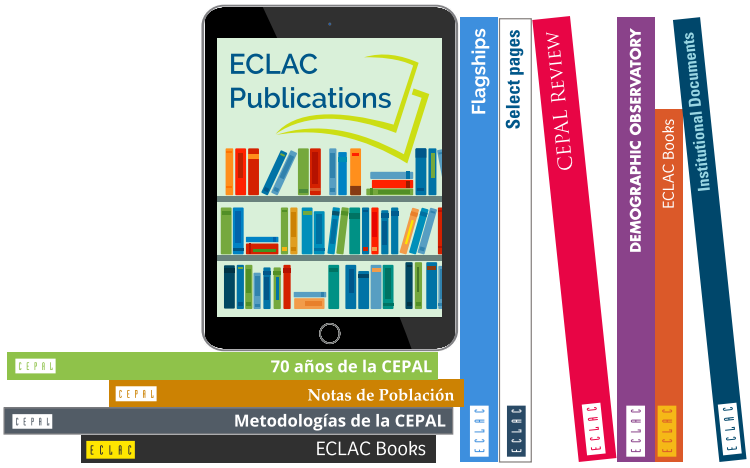
ECLAC Methodologies

Methods for measuring internal migration and its sociodemographic effects, focusing on use of censuses and migration matrices

UNITED NATIONS
ECLAC
75 years
Working for a productive, inclusive and sustainable future
german cooperation
DEUTSCHE ZUSAMMENARBEIT

Thank you for your interest in this ECLAC publication



Please register if you would like to receive information on our editorial products and activities. When you register, you may specify your particular areas of interest and you will gain access to our products in other formats.

Register

UNITED NATIONS

ECLAC

www.cepal.org/en/publications

www.instagram.com/publicacionesdelacepal

www.facebook.com/publicacionesdelacepal

www.issuu.com/publicacionescepal/stacks

www.cepal.org/es/publicaciones/apps

ECLAC Methodologies

Methods for measuring internal migration and its sociodemographic effects, focusing on use of censuses and migration matrices

UNITED NATIONS
ECLAC
75 years
Working for a productive, inclusive and sustainable future
german cooperation
DEUTSCHE ZUSAMMENARBEIT

José Manuel Salazar-Xirinachs
Executive Secretary

Raúl García-Buchaca
Deputy Executive Secretary for Management and Programme Analysis

Simone Cecchini
Chief, Latin American and Caribbean Demographic Centre (CELADE)-
Population Division of ECLAC

Sally Shaw
Chief, Documents and Publications Division

This document was prepared by Jorge Rodríguez, Research Assistant of the Latin American and Caribbean Demographic Centre (CELADE)-Population Division of the Economic Commission for Latin America and the Caribbean (ECLAC), as part of the city and mobility cluster of the project "Inclusive and sustainable smart cities in the framework of the 2030 Agenda for Sustainable Development in Latin America and the Caribbean", implemented by ECLAC and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and financed by the Federal Ministry for Economic Cooperation and Development (BMZ) of Germany. The project is part of the ECLAC-BMZ/GIZ cooperation programme.

United Nations publication
ISBN: 978-92-1-122128-2 (print)
ISBN: 978-92-1-002243-9 (pdf)
ISBN: 978-92-1-358432-3 (ePub)
Sales No.: E.23.II.G.15
LC/PUB.2023/3-P/Rev.1
Distribution: G

Printed at United Nations, Santiago
S.23-01127

This publication should be cited as: Economic Commission for Latin America and the Caribbean (ECLAC), *Methods for measuring internal migration and its sociodemographic effects, focusing on use of censuses and migration matrices*, ECLAC Methodologies, No. 4 (LC/PUB.2023/3-P/Rev.1), Santiago, 2023.

Contents

Tables

Figures

Boxes

Diagrams

Maps

Introduction[1]

This publication summarizes the work that the Latin American and Caribbean Demographic Centre (CELADE)-Population Division of the Economic Commission for Latin America and the Caribbean (ECLAC) has conducted since the 1990s to strengthen and expand the use of census microdata to measure, describe and analyse internal migration. Measurement, description and analysis of internal migration is important and useful for producing information and knowledge that can be used in the design, implementation and monitoring of different types of public policies, and particularly those with components that focus on major, intermediate and minor administrative areas.

The overarching purpose of this paper is to systematize, illustrate and disseminate a set of concepts and instruments, focusing on their links and on training and capacity-building. Several are new while others are widely known and used, but all of them can be used to capture and measure internal migration and commuting in terms of intensity, selectivity and four direct sociodemographic effects: growth, redistribution, composition and inequality.

More specifically, the aim of the text is to provide an accurate, illustrative and up-to-date guide to enable readers to thoroughly understand internal migration and commuting matrices —also known as origin-destination matrices— and to be able to prepare them and use them expertly and flexibly, in particular by processing census microdata.

The decision to strengthen and expand the use of censuses for this purpose is not offhand. First, properly systematized and updated continuous or residence records are either non-existent or inaccessible in almost all the countries of the region and household surveys do not capture sufficiently accurate or representative disaggregated migration flows, for

[1] The author would like to thank all those who made this publication possible, and especially CELADE-Population Division of ECLAC and its staff, who have always supported this initiative; the many consultants who contributed to the text in different ways, including Mario Acuña, David Candia and Alexandra Martínez; colleagues from other institutions for their input and advice; and the external reviewer, George Martine, whose comments helped to improve the document in its final version.

example between cities or municipalities or equivalent units in the countries. This makes the census the main source for measuring migration at disaggregated levels in the region, and sometimes even the only source.

Second, although they often provide information that cannot be obtained from other sources, censuses have historically been underused in analysis of migration, primarily because of the technical difficulties of processing large volumes of data and the administration and management of huge and complex origin-destination matrices (because of the high number of origins and destinations). However, these complications have been gradually overcome thanks to technological advances, in both hardware and software.

Third, in relation to computer programs, the REDATAM software package, developed by CELADE-Population Division of ECLAC, has become a standard tool for processing census microdata in Latin America and other regions of the world, capable of generating all the origin-destination matrices examined in this publication. In fact, the REDATAM webapp has enabled widespread access to census microdata in Latin America, free of charge, through the online processing tools it offers.

Fourth, CELADE-Population Division of ECLAC has comprehensive experience in development and use of internal migration matrices, as reflected in its Database on Internal Migration in Latin America and the Caribbean (MIALC) and an extensive body of publications.

Lastly, over the course of the twenty-first century, the methodologies and analyses for studying and quantifying internal migration and its effects have become more sophisticated, driven by research teams and academics from various developed countries. This progress is examined herein, with the added value of the innovative procedures and analytical advances of CELADE-Population Division of ECLAC.

In view of its overall purpose and specific aims, and given its focus on censuses as a source, this text may be of interest for different types of readers, such as: (i) those producing statistical information in the countries, particularly on migration and travel in the population, for whom it will serve as an up-to-date reference for decision-making on which official indicators should be calculated; (ii) academics who teach demography and, in doing so, train students in demographic techniques related to internal migration and commuting, for whom this publication can be an up-to-date and innovative reference for some aspects of their classes; (iii) researchers who study internal migration, especially in Latin America, for whom this publication offers specific options for measuring migration and, above all, estimating its effects, some of which are new and have great research potential; and (iv) national and subnational authorities, for whom this text illustrates the use of migration and commuting indicators for policy and management decisions in their areas of jurisdiction.

The publication is divided into 11 chapters, in addition to this introduction. Chapters I "Migration and demographic analysis: basic elements and general concepts" and II "Using the census to measure migration and two key cross-cutting issues: geography and time", which are of a conceptual nature, outline the main definitions of internal migration and its measurement, and the comparative strengths and weaknesses of the existing sources

for that measurement, focusing on the census as a source. The following eight chapters are strictly practical, describing and explaining the procedures and indicators relating to intensity of migration and commuting, their four sociodemographic effects and their selectivity, and critically analysing the results from examples of these procedures and indicators being applied. Chapter III "Measuring the intensity of internal migration" addresses the complicated and often confusing issue of internal migration intensity and discusses the difficulties encountered when comparing synchronous internal migration intensity, as well as explaining some complex methods for comparing countries and areas within them. Chapter IV "The basic migration matrix and the growth effect" describes the key instrument in this publication, the origin-destination matrix, applied in the most traditional way: to measure the growth effect of internal migration, which only has a direct impact at the subnational level. Chapter V "Specific matrices for estimating the growth effect of populations and special territories" is essentially an extension of the previous chapter, as it describes how to use the migration matrix to estimate the growth effect, but applying it to specific subpopulations, thus enabling the growth effect of migration in each one of them to be estimated separately, or applying it to special territories, defined on the basis of political or administrative divisions or specific census questions. Notable examples include migration matrices between cities or between urban and rural areas. Chapter VI "Flow indicator matrices: composition and inequality effects" summarizes the two main contributions of CELADE-Population Division of ECLAC in recent years to the development of innovative migration matrices. These are the flow indicator matrices, used to estimate unquantified effects of migration, such as the composition effect and the inequality effect. The results of these analyses open the way for a renewal and repositioning of internal migration in territorial analysis and development policy and management at the subnational level. Chapter VII "Effects of migration on spatial population redistribution", concludes the analysis of the four effects of internal migration by systematizing the procedures and indicators used for this purpose, generally at the forefront of specialized research, and provides some examples to illustrate their application and facilitate understanding of the calculations and, above all, their results. Chapter VIII, "Selectivity and types of migration", updates the stylized facts on the subject and links selectivity to the four effects of migration, in particular the composition effect, since this effect disappears in the absence of selectivity. Chapter IX "Indirect estimation of internal migration" offers an alternative to direct measurement of the growth effect using the migration matrix. In contrast to the two preceding chapters —which are of a rather standard nature and address topics that have been studied widely— Chapter X "Commuting", is very innovative, since to date there has been limited use of censuses to measure commuting and its four effects, which are analogous to those of internal migration, but with notable specific characteristics. This chapter draws directly from the recently published study on internal migration and commuting entitled "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina"[2] prepared as part of the

[2] J. Rodríguez Vignoli, "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina", *Project Documents* (LC/TS.2022/92), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.

project "Inclusive and sustainable smart cities in the framework of the 2030 Agenda for Sustainable Development in Latin America and the Caribbean", implemented by ECLAC and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and financed by the Federal Ministry for Economic Cooperation and Development (BMZ) of Germany. Lastly, Chapter XI "Conclusions and outlook" summarizes the document and its practical contributions and, above all, outlines the challenges they pose, listing different avenues for future research that could complement and build on those contributions.

Chapter I
Migration and demographic analysis: basic elements and general concepts

A. Migration in demographic analysis

Migration has historically been assigned a secondary position within demographic studies, for several reasons. First among these are conceptual factors related to the impossibility of including migration within the set of analytical and theoretical relationships that have been established around the other two components of demographic dynamics (fertility and mortality), especially the theory of stable populations developed by Alfred Lotka. Second come the methodological factors, which arise from the difficulty of defining, measuring, forecasting and obtaining reliable information on migration processes. Finally, there are historical factors, related to the lack of interest that certain schools of demographics have shown in the geographical movements of the individuals that make up the population.

The clearest and most forceful expression of the secondary importance of migration within demographic analysis can be found in the many investigations and studies in this field that have been based on the assumption that the populations they analyse are closed —in other words, that they lack migratory exchanges— when in fact they are open populations: collectives that exchange individuals with other collectives existing in their external environment. This assumption is usually justified on technical grounds and greatly facilitates a series of demographic calculations. It is far from optimal, however, especially considering that from time immemorial, migration has been a component of population change. Accordingly, what is known as the compensating equation was introduced into the

basic equation of demographics as one of the intrinsic elements that determine and modify the structure and size of the population.

Undeniably, the essentially social nature and spatial dimension of this phenomenon are at the root of these difficulties. However, those characteristics fuel a greater interest in the variable in question among social scientists. Interpreting migration processes requires a direct examination of social, economic and cultural determinants. The contribution of social analysis is therefore essential.

In short, it can be said that the study of migration is important despite the obstacles that exist, and that it should be carried out for the following reasons:

- Migration is an inherent and inescapable component of population change and, as such, can have a decisive influence on population structure, dynamics and size. In the case of internal migration, these effects are not felt on the national level, or at least not directly (they may do so indirectly, due to the reproductive and mortality patterns of migrants). They do, however, operate at the subnational scale and, as has been extensively documented, on average their effects manifest themselves more keenly at higher levels of territorial disaggregation (Dorrington and Hill, cited in Moultrie and others, 2013, p. 371).
- Migration is essentially a social phenomenon, determined by the social, cultural and economic structures of a region or country; at the same time, however, it has an impact on those structures.
- Migration is a potentially life-changing event for both individuals and societies. For this reason, it must be taken into account by development policies that aspire to greater development, more equality and better standards of living.

B. Migration: what does it mean?

1. Official and alternative definitions

The first step in studying migration is to define it as precisely as possible. The *Oxford English Dictionary* defines it as the "movement of people to a new area or country in order to find work or better living conditions" (Oxford University Press, n.d.). That conceptualization is, however, too vague to be used in sociodemographic analysis, since any movement within a territory could be considered a migration.

In contrast to birth, fertility and mortality rates —which, in general, involve events that are relatively simple to identify and specify— the migration event itself is difficult to define. Thus, while births and deaths are largely unambiguous, migration depends on geographically defined spatial units (administrative divisions) and on the intention, or subsequent actions, of the people who relocate. A given person could be considered a migrant by an analyst

studying demographic change at the provincial level, but not by another focused on national demographic change (Dorrington and Hill, cited in Moultrie and others, 2013, p. 371).

The scientific and specialized literature uses a wide variety of definitions of migration (see table I.1), many of which deviate from the United Nations standard (Lee, 1966; Courgeau, 1988; Rees and others, 2000; Rees and Lomax, 2020). They all indicate geographic movements by the population, but they vary according to which specific movements are considered migrations, in contrast to others such as daily commuting. Table I.1 shows that the possible meanings range from the very flexible and simple to the very demanding and complex. An example of the former is the definition offered by Lee (1996), in which the only important factor is a change of residence, even if it is only to a neighbouring house and for a temporary duration. The complex meanings include the one proposed by Courgeau, for whom displacement implies a change in the living space, a highly dense and abstract concept (Ares, 2010).

From the demographic point of view, the definition of migration is found in the canonical text on the subject. According to the *Multilingual Demographic Dictionary* of the International Union for the Scientific Study of Population (IUSSP), "the distinguishing characteristic of migration is that it involves a change in usual place of residence and implies movement across an administrative boundary. The administrative unit left by the migrant is the place of origin or place of departure; the unit to which the migrant goes is the place of destination or place of arrival" (Macció, Henry and van de Walle, 1982, p. 92)

■ Table I.1
Defining migration: selected definitions and meanings used in specialized literature

Authors	Definitions (selected)
Lee (1966)	Migration is defined broadly as a permanent or semi-permanent change of residence. No restriction is placed upon the distance of the move or upon the voluntary or involuntary nature of the act, and no distinction is made between external and internal migration.
Elizaga and Macisco (1975, p. 8)	"Migration can be defined in operational terms as a change of residence from one administrative division to another."
Courgeau (1988), Robette (2012)	The concept of "living space": "the spatial framework where individuals carry out their activities. This concept encompasses not only places of transit and residence, but also all other places with which the person comes into contact."
Rees and others (2000, pp. 207–208)	We adopt the following definitions. *Migration* is the change of usual residence by an individual or group of individuals over a defined time interval. No limit is put on the distance over which the change can take place or on the time interval. *Usual residence* is the address at which a person spends most non-formal work time. There are difficulties in assigning usual residences to workers away from home, but common-sense definitions usually suffice. An *internal* migration is a residential move which has both its origin and destination within the same country.
IOM (n.d.)	Internal migration: the movement of people within a State involving the establishment of a new temporary or permanent residence.
Macció, Henry and van de Walle (1982, p. 92)	"Change in usual place of residence and implies movement across an administrative boundary. The administrative unit left by the migrant is the place of origin or place of departure; the unit to which the migrant goes is the place of destination or place of arrival."

Authors	Definitions (selected)
United Nations (2017, p. 184)	For the purposes of measuring internal migration, migrants are defined as those persons who usually are residing in a civil division of the country at the time of the census, but were previously resident outside that division. That is, movements within the civil division should not be regarded as being migratory.

Source: Prepared by the author, on the basis of R. López Vega, "Medición de la migración con especial referencia a la fuente de datos censal (la medición de la migración en los censos de población y vivienda en México)", paper presented at the Taller Nacional sobre Migración Interna y Desarrollo en México: Diagnóstico, Perspectivas y Políticas, Mexico City, 2007 [online] https://www.cepal.org/sites/default/files/courses/files/rlopez.pdf; E. S. Lee, "A theory of migration", *Demography*, vol. 3, No. 1, Durham, Duke University Press, 1966; J. C. Elizaga and J. Macisco, *Migraciones internas: teoría, método y factores sociológicos*, Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 1975; D. Courgeau, *Méthodes de mesure de la mobilité spatiale: migrations internes, mobilité temporaire, navettes*, Paris, Ined Éditions, 1988; P. Rees and others, "Problems and solutions in the measurement of migration intensities: Australia and Britain compared", *Population Studies*, vol. 54, No. 2, Milton Park, Taylor & Francis, 2000; International Organization for Migration (IOM), "Key migration terms" [online] https://www.iom.int/key-migration-terms; G. Macció, L. Henry and E. van de Walle, *Multilingual Demographic Dictionary*, Liège, Ordina Editions, 1982; United Nations, *Principles and Recommendations for Population and Housing Censuses. Revision 3* (ST/ESA/STAT/SER.M/67/Rev.3), New York, Department of Economic and Social Affairs, Statistics Division, 2017; N. Robette, "Les espaces de vie individuels: de la géographie à une application empirique en démographie", *Cybergeo: European Journal of Geography*, Paris, French National Centre for Scientific Research (CNRS), 2012.

Despite the apparent clarity of this definition, it still contains inaccuracies. One useful step before exploring them would be to identify the movements that would be considered migrations and to determine which, according to this definition, would be excluded:

- First of all, there must be a change of residence. Movements that do not meet this requirement are therefore not considered migratory. Neither are relocations of populations that do not have a fixed residence. In other words, daily commuting, travel for tourism purposes and, in general, short-term movements are excluded, as are the movements of nomadic peoples.
- Second, the crossing of some administrative or geographical boundary is required. Thus, relocations of residence within a single administrative unit —which are classified as local or residential changes— are excluded.

Once the foregoing issues have been resolved, new challenges arise within the definition, particularly with respect to the borders or boundaries that have to be crossed and the concept of residence.

The borders referred to are, by definition, those that formally exist: for example, between countries or between their civil divisions. This does not entirely resolve the meaning of the concept, however, since some boundaries are ignored, imprecise or even invisible. One obvious example of an ignored boundary is the one that demarcates urban and rural areas, of which the population is generally unaware: simply, most of them intuitively recognize the place where they live or used to live as urban or rural, without understanding what official boundaries, if any, exist. The same applies to those areas known as ecological zones, for which drawing precise boundaries can be complex on account of the presence of mixed or transitional zones. Finally, within a city, a street can serve as a boundary that defines two very different territories (neighbourhoods, for example) but that no one recognizes as an official

border. In general, for purposes of demographic measurement and analysis, it is technically incorrect to speak of migration in generic terms. It is invariably necessary to assign a qualifier in order to identify it accurately. One essential qualifier indicates the geographical scale of its measurement. This idea was put forward in a recent text on demographic analysis: the first task in any migration analysis is to establish the geographical scope of the study (Dorrington and Hill, cited in Moultrie and others, 2013, p. 371). Thus, among other possibilities, migrations can entail:

- migration between major civil divisions
- migration between minor civil divisions
- migration between urban and rural areas
- migration between ecological zones
- migration between cities
- migration between settlements.

As far as residence is concerned, long and detailed texts could be written and, even then, a definition that covers all cases might not be produced. The United Nations census handbooks devote several pages to defining usual residence: "in general, 'usual residence' is defined for census purposes as the place at which the person lives at the time of the census, and has been there for some time or intends to stay there for some time. Generally, most individuals enumerated have not moved for some time and thus defining their place of usual residence is clear. For others, the application of the definition can lead to many interpretations, particularly if the person has moved often. It is recommended that countries apply a threshold of 12 months when considering place of usual residence according to one of the following two criteria: (a) The place at which the person has lived continuously for most of the last 12 months (that is, for at least six months and one day), not including temporary absences for holidays or work assignments, or intends to live for at least six months; (b) The place at which the person has lived continuously for at least the last 12 months, not including temporary absences for holidays or work assignments, or intends to live for at least 12 months. Persons who move frequently and do not have a place of usual residence should be enumerated at the place where they are found at the time of the census. Regardless of the criteria used to define the 12-month period, countries should ensure that each person should have one and only one place of usual residence. Furthermore, countries should document the definition of place of usual residence that they have adopted for their census and also provide explicit instructions on how this definition should be applied at the time of enumeration to enumerators for use during an interview or to respondents when filling in self-administered questionnaires. A number of special cases may be encountered in which the application may require some additional explanation as to the place of usual residence. Two of the more common examples where special consideration is required are as follows: (a) Students at boarding schools and living away from family homes at universities; (b) Persons working away from their family home: this situation covers a wide range of cases including: (i) People who spend the working week (five days) in the area close to their work and weekends

and holidays at the family residence; (ii) Workers who constantly travel to different places, such as travelling salesmen, truck drivers and short-term consultants; (iii) Workers on long term, or semi-permanent assignment to a location away from the family home. In many cases these workers will support the family by remitting portions of their wages to their families" (United Nations, 2008, pp. 102–103).

In addition to all the complexities inherent in the notion of usual residence identified in the previous paragraph, gathering information about it poses a major problem in the field, particularly in census operations: questions about residence are answered by the interviewees themselves, so it is falls to them to determine what they understand by usual residence.[1] First, the respondent may well be answering on behalf of the rest of the household and, therefore, may be partially or totally unaware of the usual residence of one or more of the other members. Second, the problem with defining usual residence for census purposes is that, unless respondents stop to ask, they will invariably use their own definitions of residence and not the official one. Of course, this is not a problem in most cases, when the place of residence is stable and the intuitive notion of usual residence and the official definition converge naturally. This does not happen, however, in other cases. For that reason, it is important that in spite of the ever-present risk of respondents answering according to their own ideas of residence in cases in which it is uncertain, the question used and the training and support manual given to census takers pay particular attention to this issue. Specifically, census takers must be proactive in providing the official definition when respondents hesitate or show signs of difficulty in answering.

At the same time, it should be emphasized that the concepts of residence —and, indeed, of migration as a whole— can be analysed with greater rigour and depth by means of surveys. In particular, when the aim is to understand and explain migration within the framework of life processes and life trajectories, biographical surveys yield better results than censuses (White, 2016; Dureau and others, 2011; Greenwood, 1997; Courgeau, 1990). This is because censuses often fail to capture the information necessary to correctly identify the individual determinants of migration. The same happens when inquiring about individuals' migratory trajectories and intensities since, as will be seen, censuses normally detect only a fraction of all the migrations people make during their lifetimes or even during a limited reference period close to the census. Despite these limitations, and as will be discussed later in the section on data sources, censuses offer significant advantages over surveys —particularly the possibility of detecting all migratory movements and not missing some flows or estimating them incorrectly due to the limitations of sample representativeness associated with any sample survey— and they also offer vast and novel opportunities as access to census microdata expands.

In any case, the discussion of current and former usual residences leads to a second qualifier of migration, which involves time rather than geography. At play here is the need to distinguish migration within the broad range of movements that together constitute human territorial mobility, as noted by Dorrington and Hill: a second task is to define what counts as migration, as opposed to broader mobility. The issue is further confused by the existence of

[1] For further details, see Rodríguez (2009b, pp. 63–95) and United Nations (2017).

different types of migration. Circular migratory flows, daily or weekly commuting, seasonal relocations and refugee flows all exist alongside "ordinary" changes of usual residence, and all of them have their own specific characteristics. Given these problems of definition, together with the fact that the impact of migrations on population numbers can be reverted (unlike births and deaths), it is not surprising that their measurement is also complicated (Dorrington and Hill, cited in Moultrie and others, 2013, p. 371).

Thus, the traditional distinction made in censuses is based on the questions about the place of previous residence included in the questionnaire. Broadly speaking, three options exist, which will be discussed in detail below. The first is based on the respondent's place of birth, in which case they are deemed to have engaged in "absolute" or "lifetime" migration. The second is based on their place of residence at a previous fixed date, usually five years, which for the sake of convenience is usually referred to as recent. The third and last option involves the place of previous residence, which is, in principle, not used in isolation, but rather in combination with another question regarding time of residence; this would determine, at least in a nominal sense, the temporal dimension of the respondent's migration. To summarize, the following qualifiers may apply to the temporal dimension of migration: absolute or lifetime (no specific time frame), recent (usually five years) and previous residence over specific time periods (the last two, five or ten years). Accordingly, when the word "migration" is used to denote a displacement, it must be accompanied by at least two qualifiers: the geographic scale of the displacement and its temporal dimension. Thus, for example, migration can be absolute between major civil divisions, recent between minor civil divisions, between urban and rural areas in the last ten years, or a range of other possibilities.

2. Concepts and terms associated with the study of migration

Use of the singular term "migration" should be restricted to the demographic variable that reflects the migratory phenomenon, as is the case with fertility and mortality as components of natural population growth. The plural term "migrations" is used, as a synonym for migratory movements, to refer to a series of countable events, just as births and deaths are also used to refer to events related, respectively, to fertility and mortality. It can therefore be argued that an individual may experience migrations and, conversely, that a population may experience migration.

A migrant is any person who relocates their usual place of residence from one geographical or civil division to another. In practical terms, and for the purposes of real-world applications and measurements, a migrant will be any person whose current usual place of residence does not coincide with their previous usual place of residence, and the "qualifiers" applied to that migrant will depend on the definitions of place and usual residence. Migrants are classified as emigrants or out-migrants with respect to their original places of residence (or places of origin) and as immigrants or in-migrants with respect to their current places of residence (or places of destination).

Migration can impact population growth positively, negatively or not at all. To assess the effect of migration on growth, net migration or the migratory balance are normally used, which are calculated as the population inflows caused by migration minus the outflows. The migratory balance represents migration's contribution to population growth.

Before continuing, it should be noted that migration must be considered a direct component in the population growth of a given territorial entity when measured at a more aggregated level, in geographic terms, than the entity itself. Thus, if migrations occur within the entity, it makes no sense to calculate the impact of migration on population growth: in such cases, it does not matter where in the entity in question the individual is located, since they remain a part of the population established there.

For example, in analysing world population growth, both the migratory balance and net migration would necessarily be zero because, in this case, each person's location in the world is irrelevant. Obviously, the global population does not grow —at least not directly— when a person moves from Chile to France. Similarly, in analysing a country's growth, the only migration of relevance for population increase is international migration, since, as explained above, net migration within a country is always equal to zero. Chile's population growth may be negatively impacted by migration should more people emigrate than immigrate; however, it is not directly affected, for example, by people moving from the north of the country to the Santiago Metropolitan Region. Such movements do have an impact on population growth in the geographical areas involved (here, the north and the capital region) but not on the national population. To summarize, migratory movements occurring within a given civil division (country, region, province, municipality and so on) are, by definition, irrelevant to population growth within that division.

However, movements within those divisions do influence the spatial distribution of their populations and, in this way, can indirectly impact their population growth. A simple example of this is the indirect effect that internal rural-urban migration usually has on population growth. First, it tends to lead to a drop in rural birth rates, because migrants leaving those areas are people in their prime reproductive years, especially young women. Second, it tends to reduce the fertility of in-migrants from rural areas, as pressures for reduced fertility are generally stronger in cities. It can therefore be concluded that rural-urban migration tends to reinforce falling fertility and, accordingly, to favour declining rates of population growth. An exhaustive analysis of the consequences of rural-urban migration should also take account of the effect it has on mortality, but the preceding explanation was merely intended to offer an example of its impact and not to conduct a rigorous and complete analysis (Martine, 1972).

Returning to the concepts, the sum of a population's migratory inflows and outflows is called gross migration, which indicates the total magnitude of spatial movements of a migratory nature occurring in a given civil division. The value of this indicator is important, since the result of net migration can be derived from multiple combinations of inward and outward movements. Net migration equal to zero can be deduced from a trade-off between a high magnitude of inward movements and a similar volume of outward movements. However, it can also be caused by the total absence of outward and inward movements (a closed population). Although net migration would be zero in both cases, the social (and demographic) realities of

the two situations are very different. Therefore, whenever possible, the net migration result should be shown together with indicators of inward and outward movements, such as gross migration or separate figures for inflows and outflows.

While the definitions given so far refer to migratory movements, they can perfectly well be extended to migrants, although in this case the use of alternative terminology is recommended. The net number of migrants is given by subtracting immigrants from emigrants, and the total number of migrants is the sum of both.

By definition, migration assumes two different areas of residence: the place of origin and the place of destination, which are identified by the direction of the migratory movements. Considering both areas, the number of migratory movements or the number of migrants between one area and the other is called the migration stream. The dominant stream (or simply the stream) is the one that is numerically greater, while the one with the smaller volume is called the counterstream. By analysing both flows, the net migration stream between two territorial entities can be identified as the difference between the larger dominant stream and the smaller counterstream. This difference, without the hierarchical order indicated above, is known as the bilateral migratory balance. The bilateral migratory balance between two entities has the same numeric value for both but, obviously, one is positive and the other is negative.

Migratory draw cannot be deduced from these flows separately, nor can it be determined on the basis of immigration alone. Migratory draw is always based on net migration. The higher the net migration —strictly speaking, as will be seen below, the higher the net migration rate— the greater the migratory appeal. Strictly, administrative divisions can be said to have a net pull if their net migration is positive (net in-migration) or a net push if it is negative (net out-migration). Similarly, receiving and sending administrative divisions are those notable for their absolute numbers —or, more rigorously, the relative frequency— of in-migrants and out-migrants, respectively.

One of the essential features of migration is its repetitive nature. This allows distinctions to be drawn that order migrants according to the number of movements made. The basic differentiation is between migrants who have moved for the first time, called primary migrants, and those who have moved more than once in the reference period, called secondary or multiple migrants. One particularly relevant form of multiple migration is return migration, which occurs when people return to their place of origin after a migratory path with one or more seasons of residence.

Since one migratory movement may be followed by another, the period between the migrant's arrival in a place and their date of departure (or the current date, if they have not continued migrating) is called the duration of residence. Incidentally, for individuals who have never migrated ("never migrants"), the duration of residence is the same as their age. Note that this classification depends on the territory in question, since a person could be a "never migrant" between major civil divisions, but a "migrant" between minor civil divisions (within the same major division, of course). The only category of "never migrants" who do not require a qualifier are those persons who have never changed their place of residence (those who have always resided in the same dwelling).

Migration intensity has an individual expression, as the number of migrations undertaken by a given person, or —in general terms— as the number of migrations experienced by an average person. This measure of intensity may pertain to a country or an entity within a country, or to a specific population group. In this way, the individual measurement becomes collective, but it does not lose its condition of individual intensity. When the only measurements available are those that capture a single migratory movement and, for the same reason, only distinguish between migrants and non-migrants, without counting migrations, the probability of being a migrant in the reference period becomes the measure of individual intensity. Often, only one approximation to this probability is available: the percentage of migrants within a population (country) or subpopulation (territorial or sociodemographic); in such cases, this becomes the measure of individual intensity. It then has only a community-level expression. Thus, although they are individual measurements and are expressed at that scale, they usually indicate averages among populations and subpopulations. Unlike fertility and mortality, where measurements of intensity are clear and standardized, the measurements for migration are less formalized and their regular use is less widespread. Moreover, as will be seen below, such measurements can be affected by extrinsic variables that go beyond population structure and reflect the geographical division of countries.

Migratory cohorts are groups of individuals united by a common period of departure (emigration cohorts, seen from the origin) or a common period of arrival (immigration cohorts, seen from the destination). The length of the period is variable, but calendar years are generally used, ranging from full years to five-year periods. Since, as will be seen below, almost no available source registers information on precise departure or arrival dates, the definition of migratory cohorts critically depends on the backward-looking questions used in censuses and surveys to record migration. In the case of in-migrants, however, cohorts can be constructed from the information available on the duration of residence. In this way, cohorts comprising members who have been living in the destination for different numbers of years are formed. At the same time, the term "migrant cohorts" can also be used to refer to groups of migrants united by another common event, such as age or year of birth. This can be of particular interest, for example, in studying migrants' insertion processes at their places of destination or in analysing their different fertility rates. Finally, many studies require the construction of migrant cohorts by year of arrival (or duration of residence) and age. Theoretically, the same approach used for migrant cohorts by year of departure and age could be used (in other words, emigrant cohorts) but the data sources generally available in the region do not allow this.

The concept of migratory selectivity reflects the fact that migrants are not normally a representative sample of the population and, consequently, their sociodemographic characteristics differ from those of non-migrants. This selectivity may vary depending on the type of migration, but such variations may change over time. The causes of this selectivity are the different propensities or probabilities of migrating among different population groups. As will be explained below, selectivity is easy to identify and can be measured by various procedures and indicators, most of which are simple.

As already explained and underscored above, the type of migration must necessarily be specified by identifying its territory of reference and its temporal dimension. However, many other types exist. Broadly speaking, the following types of migration can be identified:

By political-administrative distinction:

- between countries
- between major civil divisions
- between minor civil divisions, including those that make up metropolitan areas (intrametropolitan migration)
- between settlements.

By socioecological distinction:

- rural-urban
- between ecological regions (coast, highlands and jungle in Peru and Ecuador) or economic regions
- between cities.

By the nature of the process:

- recent
- long-standing
- multiple
- return, among others.

Finally, the last concept to be explained involves the most important analytical instrument for measuring migration and its territorial intensity. This is the migration matrix or origin-destination matrix, which is presented in table I.2 and will be discussed in detail in later sections of this text and used throughout this publication. It is, by far, the main tool used in this document.

■ Table I.2
Migration matrix or origin-destination matrix

Current place of residence	Definitions (selected)					Total
	1	2	3	[...]	i	
1	N_{11}	N_{21}	N_{31}	[...]	N_{i1}	$N_{.1}$
2	N_{12}	N_{22}	N_{32}	[...]	N_{i2}	$N_{.2}$
3	N_{13}	N_{23}	N_{33}	[...]	N_{i3}	$N_{.3}$
[...]						
I	N_{1i}	N_{2i}	N_{3i}	[...]	N_{ii}	$N_{.i}$
Total	$N_{1.}$	$N_{2.}$	$N_{3.}$	[...]	$N_{i.}$	$N_{..}$

Source: Latin American and Caribbean Demographic Centre-Population Division of ECLAC/Latin American Programme of Population Activities (CELADE/PROLAP), *Demografía I*, Mexico City, Latin American Programme of Population Activities (PROLAP) and Institute for Social Research of the National Autonomous University of Mexico (UNAM), 1997; M. Villa, "Introducción al análisis de la migración: apuntes de clase: notas preliminares", *Serie B*, No. 91 (LC/DEM/R.164), Santiago, Latin American and Caribbean Demographic Centre (CELADE)-Population Division of ECLAC, 1991.

C. Data sources for internal migration

Several sources of data can be used in migration studies. For analytical purposes, these sources are generally divided into two types: (i) those that record the demographic event itself, either at the time it occurs or when the individual makes declarations because of institutional requirements or incentives (permanent population records, vital statistics, electoral or police lists, among others); and (ii) those that collect answers that migrants themselves give to backward-looking questions relating to their migratory movements in the past (in censuses and surveys).

1. Permanent population records and vital statistics

Permanent population records include, first of all, those kept at countries' border checkpoints. Such registers record movements into and out of the country and therefore exclusively indicate international migration. These statistics suffer from at least two problems that, because of their magnitude, tend to be serious. First, a large number of movements go unrecorded, as many people —for a range of reasons— avoid customs checkpoints and border crossings and the registration that takes place there. This is the case with undocumented migrants. Second, these statistics also record movements that cannot be considered migration, such as travel for tourism. In some cases, the information collected includes information on the reasons for travel, which can to some extent help differentiate migrants (those who intend to change residence) from those temporarily on the move. As noted above, however, information on motivations is by definition complex and unreliable, as the actual purpose of the journey is often not stated, unclear or rationalized *a posteriori*. These two problems explain why it is not advisable to use these records exclusively and directly for reliable estimates of international migration, although any study of the issue should take them into account. Of course, if a country has such records and their data are reliable and, moreover, allow migrations to be differentiated from other movements, then they can provide fairly accurate and up-to-date estimates of international migration.

As noted above, these records only allow the study of international migration and are not useful for estimating internal migration, which is normally more significant on account of the population volumes involved. All countries keep population records of some type or another to measure and monitor given situations. These include electoral rolls, residence registers, taxpayer lists, social security and community assistance records, municipal recruitment files and so on.

When people change residence within the country, they are expected to report that relocation. Thus, a close analysis of these sources could yield valuable background information on internal migration. However, the data are usually restricted in their use and incomplete (because they do not cover the entire population, but only those members who are registered). Often, declaring a change of residence is not mandatory or involves too many formalities, which limits the frequency with which such declarations are made.

One example of a population register that could be used for internal migration estimates is the residence register kept in Cuba, which is one of the few countries in the world that has continuous internal migration statistics obtained from administrative records. In 1974, the Identity and Population Registration Card (CIRP) system was introduced, with offices in all of the country's municipalities. Its purpose is to provide each citizen with a personal identity card, in which he or she is assigned a permanent number. The system records people by their permanent place of residence (municipality). If a person changes address, the relevant office must be notified. When the move is from one municipality to another, the person must notify the office in the place to which they are moving (which is to say the destination municipality). With this, Cuba has a system through which information is continuously obtained on internal and international migrants, indicating sex, age, place of origin and destination. This type of register is most successful when institutional and personal interests are combined, above and beyond the legal obligation to report changes of residence and the oversight carried out over those changes. Cuba offers specific incentives for this purpose that are not necessarily present in other countries in the region. One of these is the population's dependence on certain public services and goods, many of which are granted on a territorial and residential basis: that is, they are provided to the people registered in a specific political-administrative entity. It is therefore natural and almost mandatory to declare a change of residence in order to receive those services in the new place of residence.[2]

Other countries have residency registers, something like internal passports, which are required for permanent settlement in certain areas. One familiar example of this is the Hukou system in China, which allows internal migration to be quantified to a certain, albeit partial degree. It should be noted that the State's strong control over the population is not a prerequisite for the existence and proper functioning of the permanent registers that exist in some countries. Certainly, a strong and efficient State is required to maintain permanent registers, but the example of several European countries —particularly the Scandinavian nations, but also others such as Spain, with its municipal register— indicates that such systems can work in different political-administrative scenarios. In all cases, these registers usually require incentives other than legal and administrative requirements. The same is true in the case of vital records, such as the birth certificate typically required among the documents needed to enrol children in schools.[3] In the case of Spain, for example, official documents underscore the importance of being included on the municipal register, particularly among international migrants.

With reference to the case of Spain, Recaño has stated the following:

> Since 1988, its level of coverage has improved considerably. The Residential Variation Statistics (RVS) record migrations, and thus include multiple displacements by persons, without ever distinguishing the range of the migration carried out. This last aspect is important, as it clearly differentiates this source of information from population counts (censuses) that record migrants. Counting migrations gives the

2 E. González, personal communication, 2014.

3 This requirement could come into conflict with higher rights, such as the right to education, and so its mandatory nature should be contextualized and perhaps relaxed if certain conditions are met.

Residential Variation Statistics a level of coverage that, in theory, should be greater than that of census counts. So, by definition, the following is satisfied:

Migrations ≥ Migrants	RVS ≥ Census

In general terms, the Residential Variation Statistics series presents a very regular cyclical trend with a periodicity of five years, coinciding with the census cycle. This behaviour is due to the fact that in the years when the municipal population registers are drawn up, residential registrations are masked by the census operation itself, whereby they directly become part of the municipality's population without being recorded as "registrations", thus excluding them from the registrations entered for that year. With all its flaws, the RVS is the only direct source on migratory movements that exists in Spain, covering a period from the early 1960s to the present. (Recaño, 2010, p. 9).

