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Internal Migration Data Around the World: Assessing Contemporary Practice

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ABSTRACT

Compared with other demographic processes, little attention has been given to the way levels and patterns of internal migration vary around the world. This can be traced in part to the absence of any central repository of internal migration data, but it also reflects widespread variation in the ways migration is measured. If robust, reliable comparisons between countries are to be made, a clear understanding of the available data is an essential pre-requisite. This paper reports results from the Internal Migration Around the GlobE project, which established an inventory of internal migration data collections for the 193 UN member States, identifying, *inter alia*, the types of data collected, the intervals over which it is measured and the spatial frameworks employed. Results reveal substantial diversity in data collection practice. We assess the strengths, limitations, and utility of the six principle ways migration is measured and examine their capacity to address key questions and issues in the field. We also identify avenues for harmonisation and conclude with recommendations which aim to facilitate cross-national comparisons.

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INTRODUCTION

This paper reports results from the Internal Migration Around the GlobE (IMAGE) project, an international research programme, which aims to facilitate comparisons of internal migration, the goal being to develop a robust set of measures that can be used to advance understanding of the way internal migration varies between nations. Compared with fertility and mortality, surprisingly little attention has been given to understanding cross-national variations in mobility. The significance of migration in facilitating human development and shaping settlement patterns is now widely recognised (The World Bank, 2009; UN, 2009), and there is a growing literature comparing different aspects of mobility (Rogers & Castro, 1981; Long, 1991; Rees & Kupiszewski, 1999a; Bell & Muhidin, 2009; Ness, 2012). However, summary indicators comparing internal migration between nations are absent from collections such as the United Nations (UN) Demographic Yearbook, and there is no comprehensive 'league table' of mobility like those ranking countries on rates of birth and death.

There are persuasive arguments for analysing internal migration within a comparative framework (Bell *et al*., 2002). Findings for individual countries become more meaningful when viewed in an international context because commonalities and differences help to distinguish unusual findings. Cross-national comparisons also encourage greater analytical rigour and advance common standards in data collection. The need for such standards is well recognised in the case of international migration (Bilsborrow *et al*., 1997; Kupiszewska & Nowok, 2008; Skeldon, 2012), and the case for

a better understanding of internal migration is equally strong. Migration within countries massively outnumbers international movements (Bell & Charles-Edwards, 2013) and is the pre-eminent process underpinning shifts in the pattern of human settlement. Timely provision of infrastructure and services also requires reliable estimates and projections, and these are driven primarily by migration. Although it is challenging to establish consistent time series on mobility for even one country, the problem intensifies when making cross-national comparisons. This is a pressing task because, as argued later, significant questions remain as to the dynamics of internal migration. A robust comparative framework for migration analysis is needed, both as a test-bed for migration theory and to help formulate effective policy.

The hiatus in comparative research reflects the multifaceted nature of migration and the absence of standard statistical indicators akin to the total fertility rate or life expectancy. Bell *et al*. (2002) addressed this deficit with 15 measures covering four dimensions of migration (see also Rees *et al*., 2000), but their implementation is constrained by a deficit of information on the data collected by statistical agencies. If analysts are to undertake rigorous comparisons, a sound understanding of the way migration is measured becomes indispensable. More broadly, if the study of internal migration is to be placed on the comparative footing already enjoyed by its demographic sister processes, a comprehensive inventory of data collections is essential. An assessment of contemporary processes is also pivotal to the development of international standards for data collection and best practice.

We address this deficit through an inventory of internal migration data collections among the 193 UN member states. The inventory, together with a data repository and a suite of analytical software, is held as part of the IMAGE project at the University of Queensland.[1] Our aim here is to provide a synthesis and assessment of global data collections. By way of background, we review prior attempts to compare data collections and examine related work (Section 2). Section 3 identifies the information needed for cross-national comparisons, describes our collection strategy, and summarises the coverage of the inventory. Sections 4–6 focus on the three instruments used to collect internal migration data: censuses, surveys, and population registers/administrative records, identifying where they are used, the way migration is measured, the time intervals considered, and the spatial frameworks employed. In Section 7, we assess the strengths and limitations of each form of data, examine their capacity to address key questions in the field, and explore avenues for harmonisation. Our conclusions (Section 8) summarise contemporary practice and set out recommendations to enhance the utility and comparability of internal migration data.

PRIOR WORK

An understanding of contemporary data collection practice is essential to robust cross-national comparisons. The UN has been at the vanguard of efforts to standardise national practices for demographic variables, but migration, particularly within countries, has proven remarkably resistant. Whereas there has been substantial progress on international migration (Zlotnik, 1987; Skeldon, 2012), internal migration statistics have received scant attention. As a result, little is known about contemporary data collection practice. Indeed, there has been only one previous attempt to establish a global inventory (UN, 1978). It identified 121 countries collecting internal migration data and reported the source of migration information, the type of data collected, and their uses. It also identified how migration was defined and established the geography of 'migration defining regions'. In a more recent project for the Council of Europe, Rees & Kupiszewski (1996, 1999b) reviewed the internal migration data collected by its then 28 member countries. Rees & Kupiszewski (1996) established the mechanisms used to collect the data and reported the time span for which they were available. They also reported the temporal intervals and zonal systems used to record movements. The significance of migration in population change is well recognised, and interregional migration data for Europe have been assembled for population projections (e.g. the DEMIFER project) but no summary of contemporary data collection practice is available.

Notwithstanding the dearth of metadata, cross-national comparisons have attracted attention from several scholars. Some collections overview migration patterns, trends, and impacts. A

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prominent example is the 'Handbook' edited by Nam *et al*. (1990), which set out data sources and analysed patterns of movement in 21 countries. Rees *et al*. (1996) presented a systematic analysis for the countries of Europe (Rees & Kupiszewski, 1999a), while Rodriguez-Vignoli (2004) analysed migration data for Latin America and the Caribbean. The 1999 World Monitoring Report (UN, 2000) drew on documents from national statistical offices to compare internal migration intensities and explore rural–urban migration. Similarly, the World Bank (2009) produced estimates of labour mobility for 35 countries drawn from household surveys, and the UN (2009) set out estimates of migration intensity for 28 nations (see also Bell & Muhidin, 2009; Bell & Charles-Edwards, 2013). Reference to internal migration practice also appears in general treatments of migration, commonly as an adjunct to discussion of international migration (Skeldon, 2012) or measurement issues (White & Lindstrom, 2005).

Collectively, this work provides valuable insights into the diversity of internal migration data but it does not constitute a comprehensive inventory. Establishing a repository of such data is even more daunting, although facilities such as the Integrated Public Use Microdata Series International, the UN Economic Commission for Latin America, and the Caribbean database, and Eurostat's online database provide useful starting points.

