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Research Article

Reducing uncertainty in Delphi surveys: A case study on immigration to the EU

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Abstract

BACKGROUND
Following the rapid increase of asylum seekers arriving in the European Union in 2015/16, policymakers have invested heavily in improving their foresight and forecasting capabilities. A common method to elicit expert predictions are Delphi surveys. This approach has attracted concern in the literature, given the high uncertainty in experts' predictions. However, there exists limited guidance on specific design choices for future-related Delphi surveys.

OBJECTIVE
We test whether or not small adjustments to the Delphi survey can increase certainty (i.e., reduce variation) in expert predictions on immigration to the EU in 2030.

METHODS
Based on a two-round Delphi survey with 178 migration experts, we compare variation and subjective confidence in expert predictions and assess whether additional context information (type of migration flow, sociopolitical context) promotes convergence among experts (i.e., less variation) and confidence in their own estimates.

RESULTS
We find that additional context information does not reduce variation and does not increase confidence in expert predictions on migration.

CONCLUSIONS
The results reaffirm recent concerns regarding the limited scope for reducing uncertainty by manipulating the survey setup. Persistent uncertainty may be a result of the complexity

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of migration processes and limited agreement among migration experts regarding key drivers.

CONTRIBUTION

We caution policymakers and academics on the use of Delphi surveys for eliciting expert predictions on immigration, even when conducted based on a large pool of experts and using specific scenarios. The potential of alternative approaches such as prediction markets should be further explored.

1. Introduction

Future immigration persistently ranks among the top issues of concern for policymakers and citizens across the EU (see recent Eurobarometer results, European Commission 2020a). Following a rapid increase in migration to the EU amidst the so-called migration 'crisis' in 2015–2016 and the ongoing pressures of population ageing and decline (Van Nimwegen and Van der Erf 2010), there is an increasing interest within the European Union (EU) to comprehend future migration and better plan and prepare for the arrival of future immigrants. In 2020 the European Commission issued the New Pact on Migration and Asylum, which includes a 'Crisis and Preparedness Blueprint' proposing the implementation of an EU-wide instrument to forecast migration and facilitate a common response to key migration trends (European Commission 2020b). Recent years have witnessed a sharp increase in the number of policy reports and academic studies aiming to provide tools and knowledge regarding how migration patterns may develop in the future (see Sohst et al. 2020 for an overview) and significant investment in research on migration scenarios and forecasts through the EU Horizon 2020 program.

Predicting the future, however, is notoriously difficult. A wide range of approaches have been developed to foresee migration trends, including early warning systems (European Asylum Support Office 2021; Shellman and Stewart 2007), quantitative forecasts based on (causal) modelling of migration flows or time series analyses (Abel et al. 2013; Bijak 2011; Böhme, Gröger, and Stöhr 2020; Disney et al. 2015; Kupiszewski 2002; Willekens 2018), as well as foresight or scenario approaches (European Asylum Support Office 2019; Lomax et al. 2020; Organisation for Economic Co-operation and Development 2020).

One increasingly popular and potentially powerful approach involves the systematic use of expert opinion. Yet while studies using experts have become more frequent (see Sohst et al. (2020) for a review), the potential of expert advice remains unclear and understudied (Abel et al. 2013; Bijak 2011; Findlay et al. 2012). Among the methods to elicit expert predictions, the Delphi survey is a tool designed to systematically collect

information from a group of experts in a way that decreases individual bias and reduces uncertainty about the future (Dalkey and Helmer 1962; Helmer-Hirschberg 1967). It is a survey method based on a pool of experts which allows individual experts to adjust their predictions based on learning about the average predictions from the group.

There is limited guidance on how to implement Delphi studies and ways to reduce uncertainty in group predictions. At the same time, there have been calls for careful consideration of guidance for survey implementation, as the value of experts has been severely challenged in other policy fields (Badescu and Chen 2014; Colson and Cooke 2018; Morgan 2014; Kahneman, Sibony, and Sunstein 2021; Tetlock, Mellers, and Scoblic 2017). In our study we aim to test whether practical, small adjustments to the Delphi survey have the potential to reduce uncertainty in the estimates and increase the credibility of the approach overall.

Based on a large-scale Delphi survey involving 178 experts who made predictions regarding immigration to the EU in 2030, we assess how the specificity of the type of migration flow (total flows vs. specific flows), the migration scenario for 2030, and information on the average group predictions may reduce uncertainty in average predictions.

Overall, the results indicate that providing additional context information, such as future scenarios, the type of migration flows, and information on group predictions, does not substantially reduce uncertainty in expert predictions. This aligns with previous research that underscores the limited validity of expert predictions based on Delphi studies and underscores the complexity of migration processes, as well as the lack of consensus among experts regarding key drivers. Irrespective of the subject matter, alternative approaches like prediction markets (e.g., Arrow et al. 2008) may offer more reliable results.

2. Expert advice and future migration

Policymakers have a range of available approaches to help them anticipate future migration trends (de Valk et al. 2022). Many of these involve quantitatively analyzing migration data using causal models, time series extrapolations, or other methods (see Bijak et al. 2019; Böhme, Gröger, and Stöhr 2020; Dao et al. 2018; Tjaden, Auer, and Laczko 2019; Willekens 2018). However, the underlying source of these forecasting approaches, which is past data, is also their main limitation: Migration data are often incomparable across time and countries, being either unavailable or of insufficient quality (Raymer 2017). Furthermore, even when data are available and of high quality, the inherent ‘randomness’ of migratory patterns and their susceptibility to unpredictable

factors (such as natural disasters or violent conflicts, often termed 'black swans') make forecasting migration notoriously difficult (Bijak and Wisniowski 2010).