Finally, still at the level of quantification and estimates based on records, vital statistics offer a sort of universal register in all countries (albeit with their coverage varying from one country to the next). They provide information on births and deaths: in other words, on natural population growth. If that information is compared with census data, indirect estimates of migration can be obtained. Experience in Latin America shows that this procedure can be used in the few places where vital statistics have a high rate of coverage. The problem with this indirect procedure —in which migration contributes the remainder that cannot be explained by natural growth— is that it only estimates net migration: migrants' origins and destinations are not disaggregated, and no distinction is made between internal and international migrants. In some cases, when the records do not contain detailed information on the resident populations, this procedure does not allow net migration to be broken down by such key variables as sex, age and schooling.

Regardless of all these disadvantages and problems, all countries —and, in particular, the countries of this region— should aspire to the goal of having a continuous register of residence and a robust vital statistics system to allow, *inter alia*, the regular monitoring of both internal and international migration.

2. Surveys

Different types of surveys have been used to study migration (Greenwood, 1997; Courgeau, 1990; Bilsborrow, Oberai and Standing, 1984). Between 1950 and 1980, several were conducted in the region with the aim of estimating rural-urban migration volumes. The primary goal was to study and conduct a detailed analysis of the determinants and consequences of migration, particularly relocations to large cities (Elizaga, 1972; Alberts, 1977). The results were influential and served as inputs for policies and lines of thought on the subject. With the passage of time, however, their intrinsic limitations became evident, particularly the difficulties in compiling a complete picture of flows and their characteristics on account of the sample nature of their data. Their specific weaknesses have also been recognized, especially the fact that they concentrated on destinations, to the detriment of places of origin. Partly

because of these problems, and also because of the sharp reduction in international funding for migration research, these surveys have tended to disappear as a source of information in the region since the 1980s.

This does not mean that surveys are no longer used to study and even measure internal migration. They have in fact continued to be used, but in the context of two different situations than in the past. The first is their periodic use in such instruments as household surveys —for example, the national household surveys in Brazil (PNAD) or in Peru (ENAHO)— but also in others, such as demographic and health surveys (DHS), multiple indicator cluster surveys (MICS) or various nationwide efforts such as the National Survey of Demographic Dynamics (ENADID) in Mexico and the National Socioeconomic Survey (CASEN) in Chile, which include modules on migration with backward-looking questions that are normally more extensive and detailed than those included in censuses. The second situation involves surveys of a more academic nature, including those known as "biographical" surveys (Dureau and others, 2011; White, 2016), which can construct migration histories and describe in much greater detail the sometimes highly complex trajectories that people follow. In the latter case, the samples are usually collected in destination cities and, for that reason, the results obtained are not representative of all the country's migrants.

Other specialized and particularly sophisticated surveys include panel surveys, which is to say those that follow migrants from origin to destination over a certain period of time. Although this monitoring can technically be achieved through a single survey with backward-looking questions related to the place of origin (the biographical ones referred to above, for example), this form of actual monitoring purportedly allows a more rigorous control of the variables involved and, above all, the *ex ante* measurement of certain variables that could be affected by migration. The main problem with these surveys, in addition to their cost and technical difficulties, is "sample loss", which can jeopardize their initial objectives.

In recent years, countries that conduct annual mega-surveys in order to monitor their sociodemographic trends continuously (such as the United States, with its American Community Survey) have revived and redesigned the use of surveys to measure and study migration. However, in addition to the technical complications involved in sampling and the subsequent expansion of results, the costs of such mega-surveys make them difficult to implement in the region.

Finally, while the focus so far has been on surveys of a quantitative nature —with the ability or at least the potential to generate estimates of migration volumes in a country or area— there are surveys and other methodologies that are not designed for that purpose but rather for the in-depth analysis of migrants (and non-migrants). These are powerful resources for analysis and qualitative research, regardless of their limitations in terms of the quantitative estimation of migratory flows and individual and territorial migration intensity, which are issues often omitted from their objectives from the outset.[4]

[4] Surveys that deal specifically with migration usually include complete migration histories and, although they pose complex analytical challenges, they do not tend to focus on estimating migrant or migration numbers (IUSSP, n.d.).

3. Population censuses

Population and housing censuses are the main source for studying migration flows in the region, as they are the only instrument that collects information on current and past residence at a disaggregated territorial scale (which must be specified beforehand) and without sampling limitations. Censuses can record all migratory flows: something that is usually beyond the scope of surveys, even those specially designed ones that over-represent small geographic entities. Censuses therefore provide useful information for constructing migration matrices at different geographic scales. With this, migration flows and balances can be calculated, measurements of the amount and intensity of migration can be obtained and geographic analyses of some of the determinants and consequences of internal migration can be produced.

Moreover, the information provided by censuses also covers the dwelling, the household and the individual, and so as a source they allow the study of migration issues that impact those levels (for example, the socioeconomic, domestic and geographic insertion of migrants).

Despite their potential, censuses have at least two generic limitations that specifically affect the migration module. The first is that reconstructing individuals' migration histories requires an extensive battery of backward-looking questions, which is beyond the scope of censuses. In fact, tracing those histories is a challenge for any source, because of the difficulties inherent in memory exercises of that kind. This is compounded in this case by ambiguities about the concept of prior residence. For this reason, censuses should select methodological choices designed to ensure the identification of certain migratory movements considered to be a priority, reliable or comparable. As with any decision regarding methodologies, choosing any option has its trade-offs: for example, the failure to record some migratory movements, the registration of inaccurate movements and the identification of movements that cannot be compared between one individual and the next.

The second important limitation of censuses, for purposes relating to migration, is that they almost always collect information on the current situation of individuals, households and dwellings. This conflicts with the backward-looking nature of migration questions and, therefore, with the examination of past displacements. The implication of this shortcoming is that censuses often provide little or no information on the individual and territorial conditions at or around the time migration occurred. In the case of territorial information, this can be corrected with data from other sources (unemployment rates or average income figures obtained through surveys, for example). However, it is usually difficult to obtain information of this type for highly disaggregated geographic levels. For individual analyses there are no alternative sources, so in practice censuses do not allow the individual determinants of migration to be analysed. The exception to this restriction involves the invariant characteristics in the migration reference time (for example, gender, educational level after a certain age, language learned in childhood, parents' place of birth and so on) with respect to which the situation at the time of the census is the same as it was at the time of migration.

In conclusion, gathering information on migration —particularly internal migration— is often a complex task, one that is undeniably more complex than collecting data on other vital events. Nevertheless, measuring migration is essential for demographic analysis and public policy.

Taking into account the scarcity of continuous records in the region and the problems and difficulties of migration surveys, the contents that follow relate first and foremost to the use of censuses to measure and estimate migration. The analysis will therefore be biased towards territorial migration intensity, since censuses have problems in recording that indicator at the individual level. However, their potential in this regard will be fully exploited and, in any case, measures and indicators related to individual migration intensity will be reviewed in more general terms.

Chapter II

Using the census to measure migration and two key cross-cutting issues: geography and time

Almost without exception, the information collected by census migration modules can be used to estimate migration at different territorial scales and over different periods of time. For that reason, discussing the geographical scales and reference periods used is a central issue in the use of those modules.

A. Territorial scale of residence[1]

In dealing with internal migration, the rule that applies to the geographical entity of reference for prior residence is to go "as far down" —in geographical terms, as disaggregated— as possible: "for an understanding of the movements of people since birth it is necessary to collect information at the smallest possible geographic level" (United Nations, 2008, p. 120). Although theoretically the most disaggregated level is the address or domicile, which would allow the dwelling to be pinpointed, in practice it is extremely difficult to go that far down, if not impossible. It is true that technology is advancing rapidly and large databases (including

[1] Sections A and B are based on J. Rodríguez, "La captación de la migración interna mediante censos de población: la experiencia de la ronda de 2000 y sus lecciones para la ronda de 2010 en América Latina y el Caribe", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2009.

address databases) are becoming easier to use than previously seemed possible; however, there are more substantive reasons for discarding the option of going all the way down to individual addresses. These relate to problems of memory and, in Latin America, to the absence of formal addresses in rural areas and irregular settlements. Even so, it should not be discarded, since it can be partially achieved through certain methodological resources, as will be discussed below.

The United Nations census handbook (United Nations, 2008) explores the distinction between localities and the smallest civil divisions (such as municipalities, communes, districts or parishes, which are generically identified as minor civil divisions). Faced with that alternative, what is the best option? Two issues are raised in the handbook regarding the definition of the smallest possible geographical level:

(a) The boundaries of administrative units such as cities and other civil divisions will change over time, which may give rise to ambiguity in reported data, and

(b) the costs of coding reported data to these smaller units may be prohibitive, especially where there are many units and the population is highly mobile. To overcome the first problem, both national and subnational boundaries should, as far as possible, refer to the boundaries in force at the time of the census. Countries must address the second problem in the light of their own circumstances (United Nations, 2008, p. 120).

Since localities change size, emerge and disappear, by definition they do not fulfil principle (a).

Do minor civil divisions comply with it? Yes, except when internal administrative boundaries or the names of civil divisions change, which is not entirely uncommon. If municipalities are created by means of documented partitions, then the new municipal division can be correlated with the previous one. This, however, is not a solution for estimating migration, because comparable figures for past residence can only be obtained with reference to the civil division that existed in the past, which reduces its usefulness for policy design and implementation. In addition, these changes can give rise to the problem of "fictitious migration", which occurs when the usual residence declared does not concur with the previous declaration but the respondents have not in fact changed their residence. This problem is illustrated below with reference to the case of the Chilean census of 1992.

The United Nations handbook's consideration (b) must be analysed by each country. It should be noted, however, that there have been cases of countries that used localities as the most disaggregated scale of previous residence and then failed to make use of that information due to its high costs and inherent problems, in addition to complications involved in its processing and dissemination.

There are other important arguments in defining the geographical scale of reference. The first of these is the linguistic accuracy (semantic and common-sense) of the selected entity. In general, localities fail to meet this requirement because: (i) among the official meanings of the term, the one that comes closest to the concept of geographical entity is "place or town", and so the degree of subjectivity in people's responses is very high; (ii) their

toponymy is often rife with repetitions, which makes coding difficult and can be misleading, and, additionally; (iii) place names change over time or are not universally agreed upon. Second, localities have an ambiguous relationship with the smallest civil entity (municipality or commune). Although they are usually assumed to be limited to a minor civil division, given the region's reality —where one out of every three inhabitants lives in a city of one million people or more (ECLAC, 2012)— metropolitan localities usually cover several municipalities or communes. Thirdly, using the locality scale would require an exhaustive and unambiguous nomenclature, which could be developed for the current locality of residence but would be difficult to apply to the previous one. In general, these problems do not arise when minor civil divisions are used, since they are given by an official political-administrative delimitation. In any case, as will be seen below (in the case of the Commune of Santiago in Chile), toponymic similarities between civil divisions also wreak havoc in some specific countries.

Can it therefore be concluded that it is best to use minor civil divisions as the most disaggregated geographical reference? Caution and pragmatism are recommended in this regard. The general suggestion is to ensure —as a minimum and not as a maximum— that the information is gathered efficiently and appropriately at that scale. If an additional query to further disaggregate the previous residence causes confusion or compromises data quality at the municipality or commune scale, the recommendation is to go no further and assume the consequences of that decision. If, however, previous census experience or the country's human settlements system supports the possibility of investigating at scales below the municipal level (whether based on localities or any other concept deemed relevant in the country), it would be reasonable to use that scale as the most disaggregated geographical reference for prior residence.

B. The temporal dimension of previous residence and whether to focus on persons or events

Normally, previous residences are recorded in conjunction with a reference date. In census practice, the great dilemma with reference times is the choice between using a set date of previous residence common to all respondents or, alternatively, an individual date associated with the time of residence at the current location, in which case the prior place of residence must also be explored. With the second option, which involves two questions, the time elapsed since each person's last migratory event can be precisely defined. In fact, assuming perfect memory on the part of respondents and unlimited space on census forms —both of which are unrealistic— a series of questions on the duration of residence in conjunction with a query regarding the place of residence would allow the reconstruction of individuals' migration trajectories. This potential has been highlighted by some authors to maintain that such a tandem of questions (duration of residence plus previous place of residence) would allow the most rigorous approach to the measurement of migration: event-based measurement

methods (Xu-Doeve, 2008, p. 44). However, this option entails biases and methodological problems, particularly with respect to the construction of migration matrices and cohorts (United Nations, 2008; CELADE/PROLAP, 1997; Villa, 1991). Since reference times vary among individuals, any migration matrix based on that information will be, by definition, forced and uncertain with respect to the place of origin.

In contrast, the use of a fixed temporal delimitation that is common to all respondents is in line with the traditional approach to measuring migration: in other words, measurement methods based on migrants (individuals) and not on migrations (events) (Xu-Doeve, 2008). It also has well-documented limitations (United Nations, 2008; CELADE/PROLAP, 1997; Villa, 1991). Any rate derived from a matrix constructed with this information will be underestimated, because it misses some migratory events (movements within the reference period). However, its simplicity for people, its economy for the questionnaire (census or survey), its communicability and the usefulness of the information it collects for decision-making or policy design make it a functional and technically sound option.

C. Backward-looking questions on internal migration

The questions discussed below are those commonly used in the migration modules of censuses and surveys and are among those officially recommended by the United Nations (see table II.1). Four prior considerations that apply to all the questions analysed must be taken into account:

(i) Normally, migratory movements made by persons who died before the census or survey date are not recorded.

(ii) The questions are asked of persons present in the territory of the country where the census or survey is being conducted and, therefore, in isolation they are of no use in measuring international emigration. In any case, it should be noted that this publication's emphasis is on internal migration, so the use of these questions to explore international migration will be considered only in passing.

(iii) The questions assume direct movements between the past and current places of residence. They therefore record a single migratory movement and any intermediate movements that may have occurred are lost. Thus, migrations are conflated with migrants, since each migrant is assigned a single movement. Incidentally, as will be seen below, the migratory movement they record changes according to the question asked. Additionally, the census can record more than one migration if it includes more questions for that purpose. However, censuses cannot include a battery of questions aimed at reconstructing individuals' migration histories.

(iv) The questions to be analysed are backward-looking, so questions on the current usual residence are not included. This issue was examined earlier both in discussing the concept of usual residence and in the discussion on defining the geographical scale of census migration questions in chapter I.

■ Table II.1
Census migration questions officially recommended by the United Nations, by priority

Geographical and internal migration characteristics (paragraphs 2.44 to 2.88)	
Place of usual residence (paragraphs 2.46 to 2.51)	■
Place where present at time of census (paragraphs 2.52 to 2.56)	■
Place of birth (paragraphs 2.57 to 2.63)	■
Duration of residence (paragraphs 2.64 to 2.66)	■
Place of previous residence (paragraphs 2.67 to 2.68)	■
Place of residence at a specified date in the past (paragraphs 2.69 to 2.70)	■
Total population (paragraphs 2.71 to 2.77)	□
Locality (paragraphs 2.78 to 2.80)	□
Urban and rural (paragraphs 2.81 to 2.88)	□

Source: United Nations, *Principles and Recommendations for Population and Housing Censuses. Revision 2*, series M, No. 67/Rev.2 (ST/ESA/STAT/SER.M/67/Rev.2), New York, Department of Economic and Social Affairs, Statistics Division, 2008.
Note: ■ Core topic; □ Derived core topic.

1. Estimates derived from the birthplace question[2]

Most population censuses include a question about the respondent's place of birth;[3] table II.2 shows that all the region's countries included one in the 2010 census round. In general, this is a simple question to formulate and understand. It also allows both domestic and international migration to be explored. An estimate of international migration is only possible if the individual's country of birth is known. If the country of birth does not coincide with the country in which the census was taken, the respondent is an international immigrant in the country taking the census and an international emigrant in their country of birth.

2 The following sections are based on Latin American and Caribbean Demographic Centre-Population Division of ECLAC/Latin American Programme of Population Activities (CELADE/PROLAP), *Demografía I*, Mexico City, Latin American Programme of Population Activities (PROLAP) and Institute for Social Research of the National Autonomous University of Mexico (UNAM), 1997; and J. Rodríguez, "La captación de la migración interna mediante censos de población: la experiencia de la ronda de 2000 y sus lecciones para la ronda de 2010 en América Latina y el Caribe", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2009.

3 As explained above, it is normal not to ask for the precise place or locality of birth, but rather for the corresponding civil division —normally the smallest unit existing in the country— and then move up administratively in its geographic identification. For example, in the case of Chile, the corresponding civil unit would be the commune; in Panama, the district (or township, if the question uses that level); and, in Brazil, the municipality. Some precautions to be taken into account when defining the spatial reference unit in migration questions are discussed below.

■ Table II.2
Latin America: internal migration and commuting questions used in the 2010 and 2020 census rounds

Country	Place of birth	Place of previous residence	Time of current residence	Place of usual residence	Place of residence on a previous fixed date	Place of study or work
Argentina, 2010	X (A)		–	X (A)	X (A) (five years)	–
Bolivia (Plurinational State of), 2012	X	–	–	X	X (five years)	–
Brazil, 2010	X (A)	X (A)	X (A)	n/a	X (A) (five years)	X X (A)
Chile, 2017	X (mother)	–	–	n/a	X (five years)	–
Colombia, 2018	X			n/a	XX (one and five years)	XX
Costa Rica, 2011	X (mother)	–	–	n/a	X (five years)	X
Cuba, 2012	X (mother)	X	X	n/a	–	X
Dominican Republic, 2010	X	–	–	n/a	X (five years)	–
Ecuador, 2010	X			X	X (five years)	X
Guatemala, 2018	X			n/a	X (five years)	X
Honduras, 2013	X			n/a	X (five years)	X
Mexico, 2010 and 2020	X (A)(B)	–	–	n/a	X (A) (five years)	X(A)
Panama, 2010	X (mother)	X	X (over periods)	X	–	–
Paraguay, 2012	X (mother)	–	–	n/a	X (five years)	X
Peru, 2017	X			X	X (five years)	XX
Uruguay, 2011	X (special wording)	X	X	n/a	X (five years)	X X
Venezuela (Bolivarian Republic of), 2011	X	–	–	n/a	X (five years)	–

Source: Prepared by the author, on the basis of the respective census questionnaires.
Note: A = expanded questionnaire; B = basic questionnaire; n/a = not applicable.

This question does not record international emigrants from the census country. A census conducted in country A cannot directly record individuals who were born there but who currently live in countries B, C or D, since the questions apply only to those residing in country A at the time the census is taken. However, if census data are available for countries B, C and D, and if their censuses include birthplace questions, an estimate of their residents born in A can be made. One successful experience in this area is the Investigation of International Migration in Latin America (IMILA) project, conducted by the Latin American and Caribbean Demographic Centre (CELADE)-Population Division of ECLAC using censuses, primarily Latin American, from the 1970s to the 2010s. Additionally, several censuses include a section titled "international emigrants", which aims to identify the number of people who

have emigrated abroad from each household. This is a novel procedure that has spread rapidly, although it suffers from considerable weaknesses and biases.[4]

To estimate internal migration, a comparison is drawn between the birthplace reported by the respondent and the declared place of usual residence (or, failing that, the place where the census was administered, although, as already noted, this would produce measurement errors and would indicate a serious design problem in the census, if this were in fact the case). If both places are the same, the respondent will be classified as an internal non-migrant. If they do not match, the respondent will be deemed an internal migrant (an out-migrant vis-à-vis the place of birth and an in-migrant vis-à-vis the place of residence at the time of the census).

The estimates produced with this question, called absolute or lifetime migration, have numerous shortcomings. These include:

- Without a migratory interval, the at-risk population cannot be determined and, therefore, the relative frequency of the phenomenon over time cannot be established. In other words, the information does not allow for the calculation of rates. This technical limitation has extremely important concrete repercussions. Since there is no defined reference period, the moment when the migration occurred is unknown; the results therefore group together migratory movements that occurred at different times in the past. This constitutes a practically insurmountable obstacle for using the information obtained through this question to analyse the determinants of migration, since not knowing when an individual migrated makes it impossible to determine the social, economic and cultural circumstances existing at the time that could have motivated the decision. At the same time, the absence of the migration interval may give rise to erroneous perceptions and conclusions about current migration patterns, since past movements may have had very different motivations and intensities than those existing in the present. Moreover, migration flows constructed with information from this question can be dangerously misleading, and so their use as inputs to formulate policies for migration and the spatial redistribution of the population is not recommended. It may be the case that a locality registers a considerable number of current residents who were born elsewhere, from which someone could deduce that this locality is currently attracting population. That conclusion would be erroneous, however, if the migration processes occurred in the past but have not survived into the present. This is the typical case of cities that grow explosively around a mine or source of wealth and that, with the reduction or depletion of output, cease to be attractive, currently receive few migrants but still report large numbers of inhabitants born elsewhere.
- Although this is an easy question to formulate and understand, it can trigger consistently incorrect answers. Those incorrect responses basically arise from a confusion between the place where the respondent was born —in other words, the

[4] As this publication is focused on internal migration, it does not delve into the quantification of international migration, for which abundant literature exists (Martínez, 2009; White, 2016).

place where the birth took place— and the place where the respondent's family or mother had their usual residence at the time. It is often the case that mothers living in rural areas or urban localities with inadequate health infrastructure go to the nearest hospital for childbirth and, consequently, their children are born in localities other than the mother's place of usual residence. After the birth, the mother and child return to their place of usual residence. If the respondent still resides there at the time of the census or survey but gives their birthplace as the locality with the hospital where the birth took place, they will be recorded as having migrated between those localities when they in fact have not. To avoid this problem, the question can be worded in such a way that respondents understand that the answer is not the physical place of birth but the place where their family usually resided at the time. This was the option used in the 1992 Chilean census ("In which place or commune did your mother usually reside when you were born?"). However, this solution may create new problems related to the respondents' knowledge and memory. For that reason, preference is usually given to the simplicity of the initial question and it is assumed that respondents will not answer in terms of the physical place of birth but rather their family's place of usual residence. That notwithstanding, several countries' censuses have used wordings that refer to the place of residence of the respondent's mother at the time of birth without encountering major problems (see table II.2).

- This question is blind to the phenomenon of return migration. If a person relocates their residence outside the geographical boundaries of the place where they were born but later returns and is recorded by the census, a cross-referencing of their birthplace with their current place of residence will define them as a non-migrant. In fact, the respondent is a migrant, given that at some juncture they resided away from their place of birth.
- At the same time, consideration must be given to potential problems arising from the following situations: (a) respondents who do not know their birthplaces, (b) the tendency to report the current place of residence as the place of birth, (c) respondents who swap their real places of birth for others deemed more culturally or socially desirable, and (d) changes in territorial or administrative boundaries that may occur between the time of the respondent's birth and the time the census or survey is conducted.

2. Estimates derived from the previous place of residence question

Sometimes, census forms and survey questionnaires include a question to identify the place of residence where the respondents lived prior to their current place of residence. Because of how they are worded, such questions allow the total population to be broken down into two groups. The first contains those who have always resided in the same place:

that is, they are non-migrants (in this case, "never migrants") at the geographical scale used for the question. The second group comprises those people who, at some point in their lives, resided in a place other than where they were living on the date of the census or survey; they are therefore defined as migrants at the geographical scale used for the question. Members of the second group are out-migrants vis-à-vis their previous places of residence and in-migrants vis-à-vis their current places of residence.

Since the question addresses only the previous residence, the data obtained cover the last move or migration. As no reference period is given, the criticisms made above regarding the birthplace question are also valid here. Accordingly, using data on the last relocation, it is impossible to estimate the relative frequency of migration. Moreover, the data collected are not useful for analysing the determinants of migration, nor are they useful as inputs for spatial redistribution policies or local and regional development plans.

Several of the practical problems that affect the birthplace question also apply to the question on previous place of residence. Of course, there is always a risk that a respondent may not know if the person to whom the information refers had a previous place of residence. In addition, even if they know, they may be unaware of exactly where it was. Even on occasions when the individual involved is the one providing the answer, confusion often arises among the places where the previous residence may have been located. This error can have important repercussions because, as will be explained below, the collected data are only fully valid at the scale to which the question refers. The forgetfulness factor can play an important role, especially among people who are long-term residents of a place. In addition, boundary changes and repeated place names are often responsible for errors and biases in responses to the question.

One advantage of migration estimates derived from the previous place of residence question over those derived from the birthplace question is that the former detect return migrants, even if they are not identified as such. This is because although it is impossible to include people who have moved back to the place where they were born in the calculation of absolute migrants, they are identified as people who had a previous residence outside the area. They are therefore part of the group of people who qualify as migrants according to the last relocation (whose current place of residence is different from the previous one). In other words, the previous place of residence question allows only those who have never resided outside their birthplace to be classified as non-migrants. Thus, the number of migrants identified by their last relocations should be higher than —or, in the extreme case that there are no return migrants, equal to— the number of absolute migrants, if both questions refer to the same type of spatial unit.

The geographical definition, in the case of this question, is of particular relevance. Unlike a birthplace, which remains unchanged over time for everyone, the last residence may vary according to the spatial demarcation that the question uses. Since the question does not have a reference interval, the data may be completely different depending on the criteria used to identify the location. Therefore, in order to avoid conflating different types of movements (between municipalities or between regions, among others), the question should

allow for the clear specification of the civil division to which the relocation refers. In other words, the question should make it possible to identify the previous locality of residence within the national administrative structure.

An example could be of use in illustrating the need for this. A person could first reside in a municipality belonging to another province, and then in another municipality in the province where they currently reside. If asked about the previous municipality of residence, this person will appear as an intermunicipal and intraprovincial migrant, and their previous status as an interprovincial migrant will be ignored. In contrast, if the question refers to the previous province of residence, the same person will be registered as both an interprovincial and intermunicipal migrant, but with a previous municipality of residence in that province that does not correspond to the municipality of their most recent residence. If, however, the question is asked at the level of the municipality (with which the individual appears as a migrant) but the data is then grouped at the province level, the person will lose their status as an interprovincial migrant, because their previous province of residence —according to the location of the previously declared municipality— is the same as the one where they responded to the census. Hence, regrouping information when explicit reference was made to a lower administrative unit leads to the omission of migrants.

To summarize, once the degree of spatial disaggregation has been specified in the previous place of residence question (without a pre-established date), the information collected will only be fully valid at that same scale. It should be noted that, in the analysis, determining the defining place of migration is a complex issue, as already explained in chapter I. If the information is grouped together with reference to small territorial units, the subsequent analysis will be quite detailed and laborious. If, on the other hand, larger geographical units are chosen, the studies may leave out important details.

3. Estimates derived from the duration of residence question

One question that is sometimes included in population movement data collection instruments asks how long a person has resided at their current location. The information it collects allows the population to be divided into two subsets. The first comprises those people who have resided in the same place all their lives, while the second contains those who have resided in the same place for only a part of their lives. Members of the first group are non-migrants (in this case, never migrants) at the geographical scale used for the question, while those in the second group are migrants. Essentially, it involves cross-referencing the length of residence with the respondent's age.[5] Thus, if the former amounts to a lower number of years than the latter, migration has taken place. Since the question references the current place of residence, these migrants are, strictly speaking, in-migrants with respect to that

[5] In practice, this usually happens in a different way, because the people with valid values for the variable are those who respond something other than "always" to this question. Therefore, cross-referencing ages is usually not necessary to identify a respondent as a migrant, although it is necessary to determine when migration first occurred.

place. If the birthplace question is available, inquiring into the length of residence would, in theory, allow for return migration to be detected: individuals whose birthplace and place of current residence coincide but who report a current residence duration shorter than their chronological age are necessarily considered return migrants. Since the in-migrants' places of origin are unknown, this information clearly does not allow the identification of out-migrants, nor the calculation of migratory balances or the determination of migratory flows. Neither do these data lend themselves to a correct estimation of rates, and using them to assess the relative frequency of migration is impossible. While the question does contain an explicit reference to the temporal dimension, it is not specified; it is therefore usually necessary to subsequently group the data by periods.

In any case, this approach has the potential to identify migration cohorts, which are defined as groups of people who experience a given migration event within a specific period. More specifically, the data provided by this question allow the identification of cohorts of in-migrants, based on categories of current residence duration. In analysing the absolute number of in-migrants, however, the erosive impact of mortality must be taken into consideration: over time, the cohorts will experience a decrease in numbers due to this factor. This is likely to have a greater impact on older migration cohorts. The same reasoning applies to the migration of those who were migrants at some point in the past.

Finally, the fact that, over time, the population experiences vegetative growth also causes distortions. If the growth rate is positive, successive generations will be increasingly numerous. Even if the relative frequency of migration were constant over time, the number of migrants (in this case, in-migrants) would increase, especially if the rate of population increase is high. In general, these factors are responsible for the tendency of in-migrant cohorts to decrease systematically and intensely with age. For the same reason, it is not surprising that data for the years closest to the date of the census report much higher amounts than those of previous years. This limitation imposes a further restriction on the calculation of rates. In addition, since the question on the duration of residence does not determine in-migrants' places of origin, drawing distinctions among them is impossible.

In short, the information that can be derived from the duration of residence is of limited analytical use. Moreover, since there is no fixed reference period for the entire population and since places of residence change over time, data collected by means of this question are only valid if they are processed at the geographical scale to which the question explicitly refers. If the current place of residence is specified according to a given level of territorial division, the information gathered will correspond only to that level, thus cancelling the possibility of subsequent aggregation. In other words, the duration of residence question suffers from the same problems relating to the data-collection scale as the previous place of residence question.

In addition to these limitations, there are also practical constraints, such as those identified in relation to the questions analysed in previous sections. One of them, the confusion between place of residence and domicile, assumes even greater importance in this case. This problem is of particular significance. By emphasizing the duration of

residence, identifying the place of residence is relegated to the background, as it is assumed to be the same as the current place of residence. Thus, if the duration of residence in the specified territorial division is equated to the duration of residence in the current dwelling, non-migrants could be counted as migrants, since they are identified by comparing the residence duration with the individuals' ages. Finally, as is often the case with census questions in which respondents are asked about chronological time, their responses are subject to certain biases, such as preference for given digits.

4. Estimates derived from the place of residence at a specified date in the past

It is increasingly common for census and survey forms to include questions about respondents' places of residence "n" years prior. In this case, migratory status is obtained by comparing the responses with the data on the current place of residence or (for *de jure* censuses) the place where the census was taken.

The main advantage of such questions is that they contain an explicit reference period that is valid for the entire population aged "n" years and older at the time of response. The information given therefore not only provides estimates of in-migrant and out-migrant numbers and data on net migration, but also facilitates the calculation of the applicable rates. Setting an interval for migrations that is common to all respondents satisfies the requirements imposed for determining the population at risk of migration. With this, the real impact of migration on population change in each territorial division can be calculated. The advantages of this question also apply to efforts to explain migration. Once the reference period is known, estimating migratory flows becomes possible and areas that attract and expel inhabitants can be identified. Moreover, since the migration interval is clearly delimited, the problem of migrants from different periods being grouped together is overcome. This allows hypotheses about the factors possibly contributing to migration patterns to be studied. This type of approach can be made quite specific in terms of geographical disaggregation. Likewise, the availability of a reference period enables researchers to perform spatial aggregations according to different criteria. Absent in this case is the problem that affects the question about the previous place of residence (without a date) and the duration of residence: since there is a measurement that refers to a given moment (five years earlier), the places acquire an immutable quality, comparable to the situation with birthplaces.

However, asking about the place of residence at a specified earlier date is not without its difficulties. The first has to do with the length of the migratory interval. Clearly, the interval should not be too long, since the estimates obtained do not take mortality or new migrations into account. Therefore, if the reference date is long in the past, there is a greater risk of omitting movements due to migrant mortality or successive migrations. Using a very remote date also limits the usefulness of the data for explanatory analyses of migration.

Conversely, two shortcomings arise if a very close date is chosen: (i) only a small number of movements would be recorded, and they would be an unrepresentative sample;

and (ii) there would be an increased probability of including some occasional journeys that do not always imply a change of residence. There is no universal solution to this problem, although one of the conventions used in population censuses is for the question to refer to a date halfway between two successive takings. Since censuses are normally conducted every ten years, this means that the question is generally formulated as: "Where did you have your usual residence five years ago?" It is common, however, for the specific question to be worded so that it explicitly identifies a given moment. For example, for a census carried out in April 1992, the question would be: "Where did you have your usual residence in June 1987?" Another way of selecting the date to be used is to choose some event that the population can easily recall. Suitable events include natural disasters (earthquakes or hurricanes, among others), political events or any event that is deemed to have had a profound impact on the country as a whole.

The successive repetition of this question, with different reference intervals each time, can reveal migration histories containing intermediate movements that cannot be detected with a single question (for example, place of residence one year ago, place of residence two years ago, three years ago, and so on). However, such migration histories would not always reflect individuals' complete migration trajectories, since the specified dates in the past suggested above could lead to the omission of migrations taking place between them.

Another constraint is that questions regarding the place of residence on a previous set date do not allow the detection of migrations prior to that date. This may have little relevance for policy decisions because, if those movements occurred in the somewhat distant past, they probably have no implications for current policies. For the purposes of research and historical knowledge, however, it is a constraint.

This question also fails to record return migrants during the reference period. In this case, the return is not to the birthplace, but to the place of residence at the time of the census. In other words, this question is blind to pendular migration (outward and return) during the reference period, and persons who did migrate in that way are classified as non-migrants.

Those who are effectively excluded from the migration calculations are those who, on the date of the census, are younger than the duration of the reference period. However, two considerations apply to such cases. The first is that children do not generally make their own migration decisions in that their relocations are normally decided on by their parents. The second involves an attempt to resolve the problem of children aged under the "n" years of the migration interval by complementing the information on the place of residence at a specified date in the past with that of the place of birth. Questions about the place of residence on a previous set date do not normally pose the danger of that place being confused with the respondent's address, since on the date in question the persons would have been resident in some easily identifiable place. However, they are at risk from some of the problems already discussed with respect to other direct migration questions. Note should also be taken of errors that could be introduced when replies come from respondents who are not the individuals to whom the information refers. Similarly, some people may not be able to identify with certainty their places of residence "n" years ago, because of confusion or other

circumstances of —for example— a cultural nature. This risk is reduced when the question is formulated with reference to a high level of territorial disaggregation (perhaps a person can more readily identify the region where they lived five years ago rather than the municipality).

5. Estimates derived from combinations of direct questions

It is not uncommon for census or survey questionnaires to contain more than one question directly related to migration. As explained above, while each one can provide specific and different estimates of migration, certain combinations exist that can increase the usefulness of the information. One interesting example, already referred to, involves correlating the questions on the previous place of residence and the duration of current residence: this combination is powerful and has been called a "tandem" or "dual" question, in light of the uselessness of asking both questions separately (United Nations, 2008). Additionally, as explained above, under hypothetical circumstances of perfect respondent memory and unlimited census form space, a series of questions on the duration of residence, together with inquiries into the place of residence, would enable the reconstruction of individuals' migration trajectories.

However, the potential of combining questions about previous places of residence and the duration of current residence can be misleading (United Nations, 2008; CELADE/PROLAP, 1997; Villa, 1991). Because of the problems affecting these questions, the migrant numbers will be skewed over time. The contributing factors include the erosion of migratory cohorts, which exaggerates the relative incidence of the most recent migration and underestimates the importance of changes of residence that occurred in previous periods. These distortions are heightened because the two questions emphasize the detection of the most recent movement and ignore other relocations that might have occurred. Thus, mortality, the population growth rate and the repetitive nature of migration would affect the quality of the information obtained from combining the two questions' results.

Moreover, since the reference time varies from person to person, any migration matrix based on this information could entail the misidentification of migrants' places of origin and, by definition, will be uncertain with respect to the place of origin. The most recent relocation may have been from a place other than the one the respondent reported at the beginning of the reference period when the years of residence are grouped together and the last residence is assigned to that year.[6] This problem is exacerbated by the fact that the two questions used in the combination require the prior specification of the location that defines migration. A subsequent decision to perform a spatial aggregation of the data would entail

[6] For example, if a matrix is constructed with all the people reporting less than five years of residence, their places of origin displayed in the matrix will not correspond to those five years, but to each person's time of residence. On that basis it would be assumed that the place where people lived "n" years before the census (with "n" being less than five) is the same as where they resided five years before the census (which is impossible to know). Several other problems must be added to this, such as the shrinkage of migratory cohorts due to mortality and consecutive or return migrations, and time of residence rounding problems, similar to those that affect age reporting.

the risk of invalidating the information —at least partially— since some past movements would be omitted. This means that combining them is only possible when the duration of residence question refers to the same territorial levels as used to determine the previous place of residence. In addition, the analysis of the data must be kept on the scale used to collect the information. It should also be noted that the length of time each person is exposed to the risk of migration will be different, even if the periods are nominally identical. This is because for each person, only the time derived from his or her last migration will be valid. From a technical point of view, therefore, it would be inappropriate to estimate the average population over the period, since it is impossible to know with certainty where a person was at a date or time common to all individuals.

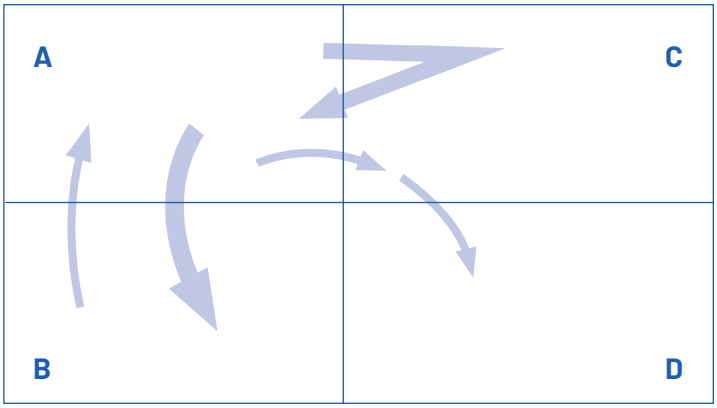
Other possible combinations of direct questions on internal migration also exist. If the data provided by the previous place of residence question are compared to those derived from birthplace question, and if both sets are free of errors, the difference between the two values indicates the amount of return migration. This comparison requires that the same geographical scale be used and that, as has been repeatedly stated, the place of residence be identified according to the same degree of spatial disaggregation. Absent those conditions, the margin of error can be considerable.

Combining data from the birthplace question and the question on the place of residence at a specified date in the past is of greater interest. This enables a comparison between recent and absolute migration patterns, as well as the definition of certain categories of migrants (primary, secondary, return, old or recent). Since both questions allow for territorial aggregations of information without requiring prior specification of the defining place of migration, it should be remembered that estimates can be made with reference to different orders of spatial division.

In short, recording and describing people's migratory trajectories using censuses is impossible, due to the complexity and repetitive nature of the migration phenomenon. Diagram II.1 is based on only two or three movements: in other words, a simple situation compared to a complete migration history. It presents three cases that illustrate the complexities of measuring migration with backward-looking questions. It assumes changes of residence with respect to the major civil division of birth (absolute or lifetime migration), where A, B, C and D are a country's four major civil divisions. First, there is B-A migration, which represents a direct shift between major civil division B and major civil division A that is fully detectable with the birthplace question. This case corresponds to an absolute or lifelong migrant between major civil divisions, who would be an in-migrant in A and an out-migrant from B. Second comes the A-C-A displacement, which represents return migration to the major civil division of birth; thus, it would not be detected through the birthplace question, although it sometimes could be by means of other questions (certainly the previous place of residence question) or in combination with other questions. The third possibility is A-C-D multiple migration which would be detected by the birthplace question, but as direct movement from A to D. The intermediate step through C —that is, the migration from A to C, and then the migration from C to D— would be lost. Of course, those relocations could be detected using other questions (at least in part), especially inquiries regarding previous

places of residence, which, assuming there are no errors in the field, would certainly allow the detection of migration between C and D. In conclusion, the identification of people's migration trajectories using census data is very limited, so all census results should be read as indicating the minimum number of migrations actually carried out.

■ Diagram II.1
Migratory flows between the beginning and the end of the five-year period



Source: J. I. Rigotti, "Información de los censos demográficos del Brasil sobre migraciones internas: críticas y sugerencias para el análisis", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2009.

6. Comparative overview of the migration module in Latin America's 2000, 2010 and 2020 censuses

- In general, and in line with international suggestions, questions about current and previous residence follow common parameters and structures, which facilitates their combined use to detect migrants. The exceptions to this pattern include the censuses of Argentina and Mexico, in both cases due to a greater degree of territorial disaggregation in the questions on residence at a specified date in the past than in the birthplace question.
- Most of the countries that conduct *de jure* censuses used minor civil divisions as the geographical entity with the highest territorial disaggregation for determining previous residence: Brazil (municipality), Colombia (municipality), Costa Rica (although "canton or place" is used, something similar to the Chilean experience occurred and "canton" prevailed), Cuba (municipality), El Salvador (head town or canton), Guatemala (municipality), Haiti (communal section), Mexico (municipality), Nicaragua (municipality), the Dominican Republic (municipality) and the Bolivarian Republic of Venezuela (municipality). In the Honduran *de jure* census, the category "village, town or city" (in other words, locality) was used to inquire into the place of residence five years earlier and "municipality" was used for the birthplace question.

