

## Patenting activity of Canadian-resident businesses



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# ***Patenting activity of Canadian-resident businesses***

by *Chahreddine Abbès, John Baldwin, and Danny Leung*

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## **Abstract**

This article presents some initial findings from a new longitudinal database created from administrative data sources to study patenting in Canada. The study of patenting is important, as patenting is a measure of innovative activity and has been linked to positive economic outcomes for firms. Over the 2001-to-2015 period, Canadian-resident businesses increasingly filed patent applications in the United States, and that the increase was accounted for by smaller, younger firms in service industries. Patent applications to other patent offices by Canadian-resident business declined over the same period. Technical areas where applications to the United States increased the most include civil engineering, medical technology, information technology methods for management, computer technology, transport, and digital communications. Finally, evidence is presented that suggests, for Canadian-resident businesses, the economic outcomes associated with filing a patent in the United States are similar to those of filing for a patent application in Canada. Once firm and industry characteristics are controlled for, data show that filing for a patent is associated with a 7.5% increase in the probability of experiencing high employment growth and a 12.9% increase in the probability of experiencing high revenue growth.

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## Introduction

Innovation is said to be a major contributor to economic growth.<sup>1</sup> While innovation can refer to a number of things, for the purpose of measurement and comparison of innovation in businesses, the Organisation for Economic Co-operation and Development and Eurostat (2018) recommend that innovation refer to product (good or service) innovations or business process innovations that differ significantly from previous products and processes. Like many countries, Canada collects data on innovation through surveys, such as the Survey of Innovation and Business Strategy.<sup>2</sup>

Considering the lack of universal definition of the notion of “innovation,” researchers have used intellectual property (IP) to measure it. As stated by Corbin (2010), IP constitutes the measurable component of innovation. IP allows the broad concept of innovation to be concretized by a set of measurable economic components (e.g., patents, industrial designs, trademarks, etc). It facilitates the study of the relationship between innovation and economic benefit, despite the fact that not all innovations are protected by IP rights, and not all IP rights have economic value.<sup>3</sup> Various countries and world organizations have used the number of patents, trademarks, industrial designs and registered copyrights as proxy measures of country innovativeness.

Patents, along with other forms of IP, are an important tool used by businesses to protect their innovations. Patents can be sought for inventions that are novel, are inventive and have industrial usefulness.<sup>4</sup> Patent holders have the right to stop others from making, using or selling their inventions for a period of 20 years from the filing date in the country in which the patent was granted. Patent statistics have also been used by some as an alternative measure of innovation.<sup>5</sup> Statistics Canada’s 2019 Intellectual Property Awareness and Use Survey shows that innovation and patent statistics can be complementary.<sup>6</sup> It found that not all businesses engaged in innovative activities were patent owners,<sup>7</sup> and not all patent owners were engaged in innovative activities.<sup>8</sup> It also found that 60.3% of patent owners were innovators, while 7.8% of businesses engaged in innovative activities were patent owners.

Patent statistics can also be important because they shed light on an aspect of the innovation process, which, for policy makers and businesses, can be as important as measuring innovation itself.<sup>9</sup> Understanding the factors and inputs that contribute to inventions, and the strategies and circumstances that lead to the successful introduction of those inventions to market, informs the development of economic policy.

To complement the existing survey data already being collected, Statistics Canada has developed from administrative data sources the Canadian Patent Research Database, which can be used

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1. See Schumpeter (1942).
  2. See <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5171> for more information.
  3. According to Brydon et al. (2014), more than 40% of patents were acquired and never used (have no economic value).
  4. According to the Canadian Intellectual Property Office, an invention is eligible for patent protection if it is new, useful and inventive. For more details, visit <http://www.ic.gc.ca/eic/site/cipolInternet-Internetopic.nsf/eng/wr03716.html>.
  5. See Brydon et al. (2014), Griliches (1990), the OECD (2009) and Nakaoka et al. (2010), for example.
  6. See <https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5291> for more information about the survey.
  7. Businesses could be using other forms of IP or trade secrets to protect their innovation. See, for example, Cohen et al. (2000), Levin et al. (1987) and Arundel (2001).
  8. Patent applications could be made for reasons other than to protect a business’s IP. They could be used to hinder the innovation activities of competitors. See Czarnitzki et al. (2020), for example.
  9. Dziallas and Blind (2019) conducted a literature review of scientific publications on innovation indicators to give an overview of the landscape of indicators covering all stages of the innovation process.

