales, firms in Latin America around 2.5 %. Argentina, approximately 2.2 %.
- The investment deficit extends beyond R&D.

Motivation: diagnosis

The main business strategy regarding innovation in the region is on technology embodied in machinery, mostly imported from abroad.

- The evidence from successful catching-countries suggests that relying on imported technology is not necessarily bad if it leads to domestic learning (Lee, 2013).
- However, technology must be combined with absorptive capacities that allow for further adaptation and incremental improvements. Consequently, at least some level of R&D might be needed to build such capacities (Cohen and Levinthal, 1989)

Motivation: cause

- The deficit in innovation investment is a consequence of market failures
  - Imperfect appropriability: "public good"
  - Lack of financing: uncertainty and intangibility
- Public good nature of the Knowledge. (Although not automatic)
- Innovation investment is different from ordinary investments.

Motivation: cause

- R&D and innovation investments are formed by a set of different inputs and it cannot be taken for granted that these market failures will affect all these inputs with the same degree or intensity.
- In fact, the problems of incomplete appropriability and liquidity constraints are expected to be more severe in the case of the intangible components of these investments (such as R&D).
- Also, it is expected that these ailments will not affect to all innovative firms in the same way.

Motivation: space for intervention

Consequently, the allocation of R&D+i is below the optimal from the socially point of view $\Rightarrow$ creating the space for policy interventions such direct subsidies and tax incentives.

Contribution - Questions

1. Can this type of tax policy extrapolated to developing countries contexts where institutional capacities and supply-side constraints are more relevant?
2. Is the subsidy targeting the right sort of innovation investment, the one a priori more affected by market failures?
3. Contribute to proper policy targeting.

Literature Review

- Since (Nelson 1959) and (Arrow 1962), knowledge has been regarded as a nonrival and nonexcludable good $\rightarrow$ "free-ride".
- Wedge between private and social returns.
- Uncertainty, asymmetric information $\rightarrow$ Financial problems.

Literature Review

- Developed countries have been experimenting with R&D tax incentives since the 1960s.
- R&D was mostly assumed to be inelastic to its user cost of capital. However, from the 1990s onward, empirical findings revealed that this elasticity was above one.
- After 2002, the findings were mixed, since in some countries the early results suggested that R&D tax credits schemes were not effective (Chirinko, Fazzari and Meyer 1999), while in others positive effects were identified (Bloom, Griffith and Van Reenen 2002).
- More recent results, however, tend to suggest that tax incentives have been effective in promoting private sector investment.

Literature Review

Table 1
Summary of principal works estimating the R&D+i tax incentives elasticity.

References	Country	Industries	Elasticity (R&D+i)	Data
Baily and Lawrence (1992)	USA	Manufacturing	−0.75	Firm level data
Berger (1993)	USA	Manufacturing	−1.25	Firm level data
Hall (1993a,b)	USA	Manufacturing	−0.8 to −1.5 in the short-run, while the long-run elasticity ranges from −2.0 to −2.7	Firm level data
Hines (1993)	USA	Manufacturing	−1.2 and −1.6	Aggregated
ABIE (1993)	Australia	Manufacturing	−1	
McCutchen (1993)	USA	Pharmaceutical Industry	−0.29	Aggregated
Dagenais et al. (1997)	Canada	Manufacturing and Services	−0.4	Firm level data
Bloom et al. (2002)	G7	Manufacturing	−0.1 in the short-run, while the long-run elasticity is −1	Aggregated
Mairesse and Mulkay (2004)	France	Manufacturing	−0.41 in the short-run, while the long-run elasticity is −2.3	Firm level data
Baghana and Mohnen (2009)	Canada	Manufacturing	−0.1 in the short-run, while the long-run elasticity is −0.14	Firm level data
Wilson (2009)	USA	Manufacturing	−1.2 in the short-run, while the long-run elasticity is −2.5	Aggregated
McKenzie and Sershun (2010)	Australia, Canada, Italy, Spain, U.S., U.K., Germany, France, Japan	Manufacturing	−0.12 to −0.22 in the short-run, while the long-run elasticity ranges from −0.46 to −0.83	Aggregated
Lokshin and Mohnen (2012)	Netherlands	Manufacturing and Services	−0.25 in the short-run, while the long-run elasticity is −0.45	Firm level data
Harris et al. (2009)	North Ireland	Manufacturing	−1.4	Firm level data
Chudnovsky et al. (2006)	Argentina	Manufacturing	They not estimate elasticity. It is a ATT measurement.	Firm level data
Porta and Lugones (2011)	Argentina	Applied Scientific Research and Manufacturing	They not estimate elasticity. It is a ATT effect measurement.	Aggregated

Literature Review

- R&D tax incentives are currently very popular innovation policy instruments in developed countries, where approximately 2/3 of the countries have some sort of scheme in place.
- They are less popular in Latin America, although an increasing number of countries are starting to experiment with this sort of instrument.

