The Macdonald-Laurier Institute

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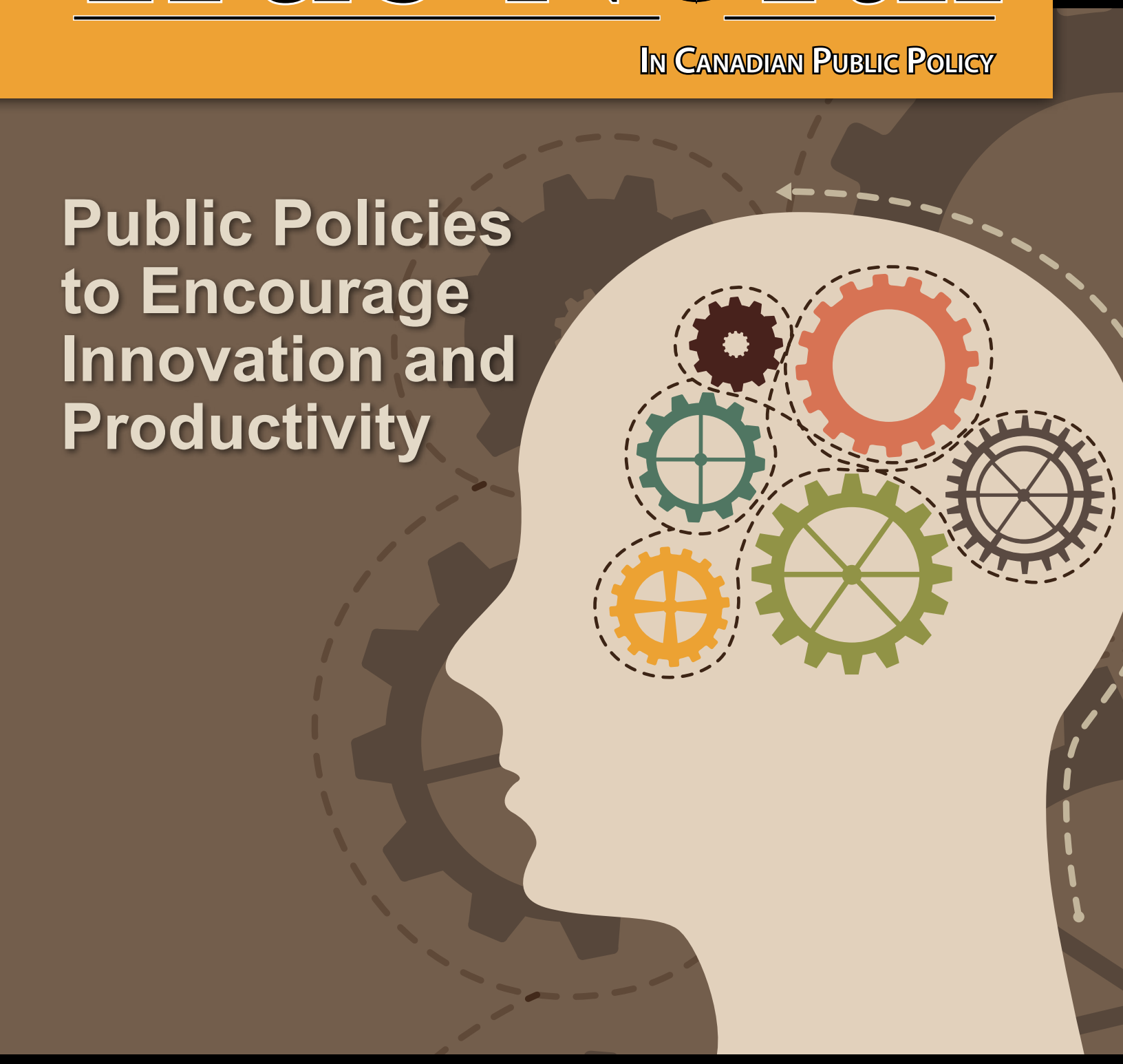
True North

In Canadian Public Policy

Public Policies to Encourage Innovation and Productivity



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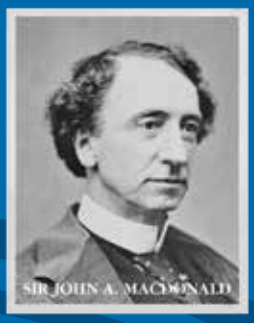
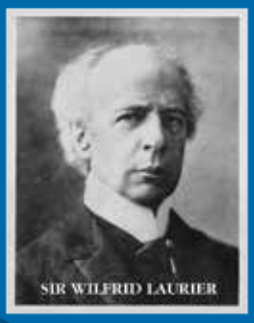
True North in Canadian Public Policy





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Executive Summary

Increasing productivity leads to higher standards of living. Government can design policy to encourage innovation, leading to these desirable outcomes. The introduction and utilization of new technology is the main driver behind increased productivity. Canada has wisely focused on innovation since the discovery of this link. Recent research in areas like organizational forms and structure and expertise gives a more nuanced view of innovation, and brings up questions regarding how policy should adapt.

When considering public policy, it is helpful to conceptualize innovation as the outcome of factors influencing the availability (or supply) of new knowledge and the usage (demand) of that new knowledge in production. This creates a useful framework for discussion, even though the separation can be arbitrary and involves overlap. Understanding the myriad factors that support innovation makes clear how difficult it is to legislate without inadvertently discouraging innovation.

Supply-Side Factors

A major factor influencing the supply of new knowledge is the quantity and quality of research and development (R&D) performed by public and private sector organizations. R&D is characterized by potential "market failures", which invites public policy solutions. Ordinarily, it is impossible for organizations to capture all of the economic benefits of the new knowledge that they create, so in the absence of corrective public policies, too little R&D would be done from the perspective of social efficiency.

