

Canada's R&D Performance: Are we missing the Boat?

*Surendra Gera, Ph.D.
Senior Fellow
Canada-India Centre for Excellence
Carleton University, Ottawa*

I. Introduction

Innovation has been the main source of long-run economic growth and of increased standard of living. It is through innovation that new products are created and existing products are produced more efficiently to take a larger share of global market. Innovation is a result of several factors but R&D is the most important one. So R&D plays an important role in generating new ideas, technologies and efficient processes that contribute to overall innovation and productivity gains in the economy.

Both private markets and government have a role to play in R&D investment. Private markets do investment with the expectation that they will be able to recover the cost and generate profits with new innovation. The government, besides conducting basic research, has an interest to provide R&D subsidy to the private sector. This is in a way correction of market failure. Firms expecting that part of their return will be absorbed by some other so they invest sub-optimally (less than socially optimal). Knowing this, government provides subsidy so that innovation takes place and investing firms get all the return they generate and society gets back the subsidy in the form of spillovers.

In that context, we evaluate the R&D performance of both the private and the government sector. This paper outlines Canada's overall R&D performance, its relative position with the other OECD countries, especially our next door neighbour- U.S.A. We also provide some diagnostics of "why we are where we are now".

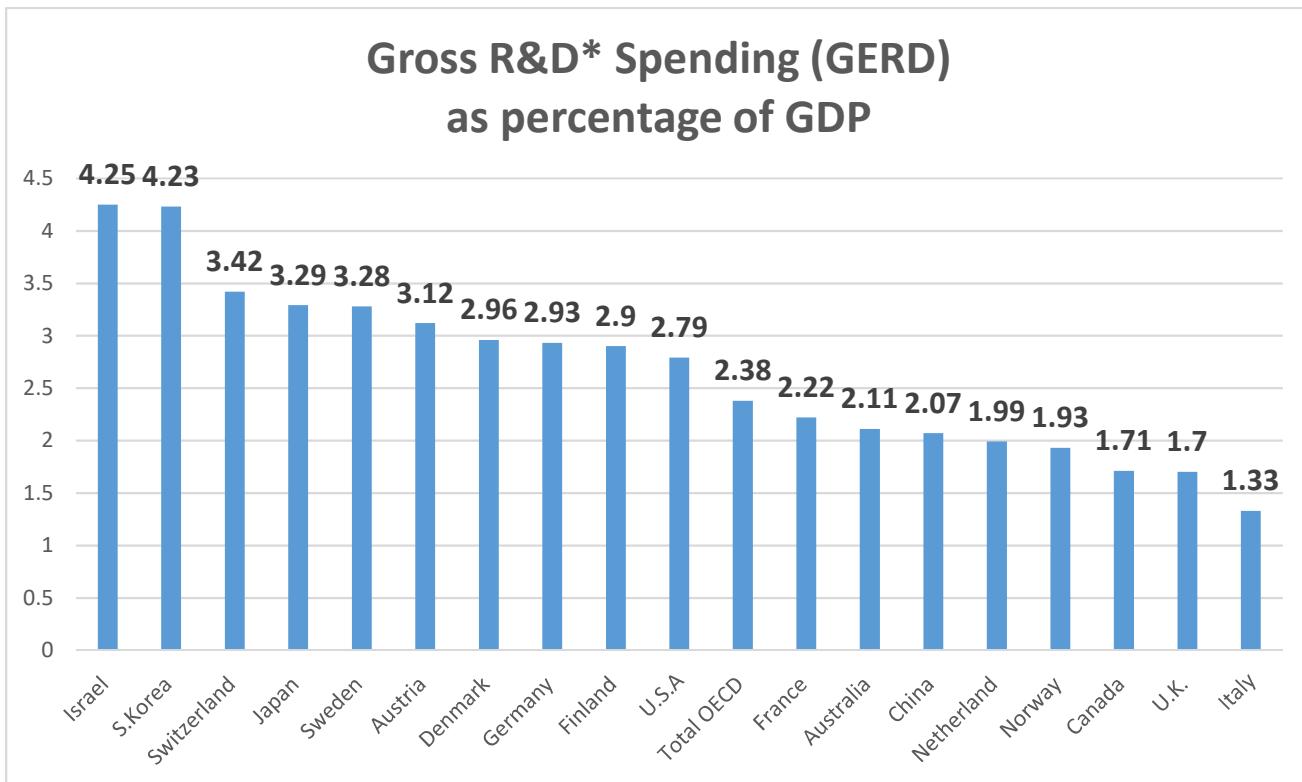
Canada's Aggregate R&D Performance

As in major OECD countries, the three main R&D performing sectors in Canada are: 1) the business community, (BERD); 2) the higher education sector (HERD); and 3) the government of Canada, or intramural R&D (GOVERD). In addition to doing research, the government plays an even more important role encouraging others to undertake R&D through funding support. The sum of all three R&D expenditures is termed as Gross Domestic Expenditure on R&D (GERD). GERD

intensity – spending as a percentage of gross domestic product - is considered an important measure of a country's investment in innovation.

The Organization for Economic Co-operation and Development (OECD) publishes international statistics on R&D as part of its Main Science and Technology indicators (MSTI). Compared to key innovative economies in the OECD, Canada's GERD intensity at 1.71% was well behind the U.S. (2.79%) and the OECD average (2.4%) in 2015. Canada ranked 16th out of 18 countries. Israel had the highest ratio at 4.25%, followed by South Korea at 4.23%, and Japan at 3.5%. China continued its steady increase in R&D intensity, reaching 2.1% in 2015, only 0.3 of a percentage point below the OECD average (Figure 1).

Figure 1



*Gross Domestic Expenditure for R&D (GERD as percentage of GDP)

Source: Main Science and Technology Indicators (MSTI), February 2017

Key Messages

- *Canada's GERD intensity in 2015, ranked 16th among 18 OECD countries*
- *Canada's GERD intensity is 62% of that of the U.S.*

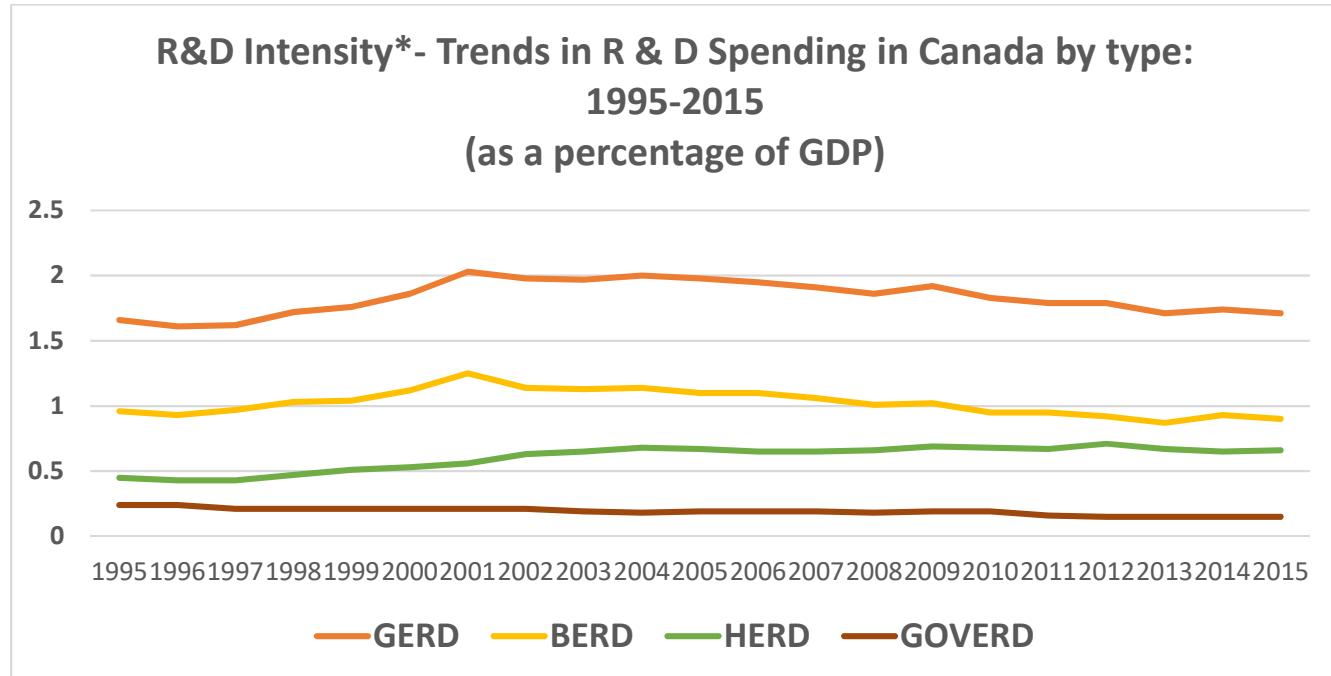
- *To meet U.S. performance Canada needs additional R&D investment of roughly 1 billion dollars*

