The private contractual funding of academic laboratories : A panel data analysis

Rachid Boumahdi[γ], **Nicolas Carayol**[φ*] **and Patrick Llerena**[φ]

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[γ] GREMAQ and LIRHE, Université des Sciences Sociales de Toulouse
Place Anatole France, F-31042 Toulouse

[φ] BETA, Université Louis Pasteur,
61 avenue de la Forêt Noire, F-67085 Strasbourg

Abstract : The paper presents new evidence explaining contractual private funding of academic laboratories. We find that public funding crowds out private one. While private funding increases with publications it decreases with publications corrected for impact.

Keywords : Contractual Funding ; Academic Laboratories ; Panel Data ; Crowding Out ; Matching

JEL classification : C33 ; L30 ; H4 ; O31

* Corresponding author. Tel. : +33(0)390242104 ; fax : +33(0)390242071.
E-mail address : carayol@cournot.u-strasbg.fr.

1 Introduction

The last two decades have been a very disruptive context for academic research funding : Shortening of public funding, evolving rationales and changing regulatory environments. One of the crucial issues relates to the rising share of public research being funded through contractual relations with private firms. Scholars mainly concentrate their attention on the consequences of private contractual funding on research production : Expected benefits are an increase of academic research due to extra funding and a shift in its economic relevance. Risks reside in a slowing down in the dissemination of findings, a shift toward applied research and a decrease of research productivity[1].

The present paper focuses on the reverse causality : What stimulates the attractivity of academic research for private funding ? What is meant here by contractual funding is all the funds received on a contractual basis, including grants. Typically, all funds received from private sources are included while recurrent public funding is excluded.

The main originality of our study is that it is micro-based, i.e. conduced at the academic research laboratory level while the literature on academic funding focuses on the university level of investigation. The laboratory is emphasized as the relevant level of analysis of scientific activity (Crow and Bozeman, 1987) especially in the Continental European style of academic research organization and as long as funding issues are concerned (Stephan, 1996 ; Arora et al. 1998).

Our data allows us to examine three series of influences.

i) Publication signaling : Funds managers are subject to high uncertainty and asymmetries of information on academics. In such a situation (adverse selection), they may use publications to better evaluate laboratories competencies in specific domains, the quality of their scientific production or even their ability to collaborate with industrial partners.

ii) Crowding : An important literature in public economics aims to evi-

[1] See Dasgupta and David (1994), Cohen et al. (1998), Blumenthal et al. (1996).

dence the effects of public funding on other sources for non profit institutions. While theoretical models differ in their predictions, Connolly (1997) shows that external funding and internal support of US universities research crowd in mutually and Payne (2001) finds that federal research funding of US universities crowds in simultaneous private donations.

iii) Matching : The characteristics of laboratories also may have a great influence on private funds managers and on laboratories' own willingness to provide the specific efforts associated with getting such funds.

The next section presents the data and the methodology. Section 3 presents the results while the last section concludes.

2 Data and methodology

Our data cover the period 1993-2000 and concern the research activity of 76 laboratories which belong to one single university, namely Louis Pasteur University (ULP) of Strasbourg. This university is quite large, diversified, has an old tradition of fundamental research and a long standing of scientific excellence[2]. The Third European Report on Science and Technology Indicators (2003) ranks it first among French universities in terms of impact and 11th among European universities.

For each laboratory, we have eight annual observations on the following time-variant variables : Private contractual funding ($PRIVF_{(it)}$), Public contractual funding ($PUBF_{(it)}$), Publication performance ($PPER_{(it)}$), Publication performance corrected for impact ($PIMP_{(it)}$)[3] and two dummy variables indicating whether at least one paper is coauthored with a researcher employed by a private firm ($INDUS_{(it)}$) or by a foreign institution

[2]ULP researchers have received numerous scientific prizes (six Nobel prices and one Field Medal). Active researchers count one Nobel laureate, eleven members of the Institut Universitaire de France and eleven members of the French National Academy of Science.

[3]We collected more than 26,000 occurrences of published articles of all permanent researchers (using SCI and SSCI databases of ISI). $PUBF_{(it)}$ sums and corrects for coauthorship. $PPIMP_{(it)}$ in addition weights each item by the impact factor (given in ISI-JCI).

($INTER_{(it)}$). Time-invariant variables relate to the personnel employed in the laboratories[4] : Number of full professors or researchers ($SENIOR_{(i)}$), assistant professors or researchers ($JUNIOR_{(i)}$), PhD students ($PHD_{(i)}$), non researchers (administrative personnel, technicians and engineers) ($NONRES_{(i)}$), number of national ($NPOST_{(i)}$) and foreign post-docs ($FPOST_{(i)}$).

The Model that we consider is :

$$Y_{it} = X_{1it}\beta_1^{'} + X_{2it}\beta_2^{'} + Z_{1i}\gamma_1^{'} + Z_{2i}\gamma_2^{'} + \alpha_i + \varepsilon_{it} \tag{1}$$

where $i = 1, 2, \ldots, 76$; and $t = 1, 2, \ldots 8$. Combining all 608 observations, we can write (1) as follows :

$$Y = X\beta + Z\gamma + \alpha + \varepsilon \tag{2}$$

where $X = (X_1 : X_2)$ and $Z = (Z_1 : Z_2)$. We assume that ε_{it} are $iid\ N(0, \sigma_\varepsilon^2)$ uncorrelated with both the explanatory variables X_{it} and Z_i. Following Hausman and Taylor (1981) - hereafter HT -, Amemiya and MacCurdy (1986) - hereafter AM - we assume that the individual effects α_i are $iid\ N(0, \sigma_\alpha^2)$ correlated with X_2 and Z_2, uncorrelated with X_1 and Z_1. For estimating the equation (2), we use the Instrumental Variable (IV) method described in HT and AM.