Most directly, governments fund R&D in government labs, as well as in universities and to a lesser extent, R&D done by for-profit companies. Less directly, governments offer tax credits to companies for the R&D expenditures made by those companies. The issue of whether government should offer more or less financial support for R&D is inextricably linked to what activities are being funded. The consensus of economists is that government should emphasize the direct funding of relatively "early stage" research, commonly identified as basic and applied research.

New knowledge is often treated as a public good, which is why governments protect intellectual property (IP) through patents, copyrights, trademarks, and industrial designs. However, as IP protection strengthens, the rate at which new knowledge is used in goods and services slows, although this relationship varies by industry. Weaker competitive conditions may encourage the supply of new knowledge, while appearing to discourage the demand, or utilization, of new knowledge.

Immigration policy plays an important role in the innovation process. In Canada, a substantial percentage of scientists and engineers are either immigrants or foreign students who stay to work in the host economy after graduating from local universities. An increased supply of scientists and engineers should also encourage an increase in the supply of knowledge available to be incorporated into new products and production processes.

Demand-Side Factors

Demand-side policies arguably promote innovation more than supply-side policies; the cheaper it is to utilize new knowledge, the more profitable it will be. Government grants to directly fund innovation activities have the most impact when directed to small and mid-sized firms.

Government procurement, whether through promises to buy a new product or requiring a foreign company to use local components as a condition of winning a government contract, is another way to reduce the market risks of innovation. However, the issue of deciding which firms should receive this benefit remains. Funding may be allocated to those more adept at lobbying than R&D.

Successful innovation requires a host of inputs that are complements to new knowledge, such as a skilled workforce, modern communications infrastructure, access to professional business services, and a good transportation infrastructure. There is not a clear answer to which programs government should fund to increase innovation, however.

R&D activities tend to be concentrated geographically because specialized resources exist in only a few locations (known as clusters). Clusters tend to appear around research universities and corporate headquarters. When attempting to use policy to encourage co-location, it is important to consider the comparative advantage of a particular location, which is key to the success of a cluster.

High marginal tax rates discourage innovation. Government regulation also affects competition, and there is abundant evidence that competition promotes the commercialization of new products, as well as the adoption of new production and organizational processes. The empirical evidence documents a strong link between the openness of an economy and productivity growth.

Summary and Conclusions

The factors influencing innovation are complementary, so getting specific policies "right" augments the effectiveness of other policies already in place. Government policies can influence the nature and extent of domestic innovation by modifying the conditions that either affect the availability of new knowledge or the incentives and abilities of domestic organizations to embody new knowledge in products and production processes. The complex nature of innovation makes it difficult to determine which policies could truly encourage innovation. However, competition is an important stimulus for improved productivity and innovation. Also, reducing barriers to market entry facilitates the emergence and growth of new firms that often introduce new products to markets. At a minimum, an effective national innovation policy should explicitly acknowledge the ways in which government policies affect competitive conditions in domestic markets, even when the laws and regulations in question are intended to achieve other public policy goals.

Sommaire exécutif

La hausse de la productivité entraîne l'amélioration du niveau de vie. Les gouvernements peuvent concevoir des politiques qui encouragent l'innovation, ce qui a ces effets favorables. En effet, l'introduction et la mise en œuvre de nouvelles technologies sont les principales sources de la croissance de la productivité. Le Canada a judicieusement mis l'accent sur l'innovation depuis la découverte de cette relation. Les recherches les plus récentes dans des domaines comme les formes et les structures organisationnelles, ainsi que le développement de l'expertise nuancent la vision de l'innovation et soulèvent des questions relatives à l'adaptation des politiques.

Lorsqu'on examine les politiques publiques, il est utile de représenter l'innovation comme dépendant des facteurs qui influent sur la présence (ou l'offre) de nouvelles connaissances et sur l'utilisation (demande) de nouvelles connaissances dans la production. Cette conceptualisation crée un cadre propice de discussion, même si la distinction entre l'offre et la demande peut être arbitraire ou qu'elle implique des chevauchements. Il est ardu de bien saisir la myriade de facteurs qui appuient l'innovation, et donc, encore plus de légiférer en sa faveur sans risquer de la compromettre.

Facteurs liés à l'offre

La qualité et la quantité de l'activité de recherche et développement (RD) effectuée par les organisations des secteurs publics et privés sont les principaux facteurs qui influent sur l'offre de nouvelles connaissances. La RD a un potentiel de « défaillance de marché » qui sollicite des solutions de politiques publiques. Ordinairement, il est impossible pour les organisations de tirer profit de tous les bénéfices économiques dérivés des nouvelles connaissances qu'elles créent. Par conséquent, du point de vue de l'utilité sociale, en l'absence de politiques publiques correctives, trop peu de RD serait effectuée.

De façon la plus directe, les gouvernements financent la RD dans les laboratoires gouvernementaux et dans les universités, ainsi que, mais à moindre échelle, dans les organisations à but non lucratif. De façon moins directe, les gouvernements accordent des crédits d'impôt aux sociétés qui consacrent des dépenses à la RD. La question de savoir si les gouvernements devraient offrir des niveaux différents de soutien financier à la RD dépend assurément des activités qui sont financées. Les économistes s'entendent sur le fait que le gouvernement devrait favoriser le financement direct des « premiers stades » de la recherche, identifiée communément comme la recherche fondamentale et appliquée.

Les nouvelles connaissances sont souvent traitées comme un bien public, ce qui explique pourquoi les gouvernements protègent la propriété intellectuelle (PI) par l'entremise des brevets, des droits d'auteurs, des marques de commerce et des dessins industriels. Cependant, alors que se renforce la protection de la PI, le rythme d'intégration des nouvelles connaissances dans les biens et les services ralentit, même si la relation n'est pas la même d'une industrie à l'autre. La fragilité des conditions concurrentielles peut encourager l'offre de nouvelles connaissances. En revanche, elle semble décourager la demande, ou l'utilisation des nouvelles connaissances.

