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Analytical Studies: Methods and References

Modelling the Impact of Immigration on Student Numbers

by Aneta Bonikowska, Garnett Picot, Feng Hou and Évamé Koumaglo

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Papers in this series provide background discussions of the methods used to develop data for economic, health, and social analytical studies at Statistics Canada. They are intended to provide readers with information on the statistical methods, standards and definitions used to develop databases for research purposes. All papers in this series have undergone peer and institutional review to ensure that they conform to Statistics Canada's mandate and adhere to generally accepted standards of good professional practice.

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Abstract

This study presents an approach to model changes in the numbers of elementary, secondary and postsecondary students who are immigrants (including both permanent residents and non-permanent residents), in response to changes in overall immigration levels. The modelling approach uses historical data on age distributions, retention rates and participation rates to capture the effects of both new admission cohorts and the ongoing presence of earlier cohorts, allowing the impacts on enrolment to be estimated over time. This framework can be used to scale the effects to any given change in immigration levels, yielding projected numbers of students that can be expected in the Canadian education systems over the next several years under a given set of assumptions.

Introduction

The rapid increase in immigration and the number of non-permanent residents (NPRs) in Canada from 2021 to 2024 prompted public discourse about the capacity of the housing, health care and education systems to absorb and respond to growing demand. This study focuses on education, presenting the methodological considerations in studying the impact that changing levels of immigration may have on the number of elementary, secondary and postsecondary students. Specifically, the objective is to model changes in the numbers of immigrant students, i.e., those who are either permanent residents (PRs) or NPRs, from a given change in overall immigration levels.

The models estimate changes in the number of students in different age groups that may be expected, given historical data, if PR levels were increased by 100,000 and the number of NPRs (which includes work permit holders, student permit holders, asylum claimants and other non-permanent residents) changed from level X to Y. These results can then be used to scale the effects to any given changes in immigration levels. This study describes how such changes can be modelled and the factors that influence the numbers of immigrant students (including both PRs and NPRs) in the Canadian education systems in a given year. These models are then used to project the numbers of elementary and secondary school-aged students and postsecondary students expected in the Canadian education systems from 2025 to 2030 under a set of assumptions. Those results are reported by Bonikowska et al. (2026a, 2026b).

1 Modelling the effect of changes in permanent residents and non-permanent residents on the elementary and secondary school-aged population

The effects of changes in PRs and NPRs on enrolment are modelled separately. Furthermore, the effect of PRs is estimated separately for two groups of school-aged children—those who were new to Canada at the time of admission (and will be referred to as one-step PRs for ease of exposition) and those who were NPRs prior to becoming PRs (referred to as two-step PRs).

1.1 Modelling the effect of a cohort of 100,000 permanent residents on the counts of permanent resident populations of elementary and secondary age

Projecting the number of immigrant children in the Canadian education systems over a given period in the future involves considering both past and future immigration intake, because future enrolment levels are affected by future immigration levels as well as past levels. For example, enrolment in elementary school in 2026 includes not only children of immigrants admitted in 2026, but also children of cohorts admitted in earlier years and who are still in the elementary and secondary systems. For that reason, the analysis includes the effect of PR cohorts admitted from 2015 to 2030. The method outlined below for a single cohort of 100,000 is thus applied to each of the 16 past and future cohorts included in this analysis.

The model consists of several steps:

- (1) The starting point for the PR component is estimating the age structure of a synthetic cohort of 100,000 immigrants admitted in year t , based on historical data. The average age distribution of the admission cohorts from 2017 to 2019 was used for this purpose, calculated from Immigration, Refugees and Citizenship Canada's (IRCC) administrative

data. This yields the number of children younger than 18 years at the time of admission that can be expected from 100,000 PRs.

