International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

Address: IIASA, Schlossplatz 1, A-2361 Laxenburg, Austria
Email: repository@iiasa.ac.at **Telephone:** +43 (0)2236 807 342

Working paper

A framework for the prospective analysis of super-diversity coming from high levels of immigration

Alain Bélanger (belanger@iiasa.ac.at)
Patrick Sabourin (sabourin@iiasa.ac.at)
Guillaume Marois (marois@iiasa.ac.at)
Jennifer Van Hook (jxv21@psu.edu)
Samuel Vézina (samuel.vezina@ucs.inrs.ca)

WP-18-008

8 August 2018

Approved by

Wolfgang Lutz, World Population Program Director

This research was funded by IIASA and its National Member Organizations in Africa, the Americas, Asia, and Europe.

The research leading to these results has received funding from the Canadian Social Sciences and Humanities Research Council (SSHRC) under the Insight program (grant No425-2015-1152).

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Abstract

Background

Pressures to keep immigration rates at relatively high levels are likely to persist in most developed countries. At the same time, immigrant cohorts are becoming more and more diverse, leading host societies to become increasingly heterogeneous across multiple dimensions. For scholars who study demographic or socio-economic behaviours, the need to account for ethnocultural “super-diversity” brings new challenges and complications.

Objective

The main objective of this paper is to present a framework for the prospective analysis of super-diversity in several high immigration countries.

Methods

We developed microsimulation models that simultaneously project several population-dimensions for Canada, the United States and countries of the European Union, with the aim of studying the consequences of alternate future population and migration trends.

Results

The paper presents the projected progression of three indicators of diversity for Canada, the USA and the EU28: percentage of foreign-born population, percentage of the population using a non-official language at home and percentage of non-Christians under the reference scenario. Results from alternative scenarios show the potential impact of modifying the composition of migrant cohorts. The paper also examines the projected changes in the labour force for each region by education level and language. Finally, the paper proposes a new longitudinal indicator that counts the number of years lived as active and inactive over the life course for foreign- and native-born cohorts.

Contribution

The microsimulation models provide much more informative results than more traditional cohort-component or multi-state models to study the future effects of ethnocultural super-diversity on high immigration countries.

Acknowledgments

The research leading to these results has received funding from the Canadian Social Sciences and Humanities Research Council (SSHRC) under the Insight program (grant No425-2015-1152).

About the authors

Alain Bélanger is an Associate Research Scholar at the Wittgenstein Centre for Demography and Global Human Capital (IIASA, VID/ÖAW, WU), International Institute for Applied Systems Analysis, Laxenburg, Austria, and Professor at the Institut National de la Recherche Scientifique, Université du Québec, Montréal, Canada. (Contact: belanger@iiasa.ac.at)

Patrick Sabourin is a Research Scholar at the Wittgenstein Centre for Demography and Global Human Capital (IIASA, VID/ÖAW, WU), International Institute for Applied Systems Analysis, Laxenburg, Austria. (Contact: sabourin@iiasa.ac.at)

Guillaume Marois is a Research Scholar at the Wittgenstein Centre for Demography and Global Human Capital (IIASA, VID/ÖAW, WU), International Institute for Applied Systems Analysis, Laxenburg, Austria. (Contact: marois@iiasa.ac.at)

Jennifer Van Hook is Roy C. Buck Professor of Sociology and Demography and Director of the Graduate Program in Sociology, Penn State. (Contact: jxv21@psu.edu)

Samuel Vézina is a Ph.D. Student at the Institut National de la Recherche Scientifique, Université du Québec, Montréal, Canada. (Contact: samuel.vezina@ucs.inrs.ca)

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Samuel Vézina

In what Coleman (2006) terms the "Third Demographic Transition," immigration has led to rapid increases in cultural, ethnic, and religious diversity in many high-income, low-fertility countries. This rise in "super-diversity" (Vertovec 2007) has challenged researchers and policy makers as they attempt to understand, anticipate the needs of, and develop policies and programs for multiple, highly diverse, subgroups. For demographers, the cohort-component projection model has long served as a crucial policy and planning tool, yet this macro-level approach is too blunt of an instrument for modeling. In this paper, we argue that a microsimulation approach is better suited for this task, and demonstrate this approach using a microsimulation model we developed for Canada, the United States, and the 28-member states of the European Union.

The rise in super-diversity

Super-diversity has emerged in the broader context of a new demographic regime characterized by low fertility, high immigration and population aging. Most developed countries are facing similar demographic changes: population aging, possible labour shortages (Mahroum 2001; Martin & Ruhs 2011; Ruhs & Anderson 2010) and reduced population growth, if not population decline (United Nations Population Division 2012). The Baby-Boom experienced by these countries after World War II was followed by a rapid fertility decline, which initiated population aging (Caldwell & Schindlmayr 2003; Coale & Watkins 1986; Gavrilov & Heuveline 2003). Boomers are now reaching retirement age and being replaced by smaller cohorts of young workers, which may compromise a balance between labour force demand and supply in specific sectors of the labour market.

In response to these trends, most developed countries have increased their immigration to historically high levels. In fact, more people are living abroad than ever before. The United Nations estimates that there were 244 million migrants in 2013, up from 173 million in 2000, and more than two thirds (71%) of all international migrants live in developed regions (United Nations Population Division 2016). Accordingly, immigration rates have significantly increased in Canada, Australia, the United Kingdom, Austria, Italy, and elsewhere in Europe (Australian Department of Immigration and Citizenship 2012; Citizenship and Immigration Canada 2012; Coleman 2009; Jennissen et al. 2006; Zaiceva & Zimmermann 2008).

International net migration now accounts for about two thirds of the total population growth of developed nations, outpacing natural increase (Population Reference Bureau 2012). Most observers believe that the current below-replacement fertility regime in Europe will hold true in the future (Frejka & Ross 2001; Lesthaeghe & Willems 1999; McDonald 2002). Furthermore, in a little more than a decade, the rate of natural increase will become negative in many developed countries, leaving immigration as the only positive driver of population growth (Lutz et al. 2014). Moreover, in the context of population aging where a growing number of people are about to withdraw from the labour market, economic pressures to keep immigration rates at fairly high levels are likely to persist (Martel et al. 2007; Zimmermann et al. 2007).

At the same time, immigration to developed countries has become more culturally diverse (Cohen & Van Hear 2008; Coleman 2006; Massey et al. 1993), dramatically changing the nature of population diversity (Vertovec 2007). Diversity in fact has multiple, overlapping dimensions involving sociocultural factors such as race, ethnicity, language, and religion, and a host of social and economic factors that are associated with these sociocultural factors. Recent censuses and surveys show increasing numbers and proportions of immigrants, of people belonging to visible minority (ethnic/racial) groups (Statistics Canada 2013), of speakers of non-official languages (Rampton et al. 1997; Statistics Canada 2007), and of people whose religion is not Christian (Goujon et al. 2007; Parsons 1994; Peach 2005; Statistics Canada 2003). These trends are expected to continue in the future (Winter & Teitelbaum 2013), raising questions about the long-term sustainability of Western countries' social security programs, healthcare and retirement plans and inequalities (Anderson & Hussey 2000; Auerbach & Lee 2011; Lichter 2013; OECD 2000).

