# The market for knowledge brokers

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**Abstract**

A widely-used policy to diminish the market failure on the market for innovations is the provision of R&D subsidies. However, the absence of competition at several stages of the procurement process could lead to inefficient use of these subsidies. To introduce more competition, a market for knowledge brokers could be created. The role of these knowledge brokers would be at four stages of the procurement process: (i) placing the call for tender; (ii) obtaining research proposals; (iii) monitoring the research efforts; and (iv) disseminating the research results. It can be expected that creation of such a market yields a better match between demand and supply on the market for R&D, yields a higher quality research product for a given price and that it increases the dissemination of research results.

**Key words**: R&D subsidies, efficiency, knowledge brokers.

**JEL Classification**: H21, H23, L52.

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# 1 Introduction

It is widely held that the market for innovations fails in the sense that from society's point of view investments in Research & Development (R&D) are too low. The main reason for this underinvestment is the existence of technological spillovers: the involuntary leakage of technological know-how to an innovator's competitors for which the innovator is not compensated. From society's point of view this leakage of knowledge is beneficial since it enhances the productivity of other firms in the industry. The benefits for the firm investing in R&D are lower however, since the innovator only considers the effect its R&D investment has on its own profits.[1]

One way authorities can diminish this market failure is to provide (in)direct R&D subsidies (see e.g. Romano [1989], Hinloopen [1997, 2000a, 2000b, 2001], and Martin and Scott [2000]).[2] This policy can be expected to enhance firms' incentive to invest in R&D (see e.g. Spence [1984]) such that the level of private R&D investments approaches the socially optimal level. In theory an optimal R&D subsidy induces firms to invest in R&D that level which maximizes total surplus (see Leahy and Neary [1997] and Hinloopen [1997, 2000a, 2000b, 2001]).

Authorities, and in particular the European Commission, generously support private R&D activities. These subsidies are provided under its Framework Programs, the latest of which (number five) started in January 1999. Some 83.7% of the R&D subsidies are meant for research that falls under one of four global themes (excluding the contributions to Euratom (1.3 billion euro) and the Joint Research Center (0.7 billion euro)): (i) quality of life and the management of living resources (18.6%); (ii) user-friendly information society (27.8%); (iii) competitive and sustainable growth (20.9%); and (iv) preserving the ecosystem (16.4%). The remaining 2,118 billion euro are for three horizontal programs: (i) international cooperation (3.6%); (ii) innovation and small and medium seized enterprises (2.8%); and (iii) improving human research (9.9%). In the period 1999 through 2002 the European Commission will spend in total some 15 billion euro on R&D subsidies.

There are several ways as to how in practise an R&D subsidy scheme can be set up. Among the distinguishing features are whether or not the arrangement is closed-ended and if it involves a generic subsidy. If the arrangement

[1] There are other reasons as well why society's reward to successful innovation exceeds private returns, including an innovator's disability to appropriate fully the economic rents of a successful innovation. For a more elaborate discussion of this market failure see e.g. Hinloopen [1997].

[2] Other policies include sustaining R&D cooperatives and granting exclusive property rights through patents.

is closed-ended and the R&D subsidy is *not* generic, the authorities have to make choices regarding the projects that receive funding. In case of a closed-ended generic R&D subsidy scheme the funds available are equally divided over all qualified projects. Note that most of the funding provided under the Framework Programs entail non-generic closed-ended subsidy schemes.

Unfortunately, empirical studies as to the effectiveness of R&D subsidies show that their intended stimulation of private R&D activity is only mild at best (see e.g. Guellec and Van Pottelsberghe de la Potterie [1997], Busom [2000], or Wallsten [2000]).[3] What could be the reason for this policy failure? A traditional explanation is that government support crowds out private R&D funding: firms use government funding to finance R&D projects they would have carried out anyway. Indeed, Busom [2000] reports that in 30% of the cases in her sample of 154 Spanish firms full crowding out cannot be ruled out. And also Wallsten [2000], using a sample of 367 firms that received funding under the US Small Business Innovation Research (SBIR) program "cannot reject the hypothesis that each dollar in SBIR grants is associated with approximately a $ 1.00 decrease in firm-financed R&D spending" (Wallsten [2000, p. 97]). On the other hand, reviewing the relevant econometrics literature of the last 35 years, David *et al.* [2000] conclude that public spending on R&D in some cases is complementary to private R&D while in other cases it substitutes for private R&D. In any case, 'crowding out' seems to be part of the explanation for the meager success of R&D subsidies.