Expert-led processes can be viewed as a response to the limitations or unavailability of data for purely quantitative approaches (Colson and Cooke 2018; Drescher and Edwards 2018; Verdolini et al. 2018). EU policymakers commonly consult with and rely on both informal and formal expert councils (European Commission 2020c; European Asylum Support Office 2019; Organisation for Economic Co-operation and Development 2015). The use of expert judgment is grounded in the belief that individuals who have observed and analysed migration data over the years, designed migration policies, or worked directly with migrants can offer valuable intuition and insights into patterns that may go unrecognized by quantitative models (Willekens 1994: 25). Additionally, experts – especially when consulted in groups – can assist in resolving conflicting knowledge and enhancing awareness about uncertainties, ideally leading to a situation where groups perform better than their single best member (Rowe, Wright, and Bolger 1991).

One approach to systematically collecting expert input is through Delphi surveys, which are a popular technique to support decision-making based on the opinions of experts (Landeta 2006; Rowe and Wright 2001). For example, the International Labour Organization (ILO) and European Commission (2009) used a Delphi survey to reach consensus on a selection of indicators for human trafficking. In other cases, the method can be applied to assess the desirability of different policy options (Lachmanova and Drbohlav 2004), or to help predict future developments without a normative evaluation, as is done in this study. In essence, Delphi surveys work by surveying experts through several rounds and collecting their opinions. After the first round, each subsequent round returns the statistically summarised responses from the previous round to the participants, allowing them to revise their assessments in light of the other participants' answers. Applied to migration research, Delphi surveys can produce estimates of future migration based on surveying experts anonymously in multiple rounds.[5] The process is intended to lead to a convergence of responses and thus aims to produce "the most reliable consensus of opinion" (Dalkey and Helmer 1962: 458; Helmer-Hirschberg 1967).

However, as there is no standard template for implementing the Delphi technique (Woudenberg 1991), there is limited guidance on how it should be structured to elicit the most reliable expert opinions and reduce group uncertainty. Much of the guidance for Delphi surveys over the past four decades has originated from fields other than migration – particularly healthcare, which often employs Delphi surveys for different purposes than those of this study (Flostrand, Pitt, and Bridson 2020). Previous studies in these fields

[5] Delphi surveys can also be used to assess the desirability of future states and the means of achieving them, e.g., through policy implications and scenarios. However, the Delphi survey in this study is purely non-normative.

have aimed to select health indicators based on expert consensus or to identify criteria for measuring health-related outcomes (see, for example, Page et al. 2015; Lau et al. 2022; Jünger et al. 2017).

More recently, researchers have proposed concrete steps to enhance the accuracy of the judgment data generated in Delphi studies (Hasson, Keeney, and McKenna 2000; Schmalz, Spinler, and Ringbeck 2021; Belton et al. 2019). Given the diverse range of Delphi approaches, these experts emphasize the ongoing need to rigorously test the reliability of various Delphi designs and to ascertain the conditions under which these designs can be considered more or less effective. Despite prior efforts in this area, there remains a scarcity of empirical evidence concerning the impacts of design choices, particularly in the context of Delphi surveys.

In the absence of clear guidance and with a large variation in survey design implementation, Delphi surveys in particular have demonstrated rather high levels of uncertainty and disagreement among experts (Drbohlav 1997; Lachmanova and Drbohlav 2004; Findlay et al. 2012). This raises questions about whether the Delphi method can truly generate consensus. Previous research in other fields has also emphasized the limitations of approaches involving experts (Kynn 2008; Morgan 2014; Sutherland and Burgman 2015; Tetlock, Mellers, and Scoblic 2017). As of now, there is limited guidance available for designing Delphi surveys, especially in the field of migration. We identify a general lack of methodological research focused on improving Delphi surveys. In our study we employ the Delphi survey to evaluate the implications of existing scenarios, providing valuable insight and a contribution to the literature on eliciting expert opinion through the Delphi approach.

3. How experts make decisions

There is a substantial body of literature in psychology, management science, and decision science on how experts make decisions (e.g., Morgan 2014; Sutherland and Burgmann 2015). Despite their expertise, experts, like all humans, are susceptible to various cognitive biases. While experts are often considered to have the ability to make more accurate predictions about the future due to their knowledge, experience, and qualifications, it is important to note that expertise can sometimes lead to what has been termed the ‘expertise trap’ or ‘cognitive entrenchment’ (Finkelstein 2019). Specialists, because of their high level of proficiency in a particular area, may develop blind spots that hinder their ability to perceive new situations or devise innovative solutions. Seasoned experts may excel in stable environments, but when past patterns no longer apply, their existing frame of reference may make them less accurate due to reduced adaptability.

Sutherland and Burgmann (2015) summarize the evidence on expert decision-making: "Estimates are influenced by experts' values, mood, whether they stand to gain or lose from a decision, and by the context in which their opinions are sought. Experts are typically unaware of these subjective influences. They are often highly credible, yet vastly overestimate their own objectivity" (page 1). With those potential biases in mind, scholars argue that expert elicitation exercises should adopt strategies designed to help experts make decisions and reduce uncertainty (Morgan 2014). Guidance for these implementation choices contains information on how questions are posed to the experts, which type of baseline information is provided, whether the experts are primed, and more.

In this study we aim to test the effect of implementation choices that contain varying context information for the expert (see details in next section). Migration is a complex phenomenon. In addition to structural drivers such as economic prosperity and population growth, large increases in migration flows are often related to events which are difficult to predict. Migration experts may approach the question of future flows with varying mental models involving their particular knowledge, expertise, ideology, etc. At the same time, there is no consensus among experts on a general theory of migration. This creates a context of high ambiguity where variation in expert predictions is likely exacerbated by experts making diverging assumptions about what will drive migration in the future. Our aim is to reduce this uncertainty by providing information and holding certain assumptions constant.