Les politiques d'immigration jouent un rôle important dans le processus d'innovation. Au Canada, une part importante des personnes œuvrant dans les professions des domaines scientifiques et du génie provient de l'étranger ou est formée de la population étudiante qui reste au pays après sa diplomation dans les universités canadiennes. Cette offre supérieure devrait aussi encourager l'offre de nouvelles connaissances prêtes à être intégrées dans les nouveaux produits et les nouveaux processus de production.

Facteurs liés à la demande

On pourrait soutenir que les politiques du côté de la demande encouragent davantage l'innovation que les politiques du côté de l'offre; moins le nouveau savoir coûte cher, plus il sera bénéfique. Les subventions gouvernementales qui financent des activités d'innovation directement ont le plus d'impact lorsqu'elles sont destinées aux sociétés de taille petite ou de taille moyenne.

Un autre moyen pour l'innovation de connaître des risques de marché moins importants réside dans la constitution de marchés publics, qu'ils tiennent à des engagements d'achats de nouveaux produits de la part des gouvernements, ou à l'exigence envers les sociétés étrangères d'effectuer des achats locaux. Reste entière cependant la question de décider

quelles sociétés devraient en bénéficier. En effet, le financement pourrait être accordé aux sociétés plus aptes à exercer de l'influence qu'à effectuer de la RD.

Pour qu'elle soit une réussite, l'innovation nécessite une gamme d'entrées qui servent à complémenter les nouvelles connaissances, telles qu'une main-d'œuvre qualifiée, une infrastructure de communications modernes, un accès aux services professionnels et un bon système de transport. Rien n'est définitif quant au type de programme qui devrait être financé par les gouvernements pour accroître l'innovation cependant.

Les activités de RD tendent à être concentrées géographiquement parce que les ressources spécialisées convergent vers un petit nombre de lieux (ce qu'on appelle des grappes). Les grappes tendent à graviter autour des universités de recherche et des sièges sociaux. Lorsqu'on essaie d'utiliser des politiques gouvernementales pour appuyer la co-installation dans un lieu géographique en particulier, il est important de tenir compte de ses avantages comparatifs par rapport à d'autres lieux. C'est la clé du succès d'une grappe.

Les taux marginaux d'imposition élevés découragent l'innovation. La réglementation gouvernementale influe également sur la concurrence, et de nombreux faits démontrent que la concurrence encourage tant la commercialisation de nouveaux produits que l'adoption de nouveaux processus de production et d'organisation. L'évidence empirique démontre une relation forte entre l'ouverture d'une économie et la croissance de sa productivité.

Résumé et conclusions

Les facteurs qui jouent un rôle sur l'innovation se complètent tous l'un l'autre, de sorte qu'établir des politiques spécifiques qui soient les « bonnes » accroît l'efficacité des politiques déjà en place. Les politiques gouvernementales peuvent influer sur la nature et l'étendue de l'innovation à l'intérieur d'un pays en modifiant les conditions qui déterminent la présence des nouvelles connaissances ou la capacité des organisations de les incorporer dans leurs produits et leurs processus de production, ainsi que les incitations à le faire. La nature complexe de l'innovation fait qu'il est difficile de cerner les politiques qui l'encourageront véritablement. Cependant, la concurrence est un enjeu important lorsqu'il s'agit d'améliorer la productivité et l'innovation. De plus, la réduction des barrières à l'entrée dans un marché facilite l'émergence et la croissance des nouvelles sociétés, qui introduisent le plus souvent de nouveaux produits. Une politique nationale de l'innovation efficace devrait tout au moins reconnaître de façon explicite les manières dont les politiques gouvernementales influencent la situation concurrentielle des marchés intérieurs, même lorsque les lois et la réglementation sont instaurées pour atteindre différents buts de la politique publique.

Introduction[1]

Governments around the world are increasingly concerned with encouraging innovation as a means to promote increased productivity and higher standards of living. Such a goal is appropriate given that increased productivity is the main source of improved living standards and that the introduction and utilization of new technology is the major contributor to improved productivity (OECD 2010). Indeed, the federal and provincial governments in Canada have been intensely focused on encouraging research and development and innovation, since the first calls for such policies by the Science Council of Canada beginning in the early 1970s (Science Council of Canada 1971).

The purpose of this briefing is to identify and discuss government's role in encouraging innovation. While there are several issues that are particularly relevant to Canada, most of the discussion is applicable to other governments. This paper defines innovation as the introduction and utilization of new knowledge in new products as well as new organizational and production processes. While the older literature on innovation tended to focus on the introduction and spread of new production processes, the more recent literature highlights the importance of intangible assets such as new organizational forms and structures, expertise in administration, design, marketing, and the like (OECD 2010).

Innovation is a process of improvement, not an event.

While a distinction is sometimes drawn between the initial introduction of a new product or process and its subsequent diffusion, this is arbitrary in practice, since improvements to initial versions of products or processes normally occur as their utilization spreads (Cote and Miller 2012). In effect, innovation is more accurately characterized as the ongoing process of product and process improvements rather than as a discrete event. That innovation encompasses subsequent improvements of new technology creates potential conflicts for public policy, particularly with regard to intellectual property (IP) protection.

When considering public policy, it helps to conceptualize innovation as the outcome of supply and demand factors, and then assess the impact of specific public policies on either the supply or demand side of the "market" for innovation. First the main factors operating on the supply side of the market are discussed, along with the potential role of public policy. Then the focus is on the main factors operating on the demand side of the market, and the potential influence of public policies on those factors. The paper closes with conclusions and specific policy recommendations.