Implications of super-diversity for population research

It is becoming increasingly important for demographers to account for the multiple dimensions of ethnocultural diversity in population projections. This is essential for research on the future consequences of immigration, and would also serve to improve analyses of demographic and social trends that are not directly focused on immigration because of the way ethnic and cultural groups vary in their demographic and socio-economic behaviors. On the demographic side, cultural-ethnic and national origin groups often vary with respect to the timing and occurrence of key demographic processes: fertility, marriage, mortality, and migration. For example, newcomers tend to show higher fertility (Abbasi-Shavazi & McDonald 2000; Andersson 2004; Bélanger & Gilbert 2003; Ng & Nault 1997; Trovato 1981) and lower mortality due to the healthy immigrant effect (Bourbeau 2002; Chen et al. 1996; Hummer et al. 2004; Rees et al. 2009; Singh & Miller 2004; Trovato 1985, 1993; Young 1987).

On the socio-economic side, cultural-ethnic and national origin groups often differ in educational and employment outcomes. For example, newcomers in Canada show on average higher levels of educational attainment (Bonikowska et al. 2008; Geschwender & Guppy 1995; Picot 2008), as the immigration policy aims at selecting highly qualified candidates (Beach et al. 2003), regardless of the region of origin. In Europe, by contrast, few immigrants are selected according to their skills (Büchel & Frick 2005; Münz 2007; Ruhs 2008), and in the US low-skill immigrants make up a large share of legal and illegal immigration (Barrett 1998; Borjas 1987, 1989, 1994; Schultz 1998). Generally, when controlling for educational attainment, immigrants show lower labour force participation rates than natives (Aydemir & Skuterud 2005; Bloom et al. 1994; Boudarbat & Boulet 2007, 2010; Boyd & Cao 2009; Ferrer & Riddell 2004; Kahn 2004; Meurs et al. 2006; Model & Lin 2002). However, the skill composition of immigrant flows affects the average labour force participation rates; immigrants tend to have higher participation rates in countries such as the US, or in Southern Europe, where they are generally less skilled (OCDE 2011).

According to Preston, Heuveline, and Guillot (2000), the cohort-component method "is now nearly the only method used for population projections, representing a rare consensus for the social sciences." However, super-diversity is impossible to account for with standard cohort-component projection models, including its multi-state variants. Although cohort-component projections are frequently produced separately for major demographic groups (such as by major racial or ethnic groups), they are inherently based on aggregated population estimates and rates, and are not agile enough to handle multi-dimensional and dynamic forms of diversity.

First, the cohort-component projection method tends to treat groups as mutually exclusive and separated fixed categories (e.g., immigrant status Lanzieri 2011; race/ethnic groups Colby & Ortman 2014; religion Pew Research Center 2015; or language spoken Termote et al. 2011). Yet group identities often involve multiple, overlapping dimensions that do not fit neatly in mutually exclusive groups. Moreover, ethnic group identities may shift or fade over time, such that later generation group members no longer identify with the group. For example, Duncan and Trejo (2011) show substantial ethnic attrition among Hispanics that is strongly linked to inter-ethnic marriage, which increases across generations and with higher levels of education. This process, which can be conceptualized as intra-generational and inter-generational ethnic mobility, can hardly be modeled with the cohort-component projection method.

Second, cohort-component models also ignore heterogeneity within groups. For example, most projections assume that all women have the same age-specific fertility rates, or all people experience the same age- and sex-specific mortality rates, when in fact, these processes are likely to depend on a number of socio-economic and cultural factors. Additionally, the composition of groups may change over time. Indeed, it is widely thought that immigrants and their families undergo profound cultural and socio-economic changes as a consequence of coming into contact with host societies. Although the pace (and even direction) of integration varies across groups, nearly all national origin groups in the United States or Canada speak English or French by the second generation (Bélanger et al. 2011; Rumbaut et al. 2006), and among immigrant groups that arrived with low levels of education, educational attainment tends to increase substantially across generations (Park & Myers 2010).

Third, cohort-component models have practical limits in the number of events, states, and groups that can be modeled. Typically, they provide information about projected population size, growth, age structure, and at the most one other dimension, but rarely provide information on socio-economic characteristics. Yet the prospective analysis of the consequences of super-diversity requires the simultaneous projection of a large number of individual characteristics or attributes, all of them having several categories. This extends beyond the capacity of the multistate model whose state-space (matrix size) would have to include all possible combinations of attribute values. These limitations suggest that it would be useful to develop a projection model that goes beyond the cohort-component model.

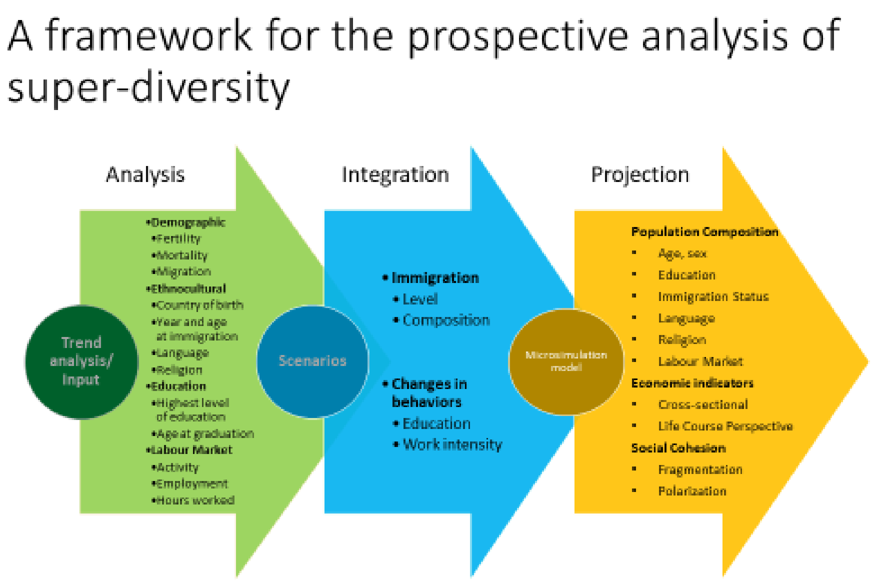
We developed a microsimulation model to meet this need. The model is designed to provide prospective analyses of the socio-economic and cultural consequences of population changes in high immigration countries. International in scope, we originally developed the model for Canada, but have since adapted it for other immigration-receiving countries, including the United States and the 28-member countries of the European Union. The model could also be extended to other countries with similar demographic regimes, such as Australia. In developing the model, our main objective has been to study the possible consequences of alternate future immigration trends in order to inform policies about important issues such as the integration of new immigrants, social cohesion, labour force supply and composition in terms of education level and skills, or long-term sustainability of social security programs and retirement plans. To achieve this objective, the model encompasses as many socio-economic and ethnocultural indicators as are available for each projected population.

Our purpose for the remainder of the paper is to present the analytical framework behind this endeavour, describe the general structure of the microsimulation models and share some of the results. We first describe the analytical framework of the research project and the general structure and logic of the microsimulation models in the next section. More detailed technical description of the modules which make up the model in terms of their events, their parameters and their outputs can be found elsewhere (Bélanger & Sabourin 2017; Lutz & Bélanger 2017; Marois et al. 2017). Next, we provide an overview of the similarities and differences of the concepts used in the different countries. Ideally, all markers of ethnocultural diversity would be available for all countries of interest and have the same categories everywhere, but in reality, this is not the case. Finally, we present some results to illustrate how the microsimulation models can be used. We present results that assess the impact of immigration on the ethnocultural (immigrant status, language and religion) and socio-economic (educational attainment, employment status) characteristics of each population. The results section also examines the projected changes in the labour force in each country by education level and language spoken, key characteristics for the analysis of economic integration.