4. Hypotheses

We hypothesize that additional context information provided to experts in the Delphi survey will 'equalize' experts' mental models and reduce the number of context assumptions they have to make, and as a result reduce uncertainty and variation in predictions among experts and increase confidence in the predictions.

We add context information in two ways: First, we ask experts to predict total migration flows, which is the sum of any type of migration that may occur until 2030. Subsequently, we ask experts to predict more specific migration flows subject to different sets of policy frameworks and drivers, including highly skilled migration, irregular migration, and asylum migration. Specific flows are less ambiguous than general flows and there is greater consensus on key drivers of specific flows in the literature (Czaika and Reinprecht 2022).

H1: *Experts' predictions show lower variation and higher subjective confidence regarding specific migration flows compared to total flows.*

Second, we ask experts to assume four varying scenarios for 2030 when making predictions. The scenarios are based on common scenario exercises and vary the degree to which countries collaborate (multilateralism) and the degree of economic convergence between countries. The scenarios provide context information for specific migration flows. For example, we assume that multilateralism paired with high economic convergence will reduce irregular migration as pressures to move decrease and enforcement efforts can be coordinated across countries.

H2: *Scenarios which assume that countries collaborate more and are economically more equal reduce variation and increase subjective confidence in expert predictions on irregular migration.*

5. Methodology

5.1 Data

This study utilizes data collected within the framework of the Horizon 2020-funded CrossMigration project. The study was collaboratively undertaken by the IOM's Global Migration Data Analysis Centre (GMDAC) and the Netherlands Interdisciplinary Demographic Institute (NIDI). The project was designed for and focused on making predictions of absolute migration flows to the EU in 2030 (Acostamadiedo et al. 2020). We now explore this survey data, focusing on the uncertainty in predictions.

The two-round, online Delphi survey is based on a group of diverse migration experts from across Europe. A total of 1,656 experts in the field of migration studies, in both academia and government policymaking, were invited via email. The recipients were encouraged to share the survey within their networks. Experts were selected based on their experience in the migration field as evidenced by their network membership and their willingness to contribute to the exercise. Following the invitation to participate, a total of 178 persons participated in the first survey round between 25 October 2019 and 15 November 2019. After the first round we provided statistical feedback to the respondents, showing them a table with the median and mean of the answers from the first round alongside their own estimate and allowing them the opportunity to change their original estimate based on this new information. Round 2 of the survey ran between 25 November 2019 and the end of 2019. Of the 178 experts, 145 participated in round 2. This is a high response rate of over 80% with little dropout (18%) in the second round.

Given the way the participants were contacted and selected, the Delphi survey constitutes a purposive, non-probability sample, the characteristics of which (membership in one of the migration networks mentioned above) are relevant to our study

(Hasson, Keeney, and McKenna 2000). However, participation relied to some degree on self-selection (within the contacted networks) and a certain level of self-declared expertise, which is a limitation in our approach that is difficult to overcome, given that there is no sampling frame or other known population of migration experts. We note, however, that our study used more experts than common Delphi surveys. Smaller expert pools are more sensitive to selection of individual experts (Akins, Tolson, and Cole 2005).

In order to ensure a minimal level of expertise, this analysis includes experts that participated in the second round and had at least five years of experience in migration issues as well as expertise in European migration, resulting in 110 respondents. The main results do not differ when including all experts (see Figures B-1 and B-2 in the Appendix).

In the end, our expert group included both senior experts (34% of experts with 20 or more years of relevant experience) and younger members of the migration research and policy community (48% with 5–14 years of experience). Two-thirds are migration scholars and one-third policy practitioners. About a quarter of respondents had previous experience with migration forecasts and/or scenarios. Lastly, the respondents had diverse academic backgrounds, including sociology (36%), economics (21%), and law (13%). A detailed overview of the sample is provided in Table 1.

Table 1: Delphi survey sample

		First round		Second round		Net sample**	
		Total (N)	Share (%)	Total (N)	Share (%)	Total (N)	Share (%)
Years of experience in the field of migration	0–4	21	11.9	18	12.4	0	0.0
	5–9	45	25.6	37	25.5	34	30.9
	10–14	30	17.1	27	18.6	19	17.3
	15–19	28	15.9	23	15.9	20	18.2
	≥20	52	29.6	40	27.6	37	33.6
Stakeholder	Others	15	8.5	12	8.3	6	5.5
	Practitioner	53	29.9	43	29.7	31	28.2
	Scholar	109	61.6	90	62.1	73	66.4
Academic background*	Political science	59	33.2	48	33.1	38	34.6
	Sociology	52	29.2	45	31.0	40	36.4
	Demography	45	25.3	36	24.8	26	23.6
	Economics	42	23.6	32	22.1	23	20.9
	Law	19	10.7	17	11.7	14	12.7
	Psychology	4	2.3	4	2.8	3	2.7
	Other discipline	46	25.8	37	25.5	27	24.6
Experience in migration research*	Drivers	72	40.5	58	40.0	46	41.8
	Forecasting	41	23.0	33	22.8	28	25.5
	Region-specific	103	57.9	84	57.9	66	60.0
	Scenarios	46	25.8	41	28.3	30	27.3
	Other methods	57	32.0	47	32.4	34	30.9
Regional expertise*	Africa	66	37.1	55	37.9	45	40.9
	Americas	41	23.0	32	22.1	24	21.8
	Asia	47	26.4	36	24.8	26	23.6
	Europe	141	79.2	120	82.8	110	100.0
	Oceania	12	6.7	10	6.9	7	6.4
Total		178		145		110	

Note: Not all respondents answered all the questions, so totals may not add up to 178.
* Totals do not add up to 100% because a respondent may belong to more than one category.
** Responses of participants with less than 5 years of experience and without expertise in European migration were excluded from the analysis.
Source: Data collected by the authors.