Canada, in fact, has been laggard in terms of R&D investment, and increasingly so. A decade ago, Canada's R&D performance vis-à-vis major OECD countries was not as weak as in 2015. For example, in 2005, Canada's GERD intensity was 75 per cent of the U.S.

A key question is: *how could we deviate in GERD intensity so much compared to that of the U.S.A. while competing the same market. More importantly, which R&D type – BERD, HERD and GOVERD - has contributed to the fall in GERD intensity!*

This question leads us to decompose Canada's R&D by three sectors and evaluate which of the three has contributed to this unsatisfactory result. In Figure 2, we map R&D spending (as a percentage of GDP) by all three sectors – BERD, HERD, and GOVERD. Both HERD and GOVERD constitute public R&D, while BERD spending is by private firms.

Figure 2



*R&D intensity is defined as R&D spending as percentage of GDP.

Source: OECD Main Science and Technology Indicators database, February 2017 (MSTI)

HERD Intensity

In the mid-1990s, federal government introduced major new investments in higher-education R&D, in particular through the creation of the Canada Foundation for Innovation and the Canada Research Chairs program. As a result, Canada's HERD intensity grew from 0.45 per cent in 1995 to a high of 0.67 per cent in 2005. In 2005, our HERD intensity was much higher than the U.S.A (0.36) and the total OECD (0.38). The result has been to shift Canada to the fore front of developed countries investing in higher-education.

In 2015, at 0.66 per cent of GDP, Canada ranked 6th among the OECD countries. It is because growth of HERD has been comparable, even faster than OECD average. Canada performed well ahead of the OECD average (0.42 per cent), and many OECD countries including U.S.A. (0.37 per cent), the U.K. (0.44 per cent), and Japan (0.40 per cent). However, Canada remained behind Denmark (0.99 per cent), Switzerland (0.91 per cent), and Sweden (0.88 per cent).

- *Between 1997 and 2015, overall HERD intensity in Canada has not fallen (see Fig. 2).*

Government Intramural R&D (GOVERD)

Besides contributing directly to higher education, government also contributes to R&D through government labs involved in the federal laboratory system*. That said, Canada is not a leader in its level of intramural R&D support.

Key Message

- Overall, GOVERD is a small part of GERD in Canada, and overtime its contribution to GERD has been stable (Figure 2).