Another explanation for the low effectiveness of R&D subsidies is implicitly suggested by Goolsbee [1998]. He finds that a substantial part of public support for private R&D is used for wage increases of R&D personnel. In particular, if in his sample R&D spending goes up by 10 percent, wages of R&D personnel increase with 3 percent. Recently, the same issue is addressed for the Dutch situation (see Marey and Borghans [1999]). Also this study shows that wages of R&D workers go up if an R&D subsidy is provided, be it to a lesser extent. If public support for private R&D increases with 10 percent, wages of R&D personnel rise on average by 2.3 percent.[4] The main reason for this adverse effect is that the supply of R&D workers is inelastic. It implies that for assessing the effectiveness of R&D subsidy schemes it should be noted that R&D has become more expensive due to the subsidy. Reported increases in R&D spending as a result of subsidy programs thus tend to overstate the increase in actual R&D activity.[5]

[3] Note however that assessing empirically the full economic impact of R&D subsidies is very difficult (see Klette *et al.* [2000]).

[4] This difference between the Dutch and American situation is attributable to differences in labour market characteristics.

[5] The results of Goolsbee [1998] and Marey and Borghans [1999] imply also the possible

In this paper I focus on yet another possible explanation for the low effectiveness of R&D subsidies. Observe that it is common practise that the institution or public body providing the R&D subsidy also monitors the R&D process and disseminates the R&D results. However, not only is it very difficult for such a body to assess whether the public funds are used efficiently by the research institutes,[6] but there is also no penalty if the R&D-subsidy-allocating body does not monitor the research adequately and/or does not disseminate the R&D results sufficiently. The state will not go bankrupt and the R&D subsidy will always be provided by the monopolist: the R&D-subsidy allocating board. Indeed, the absence of competition at several stages of the procurement process could lead to inefficient use of R&D subsidies.[7]

If this absence of competition is part of the explanation as to why R&D subsidies are only modestly effective in raising private R&D activities, the question then is if this could be resolved. To that end I discuss in this paper a particular proposal: the creation of a market for knowledge brokers. The basic idea is that there are several brokers which are all in competition with each other to participate in the procurement process. Participation in this process would be at four stages: (i) placing the call for tender; (ii) obtaining research proposals; (iii) monitoring the research efforts; and (iv) disseminating the research results. Competition among the knowledge brokers takes place along several lines, including the price/quality ratio of the research efforts and the effectiveness with which the R&D results are disseminated. Indeed, due to the competitive process efficiency gains could be achieved along these lines, possibly leading to more efficient use of R&D subsidies. Note that in the analysis that follows I focus on non-generic subsidy schemes with a finite budget (such as the funding under the European Commission's Framework Programs).

I continue the discussion as follows. In the next section I describe in more detail how R&D subsidies are allocated under a non-generic closed-ended subsidy scheme. In Section 3 I highlight the potential role of knowledge brokers

existence of an adverse effect of R&D subsidies. Firms that do not receive the R&D subsidy are forced to pay higher wages for their R&D personnel. However, not every firm will be able to do so, leading to an exodus of R&D workers for these firms. Especially if this induced labour mobility occurs between firms belonging to neighboring industry types, this can lead to serious market distortions. Indeed, given that the authorities are less well informed about market opportunities, targeted public support for private R&D activities could direct R&D personnel to commercially less promising research areas.

[6] 'Research institutes' refers to all parties that (can) receive an R&D subsidy, including firms, technological institutes and universities.

[7] These are important issues indeed; for instance, dissemination of R&D results appears to be a crucial factor for the extent to which innovative activities induce economic growth (see e.g. Eaton and Kortum [1999]).

in this process. The possible efficiency gains associated with introducing a market for knowledge brokers as well as the costs of introducing such a market are discussed in Section 4. Section 5 concludes.

