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# Innovation in Immigrant-owned Firms in Canada

by Yuri Ostrovsky and Garnett Picot

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# Innovation in Immigrant-owned Firms in Canada

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## Abstract

This paper uses data from a survey of Canadian firms in 2011, 2014 and 2017, and asks whether immigrant-owned small and medium-sized enterprises (SMEs) were more likely than those owned by Canadian-born individuals to implement an innovation. It is hypothesized that this would be the case since compared to the Canadian born, immigrant entrepreneurs are more likely to be highly educated in a science, technology, engineering and mathematics (STEM) field, are more likely to file patents (at least in the United States), and are more likely to trade internationally. These factors are positively correlated with innovation. The outcome variables include the likelihood of implementing product, process, organizational and marketing innovations, and five types of intellectual property: registered trademarks, patents, registered industrial designs, trade secrets and nondisclosure agreements. The methodology consists of using coarsened exact matching followed by a probit analysis to control for both firm and owner characteristics. Both adjusted and unadjusted results indicate that an immigrant-owned firm was more likely to implement a product or process innovation, regardless of whether the immigrant owner was a recent or longer-tenured immigrant, or whether the firm was in a knowledge-based industry or the economy as a whole. Similar results were obtained for marketing innovations. There was no difference in the likelihood of implementing an organizational innovation between SMEs with immigrant owners and SMEs with Canadian-born owners. Overall, there was little difference between the two regarding the use of the five types of intellectual property. However, recent immigrant owners were more likely to use patents.

Keywords: immigrants, entrepreneurs, innovation

JEL classification: J15, L26, M21

## Executive summary

The main objective of this paper is to determine whether the immigration status of the owner of a small or medium-sized enterprise (SME) affects the likelihood of a company implementing an innovation. A number of recent research papers tackled the issue of immigrants and innovation by concentrating on patent filing (a proxy for innovation) by individual immigrants. The novelty of this paper is the fact that it is one of very few to address this issue from the perspective of the firm, as innovation occurs within a firm context. This study uses measures of innovation and intellectual property that provide a much broader perspective of the innovation process than a focus on patents alone.

The data for this research are from the 2011, 2014 and 2017 versions of the Survey on Financing and Growth of Small and Medium Enterprises. The survey target population was derived from Statistics Canada's Business Register and consisted of all SMEs with under 500 employees and gross annual revenues of \$30,000 or more. The outcome variables include product, process, organizational and marketing innovations, and five types of intellectual property: registered trademarks, patents, registered industrial designs, trade secrets and nondisclosure agreements.

Both the unadjusted results (based on raw data) and the adjusted results (based on a sample in which immigrant-owned firms were matched to firms with Canadian-born owners to adjust for the differences in firm and owner characteristics) indicate that immigrant-owned SMEs had a higher probability of implementing a product, process or marketing innovation than firms owned by Canadian-born individuals. Immigrant-owned SMEs had an 8.6% higher likelihood of implementing a product innovation (relative to the 0.27 baseline rate computed for SMEs owned by Canadian-born individuals) and a 20.1% higher probability of implementing a process innovation (relative to the 0.17 baseline rate).

A separate analysis was conducted for firms whose owners were either more recent immigrants (in Canada for less than 20 years) or longer-tenured immigrants (in Canada for 20 years or more). Firms owned by both more recent and longer-tenured immigrants were more likely to implement a process innovation than those with Canadian-born owners, while firms owned by more recent immigrants were also more likely to implement a product innovation.

Regarding the use of five types of intellectual property, the results adjusted for firm and owner characteristics indicate that the effect of immigrant ownership was positive and statistically significant only for one of the five intellectual property types (registered industrial designs); for the probability of using nondisclosure agreements, the effect was negative. Overall, SMEs owned by immigrants or by Canadian-born individuals were largely similar in their use of intellectual property.

One interesting result is the increased likelihood of an SME with a more recent immigrant (in Canada for less than 20 years) owner using patents, compared to firms owned by the Canadian-born. This result may also be partially explained by the tendency of more recent highly educated immigrants to be educated in a more technical field (i.e., science, technology, engineering and mathematics [STEM]) than the Canadian-born.

Finally, the study also analyzed SMEs in the knowledge-based industries (KBIs). The unadjusted results and the results based on the matched sample were similar to those reported for SMEs in the economy as a whole; immigrant-owned firms were more likely to implement a product or process innovation. There was no statistically significant difference in the likelihood of implementing an organizational or marketing innovation.

Taken together, this evidence indicates that an immigrant-owned firm appears somewhat more likely to implement a product or process innovation, regardless of whether the immigrant owner is a recent or longer-tenured immigrant, or whether the firm is in a KBI or the economy as a whole.

The results may be related in part to the educational background of immigrants. Immigrant owners are more likely to hold a university degree than Canadian-born owners, which is a difference that is controlled for in this study. However, university-educated immigrants are also twice as likely to be educated in a STEM field and three times as likely to be educated in engineering or computer science as Canadian-born university-educated individuals. This difference could not be controlled for in this study because field of study information was unavailable. Given their backgrounds, immigrant owners educated in STEM fields may be more inclined to focus on product or process innovations than on organizational or marketing innovations.

# 1 Introduction

Innovation has a positive impact on firm performance. This conclusion has been confirmed by numerous studies over the past three decades (see Chen [2017], and Kleinknecht and Mohnen [2002] for literature reviews, and Baldwin and Hanel [2003] for a wide-ranging discussion on the innovation process and its effects). The finding is robust and widespread. It has been confirmed for both manufacturing and service-sector industries (Salavou 2002; Prajogo 2006), for both large and small firms (Baldwin 1995; Kleinknecht and Mohnen 2002), for Fortune 1000 companies (Cho and Pucik 2005), and for firms in numerous countries. Product innovations can positively influence sales growth and market share. Process innovations can lead to increases in productivity. These factors can lead to higher profitability and potentially greater employment growth. In Canada, Baldwin (1995) found that, among the many factors that could potentially affect the performance of small and medium-sized enterprises (SMEs), innovation activities played the biggest role in explaining the differences between the most and least successful companies. Baldwin concluded that innovation was a key to success in small firms.

The main objective of this paper is to determine whether the immigration status of the owner of an SME affects the likelihood of a company implementing an innovation. The goal is to contribute to the knowledge base in two research areas: the determinants of innovation and the economic contribution of immigrants. Given the recent high levels of immigration in most Western countries, including Canada, the effect of immigrants on the economy is an important issue for politicians, academics and policy researchers, the business community, and the population as a whole. Researchers often address this issue by taking a broad aggregate approach that focuses on the effect of immigration on gross domestic product (GDP) or GDP per capita. Alternatively, many projects assess the effect of immigration on a particular economic component, such as employment, wages, productivity, trade and—in this case—innovation. As will be discussed in the next section, a number of recent research papers tackled the issue of immigrants and innovation by focusing on patent filing (a proxy for innovation) by individual immigrants. The novelty of this paper, and its contribution to the literature, is the fact that it is one of very few to address this issue from the perspective of the firm. Innovation occurs within a firm context. This study uses measures of innovation and intellectual property that provide a much broader perspective of the innovation process than a focus on patents alone.

This paper also contributes to the literature on the determinants of innovation. The characteristics of the owner or major decision maker of a firm—such as immigration status—can influence the likelihood of implementing an innovation, particularly in SMEs, where a single individual can exert considerable influence. Few papers have had the data necessary to address the effect of owner characteristics on innovation. This paper contributes to filling that research gap.