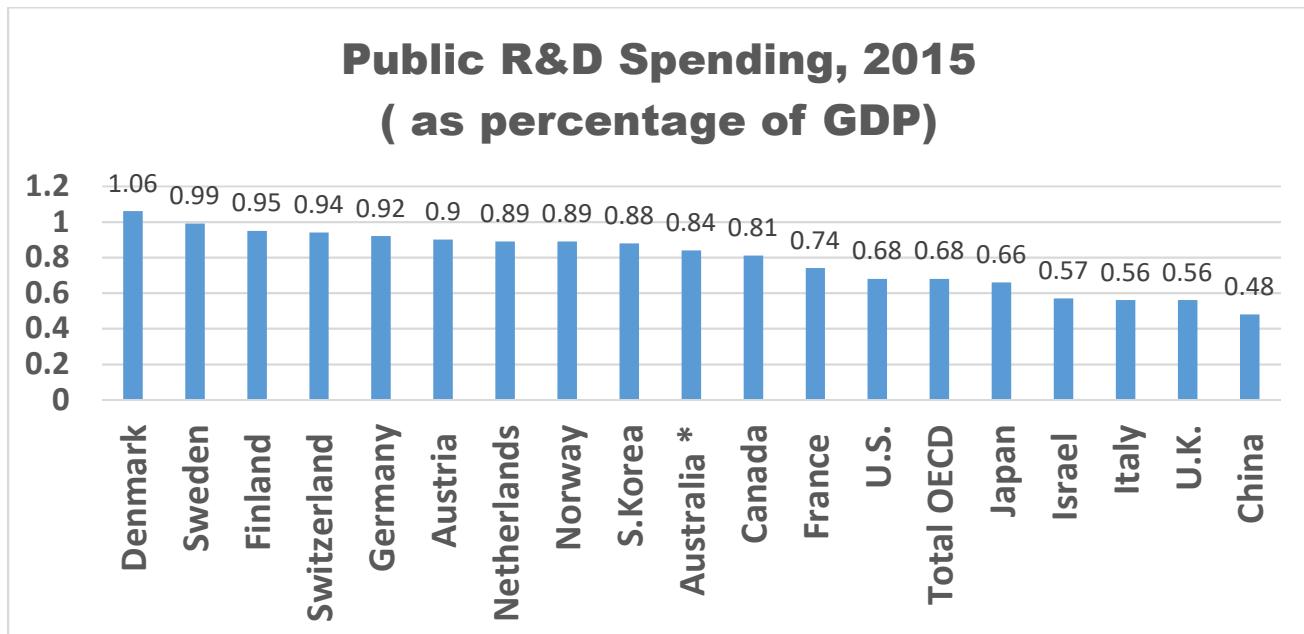
*Government-financed R&D includes: all R&D performed using government funds in all sectors of the economy; and R&D performed by businesses or universities under government contracts or grants, and within government.

Public R&D Spending

Combining both HERD and GOVERD, the public R&D spending as a percentage of GDP is not far off as it was a decade ago. In 2005, share of public R&D in GERD in Canada was 0.43 per cent, which had risen to 0.47 per cent in 2015 (see Figure 3). This indicates that Canada's falling performance in GERD may have come mainly through lower BERD. This point was also made recently by Conference Board of Canada. "Canada is middling performer on public R&D Spending. Although the proportions of higher-education and government spending in the public spending mix have shifted, Canada's overall performance has not changed over the past three decades".

Figure 3: Public R&D Spending, 2015

OECD Countries and Selected non-member Economies



In 2015, Canada ranked 11th out of 18 countries on public R&D spending. Denmark, Sweden, Finland, Switzerland, and Germany had been high performers on public R&D spending. Canada's performance on public R&D spending relative to its international competitors has been mediocre*.

*This point was also made by Conference Board of Canada in their note on Public R&D Spending dated 28th August, 2017. Their findings related to 2011 data.

Business R&D Spending (BERD)