TOWARDS A GLOBAL INVENTORY

Internal migration is measured in many different ways using various instruments and, unlike births and deaths, is rarely the primary focus of data collection. Moreover, the information collected is not necessarily a reliable guide to the data that are subsequently made available. Care is therefore needed to ensure an inventory captures the critical information. The UN and European studies described earlier provide a guide to the information to be sought, but the IMAGE inventory also took account of the data needed to implement the comparative measures proposed by Bell *et al*. (2002). Additional guidance came from the THESIM and MIMOSA projects, which assembled inventories of international migration flows in the European Union (Nowok *et al*., 2006; Kupiszewska & Nowok, 2008).

Synthesising these sources, the information required falls into six categories:

- The sort of instrument used to collect the data. Three main sources are considered here: population censuses, population registers, and administrative collections, and national sample surveys. Other forms of data collection can also be found, such as demographic surveillance systems and bespoke surveys, but the IMAGE inventory confines attention to the three former sources.
- The type of data collected. The two most common types are events, generally drawn from population registers, and transitions, commonly associated with population censuses. The latter are based on comparing place of residence at the beginning and end of a time interval but data on duration of residence are also widely collected.
- The forms of migration included. Some instruments identify all changes of residence whereas, others capture only those which cross some spatial boundary.
- The interval over which migration is measured. Event data are generally made available for single year periods, whereas transition intervals vary from single years to lifetimes.
- The system of geographic zones against which migration is recorded, that is, number of zones and nomenclature.
- The characteristics of migrants, which are available, confined for this project to age and sex.

A full list of metadata can be found in the IMAGE User Guide (www.gpem.uq.edu.au/qcpr).

The IMAGE inventory was assembled using five main strategies:

- mining of statistical organisation websites;
- review of prior inventories and papers;
- questionnaire survey of statistics agencies;
- analysis of country census forms; and
- advice from an international network of scholars.

A primary task was to decide on the spatial and temporal coverage of the inventory. There are numerous ways to define the number of countries in the world (Haub, 1995), but the IMAGE project adopts the current listing of 193 UN member states. Complete or partial information has been assembled for 183 (95%) of these. Coverage is complete for Europe, North America, and Oceania, and for all but one country in Latin

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America and the Caribbean. Information is missing for four countries in Africa, chiefly in the middle and north of the continent, and for five countries in Asia, mainly in the Middle East.

Migration statistics evolve sporadically. Whereas register-based statistics are commonly produced annually, censuses follow a less regular schedule. Surveys are undertaken on a continuous basis in some countries but intermittently in others. These differences in temporal coverage make it difficult to set a single start date, so the IMAGE inventory focuses on data collected since 1995, corresponding to the start of the UN's '2000' round of censuses.

All but four of the 183 countries collected internal migration data in some form, the exceptions being Lebanon, Andorra, San Marino, and Nauru. The remaining 179 employed a mix of sources but the census (158 countries, 88%) was most common, whereas 50 countries (28%) drew on population registers or administrative sources (Table 1). Major surveys, such as the American Community Survey or the Demographic and Health Survey, were used by 110 countries (61%). A total of 109 countries (61%) drew data from multiple sources.

The distinction between these sources is becoming blurred as countries adopt hybrid approaches (Coleman, 2013). The traditional census involving full enumeration through a questionnaire (short-form or long form) is now in decline. Alternatives involve either 'register-based censuses' or 'combined censuses' which link data from registers and surveys (UN, 2012). For this paper, internal migration statistics derived from register-based censuses are classified as register data (e.g. Denmark, Finland, Norway, and Sweden), whereas data from combined censuses are classified according to the specific instrument used to collect the migration information (e.g. register for Belgium, census for Estonia, and survey for Canada).

Table 1 reveals considerable variation between countries in the sources used. Population registers are common in Europe and feature strongly in Asia, where more than one-third of nations draw on registration systems or administrative collections. The 13 countries in Oceania rely almost exclusively on censuses, Australia being the notable exception, with data derived both from administrative records and the census. The following sections elaborate the internal migration data collected by each source, although it is important to note that not all data collected are subsequently released.

INTERNAL MIGRATION DATA COLLECTED THROUGH A CENSUS

Despite UN endeavours to encourage regular census-taking and common timing, there is substantial variation in contemporary practice (UN, 2012). While some countries undertake censuses on a systematic five or 10 yearly basis, others are more irregular and, in some cases, the latest census is now quite dated. For the IMAGE inventory, we distinguish data from the latest two UN census rounds: the 2000 round (1995–2004) and the 2010 round (2005–2014). Although the latter is now well advanced, our primary focus is information collected in the 2000 round.

Population censuses commonly produce internal migration data in the form of transitions, which compare place of residence at two points

Table 1. Countries collecting internal migration data since 1995.

Region	Census	Register	Survey	Multiple sources	Total countries collecting data	Total countries
Africa	43	0	38	31	50	54
Asia	37	15	24	27	41	47
Europe	31	32	32	34	41	43
Latin America and the Caribbean	32	0	12	12	32	33
Northern America	2	2	2	2	2	2
Oceania	13	1	2	3	13	14
Total	158	50	110	109	179	193

Source: IMAGE Inventory.

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in time. Three main types of transition can be readily distinguished:

- lifetime migration, measured by comparing current residence with place of birth (within the country);
- migration over a fixed interval, derived by comparing current residence with place of residence at some previous date (e.g. 1 year ago); and
- place of last residence, derived by comparing current residence with previous place of residence, irrespective of the date of the move.

Questions on place of last residence are commonly coupled with a question on residence duration, but the latter may also be asked separately.

Table 2 sets out the frequency of each data type. Lifetime data emerged as the most common migration statistic, collected by 122 nations and featured strongly across all continents. Many countries measured migration over a fixed interval, but there was wide variation in the choice of reference date. A total of 52 countries measured migration as a 5-year transition, whereas 29 countries used a 1-year interval. A further 32 countries employed some other fixed interval; common choices included 2 and 10 years, but 12 countries used the last census as the reference point, whereas others referred to important national events. For example, the 2004 Moroccan Census recorded place of residence when 'His Majesty Mohamed VI acceded to the throne'. Similarly, the 2003 Census of the Central African Republic asked where respondents were living at the last National Election. Some spatial variation is apparent. One-year intervals are most common in Europe but also feature in African countries. Five-year intervals are more popular across Latin America, Asia, and Oceania. Non-standard intervals appear in all continents and are surprisingly prominent in Europe.

