

***THE ROLE OF THE PROVINCES IN
PSE RESEARCH POLICY***

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1.0 Introduction

1.1 In recent years, phrases such as the ‘information society’ or ‘knowledge-based economy’ have been used with greater frequency to describe the changing nature of the industrial economies. While there is a great deal of variation in the way these concepts are used, at their core they share a basic idea — the generation of knowledge and the processing of information are assuming greater significance as a source of innovation and growth in the industrial economies. Peter Drucker has provided what is perhaps the simplest, yet most dramatic statement of this perspective, “the real, controlling resource and the absolutely decisive ‘factor of production’ is now neither capital nor land nor labour. It is knowledge.”

1.2 This theme has been taken up in a number of recent policy documents issued by both national and international bodies. It figures prominently in the work of the Organisation for Economic Co-operation and Development, which now labels the new economic order as ‘the knowledge-based economy’. The OECD has proclaimed that the use of this term reflects a growing recognition of the role played by knowledge and technology in economic growth. As such, the industrial economies are becoming more dependent on the production, distribution and use of knowledge than ever before, both in the high-technology manufacturing industries and in the rapidly growing, and knowledge-intensive, service industries. At the centre of this emerging economy, and critical to both its production and use of knowledge, is the science system, “A country’s science system takes on increased importance in a knowledge-based economy. Public research laboratories and institutions of higher education are at the core of the science system, which more broadly includes government science ministries and research councils, certain enterprises and other private bodies, and supporting infrastructure.”

1.3 In its biennial report to the U.S. Congress, Science and Technology Shaping the Twenty-First Century, the President’s Office of Science and Technology Policy picked up this theme with the assertion that, “In the United States, half of our economic productivity in the last half century is attributable to technological innovation and the science that supported this innovation. The knowledge-based society of the next century only increases the centrality of research, innovation, and human capital as our principal strengths, placing important continuing responsibilities on the Administration and Congress.” Closer to home, the theme has been echoed in numerous policy documents, most recently the federal government’s strategy paper, Science and Technology for the New Century, “Today, knowledge and information — their

applications and technologies — are at the root of the economic and societal shift now under way.”

1.4 Despite these unequivocal assertions about the role of knowledge and the ‘science system’ in the new economy, responsibility for, and the appropriate funding levels of basic research remain a matter of great contention in many countries, including Canada. Federal budget decisions in 1995 seriously reduced the level of research funding available to post-secondary educational institutions. Other initiatives of the federal government have introduced a new element of targeting into its approach to funding PSE research. The provinces, for their part, have adopted new measures to fund PSE research as well, some in an attempt to fill a perceived policy gap, others in response to federal initiatives. The result is an escalating sense of confusion and lack of clarity about their respective roles in, and responsibility for, the PSE research component of Canada’s science system. In this field, as in other jurisdictional areas, there is a pervasive sense of overlap, duplication and spillovers between the two levels of government. In attempting to clarify their respective role, there are a number of issues which the provinces should address. The following paper identifies some of these for discussion, but in no way claims to be comprehensive.

2.0 The Significance of PSE Research for the Provinces

2.1 As the provinces are the level of government with primary responsibility for the field of education, including post–secondary education, they have an obvious interest in the issue of PSE research. Yet, until relatively recently, the federal government has assumed primary responsibility for the funding and coordination of PSE research activity. Growing evidence about the link between the level of basic research activity and the process of economic development, as well as the shift to a more knowledge–based economy, have raised the profile of PSE research among provincial governments over the past decade. Highly visible success stories, such as the central role played by Stanford University and other PSE institutions in the explosive growth of Silicon Valley have fueled this interest. Yet beyond the limits of a few, well documented examples such as this, there is a larger body of academic research which indicates that the primary benefits of basic research activity are highly localized in their impact. A spreading awareness of the implications of this finding underlies the growing concern on the part of many subnational governments with the potential role of PSE research in their regional innovation strategies.