5.2 Survey guidance

First, at the beginning of the survey the experts are introduced to the prediction tasks and the purpose of the survey.[6]

[6] Interested readers can see the full questionnaire in the supplementary material.

Second, the survey explains four general scenarios (see Appendix A-1 for wording) varying along two key dimensions: (1) Multilateralism: level of cooperation between countries grading migration issues. (2) Economic development: level of economic convergence between countries. The scenarios were developed based on an extensive review of migration scenario studies (Sohst et al. 2020; Acostamadiedo et al. 2020), from which seven were selected to synthesize into the scenario narratives. Selection criteria included relevance to the context of migration to the European Union and methodological soundness (see Appendix A-2 for a comparative overview of the scenario studies included and details of how we developed the synthetized scenarios).

Third, there are four aspects of the general prediction scenario which are constant for all experts: (1) Increased demand for health and elderly care services in the European Union, (2) Shrinking working-age populations in many European Union Member States due to low fertility rates, (3) Increased importance of environmental and climate change to economies and societies, and (4) Increased impact of automation and digitalization on the functioning of economies, particularly on labour markets. These factors were identified based on prior literature review (Sohst et al. 2020).

Fourth, before they enter predictions for each flow, the experts are exposed to a line graph showing actual migration to the EU for each of the migration flow types, including total, highly skilled, asylum, and irregular (see Figure A-3 for total flows and Table A-4 for the data sources used in the Delphi survey). This anchors experts and is intended to reduce variation in predictions by levelling the base rates.

Fifth, survey respondents are asked to predict the absolute migration flow to the EU in 2030 for different types of migration flows. For total flows, the specific question is: "In 2017, there was an estimated total inflow of 2,334,000 immigrants to the EU-28 from countries outside the EU. What would be the approximate number in the year 2030 in the EU-28 for each of the scenarios described above?" Each prediction task is done four times for each scenario.

Sixth, after providing the absolute migration flow prediction, experts are asked to indicate their confidence in their own estimates using a 100-point percentage confidence scale for each of the scenarios and flow types using this question: "How confident are you about your estimation? Please provide a percentage based on the scale below." To increase a common understanding of the confidence scale across experts, they are presented with the following response categories: 'Very confident' (80%–100% confidence), 'Confident' (60%–79% confidence), 'Half–half' (40%–59% confidence), 'Unsure' (20%–39% confidence) and 'Very unsure' (1%–19% confidence).

Seventh, in the second survey round all respondents were invited to review their initial estimates vis-à-vis those of others and, if they wished, make adjustments. Experts were presented with their original estimate, mean, and median from the first survey round.

5.3 Outcomes

The main aim of the analysis is to assess the uncertainty of expert predictions. The two key measurements of uncertainty are (1) the coefficient of quartile variation, a measure of the dispersion of the expert estimates, and (2) the experts' subjective confidence in their own predictions. For any end-user of the predictions derived from the Delphi survey, both a lack of agreement (as in 1) and higher levels of subjective uncertainty (as in 2) indicate more uncertainty.

The coefficient of quartile variation is a unitless measure for comparing dispersion across variables on different scales for non-normal distributions (Zwillinger and Kokoska 2000; Bonett 2006).[7] The higher the coefficient, the higher the dispersion of individual expert predictions; i.e., the higher the uncertainty in the average prediction. Lower values indicate a closer spread of prediction around the mean; i.e., more agreement among experts and higher levels of certainty.

Subjective confidence is measured on a scale from 0% to 100%. Following each prediction (20 in total), experts are asked to assess how confident they are in their own prediction.

5.4 Robustness checks

We explore the compositional effect of experts to assess whether the results are driven by individual characteristics such as years of expertise, stakeholder background (practitioner, scholar), gender, academic background, field of expertise in migration, and expertise in geographic regions. See Tables B-3 to B-6 in the Appendix. Appendix B-7 presents the distribution of expert estimates by round, type of flow, and scenario.

6. Results

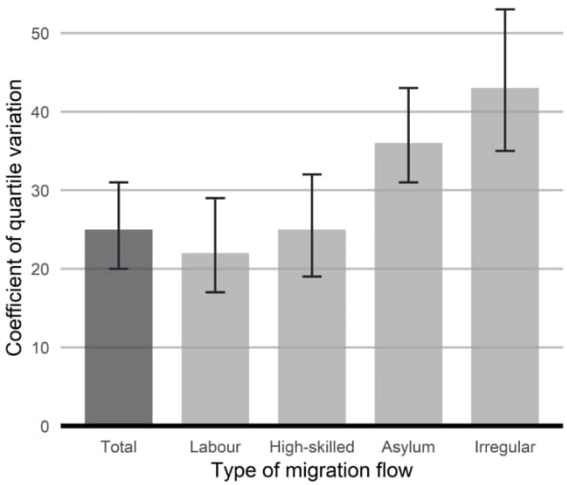
6.1 Variation in expert prediction and self-reported confidence by type of migration flow

Contrary to our expectations (Hypothesis 1), expert predictions of some of the more specific migration flows such as irregular migration (43% in the coefficient of quartile

[7] The population value of the coefficient of variation (cqv) is cqv = (Q3 − Q1) / (Q3 − Q1), where Q1 is the population 25th percentile and Q3 is the population 75th percentile. We use the confidence interval of the coefficient of quartile variation developed by Bonett (2006), given the non-normal distributions of the data at hand.

variation) and asylum-related flows (36%) show higher levels of variation than total migration flows (25%) (see Figure 1). However, the level of variation in expert predictions for other specific migration flows such as labour and highly skilled migration is similar to that for total flows. Overall, the type of flow does not appear to induce additional information that helps experts converge in their predictions. Rather, the results suggest that irregular and asylum-related migration generally produces a lack of agreement compared to migration inflows like labour migration which tend to be shaped more by the destination country characteristics, such as demand for workers. The results also suggest that total flows are likely perceived to largely consist of regular migration flows, given the similarity in variation with labour migration and dissimilarity with irregular flows. The results are consistent for different expert demographics and survey rounds (see Table B-3 in the Appendix).