Supply Side Factors

It is useful to view innovation as the outcome of factors influencing the availability (or supply) of new knowledge and the usage (demand) of that new knowledge in production. While a separation of supply and demand influences is sometimes arbitrary and some factors potentially operate on both supply and demand, it helps to organize the discussion around the distinction between supply and demand factors, focusing first on government policies influencing the growth of knowledge.[2]

Research and Development (R&D)

As noted by Shapiro, Haahr, and Bayer (2007), the creation and utilization of new knowledge is ultimately the main driver of economic growth. In turn, a major factor influencing the supply of new knowledge is the quantity and quality of R&D performed by public and private sector organizations. While R&D is not the only process through which scientific and technical knowledge can be created, it is widely recognized that the performance of R&D is a major contributor underlying innovation in modern industries, as well as a contributor to the ability of organizations to absorb and utilize new knowledge created by other organizations.[3]

It is also widely recognized that R&D is characterized by potential "market failures" which, in turn, invite public policy solutions. The main source of market failure arises from the fact that it is ordinarily impossible for organizations to

capture all of the economic benefits of the new knowledge that they create. As a consequence, in the absence of corrective public policies, too little R&D would be done from the perspective of social efficiency.

GOVERNMENT FINANCIAL SUPPORT OF R&D

There are various instruments governments use to encourage more R&D. Most directly, governments fund R&D in government labs, as well as in universities and, to a lesser extent, R&D done by for-profit companies.[4] Less directly, governments offer tax credits to companies for the R&D expenditures made by those companies. The direct and indirect funding of R&D raises several policy issues. How much and what type of R&D should the government fund? Which organizations should be funded? Are tax credits effective policies to encourage industrial R&D?

It is impossible in this brief report to discuss the complex conceptual arguments and empirical evidence surrounding these issues. Hence, broad assessments of the underlying theory and evidence are provided, while acknowledging the potential for oversimplification.

The issue of whether government should offer more or less financial support for R&D is inextricably linked to what activities are being funded. The consensus of economists is that government should emphasize the direct funding of relatively "early stage" research, commonly identified as basic and applied research. There is persuasive empirical support that the social rate of return to government funded R&D is relatively high, justifying additional government funding for early stage research at the margin (Hanel 2004; Mairesse and Mohnen 2004; Globerman 2009).

> The creation and utilization of knowledge is the main driver of economic growth.

Cote and Miller (2012) argue that government financial support for basic and applied research has a relatively low payoff for Canada, which can draw on a global commons of knowledge. That is, as a small country, the supply of early-stage knowledge available to Canadian innovators is unlikely to increase significantly if more basic and applied research is performed in Canada. Consequently, they argue that the link between research in Canada and innovation by the private sector in Canada is weak.

Several points can be made in response to the argument that Canada can readily and cheaply access new knowledge created by basic and applied research elsewhere, thereby obviating the need for government support of such research in Canada. One is that government has its own non-commercial uses for research. For example, environmental policies need to be guided by scientific knowledge that is not necessarily intended to promote commercial innovation. New environmental regulations that better safeguard public health while minimizing costs to private producers are valuable social innovations in their own right. A second point is that some scientific issues may be of particular relevance for Canada, such that policymakers cannot rely upon research results from the global commons being available in a timely manner; consider the environmental impact of extracting heavy oil from the Alberta oil sands. A third point is that countries need to pay "dues" to participate in the global commons of knowledge. For example, part of the benefit to Canada of government funding of the TRIUMF lab at the University of British Columbia is that it encourages reciprocity on the part of world-class labs to host Canadian physicists, to share ideas not yet published, and so forth.

Government funded R&D takes place in government labs, universities, and private companies. The R&D performed in government labs and by universities is largely funded directly and tends to be of the basic and applied variety. The R&D carried out by private sector organizations is primarily funded through tax credits, which raises several policy issues. One is whether governments should fund university research more generously relative to research carried out in government labs. Government funded R&D in universities seems to have larger commercial benefits than R&D carried out in government labs. This primarily reflects the fact that university researchers often enjoy the legal right to profit commercially from their R&D activities (Globerman 2009). However, this does not necessarily imply that the government should stop funding government labs. Rather, it might suggest that a sharper policy distinction be made between government labs and universities in terms of their R&D missions. For example, government labs might focus more explicitly on R&D that is primarily useful to efficient government regulation of private sector activities and the supply of public goods, such as defence and public health services.

It has been widely noted that Canada has a very generous R&D tax credit regime compared to other developed countries (Parsons and Phillips 2007; Mohnen and Lokshin 2009). In addition, the Scientific Research and Experimental Development (SR&ED) tax credit is the most significant tax incentive in Canada. At the same time, Canada's perceived poor commercial innovation performance raises an important question about whether the tax credit program in Canada is largely wasted money.[5] In focusing on the supply of knowledge, a critical issue is whether tax credits simply replace the funding of R&D activities that would otherwise be financed by the private sector. If so, tax credits will not necessarily promote an increased supply of knowledge. While the available evidence is not conclusive, the results on balance indicate that for each dollar of foregone tax revenue from the tax credit, businesses invest at least an additional dollar in R&D (Mohnen and Lokshin 2009; Tyson and Linden 2012). Czarnitzki, Hanel, and Rosa (2011) provide evidence for Canada regarding the impact of R&D tax credits on Canadian innovation. Specifically, they investigate the effect of R&D tax credits on a series of innovation indicators such as the number of new products and the originality of innovation. For a sample of Canadian manufacturing firms, recipients of tax credits show significantly better scores on most but not all performance indicators. They conclude that tax credits lead to additional innovation output. More generally, Parsons and Phillips (2007) conclude that the net welfare gain from R&D tax incentives is positive for Canada when all relevant direct and indirect costs of the incentives are included in the calculations.