## 2 Background and literature review

### 2.1 Earlier research on innovation in firms

There are numerous reasons to believe that the immigration status of the owner of a firm may affect innovation decisions. However, before the details of this research can be addressed, it is necessary to better understand the context within which this effect may operate.

Much of the research on innovation in firms—particularly European research—uses the Organisation for Economic Co-operation and Development (OECD) Oslo Manual (OECD 2018) definition of innovation, first published in 1992. This manual is an international reference guide that presents guidelines for collecting and using data on innovation in businesses. The richness of the research based on early innovation surveys is demonstrated in Baldwin and Hanel's (2003), which addresses many innovation-related issues. The OECD manual outlines four types of innovation:



product, process, organizational and marketing. Some research has suggested that all four types “are more or less positively and significantly associated with some aspects of firm performance” (Gunday et al. 2011, p. 672). All four types are important, although much of the research tends to focus on the effects of product<sup>1</sup> and process<sup>2</sup> innovations. The outcome variables used in this article include all four types of innovation, as well as five types of intellectual property.

Traditional research has focused on firm characteristics as the major determinants of the innovation level of a firm (see Kleinknecht and Mohnen [2002] for examples of this research). Generally speaking, firm size is seen as important, with larger firms being more likely to implement an innovation (e.g., De Mel, McKenzie and Woodruff 2009).<sup>3</sup> Past demand growth is also seen as an important determinant, as it has a “demand-pull” effect, which means that the greater the past demand and expected future growth, the higher the probability of a firm implementing an innovation. Sources of knowledge and technological collaboration are also seen as important. The level of research and development (R&D), the degree of R&D outsourcing, and outside collaboration on knowledge acquisition are positively associated with the likelihood of implementing an innovation—particularly a product innovation. The degree of competition—or market structure—is often also seen as a potential determinant, but the research appears to be mixed regarding the importance of this variable. While some studies found a weak positive effect for competition (e.g., Kleinknecht and Mohnen 2002), others found a weak negative effect (De Mel, McKenzie and Woodruff 2009). The industry in which the firm operates can also play a role. For example, firms in knowledge-based industries (KBIs) tend to have higher innovation rates. However, at a broader level, Prajogo (2006) found no difference between manufacturing and service-sector firms in either product or process innovation rates.

Beyond firm characteristics, the characteristics of the owner or major decision maker may also influence innovation behaviour. This may be particularly true for smaller firms, where such individuals have significant influence. However, there is little research on this topic. De Mel, McKenzie and Woodruff (2009) examined both firm and owner characteristics as determinants of the four types of innovation. They confirmed many of the earlier findings regarding the effect of firm characteristics on innovation, but also concluded that owner characteristics played a role—particularly the educational attainment of the owner—even after controlling for firm size and other firm characteristics. The positive correlation between educational attainment and likelihood of implementing an innovation was observed for all four types of innovation. This research was conducted using a large sample of SMEs in a developing country (Sri Lanka), but the authors argued that the theoretical model they developed was applicable to both developed and developing countries. However, it is unclear as to whether the empirical results would be applicable to developed nations.

## 2.2 Research on immigrants and innovation

There are a number of reasons why the immigration status of the owner or major decision maker of an SME might be correlated to the likelihood of implementing an innovation. Recent research in labour economics—primarily from the United States—has focused on immigrants and patent filing, which is used as a proxy for innovation. The main question posed is about whether high-skilled immigrants contributed disproportionately to the innovative output in the recent past. The research suggests that the answer is yes. Immigrants accounted for 24% of patents in the United States, which is twice their share in the population (Hunt and Gauthier-Loiselle 2010). Many other studies have come to a similar conclusion, including Kerr (2013), and Kerr and Lincoln (2010). According to the research, the disproportionate patent filing by immigrants (compared with the U.S.-born population) is primarily the result of immigrants being much more likely than their U.S.-born counterparts to be educated in science, technology, engineering and mathematics

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1. The introduction of a new product or service.

2. The implementation of a new production process or method designed to increase productivity.

3. Although, given the large number of small firms, most patents originate in the small-firm sector.

(STEM) fields associated with patent filing, such as engineering and science. These educational choices among immigrants explain most of the patent filing difference between highly educated immigrants and their U.S.-born counterparts (Hunt and Gauthier-Loiselle 2010; Kerr 2013).

The relationship between immigration status and patent filing may differ by country for a number of reasons, including differences in the types of immigrants, in the immigrant selection process and in where the immigrants were educated. There is very little recent Canadian research on the topic of immigrants and patent filing, with only two studies in circulation.

A recent study by Blit, Skuterud and Zhang (2019) found that the impact of Canadian skilled immigration on patent rates has been relatively modest compared with the United States. They show that an increase in the Canadian-born highly skilled population would increase patents more than a comparable increase in highly skilled immigrants.

Another study by the same authors—Blit, Skuterud and Zhang (2018)—used a very different methodology to examine patent filing rates by ethnic minorities in Canada (regardless of whether they were immigrants or born in Canada). They found that some ethnic groups, notably those with Korean, Japanese or Chinese ancestry, did display higher than average patent filing rates. Most of this advantage could be explained by the higher proportion of people in those groups with high levels of education and STEM occupations, similar to the U.S. findings.

In summary, the international evidence suggests that immigrants contribute disproportionately to patent filing compared with the native-born population, although the results for Canada are somewhat mixed. The explanation for this disproportionate contribution by immigrants seems to be related primarily to their educational choice and level of educational attainment. Since immigrants appear more likely than native-born individuals to contribute to patent filing, one might also expect that immigrants who become entrepreneurs are more likely to innovate than Canadian-born business owners.

### **3 Immigrant business owners and firm innovation**

The innovation process may be somewhat different in the business or industrial organization literature than it is in the labour economics literature mentioned above, where patent filing is seen as a proxy for innovation. Patents can be considered a form of invention that focuses on the development of new ideas, whereas innovation can be considered the development of commercially viable products, services or processes derived from creative ideas.<sup>4</sup> This leads to the identification of the four types of innovation listed above: product, process, organizational and marketing. This is the approach taken in most innovation surveys and in the survey data used in this study. It is described in the data section. A recent U.S. study also used this approach and asked a research question similar to the one posed in this paper. Brown et al. (2019) used the Annual Survey of Entrepreneurs in the United States to determine whether immigrant entrepreneurs innovate at a higher rate than their U.S.-born counterparts in the U.S. high-tech sector. They employed 16 different measures of innovation and intellectual property ownership and found uniformly higher rates of innovation in immigrant-owned firms for 15 of the 16 different measures. Interestingly, they found a strong correlation between the educational attainment of the owner and the firm's innovation rate.