- Further to the prevalence of the use of minor civil divisions as the most geographically disaggregated entity, an exploration of the microdatabases suggests that in only a couple of the six countries that inquired about localities was that information actually coded and used. The most successful case in this regard seems to be Panama, which combines a powerful census history and culture, limited demographic and geographical size and, probably, a complete and efficient nomenclature of inhabited settlements. Panama has also produced direct estimates of rural-urban migration, using localities of usual and previous residence. In contrast, there are some particularly frustrating cases of the use of this scale, such as Argentina and the Plurinational State of Bolivia, where it literally seems to have been lost. In the case of Honduras, it is not clear whether this information was used or not.
- It should be noted that this does not mean that the countries have given up on identifying displacements within minor civil divisions. In fact, and as will be seen below, several have done just that, but using a question to differentiate between the types of environment (usually the urban-rural distinction) in the minor civil divisions of usual and previous residence.
- Those censuses that used localities as the most disaggregated entity of previous residence tended to use different procedures to determine them in territorial terms. In some cases, such as Argentina, the province was used as the framework for registration and, within it, freedom (and subjectivity) was given for individual decisions on the concept of locality. In others, such as the Plurinational State of Bolivia and El Salvador, the expression "here" was used: a very risky choice because its interpretation is discretionary, as explained in the following section. Honduras and Panama used apparently precise references, as noted above (village, town or city, and place or populated place, respectively). Virtually all the countries included birthplace questions, mainly because of their usefulness in detecting international migration. Less than half of the countries —Chile, Costa Rica, Cuba, Colombia (which included both methods), Nicaragua, Panama, Paraguay and Peru— followed the recommendation to ask for the mother's usual residence at the time of birth. Although this question sounds more complex, the results have been satisfactory.
- Given the choice between the coupling of "time of residence" and "place of previous residence", on the one hand, and "residence at a specified previous date", most of the countries (15) opted only for the latter. Three countries exclusively used the "time of residence and place of previous residence" tandem while another included both.[7]
- In most of the censuses in which residence at a specified date in the past was used, the question included a fixed time (typically, the reference month).
- In one of the censuses in which time of residence was used (Panama), the response was divided into three categories and not into single years.

[7] There is one case (Ecuador) in which a question about the time of residence was asked, but not about the previous place of residence corresponding to that time of residence. It is therefore not included among the three cases in which the "time of residence plus place of previous residence" tandem was used.

- The logic followed when the "time of residence plus place of previous residence" tandem was used varied from country to country, since in two cases (Cuba and El Salvador) the time question came first (Cuba: "Have you always lived in this municipality?"; El Salvador: "Since when have you lived here?"), with the geographical question following. Meanwhile, in the other case, the geographical inquiry preceded the time question (Panama: "Where did you live before coming here?").[8] Whatever the case, in these three countries (four, if Brazil is included) "never migrants" can be identified (they have always lived in the place of residence, since all these censuses are *de jure*).
- The broad predominance of questions about the respondent's place of residence at a specified date in the past is not an insignificant finding, and neither is the use of minor civil divisions as the most disaggregated current (*de facto* censuses) and previous geographical entities of residence. Also significant is the wide use that has been made of this information in the analysis and design of public policies, as well as in the creation of innovative products such as the Internal Migration in Latin America and the Caribbean (MIALC) database. Accordingly, and taking a position on the issue, given the alternatives outlined above, the option of a known and successful question (place of residence at a specified date in the past) would appear to have an advantage. Moreover, it can be expanded on by including two specified dates in the past instead of just one (five years before the census and an intermediate date, such as two years), as suggested in the United Nations handbook (United Nations, 2008).

D. Main operational problems in using censuses to determine internal migration[9]

A review of the region's experiences in the 2000 and 2010 census rounds (at the time of writing, the only data from the 2020 census round available was that of Mexico) yields the following conclusions regarding problems and weaknesses (errors, confusions, dangers and so on) in connection with questions about places of previous residence (and current residence in the case of *de facto* censuses):[10]

- The traditional indicators for the quality of the information gleaned from the questions cover non-responses and misclassifications. In general, the number of non-response

8 The case of Brazil should be added to that of Panama, although this could be debatable due to the peculiarities of the Brazilian migration module. Whatever the case, the module's opening question is: "Have you lived in this municipality ever since you were born?" and then a couple of questions, at the least, are asked about length of residence.

9 This section is based on Economic Commission for Latin America and the Caribbean (ECLAC), "Los datos demográficos: alcances, limitaciones y métodos de evaluación", *Manuals series*, No. 82 (LC/L.3906), Santiago, 2014.

10 It should be noted that this is not about the detection problems and limitations of individual questions, which are of a theoretical or logical nature and are well described in the literature and in the previous pages of this text.

cases is low, since only a couple of countries —out of the eight with data available from the 2010 census round— exceed 2% in their birthplace questions (Dominican Republic and Uruguay), while the omission rate for questions on specified dates in the past is even lower (see table II.3). The fact that several countries report no cases of non-responses suggests imputation, which is debatable. In the absence of solid elements for this operation, the most plausible scenario is that the birthplace was imputed to be the place of residence or the place where the census was taken. In general, the highest percentages of non-response cases are recorded when current (*de facto* censuses) and previous residences are registered at the locality level, which is reasonable because of the inaccuracies and ambiguities that underlie the concept of localities, as described above.

■ Table II.3
Latin America (8 countries): percentage of omissions in basic internal migration questions, 2010 round censuses
(Percentages)

Country and census year	Percentage of non-responses at the most disaggregated geographical level		
	Residence on set date	Place of previous residence	Time of current residence
Brazil, 2010	0.5	0.4	n/a (*de jure* census)
Costa Rica, 2011	0.0	0.0	n/a (*de jure* census)
Dominican Republic, 2012	1.1	2.4	n/a (*de jure* census)
Ecuador, 2010	0.1	0.0	0.0
Mexico, 2010	0.0	0.0	n/a (*de jure* census)
Panama, 2010	0.0	0.3	0.2
Uruguay, 2011	0.0	3.7	n/a (*de jure* census)
Venezuela (Bolivarian Republic of), 2011	0.0	0.6	n/a (*de jure* census)

Source: Prepared by the author.
Note: n/a = not applicable.

- A detailed examination of the questions reveals errors and inconsistencies of various types, although these are generally infrequent. Notable among the errors are cases of invalid or non-existent codes (for example, when code 513 is given as the previous residence and no place with that code exists). In general, these are typing errors (in other words, clerical errors), and so a careful preliminary review of the database would correct them. These inconsistencies include the incorrect classification of cases as "not applicable", or contradictions between the codes used to identify major and minor civil divisions (for example, when the residence on a specified date in the past is given as a minor division that does not belong to the major division declared in response to the same question; or if a respondent declares that five years ago he lived in another state, but in the same municipality). Admittedly, this problem may arise from changes in the territory's political-administrative structure.

- One potentially serious problem, in countries that have changed the political-administrative structure of their territories, is that of fictitious migration. This problem originates in the field and is therefore virtually impossible to correct once back in the office. It was well documented in the migratory flows between communes in the Greater Santiago Metropolitan Area of Chile following the far-reaching restructuring of its civil divisions (Rodríguez, 2007).[11] Because of those changes, when naming the commune in which they lived before —the question used to identify the place of residence at an earlier set date in the 1992 Chilean census— many respondents gave the name of the old commune that existed at that time, and not the name of the new commune (distinct from the old one) where they actually lived before and were still living at the time of the census. Those people were therefore classified as migrants between communes when they were actually not. Starting the census by inquiring as to whether the person resided in the same dwelling five years earlier could be a solution to such cases of fictitious migrants (although no country in the region includes such a question, it does appear, for example, in the census of the United States).
- One possibly significant error can arise because of different civil divisions that share names. This problem also originates in the field and is therefore virtually impossible to correct in the office. The solution is not trivial and involves the preparation phase of the census and, in particular, special training for the census-takers and outreach and information campaigns for census respondents. The best example of this problem is when a city, a minor civil division and a major civil division share the same name, as occurs with the capital cities of many of the region's countries.[12] In this case, fictitious migrants from the minor civil division of the same name have been detected, particularly in the case of people migrating out of the city and the major civil division of the same name. This is due to the fact that outside the city and the homonymous major civil division, the component minor civil divisions of the city are less familiar; therefore, there will be a tendency to record as the minor civil division of previous residence the one that shares the name of the city, since the city is the place and name that enjoys the greatest recognition in the rest of the country. This risk clearly increases if informants answer census questions, since there is a greater chance that they do not know the minor civil divisions of previous residence but do know the city and, therefore, the one that bears the name of that city is recorded as the minor division of origin (or of previous residence). This problem is obviated or minimized in intrametropolitan migrations, because the inhabitants and the census takers understand the city's political-administrative territorial structure; additionally, it does not make much sense to mention the city

[11] Several of the 16 communes that made up Santiago in 1970 were subdivided, to produce a total of 34 communes in 1982.

[12] For example, in Peru: city of Lima, District of Lima (minor civil division), Province of Lima (major civil division); in Chile: city of Santiago, Commune of Santiago (minor civil division), Santiago Metropolitan Region (major civil division); in Brazil: city of Rio de Janeiro, Municipality of Rio de Janeiro and State of Rio de Janeiro; in Costa Rica: city of San José, Canton of San José and Province of San José.

as the place of previous residence if the person continues to live there. The case of Santiago is eloquent with respect to this problem, as shown in table II.4. The Commune of Santiago reported significant levels of out-migration in the last four censuses, but it is clear that the censuses (and the surveys) overestimate the net figure by a wide margin. If the recorded figures were real, the commune would have been depopulated by now. Worse still, because of this problem, the census results do not record the migratory change that this commune has experienced as a result of its renovation and repopulation programme, which has been quite successful in terms of residential construction (and which, in any case, has not been without problems). The 2002 census does indicate the change in the migration profile of this commune when only intrametropolitan migration is considered: a type of migration that, as noted above, is shielded from this problem.

■ Table II.4
Commune of Santiago (Chile): population and recent migration (five years ago) indicators by type, 1982, 1992 and 2002
(Number of persons counted)

	Total resident population	Average population (obtained from the matrix, five years or more)	Total migratory balance	Migratory balance with the rest of the GSMA	Migratory balance with the nearby periphery	Migratory balance with the distant periphery
2002	200 792	245 195	-111 747	-7 952	-3 863	-99 932
1992	230 977	241 987	-111 288	-54 947	-3 232	-53 109
1982	232 667	276 807	-105 962	-72 721	-3 785	-29 456

Source: Prepared by the author.
Note: GSMA = Greater Santiago Metropolitan Area.

- The use of "here" or similar expressions ("in this place") in *de facto* censuses can lead to errors. The temptation exists to use responses of that type as a synonym for non-migrant. However, someone who answers "here" to the previous place of residence question could be a migrant if they reside in a place other than where the census is being taken. The case of the 2001 Argentine census illustrates this (see table II.5). Some of the 30,373,183 individuals who answered that they "resided in this locality or place" five years earlier could be migrants and could, in fact, have been identified by asking about usual residence. The same reasoning warns against deeming that the 1,164,703 people who answered that five years ago they lived in the same province, but in another locality or place, are necessarily intraprovincial migrants. Incidentally, this caveat can be extended to all the other cases shown on table II.5. The general conclusion is that migrant status must always be inferred from a comparison between the current and previous places of residence. In *de facto* censuses, failure to follow this rule generates estimation errors.

■ Table II.5
Argentina: population by place of residence five years before the census and broad age groups, 2001
(Number of persons counted)

Where did you live five years ago?	Broad age groups			
	0 to 14 years	15 to 64 years	65 years or more	Total
1. This locality or place	6 422 933	20 531 584	3 418 666	30 373 183
2. This province, but in another locality or place	247 932	838 915	77 856	1 164 703
3. Another province	200 297	905 407	83 921	1 189 625
4. Another country	27 255	148 909	7 177	183 341
5. Not yet born	3 349 278	–	–	3 349 278
Total	10 247 695	22 424 815	3 587 620	36 260 130

Source: Special processing of census microdata from Argentina, 2001.

- At least four of the region's countries have used a question on the minor civil division of usual and previous residence to directly estimate rural-urban migration: Brazil (2000, but not in 2010), Cuba (2012, but not in 2002), Nicaragua, Paraguay and the Dominican Republic.[13] In some cases, the question was linked to the birthplace and place of residence five years prior and, in others, to only the latter query. Associating it solely with the question regarding the place of residence five years earlier is better, due to the problems involved in determining urban or rural conditions on remote dates. Table II.6 shows a summary of the results obtained. The data show that the most congruent results were obtained in those countries, such as Brazil, that chose the apparently less ideal question: the one that places the burden of determining the urban or rural nature of the previous place of residence on the census respondents. Two of the countries that used objective classifications of urban/rural status in their questions (Nicaragua and Paraguay) yielded either very high estimates of rural-to-urban net migration (Nicaragua) or clear underestimates (Paraguay, which registered an impossible level of net urban out-migration). In the case of the Dominican Republic, the results showed very high non-response rates, so this information appears not to have been used. Table II.6 includes the case of Panama, which is the best example of direct estimation based on the locality scale. It should be noted that the usual wording of the question prevents the detection of inter-urban or intra-rural movements within a single minor civil division, with the exception of Panama, because it records information at the locality level. Again, starting with a question on the place of residence five years ago would enable the detection of cases of or data on intra-urban or intra-rural migration within a single minor civil division.

[13] Other countries —such as Colombia, Ecuador and the Plurinational State of Bolivia— that distinguish between rural and urban areas by disaggregating the question on prior and usual residence should be included in this case. However, the results of this procedure, while formally correct, are not satisfactory, at least in the case of Ecuador, since some areas are defined as rural parishes but are in fact completely urban.

■ Table II.6
Latin America (four countries): direct estimates of recent migrations between urban and rural areas among the population aged five years and older, 2000 census round

Country and census	Area of current residence	Area of residence five years prior		
		Non-migrants at the minor civil division level	15 to 64 years	65 years or more
Brazil, 2000	Urban	111 027 460	10 775 021	3 244 288
	Rural	24 965 713	2 168 599	1 161 891
Nicaragua, 2005	Urban	2 109 103	67 567	338 008
	Rural	1 744 706	119 443	64 210
Panama, 2000	Urban	1 297 825	152 089	74 836
	Rural	832 551	40 798	29 741
Paraguay, 2002	Urban	2 175 943	248 014	31 361
	Rural	1 734 786	91 592	53 867

Source: Prepared by the author, on the basis of special processing of census microdata.

- The existence of expected patterns in migrating probabilities can be used to evaluate the results of migration questions in censuses. The most stable among those patterns is the one that exists between age and the probability of migrating, to the point that model tables of that relationship have been developed (Bernard, 2022; Rogers and Castro, 1981). Other typical patterns are found in Latin America, such as higher migration intensity among unmarried persons, or increased migration intensity with education, but the parameters of those patterns are not well established. Moreover, there are countries that do not follow the patterns. In any case, their use only allows an evaluation of the census information collected and they cannot be easily used to correct or adjust that information.
- Finally, a question on reasons for migrating was used in only two countries in the 2000 round (Colombia and Mexico). Both cases used a pre-coded question, although in Mexico it addressed changes from one state to another over the past five years and, in Colombia, the most recent relocation during the past five years. The results on table II.7 show that the question seems to discriminate correctly, by explicitly differentiating the reasons for migrations from the Federal District and the State of Mexico, on the one hand, and from the remaining states, on the other. Employment is clearly a secondary motivation in the Federal District and the State of Mexico, which was predictable. However, the same results are eloquent regarding the weakness of the question, which records very high rates of "other reasons" and "not specified".

■ Table II.7

Mexico (Federal District, State of Mexico and other states): relative distribution of replies to the question on reasons for migration, 2000 census

Migration from	Went to look for work	Went to join family	Change of workplace	Went to study	Married or started a partnership	Health reasons	Because of violence or insecurity	Other reasons	Not specified
Federal District	4.5	13.8	6.9	1.2	6.5	2.6	4.6	28.3	31.7
State of Mexico	10.0	17.4	8.6	2.0	6.0	2.4	3.1	15.2	35.4
Other states	22.1	20.3	9.4	4.6	4.6	1.2	0.6	8.4	28.7

Source: Prepared by the author, on the basis of special processing of census microdata, Mexico 2000.

Chapter III
Measuring the intensity of internal migration

Two main elements provide the structure for the extensive and diverse range of metrics used for internal migration. The breadth of that range is markedly different from the limited set of universal and standardized indicators used to quantify mortality rates and birth or fertility rates.

The first element is the entity of reference used for the measurement. Here, the contrast is between individual or population measurements and territorial measurements. This element is also used for mortality and fertility rates and gives rise to different metrics: notably, what are known as "gross" rates, which indicate the relative frequency of the event with respect to a given population, and those known as "individual" rates, which quantify the relative frequency of the phenomenon —or, in the case of mortality, its timing— at the individual level. When these measurements are calculated for average individuals —the case of total fertility rates and life expectancy rates, for example— they are extended to populations and territories. Thus, for both fertility and mortality variables, these individual metrics can be used to indicate the intensity of the phenomenon in given territories (continents, countries, municipalities) and to establish direct orderings and hierarchies among them. These indicators also control for distortions arising from the age structures of the populations and territories included in the comparison.

In the case of internal migration, individual metrics often differ from territorial ones since, as will be explained below, the latter have specific expressions that are highly dependent on the information sources used. Furthermore, direct comparisons between territorial measurements, including national ones, are very limited: not only because of age structure factors that also affect birth and mortality indicators, but also because of what is known as the modifiable areal unit problem (MAUP), as discussed below.

In both cases (individual or population measurements, and territorial measurements), the basic rule for determining migration applies: that is, the geographical and temporal qualifiers must be specified. Now, when intensity is the focus of study, these indicators require a temporal qualifier that defines a time of exposure to the risk. The alternatives are useless without a common, specified temporal dimension. For this reason, in the census measurements that are this book's central concern, intensity is calculated exclusively with respect to the temporal qualifier known as the "specified date in the past".

The second structuring element, as already noted, is the availability of data sources. This is due to the fact that recording the demographic event of "migration" is not only more complex, but also that most countries lack permanent devices for recording the phenomenon, which means that other sources and procedures must be used.

As for measurements of migration intensity themselves, at the individual level, migration intensity corresponds to the number of migrations experienced by a given person. However, knowing the data of a particular person is not usually of interest: the focus is generally on a group of people, a subgroup of the population or a specific population. In this way, an indicator of intensity among the population is obtained, which is quantified by means of some metric that is representative of the group: usually, the average number of migrations per person during a period of time or over the course of their lifetime.

Since migration is a repeatable event (and, in that, resembles fertility or marriage, and is distinct from the single-occurrence events of mortality, first marriage and first child), the indicator must allow values greater than 1 for a given population.

At the same time, and in an analogous way to the live births indicator used to examine fertility (number of a woman's live-born children or average number of live-born children among a group of women), migration can be measured longitudinally as the number of migrations accumulated by an initial population divided by that initial population. Similarly, in cross-cutting terms, it can be measured, by means of an index similar to the total fertility rate, as the sum of migration rates by age. Both cases can be calculated for population subgroups —by sex, age or educational level, for example— which allows their migration intensities to be compared.

In Latin America, however, calculating those measurements is difficult because, as explained above, there are no mechanisms to count all the migrations that individuals undertake. Thus, the measurements available for determining the intensity of migration in the region only detect one migratory movement; therefore, they only distinguish between migrants and non-migrants and cannot count total migrations. In this case, the probability of being a migrant in the reference period becomes the measure of individual and population intensity. Frequently, only an approximation of this probability is available, given as the percentage of migrants in the reference period within a population (country) or subpopulation (either territorial or sociodemographic).

Population-based metrics, such as the average number of migrations of a group (for example, men or women) or the percentages of migrants over a reference period within a group (for example, age groups), take on a special meaning when the group corresponds to a territory, be it national or subnational.

Recording a territory's migrations allows the relative frequency or intensity of internal migration to be calculated by dividing the territory's average population by the number of migrations: this indicator is called the crude migration rate (CMR) or crude migration intensity (CMI). When only the percentage of migrants is available as a population indicator, this percentage at the territorial scale becomes the crude migration rate or crude migration intensity. As noted above and examined again below, these measurements can be affected by extrinsic variables that go beyond the population structure and are related to how countries are divided geographically.

Before explaining this indicator, it must be clarified that internal migration intensity is different from the growth effect. By definition, internal migration intensity refers to migratory exchanges within a given territory, occurring between subdivisions of that territory. Its effect on growth is therefore zero by definition. The growth effect comes from migratory exchanges between a territory (A) and other territories (B, C, D and so on) that generate territory A's in-migrants and out-migrants.

However, a territory's migration intensity is often referred to in terms of its exchanges with other territories, which is technically an error. Nevertheless, it does make sense to quantify the migration intensity of a territory's migratory exchanges with other territories. The migration effectiveness index is sometimes used for that purpose. This is not the optimal method, however, because the denominator does not consider the at-risk population, but rather gross migration. Therefore, the only possible indication of the intensity of a territory's migratory exchange must be obtained by using gross migration as the numerator and the population exposed to the risk (average population) as the denominator. Net migration must never be used to that end. Net migration serves a different purpose: to detect the growth effect, as will be discussed later.

Returning to the crude migration rate (CMR or, as noted above, also CMI), it is calculated by dividing the average national population during the reference period by the number of internal migrants over that period. The formula is:

$$CMR^{t,t+n} = \frac{1}{n} * \frac{M^{t,t+n}}{NM^{t,t+n}} * 1\,000 \qquad (1)$$

Where:

CMR = Crude migration rate for the observation or reference period (t, $t+n$).

M = Internal migrants over the reference period (t, $t+n$).

NM = Average population for the period (t, $t+n$).

n = Observation or reference period.

When working with censuses and at the scale of a country or subnational territory, the only migrants reported are those who move among its corresponding territorial subentities. In this case, the quotient yielded by dividing the total population of the matrix by that total becomes the crude migration rate (or intensity); this point will be taken up later when Courgeau's k is explained and the territorial redistributive effect of internal migration is analysed.

One author who has done a vast amount of work on measuring internal migration on the global scale is Martin Bell of the University of Queensland in Australia. Since the beginning of the century, he has published several articles in which he systematizes definitions of those measurements and formalizes their calculation. In his most recent documents, he offers a compendium of more than 30 measurements for analysing different parameters: (i) migration intensity; (ii) migratory distance; (iii) migratory connectivity; and (iv) migration impact. For migration intensity, he proposes the following measurements (see the corresponding formulas in box II.1):

(i) Crude migration intensity (CMI): Identical to the crude migration rate, with the weighting constant k set at 100 (although 1,000 can also be used, as in crude birth and death rates). Note that it can be calculated using either migrants or migrations although, as noted above, the use of migrants will necessarily underestimate the rate's value. It should also be noted that if migrant numbers are obtained from a question about a previous set date in a census or survey, the rate is actually a percentage and, in any case, must be expressed on an annualized basis; it must therefore be divided by the length of the reference period.

(ii) Standardized migration intensity: A measurement that attempts to control for the effect of the age structure on crude migration intensity (or other variables, but it is clear that migration intensity changes with age and sex, and so age and sex structures exogenously affect crude migration intensity). To avoid this distortion, a standard (in other words common) population, disaggregated by age and sex, is adopted, to which the age- and sex-specific migration rates are applied to obtain the number of migrations that would occur in the country if it had the standard age structure. Its calculation is the sum of expected migrations by age and sex (the product of the rates observed by age and sex and the standard population by age and sex), divided by the sum of the standard population by age and sex (population exposed to the total risk: normally the average population over the period of the observed rates).

(iii) Gross migraproduction rate: This is comparable to the total fertility rate, since it is calculated as the sum of the age-specific migration rates (it can be broken down by sex, if age and sex rates are available, in order to obtain separate indicators for men and women). It can therefore be interpreted as the average number of migrations that a person (a man or a woman, if broken down by sex) would experience during their lifetime if exposed to the age-specific migration rates of a given year.[1] If these rates are calculated by simple age, the sum is enough to obtain the indicator. If the rates correspond to age groups, the sum should be multiplied by the interval of the groups (similar to the weighting performed in the case of the total fertility rate when specific five-year fertility rates are added). It is a communicative measure, but it is highly sensitive to the ages at which the sum starts and ends, due to the assumption of no

[1] For this same reason, some authors call this indicator the "synthetic migration index" (SMI), by analogy with the French expression *indice synthétique de fécondité* used for the total fertility rate calculated in this way (Recaño, 2010).

mortality in the exposure period (in other words, between alpha and omega, in terms of the life table). The assumption of constant migration rates by age for the reference period must also be added to this assumption.

(iv) Migration expectancy: Equal to the net reproduction rate, but in relation to the number of migrations expected on average for individuals. In other words, it is the crude migration rate adjusted or weighted by the age-specific mortality pattern. It indicates the average number of migrations a person would have over the course of their lifetime if exposed to the age-specific migration and age-specific mortality (Ly/lx) rates for a given year. Its calculation requires an appropriate life table.

(v) Peak migration intensity and age at peak migration intensity: Finally, two measurements that indicate the structure of migration rates by age. They are similar to the concepts of peak fertility and age at peak fertility.

■ Box III.1

Measurements of individual and population migration intensity

Standardized migration intensity

$$SMI = 100 \left\{ \frac{(\sum_{x} \sum_{s} m_{xs} P_{xs})}{(\sum_{x} \sum_{s} P_{xs})} \right\} \quad (2)$$

Gross migration rate

$$GMR = \sum_{xs} m_{xs} \quad (3)$$

Migration expectancy

$$ME_x = \frac{\left[\sum_{y=x}^{y=z} m_y L_y \right]}{l_x} \quad (4)$$

Source: M. Bell, P. Rees and T. Wilson, "Comparing internal migration between countries: Who collects what?", *Discussion Paper*, No. 2003/05, Queensland Centre for Population Research School of Geography, Planning and Architecture, University of Queensland, 2003.

Finally, some authors have proposed constructing "migrability" tables —similar to life tables, in which the loss of people is due to the fact that they migrated— in order to estimate the probability of a first migration being made between certain ages. The idea is to use the observed age-specific migration rates and transform them into migration probabilities, as is done with life tables, using formula (5):

$$ex,\ x + n = \frac{(2 * n * mx,x+n)}{(2+n*mx.x+n)} \quad (5)$$

The synthetic migration intensity indicator derived from the table represents the probability of migrating across all ages for a member of the fictitious cohort. It can be calculated as the sum of the migrations on the table by subtracting those who remain sedentary (non-migrants) at the end from the initial cohort members, as shown in equation (3):

$$[G–S\omega]^{\square} = \Sigma_{k=0}^{\omega} M_{x,x+n} \qquad (6)$$

Moving on, one significant but virtually unsolvable problem for the measurement of individual migration intensity is the "modifiable areal unit problem" (Bell, Rees and Wilson, 2003, p. 9). In establishing comparisons of migration intensity between countries on the basis of their national results (regardless of the source), obstacles —if not impediments— arise from differences in the number of areas used in the calculations, and that figure depends on national characteristics and definitions exogenous to the researcher. The number cannot be changed at the data processing stage, except in exceptional circumstances, such as when the current residence and previous residences up to the dwelling level are available (for example, by address or geographical coordinates).

The problem is that just as a relationship exists between the propensity to move and distance, there is also a relationship between the level of mobility and the number of areas into which a territory is divided. Thus, with a more disaggregated spatial grid, a greater number of migrations will be detected and, therefore, the migration intensity obtained will also be greater.

Several solutions have been offered to make international comparisons of migration intensity possible. One first practical —but neither complete nor definitive— solution is to ask about the dwelling (or address) of previous residence instead of the locality (the municipality or, in some censuses, some even larger territorial level) of previous residence. This removes the civil divisions from the calculation, placing all countries on an initial equal footing for comparison. Although few censuses ask the question in these terms, the fact that some do (such as those of the United States) indicates that it is a feasible option. Clearly, this option would no longer use the official definition of migration, since without the requirement of crossing a political-administrative boundary, any change of residence would be considered a migration.

As a potential solution to this problem, Bell and Muhidin (2009) suggest the use of the measurement known as Courgeau's k, which offers an alternative metric for comparing aggregate individual migration intensities. Courgeau (1973) uses the formula CMI = k ln (n^2) in an attempt to record this relationship by means of a simple equation that makes migration intensity depend on the natural logarithm of the square of the number of regions (geographical-administrative entities) used in the calculation. The calculation of Courgeau's k requires data on migration intensity by several levels of geographical disaggregation (several geographical-administrative hierarchies). These data are plotted in a point cloud, which is adjusted by linear regression. Obviously, this intensity can be expected to increase as the number of entities used in the calculation rises. The slope of this linear regression is exactly the parameter k. The values of k are directly comparable from one country to another. Higher values of k

—which is to say steeper regression line slopes— indicate greater migration intensities. In fact, k is directly scalable, such that a value of 2k indicates an underlying migration intensity that is twice that of k.

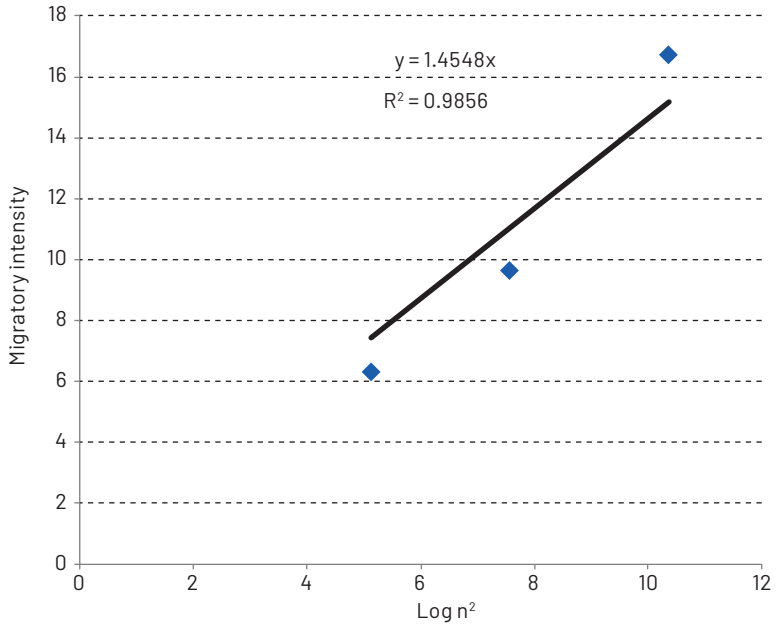
Before showing a concrete example, it should be pointed out that this measurement has several limitations. First, the available point cloud usually comprises very few observations: in general, no more than five, since it is difficult for censuses to register information on places of previous residence with a level of disaggregation that allows for the construction of more than five geographical levels. In fact, quite often they only record information on two classes of geographical-administrative entities: major civil divisions and minor civil divisions. This shortcoming raises doubts about the robustness and confidence of the adjustment line. Second, the value of Courgeau's k is neither intuitive nor does it offer an intrinsic interpretation. As an indicator it is cryptic, and its possible contributions are constrained to international comparisons of migration intensity. Finally, counting the number of geographical units is insufficient to control for differences between them, particularly in terms of size or demographic weight. These differences certainly exert an exogenous effect on the probability of emigrating, since, for example, larger territorial divisions imply higher travel costs to leave and, at the same time, a greater number of internal movements that cannot be detected if those divisions are used as the most disaggregated entity in which migration is measured.

Courgeau proposed this measurement in the early 1970s and, for a long time, it went almost unnoticed. There has been a recent upswing it its use, however, on account of the growing possibility of calculating gross migration intensity in different countries of the world afforded by increased access to census microdata. In fact, it has been used in the most recent worldwide comparative studies (Bell and Charles-Edwards, 2013).

Figures III.1 and III.2 show the method used to obtain Courgeau's k, using as examples the case of Chile in 2002 (data from Bell and Charles-Edwards, 2013) and Peru in 2017. Both countries have three observations of migratory intensity, since their censuses inquire about (or can construct) migrations between major, intermediate and minor civil divisions. For both countries, the crude migration rate was calculated using censuses, as previously indicated, for these three geographical levels: regions (13), provinces (44) and groupings of municipalities (178) in Chile in 2002, and departments, provinces and districts in Peru in 2017. The straight line that adjusts these values has a slope with a value of 1.458, which corresponds to Courgeau's k (with a goodness of fit of 89%) and of 0.796 in the case of Peru. This suggests that migration intensity in Chile in 2002 was approximately double that of Peru in 2017, once the differences between the two countries' political-administrative structures are controlled for.

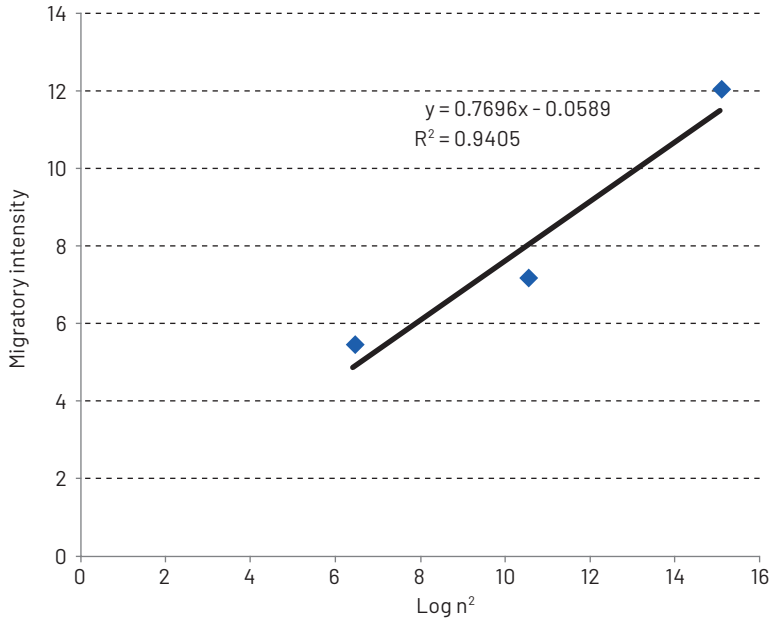
More recently, Courgeau's k was reviewed by the author and Martin Bell and his team in 2015 and then applied in a number of global studies. The new approach is basically intended to achieve two goals: (i) to give the measurement an intrinsic value or interpretation; and (ii) to take advantage of new technologies to handle the modifiable areal unit problem in a more detailed way.

■ Figure III.1
Chile: calculation of Courgeau's k, 2002



Source: M. Bell and E. Charles-Edwards, "Cross-national comparisons of internal migration: an update on global patterns and trends", *Technical Paper*, No. 2013/1, New York, United Nations, 2013.

■ Figure III.2
Peru: calculation of Courgeau's k, 2017



Source: Prepared by the author, on the basis of special processing of census microdata.

The first goal is achieved by changing the variable n (number of territorial entities) for the quotient yielded by dividing the number of households by the number of zones at each spatial level. Since the number of households is a constant (H), this variable changes according to the number of zones. It starts with small values (which, of course, vary from one country to another according to population figures and the number of administrative zones) because at the first political-administrative level the total population is divided among a few zones, but it increases with disaggregation as the population is divided among more zones. At the limit it takes on a value of 1, which means that each person in the population lives in their own area: this is impossible, but it is close to the idea of migration on which the equation is based, in which a migration is any change of residence, even from a person's current home to the house next door (as proposed by Rees and others, 2000).

The second goal is achieved by using the basic territorial units in which migration is detected (municipalities, for example) to randomly produce artificial units that randomly contribute values and increase the density of the original Courgeau's k equation (Bell and others, 2015, p. 41). Thus, figures III.1 and III.2 become point clouds and the value of the slope, which is still an updated Courgeau's k indicator, becomes much more robust. A theoretical consideration of the limiting case $H/n = 1$ allows the k value to be read in a sense much closer to the aggregate crude migration intensity (ACMI),[2] which indicates the total mobility rate: in other words, all changes of residence —regardless of the distance travelled or the crossing of geographical boundaries— occurring in a country over a given period of time.[3]

At the same time, and as has already been stated, the rates are underestimated when the data cover migrants rather than migrations (strictly speaking, a maximum of one migration per person, as will be seen below, since only one movement is recorded), which is the usual situation in Latin America. Different procedures have been used to correct those rates, but their analysis is beyond the scope of this book. Notable among them is the one proposed by the French school, led by Daniel Courgeau and his "migrants-migrations" model (Donzeau and Pan Ké Shon, 2009). Another solution is offered by the distinction between events and transitions drawn by Martin Bell and his team (Bell and others, 2015; Boden, Stillwell and Rees, 1991).

In the same vein, the transition or migrant rates detected through backward-looking questions provide different estimates of migration intensity depending on the reference period. In general, longer periods, such as the standard five years, should yield lower migration rates than shorter periods (for example, one year) for reasons that are relatively easy to understand, such as return migration, chain migration and international emigration. Although several procedures have been proposed whereby five-year rates could be abandoned in favour of annual rates, their accuracy is still a matter of debate. Dyrting (2018) offers a recent, still experimental procedure.

---

2 The ACMI indicates the highest possible CMI, in that it is calculated by deeming any change of residence within the country during the reference period to be a migration.

3 Additional details on the methodology and its application in worldwide comparative studies may be found in Bell and others (2015).

Chapter IV
The basic migration matrix and the growth effect

The basis for the territorial measurement of migration is the migration matrix or origin-destination matrix, which is shown on table IV.1. This table displays the matrix in the standard way, but in practice several other presentation methods can be used. Particular care must be taken when the presentation is inverted, with the columns indicating the current population according to their places of origin[1] and the rows showing the previous resident population (where the exact meaning of "previous" depends on the question used to construct the matrix).[2] In that case, the interpretation of the results would be exactly the opposite of the one performed below. In other presentations of migration matrices, a special row or column is used for non-migrants and the diagonals are left empty to avoid confusion. In some cases, matrices of the latter type have been used, but with diagonals containing figures that indicate migrants within the territorial entities used to construct the matrix. In this book, however, the diagonals indicate non-migrants (with the qualifiers depending on the question used to construct the matrix).[3]

1 This means that the marginal row will contain the current resident population, minus those cases excluded from the matrix for the various reasons identified in chapter II in the discussion on the questions used in census migration modules.

2 This means that the marginal column will contain the previous resident population (with what "previous" means depending on the question used to construct the matrix), minus those cases excluded from the matrix for the various reasons discussed above in the examination of questions used in census migration modules.

3 A selection of this variety of cases will be exemplified with country-specific illustrations later in this text.

■ Table IV.1
Standard migration matrix model, without identification of the question used

Place of residence	Place of previous residence					Total
	i=1	i=2	i=3	[...]	i=i	
j=1	N_{11}	N_{21}	N_{31}	[...]	N_{i1}	$N_{.1}$
j=2	N_{12}	N_{22}	N_{32}	[...]	N_{i2}	$N_{.2}$
j=3	N_{13}	N_{23}	N_{33}	[...]	N_{i3}	$N_{.3}$
[...]						
j=1	N_{1i}	N_{2i}	N_{3i}	[...]	N_{ii}	$N_{.i}$
Total	$N_{1.}$	$N_{2.}$	$N_{3.}$	[...]	$N_{i.}$	$N_{..}$

Source: Prepared by the author.

Thus, following the matrix shown in table IV.1, for any entity where i=1...i (as origin) and j=1...j (as destination, with i=j at the limit):

Nij represents the population with past residence in entity i who are now resident in entity j, which is to say migrants from i to j, out-migrants from i and in-migrants to j. By definition, the subscripts indicate the entities of origin and destination, respectively.

Nii (when i=j) indicates the population of entity i who previously resided at i (where what is meant by "previously" depends on the question used to construct the matrix) and currently reside at i. It indicates the non-migrants in the matrix (the type of matrix —e.g. "absolute between major civil divisions"— will define the qualifiers for migrants and non-migrants).