Figure 1: Variation in expert predictions by type of migration flow

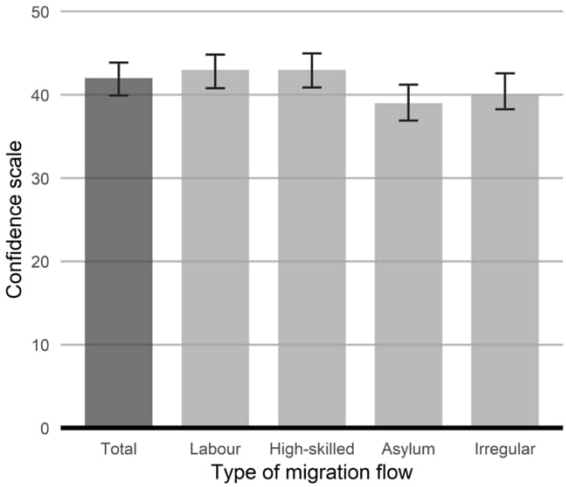


Note: Data collected by the authors. Based on 2,097 predictions by 109 experts (restricted to experts with at least 5 years of experience, expertise on migration, and participation in round 2). Coefficient of quartile variation provides standardized measure for variation in the expert predictions across different scales. Higher values represents high variation of predictions across experts. 95% confidence intervals calculated with approach from Bonnet (2006).

Regarding experts' self-reported confidence in their own migration predictions, we find that total flows had levels of confidence similar to those for more specific flows (see Figure 2). This finding rejects Hypothesis 1, which posits that experts have less confidence predicting total migration flows (because of higher uncertainty given the drivers of overall migration) compared to more specific migration flows (which are

subject to specific migration policies and clearer theories). The results are consistent for different expert demographics and survey rounds (see Table B-4 in the Appendix).

Figure 2: Experts' self-reported average confidence in predictions by type of migration flow



Note: Based on 2,128 predictions by 109 experts (restricted to experts with at least 5 years of experience, expertise on migration, and participation in round 2). Experts' confidence in their own estimates measured on a 100-point percentage confidence scale for each of the scenarios and flow types. 95% confidence intervals are represented in the error bars.

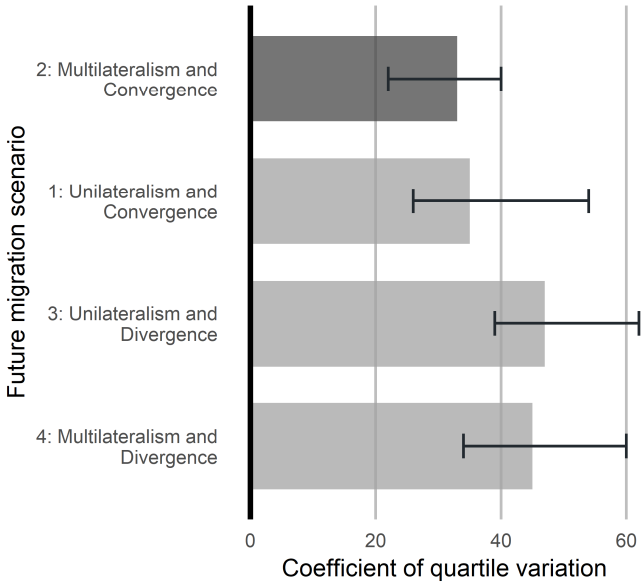
6.2 Variation in expert prediction by type of future scenario

Our second hypothesis focuses on providing experts with more ambiguous or less ambiguous future scenarios for 2030 regarding irregular migration. We anticipated that scenarios depicting a future where countries collaborate or experience economic convergence would reduce variation in expert predictions and increase confidence in projections concerning irregular migration.

Figure 3 provides modest support for this hypothesis. Both multilateralism and economic convergence lead to lower levels of variation (33%), indicating greater agreement among experts, compared to other scenarios for irregular migration. However, the differences in variation are primarily influenced by the degree of economic convergence or divergence. Experts appear to believe that economics exerts a larger impact on irregular flows than the level of cooperation between countries. Nevertheless, we interpret this as partial evidence supporting the positive effect of providing context

information on the uncertainty in expert predictions. The results remain consistent when data is analysed by expert characteristics across survey rounds (refer to Table B-5 in the Appendix).

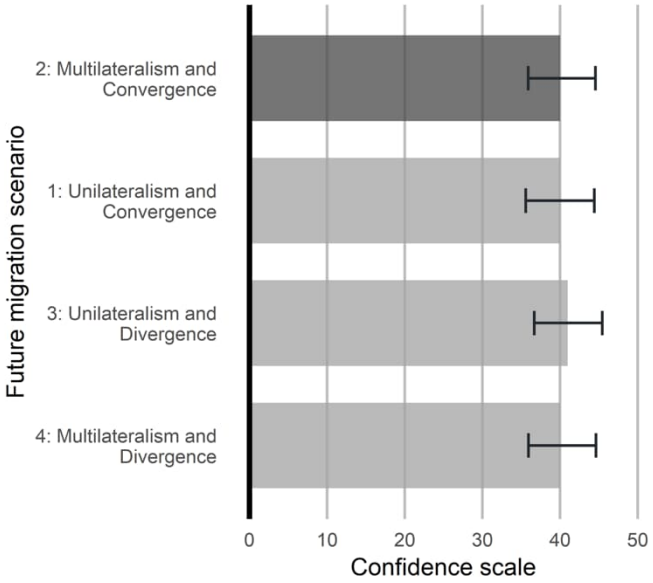
Figure 3: Variation in expert predictions by scenario



Note: Data collected by the authors. Based on 407 predictions by 103 experts (restricted to experts with at least 5 years of experience, expertise on migration, and participation in round 2). Coefficient of quartile variation provides standardized measure for variation in the expert predictions across different scales. Higher values represents high variation of predictions across experts. 95% confidence intervals calculated with approach from Bonnet (2006).