An analytical framework for the prospective analysis of super-diversity

Unlike the cohort-component projection method, which uses aggregated population estimates as inputs and outputs, our microsimulation model operates at the individual level. It projects the occurrence and timing of demographic and socio-economic events that shape future characteristics of individuals and their future offspring based on a series of interrelated multivariate prediction models. In this section, we describe the three analytic stages or steps we employed when developing the models for each country or world region, as illustrated in Figure 1.

Figure 1: An analytical framework for the prospective analysis of super-diversity



The first stage is devoted to the analysis of the effects of ethnocultural characteristics on the demographic and socio-economic behaviours of population groups. This analysis is necessary to estimate the parameters that will serve as inputs in the microsimulation model. It also provides the basis for a deeper comparative knowledge of demographic and socio-economic behaviors of new immigrants in different Western countries. During this first phase, analytical efforts concentrate on deriving the net effects of ethnocultural variables – such as race, religion, language use and immigration status – on the components of population change and labour market outcomes. Control variables of interest include age, sex and education level. The analyses aim at finding the impact of ethnocultural variables on fertility, on the likelihood of being unemployed or on the probability of achieving a given education level, to name but a few examples. Multivariate analyses are performed on available public microdata sets such as censuses or social surveys. Base risks by age and sex (and sometimes by other available variables, such as education) are usually derived from the most robust available data sources (often vital statistics). Ethnocultural differentials, which are sometimes derived from surveys with lower sample sizes, are added in the form of relative risks derived from regression parameters, controlling for variables included in the base risk. This method allows for maximum flexibility in the use of the various available data sources. Scenarios can then be built by modifying the base risks or by making alternative assumptions on the relative risks.

Our analysis of differentials in behaviours is rooted in the segmented assimilation thesis (Portes & Zhou 1993). As such, it is assumed that the process of acculturation, by which diverse ethnic groups come to share the culture and adopt the behaviours of the majority (Waters & Jiménez 2005) does not operate uniformly on all immigrants. Divergent outcomes have been observed between cohorts of immigrants (Picot & Heisz 2000) and between racial or visible minority groups (Ali & Grabb 2017; Caron Malenfant & Bélanger 2006; Corak 2008; Lian & Matthews 1998; Safi 2006). Yet, although the assimilation perspective has been challenged, our framework nevertheless underlines the importance of taking into account the duration of residence in the country when studying and projecting behaviours of newcomers. Thus, “duration of stay in the host country” and place of birth are introduced as important sources of potential change, for example in fertility behaviour or in the knowledge of the host country language. Moreover, according to Vertovec (2007), ethnicity or country of origin alone provide a misleading one-dimensional appreciation of “super-diversity”. He also proposed the term to emphasize that ‘there is much to be gained by a multi-dimensional perspective on diversity both in terms of moving beyond the ethnic group as either the unit of analysis or sole object of study and by appreciating the coalescence of factors which condition people’s lives’ (Vertovec 2007, p. 1026). In our analysis, we therefore explore the complexity of super-diversity by using, in addition to duration of stay in the country of residence and place of birth, other dimensions of ethnocultural diversity such as race, religion or language proficiency when available.

In the second stage, knowledge arising from the analysis of ethnocultural differentials is integrated into specific scenarios to inform the multiple assumptions supporting the microsimulation model. Importantly, these assumptions can be combined to create plausible population changes or policy driven “what-if” scenarios. In the context of the new immigration regime of high immigration and low fertility that describes the countries under study, we sought to evaluate the likely impacts of various future immigration scenarios. In other words, the level and composition of future cohorts of immigrants are treated as a policy-driven phenomenon. Characteristics of recent immigrants as observed in censuses or other sources can be used as a basis for a “baseline” scenario, but these characteristics can also be modified through reweighting procedures to match any other desired distributions (i.e., changes in regions of origin or in education level of future immigrants, etc.).

Although central to the current demographic trends of high immigration and low fertility, immigration is not the only component of population change shaping the structure and composition of future populations. Most of the changes in the native population are assumed to be shaped in accordance with the *Demographic Metabolism* theory (Ryder 1965) which puts forward the importance of cohort succession to explain social changes. According to the theory, even if individuals’ characteristics (education, language, etc.) tend to remain fairly stable over the life course, this process provides opportunity for social change due to the constant flow of new people entering the social process through birth and the continuous exit of older individuals through death (Lutz 2013).

For example, women with higher education levels not only tend to postpone childbearing, but also show, in most countries, lower completed fertility compared to less educated women (Basten et al. 2014). At the same time, increasing education also tends to postpone entry into the labour market, but increases work intensity (higher participation rate, lower unemployment) of both males and females over their lives, as it more than compensates for the late entry into the labour market due to longer time spent studying (Mincer 1974). As younger cohorts entering the labour market or the childbearing ages are more educated than the older cohorts exiting it, the consequence is that, even if nothing else changes, we can expect that the total number of births would decline and that the total labour force population would increase over time. Thus, the future increase in average education level of the population, that is already built into the current age/education structure, will affect not only the composition of future population in terms of education level, but also their future aggregated demographic (fertility, mortality) or economic (work intensity) behaviours. We want to measure these potential effects of demographic metabolism both from a cross-sectional perspective (total fertility rate, gross labour force participation rate, etc.) and longitudinal perspective (completed cohort fertility, cohort economic dependency ratio, etc.).

In the third stage, we use dynamic microsimulation to synthesize the outcomes of the two other phases in projection models. Microsimulation is a necessary technique to produce demographic and socio-economic projections in the context of super-diversity as it enables the modeling of complex behaviours and a large number of variables in a consistent and flexible way. The capacity of the microsimulation model to project a large number of characteristics simultaneously also allows for the production of detailed tables of the projection results. Results can be displayed in the form of cross-sectional distributions of the population at different points in time up to the projection horizon, but with many more details than would be possible with deterministic approaches to population projections.

Microsimulation models for Canada, United States, and European Union

Three microsimulation models were developed, one for Canada, one for the United States and one for the 28-member states of the European Union. All three share a common structure and general characteristics with respect to the analytical framework presented above. One necessary input to the microsimulation process is the base population, which must have micro-level information on the large number of individual characteristics related to "super diversified" populations. At the minimum, detailed data are needed on birthplace, and some other measure of diversity, either ethnicity (race), language, or religion. In addition, in order to add a socio-economic dimension to the models, data on education level and labour market activity are required.

The base population of all models comes from a public use microdata file of a recent survey or census. This allows for greater portability and also increases the transparency of the model and its potential usage since its code and parameters, including the base population, can be shared without risk of breaching confidentiality rules, which are two important qualities to microsimulation models (Sutherland, 2017). The base population of the Canadian model was extracted from the Public Use Microdata file of the 2011 National Household Survey (NHS). The survey numbers a little more than 880,000 cases and directly measures all the variables included in the microsimulation model (See table A1 in annex). The base population of the American model was extracted from the 2015 American Community Survey (ACS). All variables were directly extracted from the ACS public use data file with the exception of religion, which was imputed from the 2014 PEW survey. In total, the base population numbers more than 3.1 million cases representative of the total American population. The base population of the European model was generated from the public use EU-Labour Force Survey microdata files. Language spoken at home and religion were imputed based on data extracted from the European Social Survey (all available waves since 2002). The two most recent waves of the EU-LFS Survey (2014 and 2015) were merged to increase the sample size, with the total base population numbering near 8.3 million cases.