$N.j$ indicates the population whose current residence is located in entity j, in other words the sum of all values along a row:

$$\sum_{i=1}^{i} Nij \qquad (1)$$

$Ni.$ indicates, similarly, the total population previously resident in entity I, which is to say the sum of all the values down a column.

$$\sum_{j=1}^{i} Nij \qquad (2)$$

The first sum can be converted into the total number of in-migrants in the territorial division by means of two procedures. The exhaustive (or long) method involves totalling all the Nij except the diagonal Nii. The abbreviated (or short) method is calculated by means of the current resident population marginal minus the diagonal, bearing in mind that Nii represents the non-migrant population of the division in question.

$$Ii = N.i - Nii \qquad (3)$$

A territorial division's out-migrant numbers are calculated in the same way:

$$Ei = Ni. - Nii \quad (4)$$

Subtracting this value from the immediately preceding one, the territorial division's net migration or migratory balance is obtained:

$$NMi = Ii - Ei \quad (5)$$

It must be kept in mind that the attractiveness of an entity does not depend on its in-migration, but on its net migration. The terms are easily confused because in common usage they are equated with each other. For the demographic analysis of migration, the concept of migration attractiveness will only be measured on the basis of net migration, normally using its relative expression, which is to say the net migration rate when it can be calculated. An attractive locality will have a positive migratory balance and its attractiveness will be directly proportional to its net migration rate. An entity with a negative migratory balance will be an expeller, with higher levels of expulsion as the absolute value of its net migration rate increases. When only in-migration or out-migration is used to describe the migratory status of an entity, the terms "receiving" (for in-migrants) or "sending" (for out-migrants) are used. It goes without saying that a country's net internal migration is necessarily zero, an axiom that must be true in any migration matrix.

A closer look at the data in the matrix allows the migratory flows to be defined. Thus, for example, $N1i$ represents the number of people who previously resided in territorial division 1 and who, at the end of the observation period, had established their current residence in i. In other words, they are out-migrants from 1 and in-migrants in i. In contrast, $Ni1$ identifies in-migrants to 1 from i. The larger of these quantities determines the dominant stream or, more simply, the stream. The smaller number indicates the counterstream. The difference between the two represents the net migration stream. The size of that difference is called the bilateral balance between the two places and, to identify it correctly, the territorial division of reference must be specified.

Finally, totalling the numbers of in-migrants and out-migrants gives gross migration: an indicator that has little meaning by itself, but which allows for the qualification of net migration and serves other purposes as discussed below. Because it is calculated by subtracting, net migration can be zero (in other words, with value 0) in different migration scenarios, occurring whenever in-migrant and out-migrant numbers are the same. Thus, zero net migration can be found both in closed geographical entities (in other words, when neither immigrants nor emigrants exist) and in totally open entities that are in migratory equilibrium (many immigrants arrive, but the same number of emigrants leave). Thus, presenting net migration together with gross migration provides better information regarding the type of migratory situation experienced by the entity under analysis. In addition to this "qualification" of net migration, gross migration is widely used in other migration indicators, such as the migration effectiveness (or efficiency) index and the aggregate indices of the redistributive territorial impact of migration, which are explained below.

Table IV.2 shows a simplified and intuitive example of a standard matrix with an illustrative summary of its components, in particular the cells, the diagonal and the totals. This matrix, and other innovative ones based on it, will be examined afresh with real country data at a later point. As the main methodological tool addressed in this text, it will be used intensively to produce both standard and novel indicators of internal migration and its effects.

■ Table IV.2
Standard migration matrix: intuitive numerical exemplification and illustrative identification of components
(Number of persons counted)

Civil division of current residence	Civil division of former residence (birthplace, last residence, specified date in the past)				Total (current)
	A	B	C	D	
A	45	15	24	14	98
B	11	50	17	11	89
C	22	13	55	24	114
D	12	19	33	77	141
Total (previous)	90	97	129	126	442
N_{AD}	12	Persons residing in D at the time of the census who previously resided in A. In-migrants to D from A or, in other words, out-migrants from A to D.			
N_{BC}	13	Persons who previously resided in B and at the time of the census reside in C. Out-migrants from B to C or, in other words, in-migrants to C from B.			
N_{AA}	45	Non-migrants in A. They reside in A and also previously resided in A.			
$N_{.D}$	141	Persons residing in D who previously resided in another civil division (in-migrants to D) or in D (non-migrants in D). Current residents of D.			
$N_{A.}$	90	Persons who formerly resided in A and now reside in A (non-migrants in A) or in other civil divisions (out-migrants from A).			
$N_{..}$	442	Total number of people in the matrix.			

Source: Prepared by the author.

It should again be noted that the use of the word "previous" in the matrix is generic and, in fact, reflects reality inadequately. In most cases, that "previous" is more accurate and allows estimates of different migrant types and numbers. The "previous", as in fact stated in the horizontal header of the matrix, may be the place (civil division) of birth, the place of residence at a specified date in the past or the previous place of residence (this case is the most inexact, so it requires an additional query about the time involved for its correct identification and technical use, as was explained in chapter II).

It should also be emphasized that the standard presentation is not always followed in publications or spreadsheets dealing with the subject. In fact, several alternative formats are available. Of course, the most common is the inverted format, with usual residence in the columns and previous residence in the rows. Table IV.3 shows an ad hoc example of this case, with the proper interpretation of its components, which is exactly the inverse of the standard matrix.

■ Table IV.3
"Inverted" migration matrix and interpretation of its cells, marginals and basic computations
(Number of persons counted)

Province of previous residence (birthplace, last residence, specified date in the past)	Current province of residence				Total
	A	B	C	D	
A	45	15	24	14	98
B	11	50	17	11	89
C	22	13	55	24	114
D	12	19	33	77	141
Total	90	97	129	126	442
N_{AD}	14	Persons who reside in D and previously resided in A.			
N_{BC}	17	Persons who reside in C and previously resided in B.			
N_{AA}	45	Non-migrants in A. They reside in A and also previously resided in A.			
$N_{.D}$	126	Persons who reside in D and previously resided in another civil division or in D. Current residents of D.			
$N_{A.}$	98	Persons who previously resided in A and now reside in A or other civil divisions. Previous residents of A.			
$N_{..}$	442	Total number of people in the matrix.			

Source: Prepared by the author.

Another version, shown on table IV.4, adds two other differences to the inversion on table IV.3: (i) most importantly, the diagonals are empty, so it is a matrix of migrants only; and (ii) it includes foreign places of origin, which makes the matrix rectangular instead of square.

■ Table IV.4
Brazil: persons aged 5 years and above, by major destination regions, according to major regions of origin and foreign countries of origin, 1995–2000
(Number of persons counted)

Major regions or foreign countries of origin	Persons aged 5 and above by major destination regions					
	Total	North	Northeast	Southeast	South	Central-West
Total	3 506 679	362 840	655 797	1 466 641	378 508	642 892
North	292 751		86 836	68 186	22 956	114 773
Northeast	1 411 421	182 709		969 435	31 029	228 247
Southeast	946 286	75 467	462 628		214 918	193 274
South	349 813	26 989	27 897	205 975		88 952
Central-West	363 275	70 271	70 012	161 276	61 716	
Foreign country	143 133	7 404	8 425	61 768	47 890	17 647

Source: Brazilian Institute of Geography and Statistics (IBGE), *Censo Demográfico 2000. Migração e deslocamento: resultados da amostra*, Rio de Janeiro, 2003, box 4 [online] https://biblioteca.ibge.gov.br/visualizacao/periodicos/88/cd_2000_migracao_deslocamento_amostra.pdf.

In practice, more matrix formats exist in addition to those identified and discussed above, but reviewing them all would be excessive and inefficient. Moreover, there are non-matrix formats that can display the same information as the matrix and, for certain purposes, function better. One example of those formats is the bilateral exchange table, which can, using two simple columns plus the entity identification column, set out all the information of a matrix and facilitate calculations of bilateral balances and other indicators. Of course, the diagonal, which is key to many calculations of the intensity and effects of migration, cannot be left out. Indeed, with proper programming or computations, these tables can generate source-destination matrices or vice versa. They can be very useful in mapping applications such as ODISEA.[4]

Finally, matrices with "special" diagonals are also published; they can be identified at a glance because they usually contain smaller figures, often lower than those of other cells. While this is theoretically possible, because an entity could have a migratory flow that exceeds non-migrants, in practice it is unlikely. Table IV.5 shows an example of this, with the relevant illustrative interpretation of its components.

■ Table IV.5

Migration matrix with "special" diagonal: migrants within the matrix's civil division of reference

(Number of persons counted)

Current province of residence	Province of previous residence (birthplace, last residence, specified date in the past)				Total
	A	B	C	D	
A	5	15	24	14	58
B	11	8	17	11	47
C	22	13	2	24	61
D	12	19	33	9	73
Total	50	55	76	58	239
N_{AD}	12	Persons who reside in D and previously resided in A.			
N_{BC}	13	Persons who reside in C and previously resided in B.			
N_{AA}	5	Non-migrants from province A, but who are migrants between minor civil divisions in province A.			
$N_{.D}$	73	In-migrants to D + non-migrants from D who are intra-D migrants.			
$N_{A.}$	50	Out-migrants from A + non-migrants from A who are intra-A migrants.			
$N_{..}$	239	Total migrants between provinces of the matrix + intra-provincial migrants.			

Source: Prepared by the author.

[4] See [online] https://odisea.redatam.org/.

A. Measurements using the absolute migration matrix

A migration matrix based on the birthplace question allows the calculation of all of the aforesaid valid outcomes of any type of migration matrix (out-migrants, in-migrants, non-migrants, net migration). In addition, specific relative indicators can be calculated, as they depend on the type of matrix. Those indicators are the following: (i) proportion of in-migrants; (ii) proportion of out-migrants; and (iii) migration effectiveness. The calculation of these indicators is illustrated below, based on the generic matrix shown in table IV.6.

■ Table IV.6
Standard absolute migration matrix with three reference entities

Current place of residence	Place of birth			Total
	1	2	3	
1	N_{11}	N_{21}	N_{31}	$N_{.1}$
2	N_{12}	N_{22}	N_{32}	$N_{.2}$
3	N_{13}	N_{23}	N_{33}	$N_{.3}$
Total	$N_{1.}$	$N_{2.}$	$N_{3.}$	$N_{..}$

Source: Prepared by the author.

1. Proportion of in-migrants

According to the exhaustive (or long) procedure, the numerator corresponds to the region's in-migrants. The denominator is a subject of discussion. In theoretical terms, it should be the population actually affected by migration. Since there is no way to accurately calculate that population, the population resident in the region of in-migration at the time of the census (the resident population shown on the migration matrix) is usually considered an acceptable denominator. Its interpretation would be the relative weight of in-migrants in the current resident population, ranging from 0% to 100% (if multiplied by 100, as shown in formula 6). Thus, the equation for region 2 would be:

$$\left[\frac{N12+N32}{N12+N22+N32}\right] * 100 \qquad (6)$$

Using the abbreviated (or short) procedure, the equation for region 2 would be:

$$\left[\frac{N.2-N22}{N.2}\right] * 100 \qquad (7)$$

2. Proportion of out-migrants or probability of out-migration

The numerator indicates the region's out-migrants and the denominator is the population of origin, which is to say all those born in the locality from which the out-migrants departed. Its interpretation is closer to that of a probability (without considering the temporal dimension): specifically, the probability that the population born in a given place has migrated. Thus, the results are suggestive of the capacity to retain the local native population, although it should again be noted that the lack of a defined time frame prevents this indicator from being considered an indicator of out-migration intensity. Following the conventional notation indicated in the description of the migration matrix, and assuming that this is a country with only three regions (1, 2 and 3), the formula for calculating the proportion of out-migrants from region 2 would be:

$$\left[\frac{N21+N23}{N21+N22+N23}\right] * 100 \tag{8}$$

Using the abbreviated (or short) procedure, the equation for region 2 would be:

$$\left[\frac{N2.-N22}{N2.}\right] * 100 \tag{9}$$

Whatever the formula used, from a practical point of view, the difference in denominators between in-migration and out-migration prevents direct comparisons between the two proportions, as does the lack of a common reference period. This detracts from the usefulness of both indicators, since they cannot be used directly to calculate the relative lifetime net migration indicator.

One proposal to overcome this problem considers the population born in the place of destination as the denominator of the in-migration percentage, with which the denominators of both proportions would be the same. This option suffers from conceptual shortcomings, however, because the population included in the denominator is not the one "affected" by immigration, in that it includes those individuals who migrated from the place of destination. In any case, the calculation formula (again, for region 2) would be:

$$\left[\frac{N12+N32}{N21+N22+N23}\right] * 100 \tag{10}$$

Using the abbreviated (or short) procedure, the equation for region 2 would be:

$$\left[\frac{N.2-N22}{N2.}\right] * 100 \tag{11}$$

Similarly, calculating the net migration percentage in either direction is inappropriate, although the best option would be to calculate it with respect to the current resident population, as shown (for region 2) in equation (12). This percentage should be interpreted as the weight of net migration within the total population; this is still inappropriate, since it

tends to personalize net migration, which is a mathematical abstraction and not a particular event or person.

$$\left[\frac{N.2-N2.}{N.2}\right]*100 \tag{12}$$

Finally, migration effectiveness can be calculated using the formula explained above, which is to say as the ratio of net migration to gross migration.

$$\left[\frac{N.2-N2.}{(N.2-N22)+(N2.-N22)}\right]*100 \tag{13}$$

Or, using other terms:

$$\frac{(NM_2}{GM_2)}*100 \tag{14}$$

Its interpretation is less intuitive than that of the other indicators. What it indicates is the fraction of migratory exchanges (total inflows and outflows, denominator) that had an effect on the growth of the place. If the migration effectiveness index (MEI) is positive, it means that the region has positive net migration (net in-migration) and, if it is negative, that it has negative net migration (net out-migration). Of course, this was already known through the net migration data. Therefore, the contribution of the migration effectiveness index lies elsewhere.

An MEI value of 0 —which can only occur when net migration is zero and the population is not closed: in other words, when a migratory exchange exists— means that the entity is in perfect migratory equilibrium: it records equal numbers of in-migrants and out-migrants and, therefore, has a migratory balance of zero. This can also be called perfect symmetry between inward and outward migration flows or between in-migrants and out-migrants. From the point of view of the "effectiveness of migration in generating growth", a value of zero indicates that regardless of the inflow and outflow volumes (numbers of in-migrants and out-migrants), migration has zero effectiveness, because it does not produce any growth effect. In this case, the effect lacks a reference period, since the data are based on a birthplace question.

In contrast, a value of 100 indicates that net migration is equal to gross migration, and this only occurs when an entity has only flows and no counterflows in all its bilateral exchanges, which is to say it only registers in-migrants (in which case the MEI is +100) or out-migrants (which would yield an MEI of -100). Note that it is not the absolute numbers that matter, but rather the relationship between them. Thus, in the absence of out-migrants, a place would have a migration effectiveness of 100% if one person in-migrated and no one out-migrated, or if a million people in-migrated and no one out-migrated. Incidentally, this indifference to the numbers involved is a weakness of the indicator, which only registers the impact of migration on growth, and not the specific magnitude of that impact. Thus, although it is true that MEI results closer to 100 or -100 indicate higher effectiveness and results closer

to 0 indicate lower effectiveness, nothing can be deduced *a priori* about the growth effect. For example, an MEI of 81.8% (net migration of 9 over gross migration of 11) can be obtained with that same fraction (9/11) or any of its equivalents (90/110, 9,000,000/11,000,000 and so on). This value cannot indicate the magnitude of net migration, which is what defines the growth effect (see table IV.7).

■ Table IV.7
Identical migration effectiveness indices (equal migration effectiveness) with different impacts on growth
(Number of persons counted)

In-migrants	Out-migrants	Net migration	Gross migration	Migration effectiveness index
10	1	9	11	81.8
100	10	90	110	81.8
10 000 000	1 000 000	9 000 000	11 000 000	81.8

Source: Prepared by the author.

At the same time, a value of 50% or -50% is recorded if and only if the ratio of in-migrants to out-migrants is 3:1 or 1:3, respectively. It should again be noted that this value can be deduced from infinite combinations of net migration and gross migration (strictly speaking, all multiples of the aforementioned ratio), and so nothing can be deduced from this index regarding the impact of migration on the entity's growth.

Finally, an undefined value can only be obtained in a closed population, one which has no in-migrants or out-migrants. In such a case, there is no gross migration and, therefore, the denominator of the MEI is zero. This clarification is important because it is often hastily concluded that a zero value in the MEI is synonymous with a closed population, but for the reasons just discussed, that is clearly not the case.

Some authors claim the MEI can be used to measure "migratory rotation", as shown in box IV.1. The previous paragraphs have already warned about this claim, however, since a value of zero may come from a closed population, which would represent the opposite of the idea of a region with "high migratory rotation". This is not intended to disqualify that use, but rather to warn against an excessive and uncritical use of the MEI. In any case, in real situations with country data, it is highly probable that the MEI values will be related to the flow volumes and to the growth effect but, again, note that this is a practical and circumstantial relationship and not a logical or mandatory one.

■ Box IV.1
Migration effectiveness index

The migration effectiveness index (MEI) measures the capacity to attract, avoid or rotate migration and is obtained from the ratio between the migratory balance and the total volume of migrants (in-migrants plus out-migrants). The indicator allows comparisons between states, regardless of the absolute volumes of in-migration and out-migration. The analysis of the states' MEI results followed the classification outlined below.

The MEI results of the component parts of the Brazilian Federation revealed that half of them were areas of migratory rotation, which is to say they have similar outflows and inflows. The same was true of those areas that in the past were considered expelling or potentially attractive areas and became areas where the changes between in-migrants and out-migrants attained an equilibrium. In general, there was a downward trend in the volume of migratory flows in all units of the federation (see table).

Migration effectiveness index classifications

MEI classes	Classification of migratory absorption potential
-0.51 to -1.00	Area of strong migratory evasion
-0.30 to -0.50	Area of moderate migratory evasion
-0.10 to -0.29	Area of low migratory evasion
0.09 to -0.09	Area of migratory rotation
0.10 to 0.29	Area of low migratory absorption
0.30 to 0.50	Area of moderate migratory absorption
0.51 to 1.00	Area of strong migratory absorption

Source: Prepared by the author, on the basis of L. A. Pinto de Oliveira and A. T. Ribeiro de Oliveira (coords.), *Reflexões sobre os deslocamentos populacionais no Brasil*, Rio de Janeiro, Brazilian Institute of Geography and Statistics (IBGE), 2011.

B. Measurements using the absolute migration matrix with questions about place of residence on a specified date in the past

1. Emigration rate

It should be noted that some authors maintain that this indicator can only be calculated by quantifying migrations, which requires the existence of permanent population registers that can record all movements (for further details, see Tapinos, 1990). For that reason, the calculation of the emigration rate will be presented separately using matrices based on census information.

The rate is calculated by dividing the out-migrations recorded in a region in a calendar year (z) by the average population of the period, and it is expressed per 1,000 inhabitants:

$$\left(\frac{E^z}{NM^z}\right) * 1\ 000 \tag{15}$$

Where E^z are the total out-migrations recorded by the region in the period in question (year z) and NM is the average population of the region over the same period. Of course, this general formula can be used to calculate specific out-migration rates by sex, age or any other characteristics deemed relevant. It should be noted that this way of measuring migration does not reveal whether those outflows had a real effect on growth, because that depends on how many out-migrants return during the period under review. This problem does not arise, at least not in the same way, when backward-looking questions are used, since each out-migrant recorded cannot at the same time be a return migrant. Return migrants certainly exist, but they are not detected by this procedure and, therefore, neither their departures nor their returns are counted. The downside of the above, as has already been explained several times, is the loss of migrants.

When a question about the place of residence over a specified period in the past is asked, out-migration rates can be calculated. The numerator contains the out-migrants, which is to say those who some time ago (five years, for example) resided in the region under study and who, on the date of the census, reside in a different region. The denominator is the average population of the region during the period.

In order to avoid excessively complicated calculations, such as estimating the time lived, demographic change in the region is assumed to have a relatively linear behaviour. The calculation therefore uses the simple average of the population resident there at the time of the census (which is what a *de jure* census records) and the population resident in the specified period in the past. The formula for calculating the rate —using the total number of cases as the numerator, although, naturally, the abbreviated procedure of residents minus the diagonal can also be used— is:

$$\frac{N21+N23}{\left[\frac{\frac{N.2+N2.}{2}}{t}\right]} * 1\ 000 \tag{16}$$

Where t indicates the reference period used for the question, normally five years earlier. Dividing by the reference period, in years and fractions of years, gives an annual rate, but it must be noted that this is a figure based on assumptions of linearity that are not necessarily true in reality. It could be the case that migration was very intense over the last two years of the reference period and significantly lower in the other three years (assuming a period of five years earlier for the place of previous residence question), but the calculation method assumes that the relative frequency was similar over the entire course of the period. Recent literature addresses the annualization of measurements of this type, although to date no universally accepted standard procedure exists (for further details, see Dyrting, 2018).

2. Immigration rate

The comment regarding the quantification of migrations remains valid. If there are systems in place to record all the in-migrations occurring in a region during a given period of time, the formula is:

$$\frac{I^z}{NM^z} * 1\,000 \tag{17}$$

Where I^z is the total in-migrations recorded in the region during the period and NM^z is the region's average population over that period. To calculate the specific migration rate for the 15 to 29 age group, the formula is:

$$\left(\frac{{}_{15}I^z_{15}}{{}_{15}NM^z_{15}}\right) * 1\,000 \tag{18}$$

When a question on place of residence over a specified period in the past is available, immigration rates can be calculated. The numerator should be the in-migrants, which is to say those who lived outside the region under analysis at some point in the past (five years ago, for example) and who, at the time of the census, live in the region. The denominator should be the average population of the region during the reference period. In this case, an assumption of linearity is again used, so the equation to calculate the rate for region 2 is:

$$\frac{N12+N32}{\left[\frac{N.2+N2.}{2}\right]_t} * 1\,000 \tag{19}$$

Where t indicates the reference period of the question, usually five years earlier. The comments about the linearity assumption made for the emigration rate also apply in this instance.

3. Net migration rate

The net migration rate is the difference between the immigration rate and the emigration rate, which is a simple arithmetic operation since both have the same denominator. Together with the birth and mortality rates, this rate forms the equation for calculating the total population growth rate. The formula for its calculation is:

$$\frac{MN^z}{NM^z} * 1\,000 \tag{20}$$

Where MN^z is the migratory balance recorded by the region in the period analysed and NM^z is the region's average population over that period. To calculate the specific migration rate for the 15 to 29 age group, the formula is:

$$\left(\frac{{}_{15}NM^z_{15}}{{}_{15}NM^z_{15}}\right) * 1\,000 \tag{21}$$

When the question on the place of residence over a specified period in the past is available, net migration rates can be calculated. The numerator is the migratory balance, and the denominator is the average population of the region during the reference period. In this case, an assumption of linearity is again used, so the equation to calculate the rate for region 2 is:

$$\frac{N.2-N2.}{\left[\frac{N.2+N2.}{\frac{2}{t}}\right]} * 1\,000 \qquad (22)$$

The final figure is expressed per 1,000 inhabitants and is interpreted as the contribution that migration makes to population change over a given period. If the rate is positive, migration produces a net addition to the population. A negative result means a net subtraction of people. For example, a net migration rate of 10 means that, for every 1,000 inhabitants in the period analysed, the population increased by 10 as a result of migration.

To calculate the compensating equation, it must be borne in mind that this procedure for calculating net migration is not applicable to individuals younger than the reference period of the question used to detect migration directly.

Table IV.8 shows a recent migration matrix used to obtain the indicators described above.

■ Table IV.8
Migration matrix prepared with a question about place of residence five years previously, hypothetical data
(Number of persons counted)

Current province of residence	Province of residence five years ago				
	A	B	C	D	Total
A	45	15	24	14	98
B	11	50	17	11	89
C	22	13	55	24	114
D	12	19	33	77	141
Total	90	97	129	126	442

Source: Prepared by the author.

The diagonal contains the period's non-migrants. The numbers of out-migrants recorded in province A is 11 to B, 22 to C and 12 to D, while the number of in-migrants residing in province A at the time of the census is 15 from B, 24 from C and 14 who resided in D five years ago. Net migration, in the case of province A, would be:

(15+24+14) – (11+22+12) = (53–45) = 8

Thus, over the past five years, province A registered net in-migration and, as a result, its population increased by eight persons during that period.

The following steps are used to establish the net migration rate:

(i) Divide the number of net migrants during the period by the length of the period in years. In this case, the period is five years and, therefore, the formula that would produce the denominator for the average annual net migration rate of province A is:

(8/5)

(ii) Since the calculation of the average population for the period, in the absence of additional information (and this is usually the case), is based on an assumption of linear migration during the reference period, it is obtained as a simple average of the resident population at the time of the census and the resident population five years earlier. In province A, the formula for this figure, to be used as the denominator, is:

(98+90)/2

(iii) Having identified the numerator and denominator, the rate is calculated by simple division: in this case, the result yields an average annual rate of 17.02 per 1,000. To obtain the immigration and emigration rates, the denominator is the same as that used for the annual net migration rate and the numerator includes the in-migrants or out-migrants (depending on whether the immigration or emigration rate is being calculated) recorded over the period, divided by five.

Incidentally, as discussed in the case of absolute migration, the quotient between net migration and gross migration allows the migration effectiveness index to be calculated. In this case, the above interpretation is maintained, although it now uses a specific reference period, which makes the migration effectiveness index much more attractive and useful for policy purposes.

Chapter V

Specific matrices for estimating the growth effect of populations and special territories

The expansion of the capacity for processing census microdata has led to a revolution in the usage made of migration census modules. One leader in that field is the REDATAM programme, developed by the Latin American and Caribbean Demographic Centre (CELADE)-Population Division of ECLAC, which allows for the rapid creation of large matrices from databases containing enormous quantities of records.[1] Accompanying that progress is the development of new analytical tools, procedures, categories and indicators for analysing migration, and among those new analytical tools are extensions or derivations of the migration matrix. Most of these new matrices have emerged, essentially, because they can now be created by a properly trained user with the right data-processing package. This set of new matrices, whose operation and indicators are the same as those described in the previous chapters, include disaggregated, urban-rural, intercity and intrametropolitan matrices. A minority, however, are matrices that had not been calculated previously. As such, their usage demands new procedures and, perhaps, the tackling of issues that until recently were dealt with only theoretically and not empirically or that posed significant methodological problems; they therefore offer new possibilities for approaching those issues. Flow indicator matrices are a notable member of this latter group.

[1] REDATAM was used for all of the processing in this publication. See [online] https://redatam.org/en.

A. Disaggregated matrices

These are traditional migration matrices that are cross-referenced with an additional variable to produce as many matrices as there are categories in the variable. Succinctly, they are migration matrices for population subgroups. They offer little that is new compared to the basic matrices presented in previous chapters. Their use is illustrated in later sections.

B. Urban-rural matrices

For decades, flows from rural to urban areas, including large cities, have been the focus of debates, research and studies on migration and migration-related interventions (ECLAC, 2012; Rodríguez and Busso, 2009; Rodríguez, 2009b, 2004a and 2004b; Lattes, Rodríguez and Villa, 2002; Herrera, Pecht and Olivares, 1976). The importance of this issue becomes apparent whenever it is noted that the loss of rural population, both absolute and relative, is mainly on account of the persistent net population transfers from the countryside to the cities that remain the demographic driver behind increasing urbanization. However, as previous studies have noted, the significance of both flows has undergone substantial changes over the past two decades (ECLAC, 2012; Rodríguez and Busso, 2009; Lattes, Rodríguez and Villa, 2002; Rodríguez, 2002), as a result of reductions in both flows to large cities and flows from rural to urban areas.

As already noted, the direct detection of rural-urban migration requires that both the usual residence question and a question on previous residence —in any of its variants— allow the population to be classified into urban and rural residents.

De jure censuses pose no problems for current residence, since the area of residence in which the census is taken indicates the area of usual residence. In contrast, in *de facto* censuses, the usual residence question must allow for urban-rural distinctions to avoid misclassifying transient populations. This is not usually the case, however, because the question is asked at the political-administrative level (municipality of usual residence) and this, in most countries, is inadequate for identifying the place where the person resides as either urban or rural.

As a result, the requirement that the question explore whether the place of previous residence was urban or rural is only met in a limited number of censuses. As already seen, these include those *de jure* censuses that specifically inquire about the urban or rural status of the previous residence. These experiences, as explained above, have been varied, and a number of countries have obtained frustrating results that were deemed inconsistent and unreliable. At the same time, other countries can achieve that distinction without asking an additional question: namely, those where the urban-rural definition is administrative in nature. This occurs when municipalities are defined as urban and rural, or when all municipalities have a head town that is urban and a hinterland that is rural, or some similar arrangement. In

this case, once the question about the municipality of previous residence has been asked, the distinction between the head town and the remainder of the municipality would be sufficient for the previous place of residence to be classified as urban or rural. Finally, there are also those countries that do not require another question because they ask about the locality of previous residence, which can in turn be classified as urban or rural. While these latter cases are strictly speaking the most accurate and the most in line with the recommendations of the United Nations (2017), they present two problems. First, an adequate nomenclature that allows each locality to be identified as either urban or rural is needed. Second, both the statistics office and all the census or survey participants (including the respondents) must have a good grasp of the concept of locality, which is itself complex and even subject to changes over time.

In the past, some countries that met the above conditions published results that allowed direct estimates of rural-urban migration to be made, although sometimes they had to be deduced from more complex tables; this is the case with the data for the 1992 census in the Plurinational State of Bolivia shown on table V.1. Tables V.2 and V.3 show the case of Brazil, where the data has been processed through the IBGE System of Automatic Recovery (SIDRA) —a national system implemented by the Brazilian Institute of Geography and Statistics (IBGE)— and the special processing of the census microdatabase with REDATAM. The question was not asked in 2010 and the recording of this migration in 2000 experienced a loss of cases due to a flow error in the large questionnaire, which is the only one that registers migration and was administered to a sample of 20 million people. Respondents stating that they had always lived in the same municipality were not asked any further questions from the large form's migration module, and changes of places of residence (urban-rural) within the municipality were lost (for further details, see Rodríguez (2009b)).

For illustrative purposes only, the comparative census results for Panama are shown below on tables V.4 and V.5. Panama is a country with an exceptional record in measuring this migration: it is the only one that calculates it based on the urban/rural reclassification of places of usual residence (it is a *de facto* census) and previous residence (over a period of five years: similar to the specified date in the past question, but it is not strictly speaking a specified date in the past). The results confirm the persistence of net rural out-migration or net urban in-migration, albeit with a downward trend over time.[2] The tables also show that rural-urban migration has a decreasing quantitative impact on the growth of the urban population, but that this impact is high and relatively constant from the rural population's perspective (the figures are negative as opposed to positive, obviously). Thus, the expansion of the urban population is increasingly dependent on its own natural growth.[3] The falling rural population is still the result of out-migration.

---

2 As will be explained below in the discussion of urbanization, this type of migration continues to drive urbanization. Without population transfers from the countryside to the city, the region would become ruralized, since the rural population has a natural growth rate that is higher than that the urban population.

3 It should be noted, however, that this trend is not irreversible, because if the region's urban areas were to reach zero or negative population growth rates, rural-urban migration would once again be the main —and in this case, the only— source of population growth.

■ Table V.1

Plurinational State of Bolivia: population aged 5 and over by place of usual residence at the time of the census, by place of usual residence five years prior, 1992 census

(Number of persons counted)

Place of usual residence five years before the census	Population aged 5 and over												
	Total	Place of usual residence in the census											
		In the country											
		Total				Chuquisaca				La Paz			
		Total	Urban area	Rural area	Not specified	Total	Urban area	Rural area	Not specified	Total	Urban area	Rural area	Not specified
TOTAL	5 473 420	5 445 370	3 167 481	2 271 350	6 539	382 662	127 425	253 406	1 831	1 635 633	1 032 314	601 761	1 558
IN THE COUNTRY	5 403 352	5 403 065	3 131 809	2 264 781	6 475	380 934	126 155	252 961	1 818	1 623 711	1 020 859	601 310	1 542
Urban area	3 064 962	3 064 843	2 970 359	91 858	2 626	122 334	116 872	4 500	962	992 581	970 941	20 997	643
Rural area	2 313 119	2 312 957	143 881	2 167 612	1 464	257 190	8 577	247 994	619	624 198	44 350	579 622	226
Not specified	25 271	25 265	17 569	5 311	2 385	1 410	706	467	237	6 932	5 568	691	673
CHUQUISACA	388 177	388 096	129 602	258 072	422	358 760	109 280	249 122	358	3 277	2 843	431	3
Urban area	122 049	122 043	116 904	5 068	71	106 650	104 228	2 382	40	2 182	1 989	191	2
Rural area	262 324	262 311	10 316	251 863	132	251 354	4 823	246 428	103	497	338	159	-
Not specified	3 744	3 742	2 382	1 141	219	756	229	312	215	598	516	81	1
LA PAZ	1 635 290	1 635 238	1 029 543	603 566	2 129	2 779	2 033	234	512	1 576 605	979 363	595 783	1 459
Urban area	999 689	999 652	976 612	21 933	1 107	2 395	1 815	179	401	955 416	937 501	17 332	583
Rural area	628 943	628 928	47 692	580 904	332	318	177	48	93	616 272	38 102	577 961	209
Not specified	6 658	6 658	5 239	729	690	66	41	7	18	4 917	3 760	490	667
COCHABAMBA	914 744	914 762	477 710	435 917	1 135	2 502	1 764	322	316	9 900	8 696	1 117	27
Urban area	474 207	474 199	461 930	11 892	377	1 818	1 509	149	160	8 591	7 728	845	18
Rural area	437 157	437 154	13 729	423 094	331	634	222	256	156	1 030	726	298	6
Not specified	3 410	3 409	2 051	931	427	50	33	17	-	279	242	34	3
ORURO	311 806	311 778	209 212	102 064	502	1 803	1 438	136	129	10 673	9 278	1 378	17
Urban area	200 418	200 409	193 785	6 412	212	1 291	1 156	53	82	8 040	7 167	858	15
Rural area	109 583	109 565	14 113	95 337	115	352	234	71	47	2 353	1 851	500	2
Not specified	1 805	1 804	1 314	315	175	60	48	12	-	280	260	20	-
POTOSÍ	578 878	578 784	210 967	367 122	695	7 630	6 700	798	132	8 419	7 720	685	14
Urban area	190 264	190 247	181 189	8 888	770	4 190	3 793	340	57	5 507	5 184	313	10
Rural area	385 823	385 746	27 892	357 646	208	3 183	2 670	440	73	2 707	2 339	364	4
Not specified	2 791	2 791	1 886	588	317	257	347	18	2	205	197	8	-
TARIJA	234 065	234 058	127 349	106 458	251	1 690	943	606	141	2 365	2 232	131	2
Urban area	124 736	124 735	121 203	3 443	89	1 301	856	382	63	2 045	1 947	97	1
Rural area	108 771	108 766	5 777	102 881	108	370	74	218	78	261	230	30	1
Not specified	558	557	369	134	54	19	13	6	-	59	55	4	-

Source: National Institute of Statistics of the Plurinational State of Bolivia, Censo Nacional de Población y Vivienda 1992.

■ Table V.2

Brazil: persons aged 5 and over who were not residing in the municipality on 31 July 1995, by status of current residence and status of place of residence on 31 July 1995, and place of residence on the same date, 2000 census

(Number of persons counted)

Status of current residence	Status of residence on 31 July 1995	
Total	Total	15 458 886
	Urban	12 120 443
	Rural	3 194 799
Urban	Total	12 937 051
	Urban	10 775 021
	Rural	2 032 908
Rural	Total	2 521 835
	Urban	1 345 422
	Rural	1 161 891

Source: Prepared by the author, on the basis of data processed with IBGE System of Automatic Recovery (SIDRA) [online] https://www.sidra.ibge.gov.br/bda/tabela/protabl.asp?c=2153&z=cd&o=28&i=P.

Note: Variable = persons aged 5 and over not residing in the municipality on 31 July 1995 (number). Place of residence on 31 July 1995 = Total.

■ Table V.3

Brazil: direct estimation of rural-urban migration, 1995–2000

(Number of persons counted)

Current residence	Has never changed municipality	In the urban area of this municipality	In the rural area of this municipality	In the urban area of another municipality	In the rural area of another municipality	In another country	Total
Total	66 213 994	44 813 466	1 211 381	10 775 021	2 032 908	129 122	125 175 892
Urban	19 639 303	823 177	5 326 411	1 345 422	1 161 891	14 522	28 310 725
Rural	85 853 297	45 636 643	6 537 791	12 120 443	3 194 799	143 644	153 486 617

Source: J. Rodríguez, "Migración interna en América Latina y el Caribe: estudio regional del período 1980–2000", *Population and Development series*, No. 50 (LC/L.2059-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2004, p. 121.

■ Table V.4

Panama: rural-urban migration, 1996–2000

(Number of persons counted)

Residence in 2000	Previous residence (1996–2000)		Total
	Urban	Rural	
Urban	1 434 075	82 273	1 521 348
Rural	35 613	880 498	916 111
Total	1 469 688	967 771	2 437 459

Source: Prepared by the author, on the basis of special processing of census microdata.

Note: Individuals aged under 5 years and those with previous residences abroad or poorly defined at the parish level are excluded. Rural-urban migratory balance: 87,273 - 35,613 = 51,660 between 1996 and April 2000 (positive balance for urban areas and negative balance for rural areas).

■ Table V.5
Panama: rural-urban migration, 2005–2010
(Number of persons counted)

Area of residence	Previous residence (2005–2010)		Total
	Urban	Rural	
Urban	1 832 096	74 313	1 906 409
Rural	33 714	988 377	1 022 097
Total	1 865 810	1 062 690	2 928 500

Source: Prepared by the author, on the basis of special processing of census microdata.
Note: Individuals aged under 5 years and those with previous residences abroad or poorly defined at the parish level are excluded. Rural-urban migratory balance: 74,313 - 33,714 = 40,599 between April 2005 and April 2010 (positive balance for urban areas and negative balance for rural areas).

Another country that allows this direct calculation is Ecuador, which over the 2005–2010 period was considered an exception, since the migratory balance was favourable to rural areas. However, this balance can be partially explained by the definition used for urban and rural areas: the definition is administrative and because of it, large areas that are totally integrated into metropolitan areas and that experience accelerated expansion through migrations from the city centre are considered rural areas and, therefore, those displacements are classified as urban-rural. Thus, tables V.6 and V.7 contain migration matrices obtained with different definitions of urban and rural at the minor civil division (parish) scale from the 2010 Ecuadorian census. This allows an evaluation of the robustness of the results —in this case, of net migration— in light of the changed definitions, and their comparison with the results of another approach to this kind of migration based on intercity migration matrices (which is examined in the following section).

■ Table V.6
Ecuador: rural-urban migration matrix and rural migratory balance, semi-urban and urban, scenario 1, 2010
(Number of persons counted)

Parish of residence	Parish of residence five years ago			Total	Net urban migration	Net semi-urban migration	Net rural migration
	Urban	Semi-urban	Rural				
Urban	6 781 668	81 621	128 293	6 991 582	-7 548	-11 513	19 061
Semi-urban	78 133	1 469 623	42 149	1 589 905			
Rural	139 329	50 174	4 082 727	4 272 230			
Total	6 999 130	1 601 418	4 253 169	12 853 717			

Source: Prepared by the author, on the basis of special processing of census microdata.
Note: Individuals aged under 5 years and those with previous residences abroad or poorly defined at the parish level are excluded. Scenario 1: Considering the urban population by minor civil divisions (in other words at the level of parishes, of which there were 1,024 in Ecuador in 2010), the following categorization is established: parishes with between 80% and 100% urban population = urban; parishes with between 50% and 79.9% urban population = semi-urban; parishes with between 0% and 49.9% urban population = rural.

■ Table V.7
Ecuador: rural-urban migration matrix and rural-urban migratory balance, scenario 2, 2010
(Number of persons counted)

Parish of residence	Parish of residence five years ago		Total	Net urban migration	Net rural migration
	Urban	Rural			
Urban	7 945 088	189 146	8 134 234	-8 815	8 815
Rural	197 961	4 521 522	4 719 483		
Total	8 143 049	4 710 668	12 853 717		

Source: Prepared by the author, on the basis of special processing of census microdata.
Note: Individuals aged under 5 years and those with previous residences abroad or poorly defined at the parish level are excluded. Scenario 2: Considering the urban population by minor civil divisions (in other words at the level of parishes, of which there were 1,024 in Ecuador in 2010) and the level of urbanization registered by the country, the following categorization is established: parishes with 60.43% or more urban population = urban; all others = rural.