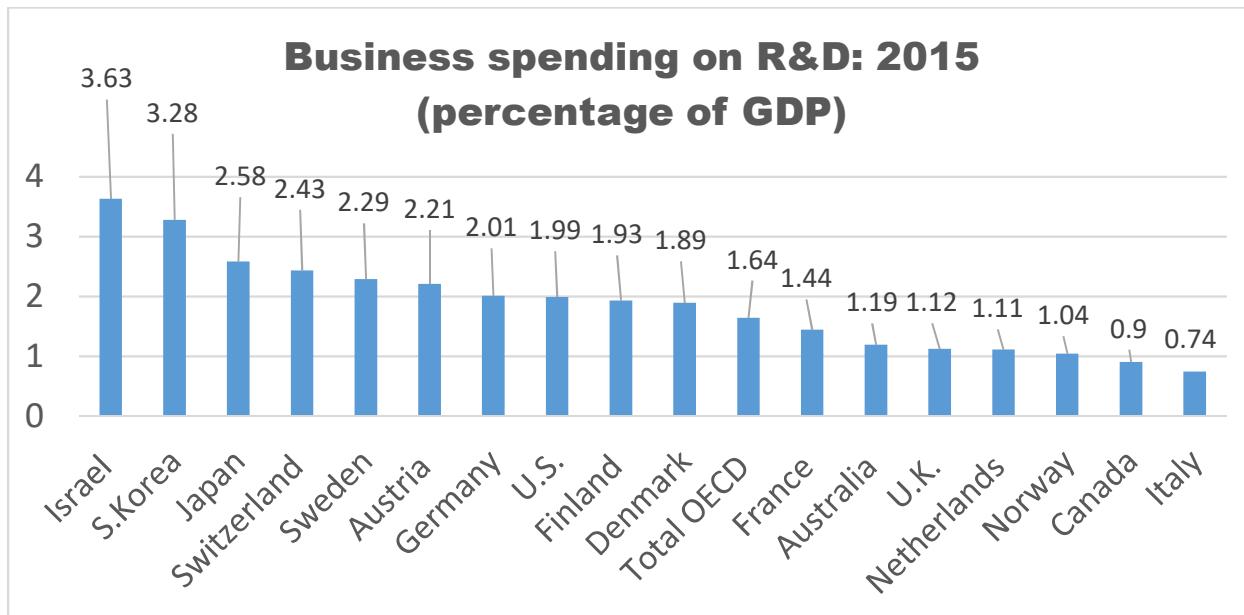
Business R&D and commercialization is the single most important contributor to innovation, yet Canadian businesses invest less in R&D, machinery and equipment, technology adoption and highly qualified people than their competitors and the OECD more broadly.

From Figure 2, we see that BERD intensity (BERD as a percentage of GDP) has fallen: In 2015, we are even lower than where we were in 2005 with intensity of 1.10 per cent. We recognize that the government role is important but the major driver of innovation is the private sector creating a business environment and market framework. The worry is not only that GERD intensity has fallen, it is more due to the fact that BERD intensity has fallen. To increase public R&D is not a herculean task, it can be done by pouring public money. The challenge is how to change the behaviour of the private sector, the lynchpin of innovation, to do more R&D?

Figure 4 shows that in 2015, thanks to Italy that Canada was not the worst performer. Canada at 0.90 per cent of GDP in 2015, its BERD spending is significantly below that of the U.S. (1.99 per cent) and the OECD average of 1.64 per cent. Why our businesses invest only 45 per cent of what U.S. businesses perform? Canada is also well behind leaders - Israel (3.63 per cent), South Korea (3.28 per cent), Japan (2.58 per cent), Switzerland (2.43 per cent), Sweden (2.29 per cent), Austria (2.21 per cent) and Germany (2.01 per cent) (Figure 4).

Canada was not that much laggard historically. In 1995, Canada's BERD intensity was 57 per cent of the U.S. level; in 2005, it increased to 64 per cent, and in 2015, it again dropped to 45 per cent of the U.S. level. In the last decade (2005-2015), U.S. BERD intensity rose from 1.73 to 1.99 per cent, whereas Canada fell from 1.10 per cent to 0.90 per cent. Two important points to note: First, at almost half BERD intensity of the OECD average, Canada's laggardness in BERD intensity is even more alarming than the case for GERD intensity; and second, not only Canada lags behind the U.S., the gap in BERD intensity between the two countries is widening more rapidly (Fig. 5). *Is it that our firms are more accustomed to imitate U.S. leaders rather than taking risk of being a leader?*

