From Uncertainty to Policy: A Guide to Migration Scenarios

To future migration,
fact of life, uncertain flight
for better times

From Uncertainty to Policy: A Guide to Migration Scenarios

Edited by

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Foreword

Adrian E. Raftery

Forecasting migration is essential to public policy. This book provides a comprehensive overview of approaches to forecasting migration in a particular context, as well as issues that arise. It focuses on forecasting international migration in Europe, defined as the 'EU+' system, including the 32 countries comprising the EU, EFTA and the UK.

The book emphasizes two main policy purposes. The first, motivated by refugee crises in Europe over the past decade, is short-term forecasting of forced migration crises, with the aim of developing an early warning system. The second is longer-term forecasting as an input to population projections at the short, medium and longer term for Europe.

Forecasting migration is hard, harder than for other components of population change, namely fertility and mortality. This is partly because the underlying data about past and present migration are often of poorer quality than for the other components. Migration is also inherently more volatile, being driven in part by economic changes and conflicts. Finally, there is a lack of the kind of strong theoretical understanding that underlies forecasting of fertility and especially mortality.

As a result, forecasts of migration tend to be highly uncertain. In countries with large amounts of in- or out-migration, uncertainty about future migration is a large part of overall uncertainty about future population. For example, it has been found that uncertainty about migration accounted for 74% of overall uncertainty about future population in Germany, with fertility and mortality between them accounting for the remaining 26% (Azose et al. 2016).

A key strength of this book is its focus on assessing uncertainty in migration forecasts (Chapter 3). It distinguishes between epistemic (reducible) and aleatory (irreducible) uncertainty. This distinction aligns with a framework by Susmann et al. (2022) for demographic data, involving a *process model* (aleatory uncertainty) and a *data model* (epistemic uncertainty). This approach traces back to Bayesian dynamic

forecasting (West and Harrison 2006) and state-space models, starting with the Kalman filter (Kalman 1960).

Historically, migration research has focused on social, economic and other drivers. The book thoroughly reviews the literature on drivers (Chapter 4), highlighting their importance in understanding migration. However, it notes that for studies of the future migration, either these drivers must be forecast or scenarios must be created. This limitation may help explain why gravity models, which heavily rely on migration drivers, perform modestly in forecasting migration (Welch and Raftery 2022). The book suggests moving away from driver-based scenarios while still using driver analysis for model-building.

The book reviews various approaches to short-term migration forecasting (Chapter 6), including an early-warning system based on selected leading indicators, which performed well for recent surges from Syria and Ukraine. It also covers time-series models, theoretical models, approximate modeling of rare migration events and agent-based (micro-simulation) models. Another important aspect for managing forced migration crises and population projections is forecasting the evolution of *ongoing* refugee crises. An initial attempt, accounting for uncertainty, was made by Susmann and Raftery (2024).

As the QuantMig project moves towards implementation and policy use, a next important step is to conduct thorough validation studies, such as out-of-sample predictive validation. This would include both crises that occurred and those that did not.

Migration forecasts are essential for population projections (Chapter 10). To forecast population by age and sex, the key migration information needed is future net migration by age and sex (i.e. in-migration minus out-migration). Despite criticisms (Rogers 1990), net migration remains the most common migration input for population projections. This is partly because, even when direct migration data are unavailable or of low quality, reasonable estimates of net migration can be obtained using the residual method (Siegel and Hamilton 1952). This method works as long as regular censuses are conducted and fertility and mortality estimates are available, which is true for most countries.

Given the high levels of uncertainty, most national, international or subnational agencies use deterministic forecasts for migration, often assuming that net migration will stay close to current levels in the short to medium term. For example, the UN Population Division had used deterministic migration forecasts combined with probabilistic forecasts for fertility and mortality (UN 2022). This is perhaps slightly

ironic because migration is the most uncertain component of population change, suggesting that if there is one component of population that should be projected probabilistically, it would be migration.

Indeed, the latest UN World Population Prospects revision, published in July 2024 (UN 2024), use probabilistic forecasts of net migration for all countries for the first time, based on methods from Azose et al. (2016). This is a significant advance and will likely inspire further research and improved methods.

Chapter 10 suggests separate forecasts for country-specific in- and out-migration, or even joint forecasts of all bilateral international migration flows, as alternatives to net migration. For the EU+, this involves 1,024 flows, and globally about 40,000, which is challenging. Some past data are available from census estimates using the pseudo-Bayes method (Azose and Raftery 2019) to convert migration stocks to flows, building on Abel's minimum-migration method (Abel 2010, 2013; Abel and Cohen 2019, 2022). However, practical implementation remains difficult for now due to data quality and computational requirements (Welch and Raftery 2022). This is an important topic for future research.

The book's focus on international migration in Europe highlights other migration forecasting challenges. Forecasting international migration outside Europe is different because data quality is often lower, unlike for Europe, which has some of the best migration data. Previous work by the QuantMig team, described in Chapter 5, has improved European migration data quality. While the UN will now start to provide probabilistic migration forecasts for all countries, there is room for enhancing their quality and the underlying data.

Another important area is forecasting subnational (internal) migration, such as between states in the countries like the US, Mexico or India, provinces, regions, or cities within a country. This type of migration constitutes the majority but receives less attention than international migration. A method for probabilistic forecasting of subnational migration has been developed (Yu et al. 2023).

Migration forecasting has focused mainly on predicting total migrant numbers, often ignoring the impact of future population age structure. Migration is highly age-stratified, with most international migrants being young adults (ages 18–35) and their dependent children. As populations age, the proportion of people in the prime migration age groups is declining, likely leading to a long-term decrease in migration (see Chapter 7). This trend will affect all countries to varying extents, but most migration forecasting methods, especially based on net migration, do not account

for it. Initial efforts to include this factor have been made (Raftery and Ševčíková 2023; Welch et al. 2024), but in both areas, subnational migration and impact of age structures, more work is needed.

These issues are important also in the context of including climate change in migration forecasts. Chapter 4 notes that long-term international climate-related mobility is relatively rare, despite popular perceptions and alarmist views. Most climate-driven mobility is short term, short distance and subnational. Research on explicitly and quantitatively including this in subnational migration forecasts and scenarios is sparse, making it another important area for future study.

University of Washington, Seattle
17 June 2024

REFERENCES

Abel, G.J. (2010) Estimation of international migration flow tables in Europe. *Journal of the Royal Statistical Society: Series A*, 173(4), 797–825.

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

Abel, G.J., and Cohen, J.E. (2019) Bilateral international migration flow estimates for 200 countries. *Scientific Data*, 6, 1–13.

Abel, G.J., and Cohen, J.E. (2022) Bilateral international migration flow estimates updated and refined by sex. *Scientific Data*, 9, 1–11.

Azose, J.J., and Raftery, A.E. (2019) Estimation of emigration, return migration, and transit migration between all pairs of countries. *Proceedings of the National Academy of Sciences*, 116, 116–122.

Azose, J.J., Ševčíková, H., and Raftery, A.E. (2016) Probabilistic population projections with migration uncertainty. *Proceedings of the National Academy of Sciences*, 113, 6460–6465.

Kalman, R.E. (1960) A new approach to linear filtering and prediction problems. *Transactions of the ASME–Journal of Basic Engineering, Series D*, 82, 35–45.

Raftery, A.E., and Ševčíková, H. (2023) Probabilistic population forecasting: Short to very long-term. *International Journal of Forecasting*, 39, 73–97.

Rogers, A. (1990) Requiem for the net migrant. *Geographical Analysis*, 22, 283–300.

Siegel, J.S., and Hamilton, C.H. (1952) Some considerations in the use of the residual method of estimating net migration. *Journal of the American Statistical Association*, *47*, 475–500.

Susmann, H., Alexander, M., and Alkema, L. (2022) Temporal models for demographic and global health outcomes in multiple populations: Introducing a new framework to review and standardise documentation of model assumptions and facilitate model comparison. *International Statistical Review*, 90, 437–467.

Susmann, H., and Raftery, A.E. (2024) Bayesian projection of refugee and asylum seeker populations. *arXiv* preprint, arXiv:2405.06857.
UN (2022) World Population Prospects: The 2022 Revision. New York: United Nations Population Division.
UN (2024) World Population Prospects: The 2024 Revision. New York: United Nations Population Division. https://population.un.org/wpp/
Welch, N.G., and Raftery, A.E. (2022) Probabilistic forecasts of international bilateral migration flows. *Proceedings of the National Academy of Sciences*, 119, e2203822119.
Welch, N.G., Ševčíková, H., and Raftery, A.E. (2024). Bringing age back in: Accounting for population age distribution in forecasting migration. *arXiv* preprint, arXiv:2403.05566.
West, M., and Harrison, J. (2006) *Bayesian Forecasting and Dynamic Models* (2nd edition). New York: Springer.
Yu, C.C., Ševčíková, H., Raftery, A.E., and Curran, S.R. (2023) Probabilistic county-level population projections. *Demography*, 60, 915–937.

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contributors to our expert meetings (e.g. Bijak et al. 2023). The readers can find some of their advice reflected on the pages of this book, but the responsibility for its use and interpretation rests entirely with the authors of individual chapters and with the book editor.

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research; it ended up as a fascinating journey and an intellectual adventure. Last but not least, ultimate thanks go to my family for their support, as ever.

On the cover: The cover image (credit: dottedhippo, iStock #1254848517) shows monarch butterflies (*Danaus plexippus*) on the move. Monarchs are a species renowned for their multi-season migrations between Mexico and the United States, with each annual cycle involving several generations of migrating butterflies. We have chosen the image not only for its migratory connection, but also for the link with uncertainty and complexity through the familiar butterfly effect from the chaos theory.

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PART I

Foundations

1. Introduction: migration uncertainty, policy and scenarios

Jakub Bijak

1.1 MIGRATION UNCERTAINTY, EVIDENCE AND POLICY SUPPORT

At first glance, Europe seems to have been in a state of perpetual migration and asylum crisis since at least 2015. This perception is due partly to the sheer numbers of people fleeing war, conflict and persecution. The European public conscience has registered many images of migration: people fleeing civil war in Syria, especially in 2015–16; others undertaking dangerous journeys across the Mediterranean Sea or long and tedious treks along the Western Balkan route to reach the European Union (EU); dramatic scenes of evacuations from Afghanistan after the Taliban takeover in August 2021; and unprecedented numbers of Ukrainian asylum seekers seeking safety in the EU following the Russian invasion on 24 February 2022. What also connects these events is their relative unpredictability, at least over longer horizons.

In the shorter term, there was *some* advance notice of what was likely to happen, if one knew where to look. The civil war in Syria started in 2011 and was only gradually building up, as were the numbers of Syrian asylum seekers in the EU and elsewhere, with numbers of new arrivals peaking in 2015–16 (UNHCR 2023). The withdrawal of United States (US) troops from Afghanistan by May 2021 was first announced in the Doha Agreement with the Taliban in February 2020 (US Department of State 2020); the deadline was subsequently adjusted by Joe Biden's administration to the end of August 2021, leading to evacuations in the second half of August (US White House 2023). Intelligence on the imminent Russian invasion of Ukraine was already known to the US and allies in November 2021 and released publicly in a *Washington Post* article on 3 December (Harris and Sonne 2021).

In Europe, the events in the Mediterranean in 2015–16 put international migration into sharp policy focus. The relative lack of preparation at the time for an increase in Syrian asylum migration led to some important changes to policy priorities, culminating in the adoption of the Migration Preparedness and Crisis Blueprint by the European Commission (2020). The Blueprint objectives explicitly include 'developing an early warning/forecasting system at EU level and supporting the development of the necessary resilience in Member States to efficiently deal with any type of migration crisis' (ibid., Annex, §2). The Blueprint has been put to the test already during the war in Ukraine, leading to the triggering of the Temporary Protection Directive[1] within an unprecedented eight days of the Russian invasion (European Council 2022).

Policy interest in future-gazing goes well beyond Europe. At the United Nations (UN) level, the first two objectives of the recently adopted Global Compact for Migration (UN 2018) are to 'Collect and utilize accurate and disaggregated data as a basis for evidence-based policies' and to 'Minimize the adverse drivers and structural factors that compel people to leave their country of origin', the latter containing several references to anticipating future migration, including preparedness and early warnings. Still, even the best-intentioned and most effective policy attempts to help short-term responses, offering the best-possible current knowledge about the future, will not lift some fundamental constraints related to managing migration. The situation is even more challenging once we look at longer horizons, from a few months to a few years or even decades ahead, where current knowledge about possible future migration trajectories becomes extremely limited.

Migration is driving population change to a large extent, especially in contemporary Europe with its low fertility and mortality. Accurate estimates of past and present migration are crucial for policymaking and for public service planning and delivery. However, migration is notable for its *complexity* and *uncertainty* (Willekens 2018; Bijak et al. 2021b). These features need to be taken into account if migration policies are to be effective. This requires several elements: first, building an appropriate evidence base, with uncertainty and complexity clearly reflected at its

[1] The Temporary Protection Directive (European Council 2001) itself was adopted already in 2001, in the follow-up of the displacement caused by the 1990s armed conflicts in the former Yugoslavia, but was never used across the whole EU before 2022.

core; second, communicating this evidence unambiguously to users and the general public; and third, being honest about the limits of our current knowledge about the future of migration.

In this book, we propose a coherent process for such policy support, based on the findings of the QuantMig research project.[2] We start by discussing the constraints of our knowledge on current and future migration. Next, we present different ways of creating robust yet realistic scenarios of future migration. Our ambition is to provide a toolkit capable of offering evidence to support policies on migration and in related areas. Throughout, we understand our key term *migration scenarios* as referring to quantitative or qualitative tools for making statements about the future of migration, conditional on specific assumptions (Chapter 2). In the book, we also reflect on the potential and limits of communicating scenarios and using them in the policy process. In what follows, we summarize the proposed process of scenario-setting and critique in slightly greater detail.

1.2 SCENARIO-SETTING: PROCESS FOR DEALING WITH UNCERTAINTY

In this book, we offer a guide to setting, analysing, understanding and communicating the possible trajectories of international migration flows.[3] We focus on quantitative scenarios – those based on possible numbers of future migrants – which are particularly prone to high levels of uncertainty and error. At the same time, we do not start from zero. Contemporary migration scholarship is very rich, in terms of conceptual and theoretical work and also methods for estimation and prediction (see e.g. Scholten 2022 for an overview). As we seek to provide theoretical, methodological and practical advice for scenario makers and users, we aim to use current migration knowledge from multiple perspectives to the fullest possible extent. By bringing together interdisciplinary expertise from demographic, sociological, economic, geographic, political and

[2] The project QuantMig: Quantifying Migration Scenarios for Better Policy was funded by the European Commission under the Horizon 2020 programme (No. 870299). For more information, visit www.quantmig.eu.

[3] In the rest of the book, we will largely drop the 'international' qualifier and use the term *migration* as synonymous with *international migration*. We discuss definitional issues in more detail in Chapters 3 and 5.

other aspects of migration studies, we suggest ways of exploring and dealing with the two key challenges of migration – complexity and uncertainty – at both the micro (individual) and macro (population) levels.

To that end, we propose a novel blueprint for constructing migration scenarios. These scenarios are quantitative, so expressed in terms of numbers representing possible future flows, yet they are based on the most recent conceptual and theoretical advances in migration studies. The key focus is on addressing the complex and uncertain nature of migration processes, by integrating insights from various scientific disciplines and multiple analytical perspectives. In this way, the proposed scenario tools can be both up to date in terms of their conceptual and technical sophistication and also context specific. The key idea that we put forward in this book is that building migration scenarios is an *ongoing process*, based on insights from many different areas. To put these ideas into practice, throughout the book we propose and evaluate such a multistep process of building a knowledge base for exploring future migration flows and patterns.

The process starts by reviewing and evaluating the available evidence. This includes relevant migration drivers in the countries of origin, destination and transit and also available estimates on migration flows, ideally with an assessment of uncertainty. Depending on the purpose of scenarios, their intended uses and time horizons, we then present a range of methods for addressing questions on future migration in a novel way, focusing on conceptualization, estimation and simulation of migration trajectories. Additionally, we offer a simple, pragmatic method for assessing migration scenario uncertainty. At the same time, we want the results to be easy to understand by their users, policymakers and migration practitioners, and this requires effective communication. To help focus the discussion on practical recommendations for policymakers and migration practitioners, we include a critical analysis of the usefulness of scenarios and their limits from users' points of view.

By design, a crucial part of the process is recognition of the limits of knowledge on current and future migration by the producers and users of scenarios. In the book, we propose different ways of identifying and dealing with these limits. One key challenge of the process as a whole is bridging the gaps between the knowledge base behind the scenarios, the formal measurement of uncertainty and the resulting decisions. Through assessing the uncertainty, even approximately, decision makers become aware of limitations of any models behind the estimates and scenarios.

This allows them to better plan for future contingencies under various plausible assumptions.

The proposed scenario-building process is illustrated by examples from the EU, but the lessons learned go beyond Europe. The ideas presented can contribute to meeting the objectives of the UN Global Compact for Migration (UN 2018) worldwide, especially those related to measuring migration and managing its drivers, as discussed in Section 1.1. In this context, quantitative scenarios can be very useful for exploring different trajectories of future migration. However, a necessary prerequisite is to explicitly acknowledge the uncertainty of migration processes and their complex tangles of drivers, features and impacts. At the same time, *preparedness* – including the commitment of resources for managing various migration contingencies – requires having not only the best-possible analytical tools to address the challenges of the uncertain and barely predictable nature of migration but also considerable levels of public buy-in and political will.

1.3 STRUCTURE OF THE BOOK AND SUGGESTED WAYS THROUGH IT

The book is divided into five parts, in total comprising 12 chapters. Part I includes the foundational information about what comes next. In Chapter 2, we summarize the process of building migration scenarios and discuss different aims of migration future-gazing, from prediction to preparedness and building resilience. We show how two types of uncertainty – *epistemic* (potentially knowable and therefore reducible, what we do not know but may learn about in the future) and *aleatory* (unknowable and irreducible, what we will never know) – shape responses to uncertainty in different ways. In this context, we examine how and where uncertainty can be reduced through more and better knowledge, and where it cannot be reduced and needs preparing for and adapting to. This distinction remains crucial for our discussions throughout the remainder of the book.

In Part II, we look at methods for identifying and dealing with epistemic uncertainty in the context of migration scenarios. Chapter 3 discusses the sources of uncertainty in migration forecasting, scenario-setting and other future-oriented studies, highlighting its conceptual role. We identify the limits of knowledge for migration definitions, data and measures, drivers, and spatial and temporal regularities. We also look at human

agency in making migration decisions and the role of policies in shaping – and being shaped by – migration uncertainty.

In Chapter 4, we look at drivers of international migration from a range of perspectives. For origin countries, we focus on the salience of networks, migration aspirations and capabilities at the individual level, and macro-structural conditions. For destination countries, with a focus on Europe, we review evidence on the role of economic and non-economic factors, such as attitudes, and the role played by uncertainty. Finally, we look at transit and onward migration within Europe, identifying different groups of migrants and directions of migration flows.

Chapter 5 describes the empirical departure point for scenario-setting: the evidence base on European migration in the 2010s. We present a unique set of estimates of migration flows within, into and out of the 32-country European migration system (EU+), by origin, destination, age and sex, from 2009 to 2019, following a harmonized definition and complete with a statistical assessment of their errors (uncertainty). In that chapter, we describe the successive steps of the estimation process, based on Bayesian hierarchical modelling methodology and expert knowledge.

Part III, in turn, is dedicated to the ways of dealing with aleatory uncertainty. In Chapter 6, we look at how this uncertainty can be reflected in migration scenarios across a range of time horizons. We look at short-term early warnings and the analysis of extreme events, attempts to model and forecast migration in the medium term, and approaches to setting scenarios in the long term. We discuss practical lessons for creating migration scenarios.

We review different qualitative and quantitative methods of migration scenario-setting in Chapter 7. We discuss recent attempts at combining the two perspectives and present a novel experimental method that seeks expert opinion on consequences of various social changes on future migration. Next, we present microsimulation models as a vehicle for implementing scenario assumptions in practice, reflecting possible future trajectories under unknown – unknowable – aleatory uncertainty.

The interface between migration scenarios and policies is the topic of Part IV, which offers an external perspective on the work on scenarios and their uses. We begin with a general discussion of the professionalization on both sides of the science–policy link in Chapter 8. We then reflect on the limitations in how much researchers can contribute to creating societal impact. On the one hand, research has to deal with uncertainty, ambiguity and lack of predictability. On the other hand, policy requires rapid information and clear and precise scenarios, especially during

a crisis. The chapter offers general insights but uses migration as a specific example, illustrating how the dialogue between research and policy may look in practice.

Chapter 9, in turn, presents a unique critical perspective of migration practitioners from the European Union Agency for Asylum on developments in forward-looking migration policies in Europe since 2015. We highlight the unmet demand for specific types of policy advice and discuss the expectations and realities related to predicting the unpredictable aspects of migration and asylum. We also reinforce the need for simple yet precise communication tailored to the intended audience and reflect on the ways to encourage forecasters to meet and liaise with policymakers. In concluding this chapter and across the whole of Part IV, we try to answer questions around who is best placed to prepare migration forecasts and how to do this.

In Chapters 10 and 11, we offer two complementary critical commentaries on scenarios and other studies of migration futures, from the point of view of their value and limits. In the first, by Rainer Muenz, we look at the ways of dealing with migration uncertainty in the broader context of demographic change and population projections. In the second, by Ann Singleton, we discuss philosophical questions on the very foundations of migration data and scenarios – epistemological and ethical – focusing on both scientific and policy aspects.

Finally, Part V contains the concluding Chapter 12, where we review and critically assess the whole scenario-setting process. Several gaps between knowledge and policy are discussed, and we make suggestions for better communication as a way of bridging these gaps. We also sketch possible developments in migration scenario methodology and in the study of migration futures more broadly; these could help practitioners better respond to the policy needs of the 21st century.

The book is practically oriented, non-technical and written largely with two types of readers in mind: the first including migration practitioners, advisors and policymakers across government, civil service and international organizations, and the second being the academic community, including students. Although we did not intend to write a textbook, some parts could be useful as supplementary reading for university courses. Individual chapters may come in handy for elective undergraduate and postgraduate courses, especially in the areas of migration studies, demography, geography, economics, sociology and international relations, or as recommended reading for doctoral studies and professional development sessions. Selected aspects of the general discussion on uncertainty

(especially in Parts I and II) may also be well suited for more basic-level undergraduate courses in migration studies, geography or population sciences.

In general, we consider the practitioner and academic communities to be equally important groups of readers but recognize that the two groups will have different knowledge priorities, despite a shared goal of creating a better future. Thus, we recommend several ways of reading the book, depending on individual needs and preferences. Readers interested in scenarios and their uses in policy can move straight from Part I to Parts III, IV and V. As key challenges of migration scenarios from theoretical and methodological points of view are discussed in Parts II and III, respectively, a reader interested in either of these aspects can skip Part IV, which is, however, highly recommended for migration practitioners and science communicators. Parts I and V together provide a high-level summary of the main arguments made throughout the book.

The book in its entirety is intended more for academic readers who would like to see a full account of the scenario-building process that we propose and of various related critical aspects of creating, communicating and using scenarios at the research–policy interface. Overall, the book has a quantitative slant, albeit presented in a non-technical way. For more technically inclined readers, interested in specific details of the proposed methods of migration estimation, forecasting and scenario-setting, background reading can be found in the reports underpinning this book: all are available from the QuantMig project website: www.quantmig.eu.

2. Collecting evidence: ingredients of scenario-building

Jakub Bijak and Mathias Czaika

2.1 TYPES AND AIMS OF FORWARD-LOOKING MIGRATION STUDIES

Scientific attempts to anticipate future events, gathered under the broad umbrella of *futures studies*, can be grouped into two main categories: *foresight* and *forecasting*. Even though the division is not strict and precise interpretations vary, forecasts tend to be more quantitative, with future processes expressed in terms of numbers, whereas foresight is more qualitative, focusing on narratives. Among the vast literature on the topic, overview works include Schwarz et al. (1982/2019) on futures studies, Armstrong (2001) on forecasting, with a recent encyclopaedic update in Petropoulos et al. (2022), and Schwarz (2023) on strategic foresight. Given the demand from many areas of policy and practice, the whole area of forward-looking scientific activity is very versatile, and migration is no exception.

Scenarios have a special place within futures studies. Depending on the underlying methodology, they can be either qualitative or quantitative or can combine both perspectives (for recent migration scenario reviews, see e.g. Acostamadiedo et al. 2020; Boissonneault et al. 2020). According to the definition we adopted in Chapter 1, scenarios reflect the consequences of assumptions regarding the future trajectories of international migration, which may or may not be those deemed most likely. Boissonneault et al. (2020) classified migration scenarios according to their focus (whether on migration or something else, e.g. population or the economy) and their purpose. Three key purposes included: explanatory – explaining what *could* happen under certain assumptions; predictive – anticipating what *might* likely happen; and (very rarely) normative – testing what *should* happen to achieve some predefined objectives.

Boissonneault et al. (2020) found that existing predictive scenarios tended to be quantitative, while explanatory ones were either qualitative or mixed. Besides, migration scenarios developed for other purposes are usually embedded in population or labour market projections (for groups, at macro level) or simulations (for individuals, at micro level).

Methodologically, qualitative approaches date at least to Zwicky's (1969) *morphological analysis*, looking at different combinations of qualitatively different trajectories of migration drivers. In practice, this often boils down to building matrices with different combinations of selected drivers. Quantitative scenarios typically follow some trends or numerical assumptions of change and may also – with an attached statement of likelihood – be used as forecasts. The migration forecasting literature, almost exclusively quantitative, is already quite sizeable and growing.[1] Recent advances include exploration of early warnings of rapid changes in migration trends (e.g. Carammia et al. 2022; Napierała et al. 2022). As hinted in Chapter 1, this is very strongly linked to the general policy discourse about the preparedness and resilience of systems: in this case, European migration and border management systems.

As noted by Hémond and Robert (2012: 404), preparedness itself has two aspects: ensuring sufficient capability to respond in the case of unforeseen events and designing management practices in such a way that guarantees the continuity of operations and processes. Throughout this book, especially in Parts IV and V, we will look into both aspects of preparedness.

From the perspective of studies of the possible migration futures, getting a proper and realistic handle on the uncertainty of migration is critical. This uncertainty can be either *epistemic* – what we do not know but would be in principle knowable given more and better information, at least in theory – or *aleatory* – what we will never know, as it is related to intrinsic randomness and therefore unknowable (e.g. Tetlock and Gardner 2015; Spiegelhalter 2017).[2] In the migration context, in Bijak and Czaika (2020) we proposed a taxonomy of the key sources

[1] For a review, see Bijak (2010), with subsequent updates in Barker and Bijak (2020), de Valk et al. (2022) and Petropoulos et al. (2022), among others.

[2] We omit here the *ontological* uncertainty, which describes the relationships between the real world and any attempts at modelling or describing it, as this cannot by definition be modelled or described (Spiegelhalter 2017).

Table 2.1 Dominant types of uncertainty in migration processes across different time horizons

Horizon	Epistemic (reducible)	Aleatory (irreducible)	Typical methods
Very short (now)	Migration data and measures (in theory)	Human free will and unpredictable behaviour	Early warning models; nowcasts
Short (months)	Concepts and definitions Aggregate decisions	Systemic 'shocks' to migration and its drivers	Horizon scanning; surveys of intentions
Medium (years)	Migration drivers and decision processes	Step changes in technological advances	Foresight; time series forecasts; simulations
Long (decades)	Driver environments and configurations	The future is open and largely unknown	Scenarios: narrative- and model-based

Source: Own elaboration based on Bijak and Czaika (2020) and Barker and Bijak (2020).

of migration uncertainty, both epistemic and aleatory, dependent on the horizon of analysis. The main types and sources of uncertainty of future migration across different time horizons are listed in Table 2.1, alongside typical methods used for looking into the future. These methods are a key element of the scenario-building process, which we discuss next. Many of these methods are discussed in more detail in Chapters 6 and 7.

2.2 CONSTRUCTING MIGRATION SCENARIOS: AN OUTLINE OF THE PROCESS

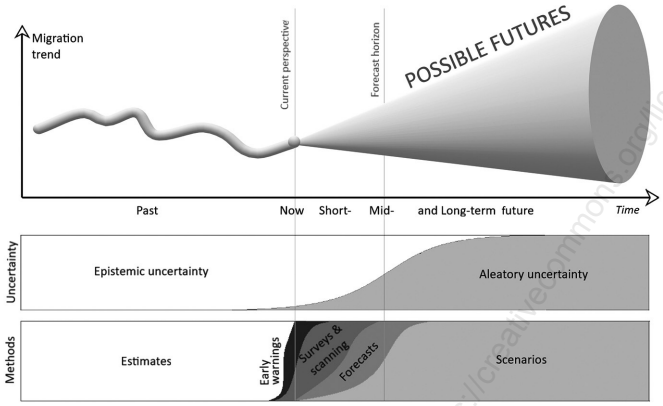
The process of scenario construction inevitably needs to start from conceptual work. We need to **define the process of interest, the purpose of scenarios, and the time horizon**. These three elements will determine our choices of methods and data later on. As one example, the process of interest could be an asylum flow from West Asia (a region including Afghanistan) to the United Kingdom (UK), over the horizon of two years, with the purpose of scenarios being to support the capacity for processing asylum claims. Another example could be a set of scenarios of net migration for Germany up to 2060, designed to test the sensitivity of population and labour force size and structure to population flows. Yet another could be related to detecting, in January 2022, any signals that could presage

the full-scale Russian invasion of Ukraine, leading to a likely exodus of a large number of people into the European Union (EU). In this case, the purpose would be related to preparing – as much as possible – for the eventuality of war and the need for an immediate and rapidly scalable humanitarian response.

Once the purpose has been identified, we then **examine the key elements and sources of uncertainty**, listed in Table 2.1. On the epistemic side, we need to take stock of the available information. The questions to ask include: What data exist, at which geographical level and for what period? How reliable are the data and measures that we use? What definitions do they correspond to? Can they reflect diverse populations? What do we know about the drivers, their behaviour and their interactions? From the aleatory perspective, we need to understand how stable – and hence how predictable (Bijak 2010) – the process is and why. If we look specifically at individuals and their decisions, we need to understand not only the decision processes, for which we can find regularities and patterns by looking at cognitive or behavioural studies; we must also factor in the degree of human agency and free will – and thus unpredictability – of the different actors involved, especially over very short horizons, with decisions made under pressure, etc. We summarize the epistemic and aleatory aspects of migration in Sections 2.3 and 2.4 and then explore some of them in more detail in Parts III and IV.

Given what we know about the process, the next step of scenario-building is to **select appropriate methodology and data** (see also Bijak et al. 2019). The different horizons of scenarios imply a different mix of epistemic and aleatory uncertainty, as schematically illustrated in Figure 2.1. The further into the future, the lower the impact of the lack of *current* knowledge and the greater the impact of unknown processes that can occur between now and the scenario horizon. At the same time, the lack of current knowledge also has a cumulative effect on future uncertainty: if we are not sure about the number of migrants this year, we are even less certain about that number in two years' time and even less so a decade from now. The 'futures cone' (cf. Gall et al. 2022) visualizes the fact that uncertainty increases with time, sometimes quite rapidly. This, in turn, has a bearing on the choice of an appropriate method, starting from the rough guidance in Table 2.1 but recognizing that for some horizons, different methodological choices may be equally valid.

Once the methods are chosen and the data are in place, the construction of scenarios can follow. The final step in the process of constructing scenarios is to **communicate the results appropriately**, together with their



Source: Own elaboration based on Bijak et al. (2019) and Bijak and Czaika (2020).

Figure 2.1 *Anticipating migration: uncertainty, future horizons and methods*

uncertainty. The communication tools ideally need to be clear, as visual as possible, narrative, metaphorical, and – crucially – tailored to their intended audience (Spiegelhalter 2017). In doing so, both the limitations of the methods used and the intrinsic uncertainty of the future, in various epistemic and aleatory guises, need to be highlighted. We come back to the topic of communication and the crucial perspective of the intended audience for migration scenarios in Part IV, with examples provided in other parts as well (e.g. Chapter 4 on how to avoid alarmism on migration in the face of climate change, or the 'welfare magnet' myth).

2.3 EPISTEMIC UNCERTAINTY: CONCEPTS, THEORIES, DRIVERS AND DATA

The initial step of scenario-building is to define the problem. The purpose of scenarios, however, depends on the objectives and needs of individual users. The 'ultimate migration scenario' does not exist: different users will have different perspectives and priorities, and will therefore require different levels of engagement with uncertainty (Raftery 2016). In any case, though, the first step towards recognizing epistemic uncertainty is to acknowledge the subjective nature of scenarios and of all the assumptions, judgements and modelling choices made in the process of building

them. Scenarios are, after all, intellectual constructs that hopefully reflect the reasons for their construction and are explicit about all the assumptions made and the uncertainty involved. Still, this does not change the fact that two scenarios for the same migration flow – for example, one aimed at exploring long-term labour market impacts and the other at ensuring that all migrants have access to healthcare soon after arrival – will inevitably differ.

To make things more complicated, there is no single agreed concept or definition of migration that suits all user needs. On the contrary, migration is to a large extent a social, political and legal construct, reflecting the priorities of particular societies at any given point in history (Bijak and Koryś 2009; Anderson and Blinder 2015). Similarly, the different concepts and categories used to define and measure migration have changed over the years. Despite many efforts to harmonize migration concepts and definitions, dating back to the 19th century (UN 1949, 1998), the policy priorities and public focus kept shifting. Across history, various types of migration dominated the public and policy discourse in Europe: from emigration in the 19th and the first half of the 20th century to immigration after the Second World War, to (increasingly) asylum in the early 21st century. In addition to the traditional categories of *permanent* and *temporary* migration, typically defined through length-of-stay criteria, new concepts have emerged, such as *circular* or *transnational* mobility (Scholten 2022). This is in addition to migration being defined through its main purpose (e.g. work, family, education, humanitarian protection or lifestyle) and mode (regular or irregular). Nevertheless, these categories are not mutually exclusive, can overlap, and can change over time (ibid.).

Similar problems are encountered with explanations for migration. There is no single theory of human mobility. Despite attempts to come up with one, dating back at least to Ravenstein's (1885) description of empirical regularities, existing theories remain fragmented, typically along disciplinary boundaries (Massey et al. 1993; Arango 2000). There are several high-level unifying perspectives: first, the *push* and *pull* factors of migration, introduced by Lee (1966), which act at the regions of origin and destination, respectively, with *intervening factors* in between. This approach was recently extended to include the levels at which different migration drivers operate (*predisposing*, *proximate*, *precipitating* and *mediating*), within the *push-pull-plus* framework (Van Hear et al. 2018).

Another perspective looks at the *aspirations* of prospective migrants and their *capabilities* to migrate, the interplay of which results in observed migration patterns and processes (Carling and Schewel 2018). However, as these frameworks are very general, there is a parallel tendency to focus on regularities, stylized facts and testable hypotheses instead (Carling et al. 2020). This follows in the footsteps of Merton (1968) and his concept of empirically grounded *middle-range theories* in sociology, without ambition for grand overarching explanations but still illuminating for specific phenomena and observed patterns.

Identification of such middle-range theories and regularities is closely related to the analysis of migration drivers. There are many dimensions of drivers – economic, social, demographic, political, environmental, life-style related, etc. – which continuously interact as part of broader, more complex *driver environments* (Czaika and Reinprecht 2022). We discuss some of these issues in more detail in Chapter 4, using selected examples of drivers in origin, destination and transit countries and focusing on Europe. Because of the presence of interactions, the roles of individual drivers are difficult to isolate. In addition, drivers as such are ambiguous and uncertain when it comes to conceptualizing and measuring them and to identifying their interactions with migration. This is yet another critical barrier to establishing more general and non-trivial migration theories, limiting the usefulness of drivers for migration forecasting or scenario-setting. To be helpful in the context of migration futures studies, drivers would either need to be forecast as well or their own scenarios would need to be designed and implemented. As popular as this approach may be (see reviews in Acostamadiedo et al. 2020; de Valk et al. 2022), it is still confronted with the basic challenge of high uncertainty, not only in migration but also its drivers.

Identification of patterns in past and present migration flows, not to mention trying to anticipate future ones, is additionally mired in many problems with empirical data. To start with, any data on migration reflect the concepts and definitions, which vary across time and space. As already argued, concepts and definitions, and therefore also data and measures, are social and political constructs. Additionally, in the case of big data, such as *digital traces* (e.g. Rampazzo et al. 2021), they can be also commercial constructs: collected for business purposes, such as advertising, rather than for measurement. This is in addition to well-documented problems with the quality of international migration data, even for more economically developed countries, including in Europe. Data availability is patchy, with many biases, low accuracy, and

low comparability across time and space (e.g. Poulain et al. 2006). We explore these topics in more detail in Chapter 5.