All three models are time-based and event-based, dynamic, continuous time, open to international migration, stochastic (Monte Carlo) microsimulation projections and use the Modgen[1] programming language. The models are time-based, meaning that all individuals are simulated for one stage in time (one year) before moving to the next stage in time. This allows for interactions between individuals and also for the use of contextual variables or feedback effects in the computation of the probability of the occurrence of a given event. The models are dynamic and in continuous time, meaning that characteristics of individuals are modified continuously in “real time”, in contrast to discrete-time models where characteristics are changed within predefined time units (typically one year). This allows for an easier treatment of competing risks. All three models simultaneously projects demographic (age, sex, place of residence, immigrant status), ethnocultural (country of birth, language, and where possible other variables such as visible minority groups in Canada or race in the United States and religion in both Canada and Europe) and socio-economic (education, labour force participation, unemployment) characteristics. Table A.1 (see annex) details the categories of the different variables that are projected for each model. Accounting for immigration, all three models work with age at immigration and duration of residence in the country for immigrants. The models further allow for changes in individual characteristics over the life course as well as for inter-generational transfers of some characteristics of the mother to the child. Finally, the models are microsimulation projections. Individuals from the base populations are simulated one by one, rather than projected as aggregated population groups as in the cohort-component or multi-state models. The occurrence of any events that shape the future population depends on a selection of individual characteristics that can vary from one type of event to another and between countries.

For each event occurring in the projection model Table 1 shows the individual characteristics taken into account to determine the probability of its occurrence and derive its waiting time. Each event can have its own set of determinants. Taking the example of fertility, in all three models, the risk of giving birth varies with age, region of residence, education and immigrant status. However, microsimulation is a flexible methodology allowing the use of different equations and risk models for the same event according to an individual’s region or country of residence. Thus, when available, other ethnocultural determinants of fertility are accounted for, such as religion and visible minority group in Canada or race in the United States.

[1] Modgen is a meta language of C++ developed and maintained by Statistics Canada. Modgen and its documentation may be downloaded for free on Statistics Canada’s website. Modgen models are coded and implemented in the Microsoft Visual Studio software suite. Once compiled, a Modgen model takes the form of a stand-alone executable file (.exe) that allows manipulation of the model through a graphical user interface. From this interface the user is able modify simulation parameters and create customized scenarios.

Table 1: The determinants of the different events in the microsimulation models

	Age	Sex	place of residence	place of birth	Race/visible minority group	immigration/ Generation status	age at immigration or duration in country	language	religion	education	mother's education	Labour market activity	Methods to estimate parameters
Fertility	X		X	X	C,U	X	X		C	X			Vital statistics, logistic regression
Mortality	X	X	X	C						C			Population estimates, Cox regression
Internal migration	X	X	X	C,U	C,U		C,U	C,U	C,U	C,U		C,U	Logistic regression; O/D matrices
Emigration	X	X	X	C									Population estimates, relative risks
Official language acquisition/Language used at home	X		X			X	X	X					Survival curves, O/D matrices
Intergenerational language shift			X			X		X					O/D matrices
Intergenerational transfers of race/visible minority					C,U	C,U							O/D matrices
Intergenerational transfers of religion	X	X	C,U			C,U			C,U				O/D matrices
Education attainment	X	X	X	X	C,U	X		X	E		E,U		Multinomial logit
Literacy	C	C	C	C		C		C		C		C	Linear regression
Labour force participation and unemployment	X	X	X		X	X	X			X			Logistic regression

Note: X= All models, C= Canada, E= EU28, U= USA

Results

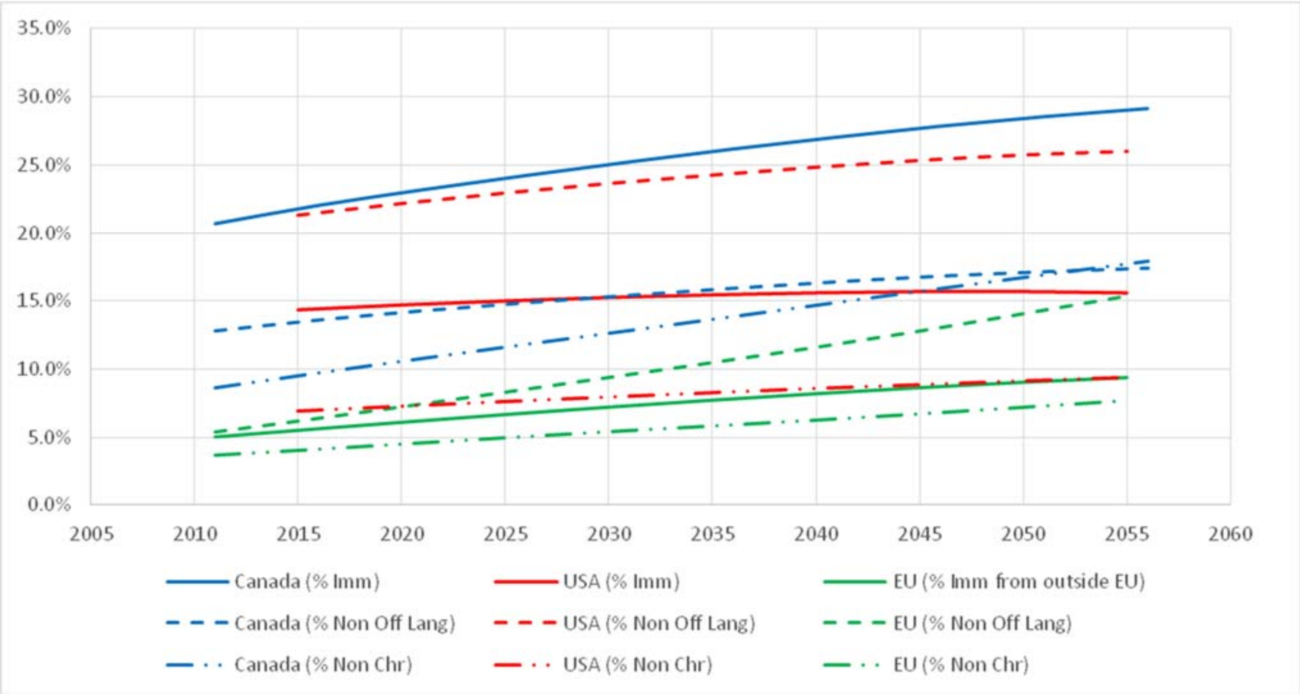
The microsimulation models provide a lot of flexibility in terms of scenario building. Assumptions can be made on the future evolution of the different components of population change both in terms of the general intensity of the phenomenon or its composition. Assumptions about future immigration, for instance, can be made not only on the size of the future cohorts of immigrants, but also in terms of its composition by country of origin, education level or any other characteristics that can be relevant.

In this section, we provide five examples that demonstrate ways that the microsimulation models can be used. The first example is a simulation that projects ethnocultural and socio-economic changes for the baseline scenario only. That is, the scenario assumes the continuation of current trends and generally replicates the medium scenario of national statistical agencies in terms of projected population size and age structure. The second example is a simulation of the consequences of changing levels of immigration. It specifically focuses on labour force consequences of different levels of immigration by constructing stylised scenarios where the number of immigrants is doubled or set to zero. The third example is a simulation that assesses the impact of changing characteristics of immigrants. It simulates the impact of modifying the composition of migrant cohorts by assuming that immigrants to the EU28 or to the USA have the same distribution by education level as Canadian immigrants. In the fourth example, we illustrate the possibility of presenting results at a more detailed geographic scale. Finally, the fifth example illustrates the way the model can be used to provide estimates calculated over the lifetime of cohorts, thus taking a longitudinal perspective for estimates of labour force characteristics.

