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- ***Title***

Cost-Benefit Analysis of Triple Helix Technology Transfer Programs in Canada: What Counts and What Can Be Counted?

- ***Abstract***

Over the past decades, university-government-industry relationships have become an important subject due to the crucial role played by technological innovation. Different public policies (tax credits, grants, institutions, etc.) have been implemented in order to improve technology transfer from universities to industries, mainly through the creation of offices, agencies and organisations devoted to technology transfer: TTOs (Bergebal-Mirabent, Sabaté, & Cañabate, 2012). Different policy analysts are however still questioning the impact of these TTOs and their real effectiveness and efficiency (Caldera & Debande, 2010). Among other questions, these analysts and other policy makers are asking what the net present value and what the proxy of the rate of return of the TTOs are.

The purpose of this paper is to investigate the real net benefit of government technology transfer policies through TTOs. Our analysis was conducted within the CREXE (a university research centre, focused on program evaluation) on behalf of the Finance and Economics Department of Quebec, Canada. More precisely, our paper aims at assessing the return on investment of public subsidies in R&D, which are given to TTOs. These organisations offer innovation services to local companies, especially small- and medium-sized enterprises across the province. Their R&D mandate is focused on applied research and adjusted for direct use by the partners; as a consequence, on a scale of proximity between university and industry (for example, the one used by Mayer & Blaas (2002)), TTOs are very close to the firms' needs (whereas other innovation organisations conduct a more basic research and are closer to the universities). This policy is an example of the public sector driving the private sector for innovation matters, because State subsidies create leverage to increase private investment in R&D. These investments are indeed quite low without public incentives, although positive impacts of R&D on the national economy are high.

The main questions for this research were: Are the public investments in TTOs profitable for the society and what is their net added value? Also, what kind of lessons can we learn from this new evidence in order to guide future public policy making?

In this paper, we used the cost-benefit evaluation methods that are well documented in the literature about R&D (U.S. Department of Energy, 2007; Ruegg & Feller, 2003; Link & Scott, 2012). An important challenge in our work is to take into account not only tangible benefits (easily observable and measurable benefits that are more of a physical or financial nature), but also intangible ones: the latter are less easily measurable with conventional metrics since they are viewed as immaterial and their presence in economic activities is latent (Soetanto & Jack, 2011). In our analysis, the tangible impacts of TTOs are valued with the profits of partners directly linked to their collaboration with the organisation. With regard to intangible impacts,

we took into account things like the increase in networking linkages, intellectual property, human capital accumulation, growth impacts of R&D, for which there is much less information available than for tangible impacts (Boardman, Greenberg, Vining, & Weiner, 2011). To reveal the value of these intangible impacts we applied hedonic pricing methods. We also measured the real value of our cashflows for the society: not only the expenditures from a budgetary point of view but their real costs, which are often underestimated.

Data used for this analysis come from different sources and data bases. This is because costs and benefits are felt and appropriated by different actors: government agencies, firms, innovation and technology transfer organisations, organisations' partners or even the whole society (Polt & Woitech, 2002). For costs and benefits concerning governments and organisations we used internal documents from the organisations (financial statements, annual reports…), data from other accountability official documents, direct interviews, semi directed interviews with some partners in the organisations, which also helped us to understand and identify the benefits felt by organisations' partners. We also used telephone and online surveys of organisations' partners: 1500 firms and public organisations. The surveys were conducted between October 2012 and March 2013 in Quebec (Canada); the telephone surveys (conducted by professional external firms) reached an average rate of response of 65% and online surveys (administered by CREXE using SurveyGizmo Software), an average rate of 25%.

The results we obtained are different among the TTOs covered by this study. The cost-benefit ratios we calculated ranged between 0.8 and 1.4 depending on the organisations, and the internal rates of return are distributed between -10% and 40%. As a result, for some TTOs public subsidies can be judged as profitable for the society according to the cost-benefit analysis, but this is not the case for two of them (based on a nominal social discount rate of 8%). Because of uncertainty and risk associated to our analysis, we have conducted a risk

analysis on all of our scenarios and simulations (using Monte-Carlo procedure), which is used to observe the impacts of variations of the hypothesis on results.

To explain the differences between the various organisations, we studied the diverse kinds of technological services they offer. Our results suggest that TTOs that have the broader offer and the most diversified service portfolios are more profitable and viable in the long term. The fact that some TTOs can also combine different policy tools (grants, tax credit, public-private partnerships...) seems also to be a positive factor for their profitability. In fact, on the one hand, technology transfer services (technical services applied to the individual needs of the customers, thus services that are the closest to the industry) seem to be the most profitable services: for example, testing technologies, strategic consulting, standardisation... On the other hand, fundamental research services seem to be less profitable, especially in the short term for TTOs' partners; thus, combining different elements balances these advantages and downsides.

As a consequence, our findings suggest that TTOs that are offering a broad range of possibilities, including commercial technology services, are more inclined to be successful in optimising not only their individual benefits (and viability) but also the technology transfer for the government's strategies and the society as a whole.

Our research results advance knowledge and help public decision making, mainly because nowadays OECD governments are investing heavily in order to diversify their technology transfer offices and platforms. We are still working on broadening our methodology to the whole research sector in order to apply the cost-benefit analysis to all kinds of publicly funded research organisations: from the closest to universities (basic research) to the farthest from universities (applied research, like the present 4). For the moment, the method we elaborated will be useful for further program evaluations focusing on mechanisms, processes and

instruments devoted to technology transfer. We indeed worked in a participative way and one of our goals was to transfer this knowledge to the evaluation team of the Finance and Economics Department of Quebec and different provinces in Canada so they are able to reuse this kind of analysis to enlighten decision making and to optimise public action in university-industry linkage.

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