Human agency can incorporate elements of both epistemic and aleatory uncertainty. The former refers to aspects of human behaviour that can be understood and predicted to some extent. This includes routines, path-dependent behaviour (where past decisions influence future choices), socialization (how individuals are influenced by social norms and interactions) and resource-dependency (how access to resources shapes behaviour). Several aspects of human behaviour, especially when observed at an aggregate (population) level, also tend to be more predictable. This predictability arises from patterns, trends and regularities that emerge from the analysis of data for a large number of people. Some migration theories, such as cumulative causation (Massey et al. 1993), or herd effects (Epstein 2008), often rely on aggregated behaviour to make predictions about migration decisions and dynamics. Yet, despite the predictability of aggregated behaviour, significant aleatory uncertainty remains at the level of individual action, as highlighted in the next section.

2.4 ALEATORY UNCERTAINTY: FREE WILL AND UNFORESEEN EVENTS

Individual migration behaviour always involves a high degree of randomness and variability, which cannot be fully predicted or explained. This unpredictability arises from personal preferences, idiosyncratic decision-making processes – including free will – and unique situational contexts. These factors are the reason why migration behaviour always exhibits a residual element of spontaneity or unpredictability that cannot be fully captured by models or explained by known factors. This spontaneity, in turn, arises from the complex interplay of individual traits, experiences and situations that influence decision-making in ways that are difficult to foresee, even with the best behavioural theories.

At the root of aleatory uncertainty there is a part of human agency related to free will: a notion that our thoughts and actions are not predetermined, but we are free to make and implement our decisions within the constraints of our biology and environment, and other factors, such as available resources. This view can be also related to the aspirations and capabilities framework mentioned in the previous section (Carling and Schewel 2018). Seen through that lens, aspirations are dynamic individual characteristics, freely decided and changed by people based

on a complex web of personal preferences and social interactions. At the same time, capabilities, such as access to resources, may either impede or facilitate the realisations of aspirations.

The free will reflected in our aspirations is one of the fundamental reasons behind the limits of our knowledge about future migration, even over very short time horizons. This is also one of the main reasons why migration policies so often fail to achieve their declared goals. Human agency and ingenuity, including finding workarounds for a wide range of policy constraints, also lead to unintended consequences from many seemingly robust policy solutions, such as building physical barriers to deter irregular migration flows (Castles 2004; de Haas 2023). In other words, people – migrants and non-migrants – aim to follow their personal or family objectives rather than the proclaimed goals of various policies. This additionally increases the unpredictability of migration (see also Carling et al. 2020; Czaika et al. 2023). We further discuss agency and human decision-making in the context of migration and various policies in Chapters 3 and 4.

Many unforeseen events can happen in the future. This further compounds the unpredictability resulting from our human agency. The occurrence of unpredictable events becomes increasingly likely the longer the horizons: migration is simply exposed to the volatility of its drivers for longer. Behind these events are changes to the migration drivers and their complex environments, with all their interactions; and the more complex an issue is, for example climate-related migration (Foresight 2011), the less predictable it can be. Moreover, technological and methodological changes are happening all the time and are also difficult to predict, especially in the long run, as periods of technological evolution are interspersed with the emergence of disruptive inventions.[3] Innovation can increase uncertainty by adding complexity to migration, for example through enabling real-time digital communication and information spread. At the same time, it can also help reduce uncertainty, by expanding the epistemic area, for example by offering more and timelier digital data for analysing migration.

[3] This echoes the famous views of economist Joseph Schumpeter, especially when considering the 'irregularly regular' nature of innovation, leading to the process of 'creative destruction' being at the root of the capitalist economy (Ziemnowicz 2013: 1173).

Aleatory uncertainty implies a constant presence of 'shocks' – or what may be more neutrally called *high-impact events* – in migration systems. In statistical terms, this is linked with the observed *non-stationarity* of migration processes, especially in the short and medium terms (Bijak 2010). Non-stationarity is a formal term recognizing that there is no stable migration reality, but rather that it varies all the time, in terms of both migration levels and their *volatility* (how quickly things may change). This also implies that there is no single state of equilibrium towards which migration gravitates, but rather that the changing social, political and economic reality produces new equilibria, all the time. For this reason, analytical methods that assume stationarity or the presence of stable equilibria are not very well suited to studying migration (Pijpers 2008).

In the realm of aleatory uncertainty, the focus moves strongly towards being prepared for what might happen. The ultimate aim of migration preparedness is making social systems resilient to various circumstances that may affect migration flows. In the words of Hémond and Robert (2012: 404), 'preparedness should no longer be seen as just the capacity to respond to an event but as anticipating *the different possible ways* of addressing the event with a resilient perspective' (emphasis added). The 'different ways' aspect is crucial for scenario-building: it explicitly recognizes that there is no single future and that many things can change with respect to different migration flows and their drivers. This means that scenarios ideally need to enable exploration of a wide range of possibilities, including events that may happen only rarely but when they do can be highly consequential. It is precisely this aspect that can turn scenarios into something more than just another academic exercise and render them, at least to some extent, useful for policy and practice.

2.5 IMPLICATIONS FOR MIGRATION POLICY AND PRACTICE

Despite all the overwhelming uncertainty, scenarios and other forward-looking studies of migration can still be very useful as long as they are imaginative enough, they explore a broad range of possible future migration pathways, they are constructed and handled with care, and their limitations are clear to different users (Raftery 2016). Users need to be particularly aware that the scenarios are just a few examples selected out of an almost infinite number of possibilities. Here, a version of what in statistics is known as *Cromwell's rule* (Lindley 2013) applies:

it stipulates that one should always take into account other possibilities (which do not have to be equally probable) except those that are logically impossible.[4] The whole philosophy and methodology of building scenarios and the practice of using them needs to acknowledge this, ideally explicitly and by design.

In this context, the pragmatic approach to scenarios – and any other studies of possible migration futures – boils down to a simple three-step heuristic. Within the realm of the possible, the process of building scenarios should attempt to **(1) reduce epistemic uncertainty as much as is realistic** under given constraints in terms of time (deadlines!) and other resources (money, human capital). Next, there is a need to **(2) openly describe and communicate the residual uncertainty**, both aleatory and as-of-yet not reduced epistemic uncertainty. Then, specifically in the aleatory context, contingency plans need to be drawn up to **(3) ensure preparedness for various eventualities**. In other words, any uncertainty that can be reasonably reduced should be, and everything else needs planning for. To give it an interpretation directly linked to the Ancient Greco-Roman philosophy of Stoicism, both scenarios and resulting policies should control what they can control, but – in contrast to Stoic thought – what cannot be controlled should not be ignored but rather prepared for as much as realistically possible.

This heuristic recognizes that any statements concerned with the future, such as scenarios or forecasts, are inevitably bound to differ from how the actual future looks, with those purporting to be too precise or ignoring the residual uncertainty especially so. The world of migration is full of unpredictable phenomena which can change in non-linear ways, sometimes very rapidly, and are very far from traditional outlooks based on comparing static socio-economic equilibria. This does not make scenarios or forecasts useless: the former are conditional on their assumptions, which can be very informative, and the latter can be explicit about their expected errors. Still, excessively 'orderly' assumptions that assume stationarity or linearity of migration are bound to fail (Pijpers 2008). A key challenge for the creators of the scenarios is then to avoid the *illusion of precision*: a cognitive bias, whereby events are seen as more

[4] The rule was named after Oliver Cromwell's letter to the Church of Scotland in 1650, where he asked them to consider uncertainty regarding their political actions: 'I beseech you, in the bowels of Christ, think it possible you may be mistaken' (Lindley 2013: 129).

predictable than they are in reality (see e.g. Forlicz et al. 2023). Equally importantly, for users, it is imperative to avoid the *illusion of control*: another bias, which makes people think that they are more in control of events than is the case in reality (Langer 1975).[5]

As we move from reducing and describing uncertainty to designing contingency plans, the primary responsibility also shifts from the producers to the users of migration scenarios. In the famous quote from Margaret Thatcher when she was prime minister of the UK, 'advisers advise and ministers decide'. This recognized not only that there are other factors in policy decisions besides pure scientific evidence but also that it is ultimately politicians, as elected representatives, that have the mandate to implement them. Still, the scientific input into the decision process needs to be as robust as possible, and the bridge between advice and decision critically relies on the fundamental role of science communication. We discuss this in more detail in Chapter 8. At the same time, scenario producers need to resist the temptation to blur the boundaries between the scientific perspective and advocacy, for example related to migrant rights. For scenario-making to be successful, the communication of its results needs to meet several criteria, of which honesty, clarity, transparency and openness about uncertainty are fundamental (Spiegelhalter 2017).

In addition, communication of scenario assumptions and results needs to be tailored to the audience, not only in terms of the content presented but also its form: avoiding jargon, making the message simple but not overly simplistic, using visuals and following good practice for presenting numerical results are among some of the crucial recommendations (ibid.). Of course, the responsibility for making decisions based on the results of scenarios ultimately rests with their end users: elected politicians with a mandate to implement policy changes. Still, it is the responsibility of the creators and communicators of the scenarios to make sure that they are as robust and as realistic as possible and that users are well aware of some of the less comfortable aspects of the scenarios, such

[5] Formally, the pioneering study on this topic defined the illusion of control as 'expectancy of a personal success probability inappropriately higher than the objective probability would warrant' (Langer 1975: 311). It is worth noting that both illusions of prediction and control are related to miscalibration of probabilities.

as their uncertainty. We return to discussing the challenges of scientific communications in more general terms in Part IV.

PART II

Dealing with epistemic uncertainty: concepts, drivers and data

3. Sources of uncertainty in migration scenarios

Mathias Czaika, Heidrun Bohnet, Federica Zardo and Jakub Bijak

3.1 CONCEPTUAL CHALLENGES IN FORWARD-LOOKING MIGRATION STUDIES

Forward-looking studies of migration focus on anticipating and understanding future trends and patterns in human mobility. When attempting to prepare for the uncertain future, analysts and various users of scenarios and other tools are already faced with several challenges at the conceptual level. These challenges arise from the complex and dynamic nature of migration and the different sources of uncertainty in predicting or preparing for future changes in migration, as discussed in Chapter 2. Here, drawing from Bijak and Czaika (2020), we discuss some of the most prominent aspects of such conceptual challenges.

First, strictly speaking, 'migration' as a concept may be misleading. For simplicity, we are using a single term for a multitude of different processes of very diverse and multifaceted nature. Decisions to stay or to move, and in consequence migration patterns and processes, are shaped by many factors or drivers – economic, social, political, environmental, etc. – all of which rely very heavily on the context in which they operate (see Arango 2000). What is applicable in one context does not need to be valid in another, due to the unique historical, cultural and geopolitical conditions of each country and region. Even though we have broad ideas about the ways in which such factors operate (e.g. labour migrants *typically* seek higher wages), these are far from being universal laws. In addition, the interplay of these factors is often complex and cannot always be clearly disentangled, which makes looking at their potential future trajectories a significant challenge.

One example of this complexity is the impact of environmental change on migration. Predicting the extent and patterns of so-called 'environment-induced' or 'climate-induced' migration or displacement is enormously challenging. This is due chiefly to the complexity of climate change impacts and their interaction with other social and economic factors, making environmental effects on their own almost impossible to isolate (Foresight 2011). Additionally, existing empirical studies demonstrate very high sensitivity to the selection of variables in models and to the way in which these models are specified (Vestby et al. 2022). This renders making precise numerical predictions a heroic, if not completely unrealistic, task: at best, the results can be described probabilistically, to reflect their underlying uncertainty in an honest manner (for a discussion, see e.g. Raftery 2016).

Second, increasing global connectivity through communication, travel and transport, trade, and other means, including migration (e.g. Vertovec 2009), makes it additionally challenging to predict how global events and changes will impact individual migration decisions and broader migration patterns. The global system becomes a much more complicated web of relationships than suggested by some of the earlier theoretical views, such as world systems theory (Wallerstein 1983) with its global core and peripheries. Communication itself can both stimulate migration with better information about opportunities and substitute some part of it through job relocation and remote work, as suggested by Zelinsky (1971). Overall, economic fluctuations, political developments and technological advancements can have far-reaching consequences on migration that also evade precise prediction, especially in an interconnected world. Hence, despite much progress in migration scholarship and in explaining various migration flows and characteristics (Scholten 2022), this renders the attempts to pin down the exact 'root causes' of all possible migration processes a futile quest.

Third, the cultural, social and policy environment is highly dynamic. Migration and other policies are subject to changing, sometimes very rapidly, in response to political, economic and social considerations. Trying to anticipate changes in national or international policies, including their direction, extent and effectiveness, can be very challenging, as they often follow specific events or headlines. We discuss this in more detail in Section 3.5. Similarly, while cultural and social factors play a fundamental role in migration decisions and integration processes, predicting their dynamics is very difficult, if possible at all. Trying to anticipate their evolution over time would require an understanding of

the nuanced interactions between different communities and how these might evolve in future, coupled with advance insights into changing cultural norms and societal values.

Last but not least, this dynamic environment can lead to unforeseen high-impact events, sometimes referred to as 'shocks'. These are the metaphorical 'black swans': outliers, dwelling in the domain of aleatory uncertainty (Taleb 2007). Such unexpected events – pandemics, wars, political crises, environmental disasters or sudden economic downturns – are hardly possible to predict, but once they happen they can have profound consequences on migration dynamics. As the increasingly more complex social, economic, technological and political transformations accelerate and diversify, migration becomes increasingly unforeseeable. In this context, anticipation is not a realistic option for studying migration futures: as we argued before, the focus of policymakers and migration practitioners should move to preparedness and risk management (Bijak et al. 2019).

At the same time, for some aspects of migration studies related to scenario-setting, we know something, but by no means everything. The challenge then becomes to delineate the limits of our knowledge: in other words, to draw the current boundary between epistemic and aleatory uncertainty, but with the view that this boundary itself may shift in the future, with further advances in science uncovering new knowledge. We discuss four such aspects – measures, drivers, decisions and policies – in the remainder of this chapter, before suggesting approximate *good-enough* solutions to the challenges of diversity, interconnectedness, dynamics and unforeseen events that characterize human migration.

3.2 UNCERTAIN DEFINITIONS AND MEASUREMENT: WHAT IS MIGRATION?

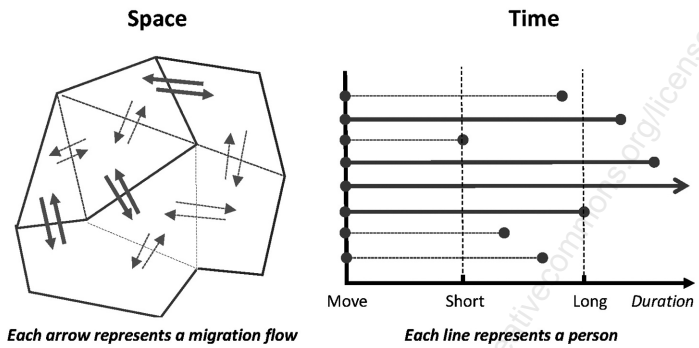
As anyone studying or working on migration well knows, the availability, quality and reliability of migration data can very often be limited (for a detailed discussion, see Chapter 5). This means that for any future migration studies that must rely on historical data and assumptions, inaccuracies in data will lead to flawed predictions: this is a clear example of epistemic uncertainty. Some of this uncertainty is related to the conceptual complexity discussed earlier with regard to the multifaceted nature of migration processes (for examples, see e.g. King 2002; Erdal and Oeppen 2018). In particular, defining and measuring migration involves many dimensions, and discrepancies in definitions and methods can lead to

challenges in accurately capturing and understanding migration patterns. In addition, differences in definitions and operationalization affect the comparability of data and studies (Lanzieri 2019). Hence, some of the key issues revolve around the following themes, which we discuss in turn: definitions, categories, process dynamics, and data collection.

To start with, there exists a **plethora of definitions of migration** and the broader term 'mobility'. Some of them depend on context and perspective: they can refer to international migration (across borders), internal migration (within a country), temporary or 'permanent' migration, forced or voluntary migration, circulation, movement within a transnational space (e.g. Vertovec 2009) or various other forms. Despite harmonization efforts (UN 1998), the lack of standardized definitions can lead to inconsistencies in research and data collection. Users may rely on different operational (including legal) definitions when studying migration. For example, definitions of who is considered a migrant (e.g. foreign resident, foreign national or foreign born) or the duration of stay required to be classified as a migrant (e.g. at least three months or one year) can vary, as can the distinctions between different types of migration (e.g. labour, family, study or asylum migration). Definitions also depend on their so-called temporal and spatial granularity, that is, on the *time and space criteria*. Here, the shorter the durations and the smaller the geographic units considered, the more migrants are counted.[1] Figure 3.1 shows an intuitive visual justification for this regularity.

Moreover, **categorizing migration** is far from straightforward. This holds for environment-induced migration, as discussed earlier (Foresight 2011) but also for the distinction between forced and voluntary migration (Erdal and Oeppen 2018; Erdal et al. 2023). Some people may experience a combination of factors: their decision to migrate may be influenced by complex and overlapping circumstances, and they may have varying degrees of control over their decisions (Czaika et al. 2022a). The interplay between aspirations – *Do I want to move?* – and capabilities – *Can I move?* (Carling and Schewel 2018) – also varies between people and contexts. Therefore, criteria for categorizing migration as forced or voluntary are often elusive. As discussed in Chapter 2, these ambiguities are

[1] For space, this issue is known as the Modifiable Areal Unit Problem (MAUP; Openshaw 1984), and for time, the discussion of associated issues can be found, for example, in Nowok and Willekens (2011).



Note: For smaller regions (left) and shorter duration definitions (right), depicted both by dotted and solid lines, more moves are counted than for larger regions and longer duration definitions only, shown exclusively by solid lines.
Source: Own elaboration.

Figure 3.1 Impact of space and time granularity on measuring migration

why migration definitions and measures are very much social and political constructs: products of their time, space and specific circumstances.

Matters are additionally complicated by the dynamic nature of migration, mobility and returns. Migration is a **dynamic process**, with individuals often engaging in multiple movements over their lifetimes (we explore this further in Section 4.3). Defining the start and end points of migration episodes can be challenging, especially in the case of circular or repeat migration, where the picture shown in Figure 3.1 is made more complicated by people moving back and forth between different regions after short durations of stay. Deciding when to categorize an individual as a return migrant involves additional considerations about the duration of stay, purpose of original migration and intention of the return. This dynamic nature complicates the measurement of migration trends and patterns (Willekens 1994; Nowok and Willekens 2011), not to mention forecasting and scenario-setting (Willekens 2018).

In addition, methods of **data collection** vary widely. The main approaches include administrative records, censuses and surveys, with more recent sources also including various forms of digital traces and other 'big data' (Cesare et al. 2018; Laczko et al. 2023). Each approach has its strengths and limitations, and the choice of method can impact the

accuracy and completeness of migration data. One crucial observation is that no method is perfect: some migration moves may be undercounted (or not captured at all) by some data collection methods, leading to gaps in data and understanding; other migrants may be captured many times (e.g. in data on border apprehensions). Improving data collection methods and addressing gaps is therefore crucial for enhancing the accuracy of forward-looking studies (Willekens 2018). This implies a need for collaborative efforts between governments, researchers and international organizations to develop common frameworks and improve comparability. We discuss this further in Chapter 5, where we present a methodology for harmonizing migration estimates for Europe and measuring their errors.

3.3 UNCERTAIN THEORIES AND DRIVERS: HOW MUCH DO WE KNOW?

Another challenge of studying migration, which translates directly into the limitations of migration scenarios, relates to the underlying drivers. On the one hand, migration is known to be influenced by many interconnected variables. On the other hand, their impacts are difficult to isolate. As a result, theories attempting to explain migration patterns are fragmented and may lack precision or face other important limitations, such as dependence on context (Arango 2000). Moreover, data limitations discussed in the previous section (e.g. the categorization of migration) also severely constrain our theoretical understanding. Incomplete or inaccurate data on migration and its drivers make it difficult to empirically test and validate migration theories, so we cannot be sure whether something that looks intellectually plausible as a theoretical proposal is, in fact, reflected in the observed reality.

In addition to data, one key issue related to the role of drivers in understanding migration and forming scenario assumptions is the complex nature of migration. Migration is multidimensional, influenced by a wide range of factors (e.g. economic, social, political, environmental and personal), whose relationships are dynamic and vary in time and across space, interacting in often unpredictable ways. For these reasons, instead of studying individual drivers, scenarios would ideally need to consider whole multidimensional driver environments (or *driver complexes*), which strongly depend on context (Czaika and Reinprecht 2022). Such environments, unfortunately, are hardly possible to conceptualize, let alone express using standard data sources. This points to the need for

realistic driver-based analysis to be context specific, as this allows for greater nuance and application of multiple perspectives.

As mentioned earlier, migration patterns are dynamic, constantly evolving due to changes in economic conditions, political landscapes, technological advancements and global events. The dynamic nature of these factors makes it challenging to predict how migration trends will unfold and which drivers will become more or less significant in future. One specific challenge in dynamic migration systems is related to feedback loops and cumulative effects. It is well known that migration can influence the conditions that initially prompted it, creating feedback effects that cause it to self-perpetuate.[2] As one example, a large emigration of skilled workers from a region may impact the economic development of that region through brain drain, subsequently influencing future migration patterns. Other examples of feedback loops include unintended consequences of policies or interventions designed to address the challenges of migration. For instance, tightening border controls may lead to the emergence of new migration routes or illegal channels or may cause what used to be circular migration to become more permanent (Castles 2004; de Haas 2023).

Finally, at the individual level, one crucial theoretical limitation is that while there may be observable regularities in migration patterns, at a very basic level everyone is different. This means that people make migration decisions based on a variety of personal factors, including their aspirations and ability to move (Carling and Schewel 2018), family considerations and perceptions of opportunities. This individual heterogeneity makes it challenging to develop universal theories that can explain migration for diverse populations. In sum, the answer to the question 'How much do we know about migration?' is limited at a very profound level by human agency and free will to act upon information. Still, not everything is uncertain: we now have a much better understanding of migration processes than ever before (e.g. de Haas 2023). By triangulating different pieces of knowledge, we can produce testable hypotheses (Carling et al. 2020), contributing to the development of middle-range

[2] A discussion of perpetuation theories of migration is offered by e.g. Massey et al. (1993). Examples of such explanations include migration systems, cumulative causation, and the role of networks and institutions. The mechanism of self-perpetuation is mediated by information, which acts as a conduit facilitating further migration (see Bijak et al. 2021b).

theories (Merton 1968). Hence, even under fundamental uncertainty, there are some common patterns to migration that can be used to make meaningful scenarios, as we discuss throughout the rest of this chapter.

3.4 UNCERTAIN HUMAN AGENCY: AMBIGUOUS MIGRATION DECISIONS

The term *human agency* broadly refers to the manifestation of people's individual capacity to act, to make decisions and choices, including those that affect them (for a broad discussion see e.g. Schlosser 2019). In the context of migration, agency can be informally conceptualized as the 'ability of agents, representing people, institutions, or other decision-making units, to react to all aspects of a situation – including their own internal state and the state of their environment – in surprising and essentially unpredictable ways' (Bijak et al. 2021b: 227). Defined in this way, agency involves navigating a range of personal, social, economic, legal and cultural factors, all of which are present in the process of making decisions about migration. Agency can also manifest itself in different ways for different flows: contrast the decision to move abroad to study with the decision to seek asylum. The uncertain nature of agency is therefore linked to several further conceptual challenges, which we summarize here along the four dimensions of individual migration decisions proposed in Czaika et al. (2022a). These dimensions are level of individual aspirations, availability and use of information, time horizon and life-course stage, and level of agency and what we called the *locus of control*.

Aspirations are a necessary, even if not sufficient, condition for migration. They emerge from a gap between the current and desired states of a person's life. As such, individual aspirations are highly subjective and are dependent on context (e.g. economic or political conditions or family circumstances), as context clearly impacts decision-making. Perceptions of current conditions or possible future opportunities are also very personal. People may prioritize different factors (e.g. economic prospects, education, family well-being, or personal safety) based on their unique circumstances and perspectives and the situation they are in. They may also have many different reasons for moving or staying. For example, in addition to economic perspectives, an individual may consider the natural or social environment, and these aspects may be very difficult to disentangle (Foresight 2011). The same holds for conflict or other situations where the distinction between *forced* and *voluntary* migration

is often blurred (Erdal and Oeppen 2018; see also Chapter 4). This makes it challenging not only to generalize or predict decisions and their impact on actual migration patterns but also to aggregate them across diverse populations. In addition, motivations and preferences, and thus aspirations, can evolve over time: after migration, aspirations often adapt to new circumstances (Czaika and Vothknecht 2014).

A second dimension includes information, learning and adaptation. Information is closely linked to uncertainty, with all decisions made under imperfect and incomplete knowledge of the world. Besides, people assess risks differently: some are risk-averse, others more risk-seeking. Factors such as the perceived risks and benefits of migration, the availability of information and the individual's risk tolerance play crucial roles in decision-making, but are hard to quantify. People may also learn from the experiences of others, especially previous migrants, and adapt their migration decisions based on changing circumstances. This is a crucial role of migrant networks: by providing information to new migrants, networks can substantially reduce the costs and barriers to migration, leading to subsequent moves (see Massey et al. 1993). The adaptive nature of migration decisions adds another layer of complexity, as individuals may modify their choices in response to feedback from their own experiences or the experiences of others.

Third, the temporal dimension of decisions reflects the dynamic character of migration. Neither migration decisions nor actual migration processes are static. Both evolve over time in response to changing circumstances and opportunities. A decision made at one point may be reassessed and modified later. In addition, decisions are made with expectations about the future in mind. This typically implies some *discounting* of expected future gains and losses, which are then contrasted with the current ones (see the discussion of a neoclassical economic model in Massey et al. 1993). In addition, time is often a proxy for people's position in the *life course*, leading to observed regularities in the age profiles of migration (Courgeau 1985). Understanding how migration decisions unfold over the life course, and what drives them at different stages of life, under various personal circumstances, has become a crucial area of contemporary research (de Jong and de Valk 2020).

Finally, in terms of agency and the locus of control – who really makes the decision – we need to look at the interactions between decision-making agents and the structural and contextual factors influencing decisions. The reason is that although agency is a key aspect of decisions, people act within larger contexts shaped by policies, economic

systems and social structures. Therefore, understanding how individual agency interacts with structural factors and constraints is critical: both play integral roles in shaping migration patterns. In particular, social networks and the influence of peers, families, households and communities play a significant role in decisions (Stark and Bloom 1985; Epstein 2008; Haug 2008). These decisions are often made within the context of social relationships, which makes understanding how social influences operate and shape migration choices yet another challenge. A special group of factors affecting agency is related to migration and other relevant policies, as we discuss next.

3.5 UNCERTAIN POLICIES: BETWEEN DECLARATIONS, INTENTIONS AND REALITY

Uncertainty in migration policies arises from the discrepancies between stated policy intentions or declarations and the actual implementation and impact of policy measures (Czaika et al. 2022b). This uncertainty can lead to unintended consequences, inconsistencies and difficulties in accurately predicting the impact of policies on future migration patterns. Moreover, the relationship between uncertainty and policy is a two-way street. On the one hand, policy changes can generate uncertain outcomes and increase overall volatility and uncertainty by 'deflecting' people from legal migration channels to irregular routes (Czaika and Hobolth 2016). On the other hand, uncertainty also impacts the frequency with which new policies are announced and enacted.

Over the last three decades, Europe has seen heightened migration uncertainty, with numerous crises linked to wars in the former Yugoslavia, Afghanistan, Syria and Ukraine. This has led to increasingly rapid enactment of policy changes that were, perhaps surprisingly, of relatively small magnitude:[3] we call it 'accelerated fine-tuning' of policies (Czaika et al. 2021a, 2022b). The visible 'pivot towards status quo'

[3] The direction and magnitude of change were assessed based on the DEMIG policy database covering the period 1990–2020 (bit.ly/quantmig-policy, Schreier et al. 2023). This database is a continuation and update of the original DEMIG database created at the International Migration Institute (IMI) then at the University of Oxford (www.migrationinstitute.org/data/demig-data/demig-policy-1, de Haas et al. 2015).

in policies can be a sign of policy risk aversion, where migration is a hot topic with high levels of political and social salience (ibid.). This is an example of a potentially problematic tendency to avoid making difficult and risky decisions for the sake of stability or short-term political gains. Major policy challenges, such as migration-related ones, can be seen as examples of 'grey rhinos' (Wucker 2016): another animal metaphor, depicting problems that 'hide in plain sight' but are conveniently overlooked until they become too big and their impact is impossible to ignore.

There are many reasons for this state of affairs which merit a deeper analysis, but some of the key aspects are summarized here. To start with, policies can be ambiguous (sometimes deliberately so) and inconsistent. Many policies influencing migration are enacted in different areas of government (e.g. home affairs, business, labour market, family affairs or social security) or at different levels of decision-making (central, regional or local). Such *migration-relevant policies* can therefore have different objectives and can at times be in conflict (Czaika et al. 2021b). In such instances, policies may lack clarity, and their interpretation can be subject to different perspectives. Inconsistencies within policy frameworks or between different levels and areas of government can create confusion both for migrants and for stakeholders involved in implementing the policies.

In addition, policy outcomes may not align with the initial policy goals, at least the officially declared ones. Unintended consequences, unforeseen challenges, or a mismatch between policy design and on-the-ground realities can contribute to the gap between policy intentions and actual outcomes (Castles 2004; de Haas 2023). Besides, political changes and shifts in public opinion, dominant ideology or discourse make migration policies subject to frequent changes and increase their volatility (Czaika et al. 2021b). This may result in frequent alterations to existing policies, creating uncertainty for migrants and stakeholders alike. At the same time, from a practical point of view, the effective implementation of increasingly frequent changes to migration policies is often hindered by limited resources, lack of administrative capacity, inadequate processes or coordination issues. These 'implementation gaps' and inefficiencies can also contribute to policies not achieving their intended impact (ibid.).

To fully assess the causes and consequences of migration policies, we also need to acknowledge the themes discussed in previous sections, such as the interconnected and dynamic nature of migration and the presence of feedback effects. The interconnectedness of migration can impact policies in many ways, such as *spillover effects*, with policies enacted in one

country (e.g. for making access relatively easier) influencing migration into other countries, or emulation, where countries mimic policy solutions that have been adopted elsewhere (Czaika et al. 2023). As migration is a global phenomenon, policies in one country can have ripple effects on migration patterns in other regions or countries. This means that in the absence of international cooperation and coordination of policy solutions, the effectiveness of individual national policies can be limited.

Another policy effect of the interconnected nature of contemporary migration is the unintended consequences of interventions, which may prevent policies from achieving their stated aims (Castles 2004). We refer to such consequences as *policy externalities* (Czaika et al. 2023): something that has not happened by design, but nonetheless has had unforeseen impact on migration processes or other areas of social and economic life. One example is policies designed to control or restrict migration, which may lead to the emergence of illegal migration channels and human smuggling networks, increased vulnerability of migrants, or other negative social and economic impacts (Castles 2004). Another example is *policy substitution effects*: policy changes restricting some legal migration channels to one country will likely be compensated by increased migration through other channels and to other countries (Czaika and de Haas 2017; Czaika et al. 2021a; Czaika et al. 2023). Understanding and mitigating these unintended consequences poses challenges for policymakers but also needs recognizing in scenarios: without taking complexity into account, such consequences will never come to the attention of policymakers.

The main challenge arising from migration being a very dynamic process is that policies must continuously adapt to changing circumstances. Policies that do not evolve in response to dynamic migration patterns may become outdated or ineffective over time. At the same time, the lack of robust evaluation mechanisms and monitoring of feedback loops can impede policymakers' ability to make informed decisions and adjust policies based on the available evidence. For these reasons, future-proofing policy solutions by building in regular evaluation of migration policies is crucial for understanding their impact and effectiveness. The same holds for scenarios as policy aids: to be useful, they need to be regularly revised in the light of new knowledge or risk becoming obsolete. In both cases, the necessary prerequisites for science-based or evidence-informed policymaking are comprehensive impact assessments and ongoing dialogue between policymakers, researchers and other stakeholders. We discuss these issues in greater depth in Chapters 8 and 9.

3.6 TOWARDS GOOD-ENOUGH, FEASIBLE SOLUTIONS FOR MIGRATION SCENARIOS

In light of all the conceptual complexity of studying future migration, what advice can be offered for the practice of setting migration scenarios? Attempting to overcome the challenges by offering precise solutions, describing this complexity in much detail for a range of drivers and their possible future trajectories, is doomed to fail. Migration uncertainty increases exponentially, not only with the length of the time horizons but also with the number of drivers taken into account.

As an example, let us look at all drivers as binary variables, with only two possible levels: for instance, attracting or repelling prospective migrants. Even in this simple set-up, while two drivers would imply the need to study four (2^2) combinations, for 24 drivers, such as those identified by Czaika and Reinprecht (2022), the number of combinations would exceed 16.7 million (2^{24}). Such a number is practically impossible to analyse in a meaningful way beyond some automated pattern recognition, let alone interpreting the results. The challenge would be even greater for a higher number of levels. To illustrate this, in Chapter 4 we focus on just a small selection of drivers operating in the countries of origin, destination and transit for European migration. We also discuss in greater depth their complexity, which prevents these drivers from being directly used in migration scenarios.

If complexity precludes the meaningful use of drivers in scenario-setting, what alternative options are available? One idea, which we advocate in this book, focuses on *good-enough* solutions for building and using migration scenarios for policy and practical applications (Czaika and Bijak 2020). Such solutions, as discussed in Chapters 6 and 7, are only approximate, often atheoretical, and designed specifically for cutting through the ambiguity with a range of simple yet effective tools for exploring *what-if* questions about future migration. Such approaches are not perfect, but they can be easy to create and scale up, while offering satisfactory solutions to certain challenges related to migration scenarios.

The proposed concept of good-enough tools explicitly recognizes the complexity and uncertainty of migration and suggests that pragmatic, adaptable and context-specific solutions may be more feasible than aspirational, ideal or comprehensive sets of approaches. This does not necessarily imply that we should not aim for the *best solutions*. The idea behind good-enough options is rather that with the complexity and

dynamic nature of migration and uncertainty, ideal solutions tend not to exist. We can strive only to minimize uncertainty as far as is possible.

There are some important prerequisites for such good-enough solutions to help us start tackling the challenge of uncertainty. First, there is a need for better data and greater standardization in the underlying definitions and methods for measuring migration; we explore these more fully in Chapter 5. Improving the accuracy of migration data is crucial for understanding migration dynamics, informing policy decisions and addressing the needs of migrant populations. Second, the scenarios produced with the help of such methods still need to conform to and be consistent with the established knowledge on migration processes, such as the high-level *stylized facts* on migration[4] (see Carling et al. 2020 for examples). As for this established knowledge, addressing the conceptual challenges discussed in this chapter ideally requires adoption of an interdisciplinary approach, not limited to just economic or sociological aspects. Only in this way can we more holistically recognize the dynamic and interconnected nature of migration processes.

Third, in practical terms, the good-enough, feasible solutions need to take into account, wherever possible, the established regularities in migration patterns. There are some well-recognized patterns of migration: for example, patterns by age across the life course (Rogers and Castro 1981; Courgeau 1985); patterns across space, including the role of distance and other *spatial gravity* features (Zipf 1946; Olsson 1965); the relative stability of migrant stocks compared with flows (IOM 2022); and the different levels of uncertainty shown by different migration processes (Bijak et al. 2019). Last but not least, these solutions need to clearly and visibly reflect the uncertainty of migration. This is to signal to users not only the usual caveats about the limitations of scenarios but, most crucially, the need to 'prepare to be unprepared' (Czaika and Bijak 2020). Acknowledging the inherent uncertainty in forward-looking studies is

[4] To list a few examples of stylized facts relevant for scenario-setting: 'Migration flows reflect pre-existing connections between countries', 'Migration flows beyond a certain threshold become self-sustaining', 'Emigration rises with economic development [only] until a certain level', or 'Migration policies on their own are ineffective in producing desired outcomes.' Note that stylized facts do not need to hold in every possible context and can – ideally should – be empirically tested (Carling et al. 2020).

essential for providing realistic assessments of future migration trends. We discuss this in more detail in Part III.

4. Migration drivers across time and space: selected examples

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4.1 COUNTRIES OF ORIGIN: FOCUS ON DEVELOPMENT, CONFLICT AND CLIMATE CHANGE

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Most forms of human mobility globally – whether travel, residential moves, or migration – occur over short distances, and even those that cover relatively longer distances tend to be mostly internal, taking place within countries (King and Skeldon 2010; Bell et al. 2015). Nevertheless, to better understand *international* migration, it is necessary to further refine existing understanding of why people want to move *abroad*. This necessitates careful examination from the angle of countries of origin.

To understand how people's desire to leave might develop and be translated into decisions to move, we draw on the notion of migration drivers in their different forms (see Chapter 3). As mentioned earlier, in contemporary theoretical migration thought, moving abroad depends on an interplay of *aspirations* – wanting to move – and *capabilities* – being able to move (Carling and Schewel 2018). Both these elements are embedded within the decision-making process, with its individual and also collective considerations, and are shaped by intangible factors, such as access to information, risk aversion, and many others (Chapter 3; see also Schon 2019 and Hagen-Zanker and Mallett 2023).

In this section we put the spotlight on selected issues related to decisions to move from countries of origin, specifically those relating to

migration aspirations and their relationships with economic development and standards of living. We also explore the links between migration and environmental (climate) change and between migration and violent conflict. All these topics are highly salient and often feature in public and policy discourse, yet the underlying evidence base is often not properly taken into account or understood (see de Haas 2023). This is why we argue that they warrant special attention.