In short, both tax credits and direct government funding appear to contribute to an increased supply of new knowledge that is ultimately linked to increased innovation and improved social welfare. However, as Parsons and Phillips (2007) note, the relevant relationships have been identified on average rather than on the margin. The implication is that it is impossible to say with confidence whether it would improve overall social efficiency to increase direct and indirect government financial support for the creation of new knowledge.

Intellectual Property Protection

As noted above, new knowledge has public goods properties. In particular, it is often difficult for the creator of knowledge to exclude others from using the knowledge for their own gain. This attribute of new knowledge is the underlying rationale for intellectual property (IP) protection. IP protection grants some degree of exclusive usage for protected assets in the form of patents, copyrights, trademarks, and industrial designs. The policy challenge for government authorities is to determine the socially optimal degree of IP protection. In principle, stronger protection should encourage an increased production of knowledge; however, it could also slow the rate at which commercially valuable knowledge is embodied in new goods and services.[6] More generally, IP protection can discourage the entry of new firms that are themselves a source of new knowledge.

The R&D tax credit is Canada's most significant tax incentive.

It is beyond the scope of this briefing paper to review the evidence on the relationship between the strength of IP protection and the rate at which new and commercially significant knowledge is created. Suffice to say that the relationship seems dependent upon the industry. Some industries, such as chemical and biological pharmaceuticals, seem to rely relatively heavily upon patent protection, whereas computer manufacturers, at least until recently, relied more heavily on the rapid introduction of new products to protect their competitive positions.

Again, Canada's relatively small open economy creates unique issues for policy makers with respect to the efficient degree of IP protection. Specifically, many of the firms enjoying IP protection in Canada are foreign-owned. Hence, to the extent that IP protection creates economic rents, that is, profits above competitive levels, a substantial share of those rents will go to foreign shareholders. One might therefore conclude that it is efficient for Canada to have a weaker IP protection regime than the United States or other economies characterized by less foreign ownership.

In fact, this conclusion would be premature in the absence of evidence about whether and how foreign affiliates respond to IP protection. For example, if multinational companies (MNCs) are willing to locate R&D activities outside the home country, weakening IP protection in Canada could discourage knowledge creation, at the margin. This outcome would be even more likely if there are knowledge spillovers from MNCs to domestically owned firms.[7] Such knowledge spillovers would increase the expected returns to additional knowledge creation on the part of domestically owned

firms in Canada. Unfortunately, there is little available evidence on the importance of IP protection in Canada to R&D location decisions of MNCs holding constant other determinants of those location decisions.

Competition policies can indirectly influence the supply of new knowledge by affecting incentives to create new knowledge. Again, the literature relating market structure to innovation is too extensive to review in this report. The evidence indicates that industrial R&D is primarily carried out by large firms, while the initial introduction of a new product or process might actually be encouraged by imperfect competition. Such evidence suggests that the Canadian government should back off an aggressive use of the Competition Act to thwart mergers and acquisitions; however, competition, especially the threat of entry by new competitors, has been found to exert a strong positive influence on the speed at which new knowledge is utilized to create new products or to adopt new production processes. In short, weaker competitive conditions may encourage the supply of new knowledge, although it appears to discourage the demand, or utilization, of new knowledge. Hence, government IP and competition policies to influence the supply side of the market may have unintended, opposite impacts on the demand side and vice versa. The policy choice will presumably be influenced by an assessment of whether actual innovation is influenced more by supply-side factors or demand-side factors. Since most innovation builds on relatively modest increases in new knowledge, this suggests that public policy should choose to err on the side of having too much, rather than too little, competition.

> While weaker competition encourages the supply of new knowledge, it discourages its utilization.

The Supply of Scientists and Engineers

The creation of knowledge can obviously arise from many different sources; however, highly educated scientists, engineers, and other technical experts generally carry out formal R&D.[8] Hence, policies that promote an increased supply of scientists and engineers should also encourage an increase in the supply of knowledge available to be incorporated into new products and production processes.

Immigration policy plays an important role in the innovation process.

Scientific and engineering expertise is primarily created through formal education. In this regard, it is difficult to say whether Canada is spending too much or too little on formal education, particularly at the university level, since public funding of education is motivated by other considerations in addition to promoting domestic innovation. What is true for Canada, as for the US, is that a substantial percentage of scientists and engineers are either immigrants or foreign students who stay to work in the host economy after graduating from local universities. Hence, immigration policy is playing an increasingly important role in the innovation process.

> Supply-side policies may have unintended consequences on demand.

While much of the evidence on the linkage between immigration and innovation is anecdotal, there is increasing statistical evidence that skilled immigrants, and not just immigrant scientists and engineers, positively influence innovation in the host country (Hunt and Gauthier-Loiselle 2008; Downie 2010). The linkage partly reflects the impact of increasing the supply of human capital in the immigrant receiving country. It might also reflect the beneficial impact of cultural diversity on innovation (Ozgen, Nijkamp, and Poot 2011). In any case, the evidence is sufficiently strong to underscore the importance of keeping Canada's borders open to inflows of human capital from foreign countries. The relevant policies encompass both permanent and temporary immigration to Canada, as well as rules for foreign visitors.[9] Indeed, relatively little attention has been given by policymakers to promoting the increased mobility of visiting university faculty and graduate students from outside Canada into Canadian universities.

Demand Side Factors

The commitment of organizations to utilize new knowledge in order to create products and implement new production and organizational processes will be influenced by slightly different factors depending upon whether the organization is in the private or public sector. In the case of private sector organizations, incentives to produce new products and utilize new processes will depend upon the expected profitability of those innovations, as well as their perceived risks. Hence, the willingness to use new information in the private sector will increase as the expected risk-adjusted profitability of new products and production processes increases. This section focuses on the factors influencing the risk-adjusted profitability of innovations.