There are a number of other reasons why immigrant SME owners may implement more innovations than their Canadian-born counterparts. Immigrant SME owners are more highly

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4. However, patent filing and innovation activity are positively correlated (Artz et al. 2010). Baldwin, Gibson and Rollin (2017) assessed the intensity of innovation and found that the numbers of firms reporting innovation, R&D and patents were clearly all related at the industry level. Using patents as a proxy for innovation appears to have some validity. However, it does present a very narrow view of innovation.

educated than Canadian-born owners (Ostrovsky, Picot and Leung 2019). As noted above, previous research has shown that educational attainment had a positive effect on the likelihood of implementing an innovation—an effect that has been confirmed in this study. Not only are immigrants more highly educated, but, among the university educated, they are twice as likely as highly educated Canadian-born individuals to be educated in a STEM field (Picot and Hou 2020). This may also increase the likelihood of immigrant business owners implementing an innovation. Immigrant owners tend to have higher levels of international trade than their Canadian-born counterparts, largely because of the networks they establish with home-country sources (Fung, Grekou and Liu 2019). Higher levels of trade also increase the likelihood of innovation.

There are also reasons why immigrants may be less likely to innovate. Some argue that they have less access to financial capital than native-born owners and, as a result, may not be able to finance innovation activities. This appears to be true in some countries, but recent Canadian research suggests that there is little evidence to support that notion in Canada (Ostrovsky, Picot and Leung 2019).

On balance, given the evidence, it was hypothesized that immigrant owners were more likely to innovate than their Canadian-born counterparts, after accounting for other factors that can influence innovation.

## 4 Data

The data for this research come from the 2011, 2014 and 2017 versions of the Survey on Financing and Growth of Small and Medium Enterprises. The survey target population was derived from Statistics Canada's Business Register (BR) and consisted of all SMEs with under 500 employees and gross annual revenues of \$30,000 or more.<sup>5</sup> The sampling unit of the survey was the enterprise. The main population was stratified by several characteristics, such as firm age, size, industry and geography, and the sample selection method was random sampling without replacement. The overall survey response rates (computed as the number of respondents divided by the number of estimated in-scope units) were 56.0% in 2011, 63.5% in 2014 and 59.7% in 2017. The sampling weights were adjusted to account for total non-response, making the final estimates representative of the entire survey population.<sup>6</sup>

The data from all three cross-sectional surveys were pooled together to create a larger sample size. The survey questions central to this analysis—notably questions related to innovation activity, types of intellectual property held, firm characteristics (e.g., firm size, age, growth rate, exporting activity and industry employment) and important characteristics of the owners (e.g., owner's age, years of experience owning a firm, educational attainment, language spoken, immigration status and years of residency in Canada)—were virtually identical in all three versions of the survey, which made it possible to pool the data. The final sample size for the pooled data from the three surveys was 27,411 firms, of which 5,092 were immigrant-owned.<sup>7</sup>

The analysis primarily focuses on the full sample of SMEs in the economy as a whole. However, there is some analysis of innovation among SMEs in KBIs. These include a narrow band of science and technology firms. Lee and Has (1996) used an industry's R&D activity and the educational attainment of its workforce to determine whether it was knowledge based. Their list was updated recently by Innovation, Science and Economic Development Canada and includes engineering and science-based manufacturers, telecommunications, data processing, computer

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5. Non-profit organizations, joint ventures, government agencies and enterprises in several specific industries were excluded. The BR is a list of all Canadian enterprises engaged in the production of goods and services.

6. More details about the survey are available on Statistics Canada's website, at <https://www.statcan.gc.ca>.

7. I.e., the majority owner or general manager (the person primarily responsible for making business decisions) was born outside Canada.

systems design, and consulting services. The list of included industries can be found in Table 2 of a paper by Picot and Ostrovsky (2017). Based on the list, 2,471 firms in the total sample were in KBIs.

The innovation questions employed in the survey have been used in various business surveys for many years, starting in Canada with the innovation surveys of the 1990s. The conceptual framework on which the questions are based is outlined in the OECD Oslo Manual (2018). The innovation question is the following (Statistics Canada 2018, Question I17):

“In the last three years has your business developed or introduced any of the following innovations? An innovation must be new to your business, but it does not need to be new to your market. [...]

- a: A new or significantly improved good or service [...]
- b: A new or significantly improved production process or method [...]
- c: A new organizational method in your business practices, workplace organization or external relations [...]
- d: A new way of selling your goods or services [...]

The question on intellectual property rights is the following (Statistics Canada 2018, Question I22):

“As of [specific date], did your business hold any of the following types of intellectual property [...]?”

- a: Registered trademarks [<sup>8</sup>] [...]
- b: Patents [<sup>9</sup>] [...]
- c: Registered industrial designs [<sup>10</sup>] [...]
- d: Trade secrets [<sup>11</sup>] [...]
- e: Nondisclosure agreements [<sup>12</sup>] [...]
- f: Any other type of intellectual property protection, [...]

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8. A trademark is any name or logo used to distinguish the goods or services of one organization from those of another.

9. A patent is a set of rights granted to an inventor for a limited period of time in exchange for a public disclosure of that invention.

10. Registered industrial designs are any combination of the visual features of a finished article.

11. A trade secret is secret information that gives its owner an advantage over their competitors.

12. A nondisclosure agreement is a legal contract that outlines confidential material that the parties share with one another but restricts third-party access.

## 5 Descriptive results

### 5.1 The characteristics of immigrant owners and Canadian-born owners and their small and medium-sized enterprises

The firms in the sample tended to be small, with an average of 10.2 employees per firm (Table 1). Immigrant-owned firms were smaller, with an average of 8.8 employees per firm.<sup>13</sup> Immigrant-owned firms were also younger. The average age of firms owned by Canadian-born individuals was 20.0 years, while the average age of immigrant-owned firms was 15.5 years. Immigrant-owned firms were also more likely to export a larger proportion of their sales and be in KBIs than SMEs owned by Canadian-born individuals. These results are all consistent with earlier research (Green et al. 2016; Picot and Ostrovsky 2017; Picot and Rollin 2019). Regarding average annual growth over the last three years, there was little difference between immigrant-owned firms and those owned by Canadian-born individuals. There was also little difference in the proportion of companies that were started by the present owner—roughly three-quarters for firms with immigrant and Canadian-born owners.

The differences between immigrant-owned firms and those owned by Canadian-born individuals (in the economy as a whole) noted above also tended to apply to firms in KBIs. However, KBI firms were younger than other firms, tended to have a higher annual growth rate over the previous three years and exported a much larger share of their sales than SMEs in general (Table 1).

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13. All reported results were produced using sampling weights.

**Table 1**  
**Characteristics of small and medium-sized enterprises and their owners in the study sample**

	All private-sector SMEs			SMEs in KBlS		
	All SMEs	Immigrant owned	Canadian-born owned	All SMEs	Immigrant owned	Canadian-born owned
<b>Firm characteristics</b>						
Owner started firm	75.0	77.8	74.2	89.3	91.5	88.3
Average firm age	19.0	15.5	20.0	14.2	12.0	15.1
<b>Annual growth in the last three years</b>						
Negative growth	13.4	14.9	12.9	14.2	13.5	14.5
No growth	20.7	20.9	20.6	16.9	16.0	17.3
1% to 10%	46.1	46.1	46.1	45.3	52.2	42.5
11% to 20%	11.4	10.6	11.6	12.2	7.7	14.0
21% or more	8.5	7.4	8.9	11.4	10.6	11.8
Average sales outside Canada	4.2	6.2	3.6	10.9	15.0	9.2
Average number of employees	10.2	8.8	10.6	9.8	8.6	10.3
Share of SMEs in KBlS	9.8	12.5	9.0	...	...	...
<b>Owners' characteristics</b>						
Average age	51.7	52.0	51.5	51.2	51.1	51.3
Average years of experience owning a firm	20.8	19.4	21.2	18.7	17.0	19.4
Average years residing in Canada	...	29.1	...	...	26.8	...
<b>Mother tongue</b>						
English	60.2	29.6	69.4	63.4	36.6	74.6
French	21.4	4.5	26.5	17.5	5.7	22.4
Other	18.4	65.9	4.2	19.1	57.7	3.0
<b>Educational attainment</b>						
Less than high school	8.1	6.0	8.8	1.1	0.3	1.5
High school diploma	23.4	16.8	25.3	8.9	3.0	11.3
Some postsecondary	30.7	24.4	32.6	20.6	12.9	23.8
Bachelor's degree	23.4	30.9	21.1	39.2	42.1	37.9
Graduate degree	14.4	21.9	12.2	30.2	41.7	25.4