To begin with, many factors influence **migration aspirations**, and demographic elements play a pivotal role. Notably, age emerges as a significant determinant, with young people often harbouring heightened aspirations. Gender also contributes, as men tend to exhibit somewhat higher migration aspirations compared with women (Aslany et al. 2021). This clearly translates into actual behaviour, as migration exhibits distinct age and sex patterns (see Rogers and Castro 1981 and Chapter 5). However, while the so-called *root causes* of migration, such as poverty or lack of development, may impact aspirations, they may not directly lead to migration, due to lack of adequate resources to move (*capabilities*, in the words of Carling and Schewel 2018). This is what makes the link between migration and economic development so difficult to capture, both theoretically and empirically.

Currently, there is a consensus view that up to a certain level, **economic development** increases migration, due to increases in both aspirations and capabilities: a higher income opens people's horizons to more opportunities overseas and provides means to seize them. At the individual level, in the words of Czaika and Reinprecht (2022: 64), there is 'consensus … that it is generally not the poorest who migrate'. However, what happens beyond that level is a bone of contention. One view is that migration peaks with increasing development and then falls, leading to an inverted-U-shaped relationship (e.g. Clemens 2014). This could indicate that a decline in aspirations offsets the increase in capabilities or that opportunities in the place of residence increase faster than aspirations. Another view is that after reaching a maximum, migration stays at a similar level when development increases further, as seen in some more recent empirical work (McAuliffe et al. 2021). This would suggest that decreases in aspirations are compensated by increases in capabilities.

A review in Aslany et al. (2021) indicated that the impacts of economic development, standards of living and inequalities on aspirations, let alone on migration, are more complex than standard economic theories would indicate. It is worth reiterating that aspirations are a necessary but not sufficient condition for migration to take place

(Chapter 3). Still, some variables (e.g. homeownership) seem to reduce aspirations, whereas others (e.g. receiving remittances or having relatives abroad) increase them. At the macro level, inadequate functioning of governments (national or local), poor public service provision, and – crucially – corruption, are all associated with increasing aspirations to leave. Unsurprisingly, so is the presence of armed conflict or violence and a general sense of insecurity (ibid.). Hence, there are already some patterns related to aspirations that reduce epistemic uncertainty: people who live fulfilled lives in well-functioning countries are less likely to aspire to leave.

At the same time, the links between aspirations, decisions and actual migration – which are mediated by capabilities (including safe, legal and affordable routes) – are still relatively unknown in nature and need to be looked at more closely. Current evidence suggests that migration aspirations decline with increasing life satisfaction (e.g. in financial aspects). However, although higher standards of living could dampen aspirations, they could at the same time increase capabilities (resources available for migrating). The ultimate result of the interplay between these two effects can be uncertain. Here, greater clarity could be achieved by including questions on life satisfaction in surveys, alongside those on migration aspirations, especially if a follow-up on actual migration could be undertaken (see Aslany et al. 2022). Another important dimension worth exploring is *time* (see Chapter 3). Uncertainty about the future, anticipation of future changes in material situation or, more generally, either hopes or fears of what the future may bring can impact migration aspirations and decisions alike (Kleist and Thorsen 2016; Aslany et al. 2022).

Similarly, the impact of **conflict and violence** on migration and mobility is far from unambiguous. Existing studies have often been limited to treating conflict as a simple binary variable (conflict/no conflict), brushing over its various dimensions, such as its nature, intensity, onset and duration (Erdal et al. 2023). Many of these considerations depend strongly on a particular context, including its cultural values and norms, and on the presence or absence of opportunities to move. This is why it may be preferable to focus on *conflict-related determinants of migration* (aspirations and capabilities), rather than on determinants of 'conflict-related migration'. The latter, in its pure form, may be difficult to isolate from other types of mobility, despite the data being possibly easier to capture in some contexts, such as asylum-seeking. After all, decisions to move are often driven by a whole range of factors, so

mobility evades simple classification into 'forced' and 'voluntary' (Erdal and Oeppen 2018).

In addition, undue attention can be paid to conflict driving outward mobility or displacement, at the expense of its driving immobility. This is the case whether immobility follows deliberate choice or is *involuntary* (see Carling 2002). Understanding the whole spectrum of decisions and behaviour, from immobility to displacement, in the context of conflict, can contribute to better preparedness in terms of humanitarian responses. A prerequisite of that is a better understanding of the dynamics and drivers of conflicts, alongside other drivers of mobility (Czaika and Reinprecht 2022; Erdal and Hagen-Zanker 2022). Some of the other knowledge gaps relate to how the impact of these drivers can be mediated by resources (capabilities), the presence of networks and other forms of human and social capital, and attitudes to risk (Rubin and Moore 2007).

The impact of **environmental change** as a driver of migration is even more uncertain, and there is a vast aleatory component to its associated uncertainty, not least propagated from models of climate change (IPCC 2023). Still, we know that some regularities and patterns exist (Foresight 2011; Vestby et al. 2022; de Haas 2023). Importantly, environmental change is more likely to lead to short-distance mobility than long-distance mobility; at least this has been the case in the past. Sudden natural events (e.g. floods, earthquakes) also typically lead to short-term rather than long-term mobility. This implies that long-term international climate-related mobility has been relatively rare, contrary to popular perceptions and some alarmist views in public discourse (ibid.). At the same time, even in this scenario, the possibility of follow-on mobility (after the initial displacement) cannot be excluded. In addition, no work so far has looked at the impact of potential climatic tipping points, which would lead to permanent changes in ecosystems.

Despite the rather weak understanding of possible connections between climate change (including extreme weather events) and human mobility, attention to these links is growing. There are three main reasons behind our imprecise knowledge, notwithstanding much solid research over the past few decades (a comprehensive review, although over a decade old, is offered in Foresight 2011). First, *operationalizing* the variables to measure climate-related factors, both direct and less proximate, is less straightforward than might be assumed, and the quality of the underlying data is poor (see Vestby et al. 2024). Second, the *level of analysis* is ambiguous and can yield different conclusions, depending on whether we look at data on individuals, households, local areas, regions, or, as is

often the case, countries. The same holds for selecting the time frame for analysis. Third, the *differences in estimation methods* have implications for the conclusions of individual studies, especially as the processes studied are so complex that they may evade traditional methods of analysis, and even the best methods produce high errors in related estimates (Vestby et al. 2022). These three aspects of uncertainty are epistemic, so could – and should – be explored and communicated further, to avoid infusing policies with unwarranted alarmism. As argued earlier, similar arguments hold for conflict-related determinants of migration.

Crucially, in the case of either environmental disaster or conflict, people might decide to leave despite not wanting to and certainly not having had aspirations to leave at the outset. At the same time, others may decide not to move despite initial aspirations, perhaps due to lack of available resources. Others may have aspirations to leave, but not capabilities, including resources (Carling 2002; Foresight 2011); such *involuntarily immobile* people become 'trapped' in vulnerable situations. Just looking at these examples points us to specific knowledge gaps in the links between aspirations and mobility in the context of displacement.

4.2 DESTINATION COUNTRIES: ECONOMIC AND NON-ECONOMIC DRIVERS

Contributed by Valentina Di Iasio and Jackline Wahba

From the perspective of destination countries, the literature on traditional economic migration drivers is vast. The seminal review of migration theories by Massey et al. (1993) summarized several key threads in this area. The neoclassical microeconomic view, dating back to Sjaastad (1962), looked at the costs and benefits of migration expressed as discounted income streams. Later, the *New Economics of Migration* school (Stark and Bloom 1985) added the perspective of whole households (who use migration to manage risk) and moved from absolute income to the perception of relative deprivation. The constant element in these models is the assumption of *rational, utility-maximizing agents*. This presumes that people considering migration aim to maximize their *utility* from migration in such a way that that the potential benefits of migration outweigh the costs. In this framework, people move in search of higher living standards, better job prospects, earnings, etc., and they can choose their destination based on income per capita, unemployment rates and similar indicators.

At the same time, from the macroeconomic side, migration is viewed as a process that can equilibrate the labour market. This approach dates back to the famous model of Harris and Todaro (1970), with equilibrium achieved through wage adjustments, although in an alternative (Keynesian) view, the mechanism can involve changes to (un)employment rates or economic opportunities (see e.g. Hart 1975). In this approach the determinants or drivers include per capita national income, overall unemployment rates, and physical and cultural distances, and their effects are estimated based on gravity models (e.g. Beine et al. 2016).

Some specific aspects used in economic models aimed at explaining migration also include sociological explanations. One example concerns migrant networks in destination countries: these play an important role in providing information and support for new migrants, contributing to the self-perpetuating nature of migration (Massey et al. 1993; Munshi 2020). The size of networks is usually measured by proxy through migrant stocks; even though conceptually these are not the same, this is often done for reasons of convenience, as stock data are much more readily available than, for example, detailed data on social networks and their sizes and structures. Another concept related to support available for migrants in the host country is the 'welfare magnet' hypothesis, according to which migrants will be more likely to move to countries with more generous welfare provisions (see Giulietti and Wahba 2015). However, a recent review (ibid.) found mixed and inconclusive evidence for this. Yet another sociological foray into economic explanations is linked to the dual labour markets theory (Piore 1979), which combines purely economic arguments around labour markets with such concepts as job hierarchies, prestige and structural conditions.

There are many other factors at play besides the economic and social drivers of migration. Typically, geographic proximity and cultural and historical links between countries of origin and destination are seen as important too. Still, political and policy theorizations going beyond simple indicators (e.g. *asylum recognition rates*: the proportion of applicants who are granted asylum) are traditionally rare, with notable exceptions, such as Zolberg (1989). Empirical work on policies exists (e.g. Ortega and Peri 2013, in general, or Czaika and Parsons 2017, on highly skilled migration), but, as discussed in Section 3.5, policy uncertainty has not yet been systematically studied to the same extent. In this section, we aim to fill this gap to some degree by focusing on policy and other non-economic drivers (e.g. attitudes among the native-born population), using traditional econometric methods. We look at three examples: the

role of policy uncertainty, the role of policies such as welfare provision for asylum seekers, and the impact of migration attitudes among the native population on migration flows into different countries.

The concept of **migration policy uncertainty** is linked both to expectations of future migration policy developments among prospective migrants and to unpredictable changes in policies, which themselves can potentially become a significant determinant of where, when and how migrants move. At the theoretical level, this tendency is related to risk aversion and to preference for greater certainty. In this case, more predictable policy and legal environments are preferable to those that are either not well defined or may change in an unknown direction, often driven by short-term political calculations. This highlights the importance of clear and timely communication of intentions to change policies and legal migration channels: prolonged periods of uncertainty can themselves act as important drivers of migration.

As an example, in Di Iasio and Wahba (2023), we used the case of the United Kingdom (UK) to study the impact of the 2016 referendum on leaving the European Union (EU) on migration to and from the rest of the EU until the UK's departure on 31 January 2020. In this nearly four-year period, the full freedom of movement of people between the EU and UK was still in force, but there was no certainty about any future migration policy or rights that would apply after Brexit. To examine the effect of what we attribute to policy uncertainty, we compared migration patterns of EU migrants in the UK with those of non-EU migrants, both before and after the Brexit referendum. We found that what we see as *policy uncertainty* – the expected but at the time still undefined migration policy changes – influenced both migration decisions and destination choices. Compared with the pre-referendum situation, the attractiveness of the UK for EU migrants declined, the number of departures increased, and the number of new arrivals dropped considerably.

In the second study (Di Iasio and Wahba 2024), we looked at the **relative role of asylum policies** vis-à-vis other possible determinants of where people are likely to seek asylum. After all, the number of asylum applications and asylum recognition rates are positively associated. Existing work in this area has focused mainly on specific aspects, such as the restrictiveness of the policies (Hatton and Moloney 2017) or the asylum process (Bertoli et al. 2022). In contrast, we wanted to jointly examine several determinants of migration flows, for a broader set of asylum destination countries across the EU. In particular, we looked at which policy aspects could determine in which EU countries first-time

asylum seekers were more likely to lodge their asylum applications. By covering the broad period 2008–20, we deliberately included the so-called Mediterranean ‘asylum crisis’, with its very large numbers of asylum seekers who had reached Europe. Our results suggested that it is not policies that matter most for the choice of destination in the case of asylum seekers in Europe. Rather, confirming earlier economic intuition, it is social networks, comprising both past asylum seekers and migrants from the same origin country or region, that matter most for choosing the country of asylum within the EU.

If policies on their own are not that important, we must look at the areas where they intersect with economic drivers. To that end, we re-examined the ‘welfare magnet’ hypothesis in the context of asylum applications. The question here was: Other factors being equal, are asylum seekers more likely to lodge applications in countries with more generous welfare systems? On their own, there was little evidence for the attractiveness of social benefits in decisions to claim asylum in a particular country. We also looked at employment bans, whereby asylum seekers are prohibited from (legal) work while their cases are processed. In that case, correlation of employment bans with the number of asylum applications was rather low. This confirms the relative importance of social networks, as opposed to policies or economic factors, for the number of asylum applications to individual countries. This holds particularly for policies designed to restrict or limit access to the labour market and welfare systems for asylum seekers. Economically, such policies are not very cost-efficient, prohibiting people who could work from working, and at the same time they are not very effective in terms of meeting their stated goals:[1] a policy gap that could be filled with political will.

In the third example, we looked at the role of **attitudes and perceptions** among destination-country populations in shaping international migration flows (Di Iasio and Wahba 2021). Our hypothesis was that other non-economic factors, especially public attitudes, could also be important determinants of international migration. To make the argument more general, we looked at the *salience* of migration in public discourse – the perceived importance of migration as a challenge faced by a country – as measured by international surveys (Eurobarometer).

[1] See also Thielemann (2006). We sidestep here the purely political arguments in favour of policies such as temporary employment bans and other measures aimed at deterring migration and asylum-seeking.

In previous studies, migration salience had been found to be important for attitudes towards migrants (Gorinas and Pytliková 2017) and voting patterns related to anti-immigration parties (Dennison and Geddes 2019). In Di Iasio and Wahba (2021), a negative effect of anti-immigration attitudes on immigration was found. This is a key consideration, especially for government policies that may aim to fill labour shortages by attracting the 'best and brightest'. With visible and salient anti-immigration attitudes in a society, potential migrants might simply not wish to come (ibid.). Migration of highly skilled and specialized professionals is often a buyers' (in this case, migrants') market, with migrants being able to choose between several possibilities, so people who intend to move for greater professional opportunities are likely to have other options to consider. This can affect individual countries' standing in the global competition: the 'race for talent' (Shachar 2006).

4.3 IN TRANSIT: MOBILITY OF THIRD-COUNTRY NATIONALS IN THE EUROPEAN UNION

Contributed by Michaël Boissonneault, Rafael Costa and Helga de Valk

One important and often-overlooked aspect of migration is transit or onward migration. With so much political focus on immigration, the fact that people do not always stop in the first country they reach can be missed. People often move to new destinations, especially when the first country disappoints or better opportunities arise elsewhere. The first country of arrival becomes an interim, not a final destination: a stepping stone on a migration journey, sometimes called an *entrepôt* country (DeVoretz and Ma 2002). This dynamic is especially crucial for looking at a migration system such as Europe's, where there are relatively high barriers to first entry but much lower barriers to subsequent moves within the common European labour market, particularly given the passport-control-free Schengen area. Individuals may therefore find it easier to get a foothold anywhere in Europe first and explore the options later, rather than necessarily making the first move to the ultimate destination country, which may have high barriers to first entry.

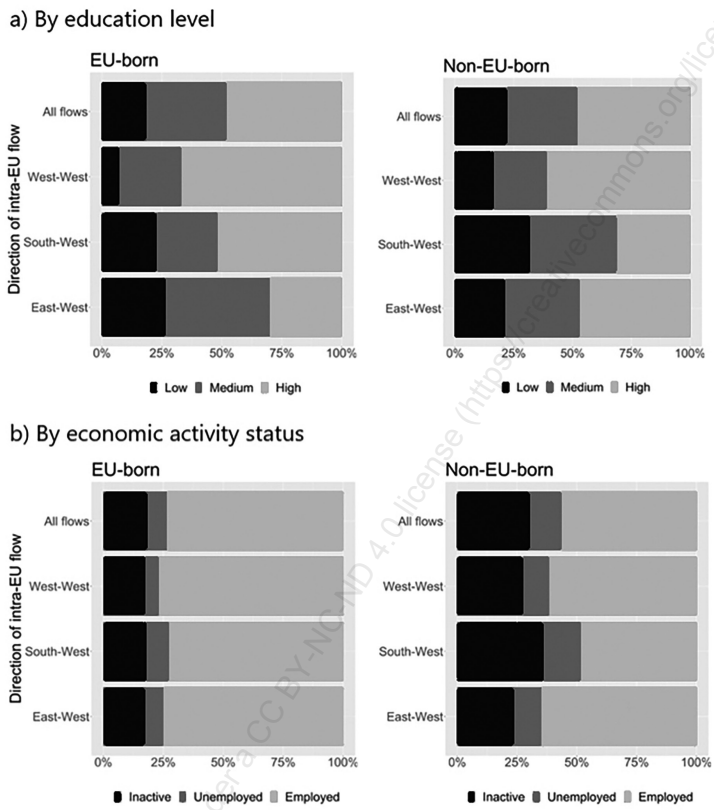
Much of the internal mobility within Europe, including onward migration of non-European nationals and also mobility of Europeans themselves, is driven by a mix of policies and attractive economic conditions. To see the patterns clearly, we first looked at intra-EU mobility as a whole (Mooyaart and de Valk 2021), based on both empirical data

from Eurostat for most of the 2010s and the literature on migration patterns. The results were unequivocal: a lot of migration within the EU is circular, with people ultimately returning to their countries of origin after a few years spent living or working in another country. At the same time, over that decade, there was a visibly increasing trend in the number of migrants who ended up settling in the destination countries: if not permanently, then at least for a longer time. There were very interesting differences between age groups and countries of origin. Nationals of Southern or Eastern European countries were more likely to settle in their destinations in Western or Northern Europe than to return to their origin countries.

For non-European nationals, the picture was somewhat different. Using migration estimates by broad region of birth from the QuantMig Migration Estimates Explorer (bit.ly/quantmig-estimates), discussed in more detail in Chapter 5, we were able to identify some key patterns of mobility. Many of these movers ended up in a few large countries of Western and Southern Europe, notably France, Germany, Italy, Spain and the UK, which taken together accounted for a sizeable mobility share. For these flows, countries in Southern and increasingly also Central and Eastern Europe often play the role of entrepôt stepping stones for migrants who originate from South American, Asian or African countries and whose intended destinations are in Western Europe.

In addition, these patterns vary by education level and labour force status, which can be gauged from the EU Labour Force Surveys. In Figure 4.1, we compare the compositions of flows within Europe according to region of birth (EU versus non-EU), by education and labour status, for the main directions of intra-European flows in 2014–19. The results show high heterogeneity of migration within Europe. On the one hand, there are hardly any differences between the breakdowns of aggregate flows by labour force status (employed, unemployed or economically inactive) for different corridors for migrants born in the EU. On the other hand, for non-EU-born migrants and the flows disaggregated by education, the differences between particular corridors are profound.

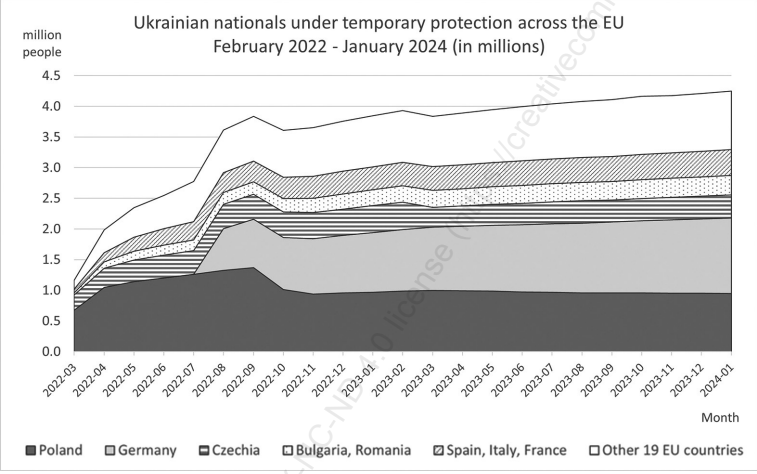
After the Russian invasion of Ukraine in 2022, similar patterns were observed for Ukrainians granted temporary protection in Europe: after the initial moves to bordering countries (especially Poland), there was a later secondary wave of moves westwards, primarily to Germany and Czechia. As of 31 January 2024, of the 4.3 million people granted temporary protection status, 1.27 million had ended up in Germany, 951,600 in Poland, and 381,200 in Czechia, with high per capita proportions also



Note: Educational levels: high – tertiary, medium – secondary, low – primary or incomplete secondary.
Source: Boissonneault and Costa (2022: 20–1). Migration data from the QuantMig Migratin Estimates Explorer, bit.ly/quantmig-estimates (Aristotelous et al. 2023), education and employment statuses from the Labour Force Surveys (Eurostat).

Figure 4.1 *Composition of the main intra-EU migration flows by education level (top panel) and economic activity status (bottom panel)*

recorded in Estonia, Bulgaria, Lithuania and Latvia (Eurostat 2024b). These westward moves are seen in the data on people under temporary protection, shown in Figure 4.2. The pictures for both asylum and other types of migration clearly reflect the interplay of the complex web of underlying drivers in countries of origin, destination and transit.



Note: Germany started reporting the data only from August 2022.
Source: Eurostat, data table migr_asytpsm__custom_9303293, as of 5 April 2024.

Figure 4.2 *Numbers of Ukrainian nationals under temporary protection across the EU and shares for the main countries of destination, March 2022–January 2024, in millions*

4.4 UNTANGLING DRIVER COMPLEXITY FOR MIGRATION SCENARIOS

Contributed by Marta Bivand Erdal, Helga de Valk, Jackline Wahba and Jakub Bijak

Throughout this chapter, we have tried to shed light on some dimensions of the complexity surrounding the drivers of migration into and within Europe. We need to remember that these are just selected examples of

the multitude of drivers that may influence individual migration flows. By presenting them, in full knowledge that they paint only a fragment of a much broader picture, we want to demonstrate how difficult it would be to build comprehensive scenarios based on presumed future driver trajectories. Based on this complexity, it is almost impossible in our view to meaningfully include drivers in scenarios while retaining the required level of detail, as a general rule. The reasons for this are both conceptual – the multitude of drivers, their own uncertainty, and the complexity of interactions – and practical, in particular the amount of effort required to isolate and operationalize the main driver pathways to use in scenarios. If scenarios were indeed based on drivers, this complexity would remain a Gordian knot preventing their meaningful development.

By looking at drivers from the three perspectives – countries of origin, destination and transit – we wanted to reinforce the argument that when it comes to migration processes, *nothing* is simple. To take this complexity of interacting drivers into account, traditional determinants (e.g. income or employment rates) no longer suffice. However, this complexity and richness would be difficult to reflect directly in scenarios without losing generality. This poses a practical dilemma: If the aim is to support robust policies, how should migration scenarios be constructed? They should by no means ignore the overwhelming uncertainty and complexity, but at the same time they should not get into the rabbit holes of very idiosyncratic and context-dependent solutions, where a particular scenario is valid only in a very specific context and nowhere else. We attempt to address this conundrum throughout the rest of the book.

In particular, there are ways in which the knot can be cut through by leaving the driver-based scenario mindset altogether. Better still, the analysis of drivers, such as those presented in this chapter, can still offer important lessons for scenarios, even though such drivers would not be used directly, their individual trajectories not charted, etc. One such lesson is that origins and destinations matter: regions of the world differ with respect to the types, dynamics and volatility of migration they generate, and so do destination countries and regions, which each have their idiosyncratic policies. A second lesson is that composition matters: ideally, flows need to be disaggregated, not only by origin but also by other characteristics, such as nationality (better reflecting legal status) or country of birth (better reflecting cultural patterns). In addition, socio-economic dimensions (e.g. education, labour market status) matter a lot for migration and are therefore worth including in scenarios.

The main message here is that no two countries or flows are the same. Heterogeneity matters.

For scenarios prepared for individual countries, disaggregation could go even further, into the main reasons for migration. It is well known that different types of migration flows – work, family, education, asylum, to name just the main ones – exhibit different dynamics, volatility and levels of unpredictability (de Beer 2008; Bijak et al. 2019). The same holds for distinguishing between original inflows, onward migration and returns. One practical issue here is the availability of data, especially if reason for migration were to be used jointly with other dimensions (e.g. origins and destinations of flows). In the EU, the Reason for Migration variable is available from the Labour Force Survey, having been first introduced in a 2014 ad hoc module on migration (Eurostat and OECD 2016). Data on reasons are now collected biennially in odd-numbered years (Eurostat 2024a) but are not readily tabulated, so any analysis would require access to microdata, increasing its complexity.

For multidimensional disaggregation (e.g. by origin, destination, age, sex, country of birth, and additionally by education, labour force status and reason for migration), sample sizes are not sufficient, so other solutions need to be found. In Chapter 5, we look into methods for estimating European migration flows by some of these characteristics (origin, destination, age, sex, and broad region of birth), and the scenarios presented in Chapter 7 also include education and labour force status. In this way, rather than modelling drivers explicitly, the process of creating scenarios that we advocate throughout this book provides a simple way of approximating the influence of drivers by looking at the main characteristics of flows as reflected in their heterogeneity.

5. Estimating European migration flows

Peter W.F. Smith, Nico Keilman, Georgios Aristotelous and Jakub Bijak

5.1 HARMONIZING MIGRATION DATA IN EUROPE: BRIEF HISTORY

Estimating migration flows is fraught with difficulties. Some of the problems have been known for over a century; the aptly titled United Nations (UN) report *Problems of Migration Statistics* (UN 1949: 1) noted that:

> The inadequacy and lack of comparability of migration statistics have been realized for a long time … The International Statistical Institute discussed migration statistics at its congresses of Vienna (1891), Budapest (1901) and Berlin (1903) … In spite of these efforts, much remains to be done in the improvement of migration statistics.

The main problems with migration statistics are epistemic, as they relate to imperfect knowledge about the world. These problems are linked to differences in the underlying concepts and definitions, accuracy of the measurement tools, and inability to capture some groups of people (undercount). As countries may use different data collection techniques (e.g. population registers or surveys) of varying quality, the quality of the resulting data may also vary. All these issues lead to lack of comparability in statistics between countries and the need to harmonize estimates.

With respect to definitions, the practice differs across countries. Most countries now use the UN 12-month duration-of-stay definition for long-term migration (UN 1998: 10):[1]

> A long-term migrant is a person who moves to a country other than that of his or her usual residence for a period of at least a year (12 months), so that the country of destination effectively becomes his or her new country of usual residence.

This definition is also echoed in European legislation, crucially in Regulation 862/2007 on migration and asylum statistics (European Council 2007), which requires harmonization of definitions across the European Union (EU). Despite all the efforts towards harmonization, adoption of the same definitions has not been universal (especially before Regulation 862/2007 came into force), with some countries using different durations or definitions of migration, migrants and populations (Poulain et al. 2006).

The challenge is to harmonize different measurements of migration to obtain coherent estimates of migration flows for a migration system such as Europe's (Willekens 1994). Importantly, Regulation 862/2007 allows the use of statistical models to achieve this aim by explicitly stipulating that 'as part of the [migration and asylum] statistics process, scientifically based and well documented statistical estimation methods may be used' (Article 9).

In parallel, a clear thread of research has also set out to achieve greater harmonization of migration statistics. In Europe, the THESIM project (Towards Harmonised European Statistics on International Migration) set the scene by taking critical stock of the various data collection practices across the EU (Poulain et al. 2006). This was followed by the MIMOSA project (MIgration MOdelling for Statistical Analyses), funded by Eurostat, which produced a pioneering set of adjusted estimates for migration flows (de Beer et al. 2010) and stocks (Bijak and Kupiszewska 2008), even though the methods used were largely mechanistic and did not provide measures of estimation uncertainty.

These efforts culminated in the IMEM project (Integrated Modelling of European Migration), which used all possible data from origin and

[1] At the time of writing, the UN recommendations are being revised: for the current state of affairs, see https://unstats.un.org/unsd/demographic-social/sconcerns/migration/ (accessed 5 December 2023).

destination countries to reconstruct a full matrix (table) of origin–destination-specific migration flows within Europe for 2002–8 (Raymer et al. 2013). This work was later extended to include a breakdown of the estimates by sex and five-year age group (Wiśniowski et al. 2016). The IMEM model, summarized in Section 5.2, forms a basis for the estimates we developed for 2009–19. The transition between the IMEM estimates and their IMEM–QuantMig update coincides with Regulation 862/2007 coming into force and changes to data availability across Europe. We discuss this transition further in Sections 5.3 and 5.4.

In addition to being used for a full origin–destination migration flow matrix, the IMEM framework has also been used for other regions, such as South America (Aparicio Castro et al. 2023), for a single country, such as the United Kingdom (UK), for combining different data sources (e.g. censuses, surveys and administrative data; Disney 2015) and for combining data on social media users with traditional survey data (Rampazzo et al. 2021). The IMEM estimates as such were also successfully used in conjunction with labour force surveys to fine-tune the estimates for a single specific flow, between Poland and the UK (Wiśniowski 2017).

In parallel, at the global scale, there have been many other efforts to harmonize estimates of migration flows in the near-complete absence of traditional sources such as registers or surveys. Some pioneering work involved combining or adjusting different sources of big data: for example, digital footprints from mobile telephony (Lai et al. 2019). Another very fruitful line of work looked at using migrant stock data to estimate flows, producing estimates typically for five-year periods (Abel and Sander 2014; Abel and Cohen 2019; Azose and Raftery 2019).

5.2 METHODOLOGY: THE IMEM–QUANTMIG MODEL

Our ambition was to produce coherent tables of migration flow estimates between the 32 EU+ countries (EU plus the UK, Croatia and the European Free Trade Association countries) and to and from eight rest-of-the-world regions,[2] for 2009–19. To do so, we modified and

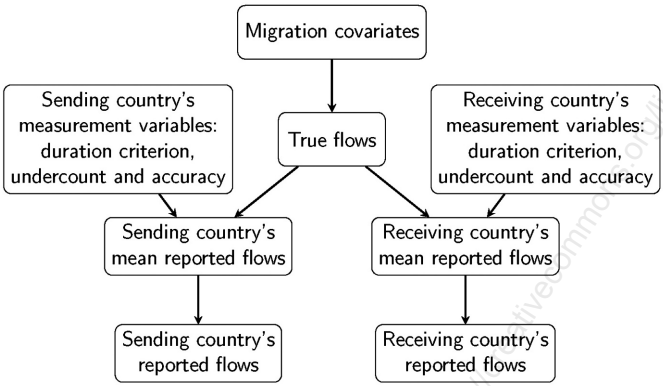
[2] These regions were: East Asia (including e.g. China), Latin America, North Africa, North America and Oceania, Other Europe (i.e. European countries not included in the EU aggregate), South-Southeast Asia (including e.g. India), Sub-Saharan Africa and West Asia.

updated the IMEM approach (Raymer et al. 2013). The approach is based on migration flow measures gathered in so-called *double-entry matrices*, where each table cell contains two numbers describing one migration flow (e.g. from Spain to Italy). For each cell, the flow can be reported by the origin and destination country, but the numbers will typically not agree. Some countries (e.g. Slovakia) report flows to Eurostat only partially, and some (e.g. Germany, Poland) do not report any flows at all.

Estimation requires a method: first, to harmonize the definitions; second, to correct for inadequacies in the available data; and third, to estimate the missing flows. We estimate the *true flows*, corresponding to the UN (1998) definition based on the 12-month residence criterion, as reflected in the EU legislation (Regulation 862/2007). The IMEM model provides a general framework for describing migration flows between countries with inconsistent, inadequate and missing data. In the IMEM–QuantMig model, we apply this framework, slightly modified, to data for 2009–19. Our model uses publicly available data from the Eurostat database and qualitative expert knowledge from an expert survey and assessment of data. Its design has, therefore, two key aspects: development of a statistical model and elicitation of relevant expert information (as discussed in Section 5.3).

Migration estimates need to reflect their epistemic uncertainty. The Bayesian statistical approach (e.g. Gelman et al. 2013) offers a natural, flexible and probabilistic framework to integrate all the sources of uncertainty: variability in data, uncertainty in model parameters, some uncertainty in model choice, and expert judgements. Our model is hierarchical, which means that there are two interconnected levels of analysis. At the top level, we handle the data availability problems by using a *migration model*, with a range of explanatory variables. At the bottom level, we handle the data quality problems (with definitions, undercount and accuracy) by using a *measurement model*. A graphical representation of the origin–destination model is shown in Figure 5.1.

We assume that the true unobserved flows follow a migration model, relating the flow to other variables, such as population sizes, gross national income ratios, trade flows or migrant numbers in the destination countries. We also use several indicators, such as membership of the EU or the Schengen area, access to labour market, colonial links or presence of a common border. We assume that the flows observed by origin and destination countries are perturbed versions of the true flows, owing to different duration criteria used, extent of undercount and accuracy of data collection. We define *undercount* as measurement error (bias) caused by



Source: Aristotelous et al. (2022: 7, Figure 1), adapted from Raymer et al. (2013).

Figure 5.1 Schematic graphical representation of the key components of the IMEM model

some migrants not being recorded in the data, which results in reported flows covering only a part of true flows, and the official numbers are therefore too low. *Accuracy* is related to the purely random errors in the reported flows, including administrative and clerical errors for population registers or random sampling errors for surveys.

For flows between EU+ countries and the rest of the world regions, we use a slightly modified measurement model, given that at most only one direction of flow is reported for such flows. These flows are more accurately measured than within-EU+ migration, which occurs largely under the freedom of movement framework. Within the EU, some migrants may have less incentive to formally register and deregister than non-EU nationals, who require visas and resident permits to legally migrate to an EU+ country.

The estimates are distributed by age, sex and region of birth using the methods developed by Wiśniowski et al. (2016). The full methodology, including all model equations and individual data sources, is presented in more detail in Aristotelous et al. (2022).

5.3 EXPERT OPINION AND QUALITY ASSESSMENT OF EUROPEAN MIGRATION DATA

To inform the model parameters that cannot be identified from the data, we sought the views of 15 experts on migration measurement using a dedicated two-round Delphi survey. The survey focused on two questions (Keilman and Aristotelous 2021): first, how did the experts rate the *undercount* of immigration and emigration flows in official international migration statistics reported by national statistical agencies in Europe? Second, how did they rate the *accuracy* of migration data? The second round additionally included anonymized feedback from the first round given to all participants.

Within the survey, the experts were asked to express their views as a range and a *confidence level*. The range reflected the excess of undercount across the EU+ countries, expressed as a percentage of the true flow. The value of 0 per cent implied no undercount, while 100 per cent meant that the data source had not captured any of the actual moves. The experts were also asked how confident (certain) they were that their range was true. For accuracy, the experts were also asked for a range and the associated level of confidence. This time, they were asked for their subjective probability that due to random errors only, migration flows reported in the data fell within ±5 per cent of the true flows. Methodological details are reported in Keilman and Aristotelous (2021).

The results were largely as expected, with high uncertainty ranges overall, wider for countries with high rather than low migration undercount and wider for emigration than for immigration. For accuracy, the countries were categorized into two groups: those using migration surveys (Cyprus, Ireland, Portugal, UK) and those using population or migration registers (remaining countries, except France, Greece and Liechtenstein). Random errors may occur in either system, but surveys bear an additional source of error: random sampling. As expected, experts identified narrower accuracy ranges for register countries than survey countries, especially for immigration.