2.2 The concept of geographical spillovers from research activity implies that the principal economic benefits from research accrue largely to firms located near research

centres, other firms, and universities. Seminal research conducted in the US measured the nature and extent of geographical spillovers in the economy. Using a three equation model (one for patenting, one for industrial R&D, and one for university research), based on 29 states from 1972-1977, 1979 and 1981, one study related the incidence of patents assigned to various corporations in different US states over time with industrial R&D and university research. The results demonstrate that there are spillovers from university research and industrial patenting, as well as an association between industrial R&D and university research at the state level. Subsequent studies have found even stronger evidence of the beneficial spillovers between university research and innovative activity in a regional economy. Based on this evidence, US researchers have concluded that distance helps determine which firms reap the economic benefits from an innovation based on academic research. Thus firms located close to major centres of academic research are deemed to have a 'major advantage' over those located at a distance from the academic source of research.

2.3 Recognition of this fact is beginning to alter the traditional economic development strategies pursued by some of the US states. Over the past decade, several attempts have been made to reproduce the success of Silicon Valley in places like Austin, Texas and the Research Triangle of North Carolina. More recently, dramatic illustration of the importance of investing in a regional research capability comes from accounts of the competition among US states to recruit top research scientists. In one example reported in the Wall Street Journal, Emory University built a \$10 million research lab to attract a top research scientist away from UCLA. Overall, the Georgia Research Alliance (a non-profit organization) has spent more than \$160 million in the past four years to recruit twenty two scientists to various research institutions in the state. This trend among the US states reflects a significant shift away from the traditional form of 'smoke-stack' chasing they have engaged in, towards a more knowledge-based approach that recognizes the benefits of regional agglomerations and technological spillovers that flow from a local research capacity. It underlines the extent to which they are beginning to perceive the fundamental research base of their economies as a critical source of competitive advantage.

2.4 This strategy is not entirely alien to provincial authorities in Canada. Beginning in the late 1980s, a number of provinces adopted strategic policies to stimulate the growth of the research capability within their own PSE sector. For the most part, however, these initiatives were adopted as one-off measures, or as part of a broader economic development strategy, with little regard to how they might fit into a comprehensive

provincial approach towards the formulation of a PSE research strategy. More recently, questions about the relative costs and benefits of such initiatives, as well as a broader concern with the potential contribution of PSE research institutions to local and regional economic development, have highlighted the need for a broader provincial PSE research policy. In so doing, they have focused attention on a number of issues that the provinces should address in any effort to formulate a broader PSE research strategy.

Included in this are the following:

- ▶ What role should a PSE research strategy play within the broader innovation or economic development strategy pursued by the province? Although research activity is critical to the success of the innovative process, few would argue that it is the sole criterion of success. How does the role of PSE research institutions complement or support other elements of the regional innovation system?
- ▶ How should PSE research activity be assessed within the context of the broader social and economic objectives for post-secondary education at large? Although research is central to the mission of post-secondary educational institutions, it is far from the sole activity or objective. The provinces as the level of government with responsibility for the sector as a whole are best situated to determine the appropriate balance between the research and other activities of the PSE sector.
- ▶ It is widely recognized that one of the principal benefits of funding research is the contribution it makes to training the next generation of researchers both for the PSE sector itself and for industry. What mechanisms exist to ensure that the required level of funding is available to train the highly qualified personnel required in key fields and that the needs of industry in this regard are being met.
- ▶ What is the appropriate role for the PSE research sector within the science system as a whole? Although PSE research is clearly critical, it is not the only component. The growing emphasis on partnerships and networking in the conduct of research activity raises issues about the linkage between PSE institutions and other components of the science system, such as other public and private research facilities.
- ▶ What is the appropriate link between PSE research activity and local and regional development strategies. As research and innovation come to be viewed as the key to economic success in the knowledge-based economy, local economic authorities are beginning to view the PSE institutions in their regional economy as valuable locational assets in building their productive base and attracting new firms. For the most part, this occurs on a somewhat random basis

- from locality to locality. But the very nature of these efforts raises important questions about the appropriate coordinating role for the provinces.
- ▶ Finally, the evidence cited above suggests that there is a critical, competitive dimension to the provinces' role in formulating a provincial PSE research strategy. As the quality of PSE research is recognized as an important source of competitive advantage for the regional economy, the provinces must ask themselves how their respective PSE research capability stacks up. Are they managing to keep pace with the expanding boundaries of knowledge in the relevant fields of scientific endeavour? Do the PSE research institutions within their jurisdiction have a sufficiently high profile and reputation to stimulate the desired level of economic activity within their economy?