■ Table V.8
Ecuador: rural-urban migration matrix and rural-urban migratory balance, scenario 3, 2010
(Number of persons counted)

Parish of residence	Parish of residence five years ago		Total	Net urban migration	Net rural migration
	Urban	Rural			
Urban	9 456 176	125 281	9 581 457	-36 562	36 562
Rural	161 843	3 110 417	3 272 260		
Total	9 618 019	3 235 698	12 853 717		

Source: Prepared by the author, on the basis of special processing of census microdata.
Note: Individuals aged under 5 years and those with previous residences abroad or poorly defined at the parish level are excluded. Scenario 3: The official classification of the parishes is not consistent, because some parishes deemed rural officially have urban populations and, in addition, some rural parishes without an official urban population contain localities that are clearly urban; this is the case in several rural parishes in the valleys surrounding Quito.

C. City matrices

In general, two types of city matrices exist: (i) matrices of a city vis-à-vis the rest of the country, which can be segmented in various ways, and (ii) intercity migration matrices. In the first case, a distinction should be made between matrices in which the city in question is presented as a unified whole, which can be called "closed matrices", and those in which the city is broken down into its constituent minor civil divisions. The latter allow estimates of intrametropolitan and extrametropolitan migration for each of those components and then, through addition, the calculation of migration from the city as a whole.

Almost without exception, these matrices can only be obtained through special processing of the census microdatabase, since the region's countries have no tradition of publishing them or creating them as official virtual tabulations. The key step in their construction is to identify the geographical divisions that make up the city. The main criterion in that regard is for the census to measure migration at the scale used (in other words, for both usual and former residences to be recorded at that level). Accordingly, applying very precise and detailed —and therefore very rigorous— definitions of the area effectively covered by the city for migration analysis could be a useless exercise if migration is recorded at the municipal scale.[4]

Once the city's territorial components have been determined, the two queries used to detect migration (usual and previous residence) must be recoded so that the variables can be processed to create the desired matrices. This requires defining the components that make up the city and the remainder and then creating the required groupings, in line with the three forms of city matrices described above. Three examples are presented below, one for each type of matrix.

First, table V.9 shows a closed city-centred matrix for Monterrey, Mexico, using data from the 2000 census.[5] This matrix's pending definitions have to do with the segmentation of the remaining administrative divisions, which is to say those that are not part of the metropolitan area. In the matrix shown on table V.9, that remainder was segmented into two groups: (i) all municipalities that are not part of the Monterrey Metropolitan Area (MMA) but that are located in the state of Nuevo León (where the MMA is located), in order to detect the close migratory exchanges of the MMA, and (ii) all municipalities that are not part of the state of Nuevo León, to detect distant migratory exchanges. This type of distinction is particularly important for discussions on the processes of suburbanization or "concentrated deconcentration" in large cities (for further details, see Rodríguez and Rowe (2019), Chávez and others (2013), ECLAC (2012) and Rodríguez (2011 and 2009a)).

The second type is the open city-centred matrix. Table V.10 depicts the same case as table V.9, except that the municipalities that make up the Monterrey Metropolitan Area are presented individually rather than as a single group. The specific contributions of these matrices assist in understanding and analysing cities' migration, by distinguishing between municipalities.[6] At the same time, they make it possible to differentiate between migratory exchanges between the city's component municipalities and the rest of the country (in the

4 For example, definitions that are made at the scale of city blocks or other very small territories. This does not necessarily imply operating with a traditional concept of the city as "the surface continuously covered by buildings", since a city can be composed of nodes that are physically separated but functionally integrated (metropolitan area). What is important is that the detailed definition allows the city blocks within each of those nodes to be identified.

5 One of the three definitions used in Chávez and others (2013), specifically comprising the municipalities of Apodaca, Carmen, García, San Pedro Garza García, General Escobedo, Guadalupe, Juárez, Monterrey, San Nicolás de los Garza, Salinas Victoria, Santa Catarina and Santiago.

6 This is a key factor in urban analysis because, as is well known, a city's migratory attractiveness is unevenly distributed within it. For example, over the past 50 years, the central municipalities of many Latin American metropolitan areas have been expellers of migrants, while the peripheral municipalities have been poles of attraction (ECLAC, 2012; Rodríguez, 2009).

different segmentations used) and migratory exchanges among the component municipalities.[7] Note that in this second type of matrix, the reference to the city itself disappears; however, by adding up the results (or at least the absolute ones), the figures obtained in the previous matrix can be reproduced. That is the case with the net migration total of 54,270 in table V.10, which is the sum of the net migrations of all the city's components and coincides with the net migration of the city (see table V.9).

■ Table V.9
Monterrey, Mexico: example of basic migration matrix, 2000 census
(Number of persons counted)

Municipality of registration	Municipality of residence five years ago			Total	Monterrey: total net migration	Monterrey: net nearby migration (exchanges with other parts of the State of Nuevo León)	Monterrey: net distant migration (exchanges with the rest of the country)
	Monterrey	Rest of the state	Rest of the country				
Monterrey	2 789 018	14 122	102 101	2 905 241	54 270	7 594	46 676
Rest of the state	6 528	435 042	17 351	458 921			
Rest of the country	55 425	7 715	81 036 611	81 099 751			
Total	2 850 971	456 879	81 156 063	84 463 913			

Source: Prepared by the author, on the basis of A. M. Chávez and others, "Nouvelles tendances de la migration métropolitaine en Amérique Latine: est-ce que les aires métropolitaines gagnent ou perdent population à cause de la migration interne", paper presented at the session 091 "Internal migration and urbanization: Overview", Conference of the International Union for the Scientific Study of Population (IUSSP), Busan, 2013.

Breaking a metropolitan area down into its component parts is of particular importance in estimating the effects of migration within it, because these tend to differ according to the area of the city in question. For example, central areas have typically been expellers, while the periphery has been attractive. This is clearly seen in maps V.1A, V.1B and V.1C, where the capital district of Bogotá systematically loses population in its exchanges with the rest of the Bogotá metropolitan area through the processes of peripheral expansion and suburbanization.

[7] This is once again a key issue, because in recent years such intrametropolitan exchanges have acquired large dimensions, along with a growing relative weight and visibility (ECLAC, 2012).

■ Table V.10

Monterrey, Mexico: example of a basic migration matrix with disaggregation of the city's component minor civil divisions, 2000 census

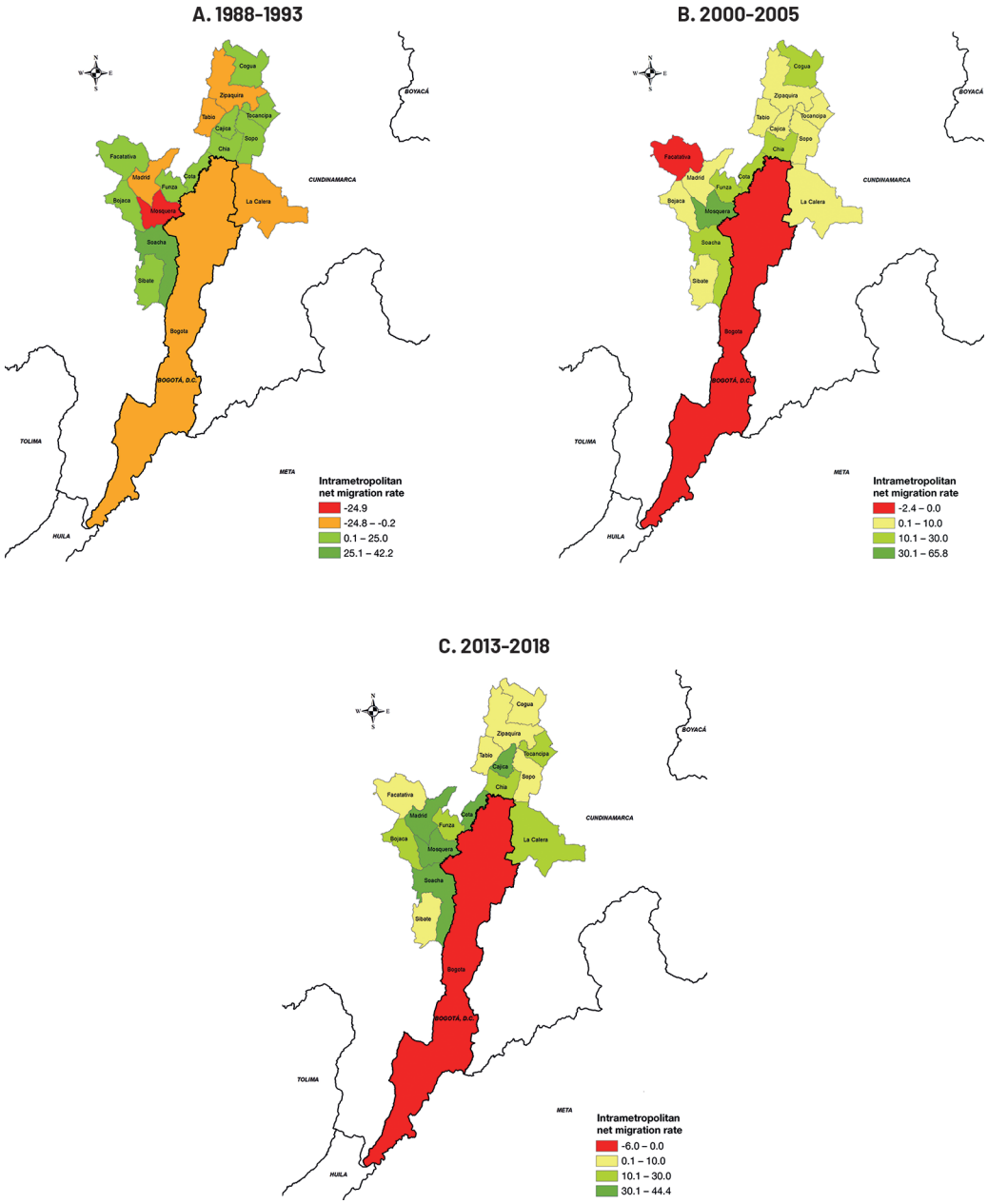
(Number of persons counted)

Municipality of registration	Municipality of residence five years ago													Total	Total in 1995	Net migration
	Apodaca	Carmen	García	San Pedro Garza García	General Escobedo	Guadalupe	Juárez	Monterrey	Salinas Victoria	San Nicolás de la Garza	Santa Catarina	Santiago	Rest of the state	Rest of the country			
Apodaca	178 845	33	-	471	3 212	10 602	440	17 228	44	16 354	1 260	211	1 887	9 472	240 059	190 515	49 544
Carmen	57	4 806	12	-	84	27	-	56	80	15	-	-	124	302	5 563	5 232	331
García	37	-	18 456	378	176	251	-	1 252	20	134	2 265	-	43	1 359	24 371	19 160	5 211
San Pedro Garza García	70	-	29	95 327	137	695	16	2 814	-	464	1 415	84	356	9 384	110 791	107 244	3 547
General Escobedo	2 251	17	-	404	151 913	2 971	150	22 129	117	6 762	780	55	1 952	8 313	197 814	162 042	35 772
Guadalupe	2 304	-	-	692	1 086	553 190	649	15 009	30	4 904	926	40	2 372	13 512	594 714	598 331	-3 617
Juárez	222	60	-	303	350	13 989	31 565	3 586	60	1 408	111	92	1 730	1 912	55 388	33 286	22 102
Monterrey	1 164	18	93	1 661	1 401	5 050	86	927 881	19	5 017	755	262	3 078	37 195	983 680	1 044 703	61 023
Salinas Victoria	533	104	-	5	871	246	-	1 016	10 976	816	114	10	265	1 261	16 217	11 718	4 499
San Nicolás de la Garza	1 977	-	18	592	685	4 804	81	9 543	108	411 564	478	3	1 680	13 650	445 183	455 883	-10 700
Santa Catarina	358	-	206	4 873	343	1 605	53	4 209	-	755	180 676	179	519	5 038	198 814	190 151	8 663
Santiago	-	-	-	-	9	149	4	472	1	262	10	30 921	116	703	32 647	32 706	-59
Rest of the state	692	64	8	67	414	946	117	3 188	96	716	113	107	435 042	17 351	458 921	456 879	**Monterrey net migration = 54 270**
Rest of the country	2 005	130	338	2 471	1 361	3 806	125	36 320	167	6 712	1 248	742	7 715	81 036 611	81 099 751	81 156 063	
Total	190 515	5 232	19 160	107 244	162 042	598 331	33 286	1 044 703	11 718	455 883	190 151	32 706	456 879	81 156 063	84 463 913	84 463 913	

Source: Prepared by the author, on the basis of A. M. Chávez and others, "Nouvelles tendances de la migration métropolitaine en Amérique Latine: est-ce que les aires métropolitaines gagnent ou perdent population à cause de la migration interne", paper presented at the session 091 "Internal migration and urbanization: Overview", Conference of the International Union for the Scientific Study of Population (IUSSP), Busan, 2013 [online] www.iussp.org/en/event/17/programme/paper/2698.

■ Map V.1

Bogotá Metropolitan Area: intrametropolitan migration rate (per 1,000), by component entities (Special District of Bogotá and surrounding municipalities), 1988–1993, 2000–2005 and 2013–2018



Source: J. Rodríguez, "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina", *Project Documents* (LC/TS.2022/92), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.

The third type is the intercity migration matrix, in which case the territorial entities that are displayed are cities constructed as groupings of municipalities. In turn, the municipalities that are not part of the cities constitute the remainder, which may in turn have its own segmentations. The key step in constructing this matrix is the definition of the cities and the identification of their component municipalities. Tables V.11 and V.12 show, for illustrative purposes, data from the 2000 Panamanian census: a simple case of a country with few cities (defined as clusters with 20,000 inhabitants or more). Note that at the end of the twentieth century, Panama reported a feature that was characteristic of the region but that, in several countries, was moderated or even reversed over the last two decades of that century: the overwhelming attractiveness of the main city, which was maintained even in the vigour of its exchanges with other cities. That situation is presented in a novel way on map V.2, where the colours and sizes of the cities indicate the direction and volume of exchanges with the reference city.

■ Table V.11

Panama: intercity migration matrix including the remainder, 2000

(Number of persons counted)

	Panama City	Colón	David	Bugaba	Barú	Changuinola	Chitré	Santiago	Other	Total
Panama City	985 154	6 882	7 539	3 282	4 729	1 492	2 436	5 797	71 494	1 088 805
Colón	2 987	137 734	272	100	199	146	41	185	6 303	147 967
David	1 918	126	94 741	2 004	2 651	834	88	169	6 426	108 957
Bugaba	750	48	999	52 573	1 417	291	14	59	3 387	59 538
Barú	450	18	492	887	46 792	131	-	27	1 820	50 617
Changuinola	334	74	528	309	259	54 542	12	54	3 688	59 800
Chitré	866	28	73	24	21	30	33 038	130	3 672	37 882
Santiago	1 413	65	162	79	52	102	106	58 371	6 194	66 544
Other	13 172	1 223	3 234	1 822	1 680	1 559	1 275	1 947	775 221	801 033
Total	1 007 044	146 198	108 040	61 080	57 800	59 027	37 010	66 739	878 205	2 421 143

Source: J. Rodríguez, "La migración interna en las grandes ciudades en América Latina: efectos sobre el crecimiento demográfico y la composición de la población", *Notas de Población*, No. 96 (LC/G.2573-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2013.

■ Table V.12

Panama: intercity migration matrix excluding the remainder, 2000

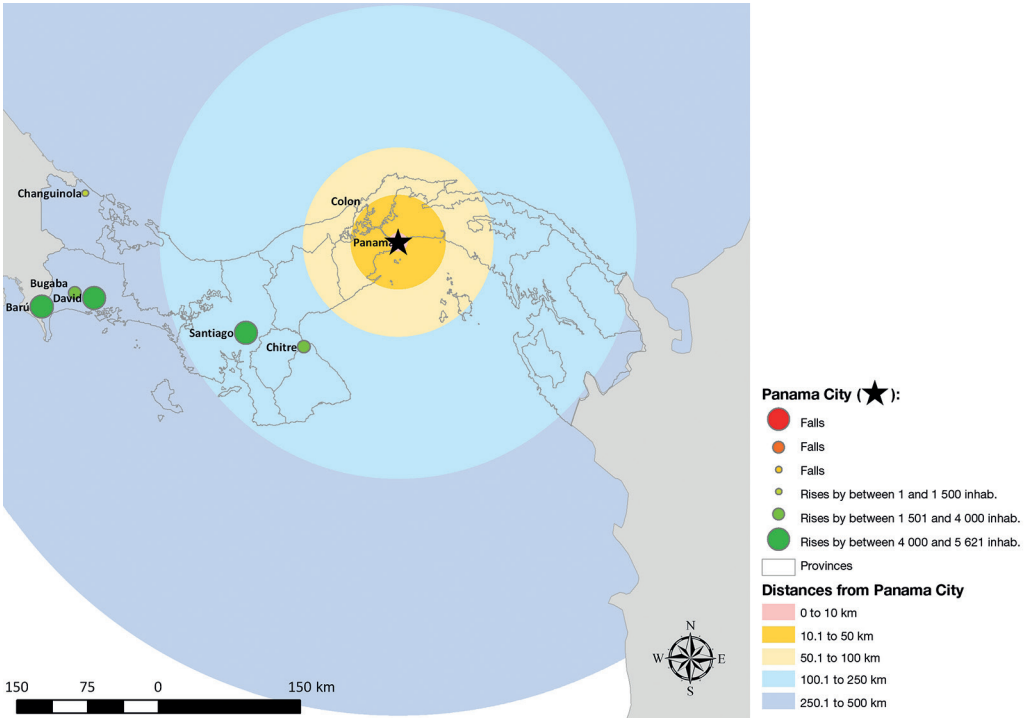
(Number of persons counted)

	Panama City	Colón	David	Bugaba	Barú	Changuinola	Chitré	Santiago	Total
Panama City	985 154	6 882	7 539	3 282	4 729	1 492	2 436	5 797	1 017 311
Colón	2 987	137 734	272	100	199	146	41	185	141 664
David	1 918	126	94 741	2 004	2 651	834	88	169	102 531
Bugaba	750	48	999	52 573	1 417	291	14	59	56 151
Barú	450	18	492	887	46 792	131	-	27	48 797
Changuinola	334	74	528	309	259	54 542	12	54	56 112
Chitré	866	28	73	24	21	30	33 038	130	34 210
Santiago	1 413	65	162	79	52	102	106	58 371	60 350
Total	993 872	144 975	104 806	59 258	56 120	57 568	35 735	64 792	1 517 126

Source: J. Rodríguez, "La migración interna en las grandes ciudades en América Latina: efectos sobre el crecimiento demográfico y la composición de la población", *Notas de Población*, No. 96 (LC/G.2573-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2013.

■ Map V.2

Panama: net population exchange of Panama City with other Panamanian cities of more than 20,000 inhabitants, 1995–2000



Source: Prepared by the author, on the basis of special processing of census microdata.

Chapter VI
Flow indicator matrices: composition and inequality effects

Migration has an impact on areas of both origin and destination. Its first impact is strictly demographic, whereby it affects population numbers; in other words, as discussed in chapter IV, it has an effect on population growth. Information on migration flows and trends is therefore very useful for subnational demographic forecasts, which until recently were prepared with little or no information on this type of migration. The impact of migration is also qualitative, in that the flows are composed of people with specific characteristics who are not representative of either their areas of origin or their places of destination; as a result, they modify the population profile in both their places of departure and arrival. Among the demographic attributes that tend to be most affected by migration flows are gender and age structures and levels of schooling. The selectivity of migratory flows according to various characteristics has already been documented: by sex (in Latin America, women had a greater migratory propensity until the end of the last century; at that point the trend switched, and now, as will be seen below, men are more likely to migrate), by age (migration is much more likely among young people) and by education (propensity tends to increase as the level of formal education rises) (Rodríguez, 2004a; Rodríguez and Busso, 2009; Bernard, Bell and Charles-Edwards, 2014). It should be noted that, like the growth effect, this compositional or qualitative effect of migration —a qualifier that does not mean it cannot be measured— varies inversely with the size of the geographical entity (see box VI.1).

■ Box VI.1
Qualitative effect of migration

It is commonly recognized that internal migration, defined as a change of residence from one county to another, is the most important component of small area population change (Long and Wetrogan, 1986; Rives and Serow, 1984; Wetrogan, 1983; Lycan and Weiss, 1979, cited in Voss, Nammer and Meier, 2001). Migration also is the principal determinant of differences in population change and structure among such areas (Goldstein, 1976, p. 425, cited in Voss, Nammer and Meier, 2001). For this reason, among others, migration is generally a major preoccupation for county and municipal planners responding to changing land use, housing, and transportation patterns; for labour market analysts examining the changing human-resource base of a local economy; for businesses confronting changing demand for goods and services; for school administrators anticipating facility construction and instructional needs due to the changing number and composition of students; and for social service providers responding to changing client and community needs.

Source: P. Voss, R. Nammer and A. M. Meier, "Migration analysis: A case study for local public policy", *Population Research and Policy Review*, vol. 20, No. 6, Berlin, Springer, 2001, p. 587.

The direction and magnitude of the composition effect is determined by the volumes and, above all, the selectivity of migratory flows. This effect is felt in areas of both origin and destination. The theoretical anticipation of this effect is usually stronger when the exchange takes place between areas that are markedly different from each other and has a systematic balance (usually positive for one and negative for the other). This is the case of rural-urban migration, where some of its effects can be anticipated even though rigorous quantitative estimates have not been calculated. On a strictly demographic level, the effects of migratory selectivity are notable (see box VI.2), but the data and methodological tools available to quantify these effects are very limited.

■ Box VI.2
Demographic effect of internal migration on cities

"The analysis reveals a marked concentration among young adults of both sexes and in particular, a more intensive migration among women. This behaviour is not the same in all the areas, because some areas are affected by international migrants whose characteristics are different from those of internal migrants. That is the case with Greater Buenos Aires where half of the population in 1960 was constituted by migrants, of which 57 percent were Argentines coming from other places of the country, and the remainder, 43 percent, were foreign migrants. The different composition by sex of the domestic and foreign migrants is not enough to balance the sex ratio of the total migration, which is found to equal 98 men per each 100 women, as compared with an even sex ratio among the non-migrant population."

Source: Z. Camisa, "Efecto de la migración en el crecimiento y la estructura de la población de las ciudades de la América Latina", *Serie C*, No. 139, Santiago, Latin American Demographic Centre (CELADE), 1972.

One important consequence of this qualitative effect of migration is that it has a direct impact on socioterritorial gaps in the attributes it affects, in the same way as it can narrow or intensify population growth gaps between a country's different regions. To put it simply: migration can cancel out —or, alternatively, exacerbate— disparities in the age structures between a country's major civil divisions (even if they are solely on account of different vegetative demographic dynamics). For example, if older persons migrate to regions where the average age is higher, the disparities will widen. In short, migration can be a key process in the reduction or widening of socioterritorial gaps in sociodemographic indicators.

Until recently, inappropriate procedures were used to examine this qualitative effect, such as comparisons between migrants and non-migrants, as shown in the example on table VI.1. The problems with this approach are obvious: since migrants are a non-representative sample of the population, they tend to deviate significantly from the averages of non-migrants (sometimes because of genuine differences and, sometimes, because of compositional effects arising from their very selectivity). The weaknesses of this approach are not overcome by including out-migrants in the comparison (a column that is absent from table VI.1 but that is included on table VI.2), since the absolute numbers or amounts are behind the averages of each group and their respective gaps. The combination of both parameters —gaps and amounts— is what defines the magnitude of migration's effect on a given attribute in areas of origin and destination.

In view of these weaknesses, the Latin American and Caribbean Demographic Centre (CELADE)-Population Division of ECLAC developed an ad hoc procedure, which it has disseminated through various channels since 2004 (Rodríguez and Rowe, 2018; Rodríguez, 2013; Rodríguez and Busso, 2009; Rodríguez, 2006, 2004a, 2004b and 2013). The procedure is based on the flow indicator matrix (from the recent migration matrix), to which a comparison of its marginals is applied: one of which corresponds to the attribute at the time of the census (in other words with migration) and the other to the attribute five years earlier (which is to say without migration). This difference is used to deduce whether migration had a (net and exclusive) effect —either upward or downward— on the attribute.[1] The idea behind the procedure is not entirely original, since it was already present in the specialized literature some years ago, as can be seen on table VI.3. However, the table reflects a simplified and ideal approximation to the quantification of migration's effect on human resources at the points of origin and destination: "simplified" because it takes only two territorial divisions into account, and countries have many more; and "ideal" because it assumes that population data both before and after migration are available, which is rare and, in fact, impossible when censuses are used (Rodríguez and Busso, 2009).

[1] It should be noted that one key assumption in the procedure is the invariance or identical variability of the attribute's entire population over the five years prior to the census, which is almost completely fulfilled with respect to several important attributes (such as sex, age, ethnicity or education after a certain age). For that same reason, the procedure is not recommended for attributes that vary over five years (unemployment, poverty and marital status), and all the more so if that variation could be due to migration (endogeneity). Similarly, the procedure yields meaningless results if it is applied to lifetime migration, because of the lack of a reference period (Rodríguez and Busso, 2009; Rodríguez and Rowe, 2018).

■ Table VI.1

Plurinational State of Bolivia: average years of schooling, labour participation rate, percentage of population with household deprivation and percentage of heads of household who are homeowners, by department of usual residence and by internal migration status at the level of major civil divisions (and gap between migrants and non-migrants), 2001

Department of usual residence	Average years of schooling (population aged 25 years and over)			Labour participation rate (population aged 15 to 64)			Percentage of population with household deprivation (or poor due to unsatisfied basic needs)			Percentage of heads of household who are homeowners		
	In-migrants	Non-migrants	Gap between in-migrants and non-migrants	In-migrants	Non-migrants	Gap between in-migrants and non-migrants	In-migrants	Non-migrants	Gap between in-migrants and non-migrants	In-migrants	Non-migrants	Gap between in-migrants and non-migrants
Chuquisaca	8.18	4.74	3.44	47.29	52.57	-5.28	31.68	61.58	-29.91	29.71	76.30	-46.59
La Paz	10.33	7.03	3.30	60.12	59.40	0.72	19.86	35.79	-15.93	34.18	69.74	-35.56
Cochabamba	8.54	6.44	2.10	58.89	58.69	0.20	28.79	44.06	-15.26	30.83	71.95	-41.12
Oruro	8.75	7.07	1.68	54.51	57.73	-3.22	33.01	45.69	-12.68	40.80	72.28	-31.48
Potosí	9.26	4.12	5.14	57.05	56.78	0.27	31.73	65.09	-33.37	38.25	80.33	-42.08
Tarija	7.96	6.17	1.79	62.38	58.96	3.42	31.71	41.18	-9.47	27.41	68.20	-40.78
Santa Cruz	7.94	7.50	0.44	66.74	59.81	6.93	38.82	37.78	1.03	27.03	59.68	-32.65
Beni	8.92	6.70	2.22	63.83	60.73	3.10	50.28	62.68	-12.39	39.03	66.53	-27.50
Pando	8.65	6.32	2.33	70.13	60.39	9.74	58.91	65.75	-6.84	37.29	74.52	-37.23
Country total	8.59	6.58	2.01	61.29	58.71	2.58	33.63	43.91	-10.28	31.18	69.40	-38.22

Source: Prepared by the author, on the basis of special processing of census microdata with REDATAM+SP.

■ Table VI.2

Plurinational State of Bolivia (Department of Chuquisaca): average years of schooling of heads of household (male and female) by internal migration status, by department of origin and destination, 2001

In-migrants' departments of origin and out-migrants' departments of destination	In- migrants	Out-migrants	Non-migrants	Gap between in-migrants and out-migrants	Gap between in-migrants and non-migrants	Gap between out-migrants and non-migrants
La Paz	11.2	12.3	5.0	-1.0	6.3	7.3
Cochabamba	9.4	8.1	12.3	1.3	-2.8	-4.2
Oruro	11.4	12.4	8.1	-1.0	3.3	4.3
Potosí	8.5	10.9	12.4	-2.4	-3.9	-1.5
Tarija	10.2	6.5	10.9	3.7	-0.7	-4.4
Santa Cruz	9.0	6.8	6.5	2.2	2.5	0.3
Beni	12.8	11.1	6.8	1.8	6.1	4.3
Pando	13.0	13.8	11.1	-0.8	1.9	2.7

Source: Prepared by the author, on the basis of special processing of census microdata with REDATAM+SP.

■ Table VI.3

"Theoretical" procedure for quantifying the impact of migration on areas of origin and destination
(Number of inhabitants and percentages)

	Region A		Region B		Migrants
	Number	Percentage	Number	Percentage	B A
Before migration					
Population *(Thousands)*	1 000		500		100
Population with secondary-school diplomas	800	80	250	50	70
Population without secondary-school diplomas	200	20	250	50	30
Diploma A/Diploma B *(Percentages)*		1.60			
After migration					
Population *(Thousands)*	1 100		400		
Population with secondary-school diplomas	870	79	180	45	
Population without secondary-school diplomas	230	21	220	55	
Diploma A/Diploma B *(Percentages)*		1.75			

Source: M. Polese, *Economía urbana y regional: introducción a la relación entre territorio y desarrollo*, Cartago, Libro Universitario Regional, 1998, p. 198.

The advantage of the proposed procedure —based on the flow indicator matrices presented below and therefore operating only with census or survey microdata and, in the latter case, with all due precautions regarding the sample representativeness of the figures— is that it allows an estimation of the net and exclusive effect of the territorial division's migratory exchanges with the country's other divisions (Rodríguez and Busso, 2009; Rodríguez and Rowe, 2018).

The calculation of the flow indicator matrix changes according to the type of variable in question. Broadly speaking, there are two methods. First are the indicators that correspond to ratios or percentages derived from the division of two population matrices. For ratios, these matrices constitute the numerator and denominator of the quotient which, as is known, belong to different populations. For percentages, these matrices serve as the numerator and denominator of the quotient, representing, respectively, a subset and its set. Second come those indicators that correspond to averages, which are obtained by the division of two matrices: the first of persons, and the second, a totalling of the attribute for which the average is to be calculated (Rodríguez, 2013).

A. Composition effect

The normal derived calculations of a migration matrix do not apply to these matrices. However, there is a standard derivative calculation routine, which allows estimates of the impact of migration on the attributes used to build the matrix, as explained below.

Tables VI.4, VI.5 and VI.6 present the generic calculation for the sex ratio of migratory flows.[2] Tables VI.4 and VI.5 show the generic migration matrices for men and women, respectively. Table VI.6 shows the flow indicator matrix. What is involved in this case is the sex ratio of each flow, obtained as the quotient between the male matrix (numerator) and the female matrix (denominator), and the derived calculations that allow the effect of internal migration on the sex ratio of the places considered in the matrix to be estimated. Tables VI.7, VI.8 and VI.9 show the generic calculation for the average number of years of schooling for the population aged over 24. Table VI.7 presents the generic migration matrix for the population aged 25 and over. Table VI.8 contains a completely new matrix —intended solely for working purposes and not for interpretation— that indicates the total years of schooling in each flow, while table VI.9 shows the flow indicator matrix.[3] This case covers the average schooling of the flows of people aged 25 and over, obtained as the quotient between the sum of the years of schooling of the population aged 25 and over (numerator) and the migration matrix of the population aged 25 and over (denominator).

2 Including the diagonal, which is technically not a flow.
3 Including the diagonal, which is technically not a flow.

■ Table VI.4
Generic migration matrix for men

Current place of residence	Place of residence five years prior					Total
	1	2	3	[...]	i	
1	M_{11}	M_{21}	M_{31}	[...]	M_{i1}	$M_{.1}$
2	M_{12}	M_{22}	M_{32}	[...]	M_{i2}	$M_{.2}$
3	M_{13}	M_{23}	M_{33}	[...]	M_{i3}	$M_{.3}$
[...]						
I	M_{1i}	M_{2i}	M_{3i}	[...]	M_{ii}	$M_{.i}$
Total	$M_{1.}$	$M_{2.}$	$M_{3.}$	[...]	$M_{i.}$	$M_{..}$

Source: Prepared by the author.

■ Table VI.5
Generic migration matrix for women

Current place of residence	Place of residence five years prior					Total
	1	2	3	[...]	i	
1	W_{11}	W_{21}	W_{31}	[...]	W_{i1}	$W_{.1}$
2	W_{12}	W_{22}	W_{32}	[...]	W_{i2}	$W_{.2}$
3	W_{13}	W_{23}	W_{33}	[...]	W_{i3}	$W_{.3}$
[...]						
I	W_{1i}	W_{2i}	W_{3i}	[...]	W_{ii}	$W_{.i}$
Total	$W_{1.}$	$W_{2.}$	$W_{3.}$	[...]	$W_{i.}$	$W_{..}$

Source: Prepared by the author.

■ Table VI.6
Generic sex ratio indicator matrix

Current place of residence	Place of residence five years prior					Total (factual)	Counterfactual	Absolute effect	Relative effect
	1	2	3	[...]	i				
1	$(M_{11}/W_{11}) = SR_{11}$	$(M_{21}/W_{21}) = SR_{21}$	$(M_{31}/W_{31}) = SR_{31}$	[...]	$(M_{i1}/W_{i1}) = SR_{i1}$	$(M_{.1}/W_{.1}) = SR_{.1}$	$(M_{1.}/W_{1.}) = SR_{1.}$	$SR_{.1} - SR_{1.}$	$(SR_{.1} - SR_{1.})/SR_{1.}*100$
2	$(M_{12}/W_{12}) = SR_{12}$	$(M_{22}/W_{22}) = SR_{22}$	$(M_{32}/W_{32}) = SR_{32}$	[...]	$(M_{i2}/W_{i2}) = SR_{i2}$	$(M_{.2}/W_{.2}) = SR_{.2}$	$(M_{2.}/W_{2.}) = SR_{2.}$	$SR_{.2} - SR_{2.}$	$(SR_{.2} - SR_{2.})/SR_{2.}*100$
3	$(M_{13}/W_{13}) = SR_{13}$	$(M_{23}/W_{23}) = SR_{23}$	$(M_{33}/W_{33}) = SR_{33}$	[...]	$(M_{i3}/W_{i3}) = SR_{i3}$	$(M_{.3}/W_{.3}) = SR_{.3}$	$(M_{3.}/W_{3.}) = SR_{3.}$	$SR_{.3} - SR_{3.}$	$(SR_{.3} - SR_{3.})/SR_{3.}*100$
[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]	*[...]*	*[...]*
i	$(M_{1i}/W_{1i}) = SR_{1i}$	$(M_{2i}/W_{2i}) = SR_{2i}$	$(M_{3i}/W_{3i}) = SR_{3i}$	[...]	$(M_{ii}/W_{ii}) = SR_{ii}$	$(M_{.i}/W_{.i}) = SR_{.i}$	$(M_{i.}/W_{i.}) = SR_{i.}$	$SR_{.i} - SR_{i.}$	$(SR_{.i} - SR_{i.})/SR_{i.}*100$
Total	$(M_{1.}/W_{1.}) = SR_{1.}$	$(M_{2.}/W_{2.}) = SR_{2.}$	$(M_{3.}/W_{3.}) = SR_{3.}$	[...]	$(M_{i.}/W_{i.}) = SR_{i.}$				

Source: Prepared by the author.

■ Table VI.7
Generic migration matrix, population aged 25 years and over

Current place of residence	Place of residence five years prior					Total
	1	2	3	[...]	i	
1	N_{11}	N_{21}	N_{31}	[...]	N_{i1}	$N_{.1}$
2	N_{12}	N_{22}	N_{32}	[...]	N_{i2}	$N_{.2}$
3	N_{13}	N_{23}	N_{33}	[...]	N_{i3}	$N_{.3}$
[...]						
I	N_{1i}	N_{2i}	N_{3i}	[...]	N_{ii}	$N_{.i}$
Total	$N_{1.}$	$N_{2.}$	$N_{3.}$	[...]	$N_{i.}$	$N_{..}$

Source: Prepared by the author.

■ Table VI.8
Total years of schooling per flow, population aged 25 years and over

Current place of residence	Place of residence five years prior					Total
	1	2	3	[...]	i	
1	$\sum YS_{11}$	$\sum YS_{21}$	$\sum YS_{31}$	[...]	$\sum YS_{i1}$	$\sum YS_{.1}$
2	$\sum YS_{12}$	$\sum YS_{22}$	$\sum YS_{32}$	[...]	$\sum YS_{i2}$	$\sum YS_{.2}$
3	$\sum YS_{13}$	$\sum YS_{23}$	$\sum YS_{33}$	[...]	$\sum YS_{i3}$	$\sum YS_{.3}$
[...]						
I	$\sum YS_{1i}$	$\sum YS_{2i}$	$\sum YS_{3i}$	[...]	$\sum YS_{ii}$	$\sum YS_{.i}$
Total	$\sum YS_{1.}$	$\sum YS_{2.}$	$\sum YS_{3.}$	[...]	$\sum YS_{i.}$	$\sum YS_{..}$

Source: Prepared by the author.

■ Table VI.9
Generic flow indicator matrix, average years of schooling among the population aged 25 and over

Current place of residence	Place of residence five years prior					Total (factual)	Counterfactual	Absolute effect	Relative effect
	1	2	3	[...]	i				
1	$(\sum YS_{11}/N_{11}) = AYS_{11}$	$(\sum YS_{21}/N_{21}) = AYS_{21}$	$(\sum YS_{31}/N_{31}) = AYS_{31}$	[...]	$(\sum YS_{i1}/N_{i1}) = AYS_{i1}$	$(\sum YS_{.1}/N_{.1}) = AYS_{.1}$	$(\sum YS_{1.}/N_{1.}) = AYS_{1.}$	$AYS_{.1} - AYS_{1.}$	$(AYS_{.1} - AYS_{1.})/AYS_{1.}*100$
2	$(\sum YS_{12}/N_{12}) = AYS_{12}$	$(\sum YS_{22}/N_{22}) = AYS_{22}$	$(\sum YS_{32}/N_{32}) = AYS_{32}$	[...]	$(\sum YS_{i2}/N_{i2}) = AYS_{i2}$	$(\sum YS_{.2}/N_{.2}) = AYS_{.2}$	$(\sum YS_{2.}/N_{2.}) = AYS_{2.}$	$AYS_{.2} - AYS_{2.}$	$(AYS_{.2} - AYS_{2.})/AYS_{2.}*100$
3	$(\sum YS_{13}/N_{13}) = AYS_{13}$	$(\sum YS_{23}/N_{23}) = AYS_{23}$	$(\sum YS_{33}/N_{33}) = AYS_{33}$	[...]	$(\sum YS_{i3}/N_{i3}) = AYS_{i3}$	$(\sum YS_{.3}/N_{.3}) = AYS_{.3}$	$(\sum YS_{3.}/N_{3.}) = AYS_{3.}$	$AYS_{.3} - AYS_{3.}$	$(AYS_{.3} - AYS_{3.})/AYS_{3.}*100$
[...]							[...]	[...]	[...]
i	$(\sum YS_{1i}/N_{1i}) = AYS_{1i}$	$(\sum YS_{2i}/N_{2i}) = AYS_{2i}$	$(\sum YS_{3i}/N_{3i}) = AYS_{3i}$	[...]	$(\sum YS_{ii}/N_{ii}) = AYS_{ii}$	$(\sum YS_{.i}/N_{.i}) = AYS_{.i\,i}$	$(\sum YS_{i.}/N_{i.}) = AYS_{i.}$	$AYS_{.i} - AYS_{i.}$	$(AYS_{.i} - AYS_{i.})/AYS_{i.}*100$
Total	$(\sum YS_{1.}/N_{1.}) = YS_{1.}$	$(\sum YS_{2.}/N_{2.}) = YS_{2.}$	$(\sum YS_{3.}/N_{3.}) = YS_{3.}$	[...]	$(\sum YS_{i.}/N_{i.}) = YS_{i.}$	$(\sum YS_{..}/N_{..}) = YS_{..}$	$(\sum YS_{..}/N_{..}) = YS_{..}$		

Source: Prepared by the author.