- (2) The cohort of childhood immigrants in year t is then aged by 1 year for each year of an 11-year period. This reflects the fact that immigrant children's schooling needs extend beyond their year of admission as they age into different school-aged groups over time.
- (3) The retention rates of one-step PRs are estimated, i.e., the proportion of a given cohort of PRs who exit Canada each year over the 11-year period:
 - a. The share of PRs who remained in Canada in year t since admission is determined by the proportion who filed T1 tax returns in year t since admission. These estimates are based on the 2015 admission cohort and calculated using the Longitudinal Immigration Database (IMDB).¹
 - b. Children typically do not file T1 tax returns, so their retention rate is proxied by that of one-step PRs aged 25 to 54 with children at the time of admission.
 - c. In recent cohorts, T1 filing rates increase over the three years following the year of admission. Therefore, retention rates for earlier years are based on the third-year filing rate.
 - d. Given the timeframe of available data at the time of writing, the retention pattern of the 2015 admission cohort is projected to a full 10 years since admission using an ordinary least squares regression.
 - e. Exits are removed from the counts of the PR children in each year of the 11-year period.
- (4) The number of children in PR families who were previously NPRs (referred to as two-step PRs for ease of exposition) must be subtracted from the number of children in a cohort of PRs (and in each year of the 11-year period) to obtain the number of PR children who were not previously NPRs (referred to as one-step PRs).² This is because not all children in the admission cohort are new to their school system—some will have been in Canada as members of NPR families before the family made the transition to PR status.
- (5) The above steps are replicated for several successive admission cohorts each year so that the cumulative effect of past admission cohorts of PRs can be gleaned for a given calendar year. The cumulative effect on enrolments in a given year is the sum of the effect of admission cohorts up to that time. Note that more distant admission cohorts contribute less to the cumulative effect on the number of immigrant children as the childhood immigrants in those cohorts age out of school.

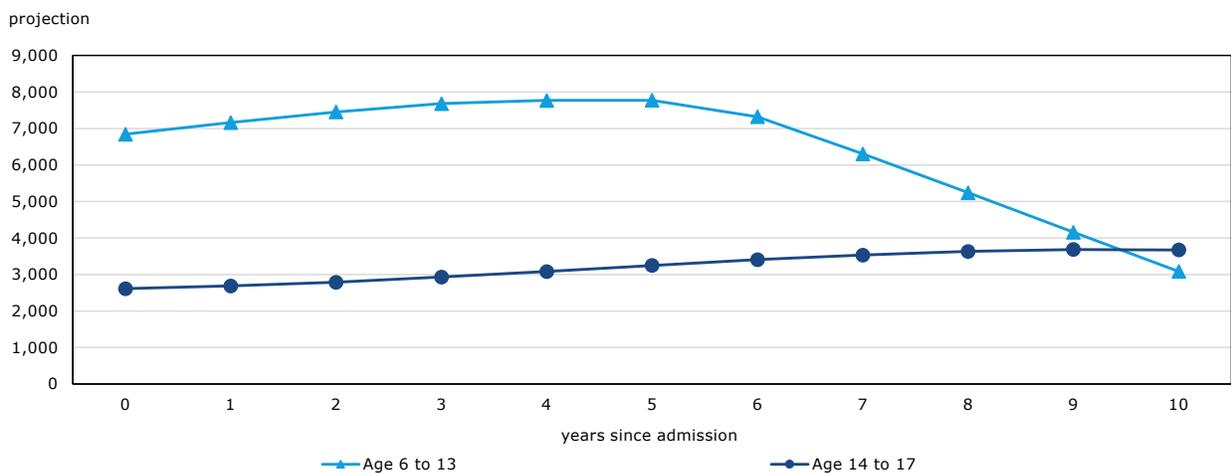
1. The IMDB is the result of a collaboration between Statistics Canada, Immigration and Refugees and Citizenship Canada (IRCC), and the provinces and territories. It consists of administrative data from IRCC and tax files from the Canada Revenue Agency.

2. It is anticipated that, in the future, at least 40% of PRs in any admission cohort will have previously been NPRs (Immigration, Refugees and Citizenship Canada, 2024). It could be assumed that, as a result, 40% of the children in the PR landing cohort were previously NPRs. But NPRs have fewer children per 1,000 than PRs because many are international students, who tend to be much younger. Census data indicate that, in 2021, NPRs had 12 children per 100, while recent PRs (in Canada for two years or less) had 20 children per 100. One reasonable estimate of the share of PR children in the admission cohort who were previously NPRs would be $12/20 \times 40\%$, or 24%. But this estimate is based on all NPRs in 2021. The NPRs who make the transition to PR status, who are of interest here, have a different age distribution than all NPRs as a group and hence will have a different number of children per 100. Data from the census allow this difference in the age distribution of all NPRs versus NPRs who become PRs to be accounted for. When this is done, it is estimated that nearly 23% of PR children in recent admission cohorts were previously NPRs. This 23% is subtracted from the total number of PR children estimated to be admitted to Canada in any cohort because they were already here as NPRs.

- (6) Combining the steps, projections of the change in two population age groups from a 100,000 annual cohort of PRs are produced for each year over a six-year projection period from 2025 to 2030. The projected age groups are 6 to 13 years (elementary school-aged children) and 14 to 17 years (secondary school-aged children). The participation rate in the elementary and secondary education systems for populations in those two age groups is assumed to be 100%.