 - ▶ Closely related to this issue is the question of a potential brain drain — both in terms of high profile researchers and newly trained graduates. The existing evidence suggests that Canada is not experiencing a brain drain in purely quantitative terms. However, recent data on the dramatic decline in the number of computer science Ph.D.'s graduating in the US combined with warnings about looming shortages of highly qualified labour in the information technology industries should act as a caution about the dangers of complacency on this subject.

While the preceding list is in no way comprehensive, it identifies a number of the issues that should be considered in an attempt to formulate a provincial PSE research agenda.

3.0 Federal and provincial roles and responsibilities

3.1 The pressing need to define a provincial PSE research strategy has been compounded by the progressive blurring of the respective roles and responsibilities of the federal and provincial governments in maintaining the PSE research component of the national science system. For much of the postwar period, there was an implicit division of responsibility between the two levels of government. Through the evolving role of the three granting councils since the 1950s, the federal government assumed responsibility for funding much of the direct costs of sponsored research in the PSE sector and some graduate training through the provision of fellowships; but not the overhead costs incurred to support that research, nor the cost of the infrastructure and equipment needed to conduct it. This was the presumed responsibility of the provinces, to be financed out of the funds available for core operations, or in some

cases, out of special envelopes established for that purpose. However, even this division of responsibilities was not as neat as it appears, given the importance of federal transfers to the provinces for PSE funding beginning in the mid-1960s.¹

3.2 However, the division of responsibilities has begun to erode over the past two decades through a variety of measures introduced on both sides. The shift from shared cost funding for PSE to a block funding formula with the negotiation of the EPF Agreement in 1977, and the gradual imposition of limits on the spending increases under the EPF transfers by the federal government in the 1980s, imposed serious constraints on the fiscal resources available to the provinces to fund the PSE sector. While the provinces compensated for some of this reduction with their own revenues, part of the reduction was inevitably passed on to the PSE sector itself. One of the institutional responses to this fiscal constraint was to begin to charge many of the overhead costs of research, including secretarial assistance, computer services, photocopying, phone, fax and courier services back to the research grants themselves. As the Johnson Report to the federal Secretary of State noted in 1985, this was a perverse way of shifting part of the overhead expenses back onto the senior level of government, but at the cost of diminishing the actual amount of research that could be purchased with the grants from the federal agencies.

3.3 The sense of overlap expanded in the late 1980s when some provinces perceived a lack of strategic direction in the research being funded by the federal granting councils and stepped into the gap with their own efforts to fund applied or targeted research through measures such as the Centres of Excellence program in Ontario, the Action Structurante program in Québec, and a number of others. The confusion was further compounded in the late 1980s with the establishment of the federal Networks of Centres of Excellence program. While the result has undoubtedly been beneficial in terms of the amount and quality of the research being conducted, it is clearly more confusing from a policy perspective. This is a classic example of the kind of spillovers from one level of government to the other that Canadian federalism has witnessed for many years.

¹ However, the very definitions of what constitutes the indirect, overhead and infrastructural component of research costs is the subject of much controversy. Further confusion is added by the fact that federal contract research with the PSE sector allows for 65 per cent additional funding to cover the indirect costs of the research. In the case of Ontario, the province established a Research Overhead and Infrastructure envelope in the 1980s to cover these costs, but it is widely believed in the PSE sector that the amount allocated to the envelope falls short of the real costs.