# 2 Allocation

As mentioned above, in case of non generic, closed-ended R&D subsidy programs, the subsidy-providing authority has to pick projects that receive funding. The procedure begins with identifying the general areas of research for which public funds are made available. Appropriate actors in the market (such as research institutes and universities) can then submit research proposals for which they seek funding. Among other things these proposals should indicate what is the explicit goal of the research project, which organization(s) is (are) to conduct the research, what are the projected cost, and how long the project will take. On the basis of several criteria, set-up by the subsidy-providing authorities, it is decided which proposals receive an R&D subsidy (and, consequently, which not). This selection decision can be made either by the authorities alone, or in cooperation with (independent) specialists. The criteria on the basis of which projects are chosen could include general relevance, minimum quality standards, the ratio of price over (expected) quality,[8] and the potential for broad (industrial) application. During the period of research the authorities (should) monitor the R&D activities of those research institutes that have received public support. And if necessary, the authorities can influence the direction of the research during the research period (this could be due for instance to unexpected research results). Also, in case a research project evolves unsatisfactory the authorities can reclaim (part) of the R&D subsidy. After the research projects have been completed the authorities evaluate the results, again possibly in conjunction with appropriate experts, and disseminate the research results. Ideally the authorities also maintain the public memory. That is, the overall performance of the research institute that carried out the research should be recorded. The track record of every research institute should then be accommodated in the selection process regarding the allocation of R&D subsidies.

This mechanism as to allocating R&D subsidies can be split in ten separate steps (see Box 1). The accompanying institutional context is illustrated

[8] Note that measuring objectively the quality of research is very difficult. Any notion of a price/quality ratio is therefore likely to be arbitrary. Yet, the R&D-subsidy allocating authorities do need selection criteria. In this respect a possible solution would be a benchmark study, in which the ratio of price to projected quality is compared with the same ratio for completed, comparable projects.

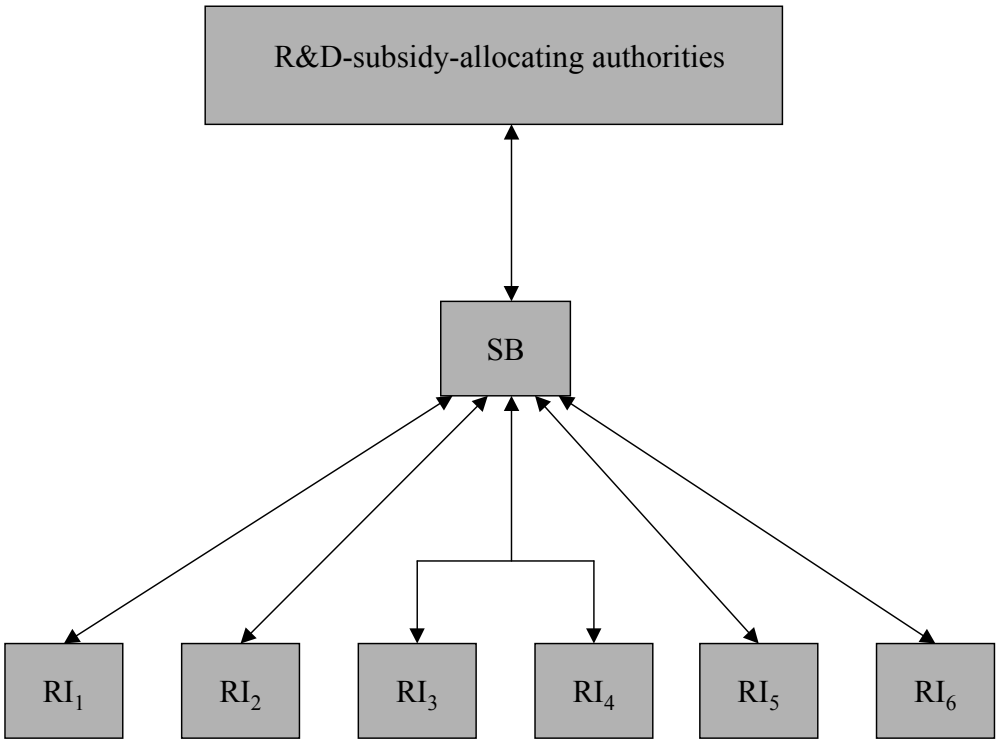


Figure 1: The institutional set-up for the provision of public support for (possibly) private R&D; SB = R&D subsidy board; RI = research institute.

1. Identifying research areas for which public support is to be made available.
2. Formulating a call for tender, possibly in conjunction with outside experts.
3. Placing a call for tender.
4. Obtaining research proposals from the players in the research market.
5. Assessing the research proposals, possibly in conjunction with outside experts.
6. Providing R&D subsidies to the qualified research proposals.
7. Monitoring the research process; altering the direction if needed.
8. Evaluating the research results, possibly in conjunction with outside experts.
9. Disseminating the research results.
10. Evaluating the research institution that received public support.