for analysis on innovation in Canada. The Canadian Patent Research Database was created from the European Patent Office Worldwide Patent Statistical Database (PATSTAT) and linked to administrative data sources at Statistics Canada on business performance and business activities.<sup>10</sup> For businesses with operations in Canada, the Canadian Patent Research Database gives the year of application, application authority, technological sector and field of the patent, whether the patent was granted, and other patent application characteristics for the period from 2001 to 2015. When linked to other Statistics Canada administrative data sources, it can be used to examine trends in patenting by firm characteristics. It complements existing survey data by providing a longer-run view of patenting activity in Canada. It offers the ability to disaggregate the data further because it contains data on all firms patenting in Canada and the ability to conduct longitudinal analysis (for example, to study the link between patenting and firm growth). This article highlights some of the initial findings from the database.

The article first looks at aggregate trends in patenting activity of Canadian-resident businesses (businesses with operations in Canada). It finds that there is a shift toward applications made to the United States Patent and Trademark Office (USPTO) underlying a modest increase in patent applications overall. The article takes advantage of the newly constructed database to examine the drivers of these trends by firm size, firm age, industry and technology field. It then presents evidence on whether there are economic consequences to the shift in applications toward the USPTO.

The number of patent applications made by Canadian-resident businesses has increased slightly over the 2001-to-2015 period. All of the increase was accounted for by an increase in patent activity in the United States. The number of patent applications filed at other patent offices, including the Canadian office, declined. The increase in applications in the United States was accounted for by smaller, younger firms in service industries, while the decrease in applications at all other offices was traced to larger firms and firms in manufacturing. The top five technical areas in which patent applications increased include civil engineering, medical technology, information technology (IT) methods for management, computer technology and transport. An area in which applications increased in the United States, but not at other offices, is digital communications. Finally, evidence is presented that suggests that, for Canadian-resident businesses, the economic outcomes associated with filing for a patent application in the United States are similar to those of filing for a patent application in Canada. Furthermore, filing for a patent is found to be positively correlated with the probability of experiencing high employment and revenue growth.

## **Canadian-resident businesses are increasingly filing for patent applications in the United States**

The number of patent applications made by Canadian-resident businesses has increased modestly over the 2001-to-2015 time period (Figure 1). It has increased from around 8,100 applications in 2001 to 8,500 applications in 2015. This small increase obscures larger changes to where Canadian-resident businesses are filing for their patent applications. Canadian-resident businesses are increasingly filing for patents at the USPTO. Patent applications to the USPTO rose from around 1,800 applications in 2001 to about 4,000 in 2015. Since 2008, the USPTO has been the leading destination for patent applications by Canadian-resident businesses. This increase has been offset by declines in patent applications at the Canadian Intellectual Property

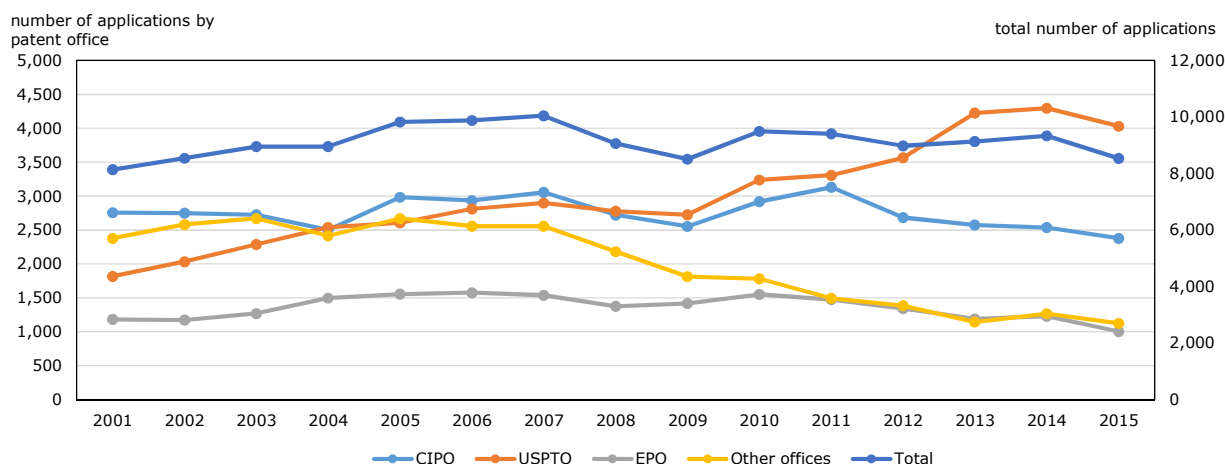
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10. See Abbes et al. (2022) for more details on the creation and content of the Canadian Patent Research Database.