Example 1: Ethnocultural diversity

Figure 2 shows the projected evolution of three indicators of diversity for Canada, the USA and the EU28: the percentage of foreign-born population (in the EU28 case, it is the proportion of the population born outside the EU), the percentage of the population using a non-official language at home and the percentage of non-Christians[2]. In terms of the percentage of foreign-born population, Canada is starting at a much higher level (22%) compared to the USA (14%) and the EU28 (5%). Compared to the USA, Canada has an immigration rate twice as high and even higher compared to the EU28. Assuming that this situation would continue, Canada's foreign-born population would continue to grow at a faster pace than in the other two regions. At the end of the projection horizon, the Canadian population can be composed of as much as 29% foreign-born, almost double the projected proportion for the USA and more than three times that of the EU28 share.

Figure 2: Proportion of the projected population with different ethnocultural characteristics, 2011-2056, Canada, USA, EU28



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[2] The percentages of non-Christian are excluding the non-affiliated.

Looking at the second indicator, the proportion of the population using a non-official language at home, the picture is much different. Canadian immigration is much more diverse in its origins and languages spoken than what is observed in and projected for the other two regions. Also, there is a larger share of its immigrant population that already speaks the official languages (English and French) at arrival compared to the United States, where a large share of immigrants speaks Spanish. Perhaps because of this greater heterogeneity, the retention of foreign languages might be lower in Canada than elsewhere. As a consequence, even if Canada has the highest share of foreign-born and the fastest increase in that share, the USA shows a much higher proportion of its population using a non-official (mostly Spanish) language at home.

Religion is another relevant ethnocultural characteristics for the projection of diversity as religious diversity is often seen as a source of social fragmentation and declining social cohesion (Alesina et al. 2003; Goujon et al. 2007). Again, the progression of this indicator draws a different picture. At the start of the projection, the proportion of non-Christians is higher in Canada and it is expected to grow faster during the projection period. In Canada and in EU28, the proportion of non-Christian population is projected to increase faster than the proportions of immigrants or the proportion of the population using a non-official language at home. This is because children of immigrants born in the country of destination are by definition native-born and because the inter-generational transfer of religion is lower than the inter-generational transfer of language. Although children born in an immigrant family where a non-official language is spoken will also use that language at home, they are more likely to experience a language shift when forming their own family than to undergo a change in faith.

Example 2: The number of immigrants

Figure 3 illustrates the impact of different levels of immigration on the linguistic composition of future labour force by assuming stylised scenarios where the number of immigrants is either doubled or set to zero. Although they start at different levels, the patterns showed by the evolution of this variable is similar in Canada and in the United States. In the baseline scenario and the doubling migration scenario, the percentage of the population using a non-official language at home increases rapidly at first, but the rate of increase decreases with time. In the EU, the percentage of non-official language starts at a lower level at the beginning of the projection period, but increases faster than in Canada and the United States. In the no-migration scenario, the percentage of the population using a non-official language at home would go down in Canada and the United States, but would remain at about the same level in the EU. This is due to the fact that in the European model migrations between EU-28 countries are treated as internal migration and are thus continuing at the same pace as before in the zero-migration scenario.

Example 3: The educational attainments of immigrants

Canada's immigration policy is often praised for its point-based selection system, which focuses on variables linked with human capital such as age, education and knowledge of the official languages. Because of this point-based system, Canada has a higher proportion of graduated immigrants when compared to many other immigration countries. It is interesting to explore how modifying the immigrant selection process rather than modifying the size of future immigration cohorts could alter the future composition of working populations in terms of education attainment. The indicator is obtained by creating a scenario that attributes the Canadian immigrants' distribution by education level to projected immigrants in both regions.

Figure 3: Percent of the population speaking a non-official language at home under three different assumption of immigration, Canada, USA and EU28, 2011-2061

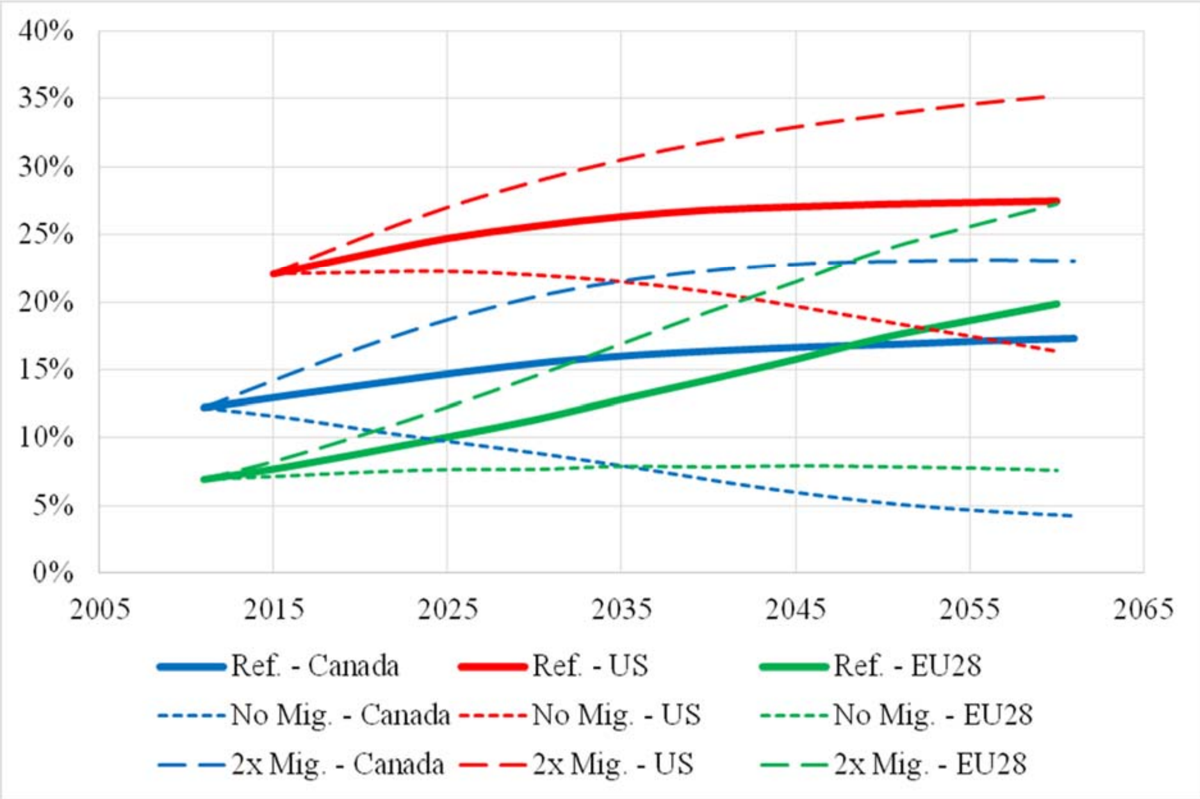
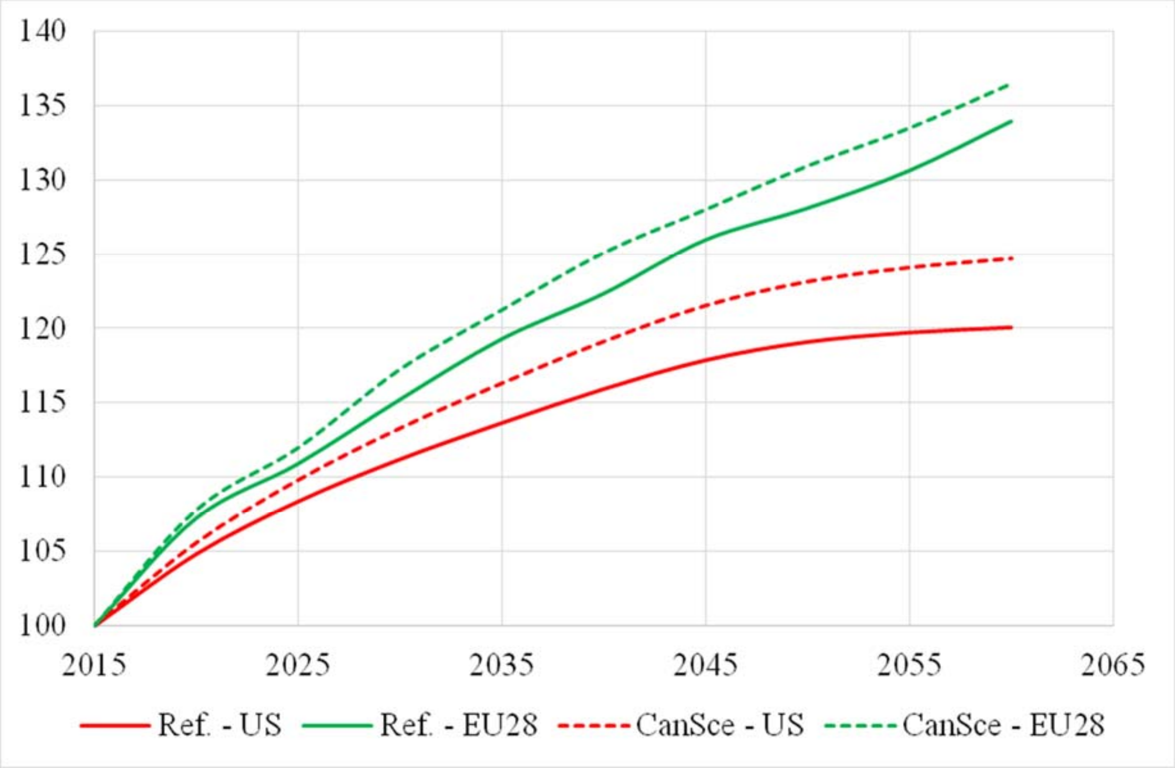