More than one-third of countries (55 in total) asked for place of last residence, essentially capturing the latest move, irrespective of when this occurred. This was usually associated with a question on duration of residence, but duration data were also collected by other countries, 71 in total, and were common around the world. Countries differed, however, in the spatial framework against which duration was measured. In nine of the 71, the question sought to establish duration of residence in the dwelling currently occupied. In 47 others, it was the length of residence in the same 'locality' that was requested. Elsewhere, there was ambiguity with some censuses asking for duration 'here' or 'in this place'. These differences are important because changes of residence occur more often than shifts between localities, so it is unclear what is being measured. Treatment of the time dimension also varies from place to place, measured sometimes as length of residence (39), and sometimes as date of arrival (32). Precision of responses varies too: some countries measure duration in months, whereas others record multi-year intervals.

Many countries collect more than one type of migration data. Figure 1 shows the number of

Table 2. Countries collecting internal migration data in the 2000 UN census round by continent and data type.

Region	Type of data						
	Observation period					Duration of residence	Total countries collecting data
	1 year	5 year	Other fixed interval	Lifetime	Last move		
Africa	9	8	8	29	13	17	32
Asia	2	13	8	27	18	24	35
Europe	13	4	12	25	10	12	31
Latin America and the Caribbean	2	17	2	29	12	13	29
Northern America	1	2	0	2	0	0	2
Oceania	2	8	2	10	2	5	13
Total	29	52	32	122	55	71	142

Source: IMAGE Inventory.

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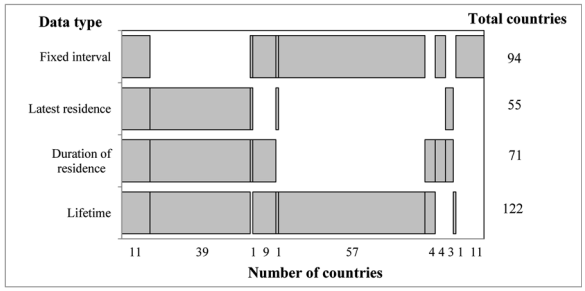

Figure 1. Countries collecting multiple types of data in the 2000 UN census round by data type.
Source: IMAGE Inventory.

countries collecting one, two, three, or all data types, with those collecting a particular combination indicated by the shaded areas. Just 11 countries collected all four data types, whereas 12 confined attention to a single type of data. Of countries collecting multiple measures, two main combinations stand out: place of birth with a fixed interval question on place of previous residence (78) and place of birth with a question on duration of residence and place of last residence (50). Where countries collected fixed interval data (Fig. 2), the majority (76) focused on a single transition, commonly 5 years. Just one country sought information on the place of residence at three points in time, but 17 assembled data for two intervals. Of these, nine countries asked both one-year and five-year questions, whereas eight combined one-year or five-year data with information for another fixed interval.

A central issue for migration data collection is the geographic framework against which movements are recorded. Current and previous place of residence are commonly sought through discrete questions but countries differ in methods

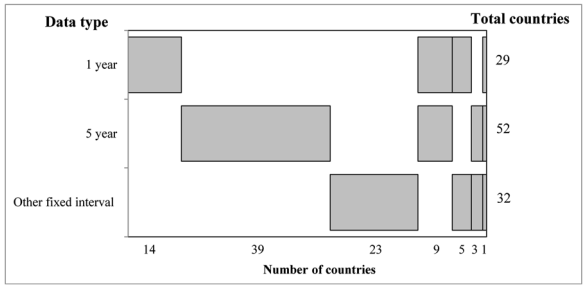

Figure 2. Countries collecting fixed interval transition data in the 2000 UN census round.
Source: IMAGE Inventory.

of collection. Whereas some censuses (e.g. Australia) ask for a specific address on a defined date, others (e.g. Gambia) seek only the village, town or province of previous residence. Information may also be sought on rural to urban migration (22 countries). For example, the 1999 Azerbaijani Census asked whether respondents were born in an 'Urban Place' or a 'Rural Place'. Questions on rural to urban migration are most commonly asked in Eastern Europe and Western Asia. There is substantial variation in zonal systems with fewer than 10 spatial units in countries such as Swaziland to more than 5,000 in Spain. In England and Wales, migration data from the 2001 Census were released for flows between 175,434 output areas. Some variation in geographies also occurs according to the type of data collected, with birthplace usually coded at a coarser spatial level than place of previous residence. Post-hoc classification of origins and destinations as rural or urban is also common although beset by definitional issues.

Variations even occur in the way place of residence is conceived. Whereas most censuses are conducted *de jure*, place of residence may be recorded as *de facto* or *de jure*, with significant consequences for migration measurement, particularly if temporary mobility is high. In China, comparison of place of residence at the 2010 Census with place of household registration (under the *hukou* system) reveals a substantial flow of 'non-permanent' migrants. A further issue is that although censuses should, by definition, collect information on the total population, some countries ask migration questions on a 'long form' addressed to a population sample. At least eight countries collected migration data using a long form at the 2000 census round but there was variation in both sample size and enumeration strategy with consequences for reliability and comparability. The 2000 US Census distributed the long form to approximately one in five households. In the 2000 Brazilian Census, on the other hand, it went to 10% of the population in municipalities with 15,000 people or more, and 20% in less populous places. As Skeldon (2012) points out, this is a concern for international migration analysis, because small samples may miss rare and spatially concentrated populations. The problem for internal migration is rather one of sparse matrices and large sampling errors at high levels of spatial disaggregation.

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INTERNAL MIGRATION DATA COLLECTED BY NATIONWIDE SURVEYS

National surveys are also widely used and are often the sole source of internal migration data in developing countries. A key advantage is in providing data more frequently than censuses and at substantially reduced cost, but the trade-off is greatly reduced spatial detail. In some countries, surveys are being adopted as an alternative to censuses (Franklin & Plane, 2006). A complete inventory of migration surveys is impractical so we focus here on surveys conducted since 1995 that potentially facilitate cross-national comparison in both developing and developed regions. For the former, we review two large-scale survey programmes: USAID's Demographic and Health Survey (DHS) and the World Bank's Living Standards Measurement Study (LSMS). For the latter, we examine large-scale survey programmes including the European Union (EU) Labour Force Surveys (LFS) and the American Community Survey (ACS) (Table 3).

The DHS programme began in the 1980s, with six phases conducted in more than 90 countries (USAID, 2013). Questions on internal migration were standard in Phases I through V, but dropped from round VI conducted between 2009 and 2012. Migration questions have generally asked questions on place of previous residence and duration of current residence (Table 4). Standard question wording has asked

- How long have you been living continuously in (name of village, town, and city)?
- Just before you moved here, did you live in the countryside, in a town, or in a city?

The utility of the data is limited by coarse response categories and lack of spatial detail but

Table 3. Countries collecting internal migration data by survey(s), by continent and survey type.

Region	Demographic and health survey	Living standards measurement survey	Other survey	All surveys
Africa	38	2	0	38
Asia	18	8	8	24
Europe	3	5	26	32
Latin America and the Caribbean	10	4	0	12
Northern America	0	0	2	2
Oceania	1	1	0	2
Total	70	20	36	110

Source: IMAGE Inventory.