Box 1: The allocation of R&D subsidies under a closed-budget non-generic subsidy scheme.

in Figure 1. The whole process is depicted as being coordinated by an R&D subsidy board, SB, consisting of officials (e.g. employees of the European Commission), of representatives of the (appropriate) industry, of spokesmen of the research community (universities and research institutes, labelled $RI_i$ in Figure 1), and possibly of representatives of non-profit, non-governmental organizations. It is to this board research institutes submit their research proposals. Whenever considered beneficial, actors from the research community can form research cooperatives (like $RI_3$ and $RI_4$ in Figure 1).

As mentioned above, an explanation for the modest success of R&D subsidies could be that the whole process of public support for R&D exhibits several inefficiencies. In particular, the research carried out with public support could not meet private demand as much as desired, it could be too expensive due to a limited exposure to cost-reducing market discipline, and/or the dissemination of research results could not be optimal. In the remainder of this paper I present a proposal as to how these possible inefficiencies could be diminished: the creation of a market for knowledge brokers.[9]

[9] Romer [1993] provides a related suggestion to increase the efficiency of research. In particular, he proposes industries to set up 'industry investment boards'. These boards 'tax' the concomitant industry and re-direct the revenues to research institutes to support targeted research. The results of these research efforts are then disseminated among all firms who were initially taxed.

# 3 Knowledge brokers

Designing a framework for supporting R&D with public funds which has competitive features boils down to considering at which stages of the procurement process competition is possible and desired.

The identification of research areas for which public funds are available and the concomitant formulation of (general) research questions are both steps of the process that fundamentally belong within the decision sphere of the public authorities.[10] If private agents would enter this phase of the process, they could use their build-up know-how of the research community strategically to influence the character of the tender to their advantage. In fact, some form of competition is already at work here; the influence of pressure groups in combination with the dynamics of western-style democracies should yield public support for the type of R&D that is in the broad public interest.

Placing the call for tender could be done by the authorities or some private party.[11] The latter option could be desirable if it yields a wider audience. Also, the administrative burden of this phase in the procurement process could be lower if it is carried out by a private party operating in a competitive environment. On the other hand, in this case the authorities incur additional monitoring cost. I conjecture however that these monitoring cost are likely to be lower than the gains of a reduced administrative burden and a potentially wider reach of the call for tender.

Competition can be introduced at the stage when research proposals are gathered from players in the research market. I refer to the organizations that gather these proposals as 'knowledge brokers'. Indeed, since there are several of these knowledge brokers, all competing for the opportunity to participate in the procurement process (as they are compensated for this participation, for instance in the form of a percentage or fixed amount of the total R&D subsidy), it is in the interest of each broker to have good contacts, both with the research community and the public authorities. The knowledge broker could see to it that research proposals better fit the research questions, and that these proposals better meet the criteria set by the authorities regarding the profile of the research. It is even conceivable that knowledge brokers actively participate in putting together (i.e. writing) the proposal.[12] Also, the knowledge brokers can accentuate the specific comparative advantage of

[10] Also, the decision as to the *type* of R&D subsidy scheme is with the authorities.

[11] Note that this step has nothing to do with the decision as to the type of research that is to be subsidized, that is, the *content* of the tender. That decision is made in the first step and remains with the public authorities.

[12] As suggested by an anonymous referee.

research institutes. That is, introduction of competition at this stage of the procurement process could yield a better match between public demand and (possibly private) supply.

The assessment of research proposals, submitted by the knowledge brokers on behalf of research institutes, and the concomitant choice of research projects that are to receive public support remain tasks of the government. It should not be done under the pressure of competitive forces other than the democratic ones alluded to above. Rather, it should be carried out with an eye on the public interest, possibly in conjunction with outside experts, an interest that is not adequately represented in a competitive market of knowledge brokers.

At the monitoring stage however competition can be introduced. Note that monitoring research institutions is a delicate issue. On the one hand, control should be tight enough such that the research program evolves along the lines of the initial proposal, or, if necessary and possible, that the research program is redirected towards areas that are in the broad public interest (due to, for instance, unexpected research results). Also, budgetary boundaries should be obeyed. Crossing these boundaries should only be allowed if this is rightly demanded by the development of the research agenda (due to, for instance, unforeseen economies of scale and/or scope of the research program). That is, within the financial boundaries of the R&D subsidy, as much publicly desirable research as possible should be carried out. On the other hand, a research environment should be maintained that fosters the creative process. Too tight control over the research process is likely to suffocate this imperative creativity. Optimal monitoring of the research process is at the delicate equilibrium between the creation of a prosperous research environment (supply push) and the direction of this research towards publicly desired areas (demand pull) within the publicly set financial boundaries.