Figure 4 illustrates such an investigation by looking at what could be the potential impact of modifying the composition of migrant cohorts on the size of the active population with post-secondary education in the EU28 and United States. To put an emphasis on the evolution of the working population with post-secondary education rather than on the different population size or educational levels observed in the two regions, results are scaled to 100 in 2015.

The solid lines in the figure represent the projected increase of highly educated in the active population under the baseline scenario and we can see that this number is likely to increase faster in the EU28 than in the United States. The dotted lines represent the possible evolution of that indicator if future immigrants would be selected using a Canadian-like point system (CanSce). For both regions, this scenario shows a faster increase in the number of highly educated, but the differences between the selection and the reference scenarios are more important in the American model than in the European model. At the end of the projection, we observe a difference of 5 percentage points between the two American scenarios and a difference of only 2.5 points in the European case. There are two reasons for that: the American immigration rate is higher and the average education of American immigrants is lower.

Figure 4: Growth of the active population with post-secondary education (2015=100), USA and EU28, 2015-2060, reference scenario (Ref.) and a scenario where immigrants are selected using a Canadian-like point system (CanSce)



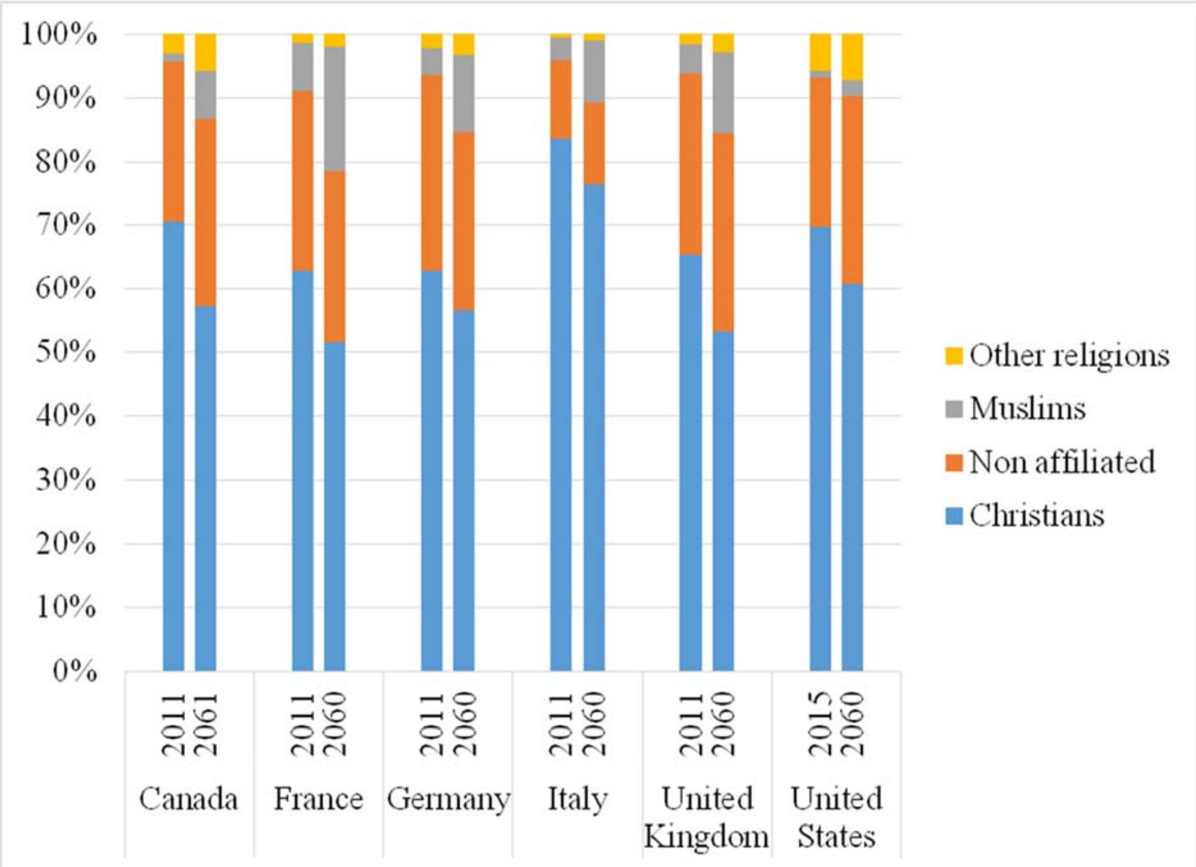
Example 4. Regional variations

The models have an important regional component that does not appear in the results presented so far. In the Canadian and American cases, regions are formed from geographic information on the metropolitan area and the state (in the American case) or province (in the Canadian case). It is thus possible to analyse the future impact of immigration on high immigration regions such as New York, Los Angeles or Miami in the United States or Montreal, Toronto and Vancouver in Canada. The analysis can focus on the ethnocultural changes in the population composition or on the impact of immigration on different labour markets in terms of active and inactive population. In the European case, the regions represent each of the national populations forming the EU28 and regional analyses would thus be limited to countries.

To illustrate the possibilities of presenting results at another geographic scale, Figure 5 shows the projected change in the population distribution by religious affiliation in six of the G7 countries (Japan is missing).