Modelling the number of new one-step PR immigrant children in the two different age groups per 100,000 PRs in a cohort constitutes the core of the PR projection results. These are PR children who are new to Canada. A single cohort of 100,000 PRs produces a varying number of school-aged children over the subsequent decade in Canada, as shown in Chart 1. The age distribution of the children in the year of admission changes as they age over the subsequent 10 years. In the year of admission, the 100,000 cohort includes approximately 6,800 6- to 13-year-olds and 2,600 14- to 17-year-olds (Chart 1). The number of 6- to 13-year-olds increases over time as children younger than 6 at the time of admission age into the 6- to 13-year-old bracket. At some point, there are no children left in the cohort who were aged 5 or younger at the time of admission and who are aging into the 6- to 13-year-old group, while at the same time, children continue to age out. The number of 14- to 17-year-olds rises gradually over the 11-year period as younger children in the cohort age into this bracket. The admission cohort consists of a higher proportion of children of every age from 1 to 13 years than of any age from 14 to 17 years, hence the continued growth in the number of 14- to 17-year-olds. The evolution of the number of students within both age groups with time since admission is also affected by the retention rate applied to the numbers. The retention rate is constant from the admission year (year 0) to the third year after admission, from which point it starts to fall. This results in a faster decline in the number of 6- to 13-year-olds and a slower increase in the number of 14- to 17-year-olds in the second part of the 11-year period shown in Chart 1 than would be the case if all immigrants remained in Canada after admission.

Chart 1
Projected number of one-step permanent resident children per 100,000 permanent residents in a cohort, aged 6 to 13 and 14 to 17, by year since admission to Canada



Sources: Statistics Canada, Longitudinal Immigration Database, 2024, and Immigration, Refugees and Citizenship Canada, 2024 administrative data.

The projected number of immigrant children in the Canadian elementary and secondary school systems in a given calendar year is obtained by summing the projected number of immigrant children from that year's admission cohort and earlier cohorts. Table 1 demonstrates this using estimated numbers of one-step PR children aged 6 to 13 for a hypothetical situation in which all PR admission cohorts from 2015 onward consist of 100,000 individuals.

The numbers in Table 1 can be scaled to the actual size of past PR cohorts and the planned size of future cohorts to obtain projections of the number of students in a given age group for each year from 2025 to 2030. Note that the total number of immigrant students in the education systems in a given year does not represent the additional capacity required each year because of immigration. The additional capacity is represented by the year-over-year change in the number of immigrant children in a given age group.³

The above approach estimates the increase in the number of PR children who were not previously NPRs (i.e., one-step PRs) associated with a 100,000-person admission cohort. When step (4) is excluded from the approach, the effect of the 100,000-person cohort on the school enrolment of all PRs, both one-step and two-step, is estimated. To determine the effect of two-step immigration on enrolment, the difference between the two estimates is used.

Table 1
Projected number of one-step permanent resident children aged 6 to 13 in a hypothetical scenario where each admission cohort of permanent residents from 2015 to 2030 consisted of 100,000 individuals, Canada, 2025 to 2030

	2025	2026	2027	2028	2029	2030
	number					
Admission year						
2015	3,090	..	..	..	..	..
2016	4,160	3,090	..	..	..	..
2017	5,240	4,160	3,090	..	..	..
2018	6,310	5,240	4,160	3,090	..	..
2019	7,320	6,310	5,240	4,160	3,090	..
2020	7,780	7,320	6,310	5,240	4,160	3,090
2021	7,770	7,780	7,320	6,310	5,240	4,160
2022	7,680	7,770	7,780	7,320	6,310	5,240
2023	7,460	7,680	7,770	7,780	7,320	6,310
2024	7,160	7,460	7,680	7,770	7,780	7,320
2025	6,850	7,160	7,460	7,680	7,770	7,780
2026	...	6,850	7,160	7,460	7,680	7,770
2027	...	...	6,850	7,160	7,460	7,680
2028	...	...	...	6,850	7,160	7,460
2029	...	...	...	...	6,850	7,160
2030	...	...	...	...	...	6,850
Total	70,810	70,810	70,810	70,810	70,810	70,810

.. not available for a specific reference period

... not applicable

Note: Totals do not add up due to rounding.

Sources: Statistics Canada, Longitudinal Immigration Database, 2024; Census of Population, 2021; and Immigration, Refugees and Citizenship Canada, 2024 administrative data.