3.4 The confusion is now complete with the creation of the Canada Foundation for Innovation and by some of the provincial responses to it, such as the Ontario Challenge Fund. The federal government, under the authority of its constitutional spending power, has moved directly into the funding of research infrastructure, but in a manner that has compelled, at least some of the provinces, to respond.² The end result is that there is no longer a clear delineation of roles and responsibilities in the area of PSE research policy, nor is there an institutionalized mechanism for monitoring the consequences of the kinds of duplication and spillovers that inevitably result. This area of jurisdictional responsibility seems marked by little advance consultation between the two levels of government, nor efforts to anticipate the consequences of new initiatives by one level for the other. Similarly, the presence of duplicate sources of funding in some targeted areas of research activity raises the possibility that a less than optimal distribution of research funding may result from the lack of monitoring and coordination (although this assertion is contested by the granting agencies). In an era of constrained resources, there is clearly a compelling need for effective monitoring and coordination of all elements of the science system on the part of both levels of government.

3.5 The blurring of the respective roles of the federal and provincial governments raises a related question of the response by the universities and the research community. To a large extent, the universities have defined their role in the research field in a reactive fashion, letting the federal and provincial governments define research programs (and sometimes priorities) and then ensuring that the research community within their respective institutions was well supported in its efforts to obtain the maximum portion of the available funds. To date, this has required relatively little planning or initiative on their own part, but it begs the question as to whether it should. For the most part, the universities, and the broader research community, have made eloquent pleas for maintaining or expanding the resource base for funding research, but made relatively few attempts to establish priorities between different funding areas or respond to the gradual shift of funding from basic to more applied research.

3.6 Outside of the largest, most research intensive universities in the country, few have the capacity to undertake any kind of strategic planning on their own, and thus have been left in this largely reactive mode. This raises the additional question of whether

² There is further controversy over what constitutes infrastructure in the CFI definition, with some observers feeling that provision must be made for soft costs as a necessary part of certain types of infrastructure.

there is a more strategic role that the PSE research institutions should play in the formulation of a provincial research policy or whether this strategic planning function must be carried out by the provinces. The absence of a strategic planning capacity makes it difficult to assess the pleas for increased research funding. Past reductions in research funding levels have not produced a dramatic decline in the quality of Canadian research output. Canada still scores highly on most comparative measures in terms of the productivity, efficiency and effectiveness of its research output. Given the long-term nature of basic research activity, it will likely be far too late to remedy the situation by the time that the decline in these measures becomes apparent.

Establishing a more effective planning capacity on the part of the PSE sector should include measures to evaluate the impact of different funding levels on research output.

4.0 Targeted Spending and the Erosion of the Core Funding Base

4.1 Closely related to the problem of spillovers and duplication is another, potentially more serious one. Over the past decade, both levels of government have displayed a growing inclination to direct their funding for the PSE sector in general, and research in particular, in a more targeted fashion. This is evinced through the introduction of new programs such as the Centres of Excellence, the CFI and the Challenge Fund. This growth of targeted funding has occurred in the context of increasingly constrained funding both for general operating costs and for sponsored research. On the one hand, this may reflect a growing concern by the two levels of government over the lack of accountability in the way general funds are allocated within the PSE sector, or the kinds of questions that inevitably are raised in Parliament when the list of projects selected by the granting councils are released. However, it must also be recognized that this shift has a number of perverse consequences from the perspective of research policy.

4.2 In the first place, the erosion of the core funding base for the universities, through constraints on EPF (now CHST) transfers and declining levels of provincial funding, undermines the capacity of the university sector to attract and retrain the best researchers available through the salaries that they can afford. In a number of highly competitive disciplines, there is now a perception that the top research universities are no longer competitive for the quality of staff they wish to hire in terms of the salaries offered. At the same time, the decline in the amount of research funding that is generally available from the granting councils creates additional problems for many researchers in obtaining the kind of funding required to sustain their work. There is a double irony in the fact that one of the reasons for the establishment of the CFI was to

ensure that universities could afford the quality of research infrastructure necessary to attract and retain top quality researchers. However, as was noted in the recent report for PAGSE, "improved research infrastructure, without continued support for the training of the next generation of researchers, or the conduct of their research activities, will not ensure that Canada realizes the (maximum) benefits from investments in basic research".