Regarding experts' confidence, we do not find support for Hypothesis 2. Experts do not appear to have higher or lower confidence depending on the specific context information they are provided (see Figure 4). Results do not vary when data is disaggregated by expert characteristics across survey rounds (see Table B-6 in the Appendix).

Figure 4: Experts' self-reported average confidence in predictions, by scenario (only irregular migration)



Note: Based on 409 predictions by 103 experts (restricted to experts with at least 5 years of experience, expertise on migration, and participation in round 2). Experts' confidence in their own estimates measured on a 100-point percentage confidence scale for each scenario. 95% confidence intervals are represented by the errorbars.

7. Discussion and conclusion

Following the rapid increase in asylum seekers arriving in the European Union in 2015/16, policymakers have invested heavily in improving their foresight and forecasting capabilities. This has included renewed interest in expert advice and how expert knowledge can be most effectively utilized to enhance these capabilities. A common method to elicit expert predictions is through Delphi surveys; however, the method has raised concern, given its high uncertainty. One recommendation to reduce uncertainty in experts' predictions is to develop specific guidance for survey implementation, i.e., ways of delivering the survey and framing the prediction tasks.

In this study we have tested whether providing additional context information about migration flows and scenarios can reduce uncertainty and increase experts' confidence in

their own predictions. The results largely reject the notion that more context information can substantially reduce uncertainty.

This finding may apply particularly to the topic of migration, which is notoriously complex. The absence of widely accepted theories often results in experts holding differing opinions on the key drivers of future migration. Our results suggest that framing migration tasks differently will only marginally improve consensus among experts. Overall, the findings underscore previous concerns regarding predictions (Colson and Cooke 2018; Morgan 2014), particularly in the field of migration, and highlight the need to continue exploring how expert opinion can be best leveraged to inform anticipatory decision-making, including through further testing of the Delphi method and alternative approaches such as prediction markets (e.g., Arrow et al. 2008).

Even though experts might not provide precise future estimates, they can provide a viable sounding board for policymakers, unpacking the complex drivers of future migration and making assumptions more transparent through open deliberation. Finally, expert input may sensitize policymakers regarding the risks of assuming specific future developments and broaden their views and responses to multiple potential scenarios.

This study is not without limitations. First, it is possible that our adjustments to the survey were not strong enough to induce major convergence in predictions. Various types of migration flow and various types of future scenarios may leave too much ambiguity to equalize the mental models of experts and level key assumptions that experts may disagree on. Further research is needed to test the effect of additional guidance for Delphi survey implementation. A potential future avenue of research is to randomly assign experts to different expert elicitation approaches to compare levels of variation and confidence. Second, our design exploits variation between different scenarios for 2030. We did not implement a baseline scenario where experts make predictions without having been provided with any context information. We encourage future studies to adjust the design accordingly.

Overall, the study suggests that policymakers and academics should carefully consider when and how to use expert surveys such as Delphi to make predictions about future migration, and be aware of the surveys' limitations. Further research is needed to fine-tune Delphi guidance for its use in migration policymaking. This study has shown that the specific adjustments tested here do not improve the outcomes.

8. Acknowledgements

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Appendix A-1: Study design: Detailed description of migration scenarios presented to experts

Scenario 1: Economic convergence and unilateralism

Summary: Protectionism and unilateral international cooperation are on the rise. Asia and Africa have caught up with Europe economically. Wealth in Africa and Asia is heavily concentrated in the top 5% of society.

Details:

- Unilateral international cooperation in policy areas affecting migration
- European Union cohesion is weakened. While some of the European Union seek collaboration, others continue to pursue an agenda of unilateral protectionist policies, with little interest in addressing global challenges. China consolidates its global economic dominance. Migration policies are focused on bilateral agreements to regulate labour shortages in Europe. Little is done to address humanitarian migration. Meanwhile, the European Union limits access to social services for migrants.
- Economic convergence between the European Union and regions of origin
- Countries of the European Union have not seen any relevant growth since 2025. China, India, and Turkey are attractive destinations for migrant workers due to spectacular economic opportunities.

Scenario 2: Multilateralism and inclusive economic growth

Summary: Global economic growth and strong international cooperation create more inclusive but also more diverse societies in the European Union, Africa and Asia.

Details:

- Multilateral international cooperation in policy areas affecting migration
- In Europe, Africa, and Asia, governments and civil society rally to implement an ambitious agenda towards multilateralism, openness, and environmental protection. European Union member states address the needs of migrant populations through a general rights-based approach.
- Economic convergence between the European Union and regions of origin
- Sustained economic growth rates in the developed world and high, equitable growth in emerging and developing countries have narrowed development gaps between European Union countries and low-income countries of origin. Labour markets in both the European Union and developing countries offer young populations attractive job opportunities.

Scenario 3: Economic divergence and unilateralism

Summary: International cooperation is at its lowest. There is a large economic gap between the European Union and Africa and Asia. Social inequalities are on the rise, causing social unrest.

Details:

- Unilateral international cooperation in policy areas affecting migration
- The European Union project is on the brink of falling apart. Protectionist and isolationist policies are the norm, as more countries consider leaving the union and abandoning some hard-won global agreements. Very few applicants are granted asylum and visas are generally difficult to obtain.
- Economic divergence between the European Union and regions of origin.
- Since Asia and Africa have not seen relevant economic growth in the past decade, there is a wide economic divide between these sending regions and European Union countries.