Competition between knowledge brokers could induce the general mode of supervision to move towards this delicate equilibrium. Knowledge brokers that consequently supply poor research results, or constantly report that the projected budget is too small, in future will find it more and more difficult to be elected as broker by the authorities. On the other hand, research institutions will be less willing to submit research proposals through too harsh brokers (in the sense of monitoring the research process). Accordingly, also for these brokers it will be difficult to become the acting knowledge broker. Indeed, a successful knowledge broker is the one who finds the optimal middle between tight control and sustaining creative liberty.

Leaving the direct supervision of research institutes to a competitive market comes with a complicating factor however: how much of the responsibility regarding the course and outcomes of the research project should be assigned

to the knowledge broker, and how much to the research institute? Indeed, the success of a research project depends on the individual efforts of the knowledge broker and the research institute, but also on the cooperation between these two. One solution would be to assign *ex ante* the responsibility jointly to the knowledge broker and the research institute. In this case the authorities do not have to make a subjective judgement as to who is responsible for what. Moreover, each player's (recorded) performance now also depends on the other player's efforts. This mutual dependence could have a disciplining effect, potentially increasing the quality of the overall product.

The evaluation of the overall performance of research projects continues to be a task of the authorities. Indeed, this evaluation regards the performance of the research institute vis-à-vis the targets specified in the research proposal and a financial assessment of the project. But also the cooperation between the research institute and the acting knowledge broker is to be evaluated. These appraisals should then be added to the public memory, which is to be consulted in every procurement round (see also Section 2). Note that the larger this public memory, the more accurate a benchmark performance can be identified regarding the whole process, including the cooperation between knowledge brokers and research institutes.

At the final stage of the whole process, when the research results are to be disseminated, competitive forces can come into play again. The objective of this step is straightforward: as much players as possible should have access to, and benefit from, the research results which are obtained with public support.[13] Since knowledge brokers are assessed according to their overall performance, it can be expected that the dissemination of research results through a competitive market of knowledge brokers will be at least as widespread as induced by a (single) public agency (e.g. the R&D subsidy board).

To summarize, in order to introduce competitive forces in the procurement process, a market for knowledge brokers could be created. The role of these knowledge brokers would be at four stages of the process: (i) placing the call for tender; (ii) obtaining research proposals; (iii) monitoring the research efforts; and (iv) disseminating the research results. The separate steps of the resulting *competitive* procurement process are presented in Box 2. The augmented institutional setup is illustrated in Figure 2.

[13] This 'folk theorem' can be traced back, at least, to Arrow [1962]. Since then many (more complicated) economic analyses have confirmed Arrow's notion (for recent confirmations see e.g. Eaton and Kortum [1999]). Indeed, Hinloopen [1997] comes to the conclusion that "The optimal R&D-stimulating policy entails the subsidization of non-cooperating firms on the provision that innovative information is fully shared within the industry" (p. 172).

1. Identifying research areas for which public support is to be made available.
2. Formulating a call for tender, possibly in conjunction with outside experts.
3. Placing a call for tender *by an agency operating in a competitive environment (possibly a knowledge broker).*
4. *Knowledge brokers obtain research proposals from different reseach institutes.*
5. Assessing the research proposals, possibly in conjunction with outside experts, *submitted by the knowledge brokers.*
6. Providing R&D subsidies to the qualified research proposals.
7. Monitoring the research process (altering the direction if needed) *by the knowledge broker.*
8. Evaluating the research results, possibly in conjunction with outside experts, *submitted by the knowledge broker.*
9. Disseminating the research results *by the knowledge broker.*
10. Evaluating *the knowledge broker*, the research institution that received public support *and the cooperation between the two.*

Box 2: The allocation of R&D subsidies under a closed-budget non-generic subsidy scheme in conjunction with a competitive market for knowledge brokers.