Immigration policy plays an important role in the innovation process.

Cost and Availability of Funding

A lower cost of capital increases the present value of future income streams. Hence, the availability of relatively low cost financial capital increases the expected profitability of utilizing new knowledge to produce new products or to utilize new production processes. In this regard, Cote and Miller (2012) argue that demand-side and sector-specific government financial support policies are more likely to promote actual innovations than financial support programs targeting the creation of knowledge (the supply-side of the innovation process).

DIRECT AND TARGETED SUBSIDIES

In contrast to the SR&ED tax incentive, which is an indirect method to subsidize private sector scientific and technical activities, government grants make financing available directly to particular companies for specific innovation initiatives. The fundamental argument in favour of direct funding and against tax credits is that the latter are available to all firms making eligible expenditures, even though many firms are presumably pursuing innovation projects that are unlikely to be commercially successful.[10] In fact, the recent action plan tabled by the Government of Canada (2012) suggests moving toward a greater use of direct funding of innovation-related activities. Two specific recommendations include doubling the contribution budget of the Industrial Research Assistance Program (IRAP) to support R&D by small and medium-sized companies and making $400 million available for venture capital funding for innovative firms that are the most likely to become global leaders.

There are prominent arguments against using direct grants or other subsidies to reduce private sector costs of capital. Most notably, it is very difficult for bureaucrats to identify promising new products or commercially talented innovators, particularly at early stages of funding. Indeed, the evidence suggests that bureaucrats have a poor record of identifying commercially successful innovations. A second concern about the use of direct funding is that targeted funding encourages "rent-seeking" behaviour on the part of potential recipients. Specifically, resources that could be used to develop new products and processes are partially diverted to lobbying for government funding of corporate projects or to modifying corporate projects to better fit government funding priorities. A third is that direct government funding might simply replace funding that companies would do from their own financial sources.

In their comprehensive overview of the SR&ED, Parsons and Phillips (2007) conclude that direct assistance in the form of grants appears likely to leverage more private sector research than tax credits, but grants are also likely to generate lower innovation spillovers for the economy. Therefore they argue that there is no evidence-based reason to choose between tax credits and grants to deliver financial support for industrial R&D. However, there is some evidence that government financial support is more effective for small firms than large firms (Mohnen and Lokshin 2009). Hence, government financing might be more "tilted" towards funding small and medium-sized companies than is currently the case.[11]

GOVERNMENT PROCUREMENT AND OTHER INDIRECT SUBSIDIES

Programs ensuring that government will purchase new products developed by domestic firms can effectively reduce the market-related risks of innovation. They can also reduce capital costs by providing a source of cash flow for

future innovation activities. Similarly, governments can require foreign-owned companies to purchase parts and components from local firms as a condition of winning government contract bids, thereby indirectly using government procurement as a risk-reduction and financing instrument. The Government of Canada's recently announced action plan calls for supporting innovation through procurement by connecting small and medium-sized companies with federal departments and agencies to build their capacity to innovate. An indirect initiative in the action plan to reduce the costs of innovation is the recommendation of the National Research Council (NRC) on demand-driven applied research that will be targeted at helping Canadian businesses develop innovative products and services. Presumably, if the NRC assumes some of the financial obligations of commercially-oriented R&D, the costs of innovation for private sector firms is reduced.

Demand-side policies arguably promote innovation more than supply-side policies.

There are several arguments against using government procurement as a policy instrument to promote innovation, and they are similar to the arguments against direct and selective funding. Specifically, if stimulating innovation is an important criterion in government purchasing, how does the government decide which specific firms are promising innovators? Furthermore, if government spends more on acquiring specific types of goods and services, it has less to spend on other potentially more robust sources of economic growth. If spending remains the same across the board, government must then take away resources (such as through taxes) from other private sector firms. Without the distortionary effects of a higher marginal tax rate, those firms might provide greater innovation benefits to the Canadian economy than the beneficiaries of government procurement programs. To the extent that government requires local purchasing of inputs and components by foreign-owned multinational companies as a condition of winning government bids, Canadian MNCs may face similar treatment by foreign governments.

The reorientation of the NRC toward more commercially oriented R&D raises issues as well. One is that government performance also depends upon innovation, and the NRC is a major source of new knowledge that the federal and provincial governments can implement in the delivery of public services. Hence, diverting resources within the NRC toward commercially oriented R&D could have a relatively high opportunity cost. Another issue is that commercially oriented R&D will likely be industry or sector specific. How does the NRC decide which industries or sectors should be the focus of its research? Making the NRC a *de facto* supplier to Canadian firms invites the same type of rent-seeking behaviour that was identified in the discussion of direct government grants. It is certainly a legitimate concern that NRC resources will be primarily allocated to industries and sectors that are more adept at political lobbying than at developing and marketing commercially successful products.

Complementary Inputs

Successful innovation requires a host of inputs that are complements to new knowledge. In particular, innovating organizations require a skilled workforce; modern communications infrastructure; access to professional business services; good transportation infrastructure; and so forth. More generally, these inputs are also required to achieve and sustain a high standard of living. Hence, an argument for government funding of education, public health, public transportation infrastructure, and the like exists independently of the goal of promoting innovation.

Still, there is some debate about precisely which programs should be funded. For example, Kanter (2012) argues strongly in favour of government funding programs that directly link business with educational institutions to ensure that educators contribute to the needs of companies seeking to develop new products or implement new processes. Others believe that direct linkages with businesses would compromise the effectiveness of educational institutions. On the other hand, permitting a policy of increased levels of immigration for highly educated and skilled workers could be targeted at promoting an increased supply of complementary inputs to facilitate innovation.