Office (CIPO), the European Patent Office (EPO) and other offices around the world.<sup>11</sup> The largest decrease in the number of applications was to the other offices category, which fell from 2,400 applications in 2001 to 1,100 applications in 2015.

The observation that patent applications by Canadian residents have increased at the USPTO has been made before by Greenspon and Rodrigues (2017).<sup>12</sup> However, because the Canadian Patent Research Database is linked to other firm-level data sources, additional insights can be gained on what is behind the increase.<sup>13</sup>

**Chart 1**  
**Patent applications by Canadian-resident businesses by patent office, 2001 to 2015**



**Notes:** CIPO is the Canadian Intellectual Property Office; USPTO is the United States Patent and Trademark Office; EPO is the European Patent Office; and Other offices is offices other than CIPO, the USPTO and the EPO.  
**Source:** Statistics Canada, Canadian Patent Research Database

## Smaller, younger firms in service industries are responsible for the increase in patenting by Canadian-resident businesses in the United States

Patent are applied for by both young and small firms and older and larger firms (Table 1). In 2001, small firms with 0 to 19 employees accounted for about one-quarter of patent applications at each patent office, while firms with 500 or more employees accounted for about 40% or more. At the same time, new firms (0 to 1 year of age) accounted for around 13% of applications, while older firms (11 years of age and older) accounted for around 50%. In 2001, patent applications were

11. Applications to the World Intellectual Property Organization are allocated to the office where the examination of the patent took place.
12. Greenspon and Rodrigues (2017) use a different data source and a different methodology. Although this article focuses on patent applications made by Canadian-resident businesses and Greenspon and Rodrigues examine patent applications made by Canadian-resident inventors, the result trends in patenting by Canadians at CIPO and the USPTO are similar.
13. This article focuses on firm size, firm age, industry and technology field in its investigation of possible drivers of the trends. Future work using the new Canadian Patent Research Database could examine deeper issues such as the incidence of patenting among firms, the intensity of patenting, and the patenting of the same invention in multiple jurisdictions.

concentrated in the manufacturing industry (over 50%), but a large fraction was also in the professional, scientific and technical services industry (around 20%).

Between 2001 and 2015, there were some changes in these shares. Although small firms with 0 to 19 employees accounted for 23.0% of USPTO patent applications in 2001, they accounted for 38.0% in 2015. USPTO patent applications rose by 2,215 between 2001 and 2015, and small firms accounted for 50.1% of that change. In contrast, large firms with 500 or more employees accounted for 48.9% of USPTO patent applications in 2001, but for 28.6% of them in 2015. Large firms accounted for 12.2% of the change in the number of USPTO patent applications between 2001 and 2015.

The changes by firm age were less stark. The youngest firms, those 0 to 1 year of age, accounted for 10.8% of USPTO patent applications in 2001 and 16.2% of the change between 2001 and 2015. The oldest firms, those aged 11 or older, accounted for 60.1% of USPTO applications in 2001 and 47.8% of the change in applications.

However, there were more significant changes by industry. Although businesses in manufacturing accounted for the majority of USPTO patent applications in 2001 (58.3%), they accounted for 8.4% of the change between 2001 and 2015. Most of the change was because of trade (15.1%); professional, scientific and technical services (30.7%); and other service industries (37.3%).