4.3 Secondly, there is a spreading concern in both the US and Canada that the balance has shifted too far in the direction of targeted research and away from basic research. A recent working paper by the National Science Board in the US (NSB-97-186) defines basic research as "the search for new knowledge and concepts that unify or extend that knowledge. The work, stimulated by theoretical or practical questions, is conducted in the context of existing knowledge and paradigms. . . . Typically, research is designed to answer specific questions to fill gaps within the existing body of knowledge or to test the paradigm itself. Work which is intended to confirm or refine an existing paradigm may, in fact, contradict it thus opening the way for a scientific revolution." Development, in contrast, is defined as "the process by which a new product or process is brought into being or improved based largely on existing knowledge and theory." Research and development are clearly related; few activities can be classified as purely one or the other. Hence, additional terms such as applied research are employed to describe the fine gradations between basic research and development.

4.4 In general, there is a growing sense in both the US and Canada that the emphasis on targeted funding for applied research at the PSE level, coupled with the decline in the basic research role of some of the key corporate laboratories is jeopardizing the long-term status of basic research. In one of the last reports issued before its untimely demise, the US Office of Technology Assessment warned that, in light of the pressure to reduce federal budget deficits, funding for basic research at universities and federal laboratories could drop further, a change which "could potentially reduce the amount of basic research available to US firms". A recent White Paper on Basic Research published by R&D Magazine in the US echoed this warning. It notes the growing concern among both R&D managers in industry and research administrators in universities that the shift away from basic research and a more long-term focus towards more commercially-relevant research with a shorter time horizon is drying up the pool of scientific knowledge that can feed future innovations.

4.5 In Canada, this problem has been compounded by the decline in funding from the granting councils resulting in the current situation of numerous worthy research proposals going unfunded for lack of resources. These concerns were underlined in a recent speech by Peter Nicholson, Executive Vice–President for Corporate Strategy of BCE, Inc. and formerly a senior policy advisor to the Minister of Finance. Citing the White Paper on Basic Research and other sources, Mr. Nicholson warned that, “The trend away from curiosity–driven research in favour of highly directed investigation . . . must not be taken too far. Otherwise, we will deplete the wellspring of truly fundamental innovation on which sustained improvement in the human condition depends.” The critical question of whether the balance has shifted too far away from the funding of basic research should rank high on the list of priorities for any consideration of provincial PSE research policy.

5.0 The Role of the Provinces in PSE Research Policy

5.1 The preceding discussion suggests compelling reasons for the provinces to assume a greater role in formulating PSE research policy. Given the growing overlap between the actions of the two levels of government and the inevitable relationship that exists between the core funding of post–secondary education and its research activity, what is the unique role that the provinces should play with respect to PSE research? Changes in both federal and provincial PSE research policy over the past decade have altered the clear position of leadership assumed by the federal government. The current state of overlap and duplication has created something of a policy vacuum in this field. The integral link between the educational function of the PSE sector and its research role provides one justification for the provinces to elaborate their own policy approach. Further support is provided by the growing body of evidence that links the strength and vitality of PSE research capability with a dynamic, innovative capacity in regional economies. Given this evidence and the increasing importance of both basic and applied research policy in a knowledge-based economy, there is an obvious need for the provinces to assume a more effective leadership and coordinating role in setting PSE research policy.

5.2 There are a number of elements of PSE research policy that could be considered. Clearly the most pressing area of concern is that of the spillovers created by the lack of coordination and integration of federal and provincial policy in this area. The lack of coordination means that the current allocation of funds for PSE research activities may be less than optimal in a number of respects:

- ▶ in terms of the distribution of available funds between direct research costs, support for graduate training, indirect or overhead costs, and the costs of infrastructure and equipment;
- ▶ in terms of the distribution of funds between longer-term basic research and more intermediate or medium-term applied research;
- ▶ in terms of the distribution of funds across different areas of research activity;

A central concern for provincial PSE research policy should be the attempt to determine the optimal distribution of funds across a number of these criteria.