The derived calculations are shown in the two new columns (highlighted in bold italics) and indicate the absolute and relative effect of internal migration on the sex ratio of the places used to construct the matrix (major civil divisions, minor civil divisions, cities, urban and rural areas, among others). The absolute value corresponds to the difference between the column marginal (which is the factual value of the sex ratio and average schooling of the population aged 25 and over in each place, in other words the observed value, which is influenced by migration during the reference period) and the row marginal[4] (which is the counterfactual value, in other words the sex ratio and average schooling of the population aged 25 and over in each place that would exist if there had been no migration during the reference period). The relative value corresponds to the absolute value divided by the counterfactual and indicates the amount of the effect with respect to the initial value (which is another interpretation of the counterfactual value) (Rodríguez, 2013; Rodríguez and Rowe, 2018).

A negative value of the effect for a given location means that migration tends to reduce the indicator being examined (sex ratio or average schooling of the population aged 25 and over). Conversely, if the effect has a positive value for a given location, migration tends to raise the indicator in question. Those positive or negative values are not necessarily repeated in the trend of the indicator in that place, because that depends on other factors. For example, the trend for the sex ratio in a given location also depends on levels and trends in the sex breakdown of international migration, the sex ratio at birth and sex-specific mortality rates (Rodríguez, 2013; Rodríguez and Rowe, 2018).

Note that this effect can be broken down into the impact of in-migration and that of out-migration. The former is obtained as the difference between the factual value and the value of non-migrants for each location. The latter is obtained as the difference between the value of non-migrants and the counterfactual value for each location (Rodríguez, 2013; Rodríguez and Rowe, 2018) (see table VI.10).

■ Table VI.10
Effect of migration on the sociodemographic composition of cities: key formulae

	Effect of migration on the attribute K of place i		
	Total	In-migration	Out-migration
Absolute	K.i - Ki.	K.i - Kii	Kii - Ki.
Relative	((K.i - Ki.) / Ki.) * 100	(K.i - Kii) / Ki.) * 100	((Kii - Ki.) / Ki.)) * 100

Source: Prepared by the author.

To summarize, the document's key formulae are shown on table VI.10, where K is the variable or indicator of interest (average age, sex ratio, percentage of children, average years of schooling) and i is the territorial entity in question (major civil division, minor civil division, city, etc.) and the points indicating the marginal at the current time or five years earlier, in keeping with the standard nomenclature used on migration matrices.

[4] Which was copied and transposed to facilitate the calculations in Excel, as well as to display the operation and the results.

At the same time, in order to avoid confusion and indicate the distinctions properly, the differences between the matrices of persons and those of flow indicators should be determined, as should those between the growth effect and the composition effect. First, in flow indicator matrices, the composition effect in all the entities can have the same sign (positive or negative), something that by definition cannot occur with the growth effect in person matrices. Second, the marginal can be less than the diagonal (and less than any cell from which it originates), which is impossible in person matrices, since the marginal corresponds to the sum of the cells where it originates. Third, the composition effect can only be calculated for some attributes: namely, those that do not change over the reference period or those that change equally for all individuals over that period (such as age). Fourth, the formula for estimating the composition effect derived from out-migration is the diagonal minus the counterfactual, which is to say it reverses the order of the subtraction formula used to calculate the effect of out-migration on growth. The fifth and final difference is that the denominator for calculating the relative effects is the counterfactual and not, as with the growth effect, the average population.

Tables VI.11, VI.12 and VI.13 show a detailed calculation of a flow indicator matrix. This is the indicator of years of schooling for the 25 to 40 age group in Mexico City (in its expanded definition, which is known as the Valley of Mexico Metropolitan Area and comprises 76 municipalities and city boroughs, with data from the 2010 census), using a closed matrix with the remainder grouped into near and far categories. Table VI.11 uses the closed city migration matrix for the reference group; table VI.12 shows the working matrix (which is not interpreted, since it only serves calculation purposes), the cells of which contain the years of schooling of the population in question. The matrix in table VI.13 shows the division of the two previous matrices, with the calculation of the four indicators that summarize the impact of this age group's migrations on the average years of schooling of this age group in Mexico City over the 2005–2010 period. Through migratory exchanges with the rest of the country's municipalities, Mexico City loses 0.01 years of schooling (11.01 factual vs. 11.02 counterfactual), which represents a drop of 0.09%. Contrary to what is still commonly thought, this loss is not due to in-migration but to out-migration, since more people leave the city than migrate to it and, in addition, they have higher levels of schooling than those who remain.

■ Table VI.11

Mexico City (expanded definition): migration matrix, 25–40 age group, 2010

(Number of persons counted)

Usual residence, Mexico City	Residence five years ago, Mexico City			
	Mexico City	Remaining municipalities in the states (includes only municipalities of the State of Mexico)	Rest of the country	Total
Mexico City	4 587 167	22 640	102 902	4 712 709
Remaining municipalities in the states (includes only municipalities of the State of Mexico)	27 268	838 980	14 203	880 451
Rest of the country	156 274	14 268	18 647 953	18 818 495
Total	4 770 709	875 888	18 765 058	24 898 834

Source: Prepared by the author, on the basis of special processing of census microdata with REDATAM+SP.

■ Table VI.12
Mexico City (expanded definition): working migration matrix (accumulated schooling) for calculating the years of schooling flow indicator, 25–40 age group, 2010
(Number of persons counted)

Usual residence, Mexico City	Residence five years ago, Mexico City			
	Mexico City	Remaining municipalities in the states (includes only municipalities of the State of Mexico)	Rest of the country	Total
Mexico City	50 446 201	243 629	1 190 516	51 880 346
Remaining municipalities in the states (includes only municipalities of the State of Mexico)	332 346	7 644 983	175 005	8 256 245
Rest of the country	1 808 228	155 973	175 764 428	181 561 827
Total	52 586 775	8 044 585	177 129 949	242 259 822

Source: Prepared by the author, on the basis of special processing of census microdata with REDATAM+SP.

■ Table VI.13
Mexico City (expanded definition): migration matrix of the years of schooling flow indicator for the 25–40 age group, 2010

Usual residence, Mexico City	Residence five years ago, Mexico City				Absolute effect	Relative effect *(Percentages)*	Effect of in-migration (absolute)	Effect of out-migration (absolute)
	Mexico City	Remaining municipalities in the states (includes only municipalities of the State of Mexico)	Rest of the country	Total				
Mexico City	11.00	10.76	11.57	11.01	-0.01	-0.09	0.01	-0.03
Remaining municipalities in the states (includes only municipalities of the State of Mexico)	12.19	9.11	12.32	9.38				
Rest of the country	11.57	10.93	9.43	9.65				
Total	11.02	9.18	9.44	9.73				

Source: Prepared by the author, on the basis of special processing of census microdata with REDATAM+SP.

Table VI.14 presents another application, based on a rural-urban migration matrix, with the percentage of older persons as the study attribute. The results confirm the effect of rural-urban migration on premature ageing in rural areas. They also reveal that this is due to the selective out-migration from rural areas by young people, which in turn explains why this in-migration tends to rejuvenate urban areas, as it more than compensates for the outflow of young people from urban areas, at least in the case of Panama in the 2005–2010 period.

■ Table VI.14
Panama: estimate of the impact of rural-urban migration on the proportion of older persons in rural and urban areas, 2005–2010[a]
(Percentages).

Area of usual residence	Area of previous residence (2005–2010)			Absolute effect of migration[b]	Relative effect of migration[c]
	Urban	Rural	Total		
Urban	11.48	6.75	11.28	-0.10627	-0.941953
Rural	6.54	12.44	12.23	0.22661	1.852441
Total	11.39	12.01	11.61		

Source: Economic Commission for Latin America and the Caribbean (ECLAC), *Population, territory and sustainable development* (LC/L.3474(CEP.2/3)), Santiago, 2012.
Note: The effect of in-migration on the urban area is 11.28 - 11.48 = -0.20, which shows that in-migration reduces the ageing of the urban population and more than compensates for the ageing produced by out-migration (11.48 - 11.39 = 0.09). In the rural areas, out-migration has a pronounced ageing effect (12.44 - 12.01 = 0.43).
[a] Proportion of the population aged 60 and over within the population aged 5 years and over in the migration matrix.
[b] The absolute effect corresponds to the difference between the observed value and the counterfactual (under the column 'Residence five years prior'). See formulae in table VI.10.
[c] The relative effect corresponds to the division of the absolute effect by the counterfactual. See formulae in table VI.10.

The use of this procedure does not, however, eliminate the need for further synthesis of the information for national analyses. The results allow estimates for each civil division (both major and minor), which may be of great interest to authorities and analysts, but they do not provide a consolidated figure that would allow the correlation of that impact to certain initial conditions. And that is often the goal of the researcher, in other words to verify whether migration has an effect that reduces or exacerbates territorial gaps within a country. In order to answer this last question, another instrument must be used: the simple correlation coefficient. If the correlation is positive, the major civil divisions with higher levels at the initial moment (five years before the census) are those that have, in the attribute in question and on average, a greater increase caused solely and exclusively by migration. If it is negative, then the major civil divisions with higher levels at the initial moment (five years before the census) are those that record, in the attribute and on average, a lower (or even negative) increase due solely and exclusively to migration (Rodríguez and Busso, 2009). Table VI.15 presents a summary of these correlations in seven study countries.

First, table VI.15 does not show a stylized relationship between the average age in the major civil divisions at the initial moment and the effect of migration on their age structures, since the coefficients are generally low and their positivity or negativity varies from country to country. However, a segmented examination of the age structure at its two extremes (children and older persons) shows a very different picture. Except in the case of the Plurinational State of Bolivia, migration between major civil divisions tends to widen territorial disparities in the proportion of these age groups. The positive coefficients, which are broadly predominant, suggest that major civil divisions with higher initial proportions of children (typically the poorest) are the ones that, on average, experience the greatest increases in that proportion through the effect of migratory exchanges with other major civil divisions.

■ Table VI.15
Latin America (7 countries): correlations between selected sociodemographic variables and their variations through the effect of recent in-migration, at the level of major civil divisions, 1990, 2000, 2010 and 2020 census rounds

Country	Census year	Indicators correlated with the impact produced by internal migration on those indicators					
		Average age	Percentage of children	Percentage of older persons	Sex ratio	Average years of schooling, population aged 30 to 59	Percentage of professionals
Argentina	2001	-0.27	0.61	-0.04	0.64	0.02	-0.08
Bolivia (Plurinational State of)	1992 2001	0.48 0.26	-0.56 -0.32	0.90 0.67	0.95 0.17	-0.14 0.85	-0.69 -0.62
Brazil	1991 2000	-0.02 -0.05	0.07 0.00	0.53 0.47	0.83 0.46	-0.33 -0.02	-0.15 0.06
Chile	1992 2002	0.00 0.08	0.02 0.18	0.77 0.61	0.79 0.78	-0.50 -0.71	-0.44 -0.39
Costa Rica	1984 2000	0.10 -0.19	0.65 0.42	0.43 0.35	0.91 0.27	0.50 0.06	0.47 0.25
Guatemala	1994 2002	-0.63 -0.67	0.15 0.21	0.21 -0.21	0.74 0.48	0.02 -0.04	-0.04 0.04
Mexico	1990 2000	-0.04 -0.17	0.34 0.29	0.53 0.50	0.54 0.19	- -0.22	-0.28 -0.10

Source: Prepared by the author.

Neither does migration between major civil divisions attenuate disparities in the territorial distribution of the population by sex. That distribution —already shaped by migratory flows, particularly from the countryside to the city— has been marked by a basic imbalance: a majority of women in the more urbanized, historically attractive major civil divisions. According to the coefficients shown on table VI.15, recent migration has widened that gap, as the major civil divisions with higher initial proportions of males have seen the rate increase through the sole and exclusive effect of migration.

Finally, the coefficients are less conclusive for the attributes related to the development of human resources. This is not because they are null, but because they lack a systematic tendency towards the positive or the negative: the positive result in some countries suggests a type of migration that widens territorial human capital gaps —because major civil divisions with higher education levels are those that experience the greatest increases as a result of migration— while in others the negative results indicate the exact opposite. Perhaps the most systematic finding is the predominance of negative results in the proportion of professionals. This would suggest that major civil divisions with fewer professionals tend, on average, to experience the greatest increases in that proportion as a result of migratory exchanges with other major civil divisions (Rodríguez and Busso, 2009).

Table VI.16 shows the calculation of the effect of net migration, in-migration and out-migration on the demographic dependency ratio of Mexico's major civil divisions through the processing of the 1990, 2000, 2010 and 2020 censuses and the subsequent calculations. The main findings are:

(i) High magnitudes of impact, approaching -10% over five years in the most extreme cases (Quintana Roo, 2000). Since the demographic dependency ratio in general changes only slowly, a 10% decrease over just five years is clearly significant.

(ii) The persistence of the negative impact of the in-migration effect (which is to say reducing the dependency ratio in all states and at all four moments in time, almost without exception) and, as a counterpart, the systematic and —almost without exception— reverse effect of out-migration. This is obviously on account of the predominant presence of young people among those who migrate. In-migration flows therefore tend to be youth-selective and have a reductive impact on the dependency ratio (increasing its denominator) at places of destination. For the same reason, out-migration flows are also youth-selective across the board, thus increasing the dependency ratio (reducing the denominator) at the points of origin.

(iii) The close correlation between migratory attractiveness (net migration rate) and the composition effect of net migration, which is not always apparent in this type of association. In fact, the simple correlation coefficients between the two indicators are -0.76, -0.81, -0.79 and -0.83 for 1990, 2000, 2010 and 2020, respectively. This corroborates that attractive states have higher balances and, above all, higher positive net migration rates among young people, suggesting that young people tend to migrate to those states. In contrast, expelling states have higher negative net migration rates among young people.

(iv) A selective examination of the cases shows the main exception to the above association: Mexico City, the former Federal District. The States of Baja California Sur and Veracruz, meanwhile, exemplify the standard association. The former is clearly attractive, with positive net migration rates above 10 per 1,000 in all four censuses and with migration effects that reduced the dependency ratio by 2.5% or more over five years in all four censuses. The State of Veracruz provides an opposite example, with chronic expulsion and a migration effect that raised the sex ratio by more than 1% over five years in the four censuses. However, the exception to this is Mexico City, which is highly expulsive in all four censuses, but despite this, migration reduces the dependency ratio in all of them. This is explained by distinguishing the effects of in-migration and out-migration, since in the 1990 and 2000 censuses this civil division is exceptional and out-migration has a reducing effect on the dependency ratio. In 2000 and 2010, however, this shifts to the expected increasing effect, but it is completely offset by a greater reducing effect caused by in-migration. It is clear that the difference arises from the special nature of this civil division, where the massive out-migration is mostly intrametropolitan migration or residential mobility to the State of Mexico (conurbated municipalities within the Valley of Mexico Metropolitan Area). This is because intrametropolitan migration or residential mobility has a different age profile than traditional migration between major civil divisions, as will be seen in the following chapter. Those leaving Mexico City are mostly families with children, and the departure of children helps reduce the dependency ratio (by reducing its numerator).

(v) Of course, the main substantive finding is the distinction between the compositional effect of in-migration and out-migration, which is highly informative for analytical, methodological and policy purposes.

■ Table VI.16

Mexico: effect of net migration, in-migration and out-migration on the demographic dependency ratio within major civil divisions, 1990, 2000, 2010 and 2020

State	1990				2000				2010				2020			
	NM	I	O	NM rate	NM	I	O	NM rate	NM	I	O	NM rate	NM	I	O	NM rate
Aguascalientes	**-1.1**	-2.0	0.9	8.8	**-1.0**	-1.5	0.5	5.3	**-0.7**	-1.1	0.4	3.9	**-0.8**	-1.6	0.8	5.6
Baja California	**-3.3**	-3.2	-0.1	27.5	**-3.9**	-3.7	-0.3	17.7	**-1.2**	-1.4	0.2	2.4	**-1.7**	-2.0	0.2	9.5
Baja California Sur	**-2.5**	-3.3	0.8	13.4	**-2.2**	-3.0	0.9	10.5	**-4.6**	-5.7	1.1	21.7	**-2.5**	-3.8	1.3	10.2
Campeche	**0.3**	-1.5	1.7	4.4	**-0.5**	-1.8	1.3	2.3	**0.3**	-1.5	1.8	0.4	**0.9**	-1.3	2.2	-3.7
Coahuila	**0.5**	-0.9	1.4	-1.3	**-0.2**	-1.2	1.0	0.2	**0.4**	-0.6	0.9	0.3	**-0.3**	-0.9	0.6	0.9
Colima	**-0.5**	-1.7	1.1	7.0	**0.3**	-0.8	1.2	3.7	**-0.3**	-1.0	0.7	9.0	**0.2**	-0.8	1.0	2.3
Chiapas	**1.0**	-0.5	1.5	-2.0	**1.2**	-0.6	1.8	-2.9	**1.3**	-0.5	1.8	-2.2	**1.6**	-0.5	2.1	-4.5
Chihuahua	**-1.0**	-1.3	0.4	7.6	**-2.4**	-2.6	0.3	8.0	**-0.3**	-0.7	0.4	-2.0	**-0.3**	-0.9	0.6	2.6
Mexico City	**-3.0**	-1.5	-1.5	-19.2	**-2.2**	-1.8	-0.4	-11.1	**-1.0**	-1.5	0.6	-9.0	**-1.1**	-2.3	1.1	-5.2
Durango	**1.8**	-0.9	2.7	-7.0	**1.0**	-0.5	1.5	-5.4	**0.4**	-0.5	1.0	-1.1	**0.3**	-0.7	1.0	-1.6
Guanajuato	**0.6**	-0.7	1.2	0.2	**0.2**	-0.8	1.0	1.0	**-0.1**	-0.6	0.4	1.0	**-0.2**	-0.8	0.6	0.4
Guerrero	**1.9**	-0.7	2.6	-6.6	**1.2**	-0.7	1.9	-6.4	**1.0**	-0.7	1.7	-3.5	**2.2**	-0.7	2.9	-7.8
Hidalgo	**2.5**	-1.0	3.5	-2.3	**1.4**	-1.1	2.6	1.5	**0.6**	-1.0	1.5	4.1	**0.6**	-1.1	1.6	5.0
Jalisco	**-0.7**	-1.4	0.7	1.8	**-0.4**	-0.9	0.5	0.3	**-0.4**	-1.0	0.6	-0.4	**-0.4**	-1.1	0.7	1.0
México	**-1.5**	-1.9	0.4	12.5	**-0.2**	-1.1	0.9	5.2	**-0.2**	-0.7	0.5	2.2	**0.1**	-0.7	0.7	-0.9
Michoacán	**0.9**	-0.8	1.7	-1.0	**0.4**	-0.8	1.2	-1.3	**0.7**	-0.6	1.3	-1.6	**0.4**	-0.5	0.9	-1.0
Morelos	**0.3**	-1.1	1.4	10.2	**0.3**	-0.6	0.9	5.5	**-0.6**	-1.3	0.8	3.9	**0.5**	-0.7	1.3	2.6
Nayarit	**1.6**	-1.2	2.8	-0.8	**1.2**	-0.2	1.5	-1.8	**-0.8**	-2.0	1.2	7.0	**0.1**	-1.4	1.5	0.8
Nuevo León	**-1.1**	-1.6	0.5	3.5	**-1.2**	-1.7	0.4	3.8	**-0.9**	-1.5	0.6	2.9	**-1.8**	-2.4	0.5	6.9
Oaxaca	**2.1**	-1.0	3.1	-5.0	**1.7**	-1.1	2.8	-4.2	**1.3**	-0.7	2.0	-1.1	**1.1**	-1.0	2.2	-2.2
Puebla	**0.7**	-1.4	2.1	-0.8	**0.6**	-1.2	1.8	-1.1	**0.2**	-1.0	1.2	-0.6	**0.3**	-1.1	1.4	0.5
Querétaro	**-1.5**	-3.0	1.5	8.9	**-1.5**	-2.4	0.9	7.3	**-1.1**	-1.7	0.6	6.1	**-1.5**	-2.6	1.1	12.4

State	1990				2000				2010				2020			
	NM	I	O	NM rate	NM	I	O	NM rate	NM	I	O	NM rate	NM	I	O	NM rate
Quintana Roo	**-9.7**	-11.0	1.3	39.9	**-8.3**	-9.1	0.8	24.1	**-3.5**	-4.9	1.4	14.7	**-1.8**	-3.3	1.5	13.3
San Luis Potosí	**1.3**	-1.1	2.4	-1.5	**1.4**	-0.9	2.3	-2.0	**0.7**	-1.0	1.7	-0.9	**0.6**	-0.9	1.5	-0.6
Sinaloa	**2.0**	-0.4	2.4	-2.3	**2.9**	0.3	2.5	-3.5	**1.0**	-0.5	1.5	-2.0	**0.6**	-0.9	1.5	-1.8
Sonora	**-0.4**	-1.3	0.9	2.3	**-0.1**	-0.9	0.8	1.7	**-0.1**	-0.8	0.7	0.6	**0.0**	-0.8	0.8	0.1
Tabasco	**0.2**	-1.6	1.8	-1.0	**1.2**	-0.7	1.9	-3.4	**0.1**	-1.0	1.2	-1.5	**1.5**	-0.6	2.1	-6.6
Tamaulipas	**-0.6**	-1.7	1.2	4.1	**-2.2**	-2.9	0.8	8.1	**-0.9**	-1.8	0.8	1.4	**-0.4**	-1.3	1.0	-0.1
Tlaxcala	**0.8**	-1.3	2.1	3.3	**0.1**	-1.3	1.4	3.5	**0.1**	-0.9	0.9	3.0	**0.0**	-1.0	1.0	2.4
Veracruz	**1.5**	-0.7	2.2	-2.7	**3.1**	-0.8	3.8	-6.9	**1.2**	-0.6	1.8	-0.8	**2.0**	-0.6	2.7	-5.7
Yucatán	**1.1**	-1.0	2.1	-1.5	**0.8**	-0.8	1.6	0.1	**0.3**	-0.8	1.2	1.7	**-0.7**	-1.8	1.1	7.8
Zacatecas	**1.9**	-0.7	2.6	-5.8	**1.4**	-0.7	2.2	-2.1	**0.7**	-0.7	1.4	-1.3	**0.8**	-0.7	1.5	-2.4

Source: Economic Commission for Latin America and the Caribbean (ECLAC), Database on Internal Migration in Latin America and the Caribbean (MIALC) [online] https://celade.cepal.org/bdcelade/mialc/.

Note: NM = net migration; I = in-migration; O = out-migration.

B. Inequality effect and intrametropolitan migration

The composition effect of migration can be particularly significant and relevant, for both theory and policy, in intrametropolitan migration (or residential mobility, a synonym used in the specialized literature). Moreover, this type of migration has intensities, profiles and determinants that are very different from those of classic internal migration, such as that which occurs between different major civil divisions and is usually motivated by better employment and living conditions. In the case of intrametropolitan migration, therefore, the stylized relationship between better living conditions or poverty levels and greater migratory attractiveness that is found in the case of labour migration cannot be expected. The most "attractive" areas of cities tend to be on the periphery, which, at least in Latin America, have historically reported lower standards of living. This migratory attractiveness is largely driven by the residential mobility of low-income families, who find more affordable land or housing in the periphery, including social housing, which does not exist or costs more (to buy or rent) in the city centre or affluent neighbourhoods. The determinants are therefore residential rather than employment- or wage-based.

Because of its size and the profile of the migrants involved, this residential mobility can have very significant composition effects. It can also have a significant impact on territorial inequality within the city, or what is often referred to as residential segregation.[5] Equally important is that its effect may change as certain areas of the city are reappraised or deteriorate. Intrametropolitan migration or residential mobility can therefore contribute to the socioeconomic decline of a neighbourhood or drive its recovery, expansion or boom. It can also promote socioeconomic, ethnic or cultural diversification or, conversely, promote socioeconomic, ethnic or cultural uniformity.

Figure VI.1 was prepared to contribute data to the debate on the change in levels of residential segregation in the region's cities caused by the emerging pattern of high and middle socioeconomic families moving from their historical niches to the traditionally poor periphery, in the form of gated communities, closed condominiums and walled developments. Sociological discussions about the implications of physical proximity for reducing social segregation are possible.[6] Such debates would be completely justified, especially given the type of physical proximity, marked by structural delimitations such as walls, wire fences, controlled access gates, cameras and even private security services, along with cultural, symbolic and ideological barriers. However, there is no doubt that such moves can reduce residential segregation, at least in terms of its standard indicators, such as the dissimilarity

5 In intrametropolitan migrations, this inequality effect can be called the "effect of migration on residential segregation". In any case, that is a topic that will be examined later in this chapter. Two calculation options are presented for this purpose, along with several considerations and safeguards to be observed in their interpretation.

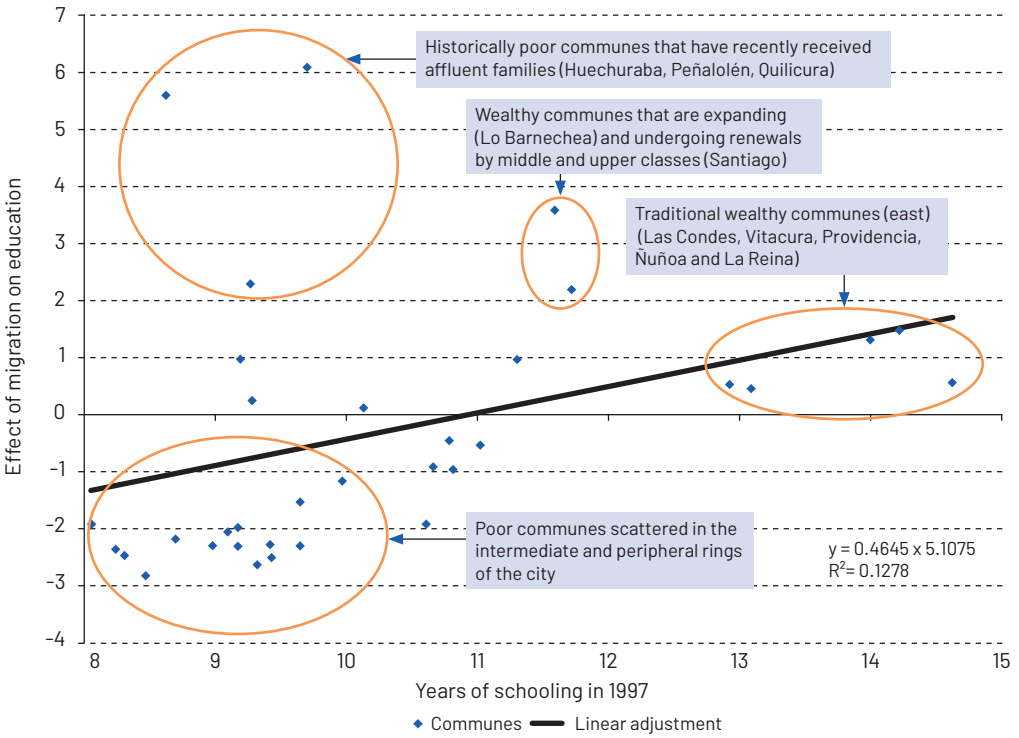
6 See Ruiz-Tagle and López (2014).

index and the entire associated family (Massey and Denton, 1988; Rodríguez, 2001). Nevertheless, considering only this kind of displacement —focused on a single socioeconomic group and only in certain areas of the cities (the periphery as it undergoes gentrification)— was biased and sometimes risky in terms of making generalized associations.

■ Figure VI.1

Greater Santiago Metropolitan Area: effect of inter-commune migration on the average schooling of household heads according to the average schooling of household heads at the commune level at the initial moment of measurement, 1997–2002

(Percentages)



Source: J. Rodríguez, "Dinámica demográfica y asuntos urbanos y metropolitanos prioritarios en América Latina: ¿qué aporta el procesamiento de microdatos censales?", *Notas de Población*, No. 86 (LC/G.2349-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2009.

Thus, following the logic applied with the simple correlation coefficients shown on table VI.15, figure VI.1 shows the point cloud from which those correlation coefficients originate, in this case to associate the effect of intrametropolitan migration in the Santiago Metropolitan Area (34 communes) on changes in schooling and, by extension, on educational inequality among its different communes. This methodology's finding for Santiago over the 1997–2002 period confirmed that a group of traditionally poor peripheral communes (Huechuraba, Peñalolén and Quilicura on figure VI.1) were evolving socioeconomically through the emerging in-migration of high- and middle-income families, but not in an amount sufficient to counteract the persistent in-migration of middle- and high-income families to rich neighbourhoods (Las Condes, Vitacura, Providencia and Ñuñoa on figure VI.1) from middle- to low-income neighbourhoods, with the subsequent increasing effect of migration on the average schooling of those communes (see figure VI.1). The hypothesis of a massive dispersion of affluent groups therefore seemed exaggerated, as did that of a significant reduction in segregation through this emerging pattern of intrametropolitan migration (Rodríguez, 2009a).

Another option for estimating the inequality effect is to calculate the effect of migration on some standard index of territorial disparity, such as the Duncan dissimilarity index (details of which are presented below). The logic of the procedure is that of the factual (with migration) and the counterfactual (without migration). The absolute and relative effects of net migration are derived from a comparison of the two.

The matrices and tables below exemplify the procedure with data taken from Rodriguez and Rowe (2019) on the effect of migration on the residential segregation of educational groups by levels of schooling in the Extended Greater Santiago Metropolitan Area (49 communes) over the 1997–2002 period (data from the 2002 Chilean census). Tables VI.17 and VI.18 show the Extended Greater Santiago Metropolitan Area intrametropolitan migration matrix of the population aged 25 and over with high education levels (see table VI.17) and total education (see table VI.18). The use of the population aged 25 and over is on account of the invariance assumption explained above for the composition effect, which also applies to the inequality effect. Using both matrices, tables VI.19 and VI.20 can be calculated, which allow different approximations to the composition effect.

Table VI.19 shows net migration rates (annual averages per 1,000) for the reference group (high education, aged 25 and over) and for the total population aged 25 and over. Areas with reference group rates higher than the total rates report increases in the weight of that group through migration. Notable in this regard are the gentrified periphery and several suburbs, particularly in the north, which report large inflows of highly educated inhabitants. This group has a rising proportion in those localities, to the detriment of other educational groups (either all or some of them, but they cannot be identified with these data, which do not distinguish or identify the other educational groups separately).

■ Table VI.17

Extended Greater Santiago Metropolitan Area (broad areas): intrametropolitan migration matrix, population aged 25 and over with high levels of education (13 or more years of schooling), 1997–2002

(Number of persons counted)

Area of usual residence (2002)	Area of previous residence (1997)											
	Centre	Pericentre	Gentrified periphery	Traditional periphery	Barrio Alto	Northern suburbs	South-eastern suburbs	Southern suburbs	South-western suburbs	Western suburbs	Melipilla	Total
Centre	38 360	3 422	367	4 039	4 305	69	33	94	162	26	73	50 950
Pericentre	2 505	59 691	408	3 904	2 277	71	26	51	92	13	27	69 065
Gentrified periphery	754	1 049	10 777	1 165	5 179	16	13	8	27	2	3	18 993
Traditional periphery	4 955	8 321	854	98 974	3 600	121	132	142	279	17	55	117 450
Barrio Alto	5 897	4 780	1 384	5 225	190 326	242	208	146	389	42	99	208 738
Northern suburbs	191	183	41	208	1 420	2 886	3	8	6	0	1	4 947
South-eastern suburbs	67	73	14	272	404	6	1 498	6	7	1	0	2 348
Southern suburbs	183	152	20	224	368	4	10	3 129	20	0	4	4 114
South-western suburbs	420	413	52	853	843	5	8	21	6 842	3	35	9 495
Western suburbs	56	24	4	45	141	3	0	2	1	723	2	1 001
Melipilla	125	46	8	68	120	2	0	5	15	8	2 686	3 083
Total	53 513	78 154	13 929	114 977	208 983	3 425	1 931	3 612	7 840	835	2 985	490 184

Source: Prepared by the author, on the basis of special processing of microdata from the 2002 population census of Chile.

■ Table VI.18

Extended Greater Santiago Metropolitan Area (broad areas): intrametropolitan migration matrix, population aged 25 years and over, 1997–2002

(Number of persons counted)

Area of usual residence (2002)	Area of previous residence (1997)											
	Centre	Pericentre	Gentrified periphery	Traditional periphery	Barrio Alto	Northern suburbs	South-eastern suburbs	Southern suburbs	South-western suburbs	Western suburbs	Melipilla	Total
Centre	246 269	15 990	1 609	18 810	9 812	630	86	330	634	121	287	294 578
Pericentre	15 889	678 853	4 319	34 757	8 413	988	146	424	769	112	243	744 913
Gentrified periphery	2 303	5 361	125 742	5 604	10 010	183	74	55	121	11	48	149 512
Traditional periphery	37 188	88 653	11 722	1 138 642	17 861	1 864	1 037	1 252	2 392	227	583	1 301 421
Barrio Alto	12 173	11 520	3 489	13 914	397 406	641	372	379	815	142	325	441 176
Northern suburbs	1 921	2 543	404	2 903	2 500	53 974	23	95	114	19	56	64 552
South-eastern suburbs	253	256	61	1 510	737	23	12 764	39	37	3	14	15 697
Southern suburbs	1 028	989	132	1 981	768	60	47	53 033	165	16	44	58 263
South-western suburbs	2 589	3 476	452	6 084	1 897	113	31	234	94 169	45	293	109 383
Western suburbs	417	266	23	431	321	39	8	15	69	16 516	140	18 245
Melipilla	799	310	57	581	282	37	17	47	216	113	47 445	49 904
Total	320 829	808 217	148 010	1 225 217	450 007	58 552	14 605	55 903	99 501	17 325	49 478	3 247 644

Source: Prepared by the author, on the basis of special processing of microdata from the 2002 population census of Chile.

■ Table VI.19

Extended Greater Santiago Metropolitan Area (broad areas): average annual intrametropolitan net migration rate (per 1,000), population aged 25 and over with high levels of education (13 or more years of schooling) and population aged 25 and over, 1997–2002

Area of Extended Greater Santiago Metropolitan Area	High education	Total
Centre	-9.8	-17.1
Pericentre	-24.7	-16.3
Gentrified periphery	61.5	2.0
Traditional periphery	4.3	12.1
Barrio Alto	-0.2	-4.0
Northern suburbs	72.7	19.5
South-eastern suburbs	39.0	14.4
Southern suburbs	26.0	8.3
South-western suburbs	38.2	18.9
Western suburbs	36.2	10.3
Melipilla	6.5	1.7

Source: Prepared by the author.

■ Table VI.20

Extended Greater Santiago Metropolitan Area (broad areas): factual and counterfactual values of the percentage of the population aged 25 years and over with high levels of education (13 or more years of schooling), and the absolute and relative effect of migration on this percentage, 1997–2002

Area of Extended Greater Santiago Metropolitan Area	Factual	Counterfactual	Absolute effect	Relative effect
Centre	17.3	16.7	0.6	3.7
Pericentre	9.3	9.7	-0.4	-4.1
Gentrified periphery	12.7	9.4	3.3	35.0
Traditional periphery	9.0	9.4	-0.4	-3.8
Barrio Alto	47.3	46.4	0.9	1.9
Northern suburbs	7.7	5.8	1.8	31.0
South-eastern suburbs	15.0	13.2	1.7	13.1
Southern suburbs	7.1	6.5	0.6	9.3
South-western suburbs	8.7	7.9	0.8	10.2
Western suburbs	5.5	4.8	0.7	13.8
Melipilla	6.2	6.0	0.1	2.4
Total	15.1	15.1	0.0	0.0

Source: Prepared by the author.

Table VI.20 presents the results of applying the procedure to estimate the composition effect. Those results ratify the observations presented above (mathematically it could not be otherwise), since the only areas where the percentage of highly education inhabitants falls are the pericentre and the traditional periphery. In the first case, this is because this group's net out-migration rate is (in absolute terms) higher than that of the total population and, in the second case, because the group's net in-migration rate is lower than the total. As explained above, the procedure for estimating the composition effect of migration can produce precise figures for that effect. In several areas this exceeds 10%, rising to 35% in the gentrified periphery and 31% in the northern suburbs: very significant increases that are exclusively on account of migration. This indicates a markedly selective in-migration to these areas by families of high socioeconomic levels, as explained above and as described in Rodríguez and Rowe (2019). The data on table VI.20 can be used to calculate the correlation between the counterfactual value and the relative effect of migration (associated with the B coefficient of the point cloud explained above). In this case, its value stands at -0.27, because the slope of the point cloud is moderately negative, suggesting that migration reduces inequalities in the percentage of this group among the different zones of the Extended Greater Santiago Metropolitan Area. However, as noted above, this procedure does not allow weightings to be assigned to each area and, as a result, may lead to distorted results.

Table VI.21 shows the second procedure for estimating the inequality effect; because it is based on the inequality indicator known as the "dissimilarity index", this method can only be applied to territorial distributions of population groups and not to averages of an indicator (Massey and Denton, 1988). This procedure uses the factual and counterfactual territorial distribution of two population groups: the reference group (in this case, the high education group) and the remainder (in other words, all other schooling groups, which is obtained by subtracting the matrices in tables VI.17 and VI.18). The factual distribution covers the proportion of both groups contained in each area at the time of the census (the distribution of the resident population by zones). The counterfactual distribution covers that of the population five years ago. The first distribution is used to calculate the factual dissimilarity index, and the counterfactual dissimilarity index is calculated with the second. The difference between the two indicates the effect of migration on territorial inequality, as measured by this indicator. In this case, the procedure yields a factual dissimilarity index of 35.7 and a counterfactual dissimilarity index of 35.1 for the reference group. In other words, migration increased the dissimilarity index of this group; this stands in contrast to the previous result and indicates that the measurement of the inequality index is sensitive to the procedure used.

■ Table VI.21

Extended Greater Santiago Metropolitan Area (broad areas): factual and counterfactual values of the percentage of the population aged 25 years and over with high levels of education (13 years of schooling or more), and the absolute and relative effect of migration on this percentage, 1997–2002

Area of Extended Greater Santiago Metropolitan Area	Factual Duncan index			Counterfactual Duncan index				
	Territorial distribution of the population with high education levels (1)	Territorial distribution of the remainder of the population (2)	Absolute difference (3) = Abs(1)–(2)		Territorial distribution of the population with high education levels (4)	Territorial distribution of the remainder of the population (5)	Absolute difference (6) = Abs(4)–(5)	
Centre	0.104	0.088	0.016	Centre	0.109	0.097	0.012	
Pericentre	0.141	0.245	0.104	Pericentre	0.159	0.265	0.105	
Gentrified periphery	0.039	0.047	0.009	Gentrified periphery	0.028	0.049	0.020	
Traditional periphery	0.240	0.429	0.190	Traditional periphery	0.235	0.403	0.168	
Barrio Alto	0.426	0.084	0.342	Barrio Alto	0.426	0.087	0.339	
Northern suburbs	0.010	0.022	0.012	Northern suburbs	0.007	0.020	0.013	
South-eastern suburbs	0.005	0.005	0.000	South-eastern suburbs	0.004	0.005	0.001	
Southern suburbs	0.008	0.020	0.011	Southern suburbs	0.007	0.019	0.012	
South-western suburbs	0.019	0.036	0.017	South-western suburbs	0.016	0.033	0.017	
Western suburbs	0.002	0.006	0.004	Western suburbs	0.002	0.006	0.004	
Melipilla	0.006	0.017	0.011	Melipilla	0.006	0.017	0.011	
	1	1	0.714260015				0.702308438	Absolute effect
Factual Duncan index: Σ(column 3) / 2 * 100			**35.71**	Counterfactual Duncan index: Σ(column 6) / 2 * 100			**35.12**	0.598
								Relative effect
								1.702

Source: Prepared by the author, on the basis of the matrices used in tables VI.17 and VI.18.

Chapter VII
Effects of migration on spatial population redistribution

The impact that internal migration has on the distribution of the population in a territory depends on the intensity and efficiency of that migration. Intensity was explained when addressing the overall mobility rate. Efficiency, meanwhile, was mentioned when the growth effect was examined and the index of migration effectiveness of an entity was explained and applied, in order to measure the efficiency of migration in producing a growth effect on that entity. However, this chapter will not analyse that form of efficiency, but rather the efficiency which applies to a territorial grouping —such as a country— and not to each of its entities. To prevent confusion, a different self-explanatory name shall be applied to this form of efficiency: "overall efficiency". This overall efficiency of migration originates from the asymmetry of the flows between the different territorial areas in which migration data is captured. The greater the asymmetry between inflows and outflows —which is to say, the larger the difference between the current and countercurrent— the greater the efficiency, since inflows are offset less by outflows or vice versa, resulting in a larger population redistribution effect between entities in the territorial grouping.