... not applicable

**Note:** KBlS: knowledge-based industries.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

There were some significant differences in the characteristics of the immigrant and Canadian-born owners of these SMEs. Most significantly, the immigrant owners were considerably more highly educated than their Canadian-born counterparts: 52.8% had a university degree, compared with 33.3% of Canadian-born owners (Table 1). There was a large difference in the proportion of those with a graduate degree: 21.9% of immigrant owners, compared with 12.2% of Canadian-born owners. Unsurprisingly, immigrant firm owners were more likely than their Canadian-born counterparts to have a mother tongue other than French or English and had marginally fewer years of experience owning a company (19.4 years and 21.2 years, respectively). There was little difference in the age of firm owners: the average age was 51.7 for both groups.

About 9.8% of all firms in the sample were in KBIs, and the share of KBI SMEs was higher among immigrant owners (12.5%) than among Canadian-born owners (9.0%). There were some differences between the owners of the SMEs in KBIs. The educational attainment of immigrant SME owners in that sector was very high: 83.8% had a university degree, compared with 63.3% of their Canadian-born counterparts. About 41.7% of these immigrant SME owners had a graduate degree (compared with 25.4% of Canadian-born owners). Interestingly, the KBI owners were not younger on average than their counterparts in other sectors. Furthermore, immigrant SME owners in KBIs had been in Canada for roughly the same length of time (26.8 years on average) as immigrant SME owners in general (29.1 years on average). The main difference between SME owners in KBIs and those in other industries was educational attainment.

## 5.2 The tendency to innovate and hold intellectual property rights

This paper uses nine outcome measures, including four types of innovation and five types of intellectual property rights. Included are measures of product, process, organizational and marketing innovations. These are standard measures used in the literature. The intellectual property rights include registered trademarks, patents, registered industrial designs, trade secrets and nondisclosure agreements, which are also all common measures used in the literature (OECD 2018). In all cases, the owner<sup>14</sup> is asked whether the firm implemented these innovations or held these intellectual property rights over the three years prior to the survey date.

Generally speaking, immigrant-owned SMEs had a higher incidence of innovation than did firms owned by the Canadian-born (Table 2). Of immigrant owned firms, 25.9% reported a *product* innovation compared to 21.5% of the Canadian-born owned. Immigrant entrepreneurs also held an edge on *process* innovation (17.0% versus 14.1%) and *marketing* innovations (19.2% versus 15.6%). All of these differences were statistically significant. There was not a statistically significant difference in the rate of *organizational* innovation between immigrant and Canadian-born owned firms.

**Table 2**  
**Innovation and intellectual property rates among immigrant and Canadian-born owners of small and medium-sized enterprises**

	All private-sector SMEs				SMEs in KBIs			
	All SMEs	Canadian-born		p-value	All SMEs	Canadian-born		p-value
		owned	Immigrant owned			owned	Immigrant owned	
	percent		p-value	percent		p-value		
<b>Innovation</b>								
Goods or services	22.5	21.5	25.9	0.000	32.8	32.0	34.7	0.399
Production process or method	14.7	14.1	17.0	0.000	18.6	17.5	21.2	0.169
Organizational	15.4	15.6	14.7	0.267	19.2	19.4	18.5	0.735
New way of selling	16.4	15.6	19.2	0.000	17.0	16.3	18.8	0.343
<b>Intellectual property</b>								
Registered trademark	8.9	8.6	9.7	0.120	13.3	14.0	11.6	0.321
Patent	1.7	1.6	2.0	0.240	3.9	3.8	4.3	0.608
Registered industrial design	0.9	0.9	1.2	0.072	1.9	1.7	2.2	0.618
Trade secret	4.8	4.8	4.8	0.950	11.7	12.7	9.4	0.072
Nondisclosure agreement	14.3	13.9	15.5	0.068	43.5	41.6	48.2	0.058

**Note:** KBIs: knowledge-based industries.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

14. The majority owner or general manager who is the primary decision maker for the company.

Immigrant SME owners were also more likely to hold intellectual property rights than Canadian-born SME owners (Table 2). The incidence was higher for four types of intellectual property rights among immigrant owners than among their Canadian-born counterparts. However, none of the differences was statistically significant at the 5% significance level.

The trends were similar for KBI SMEs, but the incidence of both innovation and intellectual property rights was higher among KBI SMEs than among SMEs in the economy as a whole. For example, 32.8% of KBI firms reported a product innovation, compared with 22.5% of those in the economy as a whole. The difference was narrower for process innovations—18.6% versus 14.7%. Similar to the results for SMEs as a whole, in KBIs, immigrant firm owners held the edge in the incidence of three of the four innovation types. Organizational innovation was the outlier once again. However, none of these differences was statistically significant. Because the sample of KBI SMEs was relatively small, it was not possible to determine whether these differences actually exist, but it is interesting that they reflect the results for the sample as a whole.

In summary, among all SMEs in the economy as a whole, the incidence of innovation ranged from 14.7% to 22.5%, depending on the type of innovation. Among SMEs in KBIs, innovation was more prevalent, with an incidence of between 18.6% and 32.8%. The incidence of holding intellectual property rights was much smaller among private-sector SMEs, ranging from 0.9% to 14.3%, depending on the type of intellectual property. In KBIs, this range was higher, from 1.9% to 43.5%. There was some difference in the tendency to innovate between immigrant and Canadian-born owners. In particular, immigrant owners reported a higher incidence of product, process and marketing innovations over the three years prior to the survey date than their Canadian-born counterparts. This was true among both SMEs in the economy as a whole and KBI SMEs (although the results for KBIs were not statistically significant). Overall, although immigrant owners appeared to have a slightly higher rate of intellectual property use than their Canadian-born counterparts, the differences were small and not statistically significant at the 5% significance level.



## 6 Econometric methods

The key objective of the econometric analysis below is to estimate the impact of the immigration status of the SME owner on the probability of innovating or holding intellectual property. One of the main problems with using standard linear, probit or logit models in this context is that the estimates are model dependent, which means that the model estimated by the researcher is assumed to be the true model generating the data. If this assumption does not hold, the estimates of the effect are likely to be biased (Ho et al. 2007; Imbens and Rubin 2015). To eliminate or greatly reduce model dependency, econometric studies now use matching estimators based on various matching methods, such as propensity score matching (Rosenbaum and Rubin 1983), entropy balancing (Hainmueller 2012) and coarsened exact matching (CEM) (Iacus, King and Porro 2011, 2012). The main goal of any matching method is to reduce the differences—or imbalance—between the empirical distributions of the pre-treatment characteristics of the treatment and control groups, and to make the treated group as similar as possible to the control group (Stuart 2010; Imbens and Rubin 2015). An important element of this process is to ensure common support by eliminating (pruning) observations outside the area where the empirical densities of the treatment and control groups overlap (Heckman et al. 1998; Imbens 2004). Multiple studies have emphasized the advantages of using matching in combination with standard regression methods (Imbens 2004; Abadie and Imbens 2006; Ho et al. 2007; Stuart 2010). A combined strategy usually involves using first-step matching methods to make the treatment and control groups similar, and second-step regression models to estimate the treatment effects while removing the remaining imbalance between the two groups.