Table 4. Internal migration questions asked by surveys by continent.

	Type of data						
	Observation period						
Region	1 year	5 year	Other fixed interval	Lifetime	Last move	Duration of residence	Total countries collecting data
Africa	0	3	0	7	37	38	38
Asia	3	2	2	11	18	22	24
Europe	24	0	4	8	9	22	32
Latin America and the Caribbean	0	2	1	5	10	11	12
Northern America	2	1	0	2	0	0	2
Oceania	1	1	0	1	1	1	2
Total	30	9	7	34	75	94	110

Source: IMAGE Inventory.

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the DHS does provide insights into the scale of rural to urban migration in the developing world.

The LSMS has been conducted in more than 30 countries over the past two decades (The World Bank, 2013), and 20 countries have collected some form of internal migration data since 1995. As in the DHS, place of last residence coupled with duration of residence has been a principal strategy (14 countries), but the LSMS has also collected data on lifetime migration (18). Spatial detail is coarse, and there is some variation in recording of residence duration which prejudices comparability. As in the DHS, however, most countries collect information on rural–urban migration.

In developed countries, the largest multinational survey programme is the EU LFS, conducted quarterly in 32 European countries and Turkey (Eurostat, 2013). In 2011, data on internal migration were collected in 28 countries, with 24 asking a question on region of residence 1 year ago. Only a handful of countries collected information on duration of residence, place of last residence and place of birth within country. Although there is some commonality of approach, the DHS, LSMS, and LFS adopt different strategies for the collection of migration data: the DHS focusing primarily on place of last residence and duration in the current location, the LSMS favouring lifetime migration, and the LFS prioritising a one-year transition interval.

In recent years, surveys have replaced the long-form census questionnaire in the USA and Canada. Both the ACS and the Canadian National Household Survey (NHS) collect data on place of birth and place of residence 1 year ago, providing lifetime migration data and one-year transitions. The NHS also collects information on place of residence 5 years ago. The data are not strictly comparable because the ACS is conducted on a rolling basis, whereas the NHS is implemented on a single day. Temporal comparability is an issue with all surveys collecting internal migration data over an extended period or on a rolling basis.

INTERNAL MIGRATION DATA COLLECTED BY POPULATION REGISTERS

Population registers are a key source of internal migration data in Europe and some parts of East Asia (Table 1). Registers are most commonly associated with Scandinavia, where Finland has maintained continuous records since the 17th century, but their importance as a source of internal migration data is growing as traditional censuses are replaced with register-based censuses (UN, 2012; Coleman, 2013). In the 2010 census round, eight European countries conducted a purely register-based census compared with just four in the 2000 round. Administrative sources are also employed to derive statistics on internal migration. Examples include the National Health Service Central Register in England and Wales and Medicare data in Australia. Registers and administrative sources commonly generate movement data since they count migration events (Rees *et al*., 2000) although it is also feasible to generate transition data from comparison of registers at two points in time.

The IMAGE inventory identifies 50 nations producing internal migration statistics using administrative records or a population register. The majority are in Europe (32 countries) and many have a long pedigree, with 18 countries holding data from the early 1990s. Less information is available on the date such registers were established in Asia (15), but at least two (Japan and Vietnam) hold lengthy time series. Administrative sources offer only partial population coverage and rarely include any legal imperative to ensure complete or timely registration. Population registers are designed to capture aggregate numbers and are therefore more complete, but variations in design and coverage complicate their use for comparative migration statistics. For example, countries vary in how a 'residence' is defined, and some allow identification of multiple homes. A qualifying duration of stay may exist before an individual has to register or before they are counted as a migrant. Moreover, foreign citizens may be excluded (e.g. Japan and Mongolia). Where registers are used to regulate rather than simply record migration, as, for example, with the Chinese *hukou* system and previously with the Soviet *propiska*, coverage is likely to be incomplete.

Comprehensive population registers should capture all changes of address, but in practice three quarters of the 50 countries drawing on registers only make available data for movements that cross administrative boundaries. As with censuses, therefore, it is rarely possible to generate a measure of migration intensity that encompasses all moves. The spatial resolution of register data is often coarse compared with that

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from censuses but total in-migration and out-migration by region are usually reported at a finer spatial level than flow matrices. In general, characteristics other than sex and age are less readily available than from population censuses.

EVALUATION

These three sources vary markedly in the way they measure migration. What are the relative merits of each? We look first at differences between sources, then turn to the strengths, weaknesses, and utility of specific migration measures. Finally, we explore prospects for harmonisation and examine the potential of existing data sources and measures to address key research questions and policy issues.

Comparing Data Sources

Table 5 provides a concise summary of censuses, registers, and surveys as sources of internal migration data. Such comparisons are fraught because these three categories conceal remarkable diversity in data collection practice. Censuses and registers combine extensive coverage with geographic detail, which reveal the spatial patterning of migration. Both sources commonly omit certain groups, and it is perhaps only a few registers, such as those in Scandinavia, that can lay claim to comprehensive coverage. Administrative collections are often confined to population subsets, such as those listed on health registers or electoral rolls, whereas censuses miss the migration of infants and those who die or emigrate. Both sources are subject to errors: recall and non-response in the census, and late notification, or non-compliance in the case of registers. The supposed census strength of 'complete' enumeration is also compromised when migration data are collected via a long form. Offsetting these limitations, censuses capture more socio-demographic characteristics than registers, although the latter offer greater capacity to track individuals through time and more potential links to other collections.

An important advantage of registers is that statistics are available on a continuous basis and so are better suited to monitoring variations in-migration intensity and distribution. Moreover, register data are produced with shorter delays than census data and are more up to date. Periodic censuses provide a long-term perspective but in many countries 2010 census migration data will not be disseminated until 2014. The utility of data from both collections may be compromised by limited dissemination.

By comparison with censuses and registers, sample surveys sacrifice geographical detail for contextual richness and temporal breadth. Sample sizes are generally too small to reveal spatial patterns, except at coarse geographic scales, but this is compensated by their capacity to collect migration histories, and link these to individual and household characteristics. They also provide an avenue to explore the causes of migration and its consequences. Microdata can also be derived from censuses as samples of anonymised records, but it is the temporal sequences, derived from panel studies or retrospective questions, that set surveys apart as a unique source of insights into the longitudinal dynamics of migration (White & Lindstrom, 2005). Censuses and registers, in contrast, are most useful for analysis of spatial patterns and migration trends, at differing temporal scales. All three sources offer insights into the overall intensity of migration and its selective nature.