The measurement model requires the flows data to be classified with regard to definition, undercount and accuracy. Information concerning definition and accuracy was compiled from publicly available sources of information and meta-information about flow data. We applied a common quality assessment framework and confirmed that all

Table 5.1 Summary of data quality categories for migration statistics, 2009–19

Country	Accuracy	Duration	Undercount
Austria	good	12-month	low
Belgium	good	12-month	excellent
Bulgaria	low	12-month	high
Croatia	low	12-month	high
Cyprus	–	–	–
Czechia	–	–	–
Denmark	excellent	12-month	excellent
Estonia	low	12-month	low
Finland	excellent	12-month	low
France	good	12-month	low
Germany	–	–	–
Greece	–	–	–
Hungary	–	–	–
Iceland	excellent	12-month	low
Ireland	low	12-month	low
Italy	good	12-month	high
Latvia	low	12-month	high
Liechtenstein	good	12-month	low
Lithuania	good	12-month	low
Luxembourg	–	–	–
Malta	–	–	–
Netherlands	excellent	12-month	excellent
Norway	excellent	12-month	low
Poland*	low	12-month	high
Portugal	–	–	–
Romania	low	12-month	high
Slovakia	low	permanent†	high
Slovenia	good	12-month	low
Spain	good	12-month	low
Sweden	excellent	12-month	low
Switzerland	excellent	12-month	excellent
United Kingdom	low	12-month	low

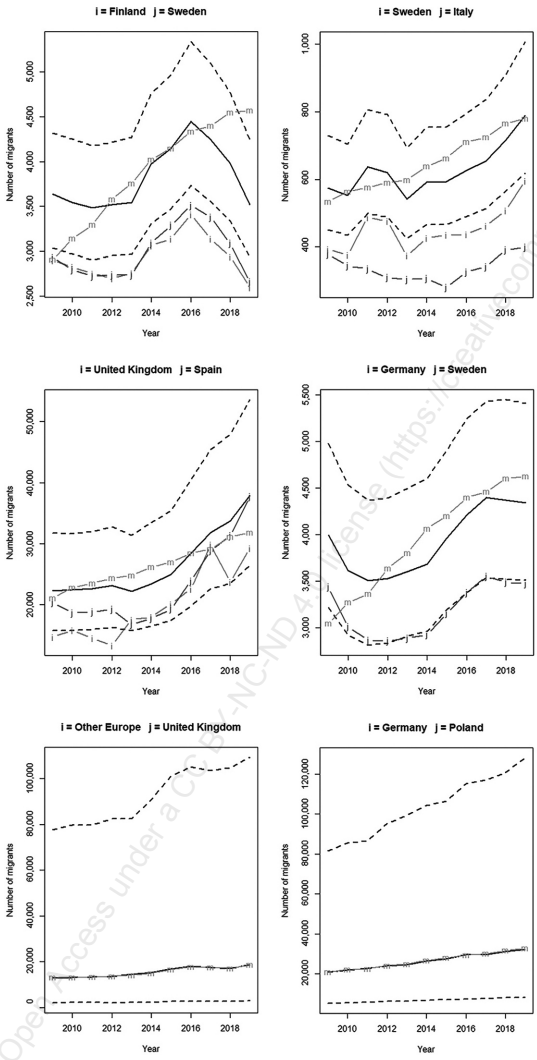
Notes: Accuracy: excellent = excellent registers, good = other good registers, low = less reliable registers or surveys; Undercount: excellent = none to very low undercount, low = low undercount, high = high undercount. Dashes (–) correspond to countries that do not report any flow data. *For Poland, the parameters ended up unused, due to the lack of flow data reported to Eurostat. †Slovakia was the only EU country in practice using the definition of migration for permanent residence in 2009–19.
Source: Reproduced from Aristotelous et al. (2022: 9, Table 2), based on Mooyaart et al. (2021), originally following metadata from Eurostat and other public sources; see reports for details.

countries except Slovakia followed the 12-month definition in 2009–19 (Mooyaart et al. 2021). We then classified countries into four groups according to data accuracy: excellent registers, other good registers, less reliable registers and surveys. We also classified countries as having excellent (i.e. minimal), low or high undercount of migration data, based on a comparison of the doubly reported flows (Aristotelous et al. 2022; Section 3.3.2). The results of the Delphi study informed constraints placed on the undercount parameters to acknowledge that immigration flows are reported with lower undercount than emigration flows. The final country groupings used in parameterizing the measurement model are shown in Table 5.1.

Our results confirm that expert-based information on data quality is subject to considerable uncertainty, although it can still offer some useful insights, especially on undercount. The expert knowledge can be formally reflected in the model as *prior information* – one key feature of the Bayesian approach to modelling – and improve the estimates, not least by providing more realistic error distributions. Still, expert judgement alone is not sufficient and needs to be triangulated with other sources of information, both about the data collection in a given country and about data from the origin or destination countries. When analysing information on data quality, we also discovered interesting trade-offs related to the implementation of Regulation 862/2007. Although data comparability across Europe has improved, this was at the expense of availability and completeness, with data for Germany, Poland and a few other countries largely not reported to Eurostat since 2009.

5.4 HARMONIZED ESTIMATES: RESULTS AND DATA GAPS

We now present several examples of the estimates for selected flows. In Figure 5.2, we present the flows reported by the origin country and the destination country, where available, alongside those predicted by the migration model. Finally, we show the posterior medians and upper and lower boundaries of the 95 per cent predictive intervals from our Bayesian hierarchical model. From the examples in Figure 5.2, it is clear that our estimated true flows are determined by weighted contributions from: (1) the data reported by the origin country, corrected by using the measurement model; (2) the data reported by the destination country, also corrected by using the measurement model; and (3) the migration



Note: The figures show median estimates (solid lines —), 95 per cent predictive intervals (dashed lines - -), data reported by the origin (–**i**–) and destination (–**j**–) countries, and medians from the migration model (–**m**–).
Source: Aristotelous et al. (2023).

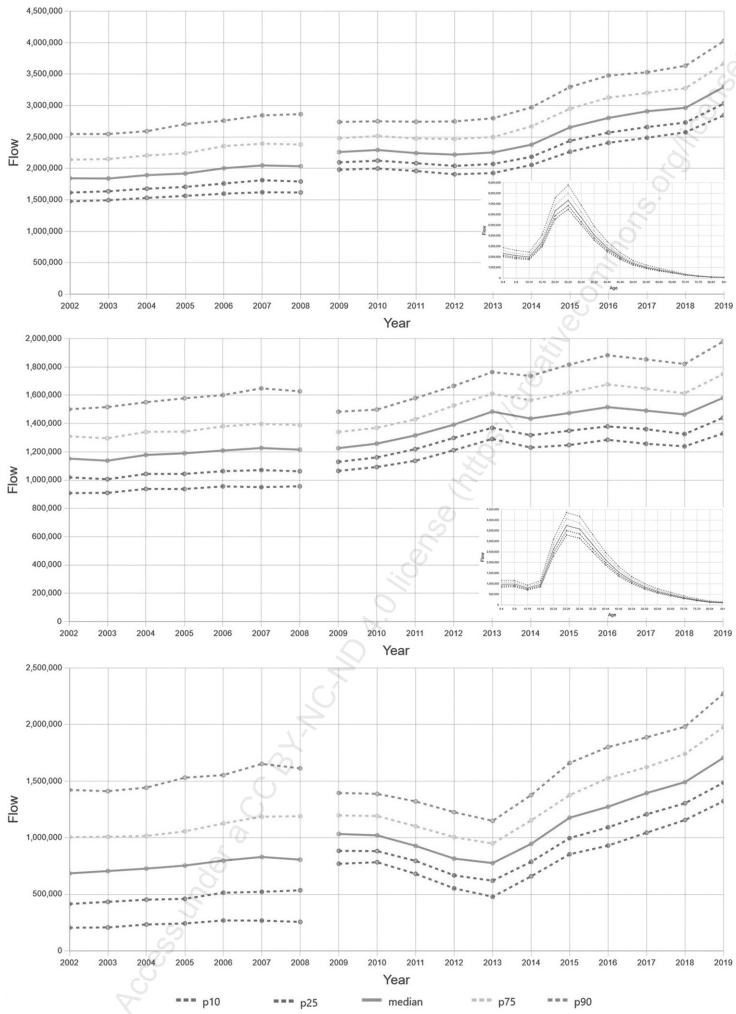
Figure 5.2 Selected migration flow estimates, 2009–19

model. In general, the weights of these components are related to their corresponding accuracy (precision) parameters.

In Figure 5.2, we show a few typical results. Estimates of migration between Nordic countries (Finland to Sweden) are well aligned to start with, thanks to data exchange (Brun et al. 2021), so the only remaining problem is correcting for undercount. With two registers of different quality (Sweden to Italy), the one deemed better (Swedish) will drive the estimates, and, similarly, when survey data are combined with a register (UK to Spain), the latter will have greater weight. When only one source of data is available (Germany to Sweden), or by default for migration into or out of the EU+ system (Other Europe to Italy), whatever data are available will drive the estimates. Only when no data are available (Germany to Poland) are the estimates produced solely by the migration model.

In Figure 5.3, we present the aggregated time series of flow estimates for all 32 EU+ countries for 2009–19, supplemented by the original IMEM estimates for 2002–08 (Raymer et al. 2013). We show immigration, emigration and net migration estimates, and we also present sketches of the estimated age structures of immigration and emigration. For each indicator, we present median estimates and 50 and 80 per cent error bounds. The estimates indicate increasing migration both into and out of Europe. While there is a visible discontinuity between the original IMEM and the IMEM–QuantMig estimates in 2008–9, driven by changes in methodology, data availability and comparability, the overall uncertainty across the EU+ system seems to have decreased following the implementation of Regulation 862/2007. At the same time, this aggregate-level discontinuity is stronger in the uncertainty around the estimates than for the central (median) values, particularly the median emigration flow.

Even though the harmonized migration estimates can contain large errors, their uncertainty is largely epistemic and, therefore, potentially reducible. To address that, harmonization of data collection, especially across the EU, requires particular attention. At the European level, this suggests further potential for combining information from different data sources and exchanging information between statistical systems, as already happens in the Nordic countries (Brun et al. 2021). At the same time, our analysis spotlights critical data gaps in Eurostat migration collections; these gaps need closing to improve data quality further. Most notably, these gaps involve Germany and Poland: two large European countries at the heart of the European migration system.



Note: Insets show age profiles. Legislation, methodology and data availability changed in 2009.
Source: QuantMig Migration Estimates Explorer, bit.ly/quantmig-estimates (Aristotelous et al. 2023).

Figure 5.3 Estimated immigration, emigration and net migration for the EU+ countries in 2002–19

The estimates were obtained by using a Bayesian hierarchical IMEM–QuantMig model, providing a natural way of integrating different sources of information and meta-information, including expert opinion and data quality assessment. Our model additionally allowed us to combine measurement and structural aspects with coherent measures of uncertainty of the resulting estimates. The modelling framework is very flexible, highlighting the potential to use multiple sources of data in a single approach. The results also strengthen the case for using model-based approaches more broadly for estimating migration, including in official statistics (Willekens 1994).[3] Our estimates are available from the QuantMig Migration Estimates Explorer at bit.ly/quantmig-estimates. These estimates subsequently serve as a basis for setting up migration scenarios, as set out in Part IV.

[3] At the time of writing, efforts have been made to establish a model-based Human Migration Database (HMigD), largely based on IMEM-type models or their ensembles, with a prototype available at https://maciej-jan-danko.shinyapps.io/HMigD_Shiny_App_I/ (Dańko 2024), and the most recent version of the HMigD (3.1.1) already incorporates the IMEM–QuantMig estimates for 2002–19 by origin and destination, including those presented in this chapter.

PART III

Adapting to aleatory uncertainty: scanning the future with scenarios

6. Ways of dealing with uncertainty in migration scenarios

Emily Barker and Jakub Bijak

6.1 MIGRATION UNCERTAINTY ACROSS TIME HORIZONS

Different migration futures can be explored in a variety of ways, and several reviews of the possible options are available in the literature (see e.g. Bijak 2010; de Valk et al. 2022). Even when we focus purely on quantitative methods, designed to give numerical answers to questions related to migration scenarios, there are many methods, tools and approaches to choose from. As suggested in Chapter 2, the main factors in choosing a method are the purpose and horizon of the analysis (see also Bijak et al. 2019). So far, most existing methods have been designed either to look at migration changes in the short to medium term (e.g. the well-established time-series methods) or very short term (focusing on early warning models, recently increasing in prominence), with long-range developments lagging behind.

The horizon of the analysis determines the way in which analytical approaches allow future uncertainty to be dealt with. Here we assume that the serious methods are not just simple deterministic extrapolations, tacitly pretending that uncertainty does not apply or at least is of no interest. For such serious migration scenarios, we can attempt a simple taxonomy of the main ways of dealing with uncertainty, along three dimensions. First, the uncertainty can be generated by the statistical model (*model-based*) or assessed by experts (*expert-based*). Second, the description can be *probabilistic*, formally using the concept of probability to assess uncertainty, or *descriptive,* providing scenarios with notional labels, such as 'high' or 'low' migration. Finally, the uncertainty itself can be described either with a *continuous* (uncountable) range of possibilities or through a *discrete* (countable and typically small) choice

between a number of predefined options (for a fuller discussion of probabilistic approaches in the communication of uncertainty, see Raftery 2016).

The main challenge of uncertainty assessment is, of course, the aleatory realm, especially crucial for long-range horizons (see Figure 2.1). Although probability is an obvious metric for describing and communicating uncertainty (Raftery 2016), the challenge here is that when moving further into the future, even probabilistic description of uncertainty becomes less reliable. The reason is that in the long run we become less and less certain that the underlying statistical model is valid, and the spectrum of possible futures becomes so wide that any prediction interval would be non-informative. The distinction between processes that are predictable to different degrees also implies the need for applying different tools and for having different expectations, among both scenario producers and users, regarding any statements made about the future. Throughout this chapter, we briefly present and evaluate several possible methods for describing scenario uncertainty across a range of time horizons and offer interpretations of the uncertainty assessments these methods produce.

6.2 SHORT-TERM APPLICATIONS: EARLY WARNINGS, FORECASTS AND IMPULSE RESPONSES

For anticipating migration, one fundamental question is: Where can information about future migration come from? In the short term, we have some knowledge on: (1) past trends; (2) current estimates; and possibly (3) some *leading indicators* of migration change. Such indicators are capable of signalling, ideally in advance, whether any changes to migration trends may be upcoming. Examples of such indicators (and therefore the data used) include different macroeconomic, labour market, or geopolitical variables. Conceptually, these indicators are a simplified reflection of the complex driver environments, distilled into a few variables that may offer us insights into processes that have just started or are about to start. These three sources of past and current information give us at least some hope of gaining insights into the current and soon-to-become current migration situation.

The idea of using carefully selected leading indicators to signal possible changes to trends comes from macroeconomics, where it has been used – with mixed success – in *early warning systems* in central banking

and finance (see e.g. Edison 2003 for a critical review, carried out before the global financial crisis; Filippopoulou 2020 for a recent example). The approach has recently been adopted for migration studies: Carammia et al. (2022) used data from a range of innovative sources, and Napierała et al. (2022) employed statistical trend change-point detection models for that purpose. These studies focused specifically on asylum migration, given its high volatility but also its political salience. In essence, early warning methodology aims to strike the right balance in models between giving false alarms of upcoming changes (false positives) and failing to give warnings of real changes (false negatives). These approaches typically use as much data at as high frequency as is practicable, and their predictive horizons are limited to a few months at most.

The process of searching for the best model, among many possibilities and with many variables, can be automated, for example by using the so-called *Lasso* procedure[1] (Tibshirani 1996). In Figure 6.1 we show selected early warning results for two of the most momentous asylum migration flows into Europe in the last decade: resulting from the civil war in Syria throughout the 2010s and the Russian invasion of Ukraine in 2022 (Barker and Bijak 2022). In the spirit of Carammia et al. (2022), who prepared four-week-ahead 'nowcasts', we estimated the probability of a significant change in migration trends or levels for up to six months in advance. The most successful models were based on a mixture of traditional and novel data and were able to pick up some signal – if still uncertain – of imminent change up to three or even six months in advance. The traditional data here included trade and exchange rate statistics, supplemented by Internet searches from Google Trends and media monitoring indicators from the GDELT database.[2]

How do early warning models work? Figure 6.1 shows the numbers of asylum applications from Syria and Ukraine lodged in Europe, with the monthly probabilities of *significant events* estimated by early warning models with a mix of current and three-months-ahead leading indicators. The significant event in this case refers to each month in which the number

[1] In full, 'Least absolute shrinkage and selection operator'. In essence, the process aims to limit the number of variables in a model, while retaining their high information content and ensuring good predictive performance.

[2] The Global Database of Events, Language and Tone, containing web-scraped information about global events and how they are being reported, https://www.gdeltproject.org (accessed 15 December 2023).

of asylum applications: (1) grew by over a quarter month-on-month; (2) grew by more than a half year-on-year; and (3) exceeded the mean value plus two standard deviations from the preceding 12 months. The models trigger a warning every time the estimated probability exceeds a given threshold, in this example arbitrarily set at 0.75.

On the graph shown in Figure 6.1, we indicate the months that were correctly and incorrectly identified as significant events in terms of asylum applications, and also months where the models failed to give adequate warnings. The presented results are just examples. In general, our early warnings proved sensitive to the exact specification of the models and variables used and to definitions of significant events, whether we focused on numbers of asylum seekers or their dynamics.

As a side note, this book has been written during continued heightened geopolitical tensions in Europe caused by the Russian invasion of Ukraine in 2022. The proposed methods for enhancing preparedness, especially in the areas of civil defence, as well as asylum, temporary protection, or equivalent procedures, could potentially apply to any large flows *within* Europe that might be caused by a spillover of the conflict into the EU. While hoping for the best, we need to dare to think the unthinkable, so that if it happens, we are prepared, with warnings, legal framework, processes and procedures in place.

For longer horizons, time-series forecasting methodology is now well established and widely used, including for migration (see Bijak 2010; Bijak et al. 2019 for overviews). Time-series models can be either *univariate*, looking only at migration, or *multivariate*, with migration modelled and predicted alongside other variables depicting its drivers. There are some important trade-offs here: univariate models approximate only the complex processes they describe, tacitly assuming that all information about future migration is already included in past trends. Multivariate models need to cumulate uncertainty, not only in migration but also in its drivers and their interactions. This often leads to very high and exponentially increasing uncertainty: migration predictors also need predicting.

However, multivariate models can also help build scenarios by enabling the construction of *impulse-response functions*. These functions depict how different variables described jointly within a model (*endogenous* variables) would change in response to a 'shock' increase or decrease in one of the other variables. In this way, the impulse-response functions enable what-if scenario analysis in the short term, provided that the uncertainty of the model's predictions is not too overpowering. Figure

Notes: Syria – eight true alarms, four false alarms, 21 undetected, out of 144. Accuracy (correct/total) = 83 per cent. Ukraine – eight true alarms, seven false alarms, nine undetected, out of 147. Accuracy (correct/total) = 89 per cent.
Source: Own elaboration based on Barker and Bijak (2022: 48, 60); asylum data from Eurostat.

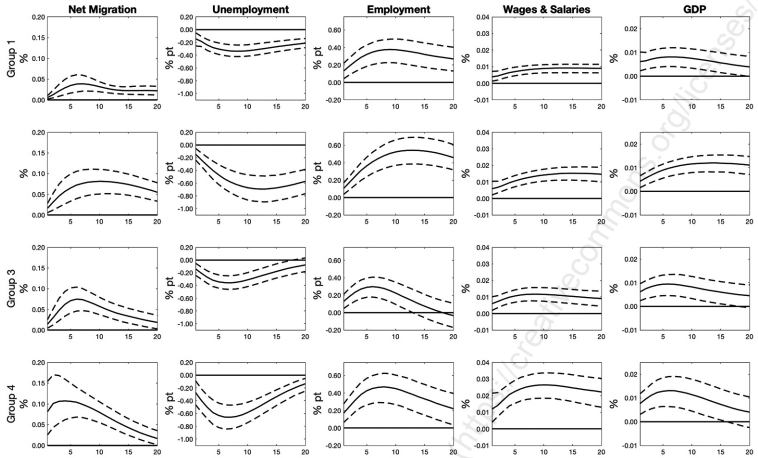
Figure 6.1 *Examples of early warning models for Syria, 2010–21, and Ukraine, 2010 to March 2022: numbers of asylum applications lodged in Europe and estimated probability of significant events*

6.2 shows such impulse responses for selected labour market variables for four groups of countries: two Western European (1: high migration, 2: moderate migration) and two Central and Eastern European (3: positive, and 4: negative net migration in the 2010s). The responses for Groups 1, 2 and 3 are to high **net immigration events**. Group 4, comprised of countries with negative net emigration in the 2010s, is subject to a **net emigration event**. For the ease of interpretation, the responses shown in Figure 6.2 for Group 4 are inverted. We assume that all events occur in the first quarter of the analysis. In Barker and Bijak (2021), we showed similar models for the economy as a whole, for a selection of classical migration drivers, and for the impacts of migration on the fiscal budget.

Time-series-based predictions can work best over short horizons of up to a few years (e.g. Bijak and Wiśniowski 2010), with high errors beyond that. Still, for time-series models we can at least describe the forecast uncertainty by using probabilities, as long as they are well calibrated. This means that the *nominal* probabilities corresponding to various error intervals (e.g. 50, 67 or 95 per cent) broadly match the *observed* frequencies of errors, comparing available data with forecasts. In other words, we would like a 50 per cent interval to contain true values half the time, etc.

There are successful examples of well-calibrated time-series models used for long-range analysis (e.g. Azose and Raftery 2015, for almost a century). However, given the horizons, the outputs of such models are probably better seen as stochastic scenarios (or *projections*, using official statistics terminology), rather than forecasts. Such models are typically based on coarse data (e.g. every five years) and assume long-term stationarity (stability) of migration trends. This reflects an assumption – and a philosophical position – that although migration can fluctuate widely in the short to medium term, long-range trends may be more stable (see van Wissen 2012). To verify that, however, models should be estimated based on sufficiently long data series, and their users need to know that the probabilistic uncertainty assessment is only approximate.

Overall, for short and very short horizons, we can therefore try to reduce – or at least describe – the epistemic uncertainty of future migration through an appropriate choice of methods and data. At the same time, our results confirm earlier insights as to the weak predictability of migration flows, with plausible horizons being either now or at most a few months ahead for early warning models, and a few years for time-series-based forecasts (Bijak and Wiśniowski 2010). Given the extent of the challenge, our early warning models for asylum migration from Syria and Ukraine did not perform too poorly, especially when they



Note: The high-impact events are of the magnitude of one standard deviation increase in the absolute value of net migration. Impulse-response functions (solid lines) are shown for four groups of countries: two Western European (1: high migration, 2: moderate migration) and two Central and Eastern European (3: positive and 4: negative net migration in the 2010s), together with their 67-per cent error intervals (dashed lines). The vertical axis shows percentage deviations from the expected trend (percentage points for unemployment and employment). Time is in quarters after the high-impact event, up to five years (20 quarters). For Group 4, responses are inverted to aid visual comparison.
Source: Barker and Bijak (2021: 24).

Figure 6.2 Estimated responses of selected labour market variables to high-impact migration events for selected groups of European countries

included both traditional and less traditional data. The models proved to be very sensitive to the way in which the response variables and models themselves were constructed and also to the warning threshold level. In addition, for these two countries, we knew where to look for signals, so in practical application, such an analysis would need to be preceded by a horizon-scanning exercise, based on qualitative field knowledge and various kinds of intelligence, simply to know in which parts of the world there may be crises leading to large and rapid changes in migration flows.

6.3 LONG-TERM SCENARIOS: THEORETICAL MODELS AND RARE EVENT APPROXIMATIONS

Over longer horizons, beyond a decade or so ahead, we move firmly into the territory of aleatory uncertainty, where probabilistic description of possible migration trajectories is unlikely to work accurately. The uncertainty is either going to be very high, too high to be useful, or too dependent on the specification of a given statistical model, which in the longer term is also likely to be incorrect. What we can do instead is try to build illustrative migration scenarios that will still have some probabilistic interpretations. In addition to the time-series-based scenarios mentioned in the previous section, here we propose two such approaches. The first possibility is based on theoretical models, and the second on approximate modelling of the frequencies of rare migration events.

As the first possibility, building **complex theoretical models for longer-term scenarios** can have important advantages. Such models can formally describe theoretically grounded, internally coherent scenarios (Burch 2018). One particular advantage of such models is that they can, in principle, combine micro-level foundations concerning individual *agents* (people, firms, institutions) and their behaviour with macro-level processes. This is particularly important for policy-oriented scenarios, as modelling responses to policies requires explicit acknowledgement of individual-level decisions. Without such micro-foundations, models could self-invalidate, as agents would change their behaviour in anticipation of policy changes and the scenarios that underpin them (e.g. Lucas 1976).

Different models can serve the purpose of setting and testing coherent migration scenarios. One possibility, with roots in computer and complexity science, is offered by *agent-based models*: micro-level computer simulations of individual agents and their behaviour, based on a set of decision and action rules. The outcomes of such models can be calibrated to macro-level data for some of the observed patterns, to offer a more realistic picture of the migration processes. A detailed discussion, including suggestions for using agent-based models for policy support and advice through building what-if scenarios and analysing them with statistical methods, can be found in Bijak et al. (2021b), with models focused on migration route formation and dynamics.

Another strand of complex theoretical modelling comes from macroeconomics, where so-called *dynamic stochastic general equilibrium* (DSGE) or similar models also enable creation of coherent scenarios for migration and the economy. DSGE models combine theoretical insights with microeconomic foundations related to the behaviour of people and firms. Such models are typically complex, data-intensive and resource-consuming to set up and calibrate to data, with tens or hundreds of equations describing the choices of individuals, households, firms and governments in different areas of the economy.

If DSGE models explicitly include migration, we can examine both the effects of rapid changes to migration on the rest of the economy and of changes to other economic parameters on migration. In particular, we can analyse responses of the whole system to uncertain events, manifesting as rapid changes (high-impact events or ‘shocks’) in various parameters. As with time-series models, the analysis can use impulse-response functions, which in this case offer a quantifiable way of setting *theoretical* what-if scenarios and analysing responses to unforeseen ‘shock’ events in more detail. In the end, such an analysis – stress-testing, common in central banking, finance and macroeconomic regulation – offers the appealing possibility of examining how robust are migration and economic systems to unpredictable events that may happen in the future.

Given the complexity of agent-based or DSGE models, it is tempting to consider alternative methods. Hence, the second (very approximate) possibility is related to the **frequencies of migration events**, inspired by the statistical theory of extreme events (Coles 2001) and by applications in planning for various civil contingencies (e.g. earthquakes and floods). Obviously, this does not in the slightest way equate migration to natural disasters but, rather, indicates that it is a process that can change very rapidly and, as such, requires appropriate preparedness: plans, procedures and resources, just in case. In essence, this approach involves looking at relative frequencies (e.g. once-in-a-decade or twice-in-a-century) and magnitudes of various rare migration events (Bijak 2023). These can be estimated – again, very roughly – by fitting *heavy-tailed* probability distributions (which do not decline too rapidly to zero) to observed data, and using their selected percentiles for setting the scenarios (Raftery 2016). This is a simple solution that can help reduce the cognitive load of users,

Table 6.1 *Estimated magnitude of rare (once-in-a-decade and twice-in-a-century) migration events: migration into Europe from eight regions of the world*

Immigration from	Annual average during 2009–19	Estimated once-in-a-decade	Estimated twice-in-a-century
East Asia	192,500	291,000	434,900
Latin America	392,000	639,100	1,118,800
North Africa	194,200	322,700	516,800
North America and Oceania	247,100	364,200	558,700
Other Europe	438,700	790,800	1,318,800
South–Southeast Asia	414,900	645,600	973,300
Sub-Saharan Africa	320,200	550,000	937,000
West Asia	208,400	507,600	1,173,800
Total	2,408,000	4,111,000	7,032,100

Source: Bijak (2023: 12, Table 2, rounded to the nearest 100).

while retaining the general statistical and probabilistic interpretation (ibid.).[3]

In Table 6.1 we show selected examples of estimates of such rare events for immigration from eight regions of the world to the EU+. These estimates are based on modelled migration flows for 2009–19, as discussed in Chapter 5, and use the Pareto distribution as best fitting from the different statistical models we tested. Immigration has been chosen for illustration, given its high policy focus in Europe, but the method is easily transferable to other contexts and flows (Bijak 2023).

In summary, despite there being no magic solution for wishing away long-term aleatory uncertainty, even for long-range scenarios we have some options for formal, quantifiable assessment of future migration uncertainty. As one possibility, we could use complex theoretical models,

[3] This interpretation can be formally framed in the language of the *statistical decision theory* (e.g. Berger 1980), whereby the probabilities of different events can be combined with *loss functions*, indicating the relative costs of overestimation (overprediction) and underestimation (underprediction) of the quantities of interest, such as current of future migration flows. Percentiles from probability distributions are solutions of decision problems when the loss functions are linear. For migration-related examples, see Bijak (2010), and a general discussion is also offered in Raftery (2016).

such as those relying on the macroeconomic DSGE or agent-based frameworks. Such models can produce internally coherent scenarios and what-if insights regarding the impact of unforeseen events on migration and other variables of interest. Still, these models need to be calibrated and tailored to specific situations, and their construction can be very resource-consuming and data-demanding (see discussion in Bijak et al. 2021b). As a simple alternative, inspired by civil contingency planning, we suggest using the analysis of rare events to produce approximate ranges of plausible futures for different event frequencies. Such ranges can then be used directly in the creation of alternative scenarios, as presented in Chapter 7.

6.4 LIMITS OF KNOWLEDGE: PRACTICAL LESSONS FOR MIGRATION SCENARIOS

There are a few lessons for setting and interpreting migration scenarios. First, the variables we focus on matter. For early warnings, the models are very sensitive to the definition of critical events and can give different results, depending on whether we concentrate on volumes or magnitude of change, a decision which is in turn contingent on the policy objectives. We need to know where to look for signals, which is why it is useful to precede early warning efforts with a horizon-scanning exercise, based on other intelligence. For early warning models, a diverse mix of data has the highest potential to detect changes in trends, in advance or as they begin to happen. Echoing earlier findings, time-series models are most useful over horizons of a few years ahead, and even then they depend on stability (stationarity) of trends. Longer-term scenarios are inevitably approximate: our suggestion to use an approach based on frequencies of rare events is a pragmatic, low-cost solution aiming to bypass the complexity of intermeshed and highly uncertain migration driver environments.

Alternatively, over longer horizons, scenarios can be built from theory-based models (e.g. DSGE, agent-based, or similar). The aim here is not so much prediction, but rather exploration of responses of the whole systems of variables interacting at different levels. Inspirations from central banking and finance allow cautious optimism about the potential to use such models for stress-testing the system and policy responses to migration events of different magnitudes. For long-range scenarios, combining model-based and expert-based insights can offer further added value, as long as the information contained in the data and

provided by the experts is complementary rather than repetitive. Where possible, migration scenario-setting should focus on individual flows for whole interrelated multi-country systems, such as Europe's. We provide examples of scenarios of unforeseen events and their implications in the next chapter.

The key message of our analysis is: in migration scenarios, wherever possible, epistemic uncertainty should be reduced or statistically described, while aleatory uncertainty needs at least approximating, especially over longer horizons. As stated by British philosopher Carveth Read at the end of the 19th century, 'it is better to be vaguely right than exactly wrong'.[4] This statement has several practical implications. In the short term, a precise description of uncertainty can help with planning and formal decision support (Bijak 2010). In the longer term, even approximate solutions provide a workable framework for stress-testing policy solutions and for contingency planning aimed at improving preparedness. An open question – a political one, that can be answered only by decision makers – is how much uncertainty can be tolerated in the system vis-à-vis how much can be committed to ensure preparedness in terms of resources, especially money and time. An example of a long-term scenario analysis using the rare events framework to test the population and labour force implications of migration flows of varying magnitudes is offered in the next chapter.

[4] Often misattributed to John Maynard Keynes; see Ratcliffe, S. (ed.) (2018) *Oxford Essential Quotations* (sixth edition). OUP. www.oxfordreference.com/display/10.1093/acref/9780191866692.001.0001/q-oro-ed6-00016758.

7. Setting scenarios: combining numbers and stories

Michaela Potančoková, Helga de Valk, Rafael Costa, Michaël Boissonneault and Jakub Bijak

7.1 QUANTITATIVE VERSUS QUALITATIVE SCENARIOS

Many attempts to create future migration scenarios have already been made, especially in the European context and with a spotlight on immigration (see e.g. Lutz et al. 2019; Acostamadiedo et al. 2020; Sohst et al. 2020). In a recent systematic review, we examined 107 migration scenario studies, nearly half of which focused on Europe (Boissonneault et al. 2020). The literature included in the review covered both *quantitative* studies (44), with migration flows described in terms of possible trajectories of future numbers, and *qualitative* studies (30), concentrated on narratives about the direction of change and interplay of migration with a wide range of drivers. Additionally, a sizeable number of studies (33) had tried to combine the advantages of both approaches within a *mixed* framework, of which Wiśniowski et al. (2021) is a more recent example. This was especially the case for studies relying on expert opinion both for setting the trajectories and providing the underlying narrative explanations.

In that review, once we looked at the focus and purpose of setting migration scenarios, an interesting picture emerged. By focus, we mean whether the scenarios are set specifically for migration or for other processes (e.g. population or the economy), with migration just one of the contributing variables. As for purposes, we distinguish *predictive* studies, with scenarios used as forecasting tools, *explorative* ones, both exploring and explaining possible futures, and *normative* studies, trying to answer

the question about the desired levels of migration required to meet some social or economic objectives. In Boissonneault et al. (2020), we offered a simple typology of existing studies and approaches, across these two dimensions. One interesting finding was that among migration-focused scenarios, explorative studies ($n = 26$) clearly outnumbered predictive ones (8). When migration was just an input to scenarios for other variables, the studies were undertaken mainly for predictive (38) rather than explorative (29) or normative (6) purposes. As a possible explanation, this difference may indicate that the migration research community is rightly cautious around using migration scenarios as predictive tools, being aware of the associated difficulties, as discussed in Part I.

Existing studies, especially on the numerical side, have explored a wide range of methods for generating and quantifying scenario assumptions. Aside from time-series methods, as discussed separately in Chapter 6, these approaches range from Delphi methods (e.g. Drbohlav 1997; Acostamadiedo et al. 2020; Wiśniowski et al. 2021) to proper foresight studies (e.g. Foresight 2011; Vezzoli et al. 2017). In addition, some scenarios are conditional on established assumptions and narratives about drivers, such as the *shared socioeconomic pathways* (O'Neill et al. 2017), which are reflected in a number of migration studies (e.g. Abel 2018; Lutz et al. 2019), or gravity-type models (Rikani and Schewe 2021). Delphi-type surveys, in particular, attempt to combine the advantages of quantitative and qualitative methods by eliciting the numbers within a broader deliberative process. Still, despite covering a lot of ground in terms of the methodology and practice of migration scenario-setting, existing methods collectively leave a few important gaps.

The first gap is that the scenarios are very often set in terms of high-level aggregates (e.g. total immigration or emigration). Worse, the most popular variable in the review was *net migration*, which does not correspond to *any* actual migration process, being simply an arithmetical difference between the numbers of immigrants and emigrants (Rogers 1990; see also Chapter 10). The second, related, gap is that the high-level aggregates for which scenarios are set rarely reflect the diversity of flows, which have different characteristics and levels of uncertainty, as discussed in Chapter 4 (see also de Beer 2008; Bijak et al. 2019). The third gap is in the quantification of assumptions, which is fraught with many pitfalls, whether rooted in analysis of individual drivers or expert opinion. This particularly involves the ways in which scenario uncertainty is described or quantified, if at all (see discussion in Chapter 6). These gaps call for the adoption of a different approach; we present two

attempts at this – a factorial experiment and microsimulations – in the remainder of this chapter.

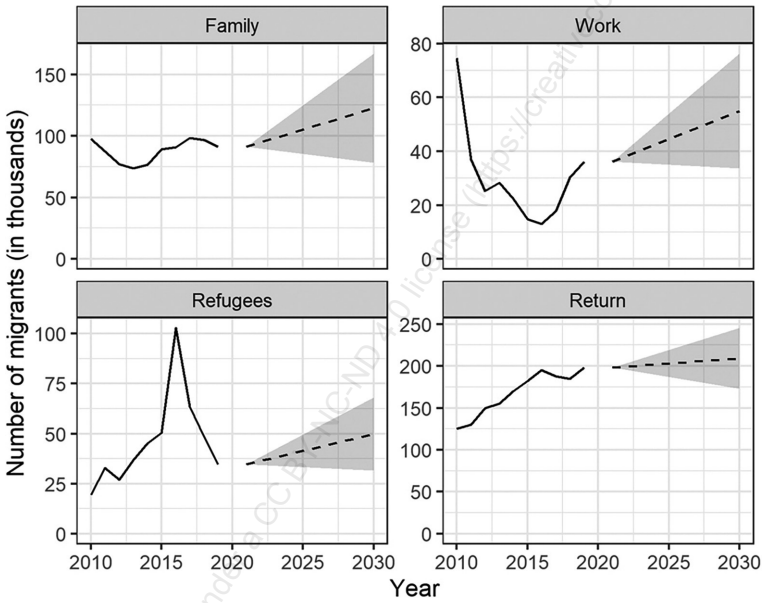
7.2 COMBINING SCENARIO-BUILDING APPROACHES: A FACTORIAL SURVEY EXPERIMENT

To combine the strengths of existing qualitative and quantitative approaches, we carried out a *factorial survey experiment* of migration researchers and other professionals, based on *vignettes* describing origin and destination regions (Boissonneault et al. 2022; Boissonneault and Costa 2023). The survey experiment involved asking invited migration experts to fill in an online survey on the expected future of selected migration flows by 2030, relative to benchmark data for the 2010s. The flows involved migration from Middle East and North Africa (MENA) to Europe and were disaggregated into four main types: family, work, asylum (refugees) and return migration. For each flow, we looked at a range of drivers, in both the origin and destination, following the work presented in Chapter 4. The choice of specific drivers was also inspired by broader theoretical views on social transformation as a mechanism driving migration (de Haas et al. 2020; de Haas 2023). The specific drivers included: (1) pace of population ageing; (2) shifts in attitudes; (3) policy changes in Europe; (4) changes in the size of the most mobile populations; (5) shifts in social stability in MENA countries; (6) shifts in political stability in MENA countries; and (7) convergence in economic conditions between the two regions.