In this study, CEM was used to match the distributions of the characteristics of immigrant-owned firms (treated group) with the characteristics of the firms owned by Canadian-born individuals (control group). The main element of the CEM algorithm is the coarsening or grouping of substantially indistinguishable (Iacus, King and Porro 2012) values of each covariate into the same numerical categories and the application of the exact matching algorithm to the coarsened data to match treated and control observations. As a variant of exact matching, CEM has several particularly desirable properties that are discussed by Iacus, King and Porro (2012). In particular, CEM is a monotonic imbalance bounding method, meaning that the level of coarsening chosen for each covariate also determines the maximum possible imbalance between the distributions of the treatment and control groups for that variable (Iacus, King and Porro 2011). Furthermore, the level of coarsening chosen for one variable cannot affect the imbalance of other variables.

The CEM algorithm consists of several steps detailed by Iacus, King and Porro (2011, 2012), and Blackwell et al. (2009).<sup>15</sup> Once a matched sample is created, the next step is to compute the main object of interest in this analysis, which is the average treatment effect on the treated (ATT),

$$ATT = \frac{1}{\sum_{i=1}^n T_i} \sum_{i=1}^n T_i E[Y_i(1) - Y_i(0) | X_i], \quad (1)$$

where  $T_i$  is the treatment indicator for firm  $i$  such that  $T_i = 1$  if the firm is immigrant-owned (treated) and  $T_i = 0$  if it is owned by a Canadian-born individual (control),  $Y_i(1)$  and  $Y_i(0)$  are counterfactual outcomes for the same firm  $i$ , and the term in the bracket is the random effect for firm  $i$  conditional on a set of observed characteristics  $X_i$ . The  $ATT$  can be interpreted as the

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15. Blackwell et al. (2009), and Iacus, King and Porro (2012) discuss various considerations for making coarsening choices and the trade-offs involved.

average effect of immigrant status on the innovation outcomes of immigrant-owned firms.<sup>16</sup> Following the CEM matching procedure, it can be computed directly by comparing weighted means of the treated and control group; or by estimating a CEM-weighted parametric model, such as probit, to remove (mop up) any remaining imbalance; or by applying propensity score methods (Iacus, King and Porro 2011).<sup>17</sup>

The set of matching variables in this study is shown in Appendix Table A.1. The choice of matching variables was determined by previous studies on innovation that highlight the importance of owner age and human capital (De Mel, McKenzie and Woodruff 2009), local labour market conditions and region-specific knowledge spillovers (Audretsch and Feldman 2004), and firm characteristics such as industry and firm size (Kleinknecht and Mohnen 2002; De Mel, McKenzie and Woodruff 2009). Several categorical variables, such as owner's education, industry and geographic region, were coarsened into fewer categories to create matching variables. Continuous variables, such as firm size and owner's age, were coarsened into matching categorical variables.

Appendix Table A.1 shows the differences between the distributions of the coarsened and raw variables before (first two columns) and after (last two columns) matching. Much of the imbalance in the raw data is related to the location of immigrant-owned firms and those owned by Canadian-born individuals. Almost 30% of immigrant-owned firms are located in Toronto, compared with 10.3% of firms owned by Canadian-born individuals. In contrast, 67.3% of firms owned by Canadian-born individuals are located outside the five largest Canadian cities, compared with 39.0% of immigrant-owned firms. Given the significance of agglomeration economies related to knowledge production, the city imbalance underscores the importance of including city effects among the matching variables. Other variables with a substantial degree of imbalance include owner's education, geographic region and the indicator of whether the firm is located in a rural area. The last two columns show that CEM resulted in a good balance between the distributions of the characteristics of immigrant and Canadian-born owners even among the variables not used for matching. Of 5,092 immigrant owners in the original sample, 4,658 could be matched to one or more Canadian-born owners, resulting in a 91.5% matching rate. The matched sample consisted of 4,658 immigrant owners (treated group) and 15,247 Canadian-born owners (control group).

The CEM algorithm produced matching weights that were used to estimate the second-stage probit. This step makes it possible to remove the remaining imbalance from the control variables. The variables that were coarsened at the matching stage were disaggregated to their original categories for the second-stage regression analysis. Variables that were continuous in the raw data and coarsened at the first stage entered the second-stage probit specification as continuous variables. The set of controls in the second-stage probit models include a quadratic of age, education, startup status, years of business experience, geographic region, city effects, rural indicator, firm size, firm age, industry (18 two-digit North American Industry Classification System categories) and survey year. As some firms can be included in more than one survey year, standard errors are clustered on firms.

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16. This interpretation is based on the standard "ignorability" assumption, which essentially means that any remaining unobserved differences between immigrant and Canadian-born owners can be ignored after balancing the two groups on the observed variables. This issue is further discussed in Section 8.

17. Another quantity of interest frequently considered in the literature on causal inference is the average treatment effect (ATE) representing the treatment effect averaged over treatment effects for all—not just the treated—units (Ho et al. 2007). This study focuses on estimating the ATT because the main object of interest is immigrant-owned firms.

## 7 Results

Using the matched dataset, the effect of immigrant ownership was estimated for each of the nine outcome variables—four innovation types and five intellectual property types. As noted earlier, CEM-weighted probit models were used to remove the remaining minor observable differences between immigrant-owned firms and those owned by Canadian-born individuals in the matched sample. The estimated effect of immigrant ownership was reported as the average marginal effect of immigrant ownership status.

Innovation adoption differences between Canadian-born and immigrant owners may dissipate the longer immigrants live in Canada. Therefore, two extensions of the main model were considered. A subsample of firms owned by immigrants in Canada for less than 20 years was matched to firms with Canadian-born owners to obtain results for more recent immigrants. Similarly, a subsample of firms owned by immigrants in Canada for 20 or more years was matched to firms owned by Canadian-born individuals to obtain results for longer-tenured immigrants. For brevity, only the estimated effects of the immigrant variables are shown. The full set of estimates is available from the authors upon request.

Table 3 shows the results for four innovation outcomes. The innovation results for all firms with immigrant owners reflect those reported earlier in the descriptive statistics. Having an immigrant owner had a positive effect on the incidence of three of the four innovation types: product innovations (goods and services), process innovations (production processes or methods) and marketing innovations (new ways of selling). For all firms with immigrant owners, the likelihood of implementing a product innovation was 2.3 percentage points higher than for firms with Canadian-born owners. For process innovations, the likelihood was 3.5 percentage points higher for immigrant-owned firms. Both effects were significant at the 0.1% significance level. Given the baseline probabilities (the probabilities associated with firms owned by Canadian-born individuals) for each of these innovation categories (0.267 for product and 0.174 for process), these effects translated into immigrant-owned firms having an 8.6% higher probability than firms owned by Canadian-born individuals of introducing a new product or service, and a 20.1% higher probability of introducing a new production process or method.<sup>18</sup> The effect of the immigrant status variable on the marketing innovation category was also positive and significant at the 1% significance level (0.025). There was no statistically significant difference between immigrant-owned firms and those owned by Canadian-born individuals in the likelihood of implementing an organizational innovation.<sup>19</sup>

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18. The ATT counterfactual in this case was the innovation rate that would prevail in immigrant-owned firms if they were owned by Canadian-born individuals.