Figure 4



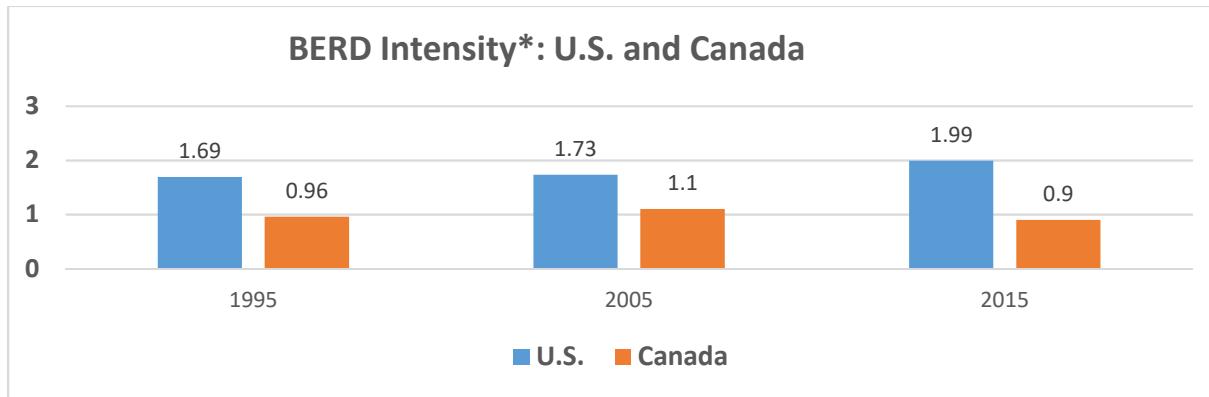
*BERD Intensity is defined as BERD spending as percentage of GDP.

Source: OECD Main Science and Technology Indicators (MSTI) database, February 2017

Smaller firm size in Canada is often mentioned as a possible reason for poor innovation performance and low intensity of business R&D (BERD). Research suggests that small firms play no role in the BERD intensity gap between Canada and the U.S. The gap between the two countries is primarily due to the higher R&D intensity of large firms in the U.S., and the prevalence of large firms in the U.S. relative to Canada. BERD intensity is lower in Canada than in the U.S. largely because of a smaller number of large-sized firms in Canada that also perform less R&D.

Research shows that the main reason for low BERD intensity is due to lower R&D performance of larger firms in Canada vis-à-vis the U.S. If this is the case, the only way to match U.S. is by having larger firms and incentivizing those firms to do R&D. What is the leverage the government has? We already have very generous tax credit. So what is lacking? We have comparable business climate. We have almost integrated North American market. So what is the culprit!

Figure 5.



*BERD intensity is defined as BERD spending as percentage of GDP

Key messages:

- Canada ranks 17 out of 18 peer OECD countries.
- BERD expenditures as a share of GDP are roughly half the U.S. level and declining.
- The BERD intensity gap between Canada and the U.S. is largely driven by Canada's low R&D intensity in the manufacturing sector.
- BERD intensity is lower in Canada than in the U.S. largely because of a smaller number of large-sized firms in Canada that also perform less R&D.

To Sum Up

It always make sense to compare Canada with the US, not only because it is the most dynamic world economy but more so because (i) Canada's market is well integrated with the US; and (ii) US firms are the first line of competitors for Canadian firms. As we noted above, Canada's GERD intensity relative to the US has fallen over time. Both public and private R&D have contributed to Canada's laggardness in GERD intensity. On the one hand, Canada's public R&D intensity has been historically higher than that of the U.S. but that lead is falling over time. On the other hand, Canada's BERD intensity has been historically lower than that of the US and this laggardness is further deteriorating over time. Nevertheless, it is the BERD intensity performance that is more worrisome. Despite very generous

R&D credit program in Canada, why is the case that the BERD intensity is so low? Is it because Canada's instrument used to boost private R&D is blunt, needing to change? Or is it because the other factors are so powerful to bring Canada's R&D low that even generous subsidy will not be able to help?

It is generally argued and might be true that Canada's low BERD intensity is due to lack of firms that are large in size. According to an estimate, in 2016 the total R&D expenditure of four main R&D spender firms (Amazon, Alphabet, Microsoft and Apple) was \$45 billion. By comparison, Canada's total GERD spending was US\$27 billion of which BERD was \$14 billion. In other words, those four firms spend more than 60 per cent of Canada's overall R&D spending and more than three times than Canada's private R&D spending.

In short, the solution seems to be to have more large firms that are innovative. However, how to get there is a challenge. High skill labor, competitive tax structure, more integrated Canadian market, removal of policies that might be hindering firms to grow bigger might be the solution to that direction.



Carleton
UNIVERSITY
Canada's Capital University



Canada-India
Centre for Excellence