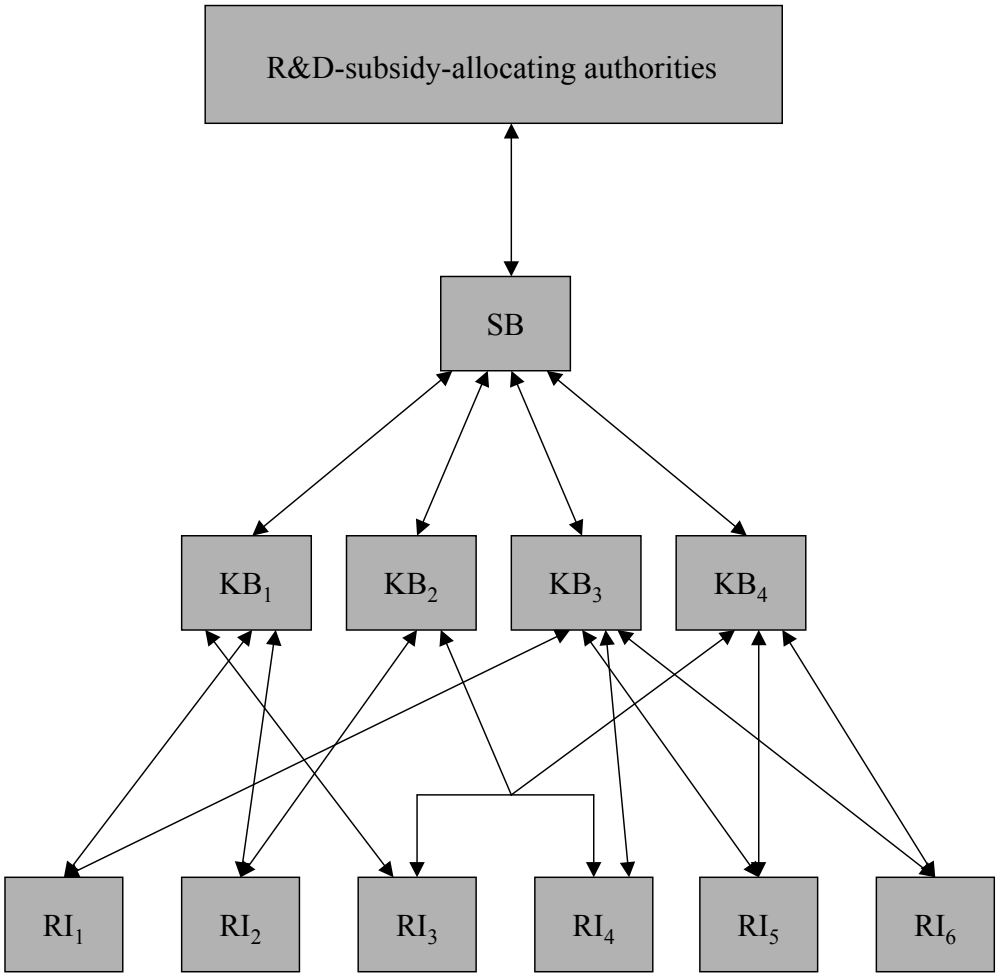


Figure 2: The institutional set-up for the provision of public support for (possibly) private R&D in conjunction with a competitive market for knowledge brokers; SB = R&D subsidy board; KB = Knowledge broker; RI = research institute.

# 4 Costs and benefits

Introducing a market for knowledge brokers potentially comes with efficiency gains. At the same time, disintegrating the procurement process also carries cost. In this section we try to assess these potential benefits and costs.

## 4.1 Efficiency gains

Introducing forces of competition into the procurement process could yield substantial efficiency gains. First, it can be expected that the criteria according to which the R&D subsidies are allocated are better met by the qualified research proposals. Indeed, it is in the interest of each individual broker to come up with research proposals that meet these criteria as good as possible since it will enhance their probability to participate in the procurement process. In addition, because the potential audience for the call for tender is widened, the probability of supporting the best suited research institute with the targeted public research funds increases. In short, there will be a better match between supply and demand on the market for R&D.

Second, due to an expected shift of the monitoring process towards the optimal position between tight supervision and lax control, a better quality product can be expected for a given price. That is, the efficiency of the public euro spent on R&D increases. Quality in this case refers to the extent that the research targets specified in the response to the call for tender are met. This potential efficiency gain is very difficult to measure however, especially if the research targets are within the sphere of fundamental research (e.g. aiming for a crucial breakthrough in biochemistry). Yet, given the competitive character of the market for knowledge brokers it is in each brokers interest to supervise the research in such a way that the final result is as close to the pre-specified targets as possible.