In the next step, for each of these seven drivers, we assumed two *levels*: either increasing or decreasing values (e.g. decreasing pace of ageing in Europe, increasing political stability in MENA). Each of the seven drivers could thus be in one of the two possible states (increasing or decreasing), resulting in $2^7 = 128$ possible combinations. This broadly follows the argumentation about drivers given in Czaika and Reinprecht (2022) and reflects the fact that the possible changes in drivers can be described qualitatively. We referred to each combination as a *vignette*, describing one of the possible worlds in terms of the driver profiles.[1] That

[1] For a general description of the vignette methodology, see Atzmüller and Steiner (2010). An existing example of a migration application is the study by de Jong and Fonseca (2020).

our survey was *factorial* means that we used all possible combinations (vignettes) in our study, with each of the 138 expert participants being presented four of them.[2] Finally, the experts were asked to indicate, for each vignette, by how much they expected each of the four migration flows in 2030 (family, work, asylum and return) to change from the 2010s baseline. Aggregate results for all experts are summarized in Figure 7.1. On the whole, participants' answers varied between flows remaining broadly the same and doubling during the 2020s.



Note: Dashed lines: mean expert assessment of future trends; shaded areas: average range between the lowest and the highest migration scenarios.
Source: Boissonneault and Costa (2023, Figure 2), reproduced by kind permission of the authors. Past data from Eurostat.

Figure 7.1 *Past trends (2010–19) and expert assessment of plausible future trajectories (2020–30) of main migration flows from MENA countries to Europe*

[2] For a discussion of the methodology of factorial experiments, see e.g. Auspurg and Hinz (2014). One related application of such a method, in the area of healthcare, can be found in Sheringham et al. (2021).

Our experiment aimed to create scenarios that were more in line with current theoretical thinking about the role of migration drivers and social change (de Haas et al. 2020; Czaika and Reinprecht 2022; de Haas 2023), while remaining within the broad confines of methodology of scenario-setting. For a single group of migration flows, from MENA to Europe, our experiment was successful, producing expert-based scenarios and engaging the participants in the process. We were also able to produce scenarios (with uncertainty assessment additionally offered by the experts) for flows disaggregated by main type (family, work, asylum and returns). If this approach could be implemented for other regions of the world, it would offer a very appealing alternative way of using expert opinion in migration scenarios. Such an approach would go beyond the state-of-the-art Delphi approaches (e.g. Acostamadiedo et al. 2020).

Unfortunately, when trying to scale up the experiment to different regions of migrant origin and for additional flows from other world regions, we encountered an important practical barrier. The experiment was well suited to a single flow but was very resource intensive and would require additional elicitation, or at least evaluation, expert time and knowledge, to derive similar parameters for additional migration flows. Because of the costs in terms of setting up and carrying out the experiment itself, we found that implementing this method for all possible combinations of flows was impractical. Further, reducing complexity of migration drivers into a few numerical parameters that can be scaled in scenarios to produce divergent migration outcomes was still deemed as too simplistic by some experts. For these reasons, we focused instead on addressing uncertainty arising from divergent migration behaviours. To that end, we decided to use microsimulation-based methods, which offer flexible tools for capturing heterogenous behaviours and modelling diverse populations. We present our solution in the remainder of this chapter.

7.3 SCENARIO-BUILDING THROUGH MODELLING: THE POWER OF MICROSIMULATIONS

As mentioned earlier, migration scenarios are most often set at the very aggregated level of overall immigration and overall emigration flows. However, individuals and groups have diverse migration aspirations and behaviours. Structural changes in populations, such as e.g. population ageing of entire populations but also of settled immigrants, and *cohort*

replacement[3] of more homogeneous cohorts by diverse ones, result in increased population heterogeneity. This heterogeneity can manifest itself especially when we look at population groups in terms of birthplace (nativity) or origin country. The resulting diversity in population composition impacts migration dynamics, as different groups have different propensities to migrate. For scenarios this is particularly important, because migration has become the key driver of population change in Europe in the 21st century. Migration scenarios are an essential part of population projection models and should be linked to demographic change and consider multiple sources of heterogeneity.

The diversity in migration processes also affects uncertainty in future migration via changing population characteristics. Expert opinion may implicitly consider this impact by providing an informed guess as to altered future population composition, but multistate demographic modelling can project or simulate these changes more precisely. Dynamic microsimulation methods (e.g. Harding et al. 2009; Bélanger and Sabourin 2017) and agent-based models (e.g. Gilbert and Troitzsch 2005; Bijak et al. 2021b) are especially well suited to flexibly incorporating multiple socio-demographic characteristics of different actors. Especially microsimulation offers a way of handling multiple dimensions linked to the many sources of heterogeneity more flexibly and can provide better projection results than conventional population projection methods (see Chapter 10). Microsimulation is also better suited to modelling life courses and links between actors. This makes it easier to handle inter-generational transmission of some characteristics, such as education, or incorporate interaction between duration of stay of immigrants in the country and their childbearing or labour force outcomes.

Microsimulations are based on data on the frequency of people's *transitions* between the different *states* they can find themselves in.[4]

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[3] This is also known as *population renewal* or *demographic metabolism* (Lutz 2013). In essence, as time goes by, older cohorts of people (here, groups born in the same year) are replaced by younger ones, as a result of an interplay of three demographic processes: *births* create new cohorts, *deaths* affect the survival of older cohorts throughout their lives, and these dynamics are influenced by *migration*. This framework can be extended to different *states* (e.g. country of residence, labour market activity status, educational level).

[4] For example, consider a 44-year-old woman, highly educated and economically active, residing in country A (state 1 = higher education, active,

Such models are particularly well tailored to simulating future population changes, which are behind the observed macroscopic, population-level demographic process of cohort replacement. Such models allow assessment of the demographic and labour force impacts of migration (e.g. if the models are set to model future labour supply). Including different migration behaviours and intensities, for different population groups and at different stages of the life course, is a feasible way of reducing epistemic uncertainty (see Chapter 4).

Migration theory and empirical analyses of migration patterns provide guidance to modelling this heterogeneity. Selectivity in migration arises though differentiated aspirations and capabilities to migrate. First, age is the most important predictor, as migration is linked to life-course changes and peaks in the 'rush hour of life' – young adulthood – when many important life transitions happen (Rogers and Castro 1981; Courgeau 1985; Bernard et al. 2014). Empirical data on migration by age, including our estimates presented in Chapter 5, clearly show that migration peaks around age 25 for most flows concerning Europe. Second, native-born individuals usually have a lower propensity to migrate internationally than the foreign-born, who may remigrate or return to their country of origin (see Chapter 4). Among immigrants, emigration (including returns) peaks in the first years after arrival. Duration of stay in a country is therefore a very important predictor of migration, alongside age and nativity status (van Hook and Zhang 2011).

Educational aspirations are also an important migration driver (Chapter 4), as is labour market activity. It is well established that people with above-average educational attainment are more likely to migrate internationally (Dustmann and Glitz 2011), and for labour migration, the higher propensity to move for those who are economically active is almost tautological. Including at least some of these differentials – not only age, but also education level and economic activity – is an important step towards causal modelling of the migration process. To that end, considering multiple sources of population diversity indirectly supports the integration of causal migration modelling into population projections, by approximating the underlying mechanisms driving migration flows

country A). If she moves to country B to take up a new job, she is making a transition to another state (state 2 = higher education, active, country B). The intensity of such transitions is described by migration rates from A to B for 44-year-old, highly educated and economically active women.

(Willekens 2018). Specifically, it can be argued that mechanism-based migration forecasting must account for the heterogeneity of cohorts and changes in personal attributes over the life course (ibid.).

In our microsimulation model, called QuantMig-Mic, we simultaneously model populations of the EU+ countries (excluding Liechtenstein, due to problems with data availability), with emigration rates varying by nativity (region of birth) availability and age. Changes in the age structure and the composition of each cohort by region of birth are subsequently translated into simulated emigration flows. The destination is assigned based on rules driven by time series of past migration flows. In this way we capture the fact that European-born migrants are more mobile within Europe than people born outside the EU+. For the last group, for example, migration involves moving to other parts of the world more often than for the European born, and it often includes return migration.

Differences in emigration rates by birthplace need not be fixed: we can project assumptions on the future dynamics of these differences according to evidence from past data and insight from relevant migration theories and spatial regularities. In the microsimulation, immigrants enter the model as new actors, with immigration linked to age structures in origin countries and changes in educational compositions of immigrant populations (Marois et al. 2023). This results in changes in the composition of projected immigration flows in terms of region of birth, as immigrants are attracted to destinations with established migration links and networks. In this way, by following past trends in various transition rates, including migration rates, we can obtain the reference scenario – the *baseline* – which we then use for the analysis presented next.

Improved data on emigration in origin countries, availability of origin–destination migration data by socio-economic status, and data organized by immigration cohorts rather than by calendar years can further reduce the epistemic uncertainty in future migration scenarios. Granular emigration data by birthplace and duration of stay would allow us to better model the diversity and life courses of foreign-born populations. This could help equip migration models and scenarios with some causal elements. In the context of microsimulations and agent-based models especially, this would enable the links between people (in families or households) and the ways in which they make migration decisions to be explored (see e.g. Klabunde et al. 2017; Willekens 2018). More granular migration data could therefore help with utilizing the power of simulation tools more fully.

7.4 ADDRESSING THE ALEATORY: INCLUDING UNCERTAINTY IN SCENARIOS

In population projections, future migration uncertainty can be accounted for by using either probabilistic methods (Bijak 2010; Azose and Raftery 2015) or a range of alternative scenarios. Data impose important limitations on how much epistemic uncertainty can be reduced by incorporating nuanced understanding of migration through causal modelling. As illustrated in Chapter 6, there are limits to mitigating epistemic uncertainty over long-term horizons. Driver-based scenarios, commonly used in migration forecasting, are by definition epistemic, as they try to make sense of macroscopic regularities and correlations between migration and its drivers. But the longer the time horizon, the greater the role of aleatory uncertainty (Chapter 2). In other words, whatever we think migration will be like decades from now is most likely incorrect. This is due to the unpredictability of micro-level migration decisions and aspirations and even more so the unpredictability of macro-level events that may impact migration (including wars and natural catastrophes but also large economic or geopolitical shifts). These factors and their causes cannot easily be distilled to a set of drivers.

To address the aleatory randomness of future migration, we propose a novel framework based on the modelling of rare migration events for long-term time horizons, introduced in Chapter 6. We start with the estimated magnitudes of rare migration events from different world regions presented in Table 6.1, for once-in-a-decade and twice-in-a-century high-migration events related to immigration into Europe. In the next step, based on these assumptions, for each immigrant origin we build four sets of scenarios for migration events that combine the magnitude of the event and the duration (persistence) of the effect. Of course, as mentioned earlier, we chose immigration for illustrative purposes and as a current policy priority in the EU, but the method would work equally well for any other migration flow of interest.

Our proposed solution approximates the inherent volatility of migration due to unpredictable events (e.g. wars, natural disasters). Such events – sometimes referred to as 'shocks', although we prefer to refer to *high-migration events*, as a more neutral term – cause disturbances to the migration system and shift the trends. Alternative scenarios can then simulate such hypothetical high-impact migration events to better understand their demographic and labour market impacts (Potančoková

et al. 2023). In our case, we simulated two contrasting scenarios. The first is a *transient high-migration event*, where after one year migration returns to the projected trend shown in the baseline scenario. This could reflect an adequate policy response that mitigates the impact or simply the driving forces ceasing to exist. Transient high-migration events even of twice-in-a-century magnitude would not be expected to leave a lasting imprint on the projected population sizes, labour force or share of foreign-born population. To put the simulated numbers into perspective, the estimated twice-in-a-century high-migration event from West Asia into EU+ would roughly correspond to the 2015–16 migration wave from Syria and Iraq (see Table 6.1 in Chapter 6).

The second situation reflects a prolonged crisis and chain migration: after the initial high-migration event, immigration from a given region remains elevated and returns only gradually to the volumes envisaged in the baseline scenario. We refer to this as a *persistent high-migration event* (PHME). This persistence in migration after the initial event lasts for a decade. Such a situation is not unusual, as family reunifications and migrant networks incentivize the perpetuation of migration from the same origin (de Haas 2010). In fact, migrant networks and past migration corridors are used in the simulation to approximate the choice of future destinations. Therefore, only PHMEs from the origins previously linked to a particular European country are assumed to impact population size and composition in that country, as illustrated by Figure 7.2. We model the alternative scenarios sequentially, with high-migration events introduced at the same time in all scenarios (from mid-2025 to mid-2030). In other words, we are asking a question: What would be the population and labour market impacts of high-migration events in the late 2020s?

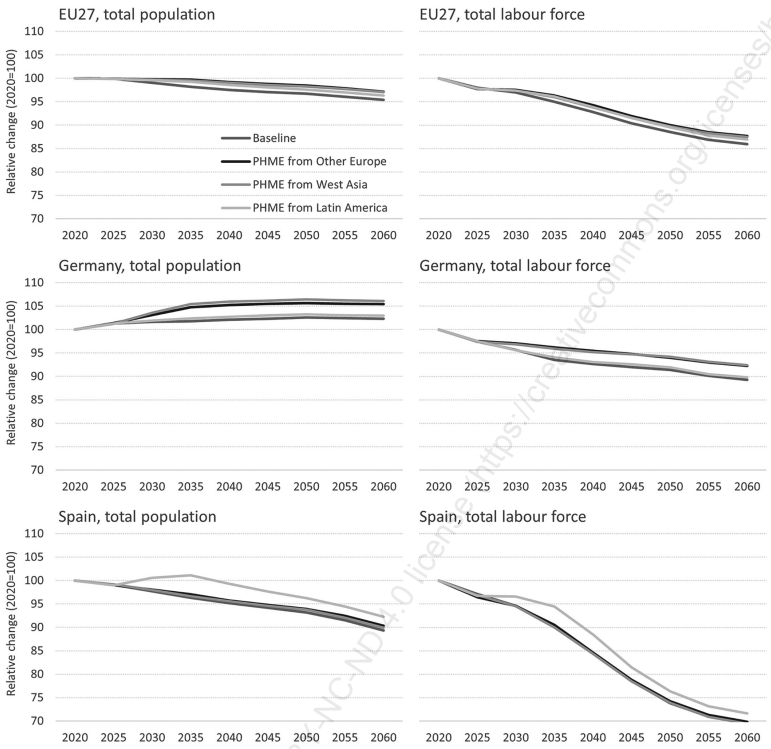
Among the two situations, PHMEs can clearly be expected to leave a larger imprint on the make-up of European populations than transient migration events. If migration into Europe continued at the same rate as in the past, the share of foreign-born population in the EU27 would increase from 13 per cent to a projected 24 per cent in 2060. The share of migrants born in EU+ countries would be smaller (Figure 7.2, upper boxes), while the foreign-born population would, of course, be larger under alternative migration scenarios (Figure 7.2, lower boxes). A PHME from Other Europe would increase the total foreign-born population in the EU27 by 5 million by 2060 in comparison with the baseline scenario, while the share of people born in Other Europe would be similar to their share in the 2020 stock. Over the same horizon, a PHME from West Asia would result in a foreign-born population larger by 2 million compared with

the baseline, with the share of foreign born nearly doubling. Still, given the importance of natural demographic dynamics (births and deaths), the long-term impacts even of PHMEs on population size and labour force are relatively limited. This confirms earlier findings (UN 2000; Bijak et al. 2008) that in spite of some diversity in trends, even seemingly large migration flows only temporarily offset the projected impact of population change, particularly ageing, as shown for the EU27, Germany and Spain in Figure 7.3. All results are available from the QuantMig Migration Scenarios Explorer, at https://bit.ly/quantmig-scenarios.

Note: Baseline and two selected persistent high-migration event (PHME) scenarios shown. The box areas are proportional to population sizes.
Source: Eurostat (for 2020); own elaboration (for 2060).

Figure 7.2 Estimated (2020) and projected (2060) distributions of the origin of the foreign-born population in the EU27

From the point of view of causal migration modelling, the proposed framework is even better suited to emigration than immigration (where PHMEs can be attributed to the countries of origin) and can also be adapted to bilateral flow forecasts. The latter can be achieved by combining the estimated volume of high-magnitude emigration – number of migrants from a country or region of origin – with decision rules



Note: PHME = persistent high-migration event related to immigration to Europe.
Source: Own elaboration.

Figure 7.3 Projected total population and labour force for selected countries and scenarios, 2020–60

regarding the absorption of the flows to different destinations. A particularly appealing possibility would be to apply this approach to climate change and environment-related migration. Linking its scenarios to the relative frequency of events could explicitly take into account caveats about the uncertain character of such mobility, avoiding unnecessary alarmism (see e.g. Foresight 2011, de Haas 2023, and discussion in Chapter 4). This would necessitate not only more nuanced emigration data but a better understanding of different situations and strategies (e.g. involuntary immobility and adaptation capacity; short-term and short-distance mobility vis-à-vis long-term and long-distance international emigration).

Our scenarios have been prepared for Europe, but with improving data availability the same process could be applied to any region of the world. To that end, improved migration data for countries of origin and advances in modelling can also reduce some of the epistemic uncertainty for environment- and conflict-related drivers of migration. However, for climate change and conflict, especially over longer time horizons, much of the uncertainty will remain aleatory and therefore irreducible. This shifts the policy focus back to ensuring adequate preparedness. We continue this discussion in Part V, but first, in Part IV, we make a foray into discussing effective science communication and use by policymakers: a necessary prerequisite of any attempts to prepare for the unexpected.

PART IV

From migration scenarios to evidence-informed policies

8. *Communico, ergo sum?* Potential and pitfalls of knowledge exchange

Daniela Vono de Vilhena, Andreas Edel and Christian Kobsda

8.1 SCIENTIFIC ADVICE FOR POLICY: AN EVER-CHANGING LANDSCAPE

Science–policy interfaces are not a new phenomenon but rather a very old one. Evidence has been considered for a long time as the basis for rational decision-making in politics. For instance, early demographers and 'political arithmeticians', such as John Graunt (1620–1674) and William Petty (1623–1687), considered their empirical research approach to be an essential contribution to evidence-informed decision-making on policy-relevant questions (Edel 2024).

Today, there is a vast literature about scientific advice for policymaking (see e.g. a review in Cairney and Oliver 2020). Specialized disciplines (e.g. political theory, philosophy of science, sociology of science, history of science, communication sciences, or science and technology studies) deal with science communication in general and scientific policy advice in particular. These disciplines have their own research programmes, research priorities and peer-reviewed journals.

Many scientific institutions – such as academies, their international umbrella organizations, such as the European Federation of Academies of Sciences and Humanities (ALLEA) and the Science Advice for Policy by European Academies (SAPEA), and research funding agencies – are explicitly obliged by their statutes to support scientific policy advice. In addition, funding schemes from many public institutions and private foundations usually require elaborated impact statements, particularly addressing the questions of how research findings will be communicated to different stakeholders (including the general public) and how they will be translated into recommendations for decision-making, including

for policy. Finally, public institutions in many European countries now include *impact* as a relevant item in the evaluation of career progression inside academia.

From a longer-term perspective, over the last four decades, there seems to have been a shift in perspective and understanding of the role of science in advising policy. From the supply side – realization of the public mission within the scientific community – this dates back to at least the so-called 'Bodmer Report' (Royal Society 1985). The report made several important recommendations, including to enhance the 'public understanding of science' in order to increase scientific literacy within the population and to move towards a new impact model, which goes beyond pure communication efforts and expects outreach to be societally relevant.

Since then, the quest for science impact at the science–policy interface has received more attention, both from higher education institutions and other governmental bodies. For example, large national research organizations in Germany followed the British example and stated their own PUSH (Public Understanding of Sciences and Humanities) memorandum, corroborating joint support for an intensified dialogue between science and society. This also led to institution-building: jointly setting up an organization dedicated to this task: Wissenschaft im Dialog [Science in Dialogue] (BBAW 2022).

On the demand side, we have the policymakers. For example, in Germany, knowledge transfer had become a political goal in its own right by the mid-1970s. At that time, it was very much focused on technology transfer, particularly around nuclear energy, mechanics, biochemistry and the like (Voigt 2023). In the Netherlands, impact was formally a policy goal from 2000, but only since 2009 has it begun to be taken seriously in that respect (Muhonen et al. 2020).

The reaction of scientists to an impact-driven culture of 'science for policy' varies. While some fear being drawn into discourse systems of the 'policy arena', instrumentalized for political or other agendas beyond their scientific liability, subject to aggressive or personal attacks or burdened with additional work obligations, others understand the different roles they can play in the political landscape (see e.g. Pielke 2007) and the benefits of embracing impact. For instance, transdisciplinary interactions with the policy and public spheres can nurture more insightful research results through cross-fertilization and feedback from practitioners, as a basic epistemic element of scientific knowledge production (Kluge 2022). This is also reflected in a broader shift from the idea of *knowledge*

transfer (going in one direction, from knowledge producers to users) to the more contemporary *knowledge exchange*, the term that explicitly acknowledges multidirectional flows of knowledge (for a review, see Mitton et al. 2007).

8.2 PROFESSIONALIZATION OF SCIENCE–POLICY DIALOGUE

Despite the complexity of science–policy interactions, researchers are frequently invited to be interviewed by media channels, to comment on trends and events, but also to contribute to parliamentary hearings and the scientific advisory boards of government bodies. However, researchers are rarely trained to work at the science–policy interface. Publications in peer-reviewed journals and other scientific outlets, joining scientific conferences, and networking within peer groups are still the basic professional 'currency', especially for early-career researchers. Non-academic engagement is often seen as a distraction from scientific work. Researchers who wish to engage at the science–policy interface thus find themselves needing to carefully consider what their role can be and how they can do both: providing policy advice, and thus engaging at least indirectly in policy affairs, while building successful academic careers (Edel et al. 2020).

To that end, it is advantageous that increasing numbers of academic institutions are investing in the establishment of specialized units to bridge science and policymaking, thus supporting the scientific community. These units employ science communication and policy officers to follow policy agendas, events organized by governments, international and civil society organizations, industries and business, and the media. They keep databases of stakeholders by knowledge area and promote dialogue activities all through the year. By doing so, these teams can identify exactly when to contribute to policy cycles, whom to approach and which information should be shared.

Such professional policy engagement units tend to use different methodological approaches to promote science–policy dialogue and are continuously trying new instruments (e.g. real-world laboratories, decision theatres). Transdisciplinary activities can be especially powerful instruments for creating an environment where scientists and stakeholders work together to find solutions for the challenges of today and tomorrow. This allows researchers to contribute knowledge in a discursive environment, where tasks are clearly defined and both sides can benefit from

each other. If necessary, this environment can be protected, for example by applying the Chatham House Rule (no individual attribution of views) or by limiting the audience to expert groups only (Kluge 2022).

Transdisciplinary activities are also increasingly organised by actors outside universities. For example, the European Commission's Joint Research Centre initiated virtual research town halls with an assembled task force of over 100 scientists to integrate their knowledge to inform policy during the COVID-19 pandemic (Quest 2022). In this sense, scientific policy advice is moving away from a 'one-way street' for communication or 'truth speaks to policy' (Renn 2021), with knowledge being broadcast only from research to practice, and is instead embracing processes for mutual learning.

The professionalization and expansion of the policy engagement sector also led to challenges. The term 'science' is not protected by law, and misuse of the term is common. There are institutions that claim to be scientific, or even call themselves research institutions, but are not actually qualified as such, nor are they employing qualified researchers. Care must be taken to ensure that 'science' is not used as a brand to market institutions that are either driven by commercial interests or pressure groups or simply not competent in the field. Policymakers should be aware that scientific policy advice requires a certain standard of training and quality control (Edel et al. 2020). In Germany, for example, some science academies already formulated such standards some years ago (BBAW 2008; Leopoldina 2014). The increased advisory activities of scholars have also led research organizations to reflect on their own standards and practices (e.g. Leibniz-Gemeinschaft 2021).

8.3 SCIENCE FOR POLICY IN AN ERA OF CRISIS

In the late 2010s and early 2020s, with wars, humanitarian disasters and the COVID-19 pandemic, we have seen a further shift in perspective on the role of science in advising policy. The predominance of a 'crisis' narrative has given knowledge exchange a new, strong push towards a relatively new impact-driven approach to the science–policy interface. In the course of the severe policy challenges of the 21st century, the policy sector and media have requested scientific advice more than ever before. Scientists, research centres and other academic bodies have been asked to provide ad hoc analyses (sometimes at a very short notice), thorough and data-based fact checks, and evidence-informed scenarios of what

might happen next. It became evident that the mechanism of scientific production and its quality standards, but also the related uncertainty, are complex and need to be properly explained to general audiences (Edel et al. 2020).

For these reasons, scientists should make clear 'what we know, what we don't know and what we might never know', as suggested in 2021 by Pearl Dykstra, then member of the Group of Chief Scientific Advisors to the Cabinet of European Commissioners, in a discussion organized by Population Europe.[1] In other words, this refers to our key distinction between knowledge, epistemic uncertainty and aleatory uncertainty, which we discuss throughout this book in the context of migration scenarios.

At the same time, crises also produce a strong push from the research side (the suppliers of knowledge). Individual scientists and institutions can become motivated to share their expertise publicly to help with public and political responses (e.g. Fecher and Hebing 2021). New projects are often set up, individual scientists intensify the exchange of research data to produce more evidence in a shorter period of time, and organizations come up with new formats for sharing their advice publicly, which inevitably also leads to communication mistakes made in public and debated afterwards (e.g. Hirschi 2021).

On the whole, trust in science can fluctuate and vary between different groups of stakeholders. Studies indicate, for example, that during the COVID-19 pandemic, among policymakers, this trust was initially highly prominent but diminished over time, as decisions started to lean towards relaxing restrictions due to economic and social pressures (Hodges et al. 2022). At the same time, from the perspective of citizens, surveys such as the annual German Science Barometer (with around 1,000 respondents) showed that in spring 2020, early in the pandemic, trust in science within the population had actually increased substantially.[2]

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[1] High-level expert meeting 'Science and Policy|Beyond COVID-19', held on 25 January 2021. The recording is available at Population Europe's YouTube channel: https://youtu.be/PoMHLZK8CZs.

[2] Wissenschaftsbarometer Corona Spezial. Wissenschaft im Dialog: Berlin (April and May 2020). Available from https://www.wissenschaft-im-dialog.de/projekte/wissenschaftsbarometer/wissenschaftsbarometer-corona-spezial (accessed on 15 January 2024).

The high levels of trust invested (generally) by citizens in scientific advice underscore the need to refine the science–policy relationship for future critical events. This relationship can be problematic in a few important areas. First, it reflects the fundamental asymmetry in the principles of knowledge production and decision-making, where academics and policymakers work under different logics and time constrains. Second, scientists often have to deal with the fact that evidence is uncertain and changes over time (Pielke Jr., 2007; Lancaster et al. 2020), particularly with regard to the predictability of societal events, such as future migration flows. The production cycles of knowledge depend especially on access to data, and the peer-review process takes time. We see examples of this throughout this book in relation to migration and the construction of scenarios.

At the other end of the spectrum, decision-making in politics, particularly during a crisis period, requires quick advice and precise facts presented in concise formats. In politics, evidence-informed decisions inevitably entail compromises, after considering practical, ethical, institutional and legal factors alongside the obvious political influences, power dynamics and electoral considerations. The social implications of expert recommendations are weighed against public benefits, which makes science 'just one piece of the policy-making puzzle' (Salajan et al. 2020: 464).

Furthermore, trust matters in the policy arena too. Decision makers need authoritative (i.e. scientifically solid) and non-partisan advice. As guidance, SAPEA, as an umbrella organization of national scientific societies, stated: 'Science can give decision makers the background knowledge and information they are looking for, but scientists should avoid persuasion and resist the temptation to convert the decision maker to their own values and preferences. Failure to do this is likely to create stigmatization and mistrust' (SAPEA 2019: 72). The mission is simple: to deliver scientific evidence without a partisan voice.

Understanding how to effectively bring scientific advice into the decision-making process is therefore of crucial importance. Scientific advice implies, among other things, translating scientific findings into simple words. To be useful outside academia, scientific results must be condensed and transformed into formats that are understandable and easily digested by non-scientific audiences. This also applies to the use of narratives that are not necessarily understandable outside academia, especially uncertainty, which is an inherent part of any science. Scientific evidence can often support decision-making only by offering a limited

number of possible scenarios and their consequences. Still, different stakeholders can use this solid input to make their own decisions under uncertainty and based on their respective values. These values may be even stronger than any evidence science can possibly provide (Pielke 2007: 27). With regard to political decision-making and social discourse, scientific evidence is in the end only one factor of influence among many but a very important one. Migration and broader demography provide very important examples of such interactions, as we discuss in the next section.

8.4 SCIENTIFIC ADVICE ON INTERNATIONAL MIGRATION: A QUANTMIG CASE STUDY

Many European demographers have been active in advising policymakers at national and international levels for decades, particularly regarding the importance of data for evidence-informed policymaking and changes in population trends. In 2009, the demographic community decided to create Population Europe, now a network of 41 demographic research centres throughout Europe (as at the end of 2024). Its objective is to disseminate the most relevant research findings on population-related issues to policy audiences and the public and to organize transdisciplinary dialogue within the policy arena. Since its creation, Population Europe has been involved in 36 research projects funded by the European Commission, member states, foundations and the private sector.

The communication experts in Population Europe's secretariat have developed tools and use well-established approaches to disseminate scientific evidence outside academia. These tools include workshops, high-level policy expert meetings, face-to-face and online public events, and publications tailored to specific audiences: for example, discussion papers, policy briefs, short summaries of policy-relevant research (*PopDigests*), and short opinion pieces similar to blog entries (*Policy Insights*). These efforts are accompanied by communication activities reaching out to a broader public (press materials, social media activities, school materials and a travelling exhibition, among others). Building up strong partnerships with various stakeholders throughout Europe plays an important role in Population Europe's activities (Edel et al. 2018).

For the QuantMig project, Population Europe led the communication and dissemination activities, in close collaboration with communication teams and experts from other partner institutions. To that end, we applied a comprehensive strategy with the aim of informing different types of

stakeholders: scholars, policymakers and experts working on international migration, particularly those relying on data as their main source of information. The main objective was to inform and integrate various stakeholder audiences into the project through a wide range of targeted communication and transdisciplinary dialogue activities. For policy audiences, these were high-level policy expert meetings, a stakeholder event, policy briefs and a discussion paper. For data experts, these were technical webinars. Younger audiences were targeted through a set of school materials and a migration quiz. Finally, expert audiences and the broader public were updated on a regular basis through general communication tools and social media. Thanks to stakeholder analyses and targeted products and activities within the project, we were able to cultivate and develop strong relationships with key players in the field of international migration and to inform our audiences on research findings using tailored formats and language.

The three key elements of our work on communicating migration scenario results and their building blocks are summarized in Box 8.1. They include the key actors involved in the process, the selected tools for knowledge exchange, and stakeholder networks.

BOX 8.1 QUANTMIG CASE STUDY: WHAT LESSONS HAVE BEEN LEARNED FOR SCIENTIFIC ADVICE ON A POLITICALLY SENSITIVE TOPIC, SUCH AS INTERNATIONAL MIGRATION?

I. Actors in the process of scientific advice. Scientists are the main actors in science advice. They play the role of 'honest brokers' (Pielke 2007) and should be expected to provide trusted evidence and analysis to facilitate evidence-informed decision-making (Bijak et al. 2021a). However, the heterogeneity in communication skills for sharing scientific results to general or specialized audiences outside academia is very high among scholars, as training or professional support inside institutions on this matter is not always available. In addition, 'users' of scientific advice do not always know who to turn to and often rely on consultants, think tanks or government technocrats (Holst et al. 2021). In our case it was therefore very important to build trust with stakeholders regarding the high standards of the scientific team

involved in the project and the quality and innovative nature of the research process. Trust needs to be built through regular communication, one-to-one dialogue and small transdisciplinary events. Having scholars who are available for consultation and willing to work at the science–policy interface has proved to be of key importance in this context.

Another important set of actors is the individuals and teams working inside policy institutions with the explicit aim of providing scientific evidence for politicians and policymakers. Examples include the European Parliamentary Research Service (EPRS), the United Kingdom's Parliamentary Office of Science and Technology (POST), Wissenschaftlichen Dienste des Deutschen Bundestages, and research teams and science advice committees inside individual ministries and government departments. In QuantMig, it proved crucial to identify stakeholders potentially interested in project results from a very diverse set of organizations and in civil society. Journalists, civil servants, analysts, representatives of non-governmental organizations, unions and other stakeholders that are close to governments all play a fundamental role in bringing scientific evidence into policymaking (Bijak et al. 2021a).

II. Tools for knowledge exchange. Dialogue formats are an important instrument for building networks and for knowledge exchange. According to Ortwin Renn (cited in Bijak et al. 2021a), a co-creation approach to knowledge exchange seems to be the best way for researchers and non-academic stakeholders to ensure mutual understanding and trust. At QuantMig, we organized a series of high-level expert meetings on different topics, including strengthening evidence-informed policymaking on migration. For these meetings, around 15 stakeholders from science, policy, and non-governmental and international organizations were invited to share, under the Chatham House Rule, their perspectives on a series of defined questions. The results of this transdisciplinary dialogue were then described in dedicated *Policy Briefs* (https://population-europe.eu/research/policy-briefs). In this way, the results of what began as a restricted meeting ended up being shared widely through the communication channels of QuantMig and its partners. One necessary prerequisite of trust is, of course, that the content and wording of such policy briefs are approved by all those who wish to be a part of its co-creation.

Co-creating knowledge in the atmosphere of a free and open

exchange of views proved fundamental for developing the scenario methodology presented in Chapters 6 and 7. During the dialogue, it transpired that the state-of-the-art scenario setting methodology, based on pre-defined driver trajectories, was an incorrect approach for highlighting the uncertainty of future migration. The arguments focused both on the difficulty to isolate the impact of individual drivers and on the limited value of such scenarios for their users. These considerations led to focusing on preparedness and rare events instead. In effect, the process of co-creation has sparked methodological innovation in scenario-setting methodology.

In addition, QuantMig has also offered a series of more technical webinars. Their goal was to explain methodological innovations and to present new products (e.g. databases, web-based tools). These webinars were open to the general public and included time for questions and answers. They proved to be an important tool for promoting the project results among different communities and attracting different audiences interested in migration, from policymakers and practitioners working on migration questions to qualitative and quantitative migration scholars. The final project results, summarized in a dedicated *White Paper on Migration Uncertainty* (Bijak et al. 2023), were presented to selected stakeholders during a face-to-face meeting in Brussels. Many of them were already familiar with the project, thanks to previous events, and could share insights and suggestions on a draft version of the White Paper circulated in advance.

In addition, as part of broader knowledge exchange activities, we created a set of teaching materials (bit.ly/quantmig-teaching) and a migration quiz (bit.ly/quantmig-quiz) targeted at younger audiences, to raise awareness of issues related to migration and migration uncertainty. The teaching materials allow students to take the role of migration scientists as they examine migration decisions, trends and patterns. These initiatives went through a testing phase with students at different educational levels, with the QuantMig team once more closely interacting with targeted audiences and reshaping final deliverables following their feedback.

III. Dissemination and Networks. In the same way that researchers rarely start a new project from nothing but bring their know-how, previous work, teams and networks as implicit inputs to advance science, outreach efforts should not start from zero either. To enter the policy arena, to collaborate with federations representing civil society

organizations, to be noted by the media, and to reach out to experts and potentially interested audiences are substantial challenges that are often underestimated. At QuantMig, we could unite institutional efforts among partners to reach out to as many people as possible through social media and mailing lists; however, it was also necessary to invest a significant amount of time in building a network of stakeholders interested in international migration scenarios. This task was made easier by the fact that there were not too many stakeholders with such precise interests, given the very specific area of research, and many of them knew each other through other professional networks. As mentioned earlier, our experience once again confirmed that creating trust, mutual respect and conditions for effective collaboration required professionalism, availability and commitment from all scholars involved in the project.

In terms of specific tools, at QuantMig, rather than circulating regular newsletters, we decided to decentralize communication efforts, so that the team could focus on more strategic knowledge products. The project's exposure paradoxically benefited from the COVID-19 pandemic, which brought scientific uncertainty to the centre of public and policy attention. We also capitalized on exposure on the social media site then known as Twitter. More generally, social media proved to be an effective tool for building a community of project stakeholders and keeping them informed on new reports or tools produced by the project. At the same time, the effectiveness of these tools varied over time, pointing to the need for flexibility to try different options or opt out of certain tools that – even if seemingly popular – demand excessive effort and luck.

8.5 CODA: SOME RECOMMENDATIONS FOR FUTURE SCIENTIFIC ADVICE

We finish with a few words of practical advice for the future of science–policy interactions. First and foremost, science should never be an elite club. It should remain open to non-scientific views, including those of policymakers and other stakeholders, while maintaining quality standards as its unique selling point. An example of how this can work is our experience with the co-production of scenario methodology, leading to new insights thanks to dialogue with the QuantMig project

stakeholders. This also means that it is essential to clearly communicate what is required to produce sound scientific evidence in accordance with the principles of good scientific practice, quality control by peer review, and reproducibility, all of which require high levels of training.