Comparing Migration Measures

In practice, censuses, registers, and surveys provide complementary rather than competing perspectives, and many countries draw data from multiple sources. Ultimately, however, it is differences in the way migration is measured that shapes the utility of the data. Alternative approaches to capturing migration are discussed in a number of contributions (UN, 1970,1992; Shyrock *et al*., 1976), and space permits only a brief assessment here. Table 6 summarises the merits of each data type under four headings. Three of these focus on their utility for analysis of specific dimensions of migration – spatial patterns, migrant selection, and migration intensity (Bell *et al*., 2002); the fourth recognises that a primary application of migration data is for population estimates and projections.

Migration events emerge as the most versatile form of migration data, provided population coverage is complete, and flow matrices are available at high resolution. Origin-destination matrices are essential for computing migration intensity and analysing spatial patterns (including population redistribution, migration distance

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Table 5. Strengths, weaknesses, and utility of internal migration data sources.

Data source	Strengths	Weaknesses	Utility
Census	- Full enumeration of the population	- Snapshots sparsely distributed in time	- Spatial analysis
	- Geographic detail	- Lag in data release	- Migration intensity
	- Long historical time series	- Omits infants and people who die or emigrate	- Migrant selectivity
	- Large range of covariates	- Does not pick up return or multiple moves	- Historical trends
	- Can modify questions across rounds	- Expensive to code	- Projections
	- Potential for cross-national harmonisation	- Data may not be disseminated	
		- Sampling via long form reduces reliability	
		- Subject to recall errors and non-response	
Register/Administrative records	- Captures all migration events	- Migration data generally collected as a by-product	- Population estimates
	- Geographic detail	- Population coverage varies	- Spatial analysis
	- Timeliness (available with minimal lag)	- Registration rules are country-specific	- Migration intensity
	- Continuous series – generally annual	- Data not always released as a matrix	- Recent trends
	- Capacity to link to other data sources via personal ID	- Limited population characteristics	- Projections
	- Capacity to construct longitudinal data	- Reliability depends on social acceptance	
Surveys	- Capacity to collect detailed migration histories	- Sampling error	- Migration intensity
	- Can collect reasons for migration and covariates	- Variability in format limits comparability	- Migrant selectivity
	- Capacity to examine causes and consequences	- Lack of spatial detail	- Migration dynamics
	- Relatively low cost		
	- Ability to modify questions		

Table 6. Utility of migration data types.

	Spatial patterns	Migrant selectivity	System-wide intensity	Projections and estimates
Event	- Potentially high spatial resolution and available for sequential annual intervals	- Generally limited to age and sex; other characteristics depend on data source; may be measured at time of migration	- Very high precision because all moves are captured and intensity can be measured over short (1 year) interval	- Easy to harmonise with other demographic data to produce population accounts - Direct input to annual population projections
One-year transition	- Potentially high spatial resolution but captured infrequently so may show atypical spatial patterns	- Potentially extensive depending on range of characteristics collected at the census but measured at end of interval	- High precision because most moves are captured and intensity measured over short (1 year) interval	- Input to single year transition based population projections
Five-year transition	- Potentially high spatial resolution and provides mean summary of spatial redistribution patterns, less influenced by unusual events.	- Potentially extensive depending on range of characteristics collected at the census but greater likelihood that status has changed since time of migration	- Moderate precision because transition probabilities conceal return and repeat moves.	- Input to five-year transition based population projections
Latest move (combination of duration of residence with place of previous residence)	- Potentially high spatial resolution but spatial patterns distorted by merging variable migration timing, except over short (eg 1 year) migration intervals	- As above but distorted by inconsistent duration since migration.	- Moderate precision when measured over short residence durations but increasingly distorted as residence duration lengthens	- Not readily useable for projections
Duration of residence	- No spatial information	- As for one and five-year transitions but can also differentiate composition of migrants by transition	- As above	- Not useful for projections
Birthplace	- Provides cumulative picture of population redistribution but generally at coarse spatial resolution	- Unreliable because timing of migration is unknown	- Provides a measure of cumulative displacement but timing is unknown and conceals intervening moves	- Not readily useable for projections

and inter-regional connectivity). The key advantage of event data is their continuous coverage. Their weakness is the dearth of migrant characteristics, which restricts analysis of selectivity.

The distinction between event and transition data is important, because they count different phenomena (moves and movers), adopt different age-time plans, and are not readily harmonised (Long & Boertlein, 1990; Bell & Rees, 2006). For a given time interval, the intensity of internal migration measured using movement data appears larger than if measured using transition data, as repeat moves generate only a single transition while return moves are obscured. The shorter the interval, the smaller the difference, so that migration transitions measured over a single year closely match event data for analysis of intensity and spatial patterns, constricted only by their lower population coverage. Offsetting this is the more extensive range of characteristics available from the census.

Five-year transition intervals lose part of this advantage because variable characteristics (e.g. occupation) are more likely to change between the time of migration and the census when characteristics are recorded. Measures of migration intensity also lose precision because transition probabilities measured over 5 years conceal multiple moves (Long and Boertlein, 1990) and further reductions in population coverage due to omission of data on children under 5 years of age, deaths and emigration. On the other hand, five-year data provide a clearer picture of spatial patterns, smoothing the volatility that characterises observations for a single year, and facilitating analysis through larger aggregate flows. Patterns of population redistribution are more reliable when measured over a multi-year period, although recall errors also become larger. Migration distance, on the other hand, may be over-estimated using five-year data, because multiple moves result in greater displacement (Bell *et al.*, 2002).

Birthplace data provide a measure of lifetime migration and have been widely used for analysis of international migration (see Castle & Miller, 2009). Fewer countries collect information on place of birth within the same country, but this is the most common census measure of migration. Lifetime data summarise the cumulative impact of migration on settlement patterns but deliver few insights into contemporary processes. Moreover, birthplace is commonly coded at a coarser spatial resolution than residence 1 or 5 years previously. As with five-year transitions, intervening moves are concealed, and the timing of migration is unknown, but with lifetime data the potential window is larger and increases with age. Consequently, birthplace data provide a poor measure of migration intensity and little insight into migrant selection.

Measuring migration by reference to place of last residence presents a more complex picture. Latest move data are less subject to recall errors and, coupled with duration of residence, are sometimes interpreted as equivalent to fixed interval transitions (Skeldon, 2012) but the comparison is flawed. A flow matrix, which is constructed by combining place of previous residence with a five-year duration of residence parameter, only captures each person's last move within the five-year period. Any prior moves within the five-year period are lost. By contrast, a transition matrix based on a five-year fixed interval question measures migration by comparing residence at the start and end of the period and therefore excludes any intermediate moves. As a result, differences will occur both in the volume of movement recorded and in the spatial patterns revealed by the two forms of measurement. UN (1992) provides a lucid elaboration. The difference between last residence and transition measures is yet to be fully explored, partly because few countries (e.g. Brazil) collect both forms of data (Schmertmann, 1999; Amaral, 2008). Differences should be smaller over shorter intervals but then become subject to imprecision in the measurement of residence duration. As noted earlier, countries measure residence duration in different ways, and these rarely match one-year transitions precisely. True duration of residence can seldom be determined, so these differences severely prejudice comparability. Spatial analysis using last residence data is further undermined by uncertainty as to the location in which residence duration is being measured. Duration data do, however, offer insights into population turnover and population structure by migration status (Bell, 1996). Xu-Doeve (2006) proposed a mechanism to utilise duration data to compute instantaneous migration probabilities, which would assist comparability across countries, but the approach is yet to be fully tested.