3. In the hypothetical example in Table 1, this year-over-year change is zero because each PR cohort was assumed to consist of 100,000 individuals.

1.2 Modelling the effect of changes in the non-permanent resident population on elementary and secondary school-aged groups

The following approach taken to estimate the number of NPR children in the school systems is simpler than that applied to the PR population:

- (1) The projected number of NPRs for each year t (e.g., 2024) to $t+6$ based on immigration level plans from IRCC provides a starting point. These are anticipated stock counts for each year.
- (2) Based on 2021 Census data regarding the age distribution of NPRs, the age distribution (e.g., age groups 6 to 13 and 14 to 17) for the annual projected stock counts is estimated.
- (3) The change in the stock counts of NPRs for each age group in each year is calculated. For example, the change in the stock count of 6- to 13-year-olds for year $t+1$ (e.g., 2025) is the stock count in $t+1$ minus the number in year t . This provides an estimate of the marginal effect of changing NPR levels on elementary and secondary school-aged populations.

To assess the marginal effect of projected changes in NPR plus PR levels, the effect per 100,000 PRs (for both one-step and two-step PRs) is scaled to the projected size of the PR admission cohorts over the projection. If that anticipated number is, e.g., 400,000 for each year, the marginal effect per 100,000 calculated above is multiplied by four for each projected year for each of the two PR groups (one-step and two-step). The effect of projected changes in NPR levels is calculated as noted above. The total effect is the sum of the NPR plus the two components of the PR (one-step and two-step) effects.

2 Modelling the effect of changes in permanent residents and non-permanent residents on postsecondary enrolment

2.1 The approach

At the elementary and secondary level, it is assumed that all school-aged children attend elementary or secondary school. That is, the participation rate is assumed to be 100%. However, at the postsecondary level, participation rates are well below 100% because only a proportion of the population aged 18 to 24, for example, attend college or university.

The effect of immigration levels on postsecondary enrolment is projected in two steps. First, the relevant immigrant populations are projected to 2030, then participation rates are applied to these populations, in the following steps:

- (1) The size of the immigrant populations aged 18 to 24 and 25 to 34 is projected. The methodology is identical to that used to project the marginal effect on elementary and secondary populations, as described earlier.
- (2) Based on 2021 Census data, postsecondary participation rates for immigrants aged 18 to 24 and 25 to 34 are estimated. These participation rates are assumed to remain constant over the projection period. Participation rates are estimated separately for colleges and universities, and for PRs (one-step and two-step separately) and NPRs. For NPRs, the participation rate is further estimated separately for three subgroups: (1) those with work

permits only, (2) those with study permits (with or without a work permit) and (3) those with all other permits.

- (3) Among PRs, postsecondary participation rates are found to vary significantly by age at immigration. This effect is accounted for in the projections because the variation in participation rates by age at immigration is modelled and embedded in the projection methodology.⁴
- (4) These participation rates are applied to the projected immigrant populations aged 18 to 24 and 25 to 34 to determine the number of immigrant college and university students to 2030.
- (5) Because not all students study full time, part-time student counts are converted to full-time equivalent numbers. Three and a half part-time students are equivalent to one full-time student (Ziegler et al. 2025). This ratio was used to calculate the full-time-equivalent number of both university and college students.

2.2 Postsecondary participation rates

2.2.1 Historical participation rates among permanent residents

Among immigrants aged 18 to 24, there was relatively little change in college and university participation rates from 2011 to 2021. Census data indicate that 36.4% of immigrants aged 18 to 24 were enrolled in university in 2021, little changed from 2011 and 2016 (Table 2). Most (93%) of these students were studying full time.⁵ The same pattern held for colleges. The participation rate was 17.5% in 2021, little changed since 2011.⁶ Of these students, 87% were enrolled full time.

The share of immigrants aged 25 to 34 who attended college or university declined from 2011 to 2021, from 10.4% to 7.2% for universities and from 10.1% to 6.8% for colleges. Of these students, whether enrolled in a university or a college, about 70% were studying full time.

Table 2
Percentage of permanent residents attending university or college, by age and year

	University		College	
	Age 18 to 24	Age 25 to 34	Age 18 to 24	Age 25 to 34
	percent			
2011	37.1	10.4	18.2	10.1
2016	38.1	9.5	17.6	9.3
2021	36.4	7.2	17.5	6.8

Sources: Statistics Canada, National Household Survey, 2011; and Census of Population, 2016 and 2021.