In addition, science communication and science policy advice need quality standards, ethical rules and innovative tools. As argued later in Section 9.2, this should ideally be carried out by professionals: experienced and knowledgeable staff, preferably with a scientific background, who understand how the work of collecting and analysing data and other sources of knowledge pays off in results and publications. Trusting that greater access to scientific literature with open science practices on its own would improve access by policymakers and practitioners seems a naïve expectation, as the evidence suggests that this is not the case. Instead, participatory forms of research and knowledge exchange, where researchers engage with stakeholders during the research process, seem to be more effective from a purely scientific perspective (Reichmann and Wieser 2022).

Bringing together science communicators, policy officers and experts in transdisciplinary dialogue as part of teams in research organizations seems to be a highly effective strategy for organizing and communicating complex scientific results without compromising their intricacies and nuances. However, the direct involvement of researchers in the process – as an unbiased and strong voice providing trustworthy evidence – is essential. More professional training and career paths for researchers in science communication and policy dialogue would help to ensure that scholars feel supported and protected in their work at the science–policy interface. It would also help them understand how their research could contribute to evidence-informed policy, for example by being aware of concrete policies that could be analysed with available data (Bann et al. 2023).

This consideration also applies to the other – receiving – side of the policy advice. Actively engaging with and creating spaces for reflection on scientific evidence should be part of policymaking routines (Bijak et al. 2021a). Regular interactions with scientists may not have an immediate impact – and may not always be electorally popular – but ensuring that policymaking is informed by evidence is more likely to improve public policies in the long run. Possible models already in place include convening temporary advisory boards for organizations and initiatives, integrating the production of commissioned reports by invited academics

into the work agenda of government departments, and organizing regular workshop series with leading experts.

Scientific policy advice also takes place via the media interface, for example through interviews and articles by researchers in internationally and nationally recognized media outlets, used by politicians and their staff as a source of authoritative information and a quotable piece of scientific output. Training courses, secondments and journalist-in-residence positions at research institutes can help to provide better training for science journalists. Journalists should see their role as a mediator between science and the public. Researchers should also recognize their role in the media: they do not have to be loud but should be an unbiased and strong voice providing solid and trusted evidence.

For this reason, offering both traditional media and social media engagement training to scholars can give them a better overview of opportunities, chances and risks when talking with the media. This is particularly important in contentious areas such as migration, where the social and policy salience can leave even the best-justified arguments and their proposers open not just to criticism but to outright expressions of (cyber)bullying and hate. Informed debate can be greatly helped by the presence of specialized outlets, such as *The Conversation*, whose very purpose is to provide a link between research on the one hand and policy and public perception on the other. Our story debunking popular myths of 'welfare magnets' for asylum seekers (Wahba and Di Iasio 2023, see also Chapter 4) provides an example of how such communication could work.

Finally, it is important to remember that science needs a protected space in order to produce high-quality research and innovation. Albert Einstein published important works leading to the Nobel Prize and the theory of relativity while working at the Swiss patent office in Bern, a place far removed from science communication and policy advice (Deutsches Patentamt 2023). This is not to say that scientific progress is possible only in a 'secular monastery', as Einstein called it. But neither should we force researchers to do the opposite: we should avoid assuming that science exists only if it has policy impact. To borrow a famous quote from René Descartes (1596–1650), we should not let *communico, ergo sum* become the model for successful scientists of our time, but should instead make this mission a shared responsibility in higher education institutions, led by professionals in the field.

For migration, with its surrounding discourse often moving into toxic territories, this mission is not an easy one, as there are too many vested interests in keeping the discussion emotive, opinionated and free from

the constraints of evidence. At the same time, if the discussion is based on openness and trust, it can lead to serendipitous developments. The scenario methodology presented in Part II would have not been developed if not for a frank feedback from stakeholders to researchers that traditional approaches are not what is needed. Still, this mission's success is a crucial prerequisite for making the most of knowledge on current and future migration, not only helping with preparedness for the future but ensuring public buy-in and a democratic mandate for the adopted solutions.

9. Forecasting asylum: the perspective of the European Union Agency for Asylum (EUAA)

Teddy A. Wilkin and Constantinos Melachrinos

9.1 SETTING THE SCENE: MIGRATION VERSUS ASYLUM

Migration and asylum, with their inherent significance, complexity and unpredictability, have shaped much of the policy landscape within the European Union (EU) for more than a decade (Hampshire 2016; Geddes et al. 2020). The so-called 'refugee crisis' of 2015–16 took EU institutions and member state asylum authorities entirely by surprise, resulting in chaotic registrations, overcrowded reception centres and delayed integration measures (Betts and Collier 2017). At the same time, *legal* migration underpins much population change in Europe today, due to increased global mobility, combined with lower birth rates and population ageing in the EU (Lutz et al. 2019). In response to these challenges and in pursuit of preparedness and more effective migration policies, strategic decision makers have expressed a growing appetite for forward-looking research capable of forecasting the full range of human migration trends (Blasi Casagran et al. 2021).

The European Union Agency for Asylum (EUAA) provides situational awareness in support of such preparedness and also hands-on operational support to on-the-ground policy implementation, offering a unique insight into these complex issues. This chapter emerges from the agency's seat on the Advisory Board of the QuantMig project, the results of which are reported throughout this book. We reflect on the EUAA's multi-faceted role as a consumer, producer and advocate for asylum forecasts and its access to the echelons of policymaking in Brussels.

The QuantMig project, a significant initiative under Horizon 2020, has played a pivotal role in advancing the methodologies of early warnings for short-term operational responses, forecasts for medium-term planning, and scenarios for long-term strategic decision-making. This chapter leverages the insights gained from QuantMig, integrating them with the EUAA's practical experiences and different strands of its methodology. Central to the discussion is the idea that effective migration and asylum policies require not only an in-depth understanding of the political landscape but also an appreciation of the different sources of uncertainty and complexity inherent in human migration and displacement trends.

The aim of this chapter is to highlight some of the challenges in navigating the complexity and uncertainty of forecasting and provide some solutions for leveraging these tools to guide the development of more resilient and future-proof migration and asylum policies. We aim to narrow the gaps between the theoretical realm of academic research, the complex reality of migration, and the sometimes impenetrable and opaque world of policy development.

To start with, in the complex field of forecasting human movements, it is important to distinguish between predicting migration – whether regular or irregular – and forecasting asylum applications. Though interconnected, migration and asylum are distinct and influence policy formulation and resource allocation in markedly different ways. Indeed, every person has the right to apply for asylum, irrespective of how they crossed international borders. Forecasts in this realm must consider the diversities of both irregular and regular migration, requiring a more comprehensive approach than for either of these areas in isolation and rendering them extremely wide-ranging. Ideally, forecasters would combine migration and asylum forecasts in the interests of creating migration management systems that are sensitive to the needs of those seeking protection.

Initiatives such as QuantMig primarily address migration forecasting, aiming to enhance preparedness in migration management and policy development (Chapter 7). This type of forecasting guides policy measures that support orderly and managed legal migration and, where possible, reduce or at least aid preparation for new waves of irregular migration (Chapter 6). Conversely, the EUAA, along with national asylum authorities within the EU, focuses on forecasting asylum applications, driven by the need to process sudden influxes of asylum seekers quickly and efficiently in line with the standards of the Common European Asylum

System (CEAS).[1] This more specific forecasting aims to optimize the deployment of resources – from case workers and interpreters to legal support and adequate accommodation facilities – to ensure a fair, efficient and equal treatment of all asylum applicants.

Another important distinction is that detections at the border provide an estimated measure of irregular migration because the relevant data[2] are shaped by *exertion dependence* – the principle that more equipment or personnel leads to more detections – which confirms the existence of undetected border crossings, often referred to as 'dark numbers'. In contrast, asylum *applications* represent a more definitive metric, as they are explicitly recorded and reported by asylum authorities, theoretically offering a more straightforward basis for prediction. However, asylum forecasting demands a deep comprehension of global political and humanitarian crises, which often trigger and precede spikes in asylum applications (Braithwaite et al. 2019). This specialization extends beyond quantifying flows from countries of origin to the EU; it also entails grasping the profiles, needs and vulnerabilities of asylum seekers, so that authorities can tailor resources for receiving and processing applications in line with their own national policies and those of the CEAS.

The EUAA has refined its methodology to address these challenges, incorporating big data on highly disruptive and conflict events in countries of origin with machine learning techniques to reveal complex matrices of drivers (Carammia et al. 2022). These enhancements often boost the accuracy of asylum forecasts but are resource intensive to perform and complex to interpret, and so a simplified methodology has emerged to underpin regular forecasting activities without losing too much predictive power (Melachrinos et al. 2020). Notably, both these approaches treat irregular migration as a partial precursor to asylum, thereby acknowledging the interconnectedness of these phenomena.

Designed to take migration and asylum into account simultaneously, the agency's scenario-building exercises (EUAA 2022) were conducted

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[1] For a brief explainer on the Common European Asylum System, see the website of the EU Directorate-General for Migration and Home Affairs: https://home-affairs.ec.europa.eu/policies/migration-and-asylum/common-european-asylum-system_en (accessed on 31 January 2024).

[2] An example is shown on the Frontex Migratory Map, https://www.frontex.europa.eu/what-we-do/monitoring-and-risk-analysis/migratory-map/ (accessed on 31 January 2024).

in collaboration with a broad range of stakeholders, such as the European Commission, including its different branches, such as Eurostat, Joint Research Centre, other EU justice and home affairs agencies, as well as academia, and member state representatives. The aim of these exercises was to address longer time horizons, currently beyond the reach of predictive analytics. These exercises blend expert opinions and comprehensive viewpoints to create multiple plausible futures for international protection in the EU, ranging from the digitalization of asylum processes to climate change, the impacts of artificial intelligence and technology, and the state of democracy on migration trends.

9.2 PREDICTING THE UNPREDICTABLE: LOST IN TRANSLATION?

Historically, there has been a mismatch between the usefulness of forecasts and scenarios and the expectations of the average user. Decision makers and policymakers at all levels should bear in mind that forecasts do not provide deterministic outcomes but are instead tools that offer a glimpse into potential futures based on existing trends.

A commonly cited adage is that forecasts, as they currently stand, can predict the trajectory of ongoing developments, but they are less adept at pinpointing the emergence of new crises yet to manifest. Another telling and equally revealing mantra states that the future is already here; it is just not very well distributed. That is, many of the factors likely to influence future migration trends already exist, albeit in small, isolated and often undetectable clusters.

Expecting 100 per cent accuracy from forecasts is impractical, as history attests to their limitations, as evidenced by unforeseen events including the Arab Spring, the 'refugee crisis' of 2015–16, the COVID-19 pandemic, Russia's invasion of Ukraine and recent developments in Israel. These events, often described as 'black swans' (Taleb 2007), highlight the inherent unpredictability and complexity of forecasting, especially over long periods of time, as these unpredictable events tend to be the strongest drivers of asylum trends in the EU+.

Therefore, effective and repeated communications about the purpose and limitations of forecasts is essential if they are to be integrated into decision-making mechanisms (see Chapter 8). Policymakers need to be aware that forecasts create a version of the future based on the recent past and do not (and may never) deliver crystal balls that can foresee the nature and extent of new crises yet to emerge. This understanding is

crucial for forecasts to be used appropriately and maintain credibility in policymaking circles.

We propose two simple principles towards achieving clarity and credibility. First, every forecast should be accompanied by a transparent description of the methodology used. This transparency empowers users to critically assess the forecast's strength and reliability. Statements lacking proper substantiation (e.g. 'we forecasted the number of migrants') offer little value and do not contribute to the advancement of credible and accountable forecasting practices.

The second principle is that of conducting backtesting – evaluating the accuracy of past forecasts in comparison to actual outcomes – and making the results available. Acknowledging and addressing both successes and failures from previous forecasts fosters accountability and transparency within the field. By openly recognizing and learning from these experiences, the field of forecasting can evolve into a reputable and trustworthy discipline.

In the realm of asylum and migration forecasting, the different dimensions of complexity and uncertainty inherent in the field present a challenging landscape for forecasters. Insights from research projects such as QuantMig and experiences of entities such as the EUAA offer valuable lessons for the broader forecasting community.

The key to effective forecasting lies in the ability to translate intricate data and complex predictive models into actionable insights that can support and enable policy formulation and decision-making. This translation requires not just numerical proficiency but also knowledge of the operational environment of decision-making, plus contextual understanding of the geopolitical, humanitarian and policy-driven factors that influence asylum and migration trends. Forecasters must navigate the delicate balance between providing technical and robust forecasts while also maintaining the accessibility and relevance of their findings for a non-technical audience.

To this end, we propose a new role – that of a *data translator* (Marr 2018) – who would act as an intermediary, bridging the gap between the deeply technical world of the forecasting community and the pragmatic realm of policymaking. This role would represent a pivotal link in ensuring that research findings reach policymakers through effective communication and that the needs and concerns of policymakers are accurately conveyed back to researchers. Ideally, this would produce a cycle of back-and-forth communications between forecast producers and consumers, a process that is currently almost entirely absent. It is not

unreasonable to assume that an engaging presentation delivered by a data translator plus an interactive workshop with policymakers would be a more effective method of disseminating forecasts compared with PDF reports, which often languish in email inboxes. Importantly, workshops would also provide an ideal platform for forecasters to highlight critical knowledge gaps. This collaborative process would lead to the development of bespoke data collection, articles integrated within legislative frameworks, and technical infrastructure, thereby ensuring the collection and delivery of highly relevant data that would underpin and advance the next generation of improved forecasts.

This data translator role would be particularly important given the challenges in understanding asylum trends and the increasingly complex methods used to forecast them. Asylum flows, influenced by a multitude of unpredictable factors (e.g. geopolitical changes, humanitarian crises, policy shifts), require a nuanced understanding and communication of the data, the analyses and their implications. Hence, any data translator should also possess the ability to interpret complex statistical data and predictive models, transforming them into actionable intelligence for policy formulation and strategic decision-making. To be effective here, analysis tools and data analysts must be firmly integrated into the processes of decision-making and into the operational activities of organizations as a whole.

Scenario-building emerges as a vital tool in this context, because scenarios can be consumed by a broad audience and do not require any particular technical expertise. Scenarios allow senior officials to engage with a range of plausible future outcomes, preparing policymakers for various potential contingencies rather than a single predicted path. This approach is particularly pertinent given the unpredictable nature of migration, as it enables a more flexible and adaptable policy response. The work in this area, as evidenced by projects such as QuantMig, underscores the importance of preparing for diverse migration futures and crafting policies that can adapt to various potential outcomes.

9.3 RECOGNIZING AND ADDRESSING THE DISCONNECT: STAKEHOLDER INVOLVEMENT

A fundamental challenge in the realm of asylum and migration forecasting lies in the disconnect between forecasters and the policymakers for whom the work is conducted. While there is widespread acknowledge-

ment of the importance of evidence-informed and future-proof policy for achieving effective outcomes, many policies remain uninformed by the latest research and data insights (see Chapter 8). This disconnect often stems from the absence of direct engagement between forecasters and policymakers, leading to a situation where forecasters make assumptions about requirements rather than responding to specific or articulated needs.

Inevitably, policymakers must grapple with political considerations, such as the need to make decisions that are popular or politically expedient. This reality can lead them to prioritize short-term political goals over the best-available evidence, complicating the integration of research findings into decision-making processes. Aaron Wildavsky's *Speaking Truth to Power* (Wildavsky 1979) is particularly relevant for forecasters who seek to support public policy. The book argues for the importance of rigorous, honest analysis and the presentation of findings to decision makers in a way that is both understandable and respectful of their decision-making authority. The challenge is to balance the technical rigour of forecasting with the practicalities and political realities of policymaking. This approach aligns with Wildavsky's argument for effective communication between analysts and decision makers, ensuring that forecasts are not just academically sound but also relevant, timely and actionable for policymakers.

To address these challenges and foster a more evidence-informed approach to policymaking, increased collaboration between policymakers and researchers is essential. Entities that often engage with policymaking at the EU level (e.g. the EUAA) can play a pivotal role in this process. By attending key policy meetings and working parties, they can provide direct channels for communication and collaboration between forecasters and policymakers. Specifically, the following recommendations may foster productive collaborations:

1. **Joint Meetings and Workshops:** Regular face-to-face interactions should facilitate a better understanding of the needs and constraints of both parties. This can help forecasters tailor their outputs to be more relevant and actionable for policymakers and will help policymakers design policies that also generate the missing data needed to produce better forecasts.
2. **Training and Capacity Building:** Providing training for policymakers in research methods and evidence-informed policymaking can enhance their ability to understand and utilize complex forecasts.

Likewise, forecasters can benefit from training that focuses on migration management and policy implications.

3. **Feedback Mechanisms:** Establishing regular feedback mechanisms can help forecasters understand the impact of their work and refine their methodologies based on feedback from policymakers.

The EUAA has pioneered a novel approach to asylum forecasting by orchestrating joint efforts involving experts from the member states. This collaborative model, which amalgamates national forecasts into a unified framework, marks a notable evolution in EU forecasting methods. By integrating distinct perspectives – such as Austria's expertise on the dynamics of the Western Balkan route, Germany's insights on Syrian and Turkish asylum seekers, and Poland's familiarity with Ukrainians' movements – this approach significantly enhances the depth and breadth of the forecasting process.

A critical achievement of this stakeholder collaboration is the generation of joint reports and unified forecasts. These outputs, forged from diverse expertise and refined during forecasting workshops, provide a holistic view of asylum trends throughout the EU. The joint authorship approach liberates isolated pockets of expertise within member states, not only elevating the quality of the forecasts but also amplifying their impact across individual member states. This presents a distinct advantage over traditional academic research, which, despite its theoretical soundness, may not achieve the same practical influence and dissemination that practitioner collaboration offers.

The EUAA, particularly its Situational Awareness Unit, has been instrumental in this process. The unit's staff, with their proficiency in data science and theoretical methodologies, gain immensely from the real-world insights contributed by experts from member states. This synergy between technical know-how and experiential knowledge is vital for producing forecasts that are not just accurate but also pertinent and actionable.

One of the most significant benefits of this joint approach is the increased likelihood of these forecasts reaching and being considered by key decision makers in each member state. Reports co-authored and thereby endorsed by the member states themselves are more likely to be prioritized and acted upon, a feat that academic studies often struggle to achieve. This aspect is particularly crucial in policymaking, where the delivery of actionable insights to the right individuals is essential for informed decision-making.

9.4 CONCLUSION: A TALE OF TWO FORECASTERS

Who should lead asylum forecasts – academics or public institutions – remains a complex yet crucial question. Academic forecasts are celebrated for their novel and increasingly complex methodologies, which benefit from peer review but are often published in obscure, hard-to-reach academic journals, and their theoretical complexity can disconnect them from practical applications. This groundbreaking academic work, while intellectually robust and objective, may not always align with the need for regular and timely forecasts tailored to support specific government initiatives. Furthermore, the academic sphere often operates without the immediate pressure of accountability, due to its detachment from the field's day-to-day realities. This raises a critical question: Who is ideally positioned to advance the field of asylum and migration forecasting?

Public entities, including different branches of the European Commission (e.g. the EUAA, JRC, Frontex), the International Organization for Migration, and the United Nations High Commissioner for Refugees, offer a compelling alternative. They bring a combination of technical know-how and hands-on field experience, tailored to meet current operational objectives. Moreover, these bodies face direct accountability, particularly when their forecasts deviate significantly from reality. However, their direct roles in support of policy implementation can lead to potential conflicts of interest, especially when implementing policies shaped around their own forecasts. There is also a risk that some institutions might lean towards producing more sensational forecasts to garner media attention, bolster their reputation or secure additional funding. Certainly, policymaking organizations themselves should probably be discouraged from producing their own forecasts.

Herein lies the strength of initiatives such as QuantMig. QuantMig symbolizes an innovative fusion, blending the academic rigour of esteemed forecasters with the practical expertise of public bodies, including, but not limited to, the EUAA. This synergistic model effectively leverages the strengths of both domains, underscoring the importance of collaborative approaches in asylum forecasting. We commend the EU Commission for its backing and the QuantMig team for elevating the importance of asylum and migration forecasting within the EU policy arena. With the EUAA poised to support future ventures, this model

paves the way for a new era in forecasting, one that balances academic excellence with real-world pragmatism.

This chapter has explored the multifaceted world of forecasting at a critical time, when asylum and migration continue to shape much of the political landscape in the EU and negotiations on a new pact on migration and asylum are underway. With increasing demand to better understand the future, it is important to understand that forecasts are not infallible predictions but rather tools to guide policy in the face of uncertainty and rapid change. Managing expectations, communicating the inherent limitations of forecasting and emphasizing the nondeterministic nature of these tools are key to their effective use in policymaking. Furthermore, the data translator role emerges as essential in bridging the gap between technical forecasting and practical policy application and in potentially filling important knowledge gaps. Besides, joint forecasting initiatives, involving experts from across the asylum and migration spheres, exemplify the value of collective expertise. Such collaboration enhances the relevance and impact of forecasts, ensuring they are tailored to the diverse needs and contexts within the EU, and increases the likelihood that the outcomes will inform and influence policy decisions at national and EU levels.

The future of migration and asylum policy in the EU will benefit greatly from continued advancements in forecasting methodologies, increased collaboration between forecasters and policymakers, and a clear understanding of the practical application and limitations of forecasts. The role of academic and public bodies in this process, as potential contributors and also facilitators, is pivotal in shaping a policy landscape that is responsive, informed and adaptable to the ever-changing dynamics of migration and asylum.

10. Comment: dealing with uncertainty in population projections

Rainer Muenz

10.1 UNCERTAIN MIGRATION IN POPULATION PROJECTIONS

All population projections are based on assumptions about future trends in fertility, mortality and spatial mobility. Forecasting fertility and mortality is facilitated by two factors. First, data are available for the majority of countries. Second, changes over time are gradual (in most cases) and trends can more easily be identified. However, assumptions about future spatial mobility, including migration, are more difficult to make, and the range of uncertainty is much larger (see Chapters 3 and 6). From the demographic point of view, the challenge of large migration uncertainty has five main reasons.

1. Data Problems. Globally, only around 50 countries collect and publish useful statistical data on international migration (Buettner 2023). Even receiving countries that collect data hold more accurate information about immigration flows and the total stock of migrants than about emigration. In sending countries with available statistics, emigration is often under-reported. As a result, *net migration* gains or losses are often used as a proxy for flows that are unknown or insufficiently documented. This 'second-best solution' calculates net migration as a residual when changes in total population and numbers of births and deaths are known.[1] Most population projections (e.g. Eurostat, United Nations Population Division, US Census Bureau) continue to use the

[1] The residual method for calculating net migration is: total population change during a defined period (usually a calendar year or a decade between population censuses), minus births, plus deaths.

concept of net migration or, in the case of Lutz et al. (2014) and Lutz et al. (2019), a *migrant pool* model, where all emigrants are combined and then redistributed to their destination countries. In neither approach are the underlying demographic dynamics captured (Buettner and Muenz 2016, 2024).

On the one hand, relying on net migration is a useful workaround in the absence of more complete data. On the other hand, the residual calculation adds to the uncertainty, as very different flow volumes can result in the same net migration. In the end, neither past and present immigration nor emigration dynamics can really be understood by looking at net migration. In such cases it is not just the future that is unknown but also the actual migration dynamics of the recent past: actual migration flows into and out of a Persian Gulf state with low net migration will differ sharply from flows in a Sahel country with similar net volumes.

As far back as 1990, geographer Andrei Rogers wrote a famous requiem for 'net migrants, a non-existing category of individuals' (1990: 283). However, for reasons already described, demographers continue to use the concept of net migration when formulating assumptions for population projections. Rogers' requiem, it seems, was performed for something holding quite successfully on to life.

2. Incidence and Prevalence: Reversible Versus Irreversible Events. Mortality data capture a universal phenomenon. We are all mortal: every person sooner or later passes away. Fertility is less universal, but still relates to a majority of women. By age 45, between 70 and 90 per cent of women from a given cohort will have given birth to a child. What varies between countries is rather the average number of children and the mean age of mothers when giving birth.

Births and deaths are binary events shaping the size and age distribution of populations. People are born, live, and die at a given moment in time. While the size of cohorts may differ, the underlying fertility and mortality trends are usually stable and therefore easier to anticipate. As a result, in 'normal' times (i.e. in the absence of war or epidemics), demographic projections are fairly accurate when migration has no significant impact.

The status of being a migrant, however, is reversible and usually relates to a minority. A large majority of people never experience spatial mobility across international borders: only 10 to 15 per cent of people living on our planet ever move to another country for an extended period

of time. All international migration events are the result of decisions taken by this minority. From a stochastic point of view, this already makes international migration more volatile.

Through cross-border mobility, people who become international migrants during their lifetime also become part of the foreign-born population of a given country and thus part of yet another minority. There are very few countries (e.g. Qatar, United Arab Emirates) with a majority of foreign-born people among their resident population. When people remigrate this status no longer applies. A return flow therefore reduces the stock of migrants.

From a demographic point of view, most of the uncertainty about future population size and composition comes from the effect of international migration driven by this mobile minority of people. This is true for both sending and receiving countries.

3. Different Types of Flows. Some migration flows are steadier than others (see also discussions in Chapters 4 and 6). For the European Union (EU) this can be exemplified by time series of different types of first residence permits issued by member states and other pathways (Figure 10.1).

- The annual number of non-EU citizens admitted for **marriage or family reunion** had the lowest volatility. It varied between 433,000 (2013) and 773,000 (2022) and displayed an upward trend.[2]
- The number of people admitted for **work and employment** reasons was more volatile. It started to decline in 2010, reaching its lowest level at 175,000 in 2015. After 2016, numbers admitted for labour and skills rose again, reaching 843,000 in 2022.[3]
- The inflow of **asylum seekers** was even more volatile. Starting from low levels in the mid-2000s the flow reached a first peak in 2015–16, when first asylum requests reached 1.2 million in both years. During the following years annual numbers dropped, to 417,000 in 2020;

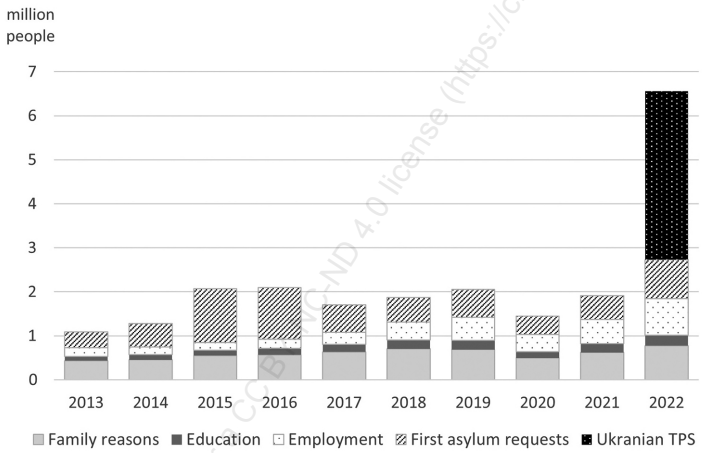
[2] Only first permits issued for a period of 12 or more months are considered. People entering an EU country for less than 12 months are not considered migrants under current definitions (see Chapter 5). Source: https://ec.europa.eu/eurostat/web/migration-asylum/international-migration-citizenship and https://ec.europa.eu/eurostat/web/migration-asylum/managed-migration.

[3] Only first permits issued for a period of 12 or more months are considered.

a low number, which can partly be explained by COVID-19-related border closures and travel restrictions. In 2023 first asylum requests returned to above 1 million.[4]

- The single most important flow occurred in 2022, when over 5 million Ukrainians displaced by the Russian invasion of their country arrived in the EU and were given **temporary protection** status. Some 3.8 million remained in an EU country until the end of that year.[5]

The European example is based on fairly solid data provided by countries with high statistical standards. It demonstrates that it is almost



Note: TPS = Temporary Protected Status.
Source: Eurostat, data tables migr_resfirst, migr_asyappctza and migr_asytpsm, as of 15 August 2024. Only residence permits issued for a period of 12 months or more are included.

Figure 10.1 Total inflows of non-EU citizens to the EU27 by type of arrival and permit, 2013–22, in millions

[4] Source: https://ec.europa.eu/eurostat/web/migration-asylum/asylum/database.

[5] See https://home-affairs.ec.europa.eu/policies/migration-and-asylum/common-european-asylum-system/temporary-protection_en (accessed 1 February 2024).

impossible to model and forecast flows of asylum seekers and others seeking protection. A one-off event, such as the inflow of millions of Ukrainians, can only be anticipated by horizon-scanning techniques (see Chapter 6).[6]

4. Migrants From Somewhere Or From Anywhere? Over time, some migration corridors become less relevant (e.g. Mexico–United States) or almost disappear (e.g. Turkey–Germany); others emerge (e.g. India–United Arab Emirates). Population projections made at national or regional level do not need to capture such changes. As the future geography of flows by corridor is uncertain, the underlying projection model can treat immigrants as coming from and emigrants as moving to anywhere (i.e. 'rest of the world'; see Chapter 5). Global population projections, however, need to have an aggregate net migration balance equal to zero. In the underlying projection model, all migrants need to come from somewhere.

In 1993, another requiem was published by geographer David Plane, trying to bury the fixed-transition-probability migrant (Plane 1993). Here, the critique of conventional approaches to modelling migration was taken one step further. Plane argued that although migration in multiregional models is formulated (in a broad sense) as *flows*, the models typically assume constancy of emigration rates (or fixed transition probabilities) and neglect the interactions between sending and receiving countries or regions. At the same time, most students of multiregional demography are still shown the beauty of stationary multiregional models with fixed transition probabilities. One reason for maintaining the constancy assumption is that it allows for concise mathematical analysis with attractive solutions. Like Rogers' requiem, Plane's call to move away from the unrealistic assumption of fixed transition rates is yet to be adopted more broadly in practical applications of multiregional projections.

5. Will Migration Last? Past World Population Prospects (WPP) projections made by the UN Population Division (UNPD) assumed that international migration would come to an end (at least on a net basis). Until the early 2010s, the end of international migration was set to materialize in 2100. Later, this end was moved to 2150. As a result, projected

[6] For the EU see: https://espas.eu/horizon.html (accessed 1 February 2024).

net migration flows became smaller over the projected period. This was based on an underlying global convergence hypothesis, assuming the emergence of similar living conditions in all (or at least most) parts of the world, making international migration 'unnecessary'. From that point of view, migration is a deviation from an equilibrium. Since 2022 the UNPD has dropped this convergence hypothesis when modelling migration. In the recent WPP projections, future annual net migration no longer declines over time.

10.2 DEALING WITH UNCERTAINTY: A WAY FORWARD

So far, demographic projections that include separate assumptions for immigration and emigration are rare.[7] This is, however, the way forward. At national and European levels, more accurate flow data can provide the basis for such a change (see Chapter 5). At the global level, ongoing data collection efforts are taking place in the framework of the Global Migration Database. This initiative has commenced under the auspices of the UNPD (UN 2014, 2020), and continues through ongoing collaboration between the UN Statistics Division and the World Bank (Özden et al. 2011). These efforts have produced a sufficient empirical base to enable translation of the available stock data into bilateral flow estimates (Abel and Cohen 2019, 2022; Azose and Raftery 2019; Abel 2022).[8] Incorporating these data into a population projection model allows for population forecasts that account for all possible bilateral (origin–destination) migration flows globally. These can then be broken down into regional and national levels.

Population forecasts that account for immigration and emigration separately, as is also the case with scenarios presented in Chapter 7, address at least the uncertainty linked to the use of net migration. They also allow for specifications in the assumptions that can address other

[7] The reasons why international migration should play a role in population projections are argued in Buettner and Muenz (2016). For attempts to incorporate bilateral migration flow estimates see: Rikani and Schewe (2021); Buettner (2023); Koeppen et al. (2023); and Buettner and Muenz (2024).

[8] For an appraisal and visualization of Abel's results, see Koeppen et al. (2023). This application also shows inconsistency and limits of the underlying data published by the UNPD.

areas of uncertainty, by quantifying scenarios capturing alternative futures and/or the effects of anticipated geopolitical or migration policy changes.

11. Contested realities: context and the ethics of migration scenarios

Ann Singleton

11.1 DATA, FORECASTS AND SCENARIOS: WHAT ARE THE ISSUES?

This book makes a unique contribution to the literature on migration and demographic forecasting and to new thinking on migration and mobilities. In addressing uncertainty and pushing at the conceptual limitations of certainty, it embraces risk in several different forms: the risk of disciplinary criticism, the risk of challenging boundaries of quantitative and qualitative methods, and the risk of incorporating uncertainty into a policy-oriented output, when the policy world cries out for certainty. These risks are compounded by temporal dimensions of uncertainty and precarity in forecasting. As discussed in Chapter 2, uncertainty increases with the forecast horizon (see also e.g. Bijak 2010; Sohst and Tjaden 2020, as cited in Laczko et al. 2023, among many others).

Previous work (Singleton 1999) highlighted that migration statistics were not up to the job of measuring migration flows. Despite more than two decades of subsequent intensive work by many scholars and policy officials, the coverage and quality of these statistics remain patchy, even in the European Union (EU), where legislation underpins a common migration data system. In this context, there are methodological and ethical concerns involved in the production and reproduction of concepts and definitions embedded in the official data used in forecasting. When these concepts and definitions are uncontested, this has consequences for the reproduction of research and policy gaps. When the gaps are a product of the framing of what constitutes migration and of the knowledge produced by existing methods and definitions, how do we factor in the possibility that the concepts and definitions used, together with the gaps, distort our understanding?

Taking the risk of being perceived as not directly relevant to current academic and policy concerns, of saying the unsayable, also requires intellectual rigour and courage. This is the time for such courage, as preceding decades have seen the evidence base for migration policy limited by the disciplinary boundaries of demography and statistics. The policy agenda in Europe has in many ways become sclerotic, apparently fixed in an ever-repeated 'crisis' narrative and reactive measures. In policy circles, the discussion of migration drivers tends to ignore the contribution of policy to producing gaps and hidden dimensions of migration. However, the political economy of migration research and policy demands that a reflexive approach to defining migration as a process is necessary in the discussion of drivers of migration (see Chapters 3 and 4).

Similarly, arguing for the inclusion of uncertainty in forecasts also brings a challenge. If uncertainty is proposed to address the problems, could it be just a conceptual 'fix', providing a solution to the gaps when those gaps are produced as a shadow to the visible data? This discussion needs to address the ways in which migration can be defined, as well as the political economy of the production of gendered and racialised inequalities in the evidence base.

Forecasting and scenario-building involves quantifying different variables or measures, often involving official statistics, and in most cases will include an inherent linear and predictive logic. Such a linear conception of knowledge and science communication with policy, even under a two-way knowledge exchange model, as discussed in Chapter 8, also risks reproducing the same gaps in evidence and in policy. As Hattan (2024) argued in her recent public lecture, the very notion of such a logic is predictive 'and gaps and fissures are rarely shown'. How do we avoid reproducing the gaps where the potential for explanatory power lie? Policy-relevant analysis requires insights with explanatory power, rather than just descriptive analysis based on official data.

The process of state-building drives and is driven by the categorization of groups and processes of othering. This has consequences for state-building, as the work of Ruppert and Scheel (2021) has shown, including the building of the EU as a political entity. The phenomena that are missed and which could bring explanatory insights are those which remain unseen by mainstream disciplinary approaches. As such, any grounding of forecasting in a knowledge base rooted in official statistics is necessarily self-limiting, as is assuming that national (or European) boundaries, borders and policymaking frameworks will remain fixed over time. The limitations of methodological nationalism or Eurocentrism,

and the false dichotomy of quantitative and qualitative methods, can also lead to a lack of insight and to a conceptual ossification.

In this context, it is important to question the role of forecasting and the contribution of scholarship to the political project of the EU. Who are 'we' in this process? Who are the researchers, policymakers and statisticians? Whose understandings are informing the assumptions behind the forecasts? What is missing from the picture and what are the implications for forecasting which risks reproducing the *colonial gaze*? Imagination beyond the disciplinary method and insight from those with lived experience is needed to overcome these limitations. As Squire (2024) has pinpointed, the insights of those with lived experience of precarity can illuminate, for example, our understanding of the dynamics of labour migration, otherwise missed in modelling.

Knowledge gaps and data gaps in forecasts cannot be 'filled in' by using the same frame of reference, concepts, definitions and methods that lack the explanatory power to identify and explain those gaps. The example of labour migration presents a case in point. How is it possible to forecast work-related migration without accounting for the dimensions of precarity or the hidden economy? Where are the economic projections that address the future scale of precarious work?

It is also important to consider how temporal dimensions are relevant to understanding and measuring precarity and harm (Anderson 2010). Missing the temporal dimension in commentary on undocumented and irregular migration is one example of how the dynamics and political economy of migration are missed. Using the concept of uncertainty more broadly can be a first step to unravelling the inherent assumptions and racialized and gendered categories that are reproduced – usually unchallenged – and compounded in forecasting.

However, it is incumbent on social scientists to respect an important principle of social science: do no harm. Demography, statistics and migration studies are all rooted in the emergence of the nation state (Singleton 1999), with its structural inequalities and power imbalances. As Squire (2024) showed, this cannot be ignored. A full understanding of the dynamics of migration and different forms of human mobility is necessary, but at the same time is not possible when conceived solely as a subset of population or demographic studies. As such, academic endeavour can deepen inequality when the production of knowledge simply *reproduces* racialized and gendered categories of information and when the limits of methodological nationalism or Eurocentrism remain uncontested.