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These differences also extend to population estimates and projections. Data capturing migration events are readily harmonised with other demographic statistics (births and deaths), which facilitates the population accounts essential for accurate estimates and projections (Rees & Willekens, 1986). Fixed interval transition probabilities derived from flow matrices also provide a basis for migration assumptions but require a different projection framework (Rees, 1986), and single year transitions are preferred because they allow finer age and time disaggregations. Data on place of last residence are not useable in population projections (UN, 1992) and the same is true for lifetime migration data, although the latter have been employed to estimate international migration flows by comparison of stock figures (Abel, 2013).

Answering Key Questions

White & Lindstrom (2005) and Skeldon (2012) identify several outstanding questions regarding contemporary internal migration including migration impacts, origin-destination linkages, and policy concerns. For this paper, we confine attention to three persistent issues that bear directly on the way migration is measured: the distinction between internal migration and residential mobility; the development of a comparative index of internal migration intensity; and the role of internal migration in urbanisation. To what extent does contemporary data collection practice enable progress on these issues?

The distinction between 'residential mobility' and 'internal migration' hinges on the extent to which a residential relocation severs local community ties. In practice, data on changes of address provide no rigorous foundation to differentiate such moves, because they fail to capture daily activity patterns (e.g. commuting). Analysts therefore commonly rely on a simple separation according to whether moves cross a zonal boundary, designating within-zone moves as residential mobility, and moves between zones as migration. This has some rationale because local moves are driven by life course and housing considerations, whereas economic motives dominate long distance migration (White & Lindstrom, 2005). Differentiating the two has potential utility in individual country settings. The problem for comparative analysis lies in defining the appropriate spatial level at which to make the distinction, because countries vary widely in their statistical geographies. Moreover, the limited available evidence suggests there is no clear breakpoint in the distance profile at which the proportion of migrants who commute falls away (Niedomysl *et al*., 2013). In this situation, the difference between residential mobility and internal migration is more apparent than real and cross-national research appears to best be served by comparing countries in terms of all moves.

As the migration inventory makes clear, however, the goal of assembling an international 'league table' of comparative migration indicators faces a daunting obstacle course, even for that simplest of comparative measures, the aggregate crude migration intensity. Long (1991) assembled data capturing all moves for 15 countries. The IMAGE inventory extends this coverage but in practice few countries measure all changes of address. Just 15 of 29 countries measuring migration as a one-year transition captured all moves, and this was the case for just 18 of 52 utilising a five-year interval. These data might be supplemented by duration of residence statistics but, as noted earlier, ambiguity in question wording undermines comparability. Similarly, information on all moves is rarely disseminated from population registers, and harmonisation of event and transition measures would be needed to merge these data. Courgeau *et al*. (2012) propose an analytic solution, which might extend the count to include countries with fine-grained flow matrices. Ultimately, however, development of a single indicator of overall internal migration intensity to match those already available for births and death requires a question capturing all changes of address over a defined interval, perhaps collected by a global survey.

A third long-standing question concerns the role of migration in urbanisation and counter-urbanisation. Comparative studies of these processes are fundamental to theorisation but internal migration data appear poorly suited to this task (Rees & Kupiszewski, 1999b; Rees & Kupiszewski, 1999a). Few countries capture both *current* and *previous* residence by rural and urban status, so rural–urban migration, and its complement, are seldom measured directly. Surveys more often address this classification but lack

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the spatial detail needed for a comprehensive picture. Post-hoc classification of administrative zones as urban or rural provides a partial solution but large zones are often heterogeneous. Comparative research is also beset by differences in definition: 'rural' in the Netherlands is very different from 'rural' in Burundi. In any event, dichotomous classifications mask the complexity of contemporary settlement patterns (Hugo *et al*., 2003). Functional territorial classifications may recognise multiple categories of space, reflecting the complexity of post-industrial landscapes. Because it is unrealistic to propose a universal classification of spatial units, analytical solutions are needed to permit cross-national comparisons. Eurostat (2010) approached this by classifying NUTS3 regions into three classes based on the percentage of rural and urban populations. A more general approach might use population density as a proxy variable for the degree of urbanisation (Rees & Kupiszewski, 1999a). Finely grained spatial units are needed to ensure analytical rigour.

Harmonising Internal Migration Data

Comparative analysis calls for comparable data, yet it is clear that current data collection practice varies widely. Is it possible to adjust for these differences? We examine the potential for harmonisation on three dimensions: the way migration is defined, the time interval over which it is measured and the spatial framework employed.

The need for a common definition has attracted particular attention in the context of international migration (Bilsborrow *et al*., 1997). Differences between countries relate in particular to the duration of stay required for identification as a usual resident and, hence, as an international migrant. Within the EU, variations range from 3 months in Belgium to 12 months in Sweden (Nowok *et al*., 2006; Kupiszewska & Nowok, 2008). In 2007, the European Parliament set 12 months as the minimum stay for a change of residence to be considered as migration. This has some force, because it forms part of a regulation, which imposes legal obligations on EU Member States in regard to provision of migration statistics. The 12 month criterion aligns with the UN definition of a long-term migrant (UN, 1998) but the UN 2010 Census recommendations propose a six-month criterion (UN, 2008), which is better suited for internal migration and used by several countries. These differences inevitably create comparability problems and demographic statistics would be better served if international organisations could agree common definitions of place of residence and of migrants and migrations.

Differences in the time interval over which migration is observed are less tractable (Rees, 1977). Several attempts have been made to harmonise one-year and five-year transition data (Kitsul & Philipov, 1981; Rogerson, 1990; Rogers *et al*., 2003). Simple conversion formulae are ineffective because of differences between countries, and over time, in the incidence of return and repeat migration, so progress towards an analytic solution has been limited. Comparison of fixed interval transitions against lifetime migration is still more problematic because the difference in observation intervals is broader and affected by age composition. It follows that the choice of observation interval for migration measurement has long-term consequences for cross-national comparability, because reliable comparisons can only be achieved using data measured over the same length interval.