19. Since a firm's innovation is self-reported, one possible concern is that immigrant owners may generally be more optimistic about their firm's innovation activities, so the differences between immigrants and Canadian-born individuals may be overestimated. This proposition cannot be tested in this study; however, there is no real evidence to suggest immigrant owners have higher levels of optimism.

**Table 3**  
**Post-matching probit estimates of average marginal effects of immigrant status on innovation**  
**(average treatment effects on the treated), private-sector SMEs**

	Innovation			
	Goods or services	Production process or method	Organizational method	New way of selling
<b>All immigrants</b>				
<b>Immigrant</b>				
Coefficient	0.0230 **	0.0350 ***	0.0014	0.0250 ***
Standard error	-0.0086	-0.0075	-0.0074	-0.0077
Controls	Yes	Yes	Yes	Yes
Baseline probability	0.2670	0.1742	0.1790	0.1808
Number of observations	19,896	19,897	19,896	19,896
<b>Immigrants in Canada for less than 20 years</b>				
<b>Immigrant</b>				
Coefficient	0.0360 *	0.0310 *	-0.0040	0.0540 ***
Standard error	-0.0150	-0.0130	-0.0130	-0.0140
Controls	Yes	Yes	Yes	Yes
Baseline probability	0.2840	0.1786	0.1883	0.1854
Number of observations	10,232	10,230	10,232	10,232
<b>Immigrants in Canada for 20 years or more</b>				
<b>Immigrant</b>				
Coefficient	0.0190	0.0370 ***	0.0067	0.0150
Standard error	-0.0097	-0.0086	-0.0083	-0.0087
Controls	Yes	Yes	Yes	Yes
Baseline probability	0.2578	0.1722	0.1738	0.1780
Number of observations	16,320	16,316	16,320	16,320

\* significantly different from reference category ( $p < 0.05$ )

\*\* significantly different from reference category ( $p < 0.01$ )

\*\*\* significantly different from reference category ( $p < 0.001$ )

**Note:** The baseline probability is the estimated probability of a positive outcome assuming that all firms in the matched sample are owned by Canadian-born individuals.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

Similar to the results for all firms with immigrant owners, firms owned by recent immigrants were more likely to implement a product (3.6 percentage points, or 12.7%, higher), process (3.1 percentage points, or 17.3%, higher) or marketing innovation (5.4 percentage points, or 29.2%, higher) than firms with Canadian-born owners (Table 3). These differences were significant at the 5% significance level. Firms with immigrant owners who had been in Canada for more than 20 years were also more likely to implement a process innovation (3.7 percentage points, or 21.5%, higher) than firms with Canadian-born owners.<sup>20</sup>

With regard to intellectual property outcomes, generally speaking, there was no statistically significant difference between firms with immigrant owners and firms with Canadian-born owners in the likelihood of holding registering trademarks or patents (Table 4). Firms with immigrant owners registered a statistically significant higher probability of using such intellectual property (0.0084) for only one of the five intellectual property types (registered industrial designs); the effect of immigrant ownership on the probability of using nondisclosure agreements was negative (-0.018). For firms with more recent immigrant owners, the probability of using intellectual property

20. As a robustness check, a set of OLS and probit models was also estimated using the raw (unmatched) sample with the same set of covariates as the second-stage post-CEM probit models. The estimated effects of immigrant ownership are shown in Appendix Table A.3 (the full set of estimates is available upon request). The estimates in Table A3 are very similar to the estimates presented in this section.

was greater for two of the five types of intellectual property at the 1% significance level. However, the results related to holding patents were particularly interesting because they were directly related to the recent studies on patent holding among immigrants mentioned in Section 3. The immigrant effect for all firms with immigrant owners in this category was not statistically significant, but firms with more recent immigrant owners had a 1.8 percentage point higher probability of registering a patent than firms owned by Canadian-born individuals, and the effect was positive and significant at the 1% significance level.<sup>21</sup>

**Table 4**  
**Post-matching probit estimates of average marginal effects of immigrant status on intellectual property (average treatment effects on the treated), private-sector SMEs**

	Intellectual property					
	Trademark	Patent	Industrial design	Trade secret	Nondisclosure agreement	Other
<b>All immigrants</b>						
<b>Immigrant</b>						
Coefficient	-0.0039	0.0035	0.0084 **	-0.0034	-0.0180 **	0.0009
Standard error	-0.0066	-0.0037	-0.0027	-0.0050	-0.0068	-0.0035
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Baseline probability	0.1403	0.0373	0.0156	0.0782	0.2052	0.0313
Number of observations	19,892	19,892	19,701	19,892	19,901	19,897
<b>Immigrants in Canada for less than 20 years</b>						
<b>Immigrant</b>						
Coefficient	-0.0022	0.0180 **	0.0190 ***	0.0091	-0.0200	0.0000
Standard error	-0.0120	-0.0068	-0.0052	-0.0088	-0.0120	-0.0061
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Baseline probability	0.1609	0.0438	0.0184	0.0837	0.2249	0.0369
Number of observations	10,228	10,228	10,122	10,228	10,232	10,228
<b>Immigrants in Canada for 20 years or more</b>						
<b>Immigrant</b>						
Coefficient	-0.0047	-0.0031	0.0040	-0.0076	-0.0160 *	0.0028
Standard error	-0.0072	-0.0038	-0.0029	-0.0055	-0.0077	-0.0038
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Baseline probability	0.1302	0.0343	0.0144	0.0752	0.1953	0.0284
Number of observations	16,316	16,186	15,889	16,316	16,324	16,320

\* significantly different from reference category ( $p < 0.05$ )

\*\* significantly different from reference category ( $p < 0.01$ )

\*\*\* significantly different from reference category ( $p < 0.001$ )

**Note:** The baseline probability is the estimated probability of a positive outcome assuming that all firms in the matched sample are owned by Canadian-born individuals.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

The next set of results focuses on immigrant business owners in KBIs. The firms with immigrant owners in this category were matched to firms with Canadian-born owners to produce a separate set of CEM weights for this part of the analysis. Of 568 immigrant-owned firms in KBIs, 521 were matched to firms with Canadian-born owners as controls, resulting in a 91.7% matching rate. There was a total of 1,664 firms in the matched KBI sample (Appendix Table A.2).

The estimation results for the four innovation categories are shown in Table 5.<sup>22</sup> Immigrant-owned firms were more likely to implement a product or process innovation (0.061), but this effect was only weakly significant at the 5% significance level. This is not surprising given the relatively small

21. The baseline probability is 0.044.

22. The full set of second-stage (post-matching) probit estimates is available from the authors upon request.

sample size. Relative to the baseline probabilities, the effects for immigrant-owned firms in KBIs were somewhat larger than those for all immigrant-owned firms (as shown in Table 3). In particular, the probability of introducing a process innovation was 28.1% higher among immigrant-owned firms in KBIs than among firms with Canadian-born owners. There was no statistically significant difference in the likelihood of implementing an organizational or marketing innovation between immigrant-owned firms and those owned by Canadian-born individuals in KBIs.