Scenario 4: Economic divergence and multilateralism

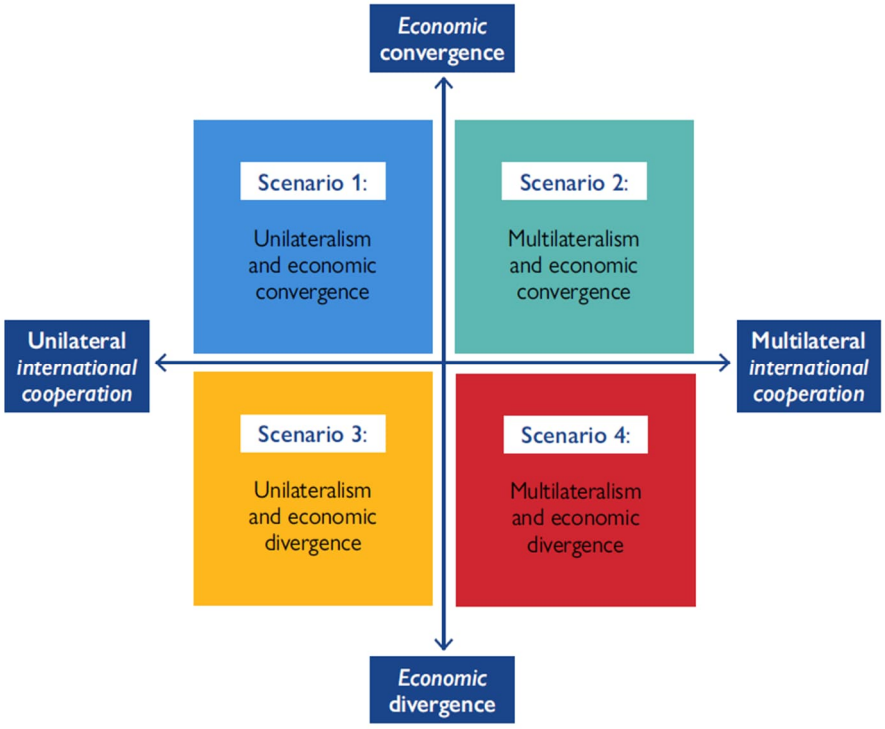
Summary: An economic crisis in Africa and Asia creates patches of instability. To deal with economic instability in migrant-sending regions, countries in the European Union, Africa, and Asia engage in multilateral cooperation that allows for some progress in migration management.

Details:

- Multilateral international cooperation in policy areas affecting migration
- The European Union has become more cohesive. African and Asian countries have deepened their partnerships with each another and the rest of the world. Countries of the European Union, Asia, and Africa engage in bilateral agreements on labour migration at all skill levels, the granting of refugee status, and integration. The European Union has increased its ability to cooperate with third countries on matters pertaining to return and on delivering humanitarian support outside Europe.
- Economic divergence between the European Union and regions of origin.

The economies of the European Union are experiencing stable economic growth. Developing economies in Asia and Africa have failed to catch up due to an economic crisis.

Figure A-1: Graphical illustration of migration scenarios



Source: Own elaboration based on Acostamadiedo et al. (2020).

Appendix A-2: Studies used as the basis for the synthesized migration scenarios

In the scenario method, the framework for the storylines is structured by 'dimensions'. The way that the dimensions of a scenario study are selected varies. A comprehensive methodological and conceptual framework has been proposed by the Global Migration Futures project (de Haas, Vargas-Silva, and Vezzoli 2010). The methodology follows roughly four steps: (a) identification of migration drivers; (b) sorting of drivers into groups based on how predictable they are (for instance, how much uncertainty there is about their future) and how much impact they have on migration patterns; (c) selection of dimensions from migration drivers perceived to have the highest impact and the

highest level of uncertainty (typically two); and (d) development of scenario narratives based on the identified dimensions.

The scenario dimensions (i.e., the potentially most impactful migration drivers with unknown outcomes) in each of the seven studies below were identified and compared. Four scenarios were aggregated and synthesized. In order of decreasing frequency, these are: (a) international cooperation (including European Union integration), (b) economic convergence between migrant-sending and receiving regions, (c) environmental change, and (d) social development. The two potentially most impactful but also highly uncertain migration drivers, (a) international cooperation and (b) economic development, were selected as the framework for the study's immigration scenarios.

Title	The future of migration in the European Union – future scenarios and tools to stimulate forward-looking discussions
Author(s) and/or institution	Szczepanikova, A. and T. van Criekinge; Joint Research Commission
Year of publication	2018
Geographical coverage	Europe; Asia and Africa as the main migrant-sending regions
Time horizon	2030
Scenario dimensions	• Level of international cooperation in policy areas affecting migration and the degree to which local governance is inclusive or exclusive • Economic gap between OECD and non-OECD countries

Title	Perspectives on Global Development 2017: International Migration in a Shifting World
Author(s) and/or institution	Organisation for Economic Co-operation and Development
Year of publication	2016
Geographical coverage	World
Time horizon	2030
Scenario dimensions	• Level of international cooperation in global governance • Economic convergence between OECD countries and non-OECD countries (in per capita incomes) • Restrictive versus open migration policies

Title	Tomorrow's World of Migration and Mobility
Author(s) and/or institution	Friedrich-Ebert-Stiftung, Global Future and International Organization for Migration
Year of publication	2017
Geographical coverage	Europe
Time horizon	2030
Scenario dimensions	• Perception of migrants by local population • Actors influencing migration policies