Tax incentives for R&D+i in Argentina

The FONTAR (23.877) manages the resources coming from the external credits destined to the innovation and technological linkage of the national productive sector. The Fiscal Credit (CF) program is aimed at

natural or legal persons holding companies of any size producing goods and services. ANPCyT annually calls for proposals within four categories:

- scientific research;
- applied research in production and/or marketing;
- precompetitive technological research aimed at the production of new materials, products or devices, and the establishment of new processes, systems or services; y
- adaptations and improvements.

Companies can submit more than one proposal as long as the total requested amount does not exceed the established maximum.

Tax incentives for R&D+i in Argentina

- Potential beneficiaries compete to obtain a fraction of the amount allocated in the region where they are presented.
- Applications are ordered by jurisdiction. In each jurisdiction, the order is set inversely to the proportion of the tax credit requested in relation to the total budget allocable annually.
- The benefit of the tax credit, in that order, is allocated up to cover all applications or even use all available funds in the jurisdiction.
- The beneficiary companies receive tax credit certificates that are non-transferable. In addition, the maximum proportion of a project that can be financed with the CF, cannot be more than 50 % of the total budget of the project.
- The tax credit is applicable exclusively to the payment of the Income Tax and has a scale with limits that vary according to the annual (the fiscal year) amount of tax.
- The use of the tax credit has a maximum term that cannot exceed 3 years, and must be used in equal parts.

Tax incentives for R&D+i in Argentina

Annual income tax		Maximum deductible per year		
More than $	Up to $	$	%	Over $
0	200,000	———	100	0
200,000	500,000	200,000	80	200,000
500,000	1,000,000	440,000	60	500,000
1,000,000	5,000,000	740,000	40	1,000,000
5,000,000	10,000,000	2,340,000	20	5,000,000
10,000,000	En adelante	3,340,000	10	10,000,000

Tax incentives for R&D+i in Argentina

	2013
Amount of Investment Submitted	155.798.776,11
Approved Investment Amount	146.128.667,51
Amount of Fiscal Credit Awarded	73.064.333,76
Cut Rate	not
Number of Projects Submitted	141
Number of Awarded Projects	87
Project Type	
I+D	40 %
Technological Modernization	60 %
Technological Counseling	0 %

Conceptual Framework and Empirical Strategy

- The ideal situation in estimating the impact of an intervention policy is a random experiment.
- Second best:
  - Structural econometric model.
  - Quasi-experimental estimation.

Conceptual Framework and Empirical Strategy

- We evaluate the impact of R&D+i tax credits schemes by means of structural econometric modelling techniques.
- This approach uses models of R&D+i investment behavior and assumes that R&D+i spending is a function of the cost to the firm of the capital used.

Conceptual Framework and Empirical Strategy

- Assuming a CES production function

$$Y_{it} = \gamma \left[\beta R_{it}^{-\rho} + (1-\beta) X_{it}^{-\rho} \right]^{v/\rho}$$

- The maximization profit implies (marginal allocation)

$$P_{it} = v \beta Y_{it}^{1+\rho/v} \gamma^{-\rho/v} R_{it}^{-(\rho+1)}$$

Conceptual Framework and Empirical Strategy

- Solving this equation for the long-term knowledge capital and taking logs

$$r_{it}^{*} = \alpha + [\sigma + (1-\sigma)/v]\, y_{it} - \sigma p_{it}$$

- the knowledge capital follows a partial adjustment mechanism

$$r_{it} - r_{it-1} = \lambda(r_{it}^{*} - r_{it-1})$$

Conceptual Framework and Empirical Strategy

- Taking into consideration previous equations

$$r_{it} = \lambda \left[\alpha + \left(\sigma + \frac{1-\sigma}{v} \right) y_{it} - \sigma p_{it} \right] + (1-\lambda) r_{it-1}$$

- The final econometric model has the following estimating form:

$$r_{it} = \pi_1 y_{it} + \pi_2 p_{it} + \pi_3 z_{it} + \phi r_{it-1} + \pi_i + c_t + e_{it}$$

- Long-run elasticity

$$E_{lp} = \frac{\pi_2}{1-\phi}$$

Conceptual Framework and Empirical Strategy

- In other to implement the model empirically, we need an observable measure of the user cost of capital (P_{it})
- Following (King and Fullerton 1984), the user cost of capital pit in its basic form is

$$P_{it} = (\eta_t + \delta_{it} - \theta_t)\frac{1 - \mu_{it}\kappa_{it} - \xi_{it}\tau_{it}}{1 - \mu_{it}}$$

Conceptual Framework and Empirical Strategy

- A problem that arises with the empirical implementation is that the user cost of capital is an endogenous variable.
- A natural instrumental variable is the tax component of the user cost. In fact, this tax component isolates the differences among companies due to variations in the fiscal credit actually used (Bloom, Griffith and Van Reenen 2002).