The source of the decreases in the number of patent applications at other offices almost mirrors the explanation for the increase in applications at the USPTO. Larger firms were mainly responsible for the decrease in the number of applications at the other patent offices examined, but especially at CIPO and the EPO. In 2001, large firms with 500 or more employees accounted for 40.6% and 44.4% of patent applications at CIPO and the EPO, respectively. By 2015, the large firm share of patent applications at CIPO and the EPO fell to 33.8% and 36.4%, respectively. Large firms with 500 or more employees accounted for 83.6% of the (-380) decrease in applications at CIPO, 90.8% of the (-181) decrease in applications at the EPO, and 49.6% of the (-1,254) decrease in applications at other patent offices.

When the decreases in applications are broken down by firm age, firms that are 2 to 5 years old were primarily responsible. In fact, 77.2% of the decline in patent applications at CIPO were because of these firms, compared with 73.0% at the EPO and 34% at other patent offices.

Finally, most of the declines in the number of applications at CIPO, the EPO and other patent offices were because of declines in applications made by businesses in manufacturing. Businesses in manufacturing accounted for 137.2% of the decline at CIPO, 157.1% of the decline at the EPO and 62.3% of the decline at other patent offices. The decline in the number of applications at CIPO and the EPO was offset somewhat by increases in the number of applications, most notably, in trade and other service industries.

**Table 1**  
**Number and share of patent applications, and share of change in patent applications by firm characteristics and patent office**

	Applications in 2001					Applications in 2015					Change in applications between 2001 and 2015			
	CIPO	USPTO	EPO	Other	Total	CIPO	USPTO	EPO	Other	Total	CIPO	USPTO	EPO	Other
	number													
<b>Total</b>	2,757	1,817	1,185	2,378	8,137	2,377	4,032	1,004	1,124	8,537	-380	2,215	-181	-1,254
	percent													
<b>Employment size of firm</b>														
0 to 19 employees	25.8	23.0	24.4	25.9	25.4	38.5	38.0	38.3	38.0	37.7	-55.9	50.1	-56.4	13.1
20 to 99 employees	18.6	13.8	15.6	18.4	17.5	17.6	19.2	13.1	19.4	17.4	25.1	23.6	30.1	17.4
100 to 499 employees	15.1	14.3	15.7	16.0	15.1	10.0	14.2	12.2	12.3	12.0	47.3	14.1	35.6	19.9
500 or more employees	40.6	48.9	44.4	39.7	42.0	33.8	28.6	36.4	30.3	33.0	83.6	12.2	90.8	49.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>Age of business</b>														
0 to 1 year	13.5	10.8	11.7	12.6	12.8	10.7	13.8	10.5	9.6	11.8	31.1	16.2	18.4	15.7
2 to 5 years	22.7	16.3	23.3	23.7	22.0	14.2	16.9	14.8	14.0	15.3	77.2	17.4	73.0	34.0
6 to 10 years	14.7	12.9	16.0	17.1	15.2	11.2	16.0	11.7	16.9	13.6	36.9	18.6	41.1	17.3
11 or more years	49.1	60.1	49.0	46.6	50.0	63.9	53.3	63.0	59.5	59.3	-45.2	47.8	-32.5	33.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<b>Industry</b>														
Unclassified	10.1	11.5	9.5	14.2	11.0	7.4	5.9	6.5	3.2	6.3	27.4	1.4	26.4	25.9
Other goods industries	2.0	0.9	2.2	2.0	1.8	3.1	2.2	1.7	1.4	2.2	-4.9	3.3	4.9	2.7
Mining, oil and gas	7.3	1.4	1.1	2.3	3.5	9.9	2.8	1.4	2.7	8.3	-8.9	3.9	-0.6	1.9
Manufacturing	50.3	58.3	55.2	50.0	52.0	36.7	30.7	37.7	38.5	33.1	137.2	8.4	157.1	62.3
Trade	3.5	3.6	4.0	5.1	4.0	9.1	9.9	6.5	6.2	8.1	-32.0	15.1	-11.0	4.1
Professional, scientific and technical servi	17.9	16.4	19.5	17.8	19.0	18.3	24.3	23.0	32.1	23.2	15.3	30.7	-0.6	2.8
Other service industries	8.9	7.9	8.6	8.4	8.6	15.6	24.2	23.2	15.9	18.8	-34.0	37.3	-76.1	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Notes:** CIPO is the Canadian Intellectual Property Office; USPTO is the United States Patent and Trademark Office; EPO is the European Patent Office; and Other offices is offices other than CIPO, the USPTO and the EPO.