4. Regression models are used to estimate the participation rates by age at immigration to be used in the projection exercise. These estimated participation rates are applied to the populations aged 18 to 24 and 25 to 34, resulting in estimates of the number of immigrant postsecondary students (college and university separately) by age at immigration. These values are summed across all ages (at immigration) to estimate the total number of immigrant college and university students in each of the two age groups.

5. This figure is based on Labour Force Survey data from 2014 to 2024. The share of immigrant students who studied full time was fairly constant over the period considered. The average proportion over the period was used in calculations.

6. This paper is concerned with trends over time. A comparison of college and university participation rates at any point in time is not a good indication of the percentage of the population that ultimately attends college or university because college students tend to be younger than university students and hence will represent a smaller share of the population aged 18 to 24 at any point in time.

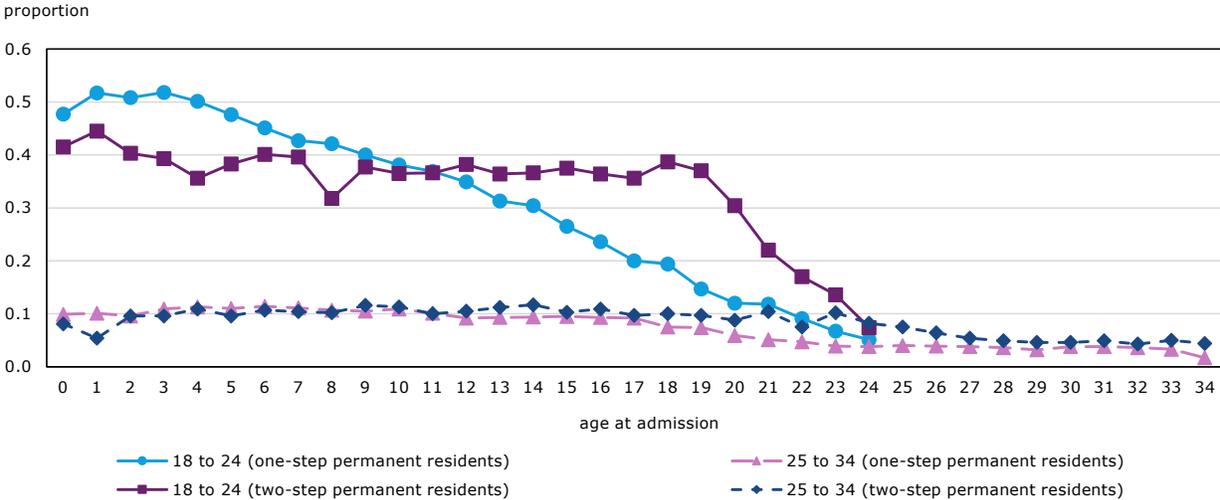
2.2.2 The effect of age at immigration on university participation rates among permanent residents

The university participation rate varied significantly with age at immigration. This is not surprising. Children who immigrate to Canada early in their life acquire most of their education in Canada and experience few language difficulties, resulting in, on average, higher rates of completing university education than their immigrant parents (Bonikowska and Hou, 2010). Those who immigrate in their middle to late teens experience more language and cultural adaptation difficulties and may not share the same educational experience as those who immigrated to Canada before becoming teenagers (Lee and Edmonston, 2011). The result is a decline in the university participation rate by age at immigration.

This is particularly evident among one-step childhood immigrants—those who are new to Canada when they become PRs. Among one-step immigrants admitted to Canada at age 1, over one-half attended university when they reached age 18 to 24, compared with about 22% of those admitted as 16-year-olds (Chart 2). Among two-step PRs, there was only a small decline in the participation rate between age 1 and age 19 at immigration. Following age 19, there was a precipitous decline. A relatively small percentage of immigrants who become PRs at age 20 to 24 attend university after PR admission. Except for graduate students, most PRs who came to Canada to attend university were likely admitted to the country prior to age 20.

Age at immigration had relatively little effect on the proportion of immigrants aged 25 to 34 who attended university, whether they were one- or two-step immigrants.