Estimation strategy

- The model is a dynamic panel: **POLS and FE are inconsistent estimator**.
- Hence, we use System GMM estimator.
- Still, we estimate the model using POLS and FE. Angrist and Pischke (2009)

Data

- The empirical implementation makes use of two waves of Argentina's Innovation Surveys, known as ENIT (Encuesta Nacional sobre Innovación y Conducta Tecnológica), from 1998 to 2004.
- Both surveys were conducted by the National Institute of Statistics and Censuses of Argentina (INDEC).

Data

Table 2
Structure of the Panel

				ENIT01				ENIT04		
Period	**Frequency**	**Relative frequency**	**Cumulative frequency**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
2002-2004	324	21.5%	21.5%					X	X	X
1998-2001	302	20.0%	41.5%	X	X	X	X			
1998-2004	266	17.6%	59.2%	X	X	X	X	X	X	X
2003-2004	69	4.6%	63.7%						X	X
1998-2001 and 2004	32	2.1%	65.8%	X	X	X	X			X
1999-2001	34	2.3%	68.1%		X	X	X			
Other patterns	481	31.90%	100%							
Total	**1508**	**100%**								

Source: ENIT 01 and ENIT 04.

Data

Table 3
Number of Companies by Size of the Firm and Technological Intensity of the Sector

Year	Fewer than 50 employees (Small)	More than 50 employees (Large)	Low Technology	High Technology
1998	196	609	517	288
1999	191	601	506	286
2000	204	613	525	292
2001	208	671	577	302
2002	153	564	437	280
2003	202	632	521	313
2004	252	701	599	354

Source: ENIT 01 and ENIT 04.
Note: the definition of high technology is according to the classification of the OECD, categories based on R&D intensities, ISIC REV. 3. While this classification is split into four categories, we use just two.

Data

Table 4
Average Effort in R&D by Size of Firm

Manufacturing Firms that Declared Expenditure in R&D

Year	Fewer than or equal to 50 employees	More than 50 employees
1998	4.37	9.31
1999	3.87	8.34
2000	4.23	8.42
2001	3.13	6.21
2002	1.86	4.95
2003	2.97	7.06
2004	2.86	5.46
Total	**3.34**	**7.08**

Note: Effort **in** R&D is calculated as the proportion of the expenditure in R&D in relation to total sales.
Source: ENIT 01 and ENIT 04.

Data

Table 5
Percentage of total R&D+i expenditures per type of innovation investment

Year	R&D	Capital Goods	Hardware	Software	Technology Transfer	Engineering and Design	Training	Consultancy
1998	7.49	70.35	4.07	2.88	6.80	3.42	3.54	1.45
1999	8.41	71.10	3.10	3.82	4.64	4.27	3.23	1.43
2000	8.84	68.36	3.35	4.43	6.10	3.45	3.62	1.85
2001	12.79	61.93	3.88	3.61	6.44	4.79	4.32	2.24
2002	16.38	59.66	5.36	3.31	6.34	1.06	6.06	1.83
2003	16.33	60.82	5.18	3.16	4.80	1.25	6.15	2.31
2004	16.87	57.39	5.10	4.13	5.58	1.31	7.33	2.30
Total	**11.2**	**65.99**	**4.00**	**3.66**	**5.73**	**3.18**	**4.43**	**1.82**

Source: ENIT 01 and *ENIT* 04.

Results

Table 7
Estimation of Equation (3) for Expenditure in R&D+i

	(1)	(2)	(3)
Log expenditure in R&D+i	**OLS**	**FE**	**System**
Log expenditure in R&D+i at t-1	0.581***	0.095***	0.246***
	(0.01)	(0.02)	(0.12)
Log *p*	-0.952***	-1.302***	-1.494***
	(0.05)	(0.12)	(0.16)
Log sales	0.358***	0.468***	0.638***
	(0.02)	(0.09)	(0.13)
Constant	-1.546***	1.666	-2.842
	(0.19)	(1.43)	(2.50)
Dummy year	Yes	Yes	Yes
Dummy industry	Yes	No	No
Fixed effect firm	No	Yes	Yes
Observations	4,017	4,017	4,017
Number of firms	1,273	1,273	1,273

Results

Table 8
Estimation of Equation (3) for Expenditures on Capital Goods and on Only R&D