**Table 5**  
**Post-matching probit estimates of average marginal effects of immigrant status on innovation in knowledge-based industries (average treatment effects on the treated), private-sector SMEs**

	Innovation			
	Goods or services	Production process or method	Organizational method	New way of selling
<b>Immigrant</b>				
Coefficient	0.043	0.061 *	0.014	0.016
Standard error	-0.028	-0.025	-0.023	-0.023
<b>Controls</b>	Yes	Yes	Yes	Yes
Baseline probability	0.366	0.217	0.218	0.196
Number of observations	1,664	1,664	1,664	1,664

\* significantly different from reference category ( $p < 0.05$ )

**Note:** The baseline probability is the estimated probability of a positive outcome assuming that all firms in the matched sample are owned by Canadian-born individuals.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

## 8 Discussion

Controlling for various important observed differences in the characteristics of firms owned by immigrants and firms owned by Canadian-born individuals, this study found that immigrant-owned SMEs were somewhat more likely to innovate. This section seeks to understand what it is about the characteristics of immigrant owners and immigrant-owned firms—beyond those controlled for in this study—that might contribute to the findings mentioned above. Several possibilities warrant particular attention.

First, it may not be necessary to turn to an inherent difference between immigrants and the native born to explain the differences in outcomes. For example, although the analysis adjusts for differences in the levels of educational attainment between immigrant and Canadian-born owners, it does not adjust for possible differences in their fields of study. University-educated immigrants are twice as likely to be educated in a STEM field and three times as likely to be educated in engineering or computer science as university-educated Canadian-born individuals (Picot and Hou 2020). Immigrant owners may be more likely to implement product and process innovations not because they are immigrants but because a larger share of them are educated in STEM fields, and there is earlier research to support this notion. For example, Hunt and Gauthier-Loiselle (2010) found that the difference in patent filing rates between college-educated immigrants and native-born individuals can be explained by the fact that college-educated immigrants in the United States are more likely than their U.S.-born counterparts to be engineers and scientists. However, the difference in the share of STEM-educated owners could not be controlled for in this study because field of study information was not available.<sup>23</sup>

23. Similarly, although Picot and Rollin (2019) observed a higher job creation rate among immigrant-owned firms, they also found that this could be explained by the fact that immigrant-owned firms tended to be younger than firms owned by Canadian-born individuals, and younger firms create jobs at a higher rate.

It is also possible that the immigrant effect found in this study stems from characteristics uniquely or primarily affiliated with immigrants. For example, immigrant-owned SMEs may be more likely to innovate because their owners are more familiar with foreign markets, have greater access to information in languages other than English or French, or benefit from the experience of doing business abroad and from being exposed to technological innovations introduced in other countries. For instance, some of the innovations introduced by immigrant SME owners may reflect practices that are well known in their countries of origin, but less known in Canada. It would be possible to shed some light on the importance of this issue if information on country of origin and mother tongue were available.<sup>24</sup>

Lastly, it is also possible that the results are related to some important features of the Canadian immigration system. About 40% of immigrant SME owners are economic-class immigrants (Green et al. 2016). The Canadian government selects economic immigrants based in part on their human capital characteristics to improve their chances of success in the Canadian labour market. Compared with an average business owner, economic-class immigrants may have the advantage of having had greater work experience in companies that value innovation and having contributed to the development of new products or processes before starting their own business. The large share of economic-class immigrants among immigrant firm owners could indirectly increase the likelihood of immigrant owners undertaking activities that lead to more successful companies, including innovation activities.

All such possibilities should be considered when interpreting the immigration effect. However, data limitations make it impossible to unpack the immigration effect further.

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24. Information about immigrants' country of origin was written in during the survey but could not be coded.

## 9 Conclusion

This paper uses data from a survey of Canadian small and medium-sized enterprises (SMEs) in 2011, 2014 and 2017, and asks whether immigrant-owned SMEs were more likely to innovate during the three years prior to the survey than those owned by Canadian-born individuals. The paper outlines a number of reasons why one might expect to see such an outcome and hypothesizes that immigrant owners would innovate at a higher rate. The outcome variables include product, process, organizational and marketing innovations, as well as five types of intellectual property: registered trademarks, patents, registered industrial designs, trade secrets and nondisclosure agreements. The central question of this study relates to whether there is any difference in innovation activity between immigrant-owned firms and firms owned by Canadian-born individuals. The survey data allow for the control of essential firm and owner characteristics in the analysis—an approach that was not often possible to implement in earlier research. In particular, there was a significant difference in the educational attainment of immigrant and Canadian-born owners (immigrant owners were more highly educated), and an owner's educational attainment, along with variables such as firm size and growth rate, is an important determinant of innovation practice. The multivariate analysis employed an approach based on matching the records of firms with immigrant and Canadian-born owners and a second-stage probit analysis.

Both the unadjusted results based on raw data and the results based on a sample in which firms owned by immigrant owners were matched to firms owned by Canadian-born individuals to adjust for the differences in firm and owner characteristics between the two groups indicate that immigrant-owned SMEs had a higher probability of implementing a product, process or marketing innovation than firms owned by Canadian-born individuals. Immigrant-owned SMEs had an 8.6% higher likelihood of implementing a product innovation (relative to the 0.27 baseline rate computed for SMEs owned by Canadian-born individuals) and a 20.1% higher likelihood of implementing a process innovation (relative to the 0.17 baseline rate). A separate analysis was conducted for firms whose owners were either more recent immigrants (in Canada for less than 20 years) or longer-tenured immigrants. The results were similar to those reported above. Both firms owned by more recent immigrants and those owned by longer-tenured immigrants were more likely to implement a process innovation than firms with Canadian-born owners, while firms owned by more recent immigrants were also more likely to implement a product innovation.

Regarding the use of the five types of intellectual property, the results (adjusted for firm and owner characteristics) indicated that the effect of immigrant ownership was positive and statistically significant for only one of the five intellectual property types (registered industrial designs). With regard to the probability of using nondisclosure agreements, the effect was negative. Overall, the evidence suggests that immigrant-owned SMEs and those owned by Canadian-born individuals were largely similar in their use of intellectual property. One interesting result is that recent immigrants who owned an SME were more likely than Canadian-born SME owners to hold a patent. This result may also be explained in part by the greater tendency of more recent highly educated immigrants to be educated in a more technical field (i.e., science, technology, engineering and mathematics [STEM]) than Canadian-born individuals.

Lastly, a separate analysis was conducted for SMEs in knowledge-based industries (KBIs). The unadjusted results and the results based on the matched sample were similar to those reported for SMEs in the economy as a whole—immigrant-owned firms were more likely to implement a product or process innovation. However, this immigrant effect was only weakly significant at the 5% significance level. This is not surprising, given the relatively small sample size. There was no statistically significant difference in the likelihood of implementing an organizational or marketing innovation.



Taken together, this evidence indicates that an immigrant-owned firm appears somewhat more likely to implement a product or process innovation, regardless of whether the immigrant owner is a recent or longer-tenured immigrant, and whether the firm is in a KBI or in the economy as a whole. These results may be related—in part—to the unobserved differences between immigrant and Canadian-born SME owners or may reflect characteristics primarily found among immigrants, such as the experience of doing business abroad and exposure to technological innovations introduced in other countries. Future research will look at the sources of immigrant innovation activities in more detail.