A potential problem might be that the research institute does not accept the knowledge broker as a supervisor of its research efforts. Indeed, in this respect outside experts might have more credibility. Yet, the research institute that received the subsidy set up its research proposal in cooperation with the knowledge broker, knowing that the latter will supervise its research efforts. If it so desires a research institute can always cooperate with a broker that it does accept as a credible supervisor. Moreover, knowledge brokers can always hire outside experts if they feel a lack of credibility from the research community as to their supervisory potential.

Third, it can be expected that the research results are better disseminated. Knowledge brokers realize that their performance in this phase of the procurement process will be added to their track record. Accordingly, each

broker will see to it that dissemination of the research results is as wide as possible, since, again, it would enhance their probability to participate in future procurement rounds.

Finally, part of the administrative burden of the procurement process will now be with the knowledge brokers. Since they operate in a competitive environment, it can be expected that these administrative aspects will be carried out more efficiently. Accordingly, the *overall* administrative burden of the procurement process could be reduced.

For all these efficiency gains to be realized however, it is imperative that the market for knowledge brokers works in the sense that competitive forces are 'strong enough' to induce competitive behavior by the knowledge brokers. For example, collusive behavior between knowledge brokers should effectively be banned (as on any other market where collusion is prohibited; see Article 81 of the Treaty of Amsterdam). In particular, the situation in which knowledge brokers informally divide the market must be avoided. Also, ties between knowledge brokers and players on the research market should be considered carefully since they can obstruct competition in the market for knowledge brokers.

## 4.2 Disintegration cost

Next to these potential efficiency gains are the costs of disintegrating the procurement process. The first comes with the probability that a market for knowledge brokers is created that does not work. As stressed above, if competition is not strong enough to command efficient behavior of knowledge brokers, many of the potential efficiency gains are lost. In addition to the efficiency losses due to the exertion of market power by knowledge brokers operating in a noncompetitive environment, the whole procurement process could be troubled; knowledge brokers selectively present research proposals to the authorities (because of, for instance, side-payments made by research institutes to brokers), knowledge brokers implement very lax supervision, knowledge brokers hamper the dissemination of research results of other (competing) projects, etc. Accordingly, it is necessary that creation of a market for knowledge brokers is done at a large scale in order to guarantee as much as possible that competition between knowledge brokers will take place.

Second, the evaluation of the performance of research institutes and the addition of this evaluation to the public memory is done more indirectly. That is, additional transaction cost are incurred. Similar cost are also introduced with the efforts towards evaluation of the knowledge broker and the cooperation between the broker and the research institute.

Finally, there are the cost of coordinating the whole procurement process. On the one hand, there are certain tasks (and associated cost) transferred from the public authorities to the knowledge brokers. But on the other hand, this implies that the public authorities now coordinate a procurement process involving players from two markets rather than one.

Quantifying these costs is likely to be very difficult. Yet, before a market for knowledge brokers is created it is of crucial importance to have at least some indications as to the expected benefits and costs. One possibility would be to start with distributing only a fraction of all funds through a knowledge broker market. If this would yield encouraging results this fraction could gradually increase.

# 5 Conclusions

Economic theory and related empirical research teach us that there are good reasons for supporting (possibly private) R&D with public funds. To that end, the European Commission for instance has set up Framework Programs: closed-ended non-generic R&D subsidy schemes aimed at boosting (effective) research efforts in designated areas.

This paper offers both an interpretation and a possible solution for the empirical 'fact' that R&D subsidies are at best mildly effective in raising effective private R&D efforts; the absence of competition at several stages of the procurement process could lead to inefficient use of R&D subsidies. The solution is that competitive forces should be introduced at those stages of the procurement process where competition is possible and desired. In particular, a competitive market for knowledge brokers could be created. The role of these knowledge brokers would be at four stages of the procurement process: (i) placing the call for tender; (ii) obtaining research proposals; (iii) monitoring the research efforts; and (iv) disseminating the research results.

Introducing forces of competition into the procurement process could yield substantial efficiency gains; there will be a better match between demand and supply on the market for R&D, a better quality research product can be expected for a given price, research results are better disseminated, and the overall administrative burden of the procurement process will be lower. On the other hand, disintegrating the procurement process also comes with costs; many of the potential efficiency gains are lost if competition is not strong enough to command efficient behavior of knowledge brokers, additional transaction cost are incurred, and coordination cost increase due to public authorities having to coordinate a procurement process involving players from two markets rather than one.