Log expenditure	(1) K OLS	(2) K FE	(3) K System	(4) R&D OLS	(5) R&D FE	(6) R&D System GMM
Log expend. of BsK at t-1	0.475***	0.018	0.353***			
	(0.02)	(0.03)	(0.09)			
Log expend. of only R&D at t-1				0.807***	0.262***	0.638***
				(0.02)	(0.04)	(0.07)
Log *p*	-2.233***	-3.245***	-1.508*	-0.307***	-0.407**	-0.313***
	(0.11)	(0.22)	(0.81)	(0.08)	(0.17)	(0.10)
Log sales	0.460***	0.345**	0.662***	0.145***	0.245***	0.250***
	(0.02)	(0.17)	(0.09)	(0.02)	(0.09)	(0.05)
Constant	-2.845***	2.21	-5.693***	-0.774***	3.634**	-0.348
	(0.31)	(2.91)	(1.16)	(0.24)	(1.59)	(0.25)
Dummy year	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect firm	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,113	2,113	2,113	2,017	2,017	2,017
Number of firms	810	810	810	711	711	711

Results

Table 9
Estimation of Equation (3) for Expenditure in R&D+i according to the Technological Intensity of the Sector

	(1)	(2)	(3)	(1)	(2)	(3)
	Low technology			High technology		
Log expenditure in R&D+i	**OLS**	**FE**	**System GMM**	**OLS**	**FE**	**System GMM**
Log expenditure in R&D+i at t-1	0.551***	0.065**	0.183***	0.628***	0.165***	0.273*
	(0.015)	(0.029)	(0.066)	(0.017)	(0.036)	(0.164)
Log *p*	-1.184***	-1.570***	-1.661***	-0.592***	-0.804***	-0.905***
	(0.072)	(0.159)	(0.142)	(0.080)	(0.181)	(0.147)
Log Sales	0.379***	0.651***	0.680***	0.336***	0.343***	0.659***
	(0.019)	(0.135)	(0.058)	(0.022)	(0.072)	(0.145)
Constant	-1.627***	(1.393)	-3.049***	-2.531***	3.583***	-2.895***
	(0.255)	(2.180)	(0.495)	(0.283)	(1.228)	(0.642)
Dummy year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy industry	Yes	No	No	Yes	No	No
Fixed effect firm [7]	No	Yes	Yes	No	Yes	Yes
Observations	2 510	2 510	2 510	1 504	1 504	1 504
Number of firms	812	812	812	466	466	466

Results

Table 10
Estimation of Parameters in Equation (3) by Size of the Firms

	(1)	(2)	(3)	(1)	(2)	(3)
		Small firms			Large firms	
Log expenditure in R&D+i	**OLS**	**FE**	**System GMM**	**OLS**	**FE**	**System GMM**
Log expenditure in R&D+i at t-1	0.593***	0.061	0.398***	0.575***	0.085***	0.191**
	(0.024)	(0.054)	(0.143)	(0.013)	(0.027)	(0.084)
Log *p*	-0.735***	-1.146***	-1.188***	-1.055***	-1.476***	-1.651***
	(0.107)	(0.240)	(0.327)	(0.063)	(0.140)	(0.170)
Log Sales	0.246***	0.361*	0.278***	0.361***	0.387***	0.649***
	(0.034)	(0.184)	(0.101)	(0.018)	(0.092)	(0.077)
Constant	(0.061)	(2.113)	(1.359)	-2.772***	3.197**	-2.543***
	(0.476)	(2.425)	(1.203)	(0.273)	(1.567)	(0.593)
Dummy year	Yes	Yes	Yes	Yes	Yes	Yes
Dummy industry	Yes	No	No	Yes	No	No
Fixed effect firm	No	Yes	Yes	No	Yes	Yes
Observations	862	862	283	3 115	3 115	2 083
Number of firms	152	151	151	890	890	890

Conclusions

- Using two waves of Innovation Surveys, we find that the Argentinean tax credit scheme has reduced the user cost of capital for R&D+i from 0.61 in 1997 to 0.54 in 2004.
- This reduction in the "price" of innovation has had a significant effect on company decisions to invest in it, the tax credit policy seems to have had a significant effect in promoting private sector investments in R&D+i.

Conclusions

- However, we also found that the policy operates differently according to the type of R&D+i investment.
- We also found that the effectiveness of the tax credit is higher in the case of low technology sectors, which is expected to the extent that capital goods make up a larger share of total innovation investment in these sectors.

Conclusions

- With regards to the size of the firm, we found that although in the long-run the effect of the tax incentive is similar across large and small firms, large firms respond quicker to the incentive suggesting that small firms face either liquidity constraints and adjustment costs that are more binding than in the case of large firms.

Muchas gracias por su atención!!!
Preguntas???