5.3 Within most of the provinces, there is a clear division of responsibility between education (including the PSE sector) and economic development. Research activity in the PSE sector falls into a grey area somewhere between the two. Furthermore, other provincial ministries, such as agriculture, energy and health, may have a defined research mission and capability of their own. The result is a clear lack of coordination within the bounds of the provincial jurisdictions themselves. As the potential economic value and benefit of PSE-based research activity is recognized more widely, it becomes essential to ensure that PSE research policy is coordinated by one ministry across the respective governments. This represents an additional challenge in this area.

5.4 A related issue concerns the question of overlap in funding from a number of key programs especially in the more targeted fields. There is considerable anecdotal evidence of the extent to which the top researchers tend to draw resources from both the granting councils, the more targeted programs such as the Centres of Excellence, as well as a number of other individual research programs. While there is little doubt about either the scholarly merit of this work or the research capabilities of this echelon of the PSE community, it raises the question of the most optimal allocation of federal and provincial research funding. Would the two levels of government and the community at large receive a more effective social and economic benefit from their research spending if some of these funds were distributed across a broader cross-section of the research community? If so, what is the best means to ensure this more effective distribution, while still respecting the core principles of academic excellence and peer review, upon which much of the funding process is based?

5.5 Another key issue concerns the relationship between core funding and the conduct of research at post-secondary institutions discussed above. Clearly the adequacy of

core funding levels has a strong impact on the research capability of PSE institutions. Statistics Canada (ST--97-06) provides estimates of the proportion of university core funds devoted to research activity (using R&D ratios derived from time-budget surveys in Canada, the US and abroad). These data indicate that the proportion of R&D expenditures in the higher education sector accounted for by the sector itself (ie. the university core funds fell from 55.1 per cent of the total in 1979-80 to 38.1 per cent in 1995-96 (the latest year for which figures are available). In other words, while total funding for research in the higher education sector increased by 300 per cent over this period in current dollars, funding by the higher education sector itself merely doubled. There is a pressing need for more detailed examination of the extent to which the erosion of core funding in the PSE sector has imperiled the research capacity at these institutions and the implications of this erosion for provincial economic development strategies.

5.6 One issue that is raised periodically in policy reviews of the PSE sector concerns the degree of differentiation that is desirable among the different institutions that comprise the research system. Within the university sector, there are clear gradations in both research capability and levels of research funding among the member institutions within each provincial system. In the past, most suggestions to formalize these distinctions within the research system have been greeted with alarm by the research community. Yet the obvious gradations exist and tend to increase over time. Without implying hierarchical distinctions in terms of either prestige or quality, a prudent approach on the part of the provinces would recognize the existence of the differing strengths and capabilities of the institutions in the PSE sector and incorporate them into a broader approach.

5.7 The PSE sector as it is considered in this paper comprises both the universities and the colleges. Traditional considerations of research activity have been limited to the universities, yet there is increasing evidence that the colleges have both a research capability and are taking on a new and more specialized role with respect to the training of highly qualified personnel in a number of emerging industries. These capabilities, in turn, serve as an important source of attraction for firms in those industries. Recent policy initiatives in some provinces have recognized these unique capabilities and provided special funds to promote the related activities in the colleges. A comprehensive approach to PSE research policy by the provinces should reflect and incorporate the capabilities of both the university and college members of the sector.

6.0 Conclusion

6.1 The preceding discussion outlines some of the emerging issues in the area of provincial PSE research and some of the reasons why the provinces should adopt a more formal policy approach to this area. It makes no claim at comprehensiveness and has focused more on the identification of problem areas, than the suggestion of solutions. However, the two driving forces identified in this paper — the shift to a more knowledge-based economy and the significant locational advantages that accrue to PSE-based research activity — offer two compelling reasons why the provinces should be concerned with this question. The issues identified in the preceding discussion offer a modest agenda for the commencement of such a review.

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