Differences between countries in the spatial framework used to capture migration present a further challenge to comparability, and these are exacerbated by variations in the geographic size of countries and their patterns of settlement. Migration indicators computed for 27 regions of a large country such as Brazil are scarcely comparable with those calculated for movements between 589 municipalities of a small country such as Belgium. These difficulties are commonly grouped under the rubric of the Modifiable Areal Unit Problem, which plagues all geographical inquiries (Wrigley *et al*., 1996; Bell *et al*., 2002). Commonality among countries on this dimension is patently unattainable but there are other avenues by which harmonisation of migration indicators can be approached. One alternative is to identify similar functional spaces in each country, as in the hierarchy of 'city regions' used by Stillwell *et al*. (2000) to compare migration in Britain and Australia. Another strategy derives from the ideas developed by Courgeau (1973; Courgeau *et al*., 2012), which links migration intensities to the number and density of geographic zones. In either case, cross-national comparability is best served by a finely grained

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spatial framework, which captures migration across a large number of zones, irrespective of a country's geographic size. Flexible spatial aggregation routines, as incorporated in the IMAGE project's analytic studio, provide the facility to enhance these comparisons (Stillwell *et al*., 2014).

CONCLUSIONS

This paper described results from the IMAGE Inventory, the first comprehensive global review of internal migration data collections. Results demonstrate that the 193 UN member states differ widely in regard to the types of internal migration data they collect, the sources they use, the ways they measure migration, the time intervals they consider, the periodicity of their collection, the scope of the questions, and the spatial frameworks they employ. Harmonisation on any of these dimensions is a challenge.

Contemporary data collection practice varies widely. Most countries rely on population censuses to measure internal migration, but population registers and administrative data are dominant in Europe and gaining ground elsewhere. Surveys are also widely used. Many countries draw data from multiple sources and each has strengths and limitations. It is in the choice of measurement interval and spatial frameworks, however, that the major challenges to comparability arise. Lifetime migration, based on region of birth, is the most common migration measure worldwide, but many countries also measure migration by reference to place of last residence, irrespective of migration date. A surprisingly small proportion of countries measure migration over a fixed interval and, even among those that do, the choice of interval length varies widely. Countries also vary widely in their geographic frameworks and remarkably few capture all changes of usual address.

We evaluated data collection practices based on statistical rigour, practical utility, comparability between countries, and capacity to capture key dimensions of migration. Individual country data needs differ, and some data measure certain aspects of migration better than others, so it is not possible to specify a single 'gold standard'. Nevertheless, contemporary data collection practice appears driven more by historical inertia than by a clear assessment of utility and statistical rigour. We conclude that migration event data from population registers, together with migration transitions measured over a fixed interval, provide the most flexible, robust, and internationally comparable forms of internal migration data. Conversely, data on lifetime migration, and data on place of last residence coupled with duration of stay, appear to have the lowest utility.

There is growing recognition that internal migration is a key component of demographic change, and reliable information is needed for infrastructure and services planning. However, migration data are expensive to collect and process, so countries worldwide are seeking more efficient methods of deriving this information (Office for National Statistics, 2012). As data collection systems evolve, rigorous standards of definition and measurement will assume added importance. Based on our assessment of contemporary international practice, analytic rigour and practical utility, we advance a number of recommendations for the future collection of internal migration data:

(1) Internal migration is best measured either as an event or over a fixed interval, ideally 1 or 5 years.
(2) Data on place of birth within a country (capturing lifetime migration) provide a useful historical perspective but should be accorded a lower priority.
(3) Place of last residence data (essentially capturing the latest move) have limited analytic value and should be phased out.
(4) Place of residence, past and present, should be coded to the smallest geographical units feasible.
(5) To enable global comparisons of migration intensity, priority should be given to collecting data on all changes of usual residence.
(6) Data on duration of residence, if collected, should be recorded as length of residence in completed years and months and clearly identify the spatial unit to which they refer.
(7) Usual residence should be defined using a threshold criterion of 6 months.
(8) Statistical agencies should disseminate a range of standard outputs including origin-destination matrices, overall migration intensities, and the composition (e.g. age and sex) of aggregate inwards and outwards flows for each spatial unit.

Coupled with a suite of statistical indicators (Rees *et al*., 2000; Bell *et al*., 2002), these proposals provide a robust foundation for comparing key dimensions of migration within countries and offer a sound basis from which to explore the

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causes, consequences and dynamics of internal migration, and the links between population mobility and human development.

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NOTES

(1) Details of the IMAGE project are available at http://www.gpem.uq.edu.au/image.

REFERENCES

Abel G. 2013. Estimating global migration flow tables using place of birth data. *Demographic Research* **28**: 505–546.

Amaral E. 2008. Improvements of techniques to estimate migration rates: an application with Brazilian censuses data. *Population Review* **47**: 1–24.

Bell M. 1996. How often do Australians move?: alternative measures of population mobility. *Journal of the Australian Population Association* **13**: 101–124.

Bell M, Charles-Edwards E. 2013. Cross-national comparisons of internal migration: an update on global patterns and trends. *Technical Paper No. 2013/1*. UN Department of Economic and Social Affairs, Population Division: New York.

Bell M, Muhidin S. 2009. Cross-national comparisons of internal migration. *Human Development Research Paper 2009/30*. UN Department of Economic and Social Affairs, Population Division: New York.

Bell M, Rees P. 2006. Comparing migration in Britain and Australia: harmonisation through use of age-time plans. *Environment and Planning A* **38**: 959–988.

Bell M, Blake M, Boyle P, Duke-Williams O, Rees P, Stillwell J, Hugo G. 2002. Cross-national comparison of internal migration: issues and measures. *Journal of the Royal Statistical Society A* **165**: 435–464.

Bilsborrow R, Hugo G, Oberai AS, Zlotnik H. 1997. *International Migration Statistics: Guidelines for Improving Data Collection Systems*. International Labour Organization: Geneva.

Castle S, Miller M. 2009. *The Age of Migration: International Population Movements in the Modern World*. Palgrave Macmillan: Basingstoke.

Coleman D. 2013. The twillight of the census. *Population and Development Review* **38**: 334–351.

Courgeau D. 1973. Migrants and migrations. *Population* **28**: 95–128.

Courgeau D, Muhidin S, Bell M. 2012. Estimating changes of residence for cross-national comparison. *Population, English edition* **67**: 631–651.

Eurostat. 2010. *Eurostat Regional Yearbook 2010*. Publication Office of the European Union: Luxembourg.

Eurostat. 2013. *European Union Labour Force Survey*. Publication Office of the European Union: Luxembourg.

Franklin RS, Plane DA. 2006. Pandora's box: the potential and peril of migration data from the American Community Survey. *International Regional Science Review* **29**: 231–246.

Haub C. 1995. How many countries are in the world? *Population Today* **23**: 4–5.

Hugo G, Champion A, Lattes A. 2003. Toward a new conceptualization of settlements for demography. *Population and Development Review* **29**: 277–297.