Implementation of a market for knowledge brokers should be based on an assessment of these expected cost and benefits. In any case, if a market for knowledge brokers is created it should be done on a sufficiently large scale (e.g. European) in order to guarantee, as much as possible, that competition commands efficient behavior of the knowledge brokers. Actors that could possibly fulfil the role of knowledge broker already exist: commercial consultancy firms. These firms have good knowledge as to the existing research infrastructure, are in close contact with the industry, and have experience in working for the public authorities. Moreover, the existing market for commercial consultants is truly international and seems to be of a size that generates 'enough' competition once the consultants also act as knowledge brokers.

Finally, note that this contribution was conceived within a policy setting and presented accordingly. Alternatively a formal principle-agent model is set up and a mechanism is designed that enhances the effectiveness of the R&D subsidy scheme, possibly along the lines of Demski and Sappington [1984] or Mookherjee [1984]. I hereby invite all who feel a pressing lack of rigor in my analysis to take up this research effort.

# References


[1] Arrow, K.J., 1962, "Economic welfare and the allocation of resources for invention", in Nelson, R.R. (editor), *The rate and direction of inventive activity: economic and social factors*, Princeton: Princeton University Press.

[2] Busom, I., 2000, "An empirical evaluation of the effects of R&D subsidies", *Economics of Innovation and New Technology*, **9**, pp. 111 – 148.

[3] David, P. A., Hall, B. H. and Toole, A. A., 2000, "Is public R&D a substitute or complement for private R&D? A review of the econometric evidence", *Research Policy*, **29**, pp. 497 - 529.

[4] Demski, J. S., and Sappington, D., 1984, "Optimal incentive contracts with multiple agents", *Journal of Economic Theory*, **33**, pp. 152 – 171.

[5] Eaton, J. and Kortum, S., 1999, "International technology diffusion: theory and measurement", *International Economic Review*, **40**, No.3, pp. 537 - 570.

[6] Goolsbee, A., 1998, "Does government R&D policy mainly benefit scientists and engineers?" *American Economic Review*, **88**, No.2, pp. 298 - 302.

[7] Guellec, D. and van Pottelsberghe de la Potterie, B., 1997, "Does government support stimulate private R&D?", *OECD Economic Review*, No. 29, pp. 95 – 122.

[8] Hinloopen, J., 1997, "Subsidizing cooperative and noncooperative R&D in duopoly with spillovers", *Journal of Economics*, **66**, No.2, pp. 151 - 175.

[9] Hinloopen, J., 2000a, "Subsidizing cooperative and noncooperative R&D: an equivalence result?", *Economics of Innovation and New Technology*, **9**, No. 4, pp. 317 - 329.

[10] Hinloopen, J., 2000b, "More on subsidizing cooperative and noncooperative R&D in duopoly with spillovers", *Journal of Economics*, **72**, No. 3, pp. 295 - 308.

[11] Hinloopen, J., 2001, "Subsidizing strategic R&D cooperatives", *De Economist*, **149**, No. 3, pp. 313 – 345.

[12] Klette, T. J., MØen, J. and Griliches, Z., 2000, "Do subsidies to commercial R&D reduce market failures? Microeconometric evaluation studies", *Research Policy*, **29**, pp. 471 – 495.

[13] Leahy, D. and Neary, J.P., 1997, "Public policy towards R&D in oligopolistic industries" *American Economic Review*, **87**, No.4, pp. 642 - 662.

[14] Marey, P. and Borghans, L., 1999, *Wage elasticities of the supply of knowledge workers in The Netherlands*, Maastricht: Research centre for education and labour market (ROA), University of Maastricht.

[15] Martin, S. and Scott, J.T., 2000, "The nature of innovation market failure and the design of public support for private innovation", *Research Policy*, **29**, pp. 437 – 447.

[16] Mookherjee, D., 1984, "Optimal incentive schemes with many agents", *Review of Economic Studies*, **51**, pp. 433 – 446.

[17] Romano, R.E., 1989, "Aspects of R&D subsidization", *Quarterly Journal of Economics*, **CIV**, No.4, pp. 863 - 873.

[18] Romer, P.M., 1993, "Implementing a national technology strategy with self-organizing industry investment boards", *Brookings Papers: Microeconomics*, **2**, pp. 345 - 390.

[19] Spence, M., 1984, "Cost reduction, competition, and industry performance", *Econometrica*, **54**, No.1, pp. 101 - 121.

[20] Wallsten, S. J., 2000, "The effects of government-industry R&D programs on private R&D: the case of the Small Business Innovation Research program", *RAND Journal of Economics*, **31**, pp. 82 – 100.