Clusters

Economists have identified the centrality of clusters to the innovation process. Specifically, R&D activities tend to be concentrated geographically because specialized resources exist in only a few locations (Narula and Santangelo 2012). When competitors in the same industry are co-located, there is more opportunity to hire skilled and experienced workers, along with greater access to knowledge spillovers. These attributes of clusters enhance the profitability of innovation for firms that locate in clusters.

The public policy issue is whether governments should actively promote clusters and how. In particular, by funding research-oriented universities, governments encourage the presence of faculty who can provide expertise to local businesses, as well as possibly create their own start-up businesses. Additionally, a substantial percentage of undergraduate and graduate students who attend a local university are likely to prefer to work in that location, thereby providing a diverse and educated workforce for local business to draw upon. As noted earlier, other factors that encourage the growth of successful clusters include good communications and physical infrastructure and a safe and healthy environment.

Funding may be allocated to those more adept at lobbying than R&D.

One important component of economic clusters is the presence of corporate headquarters. The role the latter play in encouraging and sustaining the growth of clusters has been noted in the literature (Globerman 2012). Governments frequently use tax incentives and other subsidies to encourage firms to relocate corporate headquarters to their jurisdiction; however, those incentives and subsidies frequently amount to nothing more than a transfer of wealth from taxpayers to shareholders of the recipient companies. Conversely, outward foreign direct investment (OFDI) promotes the growth of corporate headquarters in the home country without requiring taxpayer assistance. Hence, government policies that discourage OFDI likely have the undesirable consequence of discouraging innovation.

If government plays an active role in encouraging co-location of potential users and creators of new knowledge, or more generally to promote industrial clusters, it should be guided by the principle of comparative advantage. Specifically, it should explicitly acknowledge that the underlying capabilities and institutions that support the use of new knowledge to innovate vary across locations. Therefore, it is inefficient to encourage clusters in comparatively disadvantaged locations is inefficient. Furthermore, government initiatives in the name of regional equality to promote the spread of specific types of clusters are likely to damage the innovation process. Successful clusters are linked to the comparative advantages of their locations. Put simply, it is unlikely that a cluster can be sustained in a given location unless key firms can access one or more inputs that are not readily available elsewhere. For example, bio-agricultural clusters are unlikely to thrive unless they are also close to agricultural-intensive activities. Hence, government funding of companies and institutions in specific locations should be informed by the comparative advantages of those locations.

Taxes

There is an ongoing debate about the impact of a country's tax structure on entrepreneurship generally, and on innovation specifically. This is again both too broad and too complex a topic to be addressed here. Suffice to say that most experts believe that relatively high marginal personal and corporate income tax rates discourage entrepreneurs from taking the risks of starting new business ventures and firms (Llewellyn Consulting 2011). Since new firms are frequently the conduit for introducing new products and production processes into an economy, relatively high marginal tax rates are likely to discourage innovation.

R&D clusters enhance the profitability of innovation.

Competition

There is abundant evidence that competition promotes the commercialization of new products, as well as the adoption of new production and organizational processes (Schiantarelli 2008). That is, competition stimulates the demand for new knowledge to incorporate into innovations.[12] Obviously, governments have numerous

policy instruments to affect competitive conditions in domestic markets, notably international trade and investment agreements. In particular, lower domestic trade barriers will increase competition in domestic markets, as will reduced barriers to inward foreign direct investment. The empirical evidence documents a strong link between the openness of an economy and productivity growth (Edwards 1997; Persson 2009).[13]

Government regulation also affects competition, although that is rarely the primary intent. A prominent example is the adverse impact communications regulation had on the adoption of new information communications technology (ICT). A number of studies tie faster productivity growth in the US compared to Europe from around the mid-1990s to ICT-producing and using industries. Their faster growth, particularly in ICT-using sectors, is partly ascribed to less onerous regulations facing these firms in the US (Bloom, Sadun, and Van Reenan 2012; Globerman and Georgopoulos 2012). The complication is that the impacts of government regulation on competition should be assessed regularly, and regulations with substantial adverse impacts that are incidental to the intent should be modified or eliminated.

High marginal tax rates discourage innovation. The openness of an economy affects the growth rate of its productivity.

Summary and Conclusions

There are numerous public policies that potentially influence the innovation process, but the available evidence does not allow ranking them with any confidence. Nevertheless, the factors influencing innovation are complementary, so that getting specific policies "right" augments the effectiveness of other policies that are in place. Government policies can influence the nature and extent of domestic innovation by modifying the conditions that either affect the availability of new knowledge or the incentives and abilities of domestic organizations to embody new knowledge in products and production processes.

The Canadian government has utilized a range of policies to promote domestic innovation. The most high profile policies include government R&D tax credits and the funding of R&D undertaken in universities and government laboratories. The government also has directly funded applied research and development through various programs. The perception of policymakers and business leaders that government initiatives, to date, have not been successful in improving Canada's innovation performance, at least relative to other developed countries, has spawned a new action plan (Government of Canada 2012). The action plan includes an increased emphasis on direct subsidies to companies in support of specific innovation initiatives, as well as more focus of government-funded labs on helping Canadian companies commercialize technology and less on their traditional role of creating scientific knowledge.

There are grounds to question if extensive indirect government funding of commercial R&D has had the desired impact on the emergence and growth of innovative Canadian companies. Moreover, there are also grounds for concern that an emphasis on more direct and targeted government support will result in even poorer outcomes. In particular, it does not seem reasonable to expect bureaucrats to be able to identify which successful commercial innovations, even in the later stages of the innovation process, should receive government funding. Nor is it plausible that politicians will be resistant to the lobbying efforts of politically well-connected companies, even when those companies have a record of relatively poor innovation performance.