**Source:** Statistics Canada, Canadian Patent Research Database.



## Canadian-resident businesses are increasingly patenting in the technology field of civil engineering

Overall, the number of patent applications by Canadian-resident businesses increased the most in civil engineering (for example, the construction of buildings and roads, and some mining infrastructure).<sup>14</sup> Between 2001 and 2015, the weighted<sup>15</sup> number of patent applications in civil engineering grew by 317. Medical technology (+198), IT methods for management (+153), computer technology (+153) and transport (+127) were the four other areas that showed the largest increases between 2001 and 2015.

When only patent applications to the USPTO are considered, the top fields are similar. Between 2001 and 2015, the weighted number of applications increased the most in the field of computer technology (+300), civil engineering (+235), digital communications (+227), medical technology (+185), transport (+142) and IT methods for management (+132). Interestingly, despite the increase in patenting in digital communications at the USPTO, overall, Canadian-resident businesses are patenting less in the area of digital technologies (-160). There were declines in the number of patent applications in digital communications at CIPO, the EPO and other patent offices.

## Data show that Canadian-resident businesses that file for patent applications are more likely to experience an episode of high growth, regardless of where the patent application is made in Canada or the United States

The increase in patent applications made to the USPTO by Canadian-resident businesses could be motivated by a number of factors. Zhao (2020) notes several differences in the patent systems in Canada and the United States. The USPTO allows for patents in areas related to medical methods and software and business methods, while CIPO requires a technical solution (a computer) as an essential element of a construed claim in these cases;<sup>16</sup> patents proceed to examination automatically at the USPTO, while a separate request for examination is required at CIPO; and there are annual maintenance fees for patents and patent applications at CIPO, while maintenance fees are due only three times over the life of a patent at the USPTO. Ultimately, differences in the potential monetary benefits from holding a patent in the United States versus Canada because of differences in the size of the markets may be an important factor, but it is not clear why this factor has changed over time.

Investigating further the reasons behind the increase in patenting in the United States is beyond the scope of this first article using the new Canadian Patent Research Database. Instead, some evidence on the relationship between filing for patents and growth at the firm level is presented to see whether the economic outcomes of applying at CIPO and the USPTO are different.

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14. More details on the technological fields in patent applications can be found in Schmoch (2008).

15. Since a patent application can be associated with more than one technological field, the applications give weights to each field the patent belongs to. For a given patent application, the weights sum to one.

16. According to the *Patent Act*, mere scientific principles and abstract theorems are not patentable. However, where a computer is found to be essential to construct a claim, the claimed subject matter can be perceived as statutory. For more details, visit [Examination Practice Respecting Computer-Implemented Inventions](#).

Table 2 shows that firms that applied for at least one patent over the 2001-to-2015 period to any patent office had a 25.2 percentage point higher chance of experiencing at least one episode of high employment growth over that same period and a 36.0 percentage point higher chance of experiencing at least one episode of high revenue growth.<sup>17</sup> When controls for industry sector, firm employment size, age of firm, whether the firm had research and development expenditures at least once over the period, and year of observation are included, applying for at least one patent is still found to be correlated with experiencing an episode of high employment and revenue growth. Filing for a patent is associated with a 7.5 percentage point higher probability of experiencing high employment growth and a 12.9 percentage point higher chance of experiencing high revenue growth.