In all six countries, the share of Christians decreases, but for different reasons. In the United States, most immigrants are Christians and the 9 points decrease in the percentage of Christians over the projection period results almost all from an increase in Non Affiliated; the Muslims and "Other" religions categories having their share increased by only one percentage point over the projection period. In the European countries, by contrast, the decrease in the proportion of Christians is much less attributable to disaffiliation and much more to the faster increase in the number of Muslims. Between 2011 and 2060, the reference scenario projects an increase of the Muslims' share, varying between 6 percentage points for Italy and 12 percentage points for France. Since the reference scenario assumes that the characteristics of future immigrants will be the same as the most recent immigrants, the share of the "Other" religions category barely changes over the projection period in all European countries. Reflecting the more diverse origins of Canadian immigrants, the figure also shows that in the Canadian case, the decrease in the share of Christians is associated with both a faster increase in the population of Muslim (plus 6 percent points) and of other religions (plus 3 percent points).

Figure 5: Observed (2011/2015) and projected (2060/2061) total population by religious affiliation, Canada, USA, EU28, reference scenario



Example 5. A cohort perspective to economic dependency ratio

The examples provided just now are essentially cross-sectional analyses in that they provide estimates of the size or composition of the population or population subgroups at various points in time. However, our microsimulation models also permit a longitudinal analysis that follows individuals over time. As an example, to better determine the impact of immigration on pension plan sustainability (at least in a pay-as-you-go type of pension plan), it is preferable to take a longitudinal perspective and count the number of years lived as active and inactive over the life course for foreign-born and native-born cohorts.

We carried out this analysis and present the results in Figure 6, which compares the cohort economic dependency ratios of foreign- and native-born by education level. The cohort economic dependency ratio (CEDR) is defined as the ratio between the number of years lived inactive divided by the number of years lived active over the life course. It takes into account the increase in life expectancy as well as, in our microsimulation model, the increase in older worker labour force participation and the increase in educational attainment. CEDR also considers differentials in labour force participation by immigrant status and education level and differentials in educational attainment between population groups. In the context of current labour market changes, it is important to take these characteristics of the population and their plausible evolution in the different regions into consideration to better estimate the potential effects of immigration. Education is generally completed by age 25 and, for that reason, we compute the CEDR for the population aged 25 and over.

We note on Figure 6 that for all educational groups combined, the CEDR is higher for immigrants compared to natives in all three regions, meaning that in general immigrants contribute fewer years of activity for each year lived inactive. The differences between natives and immigrants are larger in the EU-28 and smaller in the United States. In the EU28, an immigrant can expect to live 1.4 years inactive for each year lived active compared to 0.95 for a European-born. In the United States the corresponding ratios are much closer with 0.91 and 0.83. Canada, on the other hand, has the lowest CEDR for its native population (0.77) but an intermediate CEDR for its immigrant population (0.96).

Looking next at the differences in CEDR by educational level, we note that the ratios tend to be lower for higher educational levels. This holds for natives and immigrants alike. Higher participation rates over the working life and higher age at retirement add up to fewer years lived as inactive for each year lived as active among the more educated population. Additionally, immigrants have higher ratios than natives for all educational levels except for the less than high school level in the USA, although the differences between immigrants and natives tend to decrease as education level increases.

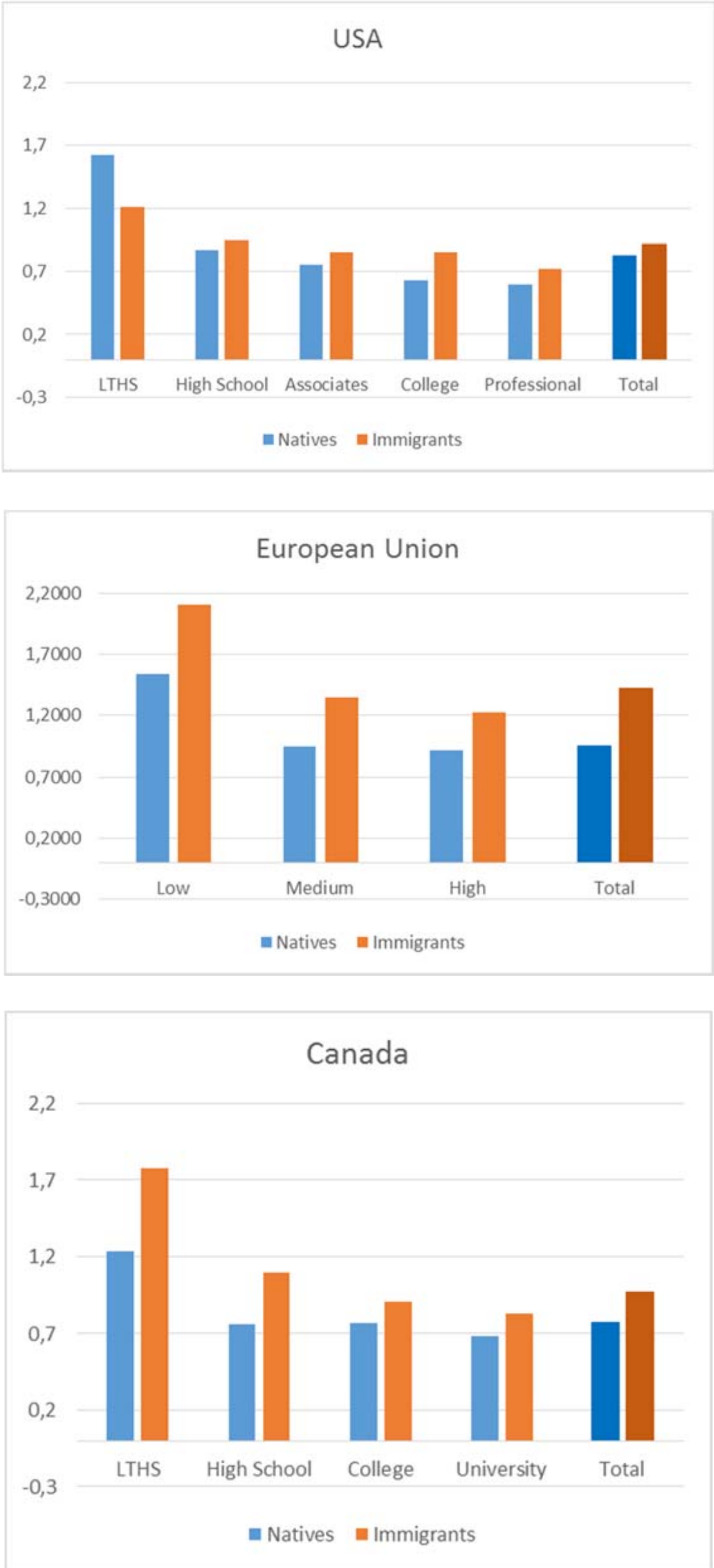
Limitations

We aimed at developing microsimulation models to project ethnocultural diversity in selected developed countries to foresee the implications of high immigration for demographic changes and of socio-economic impacts. Although demographic and socio-economic variables are derived from very similar concepts across all studied countries, the nature of ethnocultural variables differ between the three models due to different historical and social contexts.

First, the notion of race or ethnic origin is absent from the European data used (and from most European surveys). In the United States, the race variable is built around racial groups (Black/White) and from Hispanic and Asian origins from which we created 6 categories, while in Canada the similar concept is defined into 12 categories of visible minority groups specified by the 1991 Law on employment and equity.

Second, language variables are part of the Canadian Censuses since its beginning and are still omnipresent in Canadian surveys because of the dual French and English origins in Canada. Thus, the Canadian model projects the first language spoken by a person (mother tongue), language used at home and knowledge of the official languages (English or French), but there is no question on language proficiency. The American survey asks only about the language spoken at home, but for those not using English it asks the level of proficiency in English, which for our purpose is probably a better concept than the Canadian one. Europe is of course a multi-lingual region where the official language (or languages in some cases) differs from one country to the other. From the question on language spoken at home in the European Social Survey we derived a three-category variable that distinguishes speakers of the country’s official language from those speaking another European language and those speaking another non-European language.