Therefore, the intensity of migration in a country may be high, but with no population redistribution effect, if all of the political and administrative divisions used in measurements record zero net migration, meaning that the overall efficiency of migration in the country is also zero. This is because net migration is what causes population redistribution (because the proportion of the population in the regions with positive net migration increases and the proportion in regions with negative net migration decreases).

To measure the efficiency of migration and its impact on population redistribution at the national level, some indices have been developed that have begun to be disseminated and used only recently (Bell and Muhidin, 2009; Rowe and others, 2019). These indices are the main subject of this chapter.

There are few theoretical forecasts regarding the trend in overall migration efficiency, but regional convergence models suggest a gradual reduction. This convergence reduces both migration intensity (fewer incentives for migration in a situation with smaller territorial inequalities) and overall migration efficiency (less asymmetry between inflows and outflows among regions, which are increasingly less unequal with respect to each other). However, for the time being these are only hypotheses. Further research and more data are required to verify these hypotheses on the basis of evidence —including the empirical questioning of the theory of territorial convergence— particularly in Latin America.

A. Indicators

To estimate overall migration efficiency, the migration effectiveness index (MEI) is used (Bell and Muhidin, 2009), which links the sum of the net migration of all political or administrative divisions (in absolute values so that they do not cancel each other out) to the sum of the gross migration of each political or administrative division. This indicator captures the asymmetry of flows among political and administrative divisions. The greater the asymmetry, the less flows offset each other, meaning that migration is more effective in redistributing the population among different political or administrative divisions of a territorial grouping. A value of 100 for this index indicates that in no political or administrative division did inflows and outflows offset each other (one or more divisions only had in-migrants and the remaining ones only had out-migrants). Consequently, the overall redistributive impact is equivalent to the number of migrants, which is to say that migration has been very effective in redistributing the population among political or administrative divisions. A value of zero for the index means that in each division the numbers of in-migrants and out-migrants were equal and, therefore, migration was very inefficient in redistributing the population between those divisions. In fact, in this case migration had no redistributive effect at all.

However, since this efficiency only takes into account migrants and not the entire population, it cannot be considered to be an indicator of the population redistribution effect. The latter is measured using the aggregate net migration rate (ANMR), which has the same numerator as the previous indicator, but its denominator is the population at risk. The closer to zero, the lower the impact of internal migration in terms of population redistribution among the political or administrative divisions that make up the territorial grouping. Its maximum value is 200, so some researchers divide the rate by 2 to make the maximum value 100. Such a value would indicate that the entire population of a country had migrated from its inhabited political or administrative divisions to uninhabited divisions (an extreme case that is very unlikely to occur in reality at the country level).

The MEI is calculated using the following formula:

$$MEI = 100 \{\Sigma i |Ii - Ei| / \Sigma i (Ii + Ei)\} \quad (1)$$

where i is a major or minor political or administrative division of the territorial grouping —hereinafter assumed to be a country— Ii is in-migrants into i and Ei out-migrants from i. The

formula entails adding together the balances of migration of all the political or administrative divisions of a country, which, as previously explained, produce the redistributive effect on the population in the territory. Since this sum is necessarily zero, the absolute value is applied, eliminating the sign.[1] This results in double counting of the amount of population redistribution caused by internal migration, since net immigration from one area must necessarily be fully offset by net emigration from one or more of the other areas. However, since there is also double counting in the denominator —by adding in-migrants and out-migrants, who at the national level are the same people, as already explained— this problem is eliminated and the value of the index can be directly interpreted as the proportion of all migratory movements that occurred in the country and had a redistributive effect. It is important to note that is a measure of efficiency and not of impact, so a high value means that, overall, the recorded movements had redistributive effects. However, their impact is unknown because the indicator itself does not reveal the number of internal migration movements.

ANMR is calculated using the following formula:

$$ANMR = 100 * \frac{1}{2} \left(\Sigma_i |I_i - E_i| / \Sigma_i P_i \right) \quad (2)$$

where i is a major or minor political or administrative division. The main change in this formula with respect to the previous one is the denominator, which is the sum of the population at risk of migration from each political or administrative division (or directly, the total population of the country, which in the case of the migration matrices corresponds to N). In this case it is possible to overcome the problem of double counting (and thus restrict the range of the index from 0 to 100) by dividing the rate by two.

Having described these two indicators, on overall migration effectiveness and aggregate population redistribution caused by migration, a concise analysis follows of the relationship between these indicators and the intensity of migration. As previously mentioned, for there to be a redistributive effect, there must first be internal migration, and the overall effectiveness of that migration must not be zero. If both conditions are met, the population redistribution effect of migration will depend on the combination of its intensity and its efficiency, as set out in the following formula:

$$\begin{aligned} &\textit{Population redistribution effect } (ANMR) = \\ &\textit{internal mobility rate (crude migration intensity, } CMI) \text{ x} \\ &\textit{migration effectiveness index } (MEI) \end{aligned} \quad (3)$$

[1] This is similar to the method for standard indicators of dispersion in statistics, such as variance, although in the latter is squared to eliminate the sign.

Table VII.1 outlines an extreme case of a country, with two major administrative divisions, whose pattern of spatial distribution of the population undergoes a u-turn. Currently, the entire population (30 people) resides in A, but five years earlier those 30 people resided in B. Net migration is 30 for A and -30 for B and gross migration is 30 for A and 30 for B, so their MEIs are 1 and -1, respectively.[2] Therefore, its overall MEI would be (|30| + |-30|) / (60) = 1, meaning that overall migration effectiveness is 100%, since all the migration that took place in that country in the reference period had a redistributive impact. ANMR would also be 1, because: ((|30| + |-30|) / (30)) / 2 = 2 / 2 = 1, meaning that migration had the effect of redistributing 100% of the population of that country. This is clearly reflected in the matrix, because it shows that the country went from only having population in B to only having population in A.

A change in the diagonals of this matrix shows the difference between the two indicators. If there were 10,000 people in both diagonals (see table VII.2), MEI would still be 1, but ANMR would be significantly lower at 0.15%, owing the increase in the population at risk of migrating that did not do so. In other words, the redistributive impact of migration would be much lower. Table VII.3 applies these calculations and indicators to the 2011 census in Costa Rica. Since these are new measures that refer to effects originating from migration, and not to migration intensity itself, these indicators are not divided by the reference period. In fact, such a division for the purpose of annualizing does not make sense in the case of migration efficiency (which would not change when annualized), but is valid in the case of migration impact. In this text (see tables VII.1, VII.2 and VII.3) such a division by reference period is not performed, solely to conform to the standard in the literature, but strictly speaking it should be applied.

[2] To prevent confusion, this should be qualified in two respects: (i) these values correspond to the migration effectiveness in producing a growth effect in each political or administrative division, not to overall migration efficiency (MEI); (ii) these values are not expressed per 100, but this indicator (strictly speaking a percentage) is often expressed per 100 to facilitate interpretation.

■ Table VII.1

Hypothetical migration matrix, extreme case of population redistribution attributed to internal migration and calculation of migration effectiveness indices and aggregate impact of migration on the spatial distribution of the population

Standard major administrative division	Major administrative division five years earlier		Current total					Overall migration efficiency			Aggregate net migration rate (ANMR)		
	A	B	Current total	In-migrants	Out-migrants	Net migration	Gross migration	Absolute value of net migration	Gross migration	Ratio (per 100)	Absolute value of net migration	At-risk population	Ratio (per 100) and final division by two
A	0	30	30	30	0	30	30	30	30		30	15	200
B	0	0	0	0	30	-30	30	-30	30		-30	15	
Total five years earlier	0	30	30				Sum of absolute values	60	60	100	60	30	100

Source: Prepared by the author.

■ Table VII.2
Hypothetical migration matrix, with overall efficiency and low impact on population redistribution from internal migration and calculation of effectiveness indices and aggregate impact of migration on the spatial distribution of the population

Standard major administrative division	Major administrative division five years earlier		Current total					Overall migration efficiency			Aggregate net migration rate (ANMR)			ANMR (rate divided by two)
	A	B	Current total	In-migrants	Out-migrants	Net migration	Gross migration	Absolute value of net migration	Gross migration	Ratio (per 100)	Absolute value of net migration	At-risk population	Ratio (per 100)	
A	10 000	30	10 030	30	0	30	30	30	30		30	10 015	0.2996	
B	0	10 000	10 000	0	30	-30	30	30	30		30	10 015		
Total five years earlier	10 000	10 030	20 030				Sum of absolute values	60	60	100	60	20 030	0.2996	0.1498

Source: Prepared by the author.

■ Table VII.3
Costa Rica: efficiency and redistributive impact of internal migration, 2006–2011

Province	Resident population in		Non-migrants	In-migrants	Out-migrants	Migration		Rate of			Migration effectiveness index (MEI)	MEI and ANMR calculations	Overall migration effectiveness index (MEI)	Aggregate net migration rate (ANMR)
	2011	2006				Net	Gross	Immigration	Emigration	Net migration				
Total	3 874 413	3 874 413	3 659 038	215 375	215 375	0	430 750	11.1	11.1	0.0	0.0	Σ net mig. (abs.) / Gross mig.	**15.6%**	**0.87%**
												Σ net mig. (abs.)	**67 220**	0.87% = (67 220 / 2) / 3 874 413) * 100
San José	1 269 838	1 301 622	1 223 122	46 716	78 500	-31 784	125 216	7.3	12.2	-4.9	-0.3	Net migration in absolute values	31 784	
Alajuela	758 997	748 382	715 520	43 477	32 862	10 615	76 339	11.5	8.7	2.8	0.1		10 615	
Cartago	448 434	440 136	422 589	25 845	17 547	8 298	43 392	11.6	7.9	3.7	0.2		8 298	
Heredia	392 348	380 148	354 366	37 982	25 782	12 200	63 764	19.7	13.3	6.3	0.2		12 200	
Guanacaste	293 884	291 387	275 133	18 751	16 254	2 497	35 005	12.8	11.1	1.7	0.1		2 497	
Puntarenas	367 596	368 615	344 992	22 604	23 623	-1 019	46 227	12.3	12.8	-0.6	0.0		1 019	
Limón	343 316	344 123	323 316	20 000	20 807	-807	40 807	11.6	12.1	-0.5	0.0		807	

Source: Prepared by the author, on the basis of special processing of census microdata from Costa Rica, 2011.

Chapter VIII
Selectivity and types of migration

The selectivity of migration corresponds to differences in characteristics between migrants and non-migrants or, on a mathematical basis, to different intensities of migration across different population groups. All migration theories recognize this selectivity and consider it stylized and substantiated for a small set of attributes. These include age, as will be examined below. However, several other attributes are still subject to debate, typically because they do not apply systematically, because they vary from country to country or culture to culture, or because they have undergone reversals over the course of history.

When only the census is available, selectivity can be calculated through tabulation, distinguishing among individuals according to their social segment and migration status (migrants or non-migrants, with the respective "suffixes" that define migration). The ratio of migrants to the total population —which is to say the percentage of migrants— is an approximation of the probability of having migrated within the country (in other words, between major or minor administrative divisions, the "suffixes" of migration) in the reference period. For this purpose, a shared reference period is required, and it is therefore advised to use the question on place of residence at a specified date in the past. The use of both questions, namely, duration of residence and place of previous residence ("the pair" explained in chapter II), also enables an estimate to be obtained, albeit an improper one, as explained in chapter II. Table VIII.1 and figure VIII.1 present the case of Panama in 2010, whose census includes the pair of previous place of residence and time residing at the current location. Filtering by five or fewer years of residence, migrants can be identified and, using their previous place of residence, it is possible to determine whether they lived in a different major administrative division (again, the use of this pair of variables does not guarantee a shared reference period, so this finding could be said to be improper or uncertain). There is a clear age-based pattern in migration intensity, which is much higher at younger ages, and the pattern is maintained when controlling for intervening variables such as sex (see figure VIII.2 for the case of Ecuador in 2010, which does use the set date question).

■ Table VIII.1

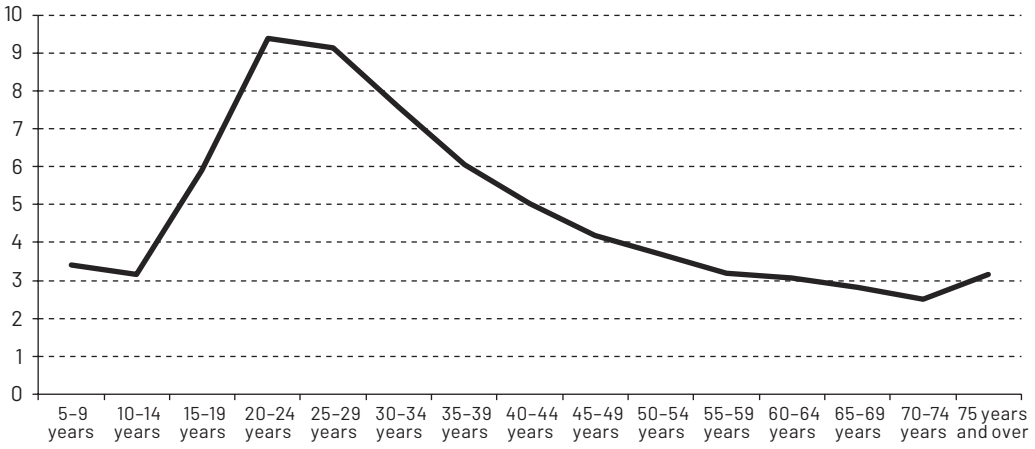
Panama: population by migration between major administrative divisions in the last five years and by age, 2010

Age bracket	Migration status: migration between major administrative divisions			Percentage of migrants
	Non-migrant	Migrant	Total	
5–9 years	312 779	11 082	323 861	3.4
10–14 years	320 911	10 447	331 358	3.2
15–19 years	269 420	16 911	286 331	5.9
20–24 years	241 969	25 009	266 978	9.4
25–29 years	229 525	23 086	252 611	9.1
30–34 years	217 881	17 873	235 754	7.6
35–39 years	214 428	13 831	228 259	6.1
40–44 years	198 594	10 493	209 087	5.0
45–49 years	174 877	7 629	182 506	4.2
50–54 years	143 601	5 483	149 084	3.7
55–59 years	118 528	3 906	122 434	3.2
60–64 years	99 872	3 156	103 028	3.1
65–69 years	75 513	2 200	77 713	2.8
70–74 years	59 684	1 535	61 219	2.5
75 years and over	95 164	3 113	98 277	3.2

Source: Prepared by the author, on the basis of special processing of census microdata from Panama, 2010.

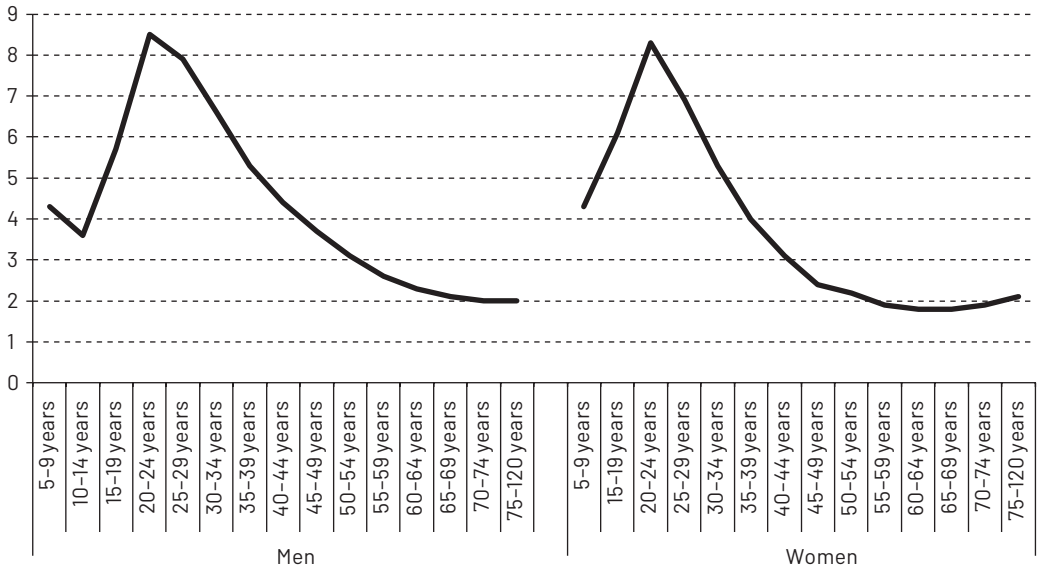
■ Figure VIII.1

Panama: probability of having migrated between major administrative divisions in the last five years, by age group, 2010



Source: Prepared by the author, on the basis of special processing of census microdata from Panama, 2010.

■ Figure VIII.2
Ecuador: probability of having migrated between major administrative divisions in 2005–2010 (set date), by sex and age group, 2010

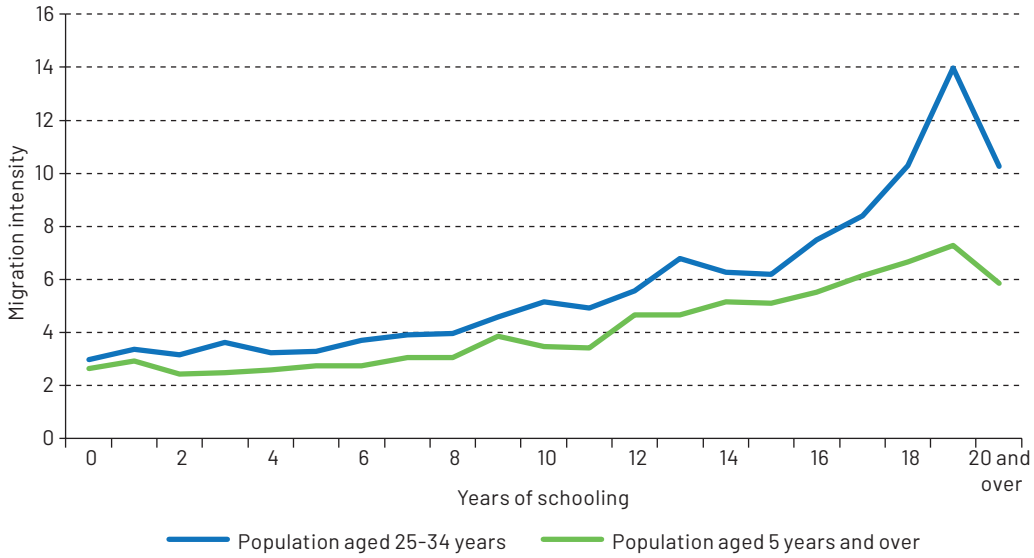


Source: Prepared by the author, on the basis of special processing of census microdata from Ecuador, 2010.

In general, the pattern in the probability of migrating according to age is predictable at the global level, although it has cultural and historical nuances (Bernard, 2022). In fact, this has enabled development of templates for tables that can be used to obtain indirect estimates of migration (Rogers and Castro, 1981), among other purposes. This topic is not dealt with in detail here, because it has been extensively studied in numerous works on the subject, including recent ones in Spanish and Portuguese (Santos and Barbieri, 2019).

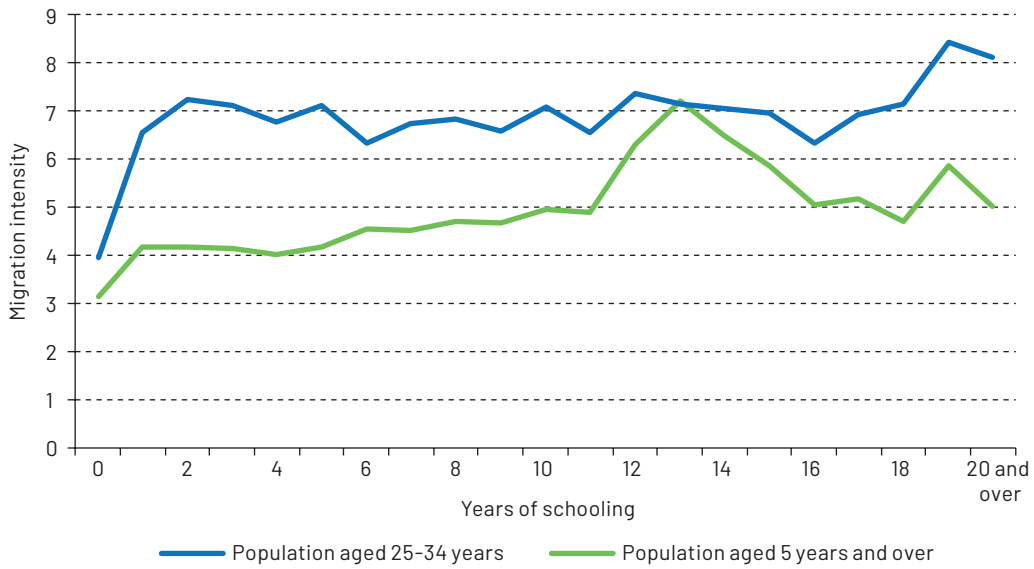
A stylized pattern in the probability of migrating is not apparent in other variables, but well-established relationships have been documented. For example, in Latin America the education variable appears to correlate with migration intensity, but the nature of the relationship varies considerably from one country to another and the sign of the correlation coefficient is not substantiated in all of them. This is illustrated in figures VIII.3 and VIII.4, which contrast migration patterns according to years of schooling in Mexico and Ecuador, based on their 2010 censuses.

■ Figure VIII.3
Mexico: migration intensity of the population aged 5 years and over and of the population aged 25–34 years, by years of schooling, 2010 census
(Percentages and numbers of years)



Source: Prepared by the author, on the basis of special processing of census microdata from Mexico, 2010.

■ Figure VIII.4
Ecuador: Migration intensity of the population aged 5 years and over and of the population aged 25–34 years, by years of schooling, 2010 census



Source: Prepared by the author, on the basis of special processing of census microdata from Ecuador, 2010.

One important point regarding this issue of systematically different intensities between population groups relates to causality. In some cases, the causal direction is naturally straightforward (for instance, migration cannot determine age) and, in others, it is well grounded theoretically (for example, marital status or home ownership).[1] However, in many cases, the link is not as straightforward, and in fact there may be reverse causality. This occurs, for example, when migration is what enables people to obtain higher levels of education, rather than when, once such levels are achieved, migration intensity is greater. There may also be self-selection or determination according to third variables.

In this same cautious vein, it is important to note that these migration tendencies can vary according to whether they are approached from a territorial perspective or refer to specific past time periods. The greater propensity of women to migrate during a portion of the twentieth century can be at least in part attributed to mass migration from the countryside to large cities, which were particularly attractive to women. In contrast, the clear male selectivity of internal migration in the region since the end of the last century is a result of increasing migration between cities.

In conclusion, the variables that tend to affect or at least have a relationship with migration intensity are: (i) age; (ii) marital status; and (iii) real estate ownership. Educational level and gender appear to affect the propensity to migrate, but their impacts are far from uniform across countries or over time.

A. Summary indicators of migration selectivity

Migration selectivity can be defined as a bias among migrants with respect to one or more characteristics. There is no migration selectivity when migrants are fully representative of the entire population, which only occurs if the profiles of migrants and non-migrants are identical. Migration selectivity is derived from the differences in propensity described above, but its measurement requires other indicators. One point that distinguishes selectivity is that, while it can be calculated for migrants as a whole, it is generally also calculated for non-migrants at origin and destination, separately. In fact, in technical terms, the expression "selectivity of migration" is reserved for the distinction with respect to the non-migrant population at the area of origin and the term "migration differential" is "used to contrast the migrants and the rest of the population of destination". (Macció, 1982, p. 99).

Thus, there is a mathematical condition of non-selectivity of migration when the distribution according to an attribute of migrants (structure) coincides with the territorial distribution of the remainder (non-migrants). The dissimilarity index (D), which can be used

[1] Even in these obvious cases, the event may be linked to a spike in migration intensity (because marriage or obtaining housing may cause migration), which is then more than offset by the long-term settlement in the territory in question caused by the event (an effect that is contingent on the duration of the state resulting from the event).

to estimate this selectivity, is derived from the above definition.[2] The index is calculated as the difference between the structure of migrants and non-migrants in terms of the selectivity variable. Since these are unitary structures, this difference is zero by definition, so the absolute values of the subtractions are used. To avoid double counting and to define a path from 0 to 1, it is divided by 2 (see diagram VIII.1).[3]

■ Diagram VIII.1
Formula for calculating the Duncan index of dissimilarity

$$D = \frac{1}{2} \sum \left| \frac{N_{1i}}{N_1} - \frac{N_{2i}}{N_2} \right|$$

Definitions	
N_1	Total migrant population
N_{1i}	Migrant population in category *i* of the characterizing variable
N_2	Total non-migrant population
N_{2i}	Non-migrant population in category *i* of the characterizing variable

Source: J. Rodríguez, "Segregación residencial socioeconómica: ¿qué es?, ¿cómo se mide?, ¿qué está pasando?, ¿importa?", *Population and Development series*, No. 16 (LC/L.1576-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2001.
Note: There are no explicit weightings because the formula uses absolute numbers and is therefore self-weighted.

In the specific case of migration selectivity, D is zero when the ratio between the migrant population in each category and the total migrant population —which is to say the distribution of the migrant population according to the categories of the selectivity variable— is identical to the corresponding distribution of non-migrants. It is thus concluded that migration is not selective according to the variable used, although this conclusion should undergo additional controls on some intervening variables. D is maximum (1) when migrants are fully classified in one or more categories from which non-migrants are absent.

The interpretation of the Duncan index in the case of the selectivity of migration is the proportion of the minority (migrant) population that would need to be reclassified to result in a situation of no segregation ($D = 0$). D does not identify selective categories. The categories are deduced from the table that forms the basis of the calculations. The sign of each category is given by the difference between its weights for migrants and for non-migrants. It is this difference that is added to obtain the Duncan index, except that in the case of the index it is the sum of the absolute values of this difference. A positive sign indicates selectivity of migration because migrants are found to be overrepresented in the category. Such a finding already indicates the direction of the reclassifications, which in this case would be

2 This index is also widely used to measure territorial, occupational and social segregation (Massey and Denton, 1988).
3 In studies on the subject there are different names for the formula, although this is generally not a problem, since they are equivalent terms. However, in some cases, the formula takes as the majority not the rest of the population, but a group x, which is usually the majority. This method normally produces higher levels of segregation and should not be used to compare results obtained with the formula shown in diagram VIII.1. Some authors argue that the latter algorithm should be called the dissimilarity index and the former the segregation index. However, there is no consensus in the literature on such names.

intertemporal. In other words, to achieve non-selectivity, future generations of migrants would have to account for a lower proportion in these categories and a higher proportion in other categories, until their distribution equals that of non-migrants. The specific amounts that this redistribution should involve can be obtained through optimization models.

These steps to achieve a situation of "non-selectivity of migration" are presented only to illustrate a mathematical procedure. There is no substantive or policy reason, in principle, to condemn or promote selectivity of migration. However, in practice, under specific conditions or based on certain political or ideological viewpoints, there may be an interest in taking action with regard to the selectivity of migration, but this is entirely beyond the scope of this technical text on the measurement of migration (and, in this case, of its selectivity).

Table VIII.2, for example, shows the calculation of D to estimate migration selectivity according to five-year age groups. The indicator of 0.193 means that 19.3% of migrants are selectively classified, which is to say that they deviate from the age distribution of the non-migrant population. Consequently, zero migration selectivity by age would be achieved if that 19.3% were reclassified. How would the reclassification work? Essentially, concentration would have to be lower in the younger age groups (15–40 years) and higher in the rest of the age groups. Who would be reclassified and to where? This is estimated with an optimization model or similar, which calculates the redistribution necessary to achieve identical age structures between migrants and non-migrants.

B. Types of migration

Given the practice of census measurement described in chapter II, migration data captured using a specified date in the past tends to reflect recent migration. In contrast, migration identified using the question on birthplace generally reflects cumulative migration, so it tends to be further back in time.[4]

Combining both queries, it is possible to obtain a more detailed and precise typology of migrants, with the following categories:

- **Non-migrant:** person whose place of habitual residence (PHR), place of residence five years earlier (PR5Y) and place of birth (PB) are the same. This can also be expressed as: PHR = PR5Y = PB.
- **Earlier migrant:** a person whose place of habitual residence is the same as his or her place of residence five years earlier but is different from his or her place of birth. This can also be expressed as: PHR = PR5Y < > PB.

[4] Clearly, this attribution is not accurate, because such migration may also be very recent. On average, however, it does tend to be older than that captured using place of residence five years prior to the census.

- **Recent migrant:** a person whose place of residence five years earlier and place of birth are the same, but whose place of habitual residence is different from both. This can also be expressed as: PHR < > PR5Y = PB.
- **Return migrant:** a person whose place of habitual residence is the same as his or her place of birth but differs from his or her place of residence five years earlier. This can also be expressed as: PHR = PB < > PR5Y.
- **Multiple migrant:** a person whose place of habitual residence, place of residence five years earlier and place of birth all differ from each other. This can also be expressed as: PHR < > PR5Y < > PB.

■ Table VIII.2
Application of the Duncan index of dissimilarity to estimate migration selectivity

Age group	Migrants	Non-migrants	Total	Age distribution of migrants (a)	Age distribution of non-migrants (b)	Absolute difference (a) – (b)
5–9 years	11 669	279 929	291 598	0.076	0.123	0.048
10–14 years	11 156	269 701	280 857	0.073	0.119	0.046
15–19 years	19 904	242 316	262 220	0.130	0.107	0.023
20–24 years	25 646	214 445	240 091	0.167	0.095	0.072
25–29 years	22 632	207 725	230 357	0.147	0.092	0.056
30–34 years	18 371	194 588	212 959	0.120	0.086	0.034
35–39 years	13 339	176 265	189 604	0.087	0.078	0.009
40–44 years	8 756	145 982	154 738	0.057	0.064	0.007
45–49 years	6 037	122 092	128 129	0.039	0.054	0.015
50–54 years	4 688	106 022	110 710	0.031	0.047	0.016
55–59 years	3 144	82 824	85 968	0.020	0.037	0.016
60–64 years	2 484	67 808	70 292	0.016	0.030	0.014
65–69 years	1 786	51 666	53 452	0.012	0.023	0.011
70–74 years	1 397	41 133	42 530	0.009	0.018	0.009
75 years and over	2 649	64 989	67 638	0.017	0.029	0.011
Total	153 658	2 267 485	2 421 143	1.000	1.000	0.387
Duncan index (sum divided by 2)						0.193

Selectivity of migration by age

Source: Prepared by the author.
Note: Formula for the calculation of the Duncan dissimilarity index, $D = \frac{1}{2}\sum\left|\frac{N_{1i}}{N_1} - \frac{N_{2i}}{N_2}\right|$

Chapter IX
Indirect estimation of internal migration

Introduction

Migration can be estimated indirectly following several procedures. All of them share a significant restriction: that they obtain migration as a remainder and, therefore, by estimating only the balance of migration but not the in-migrants and out-migrants that determine the balance. As a result, this type of estimation has a second shortcoming, namely that it is unable to differentiate between internal and international migration. In addition to these weaknesses, others will be explained in each of the cases described below.

There are two main families of available procedures. One family aims to estimate migration, specifically the balance of migration, as indicated above. In this case, procedures are based on the demographic balancing equation and application of survival ratios to a given population. In the second family, procedures aim to estimate migration by means of models that already use some migration data. In some cases, rather than estimating, the aim is to adjust or smooth observed values (migration model tables and log-linear models). This chapter is somewhat general and concise because the details of the methodologies described can already be found in the bibliography (Villa, 1991; CELADE/PROLAP, 1997; Moultrie and others, 2013).

A. Indirect estimation through the demographic balancing equation

As is well known, the basic equation of demography, called the demographic balancing equation, balancing equation or population balancing equation, indicates that a current population in $x + n$ depends on the population at time x, the number of births and deaths (their balance) and migration (the balance of migration) in period $x + n$, as shown in formula 1. A basic algebraic manipulation leaves migration (the aforementioned balance of migration) as the unknown to be found. The problem with this estimation, therefore, is having good quality data for the variables on the right of the equation, which is to say the population at two points in time and the births and deaths between the two points. In most Latin American countries, these two requirements are not met, either at the national level (in which case international migration could be estimated as a remainder) or at the subnational level (to estimate internal migration, although such an estimate would contain both internal and international migration, without distinguishing between the two).

The various risks of this procedure include a change in sources' data quality during the reference period. For example, if a population estimate were to originate from a census and in the intercensal period the coverage of this source was to improve, then part of the population recorded by the census at time $x + n$ would be population existing at time x, but uncounted in the census at time x. Therefore, this additional population would be attributed in full to the balance of migration, inflating the migration estimate.

It is technically possible to estimate balances of migration by age if the populations at times x and $x + n$ are available and the deaths for period n are disaggregated by age.

$$N(t+n) = N(t) + B–D + I–E \quad (1)$$

$$(I–E) = N(t+n) – N(t) – (B–D) \quad (2)$$

$$M(t,t+n) = N(t+n) – N(t) – B+D \quad (3)$$

$$M(t,t+n)\ (x,x+n) = N(t+n)\ (x+n) – N(t)(x) + D(t,t+n)(x,x+n) \quad (4)$$

$$M(t,t+n)(0,0+n) = N(t+n)(0,0+n) – B(t,t+n) + D(t,t+n)(0,0+n) \quad (5)$$

B. Remainder of growth

Based on the reasoning set out in the previous section, if the population growth rate and the rate of natural increase in the period $x + n$ are available, it would again be possible to obtain the total net migration as a remainder (mixing internal and international migration, without being able to disaggregate them). The formulae for this case are as follows:

$$r = b - d + m \tag{6}$$

But

$$b - d = r_{natural} \tag{7}$$

Therefore

$$r = r_{natural} + m \tag{8}$$

Ergo

$$r - r_{natural} = m \tag{9}$$

Chapter X
Commuting[1]

Commuting is regular travel by people to perform a systematic and ongoing activity. Studying and working are prime examples of such activity. Other examples include shopping, running errands, dropping off or picking up children at different places (such as schools), dropping off or picking up other people, or engaging in leisure activities. Unlike migration, commuting does not entail a change of residence and, in fact, the vast majority of those who commute return home after completing the activity for which they travelled. However, for travel to be considered commuting it is not necessary for it to be daily, but it must be regular and ongoing. This does not rule out brief breaks caused by specific inconveniences, circumstances or situations, such as leave or vacations.

In terms of measuring commuting through censuses, the traditional approach has focused on travel for paid production activities —which is to say employment— and also regular travel to an educational institution, which may be a school, university or other establishment.

The United Nations *Principles and Recommendations for Population and Housing Censuses* (United Nations, 2017 and 2008) include this topic under the heading "place of work". Reviewing how this topic is addressed in these manuals, it can be concluded that: (i) it is measured in the case of the employed with respect to their main occupation; (ii) responses should have at least three categories: (a) people who work at home (no commuting to work), (b) people who commute to work, and (c) people who have no fixed place of work and who are usually not included as valid cases of commuting; and (iii) a higher frequency of commuting in conurbations naturally produces specific categories of urban commuters.

In addition to questions concerning the location of the workplace, other queries related to commuting can be included, such as mode of transportation, average travel time to work,

[1] This chapter uses the terms "commute", "commuting" and "commuter" to refer to daily or regular travel to a place of work or study and to those who undertake such travel.

and whether the return journey to the place of residence occurs during the day or after performing the activity that gave rise to the commuting.

As in the case of migration, the destination can be specified geographically in different ways. The traditional (and only) way this is done in Latin America is at the level of the minor administrative division. However, this means that intramunicipal commuting is not captured, despite potentially being highly significant in very populous minor administrative divisions that account for a large concentration of jobs (such as the municipality of São Paulo or Bogotá, D. C.). However, as already indicated, the use of the question recommended by the United Nations allows another distinction to be made that prevents this omission, a situation that, at least in Latin American censuses, is not possible in the case of migration. This involves filtering those who live and work in the same minor administrative division into two categories: (i) people who work at home and therefore do not commute to work;[2] and (ii) people who work in the municipality where they reside, but outside their home, and therefore commute to work.

A much-debated aspect of the question and the situation it measures is whether the statement corresponds to daily commuting, which is to say whether it is a daily round trip. The answer is that it does not correspond solely to daily travel and that there are ever more work and educational trips for longer periods, from weeks to months, which do not entail a change of residence. The fact that the question allows for the category "other country" is revealing, even though there are circumstances in which a border may be crossed daily for work (between border cities such as Tijuana and San Diego, Encarnación and Posadas, or Ciudad del Este and Foz de Iguazú).

In any case, in some situations this possibility of working or studying for periods or seasons may contaminate other questions in the commuting module, such as those related to travel time to work, since it would be quite natural that in such a case for people to respond according to the place where they work; in other words, respondents refer to the commute between their place of temporary accommodation and their job, and not to the commute between their permanent residence and where they work. Although this pattern of seasonal or weekly commutes has increased —for example, in the case of mining or fishing— it still seems to be a minority of commutes. This is reflected in the only country whose censuses have included a question on returning to the place of residence after work (Brazil in 2010 and 2022), where more than 95% of those commuting for work reported returning home after finishing work.

Considering the above and the importance of metropolitan areas in relation to commuting, the census question about where the person works or studies (the most common is "in which minor administrative division is your place of work or study located?"), enables the following typology of commuters in a metropolitan area to be assembled:

[2] If these cases are included in the calculations of indicators for average commuting time, they skew the result downward.

- Extrametropolitan commuters, arising from the exchange of workers between the metropolitan area and the rest of the world. This encompasses at least the following categories:
  - Commuters who travel for work or study to a metropolitan area from the rest of the country.
  - Commuters who travel for work or study to the rest of the country from a metropolitan area.
  - Commuters who travel for work or study to a metropolitan area from another country.
  - Commuters who travel for work or study to another country from a metropolitan area.
- Intrametropolitan commuters:
  - Home-based work: historically significant (10% to 20% of workers) and typically informal. However, this percentage may be changing, mainly owing to technology and the coronavirus disease (COVID-19) pandemic.
  - Commuters within a minor administrative division: they work and reside in the same minor division, but do not work in the same home. To determine their proportion, the standard question proposed by the United Nations must be asked; in other words, identifying home-based work, which can be used to determine who works and resides in the same minor administrative division and must commute to work.
  - Commuters between minor administrative divisions: they work in one district of a metropolitan area and reside in another district of the same metropolitan area.
  - Multiple destinations: workers whose main job has no fixed location and who travel to several destinations during their workday or change their destination depending on the day. They are generally overlooked as commuters.

A. Experiences of commuting measurements in Latin American censuses

In Latin America and the Caribbean, there is growing experience with modules on commuting.

- In 1980, only one country included questions on this issue: Brazil (in the expanded form applied to a sample).
- In the 1990s, no country included questions on commuting.
- In the 2000s, 6 of 19 countries asked questions about commuting: Brazil (in the extended form applied to a sample), Chile, Colombia (in the extended form applied to a sample), El Salvador, Mexico (in the extended form applied to a sample) and Nicaragua.

- In the 2010s, 9 of 16 countries asked such questions: Brazil (in the expanded form applied to a sample), Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico (in the expanded form applied to a sample), Peru and Uruguay.
- In the 2020s, of the four censuses conducted or to be conducted, whose census form is already available (Mexico, 2020; Argentina, 2022; Costa Rica, 2022, and Brazil, 2022), in three (Mexico, Costa Rica and Brazil), questions on commuting to places of work and study were included. In all three, other questions were added, for example, on the type of transportation, travel time, return home during the day and teleworking.
- Some Caribbean countries include one or more questions on the subject, but not Jamaica or Trinidad and Tobago, the largest and most populous (United Nations, n.d.).

B. Other sources for measuring commuting and the comparative strengths and weaknesses of censuses

There are many other sources for measuring and analysing commuting. The most commonly used are "origin-destination" surveys, which are normally applied to a city or metropolitan area. Other sources include public transport passenger records, vehicle counting (human observation, toll statistics or telematic detection, satellite images and, more recently, device tracking, particularly mobile telephones, and information provided by social networks and digital applications, particularly those related to transportation (such as Waze or Uber).

Given this multitude of alternatives, why should censuses be used? For numerous reasons, such as their:

(i) representativeness, as they are universal and non-sampling operations.

(ii) coverage of all minor administrative divisions in a country and, by aggregating such divisions, of all metropolitan areas in a country.

(iii) capacity to capture both intrametropolitan and extrametropolitan commuting, as well as commuting from all types of cities and rural areas.