Chart 2
University participation rates among one- and two-step permanent residents aged 18 to 24 and 25 to 34, by age at admission



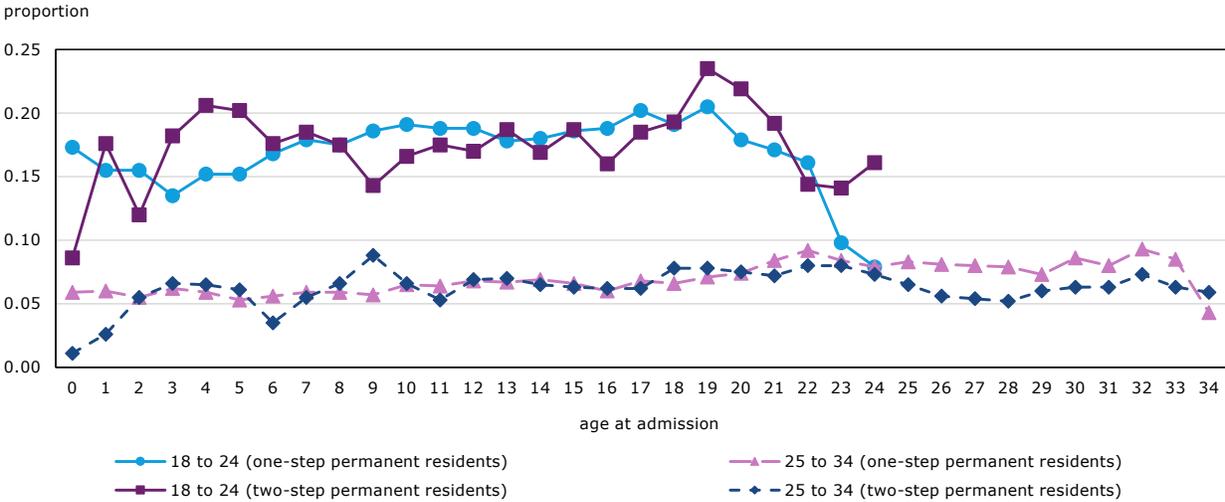
Note: Age at admission is the age at which a person obtained permanent resident status in Canada.
Source: Statistics Canada, Census of Population, 2021.

2.2.3 The effect of age at immigration on college participation rates among permanent residents

Age at immigration had a smaller and opposite effect on the likelihood of attending college. The participation rate at age 18 to 24 rose marginally from about 15% among those who became PRs aged 0 to 3 to around 19.5% among those admitted aged 16 to 19. This pattern held for both one-step and two-step immigrants (Chart 3). As with university trends, a relatively small percentage of immigrants who became PRs aged 20 to 24 attended college.

The percentage of 25- to 34-year-old PRs who attended college also increased with age at immigration. Comparing those who were admitted aged 0 to 3 with those admitted aged 21 to 24 results in an increase in the participation rate from 5.9% to 8.9% for one-step immigrants and from 4.0% to 7.6% for two-step immigrants.

Chart 3
College participation rates among one- and two-step permanent residents aged 18 to 24 and 25 to 34, by age at admission



Note: Age at admission is the age at which a person obtained permanent resident status in Canada.
Source: Statistics Canada, Census of Population, 2021.

2.2.4 Non-permanent resident participation rates

The participation rates shown in Table 3 from the 2021 Census are held constant throughout the projection period. They are estimated and applied separately for anyone with a student permit (they may have another permit as well), those with a work permit only and others. Those with student permits have participation rates in the range of 34% to 44% for university and college separately.⁷ Interestingly, NPRs with work permits only are more likely to participate at the college level than the university level.

Table 3
Participation rates in postsecondary education, non-permanent residents, 2021

	University		College	
	Age 18 to 24	Age 25 to 34	Age 18 to 24	Age 25 to 34
	percent			
Work permit only	6.3	3.1	15.6	4.6
Student permit (with or without work permit)	44.4	39.5	36.3	34.4
Other permits	15.1	3.7	14.3	6.5

Source: Statistics Canada, Census of Population, 2021.

7. They are not 100% because these rates apply to broad age groups (e.g., 18 to 24) at one point in time. For the rates to be 100%, all students would have to be in school for all years from age 18 to 24.

3 Summary

This study develops a modelling framework to estimate how changes in immigration levels—both PRs and NPRs—affect the number of immigrant students in Canada’s elementary, secondary and postsecondary education systems. The analysis seeks to answer the following question: if PR levels were increased or decreased by 100,000 and the number of NPRs changed from level X to Y, by how much would enrolment levels increase above and beyond the enrolment level of the Canadian-born population? The modelling approach uses historical data on age distributions, retention rates and participation rates to capture the effects of both new admission cohorts and the ongoing presence of earlier cohorts, allowing enrolment impacts to be estimated over time. By scaling results to hypothetical changes of 100,000 immigrants, the framework provides a flexible tool for answering policy-relevant “what if” questions about the future demand for educational resources.

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