Figure 6: Cohort economic dependency ratios (CEDR) of immigrants and natives by education level, Canada, USA and EU28



Third, religion is directly asked in the Canadian decennial censuses and the large sample size allowed for the creation of eight religious categories reflecting the most important groups of this highly multicultural country. The same categories were derived from the PEW survey and imputed to the American base population extracted from the ACS. In Europe, the smaller sample size of the European Social Survey used to impute religion to the base population and the high prevalence of Islam among non-Christian population forced us to create only four categories for the religion variable.

Finally, all three models have a sufficient number of regions of birth categories for foreign-born, but these categories differ between models to better reflect the immigration source countries of each. Age at immigration and duration of stay in the current country of residence for foreign-born is available in all three microsimulation models, but place of birth of parents is only available in Canada which allows for a more detailed generational status variable. Despite these limitations and inconsistencies across models, our models undoubtedly offer a new innovative tool to address issues related to super-diversity in high immigration developed countries.

Discussion and conclusion

The main objective of this paper was to present the analytical framework supporting our efforts in analysing prospective super-diversity in high immigration countries. We believe that this is important because these societies are getting more diverse at a rapid pace. Ethnic, linguistic, and religious diversities have become, and will likely continue to be, a critical matter with political and social implications in several countries. Alesina et al. (2003) showed that ethnic and linguistic fragmentation can contribute to slower economic growth and more homogeneous countries also tend to be better governed. More recently, Patsiurko et a;. (2012) applied a similar analysis to 30 OECD countries for two periods (1985 and 2000). They showed that the negative relationship between ethnic fragmentation and economic growth is also present in the context of developed economies. Increasing diversity from mass migration can also have a negative impact on aspects of social capital like shared norms and trust (Levy 2017; Putnam 2007) and have influenced critical political outcomes such as the Brexit (Coleman 2016; Gietel-Basten 2016), the rise of populism movements such as the one leading to the election of Donald Trump in the USA, or the recent entrance of deputies from an extreme right party (Alternative für Deutschland) in the German's Bundestag for the first time since World War II. Projecting the changes in population composition in terms of diversity has therefore an interest *per se*.

Another important aspect of our model and analysis is the focus on the projection of educational attainment and labour force activity. Although international immigration has, at best, only a small effect on a country population aging, the concentration of immigrant cohorts in the working age groups can certainly help in addressing slower and possibly negative labour force population growth, at least for high immigration regions. By increasing the number of workers, increasing immigration can decrease the economic dependency ratio of a population, but in a context of below replacement fertility, adopting such a solution leads to a continuously increasing need for immigration (United Nations 2000). At best, this is a short-term view. In addition, simply increasing the working age population through immigration might not help the economy if the number of unemployed increases faster than the number of employed because of low employment rates among migrants (Bélanger & Bastien 2013).

A second objective of this paper was to present the general structure of the microsimulation models and to show how much more informative results from this type of projection models can be in comparison to more traditional cohort-component or multi-state models. We illustrated this point by presenting a selection of results that demonstrate the capacity of the model to address a variety of research questions. In doing so, the paper only superficially touches upon the issues related to population changes coming with super-diversity. The models provide many opportunities to conduct future in-depth studies, many of which are currently in preparation.

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Annex

Table A1: Description of the main data sources and variables included in the three microsimulation models

	Canada		European Union		United-States	
	Number of categories	Details	Number of categories	Details	Number of categories	Details
Demographic variables						
Age	0-100	85+ as the open age group; age is also a continuous variable	0-100	Age is provided in 5 years age groups in EU-LFS, assume an uniform distribution of the population in each single year of age inside of a given age group	0-100	85+ as the open age group; age is also a continuous variable
Sex	2	Female and Male	2	Female and Male	2	Female and Male
Place of residence	24	Provinces and CMA counting more than 500 000 people and 15% visible minorities; non-CMA regions and smaller CMAs are regrouped at the provincial level into "Rest of province"	28	28 European Union member states	31	Major immigration CMA's, rest of major immigration states and rest of census regions
Ethnocultural variables						
Visible minority groups / Race	12	White, Aboriginal, South Asian.Chinese, Black, Filipino, Latin Amerian,Arab, Southeast Asian, West Asian, Korean, Japaneses, Other visible minority			6	Non-Hispanic White, Black, Asian, Hipanic, Other, Multi-race
Mother tongue	4	English and French as official languages and two groups of non offical language (Anglotrope and Francotrope)				
Language spoken most often at home	3	English, French and others	3	Official language of the country of residence, Other EU28 languages, Non EU28 languages	3	English, Spanish, Other
Knowledge of Official Language /	4	English, French, English and French and neither English nor French				
English Proficiency					3	English only, English proficient, not English proficient
Religion	7	No religion, Christian, Hindu, Sikh, Muslim, Jewish, Boudhist, Other religions	4	Christian, Muslim. No religion and Other religious affiliation (imputed from the European Social Survey)	8	No religion, Christian, Hindu, Sikh, Muslim, Jewish, Buddhist, Other(imputed from PEW 2014 survey)
Place of birth	26	Canada, United States,Central America, Jamaica, Other Caribbean, South America, United Kingdom, Germany, Otehr Northern and Western Europe,Poland, otehr Eastern Europe, Italy Portugal, Other Soutern Europe, Eastern Africa, Northern Africa, Other Africa, West Central Asia and the Middle East, China Hong-Kong, Other Eastern Asia, Philippines, Other Southeast Asia, India, Pakistan, Oher Southern Asia, Oceania and others	12	Own country, EU15, EU13, Europe outside EU28, North Africa, Ohter Africa, Near Middle east, East Asia, Southeast Asia, North America, Australia-Oceania, Latin America	11	United-States, Mexico, Central America and West Indies, South America, Canada, Europe, East-Asia, Southeast Asia, Rest of Asia, Africa, Other
Immigration status	3	Non-Immigrant, Immigrant, Non-Permanent Resident	3	Non-immigrant, born in EU28, born outside EU	2	U.S.-Born, Immigrant
Duration of residence			7	Natives, 0-4 years, 5-9 years, … ,20-24 years, 25+		
Age at immigration	0-100		0-100		0-100	
Generation Status	5	G1, G1.5, G2, G2.5, G3+	3	G1, G1.5, G2+	3	G1, G1.5, G2+
Socio-economic variables						
Education	4	Less than High school, High school diploma, post secondary- less than bachelor, University diploma (bachelor or above)	3	Less than High School, High School, Post secondary	5	Less than High school, High school diploma,Associates Degree, College, Professional degree
Education of the mother			3	Less than High School, High School, Post secondary	3	Less than High School, High School, Post secondary
Country of highest degree	2	Canada, outside Canada				
Labor Force Participation	2	Active, Not in the Labor Force	2	Active, Not in the Labor Force	2	Active, Not in the Labor Force
Unemployment					2	Employed, Unemployed
Main data source		National Household Survey Public Use Microsample		Merged 2014-2015 EU-Labor Force Survey and European Social Survey (2001-2014), European 2011 Censuses		2015 American Community Survey
Number of cases		882,287		8,297,031		3,147,005
Weights		Average of 60.2, range from 0.1 to 12026.0		Average of 37.0, range from 32.4 to 460.6; adjusted to match 2011 Census population counts by age, sex, education and place of birth		