Kitsul P, Philipov D. 1981. The one-year-five-year migration problem. *Advances in Multiregional Demography, Research Report 81-6*. International Institute for Applied Systems Analysis: Laxenburg, Austria.

Kupiszewska D, Nowok B. 2008. Comparability of statistics on international migration flows in the European Union. In *International Migration in Europe: Data, Models and Estimates*, Raymer J, Willekens F (eds.); John Wiley and Sons: Chichester; 41–71.

Long L. 1991. Residential mobility differences among developed countries. *International Regional Science Review* **14**: 133–147.

Long L, Boertlein C. 1990. Comparing migration measures having different intervals. *Current Population Report*. U.S. Bureau of the Census: Washington DC.

Nam CB, Serow WJ, Sly D. (eds.). 1990. *International Handbook on Internal Migration*. Greenwood Press: New York.

Ness I. (ed.) 2012. *The Encyclopedia of Global Human Migration*. John Wiley and Sons Ltd: Chicester.

Niedomysl T, Ernstsson U, Fransson U. 2013. Are non-contiguous administrative areas a feasible solution to the spatial delineation problem in the definition of internal migration? *7th International Conference on Population Geographies*: Groningen, The Netherlands.

Nowok B, Kupiszewska D, Poulain M. 2006. Statistics on international migration flows. In *THESIM: Towards Harmonised European Statistics on International Migration*, Poulain M, Perrin N, Singleton A (eds.); Presses Universitaires de Louvain: Louvain-la-Neuve; 203–231.

Office for National Statistics. 2012. Migration statistics improvement programme. http://www.ons.gov.uk/ons/guide-method/method-quality/imps/index.html. Accessed 06/06/2013.

Rees P. 1977. The measurement of migration, from census data and other sources. *Environment and Planning A* **9**: 247–272.

Rees P. 1986. Choices in the construction of regional population projections. In *Population Structures and Models*, Woods R, Rees P (eds.). Allen and Unwin: London.

Rees P, Kupiszewski M. 1996. Internal migration and regional population dynamics: what data are available in the Council of Europe member states? *Working Paper 96/1*. School of Geography, University of Leeds: Leeds, UK.

Rees P, Kupiszewski M. 1999a. Internal migration and regional population dynamics in Europe: a synthesis. *Population Studies No.32*. Council of Europe Publishing: Strasbourg.

Rees P, Kupiszewski M. 1999b. Internal migration: what data are available in Europe? *Journal of Official Statistics* **15**: 551–586.

Rees P, Willekens F. 1986. *Data and accounts. Migration and Settlement: A Multiregional Comparative Study*. Reidel: Dordrecht.

Rees P, Stillwell J, Convey A, Kupisweski M (eds.). 1996. *Population Migration in the European Union*. Wiley: Chichester.

Rees P, Bell M, Duke-Williams O, Blake M. 2000. Problems and solutions in the measurement of migration intensities: Australia and Britain compared. *Population Studies* **54**: 207–222.

Rodriguez-Vignoli J. 2004. Migración interna en América Latina y el Caribe: estudio regional del período 1980-2000. *LC/L 2059-P, Serie Población y Desarrollo, No 50*. Centro Latinoamericano y Caribeño de Demografía; CELADE, División de Población de la CEPAL: Santiago de Chile.

Rogers A, Castro L. 1981. *Model Migration Schedules*. International Institute for Applied Systems Analysis: Laxenburg, Austria.

Rogers A, Raymer J, Newbold KB. 2003. Reconciling and translating migration data collected over time intervals of differing widths. *The Annals of Regional Science* **37**: 581–601.

Rogerson PA. 1990. Migration analysis using data with time intervals of differing widths. *Papers of the Regional Science Association* **69**: 97–106.

Schmertmann C. 1999. Estimating multistate transition hazards from last-move data. *Journal of the American Statistical Association* **94**: 53–63.

Shyrock H, Siegel J, Associates. 1976. *The Methods and Materials of Demography*. Academic Press: New York.

Skeldon R. 2012. Migration and its measurement: towards a more robust map of bilateral flows. In *Handbook of Research Methods in Migration*, Vargas-Silva C (ed.). Edward Elgar Publishing Ltd: Cheltenham; 229–248.

Stillwell J, Bell M, Blake M, Duke-Williams O, Rees P. 2000. A comparison of net migration flows and migration effectiveness in Australia and Britain: part 1, total migration patterns. *Journal of Population Research* **17**: 17–38.

Stillwell J, Daras K, Bell M, Lomax N. 2014. The IMAGE studio: a tool for internal migration analysis and modelling. *Applied Spatial Analysis and Policy*. DOI: 10:1007/s12061-014-9104-4

The World Bank. 2009: *World Development Report 2009: Reshaping Economic Geography*. The World Bank: Washington DC.

The World Bank. 2013. Living standards measurement study. http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21610833~pagePK:64168427~piPK:64168435~theSitePK:3358997,00.html. Accessed 15/03/2012.

UN. 1970. *Methods of Measuring Internal Migration*. UN Publications: New York.

UN. 1978. *Statistics of Internal Migration: A Technical Report. Studies in Methods, Series F23, ST/ESA/STAT/SER F/23*. Department of International Economic and Social Affairs, UN: New York

UN. 1992: *Preparing Migration Data for Subnational Population Projections*. UN: New York.

UN. 1998. *Recommendations on Statistics of International Migration, Revision 1. Statistical Papers, No. 58, Rev. 1*. UN: New York.

UN. 2000. World population monitoring 1999: population growth, structure and distribution. Population Division, ST/ESA/SER A/183; Department of Economic and Social Affairs, UN: New York.

UN. 2008. *Principles and Recommendations for Population and Housing Censuses*. UN: New York.

UN. 2009. *Human Development Report 2009, Overcoming Barriers: Human Mobility and Development*. UN Development Program: New York.

UN. 2012. *Overview of the 2010 Round of Population and Housing Censuses in the UNECE Region*. UN Economic Commission for Europe: Geneva.

USAID. 2013. Measure DHS: Demographic and Health Surveys. http://www.measuredhs.com/. Accessed 15/03/2012.

White MJ, Lindstrom DP. 2005. Internal migration. In *Handbook of Population*, Poston D, Micklin M (eds.). Springer: New York; 311–346.

Wrigley N, Holt T, Steel D, Tranmer M. 1996. Analysing, modelling, and resolving the ecological fallacy. In *Spatial Analysis, Modelling in a GIS Environment*, Longley P, Batty M (eds.). GeoInformation International: Cambridge; 23–40.

Xu-Doeve W. 2006. The measurement of international and internal migration in the 2010 global round of population censuses. *European Population Conference*: Liverpool,.

Zlotnik H. 1987. The concept of international migration as reflected in data collection systems. *International Migration Review* **21**: 925–946.