Introducing uncertainty explicitly into forecasts, and underlining the need to acknowledge the validity of its inclusion, allows the limitations of mainstream methodology to be overcome, in principle. Including a wider range of actors in the research design and policy process may appear to present a challenge to notions of scientific rigour and to involve ethical issues. However, not including a wider range of voices is also an ethical issue.

11.2 WHAT CAN BE DONE?

Forecasting measurable outcomes for which the unit of measurement is that defined in pre-existing data categories is one challenge. How then do we forecast the dynamics of migration and mobilities? These dynamics include individual human responses to changing state practices and to unknown and unforeseen social and economic contexts. The literature on science and society has exposed time and again the harm caused when academic activity produces knowledge about people without the input and insights of those who are the subject of enquiry.

Decolonizing migration studies (if this is at all possible), exploring the potential of new concepts and paradigms (Squire 2024), and debunking myths (de Haas 2023) are all necessary steps. The ethical challenge for migration researchers is how to develop methods – or, more broadly, methodological approaches – that include the lived experience and insights of people who are defined as migrants and those who are not, as well as building on the data and even policymakers' insights. A reflexive approach is needed, allowing for doubt and uncertainty and being open to different forms of knowledge. This has potential to enrich the scope and depth of research enquiry and can be used in the ongoing process of identifying and understanding how to work with uncertainty.

This challenge applies to forecasting methods as much as to other qualitative and quantitative methods. Methodological approaches including co-production or incorporating different knowledge bases, such as Indigenous knowledge, connected with a specific place or group of people, can bring insights into lived experience that might otherwise be overlooked. The lived experience of precarity in the labour market is a powerful example of a dimension of migrant lives that is needed to illuminate forecasting methods.

Squire (2024) discussed the potential for people with direct experience of migration to make various *migratory claims*, or in other words, legal, social or cultural claims related to their migrant status. Such claims can

be made with respect to safety, rights, recognition, or other aspects of citizenship and participation in social life. The emerging concept of *global citizenship* is specifically suggested as an analytical lens 'by which to analyse the politics of precarious migration' (Squire 2024: 1). An inventory of such migratory claims can become an important frame of reference for the creation of data, scenarios and forecasts, which all at the end of the day remain political and social constructs (see Chapter 2). Incorporating such conceptual thinking into future forecasting methods might bring the reflexivity necessary to overcome the hegemony of current methods and approaches to forecasting.

PART V

Conclusions

12. *From Uncertainty to Policy:* concluding remarks

Jakub Bijak

12.1 MIGRATION SCENARIOS: BRIDGING THE THREE GAPS

Throughout this book, we have proposed and evaluated a process of setting realistic migration scenarios to address policy challenges. The key lesson from our scenario-building exercise is that there is no single way of achieving this goal: the ubiquitous uncertainty of migration demands humility and clear communication about the limits of what can be offered for which future horizon (Chapter 2). Bearing this uncertainty and the underlying complexity of migration in mind, we have proposed a blueprint for exploring future migration flows across a range of time horizons. The blueprint has three main components. The first stage consists of gathering current knowledge about the processes of interest and their uncertainty (Chapters 3, 4 and 5). The second stage involves setting scenarios based on user needs and decision horizons but acknowledging the unique nature and dynamics of different flows that will drive the choice of a method (Chapters 6 and 7). The third stage is all about communicating the scenarios and their uncertainty – and other limitations – to users (Chapters 8 and 9; commentary Chapters 10 and 11). Although we have tested the blueprint on European migration, which is used as an illustration throughout the book, its design allows its application to any other migration context with available data, even imperfect data.

To make the blueprint work, three challenges or gaps need to be acknowledged.[1] First, with respect to scenario production, there are **gaps in the current knowledge, data and methods** for migration scenario-setting: some can be overcome by more data or better methods, but some are simply irreducible. Second, at the user end of the spectrum, there are **gaps in policies and decisions** with respect to achieving the desired aims and outcomes in the light of the best available knowledge. Third, between users and producers, even with the best intentions, there are **communication gaps**. Trying to fill them reveals the pivotal roles of researchers and scientific advisors, who can – and should – act as *honest brokers* (Pielke 2007) and also as trusted partners in communicating, not being afraid to say that we do not know everything (Chapter 8).

To start with, **knowledge gaps** are inevitable: this is just a way of aleatory uncertainty manifesting itself, even over short horizons, not to mention longer ones. Perfect knowledge of future migration does not exist (Chapters 2 and 3). Even when applying state-of-the-art tools, the statements we can make about the future may vary widely, depending on the methodological choices made (Chapters 6, 7 and 9). This fundamental limit of knowledge needs to be borne in mind, even if there are many promising ways of elucidating the complex migration reality further. One area that has only recently started gaining traction involves computer-based simulation of what-if scenarios (for examples, see Bijak et al. 2021b), to show trade-offs and possible unintended consequences of various processes and decisions. In this respect, one particularly interesting question for future exploration is: How does the agency of migrants interact with the agency of states, expressed through various policies?

Knowledge gaps are compounded by **data gaps**. Migration data exist, but in scattered form, and often do not measure migration but something loosely related (administrative processes, online or phone activity). No single source is perfect, and different data may not map directly onto what decision makers need. For official statistics, harmonization is a worthwhile effort, but the primary challenge remains availability. In other words, it is better to have some data and correct for any imperfections by using models than to have no data at all (Chapter 5). For all the enthusiasm and promise of novel forms of data (mobile, digital, satellite, etc.), which can be very useful for some purposes and time horizons, their

[1] The credit and thanks for the conceptual framing of these three gaps go to Ann Singleton.

limitations (including ethical ones) need to be better understood and their use for research and policy purposes better regulated, to avoid dual use or other harms (Chapter 11).

In this realm, further work could involve harnessing and testing more data and types of information on the one hand, but also better understanding the data and ethical challenges on the other hand. In that context, including additional perspectives (e.g. migrants' own) in the picture does not only follow a moral argument, as presented in Chapter 11, but also a pragmatic one. More information from multiple different perspectives should ultimately make scenarios more robust and useful, as long as the ethical challenges of protection against harm and dual use are addressed.

The fundamental **methodological gap**, in turn, is that there is no single way of translating scenario narratives into numbers. Numbers are not always needed, least so for strategic decisions, and can even be unhelpful, distracting from the more important aspects of migration processes. At the same time they can be indispensable for planning purposes. The civil contingencies approach we proposed in Part III of this book offers a simple and interpretable, if still approximate, way of carrying out such translation of a preparedness narrative into numbers. In this area, further work could include fine-tuning estimation of the underlying statistical distributions and including explicit *loss functions*, to reflect the trade-offs between the costs and benefits of preparedness. This is yet another area in which communication between users and producers of scenarios is crucial. Another promising line of enquiry could be to add more explanatory power to predictive models, through simulation or other means (see Willekens 2018).

As for **policy and decision gaps**, what should politicians and other decision makers be aware of? Migration is inherently complex and uncertain, and this complexity and uncertainty will not disappear, even with better data and methods. The diversity of migration processes must also be acknowledged: given how different they can be, with respect to who is migrating, from where and how, there can be no one-size-fits-all solution. Uncertainty is generally largest for irregular and asylum migration and lowest for family reunion, but closing or opening legal migration channels can lead to people switching between different categories (Chapter 3, see also de Haas 2023). Crucially, even though the examples we gave in this book related to Europe, as migration processes are global, the same principles and methods can be applied elsewhere.

To that end, throughout this book we have looked into two aspects of preparedness (see Chapter 2). The methodological advancements in

scenario-building (Part III) are aimed primarily at the first aspect: ensuring sufficient capability to respond to unforeseen events. The responses and their constraints (Part IV) involve the second aspect: designing management practices in such a way that guarantees the continuity of operations and processes or, to use a popular phrase, ensures their resilience. The first aspect can be helped by better scenarios, but the second – besides data and knowledge – requires appropriate communication and adequate resourcing. The question of resources as such is not a topic for scenario research but rather a matter for an honest political debate and working towards a public consensus, which would translate into a political mandate at national or pan-national levels.

To bridge the **communication gaps**, it would help the debate if migration were reframed as a normal fact of life: neither a threat nor a boon (de Haas 2023). Ideally, this would need to be accompanied by a moving away from the 'crisis' narrative and alarmism, so visible in the case of climate-related mobility or various misplaced economic arguments about 'welfare magnets' etc. (Chapters 3 and 4). At the same time, the boundaries between communication (and research more broadly) and political activism or advocacy should not be blurred. Still, we need to remain vigilant with respect to the ethical challenges related to migration and its scenarios. One of those is linked to dual use, where scenarios can be used by malevolent actors to weaponize migration for geopolitical aims (Greenhill 2016). The creation of state-sponsored migration pressure at the Belorussian–EU border since 2021 can be interpreted as an example of such weaponization (Filipec 2022). A possible remedy lies in restricting access to some of the more critical operational scenarios, to reduce their vulnerability to misuse. Another ethical risk relates to possible misappropriation of scenarios for political gains, for example through biased presentation of results to score populist points in an electoral contest, although this can be countered, to some extent, by effective communication strategies.

In addition, the gap between scenario users and producers can be reduced by their working more closely together (Chapter 9). From the producers' side, better communication of results is worthy of additional effort, especially with respect to their uncertainty (see Raftery 2016). The message here needs to be simple – but not oversimplified – and honest about its limits. There are indications that especially after the COVID-19 pandemic of 2020–1, the general public is better attuned to the message about scientific uncertainty. According to encouraging empirical research (Kerr et al. 2023), uncertainty does not seem to reduce trust in the general

message, even though it may slightly – and rightly – reduce trust in any 'single number' values. On the policy (and media) side, this improved communication can be matched with developing and promoting the *just culture*: accepting that even the best-designed systems, processes and scenarios, can – and will – every now and then miss their aims and not deliver. The key is to use mistakes as an opportunity to learn and change the processes, making them more future-proof, rather than apportioning blame (e.g. Catino 2008).

The focus on the link between scenario producers and users, or more broadly science and policy, does not preclude other society-wide initiatives, such as improving numerical literacy skills, with a focus on statistical understanding of uncertainty (Spiegelhalter 2017). Future migration stories can be told through numbers, but these numbers can also form the basis of narratives that at a general level cut through to the broader public consciousness. There are numerous examples of success stories in many areas, including popular science reading on topics related to our book (see Taleb 2007 or Wucker 2016 on dealing with uncertainty, or de Haas 2023 on migration myths). Crucially, this debate should not be the domain only of highly trained specialists and intellectuals but also of the general public. To that end, in this book we have aspired not only to transform the theory and practice of creating migration scenarios, and migration futures studies more broadly, but to communicate them clearly in a non-technical way. We hope we have achieved our aim, or at least have made a step in the right direction. We present our final thoughts on the future of migration and its scenarios in the last section.

12.2 SHAPING THE FUTURE OF MIGRATION AND ITS SCENARIOS

One other tacit ambition of this book has been to inform prospective work on migration futures so it can be of better quality and more realistic. As we argued earlier, there is much productive work to do on aspects of migration that we do not yet know, expanding the epistemic boundaries of what *can* be known and what can therefore be realistically expected. At the same time, we very much advocate expanding the focus to what *cannot* be foreseen but needs preparing for. If we manage to include uncertainty in mainstream social and political discourse, it will help move policy responses away from the false illusion of control (see Chapter 3). At the same time, we need to remain clear-headed and realistic, so that

long-term preparedness goals are not jeopardized by overreaction to specific sudden-onset migration events.[2]

Of course, the future migration policy agenda is very likely to drive the future research agenda, not least through funding, and our work is a prime example of that, being funded through a dedicated call within the EU's Horizon 2020 programme (see Acknowledgements). It is still the case that both migration data and forward-looking studies (e.g. forecasts, scenarios) are social and political constructs and respond to specific political aims or needs. At present, the main directions of such research priorities, at least in the European context, seem to be threefold: (1) asylum and irregular migration, due to their political salience; (2) labour migration, due to sectoral shortages and long-term implications of population ageing for health and social care; and (3) depopulation of selected more peripheral regions through migration. As argued throughout the book, these different challenges require a varied set of methods and approaches but still need to follow similar principles to make meaningful differences to policies and (hopefully) reality.

In Czaika and Bijak (2020), we suggested five such principles, which could guide preparedness for migration surprises and therefore serve as priorities to be addressed through migration futures studies, including scenarios, forecasts and simulations. First, it is important to know the systemic risks, causes and vulnerabilities, and these can be identified through stress-testing migration policies through what-if methods (Chapter 6). Second, there is a need to find out the reasons behind the failures of individual policies and learn lessons from them in an open way. Third, given that resources are always short, good-enough methods for examining migration futures should be developed (Chapter 3): this holds for data and monitoring, building new knowledge, and exploring scenarios and their uncertainty. Fourth, on that basis, we can then start thinking about future-proofing migration governance, by building in systematic reviews of the processes, decisions and communications, ensuring that solutions are adaptable and scalable in the face of uncertainty. Last, but by no means least, a switch to the *just culture*, with willingness to learn

[2] It can be argued that this overreaction is fuelled by the availability of higher-frequency data on some migration processes than others, the reaction being amplified through high media attention and the demands of the 24-hour news cycle (with thanks to Rainer Muenz and Marie McAuliffe for this observation).

from mistakes rather than necessarily pinning blame, allows planners to be better prepared for the unpredictable. This, as argued before, needs reserves in terms of resources (e.g. money, work, spare capacity and time, processes and legal frameworks) that can be activated if needed.

In Box 12.1, we summarize five key lessons we have learned from carrying out the work presented in this book. These lessons, based on the *White Paper on Migration Uncertainty* (Bijak et al. 2023), can serve as recommendations for future migration policy and practice.

BOX 12.1 LESSONS LEARNED: RECOMMENDATIONS FOR FUTURE MIGRATION POLICY AND PRACTICE

I. Don't focus on numbers, except for planning. Future migration levels are too uncertain to offer a reliable basis for any strategic policy direction. Instead, policies should focus on what they are trying to achieve and explore the broader implications of migration by using different scenario tools.

II. Present and future numbers are very uncertain. Even for operational planning and response purposes, the uncertainty of migration numbers needs to be acknowledged, communicated and managed. Methods for short horizons (e.g. early warnings) can effectively help with this.

III. Migration is an independent process, not a target. Policies do not easily translate to changes in migration processes, which are complex and result from decisions of many interacting actors. Using what-if scenarios can help reconcile the trade-offs between different policy priorities.

IV. Design policies for their purpose, not headlines. Scoring political points through migration may be tempting, but continuously overreacting to single events is counterproductive. To better prepare for the future changes, focus on the impacts that really matter and be honest about uncertainty.

V. Future-proof policies and procedures by design. Policies, procedures and regulations, including some aspects of legislation, would benefit from regular checks and updates to ensure that they remain fit for purpose. Scenarios, once set up, also need regularly updating as a matter of routine.

Source: Bijak et al. (2023: 26).

One important element of future-proofing of processes, policies and procedures is especially important in the context of scenarios. To be effective and reflect current knowledge and its limits, scenarios should ideally be continually – or, in practice, periodically – revised in the light of new information and methodological advances. From a statistical viewpoint, this has a natural Bayesian interpretation: updating *prior assumptions* with new data to turn them into *posterior knowledge* and hopefully reduce the uncertainty. Moving towards this ever-better-informed future requires a constant inflow of new data and knowledge.

Applying these principles in practice requires long-term political commitment and funding to match. Given competing priorities, we contend that efforts should be focused where gains may be greatest, so on processes with the highest uncertainty (e.g. asylum or irregular migration flows). With the adoption of the EU Migration Preparedness and Crisis Blueprint, we are already witnessing a change of perspective in the policy sphere. As it becomes more broadly accepted that precise prediction is impossible, more efforts are being switched to preparing for, managing and adapting to the changes and challenges of migration, including sharing commitments where necessary (e.g. in the case of asylum).

At the same time, this updating cannot be too frequent, to avoid furthering the practice of *incremental fine-tuning* of policies and procedures (Chapter 3). If we are to avoid overreacting to rapidly changing news headlines, the time frame for updating policies (and by extension also scenarios, forecasts and early warnings) needs to be reasonable but also flexible. For practical reasons, due to resource implications, it may be worthwhile to update the tools every year or every time a significant shift in migration trends occurs (e.g. on the scale of asylum-related migration from Syria in the 2010s or Ukraine in the 2020s). This is very important, given the great uncertainty about specific regions of origin. An alternative option could be to connect scenarios, forecasts and early warnings explicitly to a horizon-scanning exercise; this would generate the impetus to update every time there is a suspicion of an upcoming shift in a certain migration stream or a disruptive change in some parts of the world.

However, as most migrants come through legal pathways other than asylum, this points to further challenges for research aimed at supporting policy. There is a need to collect data on duration of stay and the demographic and economic behaviour of different groups of migrants, with respect to their return propensities, integration into the destination labour

markets, educational priorities, etc. For existing data sources, improving their interoperability (ability to be used *jointly* in different contexts to answer a variety of questions) is a challenge. For individual-level data, linking is an appealing option, but this needs to be accompanied by privacy and other ethical safeguards. Another open-ended area of ongoing work that will continue into the foreseeable future is deepening our knowledge and understanding of migration drivers and of individual aspirations and capabilities, and their interactions. Specific topics yet to find scientific consensus – or rather, where both epistemic and aleatory uncertainty currently remain very high – include the two-way relationships between environmental change and migration (Foresight 2011; de Haas 2023) and between economic development and migration (Clemens 2014; McAuliffe et al. 2021; see also Chapters 3 and 4).

There are further ways in which scenarios can be developed. Existing models can be expanded and fine-tuned, possibly to gain improved understanding of not only drivers but also the causal mechanisms through which drivers operate (Willekens 2018). Such models (e.g. based on simulations) can be made even more realistic by including aspirations, decisions, actions and interactions of various actors and also an assessment of some of their uncertainty (Bijak et al. 2021b). Still, we must remember that due to the presence of aleatory uncertainty, even with the best models in the world, any answers to questions about numbers (*how many?*), when describing current and future migration, are only approximate. However, even with these limitations, models can still offer valuable indications of the direction of current – and likely future – trends.

For preparedness, even a broad indication of the order of magnitude (e.g. of the number of people requiring asylum assistance) can help us prepare for the unexpected. In addition, models can help by stretching the imagination of decision makers through what-if thought experiments and stress-testing. They can also illuminate the trade-offs between different variables in a migration and broader socio-economic system. Examples of relevant questions could include: If, hypothetically, migration reduced by half, how would the labour market look in 50 years' time? If prospective migrants found it more difficult to find legal employment, would they not come or come illegally? If border enforcement became tougher, how would this influence the migrant-smuggling market? The non-trivial answers to these and many other questions could provide policymakers with a more robust basis for their decisions.

Importantly, despite our examples being focused on Europe, the whole blueprint and the individual methods are not intended to be Eurocentric (Chapter 11). The approaches we propose are readily transferable to other contexts, as long as migration flow estimates are available (Azose and Raftery 2019; Abel and Cohen 2022). In addition, *within* Europe, they can help increase preparedness mechanisms, supporting civil defence efforts in case natural disasters or armed conflict directly affect EU+ countries. Their implementation would require development of an appropriate legislative framework, at least at EU level, parallel to asylum and temporary protection directives, to cover such eventualities and enable an efficient response.

On the whole, the process for scenario-setting and its critique, as we have sketched in this book, is not meant to provide definitive, once-for-all answers to policy-relevant questions. Rather, we see it as one element of a broader iterative scheme for offering continually updated policy advice in the quest for a better future. Seen in this frame, the various tools we presented – and many more – can provide incrementally better and more up-to-date answers to policy questions as new information becomes available. In this way, the epistemic part of the uncertainty is continually being reduced, with the aleatory remainder left to the domain of preparedness. Making migration scenario-setting part of such a – somewhat boring – updating routine can also help overcome the 'crisis' narrative and shift the discussion towards ever-better preparedness and resilience.

Perfect scenarios do not exist, and neither do perfect policies. However, with the ultimate policy goal of finding a balance between improving the welfare and security of both migrants and host societies, such an incremental approach promises a solution that is good enough and works and, even more importantly, can be always improved. This is not about grand solutions that are bound to overpromise and then fail to deliver. Conversely, this is about the quiet power of conscious, gradual improvements. This is about making migration and other policies work better and reconciling the interests of different groups of people. This is also about having a mature relationship with uncertainty, and being prepared to see it for what it is: a necessary fact of life, which cannot be wished away. At the same time, to paraphrase Leonard Cohen's

migration-themed song *Anthem*,[3] this is also about believing that some light will always find a way through the cracks in darkness and the uncertainty.

[3] Cohen, L. (1992) 'Anthem'. From the album: *The Future*. New York: Columbia Records.

References

All listed QuantMig Project deliverables are available from www.quantmig.eu (as of February 2024).

Abel, G.J. (2018) Non-zero trajectories for long-run net migration assumptions in global population projection models. *Demographic Research*, 38(54): 1635–1662.

Abel, G.J. (2022) Gender and Migration Data. KNOMAD Working Paper 44. Washington DC: World Bank. https://www.knomad.org/publication/gender-and-migration-data.

Abel, G.J., and Cohen, J.E. (2019) Bilateral international migration flow estimates for 200 countries. *Scientific Data*, 6: 82.

Abel, G.J., and Cohen, J.E. (2022) Bilateral international migration flow estimates updated and refined by sex. *Scientific Data*, 9: 173.

Abel, G.J., and Sander, N. (2014) Quantifying global international migration flows. *Science*, 343: 1520–1522.

Acostamadiedo, E., Sohst, R., Tjaden, J., Groenewold, G., and de Valk, H.A.G. (2020) Assessing Immigration Scenarios for the European Union in 2030 – Relevant, Realistic and Reliable? Geneva: IOM and The Hague: NIDI.

Anderson, B. (2010) Migration, immigration controls and the fashioning of precarious workers. *Work, Employment and Society*, 24(2): 300–317.

Anderson, B., and Blinder, S. (2015) Who Counts as a Migrant? Definitions and their Consequences. Migration Observatory Briefing, COMPAS, University of Oxford. http://migrationobservatory.ox.ac.uk/wp-content/uploads/2016/04/Briefing-Who_Counts_as_a_Migrant.pdf, accessed on 30 November 2023.

Aparicio Castro, A., Wiśniowski, A., and Rowe, F. (2023) A Bayesian approach to estimate annual bilateral migration flows for South America using census data. *Journal of the Royal Statistical Society A*, Online first: https://doi.org/10.1093/jrsssa/qnad127.

Arango, J. (2000) Explaining migration: A critical view. *International Social Science Journal*, 52: 283–296.

Aristotelous, G., Smith P.W.F., and Bijak, J. (2022) Technical Report: Estimation Methodology. *QuantMig Project Deliverable D6.3*.

Aristotelous, G., Smith, P.W.F., and Bijak, J. (2023) QuantMig Migration Estimates Explorer. Online database, https://bit.ly/quantmig-estimates, data downloaded on 5 December 2023.

Armstrong, J.S. (2001) *Principles of Forecasting. A Handbook for Researchers and Practitioners*. New York: Springer.

Aslany, M., Carling, J., Mjelva, M.B., and Sommerfelt, T. (2021) Systematic Review of Determinants of Migration Aspirations. *QuantMig Project Deliverable D2.2*.

Aslany, M., Sommerfelt, T., and Carling, J. (2022) Empirical Analyses of Determinants of Migration Aspirations. *QuantMig Project Deliverable D2.5*.

Atzmüller, C., and Steiner, P.M. (2010) Experimental vignette studies in survey research. *Methodology*, 6(3): 128–138.

Auspurg, K., and Hinz, T. (2014) *Factorial Survey Experiments*. London: Sage.

Azose, J.J., and Raftery, A.E. (2015) Bayesian probabilistic projection of international migration. *Demography*, 52(5): 1627–1650.

Azose, J.J., and Raftery, A.E. (2019) Estimation of emigration, return migration, and transit migration between all pairs of countries. *Proceedings of the National Academy of Sciences*, 116(1): 116–122.

Bann, D., Courtin, E., Davies, N.M., and Wright, L. (2023) Dialling back 'impact' claims: Researchers should not be compelled to make policy claims based on single studies. *International Journal of Epidemiology*, Art. dyad181.

Barker, E.R., and Bijak, J. (2020) Conceptualisation and Analysis of Migration Uncertainty: Insights from Macroeconomics. *QuantMig Project Deliverable D9.1*.

Barker, E.R., and Bijak, J. (2021) Uncertainty in Migration Scenarios. *QuantMig Project Deliverable D9.2*.

Barker, E.R., and Bijak, J. (2022) Could We Have Seen It Coming? Towards an Early Warning System for Asylum Applications in the EU. *QuantMig Project Deliverable D9.3*.

BBAW (2008) Leitlinien Politikberatung. Präsident der Berlin-Brandenburgischen Akademie der Wissenschaften. Berlin: BBAW. https://www.bbaw.de/files-bbaw/user_upload/publikationen/BBAW_Leitlinien_Politikberatung_2008.pdf.

BBAW (2022) Gute Wissenschaftskommunikation in der digitalen Welt. Politische, ökonomische, technische und regulatorische Rahmenbedingungen ihrer Qualitätssicherung. Report, *Wissenschaftspolitik im Dialog*, 19/2022. Berlin: Berlin-Brandenburgische Akademie der Wissenschaften. https://www.bbaw.de/files-bbaw/publikationen/wissenschaftspolitik_im_dialog/BBAW_Wissenschaftspolitik-Dialog_19_2022.pdf.

Beine, M., Bertoli, S., and Fernández-Huertas Moraga, J. (2016) A practitioners' guide to gravity models of international migration. *The World Economy*, 39(4): 496–512.

Bélanger, A., and Sabourin, P. (2017) *Microsimulation and Population Dynamics. An Introduction to Modgen 12*. Dordrecht: Springer.

Bell, M., Charles-Edwards, E., Ueffing, P., Stillwell, J., Kupiszewski, M., and Kupiszewska, D. (2015) Internal migration and development: Comparing migration intensities around the world. *Population and Development Review*, 41(1): 33–58.

Berger, J.O. (1980) *Statistical Decision Theory. Foundations, Concepts, and Methods*. New York: Springer.

Bernard, A., Bell, M., and Charles-Edwards, E. (2014) Life-course transitions and the age profile of internal migration. *Population and Development Review*, 40(2): 213–239.

Bertoli, S., Brücker, H., and Fernández-Huertas Moraga, J. (2022) Do applications respond to changes in asylum policies in European countries? *Regional Science and Urban Economics*, 93: 103771.

Betts, A., and Collier, P. (2017) *Refuge: Transforming a Broken Refugee System*. London: Penguin.

Bijak, J. (2010) *Forecasting International Migration in Europe: A Bayesian View*. Dordrecht: Springer.

Bijak, J. (2023) European Migration Scenarios with Probabilistic Uncertainty Assessment. *QuantMig Project Deliverable D9.4*.

Bijak, J., and Czaika, M. (2020) Assessing Uncertain Migration Futures – A Typology of the Unknown. *QuantMig Project Deliverable D1.1*.

Bijak, J., and Koryś, I. (2009) Poland. In: H. Fassmann, U. Reeger, and W. Sievers (eds) *Statistics and Reality: Concepts and Measurements of Migration in Europe*. Amsterdam: AUP (pp. 195–216).

Bijak, J., and Kupiszewska, D. (2008) Methodology for the estimation of annual population stocks by citizenship group, age and sex in the EU and EFTA countries. *Informatica* (SI), 32(2): 133–145.

Bijak, J., and Wiśniowski, A. (2010) Bayesian forecasting of immigration to selected European countries by using expert knowledge. *Journal of the Royal Statistical Society A*, 173(4): 775–796.

Bijak, J., Kupiszewski, M., and Kupiszewska, D. (2008) Replacement migration revisited: Simulations of the effects of selected population and labor market strategies for the aging Europe, 2002–2052. *Population Research and Policy Review*, 27(3): 321–342.

Bijak, J., Disney, G., Findlay, A.M., Forster, J.J., Smith, P.W.F., and Wiśniowski, A. (2019) Assessing time series models for forecasting international migration: Lessons from the United Kingdom. *Journal of Forecasting*, 38(5): 470–487.

Bijak, J., Fähnrich, B., Leboeuf, L., and Vono de Vilhena, D. (2021a) Strengthening Evidence-informed Policymaking on Migration. *Population and Policy Brief*, 32, Berlin: Population Europe.

Bijak, J., Higham, P.A., Hilton, J., Hinsch, M., Nurse, S., Prike, T., Reinhardt, O., Smith, P.W.F., Uhrmacher, A.M., and Warnke, T. (2021b) *Towards Bayesian Model-Based Demography: Agency, Complexity and Uncertainty in Migration Studies*. Methodos, vol. 17. Cham: Springer.

Bijak, J., Vono de Vilhena, D., Potančoková, M., and The QuantMig Team (2023) White Paper on Migration Uncertainty: Towards Foresight and Preparedness. *Discussion Paper*, 19, Berlin: Population Europe. https://bit.ly/migration-uncertainty.

Blasi Casagran, C., Boland, C., Sánchez-Montijano, E., and Vilà Sanchez, E. (2021) The role of emerging predictive IT tools in effective migration governance. *Politics and Governance*, 9(4): 133–145.

Boissonneault, M., and Costa, R. (2022) The Intra-European Mobility of Non-European-born Migrants. *QuantMig Project Deliverable D4.3*.

Boissonneault, M., and Costa, R. (2023) Experts' assessments of migration scenarios between the Middle East & North Africa and Europe. *Scientific Data*, 10(1): 640.

Boissonneault, M., Mooyaart, J., de Jong, P., and de Valk, H. (2020) The Use of Migration Scenarios in Future Characterisations: A Systematic Review and Typology. *QuantMig Project Deliverable D7.1*.

Boissonneault, M., Costa, R., and de Valk, H.A.G. (2022) The Future of Migration Between Europe and the Middle East & North Africa Under Scenarios of Social Change: A Factorial Survey Among European Migration Professionals. *QuantMig Project Deliverable D7.2*.

Braithwaite, A., Salehyan, I., and Savun, B. (2019) Refugees, forced migration, and conflict: Introduction to the special issue. *Journal of Peace Research*, 56(1): 5–11.

Brun, N., Ekmark, S., Haagensen, K.M., Harðarson, Ó., Rustad Holseter, A.M., Næsheim. H.N, and Ruotsalainen, K. (2021) Nordic Cross-border Statistics: The Results of the Nordic Mobility Project 2016–2020. Nord 2021:006. Copenhagen: Nordic Council of Ministers.

Buettner, T. (2023) Migration Projections: Baseline Profiles, Corridors. KNOMAD Working Paper 50. Washington DC: World Bank. https://www.knomad.org/publication/migration-projections-baseline-profiles-corridors.

Buettner, T., and Muenz, R. (2016) Comparative Analysis of International Migration in Population Projections. KNOMAD Working Paper 10. Washington DC: World Bank. https://www.knomad.org/publication/comparative-analysis-international-migration-population-projections.

Buettner, T., and Muenz, R. (2024) The Impact of Migration on Future Population Change. Comparative Global Demographic Projections with Integrated Immigration and Emigration Assumptions. KNOMAD Working Paper 60. Washington DC: World Bank. https://www.knomad.org/sites/default/files/publication-doc/knomad-paper-60_the-impact-of-migration-on-future-population-change-technical-information_thomas-buettner-and-rainer-muenz_march_2024.pdf.

Burch, T.K. (2018) *Model-Based Demography: Essays on Integrating Data, Technique and Theory*. Demographic Research Monographs. Cham: Springer.

Cairney, P., and Oliver, K. (2020) How should academics engage in policymaking to achieve impact? *Political Studies Review*, 18(2): 228–244.

Carammia, M., Iacus, S.M., and Wilkin, T. (2022) Forecasting asylum-related migration flows with machine learning and data at scale. *Scientific Reports*, 12: 1457.

Carling, J. (2002) Migration in the age of involuntary immobility: Theoretical reflections and Cape Verdean experiences. *Journal of Ethnic and Migration Studies*, 28(1): 5–42.

Carling, J., and Schewel, K. (2018) Revisiting aspiration and ability in international migration. *Journal of Ethnic and Migration Studies*, 44(6): 945–963.

Carling, J., Czaika, M., and Erdal, M.B. (2020) Translating Migration Theory into Empirical Propositions. *QuantMig Project Deliverable 1.2*.

Castles, S. (2004) Why migration policies fail. *Ethnic and Racial Studies*, 27(2): 205–227.

Catino, M. (2008) A review of literature: Individual blame vs. organizational function logics in accident analysis. *Journal of Contingencies and Crisis Management*, 16(1): 53–62.

Cesare, N., Lee, H., McCormick, T., Spiro, E., and Zagheni, E. (2018) Promises and pitfalls of using digital traces for demographic research. *Demography*, 55(5): 1979–1999.

Clemens, M.A. (2014) Does development reduce migration? In: R.E.B. Lucas (ed.) *International Handbook on Migration and Economic Development*. Cheltenham: Edward Elgar (pp. 152–185).

Coles, S. (2001) *An Introduction to Statistical Modeling of Extreme Values*. New York: Springer.

Courgeau, D. (1985) Interaction between spatial mobility, family and career life-cycle: A French survey. *European Sociological Review*, 1(2): 139–162.

Czaika, M., and Bijak, J. (2020) Five Facts Everybody Should Know Before Discussing Future Migration Trends. *Policy Insight*, Population Europe. Via: https://population-europe.eu/research/policy-insights/five-facts-everybody-should-know-discussing-future-migration-trends.

Czaika, M., and de Haas, H. (2017) The effect of visas on migration processes. *International Migration Review*, 51(4): 893–926.

Czaika, M., and Hobolth, M. (2016) Do restrictive asylum and visa policies increase irregular migration into Europe? *European Union Politics*, 17(3): 345–365.

Czaika, M., and Parsons, C.R. (2017) The gravity of high-skilled migration policies. *Demography*, 54(2): 603–630.

Czaika, M., and Reinprecht, C. (2022) Migration drivers: The theoretical basis. In: P. Scholten (ed.) *Introduction to Migration Studies*. Cham: Springer (pp. 49–82).

Czaika, M., and Vothknecht, M. (2014) Migration and aspirations – are migrants trapped on a hedonic treadmill? *IZA Journal of Migration*, 3(1).

Czaika, M., Bohnet, H., and Soto-Nishimura, A. (2021a) Spatial and Categorical Dependence of European Migration Flows. *QuantMig Project Deliverable 5.2*.

Czaika, M., Bohnet, H., and Zardo, F. (2021b) The Evolution of the European Migration Policy-Mix. *QuantMig Project Deliverable D5.5*.

Czaika, M., Bijak, J., and Prike, T. (2022a) Migration decision-making and its key dimensions. *The Annals of the American Academy of Political and Social Science*, 697(1): 15–31.

Czaika, M., Bohnet, H., Zardo, F., and Bijak, J. (2022b) European Migration Governance in the Context of Uncertainty. *QuantMig Project Deliverable 1.5*.

Czaika, M., Erdal, M.B., and Talleraas, C. (2023) Exploring Europe's external migration policy mix: On the interactions of visa, readmission, and resettlement policies. *Journal of Ethnic and Migration Studies*, 49(12): 3140–3161.