(iv) capacity to make other distinctions within extrametropolitan commutes, for example, between travel to or from the city environment, areas at an intermediate distance, remote areas or even other countries, all of which might require specific means of transport and infrastructure.

(v) ability to produce territorial, household and population (individual) indicators of commuting.

(vi) ability to combine territorial, household and individual information on persons according to the category of commuting, enabling territorial and population (subpopulation) commuting patterns to be described.

(vii) availability free of charge, as census information is freely provided to citizens and researchers in various formats, including microdata.

Reasons (i) to (iv) are advantages over origin-destination surveys. Reasons (v) to (vii) are advantages with respect to the other records mentioned above, as well as with respect to digital applications (big data). Normally, these sources or measuring devices only detect commuting and do not capture data from commuters.

Despite this list of strengths, censuses clearly have limitations in this respect, and significant ones, at least compared to the information obtained from other sources. For illustrative purposes only, three of the shortcomings of censuses are:

(i) Static data that is very far apart in time (every 10 years, or the frequency of the census), which is entirely insufficient to capture patterns in movements, which can change from one day to the next. This shortcoming is structural and inherent in censuses that are conducted once every several years, although this could be mitigated by adopting a rolling census format.

(ii) The impossibility of determining the precise destination of a trip, because the questions are about whether trips are made to other districts or within a district, without asking for the exact address of the place of work. Of course, this can be solved by asking for the address, or by using geolocation when collecting census data with mobile devices, or by allowing respondents to fill in the information in online forms (which poses the resulting challenge of processing and managing that information).

(iii) A limited set of questions, resulting in a focus on only one or two types of trips (to work and school) and preventing key questions being asked; such questions are asked in origin-destination surveys, on matters such as costs, schedules and comfort of travel.

C. Census instruments and indicators of commuting to work or study

Origin-destination matrices and commuting status tables are the main instruments used to obtain indicators for commuting. These indicators are largely less systematized and standardized than those for migration. In any case, the principles and formulas applied in migration origin-destination matrices and migration status tables remain valid, both for commuting origin-destination matrices and for commuting status tables, but with some specificities and differences.

These include: (i) use of the resident population as the denominator instead of the average population, although the average population can also be used and thus a rate rather than a ratio is obtained; (ii) the inclusion of those who work at home to obtain highly significant indicators, which is less common in the case of migration; (iii) at least three categories in the tables (works at home, commutes within the minor administrative division of residence, or commutes to another minor administrative division) rather than two (migrant and non-migrant); and (iv) in practice, since these movements tend to be more frequent in cities and metropolitan areas, there are in fact three categories for migrants (owing to the distinction between those who change their residence from a specific conurbation to another place, called intrametropolitan migrants, and those who arrive in a specific conurbation from another place, called extrametropolitan migrants) and four for commuters (owing to the distinction between intra- and extrametropolitan commuters).

In view of all the above, a simple list of commuting indicators is provided below, with their respective formulae and interpretations.

1. Population indicators

Unlike migration, commuting for work or study does not lend itself as clearly to quantification of the number of events. While a person may simultaneously be commuting for different reasons (such as work, schooling, shopping, unpaid care work, health care, or to reach a community or recreational space), as previously mentioned the census generally captures one or two types of commutes (work and education). A person may also have a history of commuting owing to a change in the origin or destination. As already explained, censuses only record commuting at the time they are conducted. Thus, in census measurement practice, commuting is treated through the binary status of either being or not being a commuter. If a person is categorized as a commuter, subcategories of commuters are usually applied, as outlined above. Therefore, the distinction between commuting for work (or study) and commuter for work (or study) does not make much sense, since they overlap. For the same reason, the standard indicator for commuting intensity at the population level is the percentage of commuters within a group.

Thus, the first population-level indicator of commuting provided by a census is the number of commuters within a population and its subpopulations, which is to say how many commuters there are in the country or metropolitan area and how many of them belong to particular groups, such as men or women and youth or adults, in a given territory. It should be noted that the term "commuter" was originally reserved for those who had long commutes to work or who travelled across political or administrative divisions to work or study. However, with the standard question recommended by the United Nations, it is possible to identify all workers or students who commute to work or study, respectively, which is to say those who do not work or study at home. For this reason, it is particularly important that this population quantification explicitly specifies what is meant by "commuter", clearly defining whether it refers to all those who commute to work or only to those who commute to work in a municipality other than their place of residence.

The second population indicator corresponds to the relative frequency of commuting in populations and subpopulations, known as its intensity. It usually refers to the percentage of commuters in each subpopulation of men and women by age and schooling, among other factors. The numerator is the number of commuters, and the denominator is the resident population (workers).

The third population indicator refers to selectivity. In this case there are several options, but the simplest is the ratio of the intensity in each subpopulation to overall intensity. A value of more than 1 indicates selectivity of commuting for the group in question. In any case, the dissimilarity index and similar metrics can be used for these purposes, in a similar way to how it is employed for migration, as demonstrated in chapter VIII.

The remaining population indicators are derived from other questions on travel time, means of transport and return home during the day.

In the first case, the standard indicator is average travel time in minutes, whose method of calculation depends on the question used. If it is in minutes, it is the direct mean of that distribution. If it is in time brackets, it is the weighted mean of each category, using the midpoint of the brackets to obtain the accumulated minutes. This indicator should be calculated considering all workers and only those who commute to work. This controls for the effect of working from home, which naturally reduces the average in a way that can be considered distorting. As both averages are valid and provide valuable but different information, the recommendation is to present the indicator calculated with and without those who work at home.

In the second case, the standard indicators correspond to modes of transport, the percentage of each mode (distribution) and the combinations, either in terms of number of modes (one, two, three or more modes of transport to reach the place of work) or in terms of the detail (chain) of the combinations. In this case they are also expressed as the combination of modes and the relative proportion of each category. When there are many potential categories, reporting may be limited to the most habitual, although there is no standard for determining this.

In the third case, percentage returning home by subpopulations is the standard indicator.

2. Territorial indicators (especially for minor administrative divisions, particularly those in metropolitan areas, and major administrative divisions)

Censuses can be used to obtain numerous and varied indicators of commuting at the territorial level. Many of them are similar to those explained for migration, when their basis is the origin-destination matrix for travel to work or study, although with some specificities and differences. There are other indicators that are specific to commuting, if the necessary census questions have been asked. When the origin-destination matrix for commuting to place of work or study is taken as the basis for the calculations, the main territorial indicators are as follows.

First is the intensity of commuter flows (workers and students). Expressed in absolute terms, it is the sum of workers and students who arrive in a political or administrative division on a daily basis to work or study and workers and students who leave the same division on a daily basis to work or study. In other words, it is the "gross commuting flows" of the division. Expressed in relative terms, the aforementioned numerator is divided by a denominator (number of workers or students), to determine the relative frequency of the flows. There are at least three alternatives for this purpose: (i) residents of the division; (ii) non-commuters of the division; and (iii) average population of workers and students of the division. As in the case of migration, this intensity of commuter flows has no concomitant impact in terms of the growth effect.

Second are indicators of worker and student retention. Expressed in absolute terms, these indicators are the number of non-commuters in a political or administrative division. Expressed in relative terms, the above numerator is divided by the resident population, which yields the percentage of workers and students who work or study in the same division in which they reside. This indicator can also be calculated with respect to migration, although it is rarely used in this case. However, for commuting it is crucial because it reflects the demand for employment in each division that is met by local workers, or the educational needs of the local student and school-age population that is absorbed by local establishments. Its methodological interpretation is limited to retention and does not extend to inflows or outflows of workers and students, which can be seen in the following point. For example, low retention is not incompatible with an inflow of commuters and a high retention is not incompatible with an outflow. From a substantive point of view, conclusions should not be drawn immediately. For example, retention of 100 workers (that would intuitively suggest socioeconomic strength of a division) may be based on precarious employment conditions, which would be more of a sign of socioeconomic weakness of a division.

Third are the indicators of departures, arrivals and net flows of commuters (growth effect in a day). Expressed in absolute terms, these are divided into: (i) the number of arrivals (commuters arriving to work or study); (ii) the number of departures (commuters leaving to work); and (iii) the net flow of commuters (difference between arrivals and departures or the difference between those working in a division and those living in it). The net flow of commuters in this matrix is obtained through a subtraction that is the opposite of that performed for migration (both with a standard presentation), as the population that works in a division (marginal total of the row) is the minuend and that which resides in the division is the subtrahend (marginal total of the column). This net flow of commuters corresponds to the growth effect of commuting, which is substantially different to the analogous effect caused by migration. This is growth during the working day, so it can be expressed with the colloquial notion of "growth in the day". Although this idea is not exact (owing to night work and commuting over periods that are not a day), it is illustrative and intuitive and that is why it is used, even though it is not strictly correct.

Expressed in relative terms, the above numerator is divided by the resident population and a growth ratio is obtained if the denominator is the resident population and a growth

rate if the denominator is the average population. The first option is the most widely used and intuitive, as it shows the magnitude of the growth effect with respect to the resident population. This is the key data for local authorities, whose management naturally concentrates on residents, although they cannot ignore the whole population they have "during the day", which may be X% more or x% less than the resident population, depending on whether there is a net inflow or net outflow of commuters. As it is a ratio, it can exceed 100%. However, for more technical analysis, the rate is more precise because it accounts for the magnitude of the exchange of commuters.

Fourth, the redistribution, composition and inequality effects examined in the previous chapters on migration apply in a comparable manner to commuting. In this case the subtractions are reversed, both to obtain balances when applicable, and to obtain the effects themselves. Regarding the latter, the notions of factual and counterfactual, which are properly applied in the case of migration, lose their conceptuality in the case of commuting. This is because both marginal totals of the matrix capture real values, but one is at night (residents) and the other is during the day (workers and students). The effect of commuting therefore corresponds to a subtraction with the marginal total for the row as the minuend (workers or students in the entity), and the marginal total for the column as the subtrahend (resident workers and students).

Fifth, with the marginal totals from the migration matrices it is possible to calculate different indicators of territorial disparity of residence and of territorial disparity of work or study. Among other relevant issues that can be investigated with these indicators are cities' monocentrism or polycentrism with respect to labour. A simple comparison of the percentage of residents and workers in central municipalities provides an initial idea of the extent of this phenomenon.

Sixth and lastly, travel times can also be calculated for territories, but distinguishing between those arriving in and those leaving a political or administrative division. The simplest way to do this is through the flow indicator matrix, as was previously explained in the case of migration. In this case, the indicator is for travel time the diagonal is excluded, to obtain only the travel time of those who leave for work (marginal total for the column) and those who arrive to work (marginal total for the row). However, the diagonal can also be included, in which case the commuting time of those who work and live in the same municipality would be shown, which is a key indicator of the level of intramunicipal congestion.

In addition to the matrix, in the case of commuting there another procedure than can be employed for certain indicators. This involves making direct use of the question on the place of work (or study) and calculating its distribution according to the place (municipality) of residence of workers and students. Through this procedure, a distribution will be available for each municipality, distinguishing between non-commuters, those who work at home and those who work away from home, but in the same municipality.

For illustrative purposes, table X.1 shows a simplified example of a commuting matrix, used to calculate several of the indicators listed and explained above. The same nomenclature is used as in the internal migration matrix, the first subscript for the place of work and the

second subscript for the place of residence. Evidently, the concept of origin and destination is inverted in the two matrices, since in the matrix of table X.1 current residence (left column) is the origin, while the place of work (top row) is the destination. Therefore, in general, the commuting indicators are obtained using the same formulae as for internal migration, but they are inverted when dealing with subtractions and have a different denominator when dealing with ratios (resident population is preferable to average population, although the latter can also be used), as shown in table X.2.

■ Table X.1
Example of a commuting matrix and derived calculations

Administrative division of current residence	Administrative division of work or study				Workers and students residing
	A	B	C	D	
A	45	15	24	14	98
B	11	50	17	11	89
C	22	13	55	24	114
D	12	19	33	77	141
Working or studying	90	97	129	126	442
N_{DA}	14	People who work in D and reside in A. Commuters who come to work or study in D from A or, in other words, commuters who leave A to work or study in D.			
N_{CB}	17	People who work in C and reside in B. Commuters who come to work or study in C from B or, in other words, commuters who leave B to work or study in C.			
N_{AA}	45	People not commuting for work from A. Residing in A and working in A.			
$N_{D.}$	126	People who work or study in D and reside in D or outside D. Total number of people working in D.			
$N_{.A}$	98	People who reside in A and work in A or outside A. Total number of people residing in A.			
$N_{..}$	442	Total number of people in the matrix.			
Balance of commuters for A	−8	Effect of growth in the day: A loses eight workers per commute in the day: 90 − 98.			
Commuting ratio of A	−8.2	Relative weight of the balance of commuters: the daily loss of workers for A is equivalent to 8.2% of its resident workers: -8/98.			
Percentage retention of A	45.9	45% of workers residing in A work in A: 45/98.			

Source: Prepared by the author.

■ Table X.2
Formulas for key indicators of the commuting matrix, with administrative division A as reference

Population indicators	
Commuters from A (leaving A to work): N.A - NAA	(1)
Commuters to A (coming to A to work): NA. – NAA	(2)
Non-commuters of A (residing and working in A): NAA	
Balance of commuters for A: NA. – N.A	(3)
Proportion of non-commuters (or retention percentage, if weighted by 100): NAA/N.A	(4)
Proportion of commuters of A: (N.A - NAA)/N.A	(5)
Ratio of commuters for A: (NA. – NAA)/N.A	(6)
Ratio of balance of commuters for A: (NA. – N.A)/N.A	(7)

Source: Prepared by the author.

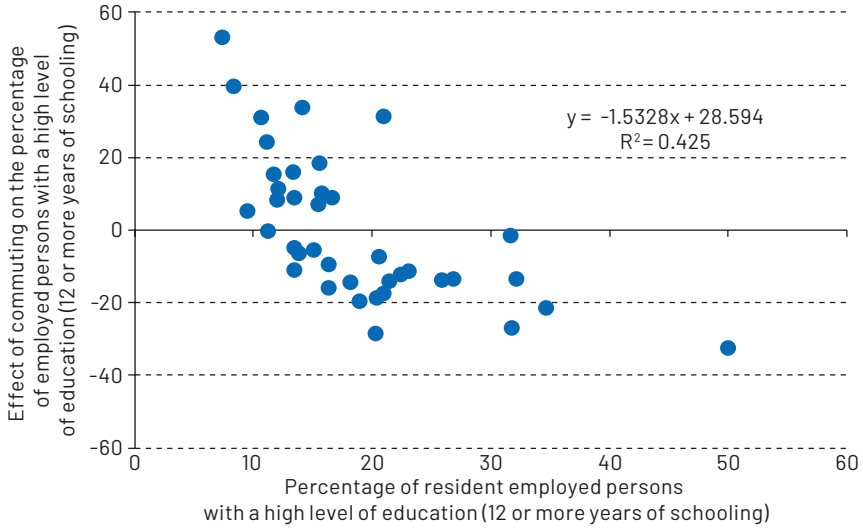
Figure X.1 shows application of the procedure explained above to estimate the effect of migration on the composition of the population and the spatial inequality of the composition. In this case, the impact of commuting on the percentage of employed people with a high level of education is used. The first finding is that commuting has significant effects in many municipalities. In some cases, the percentage of employed people with a high level of education increases by almost 60%. Second, the slope of the line of best fit is clearly negative, indicating that commuting contributes to reducing educational inequalities between municipalities during the working day.

Using the question on daily commuting to detect levels of monocentrism, figure X.2 reveals that, despite the predominant hypothesis in the literature of a gradual transition from a monocentric to a polycentric city model (Rodríguez, 2022), this has not yet been consolidated in the region, whose levels of over-concentration of employment in the central area have remained constant thus far in the twenty-first century. However, the same data in figure X.2 confirms that the modifiable areal unit problem (MAUP) also affects comparisons of cities. In fact, the difference between the central areas of the Metropolitan Area of the Valley of Mexico and the São Paulo Metropolitan Region are decisive in terms of the differences among the values for the monocentrism indicator in figure X.2. However, the trend for each city is valid, with the central area delimitation used. If the delimitation is changed, the trend could also change. Figure X.2 adds another relevant finding: monocentrism is greater in the case of skilled jobs (those held by workers with high levels of education).

Lastly, map X.1 shows the travel time indicator at a territorial scale and using only the employed population that commutes to work and resides in the Metropolitan Area of the Valley of Mexico. Clearly, residents of central areas are among those who take the least time to get to work, as jobs are abundant in their surroundings, making it easier for them to live close to their place of work. Even so, vast areas of the periphery record comparatively short travel times, because a significant portion of the employed population works in the same municipality, which discredits the idea of the periphery as a commuter belt. In contrast, the southern area of Mexico City, which is not as far from the centre as large swathes of the northern and eastern periphery, shows the longest travel times for mass commuting to the centre, as roads are congested, as are all means of transportation in general (Rodriguez, 2022).

■ Figure X.1

São Paulo (Brazil): composition and inequality effect of commuting, impact on the percentage of employed persons with a high level of education (12 years or more of schooling), 2010

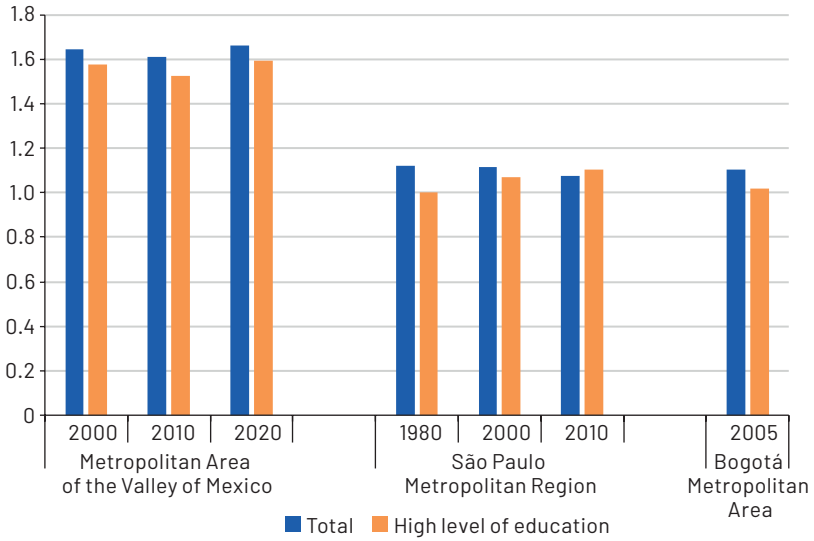


Source: J. Rodríguez, "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina", *Project Documents* (LC/TS.2022/92), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.

■ Figure X.2

Metropolitan Area of the Valley of Mexico, São Paulo Metropolitan Region and Bogotá Metropolitan Area: ratio of percentage of employed persons working in the greater central area and those residing in the greater central area, total and employed persons with a high level of education, 1980–2020

(Percentages)

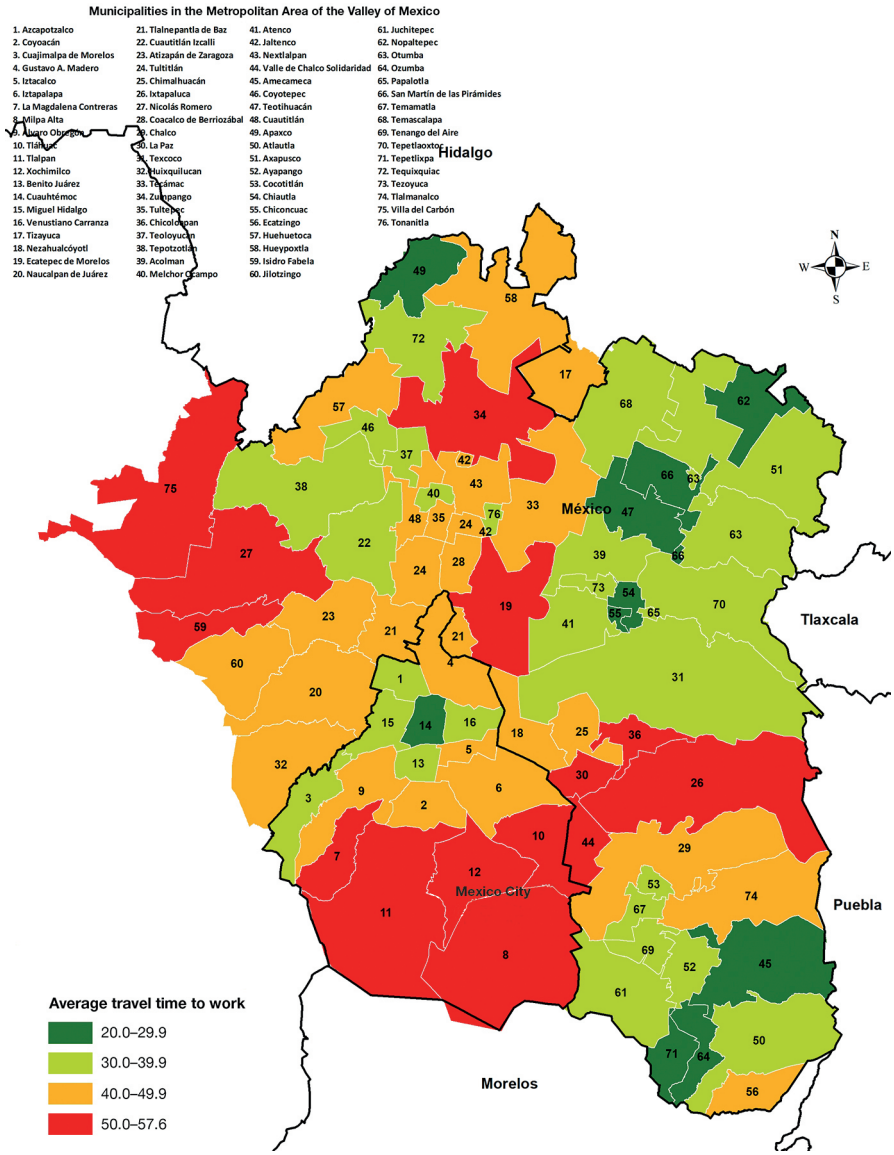


Source: J. Rodríguez, "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina", *Project Documents* (LC/TS.2022/92), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.

■ Map X.1

Metropolitan Area of the Valley of Mexico: average travel time of employed persons by municipality or council district of residence, 2020

(Minutes)



Source: J. Rodríguez, "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina", Project Documents (LC/TS.2022/92), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.

Note: Figures include only employed persons with valid values for calculations and who report travel time to work; in other words, they exclude those who do not commute because they work at home.

Chapter XI
Conclusions and outlook

The main purpose of this publication is to contribute to building capacity for critical, intensive and systematic use of origin-destination matrices to quantify internal migration intensity and commuting. These matrices can also be used to estimate four of the direct sociodemographic effects (growth, redistribution, composition and inequality) of internal migration and commuting, almost all of which have been only scarcely measured and studied thus far in Latin America.

The time and effort required for such a quantification, which in the past would have been impossible, can thus be limited and made easily manageable for a standard national statistical office, once proper routines are established for the calculations. In addition, the financial investment required for these estimates is lower, as they draw on free census data. Strictly speaking, these are data that can be accessed without paying to do so.[1] This makes their proper use even more important.

However, their analysis and subsequent use in relation to public policies and decisions merits special attention. Some national indicators can be described in a straightforward and simple manner and analysed in terms of their relationships with other national indicators. However, the standard indicators presented herein are generally territorial and are disaggregated according to political, administrative or geographic divisions, which can be very numerous. This complicates analysis, making it more time-consuming and even exhausting, since each entity is a stand-alone unit that warrants individual analysis to enable indicators to be read according to its specific reality. The only answer to this challenge is the one outlined in the introduction, when it describes the different audiences to which this document is addressed. These include national and subnational authorities. It is their technical teams who must analyse the indicators that are relevant to their administrative divisions, to be used as inputs for programmes and for decisions at the local level.

[1] However, the data do have a cost, which has been covered by the general taxes that finance population censuses.

This text can be said to be rigorous, consistent and thorough, given its thematic focus, concentration on one data source, particularly methodological approach and its aim to contribute to capacity-building. The disadvantage of such a selective approach to the text is that many issues relating to migration and commuting are omitted or examined only superficially or in passing. These include issues linked to the determining factors of migration, its economic repercussions and its relationship with other forms of human mobility such as internal migration, forced displacement and asylum-seekers or refugees. These are all important sources of migration that are barely examined or used in the text. The data presented were not systematized to obtain an updated regional picture of the intensity and effects of internal migration and commuting. In general, the discussion of theory and policy was limited and basic.

However, these shortcomings can be overcome in the future through: (i) new studies that draw on the definitions, instruments and applications in this text to obtain data and indicators to describe and analyse the levels, trends and patterns of internal migration and commuting in the countries of the region; (ii) new methodological work to make use of sources not addressed in this text; and (iii) conceptual and analytical innovations to examine the determinants of migration in its current multiple forms, employing theory based on the experience of other regions but recognizing the specificities of Latin America.

Bibliography

Alberts, J. (1977), "Migración hacia áreas metropolitanas de América Latina: un estudio comparativo", *Serie E*, No. 24, Santiago, Latin American Demographic Centre (CELADE).

Ares, S. E. (2010), "Espacio de vida y movilidad territorial habitual en Chapadmalal, Buenos Aires, Argentina", *Cuadernos de Geografía. Revista Colombiana de Geografía*, No. 19, Bogotá, National University of Colombia [online] www.redalyc.org/articulo.oa?id=281822029003.

Bell, M. and E. Charles-Edwards (2013), "Cross-national comparisons of internal migration: an update on global patterns and trends", *Technical Paper*, No. 2013/1, New York, United Nations.

Bell, M. and S. Muhidin (2009), "Cross-national comparison of internal migration", *Human Development Research Paper*, No. 2009/30, United Nations Development Programme (UNDP).

Bell, M., P. Rees and T. Wilson (2003), "Comparing internal migration between countries: Who collects what?", *Discussion Paper*, No. 2003/05, Queensland Centre for Population Research School of Geography, Planning and Architecture, University of Queensland.

Bell, M. and others (2015), "Internal migration and development: comparing migration intensities around the world", *Population and Development Review*, vol. 41, No. 1, March.

Bernard, A. (2022), "Internal migration as a life-course trajectory: an introduction", *The Springer Series on Demographic Methods and Population Analysis*, vol. 53, Springer.

Bernard, A., M. Bell and E. Charles-Edwards (2014), "Improved measures for the cross-national comparison of age profiles of internal migration", *Population Studies: A Journal of Demography*, vol. 68, No. 2 [online] http://dx.doi.org/10.1080/00324728.2014.890243.

Bilsborrow, R., S. Oberai and G. Standing (1984), *Migration Surveys in Low-Income Countries*, London, Croom Helm.

Boden, P., J. Stillwell and P. Rees (1993), *Migration Processes and Patterns: Population Redistribution in the United Kingdom*, Hoboken, Wiley.

Calvelo, L. (2011), "Viejos y nuevos asuntos en las estimaciones de la migración internacional en América Latina y el Caribe", *Population and Development series*, No. 98 (LC/L.3290-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Camisa, Z. (1972), "Efecto de la migración en el crecimiento y la estructura de la población de las ciudades de la América Latina", *Serie C*, No. 139, Santiago, Latin American Demographic Centre (CELADE).

CELADE/PROLAP (Latin American and Caribbean Demographic Centre-Population Division of ECLAC/Latin American Programme of Population Activities) (1997), *Demografía I*, Mexico City, Latin American Programme of Population Activities (PROLAP) and Institute for Social Research of the National Autonomous University of Mexico (UNAM).

Chávez, A. M. and others (2013), "Nouvelles tendances de la migration métropolitaine en Amérique Latine: est-ce que les aires métropolitaines gagnent ou perdent population à cause de la migration interne", paper presented at the session 091 "Internal migration and urbanization: Overview", Conference of the International Union for the Scientific Study of Population (IUSSP), Busan.

Courgeau, D. (1990), "Nuevos enfoques para medir la movilidad espacial interna de la población", *Notas de Población*, vol. 18, No. 50 (LC/DEM/G.104), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___ (1988), *Méthodes de mesure de la mobilité spatiale : migrations internes, mobilité temporaire, navettes*, Paris, Ined Éditions.

___ (1973), "Migrations et découpages du territoire", *Population (French Edition)*, vol. 28, No. 3, May-June.

Donzeau, N. and J.-L. Pan Ké Shon (2009), "L'évolution de la mobilité résidentielle en France entre 1973 et 2006 : nouvelles estimations", *Population*, vol. 64, No. 4.

Dureau, F. and others (2011), "Encuestas movilidad espacial Bogotá METAL 2009: metodología de las encuestas", *Documento CEDE*, No. 23-2011, Bogotá, University of the Andes .

Dyrting, S. (2018), "A framework for translating between one-year and five-year migration probabilities" [online] DOI:10.13140/RG.2.2.24261.91362.

ECLAC (Economic Commission for Latin America and the Caribbean) (2014), "Los datos demográficos: alcances, limitaciones y métodos de evaluación", *Manuals series*, No. 82 (LC/L.3906), Santiago.

___ (2012), *Population, territory and sustainable development* (LC/L.3474(CEP.2/3)), Santiago.

___ (2011), "Recomendaciones para los censos de la década de 2010 en América Latina", *Handbooks series*, No. 72 (LC/L.3364), Santiago.

Elizaga, J. C. (1972), "Migraciones interiores, el proceso de urbanización, movilidad social", *Serie A*, No. 117, Santiago, Latin American Demographic Centre (CELADE).

Greenwood, M. (1997), "Internal migration in developed countries", *Handbook of Families and Population Economics*, vol. 1, Amsterdam, Elsevier.

Herrera, L., W. Pecht and F. Olivares (1976), "Crecimiento urbano de América Latina: mapas y planos de ciudades", *Serie E*, No. 22, Santiago, Latin American Demographic Centre (CELADE).

INE (National Institute of Statistics) (2013), "Migration Statistics Methodology" [online] http://www.ine.es/en/metodologia/t20/t2030277_en.pdf.

IUSSP (International Union for the Scientific Study of Population) (n.d.), "Introduction to migration analysis" [online] http://demographicestimation.iussp.org/content/migration-intro.

Lattes, A., J. Rodríguez and M. Villa (2002), "Population dynamics and urbanization in Latin America: concepts and data limitations", paper presented at the seminar New Forms of Urbanization: Conceptualising and Measuring Human Settlement in the 21st Century, Bellagio, March.

Lee, E. S. (1966), "A theory of migration", *Demography*, vol. 3, No. 1, Durham, Duke University Press.

López Vega, R. (2007), "Medición de la migración con especial referencia a la fuente de datos censal (la medición de la migración en los censos de población y vivienda en México)", paper presented at the Taller Nacional sobre Migración Interna y Desarrollo en México: Diagnóstico, Perspectivas y Políticas, Mexico City [online] https://www.cepal.org/sites/default/files/courses/files/rlopez.pdf.

Macció, G., L. Henry and E. van de Walle (1982), *Multilingual Demographic Dictionary*, Liège, Ordina Editions.

Maguid, A. (2009), "El estudio de la emigración internacional mediante los censos realizados en los países de origen: evaluación de resultados y recomendaciones", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Martine, G. (1972), "Migration, natural increase and city growth in Rio de Janeiro", *International Migration Review*, vol. 6, No. 2.

Martínez, J. (2009), "Medición e información sobre la migración internacional a partir de los censos: lecciones, desafíos y oportunidades", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Massey, D. and N. Denton (1988), "The dimensions of residential segregation", *Social Forces*, vol. 67, No. 2, December.

Moultrie, T. and others (2013), *Tools for Demographic Estimation*, Paris, International Union for the Scientific Study of Population (IUSSP).

Oxford University Press (n.d.), Oxford Dictionaries Premium [online] https://premium.oxforddictionaries.com.

Polese, M. (1998), *Economía urbana y regional: introducción a la relación entre territorio y desarrollo*, Cartago, Libro Universitario Regional.

Pötzschke, S. and S. Rinken (eds.) (2021), *Migration Research in a Digitized World: Using Innovative Technology to Tackle Methodological Challenges*, Cham, Springer.

Recaño, J. (2010), "Análisis demográfico de las migraciones", Bogotá, National University of Colombia [online] http://www.institutodeestudiosurbanos.info/descargasdocs/doc_download/1127-analisis-demografico-de-las-migraciones.

Rees, P. and N. Lomax (2020), "Ravenstein revisited: the analysis of migration, then and now", *Comparative Population Studies*, vol. 44, May.

Rees, P. and others (2000), "Problems and solutions in the measurement of migration intensities: Australia and Britain compared", *Population Studies*, vol. 54, No. 2.

Rigotti, J. I. (2009), "Información de los censos demográficos del Brasil sobre migraciones internas: críticas y sugerencias para el análisis", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Rodríguez, J. (2022), "Migración interna y movilidad para trabajar y estudiar en cuatro megápolis de América Latina", *Project Documents* (LC/TS.2022/92), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2019), "El efecto de la migración interna sobre la estructura y las disparidades etarias en las grandes ciudades de América Latina", doctoral thesis in demography, National University of Córdoba.

___(2013), "La migración interna en las grandes ciudades en América Latina: efectos sobre el crecimiento demográfico y la composición de la población", *Notas de Población*, No. 96 (LC/G.2573-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2011), "Migración interna en ciudades de América Latina: efectos en la estructura demográfica y la segregación residencial", *Notas de Población*, No. 93 (LC/G.2509-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2009a), "Dinámica demográfica y asuntos urbanos y metropolitanos prioritarios en América Latina: ¿qué aporta el procesamiento de microdatos censales?", *Notas de Población*, No. 86 (LC/G.2349-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2009b), "La captación de la migración interna mediante censos de población: la experiencia de la ronda de 2000 y sus lecciones para la ronda de 2010 en América Latina y el Caribe", *Notas de Población*, No. 88 (LC/G.2409-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2007), "Paradojas y contrapuntos de la dinámica demográfica metropolitana: algunas respuestas basadas en la explotación intensiva de microdatos censales", *Santiago de Chile: movilidad espacial y reconfiguración metropolitana*, C. De Mattos and R. Hidalgo (eds.), Santiago, Eure Libros.

___(2006), "Midiendo la segregación residencial y sus determinantes demográficos con microdatos censales: capítulo II. Índice de disimilitud de Duncan y derivados e Índice de Segregación Residencial (ISR)", *Redatam Informa*, vol. 12 (LC/L.2640), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2004a), "Migración interna en América Latina y el Caribe: estudio regional del período 1980–2000", *Population and Development series*, No. 50 (LC/L.2059–P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2004b), "Explotando el módulo sobre migración interna de los censos de población y vivienda de América Latina", *Redatam Informa*, vol. 10 (LC/L.2261), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2002), "Distribución territorial de la población de América Latina y el Caribe: tendencias, interpretaciones y desafíos para las políticas públicas", *Population and Development series*, No. 32 (LC/L.1831–P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2001), "Segregación residencial socioeconómica: ¿qué es?, ¿cómo se mide?, ¿qué está pasando?, ¿importa?", *Population and Development series*, No. 16 (LC/L.1576-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Rodríguez, J. and G. Busso (2009), *Migración interna y desarrollo en América Latina entre 1980 y 2005: un estudio comparativo con perspectiva regional basado en siete países*, ECLAC Books, No. 102 (LC/G.2397-P), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Rodríguez, J. and A. Martínez (2021), "Nuevas herramientas y análisis sobre segregación residencial socioeconómica, migración interna y movilidad cotidiana en Costa Rica, Guatemala y el Perú, 1980-2018", *Population and Development series*, No. 136 (LC/TS.2021/152), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Rodríguez, J. and F. Rowe (2019), "Efectos cambiantes de la migración sobre el crecimiento, la estructura demográfica y la segregación residencial en ciudades grandes: el caso de Santiago, Chile, 1977-2017", *Population and Development series*, No. 125 (LC/TS.2018/110/Rev.1), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

___(2018), "How is internal migration reshaping metropolitan populations in Latin America? A new method and new evidence", *Population Studies*, vol. 72, No. 2, January.

Rogers, A. and L. J. Castro (1981), "Model migration schedules", *Research Report*, RR-81-30, Laxenburg, International Institute for Applied Systems Analysis (IIASA).

Rowe, F. and others (2019), "Impact of internal migration on population redistribution in Europe: urbanisation, counterurbanisation or spatial equilibrium?", *Comparative Population Studies*, vol. 44.

Ruiz-Tagle, J. and E. López (2014), "El estudio de la segregación residencial en Santiago de Chile: revisión crítica de algunos problemas metodológicos y conceptuales", *Revista EURE. Revista Latinoamericana de Estudios Urbano Regionales*, vol. 40, No. 119 [online] https://www.eure.cl/index.php/eure/article/view/393/599.

Santos, R. O. and A. F. Barbieri (2019), "Funções modelo de migração: limites e aplicações", *Revista Brasileira de Estudos de População*, vol. 36.

Tapinos, G. (1990), *Elementos de demografía*, Madrid, Espasa-Calpe.

United Nations (2017), *Principles and Recommendations for Population and Housing Censuses. Revision 3* (ST/ESA/STAT/SER.M/67/Rev.3), New York, Department of Economic and Social Affairs, Statistics Division.

___(2008), *Principles and Recommendations for Population and Housing Censuses. Revision 2*, series M, No. 67/Rev.2 (ST/ESA/STAT/SER.M/67/Rev.2), New York, Department of Economic and Social Affairs, Statistics Division.

___(n.d.), "Demographic and Social Statistics: World Population and Housing Census Programme Census Documents" [online] https://unstats.un.org/unsd/demographic-social/census/document-resources.

Villa, M. (1991), "Introducción al análisis de la migración: apuntes de clase: notas preliminares", *Serie B*, No. 91 (LC/DEM/R.164), Santiago, Latin American and Caribbean Demographic Centre (CELADE)-Population Division of ECLAC.

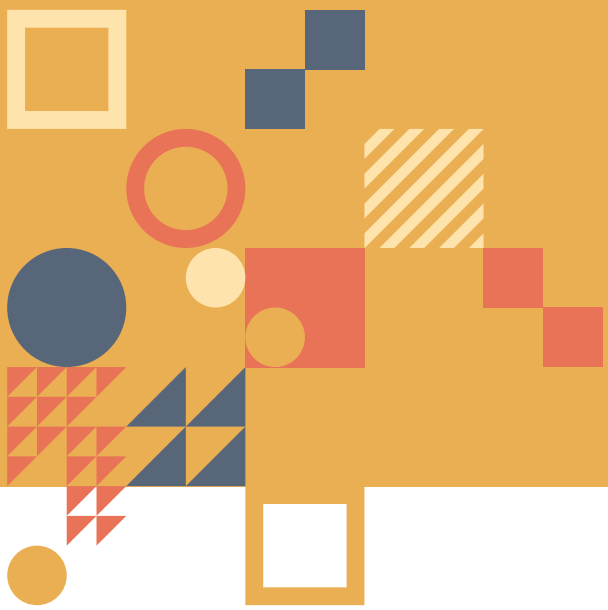
Voss, P., R. Nammer and A. M. Meier (2001), "Migration analysis: a case study for local public policy", *Population Research and Policy Review*, vol. 20, No. 6.

White, M. (2016), *International Handbook of Migration and Population Distribution*, vol. 6, Dordrecht, Springer.

Xu-Doeve, W. (2008), *Introduction to the Measurement of Internal and International Migration*, Kingdom of the Netherlands, NRC Publishing.

This document discusses the difficulties of measuring internal migration and examines the use of the migration module of population censuses to build migration matrices. Different ways of interpreting the intensity of internal migration are outlined and the corresponding existing indicators are explained. Four direct sociodemographic effects of internal migration —growth, redistribution, composition and inequality— are then described, along with the measurement procedures and indicators for all four. Selectivity of migration and indirect measurement of migration are also discussed. The last point analysed is another form of population movement —commuting for work or study— and how it can be measured using census data. The document concludes with a summary of the available instruments and the challenges that must still be overcome to measure spatial mobility of the population in Latin America in a specialized and rigorous manner.

The *ECLAC Methodologies* collection describes the conceptual principles, technical specifications and applications of the quantitative and qualitative tools developed and used by the Economic Commission for Latin America and the Caribbean (ECLAC). The collection's main aim is to offer better and new policymaking tools, thus contributing to evidence-based public policymaking that fosters sustainable development with equality.



ECLAC

Economic Commission for Latin America and the Caribbean (ECLAC)
Comisión Económica para América Latina y el Caribe (CEPAL)
www.cepal.org/en

ISBN 978-92-1-122128-2