# 10 Appendix: Tables

**Table A.1**  
**Balancing the sample of all private-sector SMEs using coarsened exact matching**

	Raw data <sup>1</sup>		CEM-weighted	
	Canadian-born	Immigrants	Canadian-born	Immigrants
	percent			
<b>Matching (coarsened) variables</b>				
<b>Owner's age</b>				
18 to 34	6.3	5.0	3.7	3.7
35 to 54	51.7	53.3	50.8	50.8
55 and older	41.9	41.7	45.5	45.5
<b>Owner's education</b>				
No university	66.7	47.2	51.0	51.0
Bachelor's degree	21.1	30.9	30.1	30.1
Graduate degree	12.2	21.9	18.9	18.9
<b>Industry</b>				
Primary	8.1	2.3	5.0	5.0
Construction	19.1	9.6	7.3	7.3
Manufacturing	6.4	7.0	13.0	13.0
Wholesale	5.7	6.1	11.3	11.3
Retail	10.9	12.0	9.9	9.9
Transportation	5.4	6.5	7.9	7.9
Professional	12.5	15.7	14.1	14.1
Accommodation	5.9	11.7	9.6	9.6
Other services	7.4	6.7	7.4	7.4
All other industries	18.6	22.5	14.5	14.5
<b>Firm size (employees)</b>				
Less than 5	54.2	60.9	48.5	48.5
5 to 9	21.1	20.0	17.4	17.4
10 to 49	20.5	16.5	22.4	22.4
50 or more	4.1	2.6	11.7	11.7
<b>Geographic region</b>				
Atlantic	7.9	2.6	4.8	4.8
Quebec	24.9	11.6	9.9	9.9
Ontario	31.2	48.3	51.0	51.0
Prairies	20.7	15.9	17.8	17.8
British Columbia and the Northwest	15.2	21.4	16.5	16.5
<b>City</b>				
Other cities	67.3	39.0	52.7	52.7
Montréal	9.5	9.1	7.0	7.0
Toronto	10.3	29.6	21.3	21.3
Calgary	3.7	5.4	5.0	5.0
Edmonton	3.4	4.0	3.6	3.6
Vancouver	5.8	13.0	10.4	10.4
Rural	23.3	8.8	11.4	11.4
	number			
<b>Sample variables</b>				
Owner's average age	51.5	52.0	52.6	53.1
CEM of owner's average years of experience	21.2	19.4	21.9	21.2
Average firm size (employees)	10.6	8.8	23.4	24.5
	percent			
Share of startups	74.2	77.8	71.5	74.3
<b>Education</b>				
Less than high school	8.8	6.0	5.6	6.5
High school	25.3	16.8	20.7	18.3
Some postsecondary	32.6	24.4	24.7	26.2
Bachelor's degree	21.1	30.9	30.1	30.1
Graduate degree	12.2	21.9	18.9	18.9
	number			
<b>Observations (unweighted)</b>				
All	22,320	5,092	...	...
Matched	15,247	4,658	...	...
Unmatched	7,073	434	...	...

... not applicable

1. Raw data are weighted using survey weights.

**Note:** CEM: coarsened exact matching.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

**Table A.2**  
**Balancing the sample of private-sector SMEs in knowledge-based industries using coarsened exact matching**

	Raw data <sup>1</sup>		CEM-weighted	
	Canadian-born	Immigrants	Canadian-born	Immigrants
	percent			
<b>Matching (coarsened) variables</b>				
<b>Owner's age</b>				
18 to 34	4.9	2.4	1.5	1.5
35 to 54	55.6	60.1	55.9	55.9
55 and older	39.4	37.6	42.6	42.6
<b>Owner's education</b>				
No university	36.6	16.2	15.4	15.4
Bachelor's degree	37.9	42.1	40.1	40.1
Graduate degree	25.4	41.7	44.5	44.5
<b>Owner's experience (years)</b>				
Less than 10	18.7	27.9	15.1	21.9
10 to 19	31.6	30.4	33.3	31.7
20 or more	49.7	41.7	51.7	46.4
<b>Firm size (employees)</b>				
Less than 5	62.8	71.7	53.4	53.4
5 to 9	16.4	12.8	10.6	10.6
10 to 49	16.4	12.2	21.7	21.7
50 or more	4.4	3.3	14.4	14.4
<b>Geographic region</b>				
Atlantic	3.8	1.4	3.6	3.6
Quebec	22.3	8.7	10.0	10.0
Ontario	34.9	53.9	53.7	53.7
Prairies	22.1	15.6	15.5	15.5
British Columbia and the Northwest Territories	16.9	20.4	17.1	17.1
<b>City</b>				
Other cities	48.4	26.9	42.0	42.0
Montréal	13.4	7.3	6.9	6.9
Toronto	16.6	39.6	28.4	28.4
Calgary	7.5	8.3	8.1	8.1
Edmonton	4.7	3.9	2.7	2.7
Vancouver	9.5	14.1	11.9	11.9
Rural	9.9	4.2	4.8	4.8
Startup	11.7	8.5	13.1	13.1
	number			
<b>Sample variables</b>				
Owner's average age	51.3	51.1	52.1	52.2
CEM of owner's average years of experience	19.4	17.0	19.8	18.4
Average firm size (employees)	10.3	8.6	28.2	28.2
	percent			
<b>Education</b>				
Less than high school	1.5	0.3	0.4	0.4
High school	11.3	3.0	5.0	2.9
Some postsecondary	23.8	12.9	9.9	12.1
Bachelor's degree	37.9	42.1	40.1	40.1
Graduate degree	25.4	41.7	44.5	44.5
	number			
<b>Observations (unweighted)</b>				
All	1,903	568	...	...
Matched	1,143	521	...	...
Unmatched	760	47	...	...

... not applicable

1. Raw data are weighted using survey weights.

**Note:** CEM: coarsened exact matching.

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

**Table A.3**  
**Ordinary least squares and probit estimates of the immigrant effect on innovation and intellectual property, private-sector SMEs**

	Ordinary least squares		Probit	
	coefficient	standard error	coefficient	standard error
<b>Innovation</b>				
Goods or services	0.0240 *	-0.0110	0.0240 *	-0.0100
Production process or method	0.0310 ***	-0.0086	0.0320 ***	-0.0088
Organizational method	-0.0120	-0.0084	-0.0120	-0.0083
New way of selling	0.0240 **	-0.0093	0.023*	-0.0091
<b>Intellectual property</b>				
Trademark	-0.0042	-0.0067	-0.0028	-0.0061
Patent	0.0000	-0.0026	0.0002	-0.0023
Industrial design	0.0034	-0.0019	0.0034	-0.0019
Trade secret	-0.0056	-0.0049	-0.0049	-0.0046
Nondisclosure agreement	-0.0160	-0.0089	-0.0150 *	-0.0077
Other	-0.0036	-0.0043	-0.0025	-0.0036

\* significantly different from reference category ( $p < 0.05$ )

\*\* significantly different from reference category ( $p < 0.01$ )

\*\*\* significantly different from reference category ( $p < 0.001$ )

**Source:** Statistics Canada, authors' calculations based on data from the Survey on Financing and Growth of Small and Medium Enterprises, 2011, 2014 and 2017.

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