When similar analysis is carried out controlling for where the patent application is filed, there is little difference in the relationship between filing a patent application in Canada and the United States and the probability of experiencing either high employment or revenue growth. When other firm characteristics are taken into account, making at least one patent application at CIPO over the 2001-to-2015 period is associated with a 4.4 percentage point higher chance of having an episode of high employment growth, compared with a 4.1 percentage point higher chance when a patent application is filed at the USPTO. The results are similar for revenue growth. Firms that file patent applications at CIPO have a 7.0 percentage point higher chance of having high revenue growth, compared with a 5.7 percentage point higher chance for firms filing applications at the USPTO.<sup>18</sup>

The relationship between filing a patent application at the EPO or other patent offices and high employment or revenue growth is less strong and not always statistically significant. It might be the case that applications to the EPO and other patent offices are often accompanied by or preceded by applications to CIPO and the USPTO, and disentangling the relationships requires more sophisticated analysis. Nevertheless, the analysis presented here suggests that patenting in the United States is associated with similar economic outcomes to patenting in Canada, and that the increase in patenting in the United States by Canadian-resident businesses may not be of concern.

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17. The results in Table 2 are based on a probit regression of whether a firm experienced at least one episode of high growth on whether a firm filed at least one patent application. A period of high employment growth is defined as having an average annualized growth in employees greater than 20% per year over a three-year period for firms with at least two employees at the beginning of the observation period. Normally, having 10 employees is used as the requirement at the beginning of the observation period, but because the increase in patenting occurred in the smaller firms, a lower threshold was used. The results still hold if a higher threshold of 5 or 10 employees is used. A period of high revenue growth is similarly defined. For the regression, the sample is restricted to firms with employees that were observed for at least six consecutive years. Controls for industry were at the three-digit North American Industry Classification System level.

18. The difference in the marginal effects of patenting at the USPTO and CIPO is not statistically significant.

**Table 2**  
**Marginal effect of filing a patent application on the probability of experiencing an episode of high employment or revenue growth**

	Probability of high employment growth				Probability of high revenue growth			
	No controls	With controls	No controls	With controls	No controls	With controls	No controls	With controls
<b>Filed a patent application</b>								
Coefficient	0.252	0.075	...	...	0.360	0.129	...	...
P-value	(0.000)	(0.000)	...	...	(0.000)	(0.000)	...	...
<b>CIPO</b>								
Coefficient	...	...	0.149	0.044	...	...	0.218	0.070
P-value	...	...	(0.000)	(0.000)	...	...	(0.000)	(0.000)
<b>USPTO</b>								
Coefficient	...	...	0.114	0.041	...	...	0.151	0.057
P-value	...	...	(0.000)	(0.000)	...	...	(0.000)	(0.000)
<b>EPO</b>								
Coefficient	...	...	0.023	0.008	...	...	0.025	0.016
P-value	...	...	(0.016)	(0.351)	...	...	(0.012)	(0.088)
<b>Other offices</b>								
Coefficient	...	...	0.006	0.007	...	...	0.034	0.032
P-value	...	...	(0.511)	(0.440)	...	...	(0.001)	(0.001)

... not applicable

**Notes:** CIPO is the Canadian Intellectual Property Office; USPTO is the United States Patent and Trademark Office; EPO is the European Patent Office; and Other offices is offices other than CIPO, the USPTO and the EPO. P-values are in parentheses. Control variables include employment size of firm, age of firm, whether the firm conducted research and development, industry, and year of observation.

**Source:** Statistics Canada, Canadian Patent Research Database.

## Conclusion

This article presents some initial findings from the new Canadian Patent Research Database. Over the 2001-to-2015 period, the number of patent applications made by Canadian-resident businesses increased modestly, but there was a stronger increase in patent applications made in the United States. This increase in patenting in the United States can be traced to the increased activity of smaller, younger firms in service industries and in the technological fields of computer technology, civil engineering, digital communications, medical technology, transport, and IT methods for management.

It is not clear why Canadian-resident firms are increasingly patenting in the United States, but evidence suggests it is not detrimental. Canadian-resident firms that file patent applications in the United States are as likely to experience high employment or revenue growth as firms that make applications in Canada.

Future research using the Canadian Patent Research Database will take full advantage of the longitudinal nature of the database to examine the causal impact of patenting on firm outcomes, and the ability to disaggregate results along a number of dimensions, including whether businesses are owned by men or women. The database will also be further developed to include data on individual inventors, in addition to business applicants. These developments will facilitate studies on, for example, the role inventors play in the success of businesses and knowledge diffusion through the movement of inventors between businesses.

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