3 Results

In Table 1 (columns 1 and 2) we consider, first, the conventional procedures Within and GLS estimates. The Within estimates are unbiased whether or not the effects α_i are correlated with the explanatory variables[5]. However the GLS estimates are biased if the individual effects are correlated with some explanatory variables. The assumption that α_i are uncorrelated with (X, Z)

[4] These variables come from standardized administrative reports completed by all laboratories in 1996 which are both a *précis* of the past four years and a project for the next four years.

[5] All time-invariant variables are eliminated by the data transformation.

is rejected in a Hausman test of the difference between the GLS and Within estimates. The Hausman test is $\chi^2_5 = 21.55$ which is significant at 5 per cent level. The HT and AM estimates are presented in columns 3 and 4. In this regression we let X_1 =(*PUBF, INDUS, INTER*), X_2 =(*PPER, PIMP*), Z_1 =(*PhD, JUNIOR, SENIOR, NONRES*) and Z_2 =(*NPOST, FPOST*). The set of instruments proposed by HT is legitimate and supported by a Hausman test of the difference between the Within estimator and the HT estimator. This test is $\chi^2_5 = 0,32$ and is insignificant at five per cent level. Similarly, the additional exogeneity restrictions allowed by AM are not rejected[6]. The Hausman test which compares AM and HT is $\chi^2_{12} = 2,22$.

Our first result shows that present public contractual funding coefficient is negative and significant. This supports the crowding out hypothesis. Neither the dummy for international collaborations, nor the one for industrial collaborations are significant. It may indicate that such signals are either not used by private funds managers or ambiguous. The level of publication performance has a positive and significant effect (as in Payne, 2003). The laboratories that publish more are more attractive in the eyes of private funds managers.

The coefficient of publication performance corrected for impact is negative. This result may seem counter-intuitive at first glance since the impact factor of scientific journals may signal the quality of research. Nevertheless, other phenomena seem to be predominant here. Let us suggest two of them. First research appearing in the most prominent journals is likely to be more fundamental while private contractual funding may seek research closer to applications. Secondly contracts with private partners often generate dedicated and specific efforts from faculty members (*ex ante* for attracting funds and *ex post* for meeting the requirements). Laboratory managers may consider the opportunity costs of contracts which are not independent of laboratory characteristics. The alternate use of their time and efforts in the academic

[6] As the set of instruments proposed by AM is legitimate, we concentrate our attention on AM estimates.

sphere is better valued by the ones who are publishing in the best ranked journals (Carayol, 2003 finds similar results).

We now turn toward the effects of labor force composition. Post-docs effects are positive and significant (the coefficient for the domestic ones is three times higher). This indicates that they strongly contribute to the research efforts implied by contracts signed with private partners. The coefficient for PhD students is also positive but significance is much lower : They are less intensively involved in contractual research being also strongly driven by doctorate accomplishments. The effect of non researchers is also positive : Sufficiently large administrative and engineering staff are important for attracting interest and/or for meeting requirements (organization, delays, instrumentation, etc.). Associate professors and researchers are negatively correlated with private funding : Not yet promoted researchers tend to concentrate on pure academic work because of career concerns.

4 Conclusion

The paper proposes an analysis of the yearly arrival of private contractual funding of academic laboratories. We find that contractual public funding crowds out simultaneous private funding. Private funds are attracted by the most active laboratories within the academic sphere while best ranked publishing laboratories attract less. Post-docs increase private support substantially because of "who is doing the job" issues.

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Table 1. The dependent variable is $PRIVF_{(it)}$ (Private contractual funding)

	Within	GLS	HT	AM
Constant	–	34.61	93.50	-3.44
		(230.76)	(272.72)	(234.97)
$PUBF_{(it)}$	-0.09*	-0.089*	-0.093*	-0.0870*
	(0.04)	(0.038)	(0.039)	(0.038)
$INDUS_{(it)}$	172.15	204.66	153.34	178.65
	(140.95)	(131.48)	(136.44)	(132.76)
$INTER_{(it)}$	-97.55	-116.43*	-138.88	-160.42
	(256.53)	(20.67)	(244.94)	(221.74)
$PPER_{(it)}$	66.66*	31.52*	63.11*	64.66*
	(22.06)	(15.70)	(21.07)	(18.59)
$PIMP_{(it)}$	-22.74*	-11.65*	-22.33*	-21.63*
	(4.24)	(3.38)	(4.16)	(4.01)
$PHD_{(i)}$	–	22.50**	21.73	21.34**
		(12.28)	(31.62)	(12.97)
$JUNIOR_{(i)}$	–	-29.62	-45.43	-40.23**
		(22.10)	(41.86)	(23.07)
$SENIOR_{(i)}$	–	-15.32	-27.62	-27.57
		(24.71)	(33.83)	(25.45)
$NONRES_{(i)}$	–	8.836	8.09	11.50**
		(5.78)	(12.73)	(6.10)
$NPOST_{(i)}$	–	173.93*	103.65	204.01*
		(39.10)	(227.33)	(63.28)
$FPOST_{(i)}$	–	44.940*	94.18*	60.22*
		(11.65)	(35.44)	(16.62)

Standard errors are in parentheses. The * and ** indicate that coefficients are statistically significant at the 0.05 and 0.10 levels respectively.