Changing one policy augments the effectiveness of others. Direct, targeted government support may not increase innovation.

While competition is not a panacea, it is an important stimulus for improved productivity and innovation. Furthermore, reducing barriers to market entry facilitates the emergence and growth of new firms that often introduce new products to markets. Many broad areas of public policy, including regulation, international trade and investment agreements, intellectual property protection, and regional development initiatives all influence competitive conditions in domestic markets, and therefore affect incentives and

rewards for successful innovation. Yet, their impacts on competitive conditions and hence domestic innovation are usually not important considerations in constructing and implementing relevant legislation and regulations. At a minimum, an effective national innovation policy should explicitly acknowledge the ways in which government policies affect competitive conditions in domestic markets, even when the laws and regulations in question are intended to achieve other public policy goals. Legislation and regulations achieving public policy goals that support and encourage competition and ease the entry of new firms should be strongly preferred to those that increase the market power of dominant domestically owned firms.

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Endnotes

1 The author thanks an unidentified reviewer for many helpful comments and suggestions on an earlier draft.

2 The various factors discussed in this report are summarized in the appendix.

3 Bosch, Lederman, and Mulroney (2005) discuss the strong relationship between R&D and innovation.

4 The Government of Canada's Action Plan (2012) calls for additional government support of advanced research at universities and other research institutions.

5 The Expert Panel on Business Innovation (2009) ascribes Canada's weak productivity performance largely to poor business innovation.

6 In this context, IP laws potentially affect both the supply and usage of new knowledge.

7 For a survey of evidence on knowledge spillovers to host country firms from inward foreign direct investment, see Globerman and Chen (2010).

8 Highly educated professionals are also often required to embody new knowledge in the design and production of new products and production processes. Hence, public policies affecting the supply of highly educated labour affect both the supply and demand for innovation.

9 The recently released Action Plan of the Government of Canada (2012) identifies moving to an increasingly fast and flexible immigration system to meet Canada's labour market needs as a government priority.

10 The SR&ED tax incentive program gives claimants cash refunds and/or tax credits for their expenditures on eligible R&D work done in Canada. Work that qualifies for SR&ED tax credits includes basic research, applied research, and experimental development to achieve technological advancement to create new materials, devices, products, or processes, or improve existing ones.

11 For example, under the SR&ED Program, Canadian controlled private companies can earn an investment tax credit of 35 percent up to the first $3 million of qualified expenditures and 20 percent on any excess amount. The credit allowances might be tied more directly to the size of the company making any given sized eligible expenditure.

12 There is more controversy surrounding the linkage between competition and the supply of new knowledge, as noted earlier. One prominent perspective is that oligopolistic market structures with moderate barriers to entry are most appropriate for encouraging early stage industrial research and development to create new knowledge. To the extent that patents provide a substitute method for protecting intellectual property rights, and to the extent that the conditions surrounding the granting of patents do not unduly restrict usage of new knowledge, competition is feasible on the demand side of the market without necessarily compromising incentives to create knowledge.

13 It is therefore noteworthy that the Government of Canada's (2012) Action Plan commits the government to pursuing new and deeper trading relationships and addressing security and regulatory-related barriers to trade and investment flows with the United States.

Appendix
Factors and Policies Influencing Innovation

Supply-Side

R&D (government funding)
Intellectual Property Protection (IP legislation)
Competition (Competition legislation and enforcement)
Scientists and engineers (Public education; immigration policy)

Demand-Side

Cost and availability of risk capital (Direct government subsidies; tax credits)
Demand for new products (Government procurement; offsets)
Development costs (Government labs augment commercial labs)
Competition (Trade and investment agreements; regulation)
Clusters (Provision of public goods; OFDI)
Complementary inputs (Education; public health; infrastructure)
Entrepreneurship (Marginal tax rates)

About the Author

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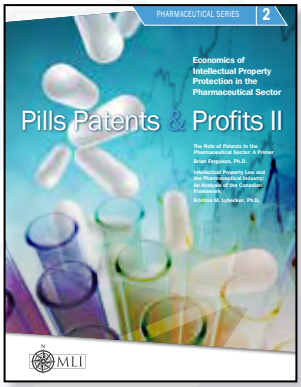

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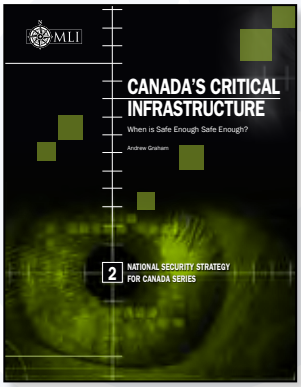

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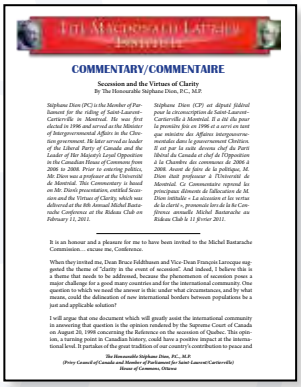

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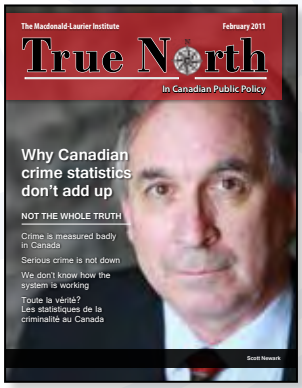

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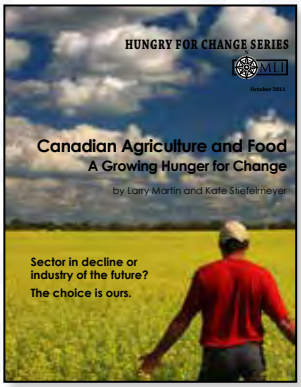

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