Dańko, M.J. (2024) HMigD I App: The Human Migration Database I App. Version 3.1.1, February 2024. Rostock: Max Planck Institute for Demographic Research. Online resource: https://maciej-jan-danko.shinyapps.io/HMigD_Shiny_App_I/, accessed on 7 April 2024.

de Beer, J. (2008) Forecasting international migration: Time series projections vs. argument-based forecasts. In: J. Raymer and F. Willekens (eds) *International Migration in Europe: Data, Models and Estimates*. Chichester: Wiley (pp. 283–306).

de Beer, J., Raymer, J., and van der Erf, R. (2010) Overcoming the problems of inconsistent international migration data: A new method applied to flows in Europe. *European Journal of Population*, 26(4): 459–481.
de Haas, H. (2010) The internal dynamics of migration processes: A theoretical inquiry. *Journal of Ethnic and Migration Studies*, 36(10): 1587–1617.
de Haas, H. (2023) *How Migration Really Works: A Factful Guide to the Most Divisive Issue in Politics*. New York: Viking/Penguin.
de Haas, H., Natter, K., and Vezzoli, S. (2015) Conceptualizing and measuring migration policy change. *Comparative Migration Studies*, 3: 15.
de Haas, H., Fransen, S., Natter, K., Schewel, K., and Vezzoli, S. (2020) Social Transformation. IMI Working Paper 166/2017. Amsterdam: International Migration Institute.
de Jong, P.W., and de Valk, H.A.G. (2020) Intra-European migration decisions and welfare systems: The missing life course link. *Journal of Ethnic and Migration Studies*, 46(9): 1773–1791.
de Jong, P.W., and Fonseca, M.L. (2020) The role of the origin country in migration aspirations: A cross-national comparison of Master students in Portugal and the Netherlands. *Population, Space and Place*, 26(5): e2325.
de Valk, H.A.G., Acostamadiedo, E., Guan, Q., Melde, S., Mooyaart, J., Sohst, R.R., and Tjaden, J. (2022) How to predict future migration: Different methods explained and compared. In: P. Scholten (ed.) *Introduction to Migration Studies*. Cham: Springer (pp. 463–482).
Dennison, J., and Geddes, A. (2019) A rising tide? The salience of immigration and the rise of anti-immigration political parties in western Europe. *The Political Quarterly*, 90(1): 107–116.
Deutsches Patentamt (2023) Albert Einstein. Online material, retrieved on 28 November 2023. https://www.dpma.de/english/our_office/publications/milestones/greatinventors/einstein/index.html.
DeVoretz, D.J., and Ma, J. (2002) Triangular human capital flows between sending, entrepot and the rest of the world regions. *Canadian Studies in Population*, 29(1): 53–69.
Di Iasio, V., and Wahba, J. (2021) Natives' Attitudes and Immigration Flows to Europe. *QuantMig Project Deliverable D3.3*.
Di Iasio, V., and Wahba, J. (2023) Expecting Brexit and UK migration: Should I go? *European Economic Review*, 157: 104484.
Di Iasio, V., and Wahba, J. (2024). The Determinants of Refugees' Destinations: Where do refugees locate within the EU?. *World Development*, 177: 106533.
Disney, G.N. (2015) Improving the quality of international migration statistics in the UK. PhD Thesis, University of Southampton.
Drbohlav, D. (1997) Migration policy objectives for European East-West international migration. *International Migration*, 35(1): 85–108.
Dustmann, C., and Glitz, A. (2011) Migration and education. In: E.A. Hanushek, S. Machin, and L. Woessmann (eds) *Handbook of the Economics of Education*. Amsterdam: Elsevier (pp. 327–439).
Edel, A. (2024) *Zwischen Pest und Feuer. John Graunt (1620–1674): Der Mensch hinter den Zahlen*. Freiburg im Breisgau: Verlag Herder GmbH.

Edel, A., Lines, E., López-Falcón, D., Wilkoszewski, H., and Zimmermann, A. (2018) Forschungs-netzwerke als Öffentlichkeitskatalysatoren für die Wissenschaft. In: S. Selke and A. Treibel (eds) *Öffentliche Gesellschaftswissenschaften. Öffentliche Wissenschaft und gesellschaftlicher Wandel*. Wiesbaden: Springer (pp. 269–287).

Edel, A., Kübler, L., Lines, E., Nanz, P., Patzwaldt, K., Speiser, G., Stasiak, D., and Weißkopf, M. (2020) Grenzüberschreitungen: Wie öffentlich soll Wissenschaft sein? Berlin: Friedrich-Ebert-Stiftung. https://library.fes.de/pdf-files/studienfoerderung/16520.pdf.

Edison, H.J. (2003) Do indicators of financial crises work? An evaluation of an early warning system, *International Journal of Finance & Economics*, 8(1): 11–53.

Epstein, G.S. (2008) Herd and network effects in migration decision-making. *Journal of Ethnic and Migration Studies*, 34(4): 567–583.

Erdal, M.B., and Hagen-Zanker, J. (2022) Migration decision-making. In: A. Triandafyllidou (ed.) *Routledge Handbook of Immigration and Refugee Studies*. London: Routledge (pp. 63–72).

Erdal, M.B., and Oeppen, C. (2018) Forced to leave? The discursive and analytical significance of describing migration as forced and voluntary. *Journal of Ethnic and Migration Studies*, 44(6): 981–998.

Erdal, M.B., Mjelva, M.B., and Tollefsen, A.F. (2023) Conflict-Related Determinants of Migration. *QuantMig Project Deliverable 2.7*.

EUAA (2022) The Future of International Protection in the EU+ in the Next 10 Years. Comprehensive Report: European Union Agency for Asylum. Luxembourg: Publications Office of the European Union.

European Commission (2020) Recommendation (EU) 2020/1366 of 23 September 2020 on an EU mechanism for preparedness and management of crises related to migration, OJ L 317, 1.10.2020, pp. 26–38. http://data.europa.eu/eli/reco/2020/1366/oj.

European Council (2001) Council Directive 2001/55/EC of 20 July 2001 on minimum standards for giving temporary protection in the event of a mass influx of displaced persons […]. OJ L 212, 7.8.2001, pp. 12–23. https://eur-lex.europa.eu/eli/dir/2001/55/oj.

European Council (2007) Regulation (EC) No 862/2007 of the European Parliament and the Council of 11 July 2007 on Community statistics on migration and international protection. OJ L 199, 31.7.2007, pp. 23–29. Consolidated text: http://data.europa.eu/eli/reg/2007/862/2021-07-01.

European Council (2022) Council Implementing Decision (EU) 2022/382 of 4 March 2022 establishing the existence of a mass influx of displaced persons from Ukraine within the meaning of Article 5 of Directive 2001/55/EC, and having the effect of introducing temporary protection. OJ L 71, 4.03.2022, pp. 1–6. https://eur-lex.europa.eu/eli/dec_impl/2022/382/oj.

Eurostat (2024a) EU Labour Force Survey Database User Guide, v. January 2024. Luxembourg: Eurostat. https://ec.europa.eu/eurostat/documents/1978984/6037342/EULFS_Database_UserGuide_2021.pdf, accessed 11 January 2024.

Eurostat (2024b) Temporary protection for persons fleeing Ukraine – monthly statistics. Data extracted on 5 March 2024. https://ec.europa.eu/eurostat/

statistics-explained/index.php?title=Temporary_protection_for_persons_fleeing_Ukraine_-_monthly_statistics, accessed 7 April 2024.
Eurostat and OECD (2016) How are Refugees Faring on the Labour Market in Europe? A First Evaluation Based on the 2014 EU Labour Force Survey Ad Hoc Module. Working Paper 1/2016. Luxembourg: European Commission, and Paris: OECD.
Fecher, B., and Hebing, M. (2021) How do researchers approach societal impact? *PLoS ONE*, 16(7): e0254006.
Filipec, O. (2022) Multilevel analysis of the 2021 Poland-Belarus border crisis in the context of hybrid threats. *Central European Journal of Politics*, 8(1): 1–18.
Filippopoulou, C., Galariotis, E., and Spyrou, S. (2020) An early warning system for predicting systemic banking crises in the Eurozone: A logit regression approach. *Journal of Economic Behavior & Organization*, 172: 344–363.
Foresight (2011) Migration and Global Environmental Change: Future Challenges and Opportunities. Final Project Report. London: Government Office for Science.
Forlicz, M., Rólczyński, T., and Simonetti, B. (2023) Illusion of prediction possibility of random outcomes: Experimental results. *Quality and Quantity*, 57(Suppl 3): 481–495.
Gall, T., Vallet, F., and Yannou, B. (2022) How to visualise futures studies concepts: Revision of the futures cone. *Futures*, 143: 103024.
Geddes, A., Hadj Abdou, L., and Brumat, L. (2020) *Migration and Mobility in the European Union*. London: Bloomsbury.
Gelman, A., Carlin, J.B., Stern, H.S., Dunson, D.B., Vehtari, A., and Rubin, D.B. (2013) *Bayesian Data Analysis* (third edition). Boca Raton, FL: Chapman & Hall/CRC.
Gilbert, N., and Troitzsch, K.G. (2005) *Simulation for the Social Scientist* (second edition). Maidenhead: McGraw-Hill.
Giulietti, C., and Wahba, J. (2015) Welfare migration. In: A.F. Constant and K. Zimmermann (eds) *International Handbook on the Economics of Migration*. Cheltenham: Edward Elgar (pp. 489–504).
Gorinas, C., and Pytliková, M. (2017) The influence of attitudes toward immigrants on international migration. *International Migration Review*, 51(2): 416–451.
Greenhill, K.M. (2016) *Weapons of Mass Migration: Forced Displacement, Coercion, and Foreign Policy*. Ithaca, NY: Cornell University Press.
Hagen-Zanker, J., and Mallett, R. (2023) Inside the 'efficacy gap': Migration policy and the dynamics of encounter. *International Migration*, 61(3): 148–161.
Hampshire, J. (2016) European migration governance since the Lisbon Treaty: Introduction to the Special Issue. *Journal of Ethnic and Migration Studies*, 42(4): 537–553.
Harding, A., Zaidi, A., and Williamson, P. (eds) (2009) *New Frontiers in Microsimulation Modelling*. London: Routledge.
Harris, J.R., and Todaro, M.P. (1970) Migration, unemployment and development: A two-sector analysis. *American Economic Review*, 60(1): 126–142.

Harris, S., and Sonne, P. (2021) Russia planning massive military offensive against Ukraine involving 175,000 troops, U.S. intelligence warns. *Washington Post*, 3 December 2021. https://wapo.st/3MYjYto, accessed on 20 November 2023.

Hart, R.A. (1975) Interregional economic migration: Some theoretical considerations (Part I). *Journal of Regional Science*, 15(1): 127–138.

Hatton, T., and Moloney, J. (2017) Applications for asylum in the developed world: Modelling asylum claims by origin and destination. In: M. McAuliffe and K. Koser (eds) *A Long Way to Go: Irregular Migration Patterns, Processes, Drivers and Decision-making*. Canberra: ANU Press (pp. 227–254).

Hattan, V. (2024) Border Economies/Capitalist Imaginaries. SPAIS/Leverhulme/MMB Annual Lecture, 7 March 2024. Bristol: University of Bristol. https://www.bristol.ac.uk/spais/events/2024/spais-annual-lecture-march-2024.html.

Haug, S. (2008) Migration networks and migration decision-making. *Journal of Ethnic and Migration Studies*, 34(4): 585–605.

Hémond, Y., and Robert, B. (2012) Preparedness: The state of the art and future prospects. *Disaster Prevention and Management*, 21(4): 404–417.

Hirschi, C. (2021) Wenn Wissenschaft zu Ideologie wird. *Frankfurter Allgemeine Zeitung*, 9 March 2021. https://www.faz.net/aktuell/feuilleton/debatten/wie-sich-die-rolle-von-experten-in-der-pandemie-wandelt-17233562.html.

Hodges, R., Caperchione, E., van Helden, J., Reichard, Ch., and Sorrentino, D. (2022) The role of scientific expertise in COVID-19 policy-making: Evidence from four European countries. *Public Organization Review*, 22: 249–267.

Holst, C., Løke Kjos, H., Krick, E., and Gundersen, T. (2021) White Paper Science Advice Mechanisms – Varieties and Reform. *Deliverable D3.1, PERITIA Project*. https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5dc61d3b2&appId=PPGMS.

IOM (2022) *World Migration Report 2022*. Geneva: International Organization for Migration.

IPCC (2023) Climate Change 2023. AR6 Synthesis Report. Geneva: Intergovernmental Panel for Climate Change. https://www.ipcc.ch.

Keilman, N., and Aristotelous, G. (2021) Expert Opinion on Migration Data. *QuantMig Project Deliverable D6.1*.

Kerr, J., van der Bles, A.-M., Dryhurst, S., Schneider, C.R., Chopurian, V., Freeman, A.L.J., and van der Linden, S. (2023) The effects of communicating uncertainty around statistics, on public trust. *Royal Society Open Science*, 10(11): 230604.

King, R. (2002) Towards a new map of European migration. *International Journal of Population Geography*, 8(2): 89–106.

King, R., and Skeldon, R. (2010) 'Mind the gap!' Integrating approaches to internal and international migration. *Journal of Ethnic and Migration Studies*, 36(10): 1619–1646.

Klabunde, A., Zinn, S., Willekens, F., and Leuchter, M. (2017) Multistate modelling extended by behavioural rules: An application to migration. *Population Studies*, 71(Suppl 1): 51–67.

Kleist, N., and Thorsen, D. (2016) *Hope and Uncertainty in Contemporary African Migration*. New York: Routledge.

Kluge, F.A. (ed.) (2022) Transdisciplinarity. A Research Mode for Real-World Problems. Discussion Paper, 16, Berlin: Population Europe.

Koeppen, B., Buettner, T., and Muenz, R. (2023) Review of Global Flow Estimates and the Identification of Migration Corridors. KNOMAD Working Paper 51. Washington DC: World Bank. https://www.knomad.org/publication/review-global-flow-estimates-and-identification-major-migration-corridors.

Laczko, F., Mosler Vidal, E., and Rango, M. (2023) *Measuring Global Migration. Towards Better Data for All*. London: Routledge.

Lai, S., zu Erbach-Schoenberg, E., Pezzulo, C., Ruktanonchai, N.W., Sorichetta, A., Steele, J., Li, T., Dooley, C.A, and Tatem, A.J. (2019) Exploring the use of mobile phone data for national migration statistics. *Palgrave Communications*, 5: 34.

Lancaster, K., Rhodes, T., and Rosengarten, M. (2020) Making evidence and policy in public health emergencies: Lessons from COVID-19 for adaptive evidence-making and intervention. *Evidence & Policy*, 16(3): 477–490.

Langer, E.J. (1975) The illusion of control. *Journal of Personality and Social Psychology*, 32(2): 311–328.

Lanzieri, G. (2019) An alternative view on the statistical definition of migration. Meeting of the Work Session on Migration Statistics, UNECE, Geneva, 29–31 October 2019.

Lee, E.S. (1966) A theory of migration. *Demography*, 3(1): 47–57.

Leibniz-Gemeinschaft (2021) Leibniz-Leitlinie Politik- und Gesellschaftsberatung. Berlin: Leibniz-Gemeinschaft. https://www.leibniz-gemeinschaft.de/fileadmin/user_upload/Bilder_und_Downloads/%c3%9cber_uns/Strategie-_und_Wissenschaftspolitik/Leitlinie_Politik-_und_Gesellschaftsberatung.pdf.

Leopoldina (2014) From ideas to statements. Halle: Deutsche Akademie der Naturforscher Leopoldina. Mimeo. https://www.leopoldina.org/uploads/tx_leopublication/2014_Leopoldina_Leitfaden_Politikberatung_02.pdf.

Lindley, D.V. (2013) *Understanding Uncertainty* (revised edition). Hoboken, NJ: Wiley.

Lucas, R.E. (1976) Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy*, 1: 19–46.

Lutz, W. (2013) Demographic metabolism: A predictive theory of socioeconomic change. *Population and Development Review*, 38(S1): 283–301.

Lutz, W., Butz, W.P., and Samir, K.C. (eds) (2014) *World Population and Human Capital in the Twenty-First Century*. Oxford: Oxford University Press.

Lutz, W., Amran, G., Bélanger, A., Conte, A., Gailey, N., Ghio, D., Grapsa, E., Jensen, K., Loichinger, E., Marois, G., Muttarak, R., Potančoková, M., Sabourin, P., and Stonawski, M. (2019) Demographic Scenarios for the EU: Migration, Population and Education. Luxembourg: Publications Office of the European Union.

Marois, G., Potančoková, M., and González-Leonardo, M. (2023) Demographic and labor force impacts of future immigration flows into Europe: Does an immigrant's region of origin matter? *Humanities and Social Sciences Communications*, 10: 957.

Marr, B. (2018) Forget data scientists and hire a data translator instead? *Forbes*, 12 March.

Massey, D.S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A., and Taylor, J.E. (1993) Theories of international migration: A review and appraisal. *Population and Development Review*, 19(3): 431–466.

McAuliffe, M., Abel, G., Oucho, L., and Sawyer, A. (2021) International migration as a stepladder of opportunity: What do the global data *actually* show? In: M. McAuliffe and A. Triandafyllidou (eds) *World Migration Report 2022*. Geneva: IOM International Organization for Migration (pp. 191–214).

Melachrinos, C., Carammia, M., and Wilkin, T. (2020) Using big data to estimate migration 'push factors' from Africa. In: F. Fargues, M. Rango, E. Börgnas, and I. Schöfberger (eds) *Migration in West and North Africa and Across the Mediterranean. Trends, Risks, Development and Governance*. Geneva: International Organization for Migration (pp. 98–116).

Merton, R.K. (1968) *Social Theory and Social Structure* (enlarged edition). New York: The Free Press.

Mitton, C., Adair, C.E., McKenzie, E., Patten, S.B., and Waye Perry, B. (2007) Knowledge transfer and exchange: Review and synthesis of the literature. *Milbank Quarterly*, 85(4): 729–768.

Mooyaart, J.E., and de Valk, H.A.G. (2021) Intra-EU Migration 2010–2020. *QuantMig Project Deliverable D4.2*.

Mooyaart, J.E., Dańko, M.J., Costa, R., and Boissonneault, M. (2021) Quality Assessment of European Migration Data. *QuantMig Project Deliverable D6.2*.

Muhonen, R., Benneworth, P., and Olmos-Peñuela, J. (2020) From productive interactions to impact pathways: Understanding the key dimensions in developing SSH research societal impact. *Research Evaluation*, 29(1): 34–47.

Munshi, K. (2020) Social networks and migration. *Annual Review of Economics*, 12(1): 503–524.

Napierała, J., Hilton, J., Forster, J.J., Carammia, M., and Bijak, J. (2022) Toward an early warning system for monitoring asylum-related migration flows in Europe. *International Migration Review*, 56(1): 33–62.

Nowok, B., and Willekens, F. (2011) A probabilistic framework for harmonisation of migration statistics. *Population, Space and Place*, 17(5): 521–533.

Olsson, G. (1965) Distance and human interaction. A migration study. *Geografiska Annaler B*, 47(1): 3–43.

O'Neill, B.C., Kriegler, E., Ebi, K.L., Kemp-Benedict, E., Riahi, K., Rothman, D.S., van Ruijven, B.J., van Vuuren, D.P., Birkmann, J., Kok, K., Levy, M., and Solecki, W. (2017) The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. *Global Environmental Change*, 42: 169–180.

Openshaw, S. (1984) *The Modifiable Areal Unit Problem*. Norwich: GeoBooks.

Ortega, F., and Peri, G. (2013) The effect of income and immigration policies on international migration. *Migration Studies*, 1(1): 47–74.

Özden, Ç., Parsons, C., Schiff, M., and Walmsley, T. (2011) Where on earth is everybody? The evolution of global bilateral migration 1960–2000. *The World Bank Economic Review*, 25(1): 12–56.

Petropoulos, F., et al. (2022) Forecasting: Theory and practice. *International Journal of Forecasting*, 38(3): 705–871.

Pielke Jr., R.A. (2007) *The Honest Broker: Making Sense of Science in Policy and Politics*. Cambridge: Cambridge University Press.
Pijpers, R. (2008) Problematising the 'orderly' aesthetic assumptions of forecasts of East–West migration in the European Union. *Environment and Planning A*, 40(1): 174–188.
Piore, M.J. (1979) *Birds of Passage: Migrant Labor and Industrial Societies*. Cambridge: Cambridge University Press.
Plane, D.A. (1993) Requiem for the fixed-transition-probability migrant. *Geographical Analysis*, 25(3): 211–223.
Potančoková, M., Marois, G., and González-Leonardo, M. (2023) Demographic and Labour Force Implications of High Immigration Events Scenarios. *QuantMig Project Deliverable D10.1*.
Poulain, M., Singleton, A., and Perrin, N. (eds) (2006) *THESIM: Towards Harmonised European Statistics on International Migration*. Louvaine-la-Neuve: Presses Universitaires.
Quest, S. (2022) Evidence-informed policymaking: Learning from COVID-19. European Commission's *Knowledge for Policy* post, published 26 April 2022, https://knowledge4policy.ec.europa.eu/blog/evidence-informed-policymaking-learning-covid-19_en.
Raftery, A.E. (2016) Use and communication of probabilistic forecasts. *Statistical Analysis and Data Mining*, 9(6): 397–410.
Rampazzo, F., Bijak, J., Vitali, A., Weber, I., and Zagheni, E. (2021) A framework for estimating migrant stocks using digital traces and survey data: An application in the United Kingdom. *Demography*, 58(6): 2193–2218.
Ravenstein, E.G. (1885) The laws of migration. *Journal of the Statistical Society of London*, 48(2): 167–235.
Raymer, J., Wiśniowski, A., Forster, J.J., Smith, P.W.F., and Bijak, J. (2013) Integrated modeling of European migration. *Journal of the American Statistical Association*, 108(503): 801–819.
Reichmann, S., and Wieser, B. (2022) Open science at the science–policy interface: Bringing in the evidence? *Health Research Policy and Systems*, 20: 70.
Renn, O. (2021) Transdisciplinary approaches to understand and facilitate transformations towards sustainability. In: N. Rezaei (ed.) *Integrated Science: Science Without Borders*. Cham: Springer International Publishing (pp. 127–144).
Rikani, A., and Schewe, J. (2021) Global bilateral migration projections accounting for diasporas, transit and return flows, and poverty constraints. *Demographic Research*, 45(4): 87–140.
Rogers, A. (1990) Requiem for the net migrant. *Geographical Analysis*, 22(4): 283–300.
Rogers, A., and Castro, L.J. (1981) Model Migration Schedules. Research Report RR-81–30. Laxenburg: IIASA.
Royal Society (1985) The Public Understanding of Science: Report of the Royal Society's Ad Hoc Group. London: Royal Society.
Rubin, J.H., and Moore, W.H. (2007) Risk factors for forced migrant flight. *Conflict Management and Peace Science*, 24(2): 85–104.

Ruppert, E., and Scheel, S. (eds) (2021) *Data Practices. Making Up a European People*. London: Goldsmiths Press.
Salajan, A., Tsolova, S., Ciotti, M., and Suk, J.E. (2020) To what extent does evidence support decision making during infectious disease outbreaks? A scoping literature review. *Evidence & Policy*, 16(3): 453–475.
SAPEA (2019) Making Sense of Science for Policy Under Conditions of Complexity and Uncertainty. Berlin: Science Advice for Policy by European Academies. https://doi.org/10.26356/MASOS.
Schlosser, M. (2019) Agency. In: E.N. Zalta (ed.) *The Stanford Encyclopedia of Philosophy*. https://plato.stanford.edu/archives/win2019/entries/agency, accessed on 5 January 2024.
Scholten, P. (ed.) (2022) *Introduction to Migration Studies. An Interactive Guide to the Literatures on Migration and Diversity*. IMISCOE Research Series. Cham: Springer.
Schon, J. (2019) Motivation and opportunity for conflict-induced migration: An analysis of Syrian migration timing. *Journal of Peace Research*, 56(1): 12–27.
Schreier, S., Skrabal, L., and Czaika, M. (2023) DEMIG-QuantMig Migration Policy Database. *QuantMig Project Deliverable D5.4* [version 1.2].
Schwarz, B., Svedin, U., and Wittrock, B. (1982/2019) *Methods in Futures Studies: Problems and Applications*. Abingdon: Routledge.
Schwarz, J.O. (2023) *Strategic Foresight. An Introductory Guide to Practice*. Abingdon: Routledge.
Shachar, A. (2006) The race for talent: Highly skilled migrants and competitive immigration regimes. *New York University Law Review*, 81(1): 148–206.
Sheringham, J., Kuhn, I., and Burt, J. (2021) The use of experimental vignette studies to identify drivers of variations in the delivery of health care: A scoping review. *BMC Medical Research Methodology*, 21(1): 1–17.
Singleton, A. (1999) Measuring international migration: The tools aren't up to the job. In: D. Dorling and S. Simpson (eds) *Statistics in Society. The Arithmetic of Politics*. London: Arnold (pp. 148–158).
Sjaastad, L.A. (1962) The costs and returns of human migration. *Journal of Political Economy*, 70(5): 80–93.
Sohst, R.R., and Tjaden, J. (2020) Forecasting migration: A policy guide to common approaches and models. *Migration Policy Practice,* X(4): 8–14.
Sohst, R.R., Dag Tjaden, J., de Valk, H., and Melde, S. (2020) A Systematic Review of the Literature on Migration Scenarios and Forecasting. *CrossMigration Project Deliverable 9.1*. Geneva: IOM and The Hague: NIDI.
Spiegelhalter, D. (2017) Risk and uncertainty communication. *Annual Review of Statistics and Its Application*, 4(1): 31–60.
Squire, V. (2024) Global citizenship in the making? Generating an inventory of migratory claims. *Citizenship Studies*, 27(8): 967–982.
Stark, O., and Bloom, D.E. (1985) The new economics of labor migration. *The American Economic Review*, 75(2): 173–178.
Taleb, N.N. (2007) *The Black Swan: The Impact of the Highly Improbable*. New York: Random House.
Tetlock, P.E., and Gardner, D. (2015) *Superforecasting: The Art and Science of Prediction*. New York: Random House.

Thielemann, E.R. (2006) The effectiveness of governments' attempts to control unwanted migration. In: C.A. Parsons and T.A. Smeeding (eds) *Immigration and the Transformation of Europe*. Cambridge: Cambridge University Press (pp. 442–472).

Tibshirani, R. (1996) Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society B*, 58(1): 267–288.

UN (1949) *Problems of Migration Statistics*. Population Studies No. 5. Lake Success, NY: United Nations.

UN (1998) *Recommendations on Statistics of International Migration*. Rev. 1. New York: United Nations.

UN (2000) *Replacement Migration: Is it A Solution to Declining and Ageing Populations?* New York: United Nations Population Division.

UN (2014) International Migration 2013: Migrants by Origin and Destination. *Population Facts*, 2013/3, Rev.1. New York: United Nations Population Division. http://www.un.org/en/development/desa/population/publications/pdf/popfacts/PopFacts_2013-3Rev1_new.pdf.

UN (2018) Global Compact for Safe, Orderly and Regular Migration. New York: United Nations. https://undocs.org/A/CONF.231/3, accessed on 20 November 2023.

UN (2020) International Migrant Stock 2020. Database. POP/DB/MIG/Stock/Rev.2020. New York: United Nations Population Division. https://www.un.org/development/desa/pd/content/international-migrant-stock.

UNHCR (2023) Syria Regional Refugee Response: Operational Data Portal. Geneva: UN Refugee Agency. https://data2.unhcr.org/en/situations/syria, accessed on 20 November 2023.

US Department of State (2020) Agreement for bringing peace to Afghanistan between the Islamic Emirate of Afghanistan which is not recognized by the United States as a state and is known as the Taliban and the United States of America. Signed in Doha, Qatar, on 29 February 2020. https://bit.ly/49Nls3q, accessed on 20 November 2023.

US White House (2023) US Withdrawal from Afghanistan. Mimeo. https://bit.ly/3Gcp3ud, accessed on 20 November 2023.

Van Hear, N., Bakewell, O., and Long, K. (2018) Push-pull plus: Reconsidering the drivers of migration. *Journal of Ethnic and Migration Studies*, 44(6): 927–944.

Van Hook, J., and Zhang, W. (2011) Who stays? Who goes? Selective emigration among the foreign-born. *Population Research and Policy Review*, 30(1): 1–24.

van Wissen, L. (2012) Comments on 'An uncertain future of immigration in Europe' by Wiśniowski et al. In: M. Okólski (ed.) *European Immigrations: Trends, Structures and Policy Implications*. IMISCOE Research. Amsterdam: Amsterdam University Press (pp. 233–237).

Vertovec, S. (2009) *Transnationalism*. London: Routledge.

Vestby, J., Tollefsen, A.F., and Buhaug, H. (2022) Climate and International Migration Flows: A Sensitivity Analysis of Gravity Model Specifications. *QuantMig Project Deliverable 2.6*.

Vestby, J., Schutte, S., Tollefsen, A.F., and Buhaug, H. (2024) Societal determinants of flood-induced displacement. *Proceedings of the National Academy of Sciences*, 121(3): e2206188120.

Vezzoli, S., Bonfiglio, A., and De Haas, H. (2017) Global Migration Futures: Exploring the Future of International Migration with a Scenario Methodology. IMI Working Paper 137/2017. Oxford: International Migration Institute.

Voigt, C. (2023) Paradigm Shift in Knowledge Transfer. GESIS Blog Growing Knowledge in Social Sciences, 16 November 2023. https://blog.gesis.org/paradigm-shift-in-knowledge-transfer/.

Wahba, J., and Di Iasio, V. (2023) Hotels and employment aren't major 'pull factors' for refugees – Here's what really draws people to move. *The Conversation*, 25 August 2023. https://theconversation.com/hotels-and-employment-arent-major-pull-factors-for-refugees-heres-what-really-draws-people-to-move-211796.

Wallerstein, I. (1983) *Historical Capitalism*. London: Verso.

Wildavsky, A. (1979) *Speaking Truth to Power: The Art and Craft of Policy Analysis*. Boston, MA: Little, Brown & Company.

Willekens, F. (1994) Monitoring international migration flows in Europe. Towards a statistical data base combining data from different sources. *European Journal of Population*, 10(1): 1–42.

Willekens, F. (2018) Towards causal forecasting of international migration. *Vienna Yearbook of Population Research*, 16: 199–218.

Wiśniowski, A. (2017) Combining Labour Force Survey data to estimate migration flows: The case of migration from Poland to the UK. *Journal of the Royal Statistical Society A*, 180(1): 185–202.

Wiśniowski, A., Forster, J.J., Smith, P.W.F., Bijak, J., and Raymer, J. (2016) Integrated modelling of age and sex patterns of European migration. *Journal of the Royal Statistical Society A*, 179(4): 1007–1024.

Wiśniowski, A., Campbell, G., and Kim, J.H. (2021) Delphi Study. Future Migration Scenarios for Europe. FUME Project report. Manchester: University of Manchester. https://zenodo.org/records/8183493.

Wucker, M. (2016) *The Gray Rhino. How to Recognize and Act on the Obvious Dangers We Ignore*. New York: St Martin's.

Zelinsky, W. (1971) The hypothesis of the mobility transition. *Geographical Review*, 61(2): 219–249.

Ziemnowicz, C. (2013) Joseph A. Schumpeter and innovation. In: E.G. Carayannis (ed.) *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship*. New York: Springer (pp. 1171–1176).

Zipf, G.K. (1946) The P_1P_2/D hypothesis: On the intercity movement of persons. *American Sociological Review*, 11(6): 677–686.

Zolberg, A.R. (1989) The next waves: Migration theory for a changing world. *International Migration Review*, 23(3): 403–430.

Zwicky, F. (1969) *Discovery, Invention, Research Through the Morphological Approach*. Toronto: Macmillan.

Online resources

QuantMig project website. The QuantMig project team has produced a range of public resources, aimed not only at sharing our outputs with the interested academic and practitioner audience but also at engaging the broader public with some of the project's topics. As of 2024, all online resources, including project reports, academic publications and other news items related to QuantMig, are available from the project website: www.quantmig.eu.

White Paper on Migration Uncertainty. The White Paper contains a high-level summary of the key results and recommendations from the QuantMig project (Bijak et al. 2023), which are elaborated in more detail in this book. bit.ly/migration-uncertainty.

DEMIG-QuantMig Migration Policy Database. The searchable database contains information about changes in migration policies in 31 European countries during 1990–2020, extending and updating the original DEMIG policy database (de Haas et al. 2015), first developed at the International Migration Institute, at that time at the University of Oxford (see Chapter 3). bit.ly/quantmig-policy.

QuantMig Migration Estimates Explorer. One of the numerical outputs of the project, containing estimates of within-Europe migration flows and those into and out of Europe, for 2009–19. It additionally includes earlier estimates obtained from the Integrated Model of European Migration for 2002–8 (Raymer et al. 2013). Depending on the exact data choice, the estimates are available by origin, destination, age, sex and broad region of birth, and they contain selected probabilistic measures of error (see Chapter 5). bit.ly/quantmig-estimates.

QuantMig Migration Scenarios Explorer. Another key numerical output of QuantMig: a visualized set of migration scenarios for European migration, population and labour force, generated by using microsimulation models presented in detail in Marois et al. (2023) and Potančoková et al. (2023). Available outputs include population and migration trends and a range of predefined indicators, such as labour force dependency ratios, with disaggregation possible by age, sex, region of birth, labour force status and level of education (see Chapter 7). bit.ly/quantmig-scenarios.

QuantMig Migration Data Inventory. A searchable online inventory including metadata on various quantitative sources of information on migration that can be used for modelling and scenario-setting, with basic information about coverage, levels of disaggregation and a quality assessment. bit.ly/quantmig-inventory

QuantMig Migration Driver Inventory. Another searchable inventory, this time focused on metadata about empirical studies examining the impact of various drivers on migration and also potentially useful for modelling or scenario-setting. In addition to the basic information, for quantitative studies the inventory includes information about the direction (positive, negative or none) of an effect identified in the empirical analysis. bit.ly/quantmig-drivers.

QuantMig Teaching Materials on Migration Uncertainty. Designed for students in secondary (high) schools, especially for subjects such as geography, history and mathematics, these teaching materials focused on key themes of the QuantMig project contain five lesson plans, complete with dynamic online Prezi slides, a student workbook and teacher's guide. bit.ly/quantmig-teaching.

QuantMig Migration Quiz. Either as a part of the teaching materials or a stand-alone quiz, this tool provides a quick introduction to current migration patterns across Europe and to the changes expected by 2060, at least according to our scenarios. bit.ly/quantmig-quiz.

Glossary of key terms

Below we summarize the meaning of some of the key terms used throughout this book, as we understand them, noting that alternative definitions may exist and may differ from ours. Further discussion and examples are provided in the chapters signposted for each entry.

Agency (of people): informally, a notion that human actions are not predetermined but that people (and institutions comprising people) have free will to make choices and decisions and to act within external constraints, such as those related to biology and the environment (Chapters 2 and 3)

Aleatory uncertainty: a part of uncertainty linked to the intrinsic randomness and indeterminism of the world and human **agency**. Aleatory uncertainty cannot be reduced through better knowledge and increases steeply once we move from the past and present to the future (Chapters 1, 2, 6 and 7)

Complexity: informally, a property of many systems, including social systems, whereby a broad range of interacting factors (**drivers**) influence the system's state and dynamics. Complexity is difficult to analyse and predict due to multiway interactions, feedback loops, etc. (Chapters 1, 2, 3 and 4)

Data translation: after Marr (2018), a process of transforming data and knowledge, including from scenarios, into insights that would be useful for decision makers. Given its importance, this process should be professionalized, ideally involving dedicated **data translators** (Chapters 8 and 9)

Drivers: individual factors that are theorized to influence migration processes, including flows. Due to migration **complexity**, no single driver or group of drivers suffices for explaining and predicting flows, which are driven by broader multidimensional **driver environments** (Chapters 3 and 4)

Early warnings: analytical techniques aimed at giving advance or simultaneous notice that a dynamic process of interest – such as migration – departs from its expected trajectory and where this departure

may lead to a **high-impact** event and require adequate **preparedness** (Chapters 2 and 6)

Epistemic uncertainty: a part of uncertainty resulting from imperfect knowledge about the world, especially the past, present and nearest future. Epistemic uncertainty is potentially reducible through research and the development of new theories (on **drivers**), data and analytical methods (Chapters 1, 2, 3 and 5)

EU+: a migration system comprising 32 countries: 27 countries of the European Union, **EU27** (as of 2024), four countries of the European Free Trade Association (Iceland, Liechtenstein, Norway and Switzerland) and the United Kingdom (Chapters 5, 6 and 7)

Forecasts: a group of **futures studies** methods and their products, typically quantitative, expressing current state-of-the-art knowledge about future processes (e.g. migration), ideally with a statement on their likelihood, as measured through probabilities (Chapters 2, 6 and 10)

Foresight: another group of **futures studies** techniques, this time typically qualitative and based on narratives, exploring, ideally in an internally coherent way, the possible future trajectories, causes and consequences of the processes under study (Chapters 2 and 7)

Futures studies: an umbrella term for a range of scientific attempts to predict or anticipate future events based on current knowledge, encompassing **forecasts**, **early warnings** and other **foresight** techniques, such as **scenarios** and **horizon scanning** (Chapter 2)

Good-enough (**scenarios**, tools): a range of pragmatic, easy-to-implement, approximate methods for analysing and communicating current knowledge about migration now and in the future, recognizing that in the presence of uncertainty, perfect methods do not exist (Chapters 3 and 12)

High-impact (events): rare events which can have very high social, economic or political impact. In the migration context, one example involves large inflows of people seeking asylum abroad. We prefer this term to avoid perpetuating the 'crisis' narrative around migration (Chapters 6 and 7)

Horizon scanning: a type of **foresight** exercise, aimed at identifying signals of upcoming changes to (migration) trends, based for example on field knowledge and intelligence. We suggest that horizon scanning should precede analysis of **early warnings** (Chapters 2, 6 and 10)

Microsimulations: an analytical technique for setting **scenarios** or **forecasts** by using computer simulations of the whole populations of interest and seeing how they evolve through **transitions** between different

states (e.g. age groups, countries of residence, or economic activity classes) (Chapter 7)

Preparedness: after Hémond and Robert (2012), the state of preparedness for unforeseen events and circumstances involves both having sufficient capability for responding and having appropriate management practices in place to ensure the continuation of operations (Chapters 1, 2, 9 and 12)

Scenarios: a set of **foresight** tools which chart, quantitatively or qualitatively, various possible consequences of assumptions about the future trajectories of processes under study (e.g. migration). Scenarios can be explanatory, predictive (**forecasts**) or normative (Chapters 2, 6 and 7)

True flows: a theoretical concept of real, yet unobserved, migration flows, conforming to internationally agreed definitions, which in reality are measured through imperfect means. These imperfections result in various errors, biases and different levels of accuracy in the data (Chapter 5)

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