Title	The future of international protection in the EU+ 2030: a scenario study
Author(s) and/or institution	European Asylum Support Office
Year of publication	2019
Geographical coverage	World, with a focus on the European Union
Time horizon	2030
Scenario dimensions	• Quality of governance • Intensity of violent conflicts • Intensity of climate change • Approval rating of the European Union • European Union cooperation level • State of European Union democracies • Degree of global inequality • Societal perception of migrants • Terrorism in the European Union • Societal openness • Development of a European legal international protection framework

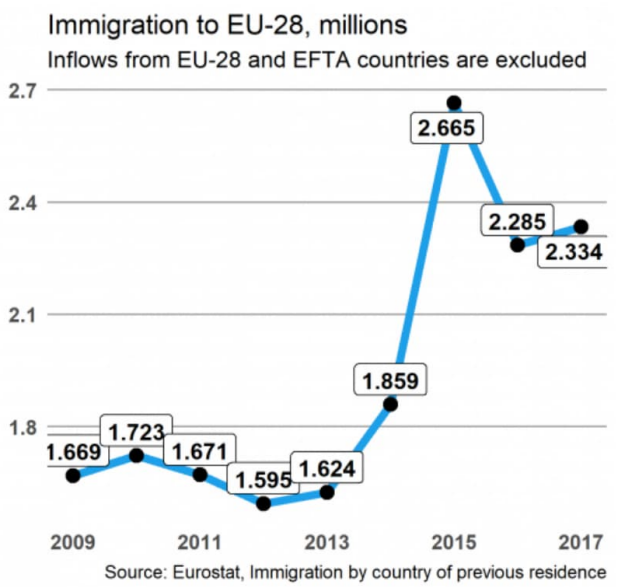
Title	Mediterranean migration futures: patterns, drivers and scenarios
Author(s) and/or institution	de Haas, H.
Year of publication	2011
Geographical coverage	Mediterranean
Time horizon	2050
Scenario dimensions	• Economic growth or stagnation in sending regions determining regional economic disparities • Political process moving towards openness, regional integration, and democratization vs. nationalism, xenophobia, and autocracy

Title	Migration and global environmental change: future challenges and opportunities
Author(s) and/or institution	United Kingdom Government Office for Science
Year of publication	2011
Geographical coverage	World
Time horizon	2030 and 2060
Scenario dimensions	• Degree of inclusivity of political, social, and economic local governance (inclusive versus exclusive) • Availability of global migration opportunities (linked to high global economic growth versus low global economic growth)

Title	Risk Analysis for 2016
Author(s) and/or institution	Frontex
Year of publication	2016
Geographical coverage	Europe
Time horizon	2021–2026
Scenario dimensions	• Global environment (conflict and economy) • Terrorism • European Union integration • European foreign policy • Migration and integration: openness of society • European asylum policies • Security and internal mobility • Border management

Source: Own elaboration based on Acostamadiedo et al. (2020).

Figure A-3: Total migration flows



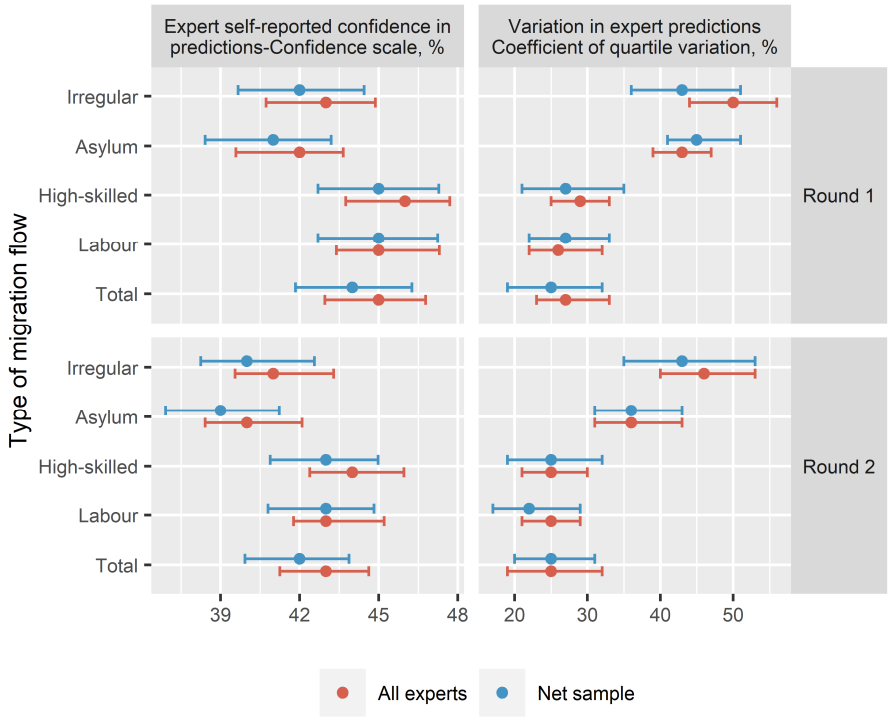
Source: Own elaboration

Table A-4: Data sources for the immigration figures used in the Delphi survey

Title	Source
Total	Eurostat. (2020). Immigration by age group, sex, and country of previous residence – migr_imm5prv. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=migr_imm5prv&lang=en
Labour	Eurostat. (2020). First permits issued for remunerated activities by reason, length of validity, and citizenship – migr_resocc. http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=migr_resocc&lang=en
High-skilled labour	Eurostat. (2020). First permits issued for remunerated activities by reason, length of validity, and citizenship - migr_resocc (filter: highly skilled workers and researchers). http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=migr_resocc&lang=en
Asylum applications	Eurostat. (2020). Asylum and first-time asylum applicants by citizenship, age, and sex – migr_asyappctza. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=migr_asyappctza&lang=en
Irregular border crossings	Frontex. (2020). Detections of illegal border crossings statistics download (updated monthly). Frontex Migratory Map. https://frontex.europa.eu/along-eu-borders/migratory-map/

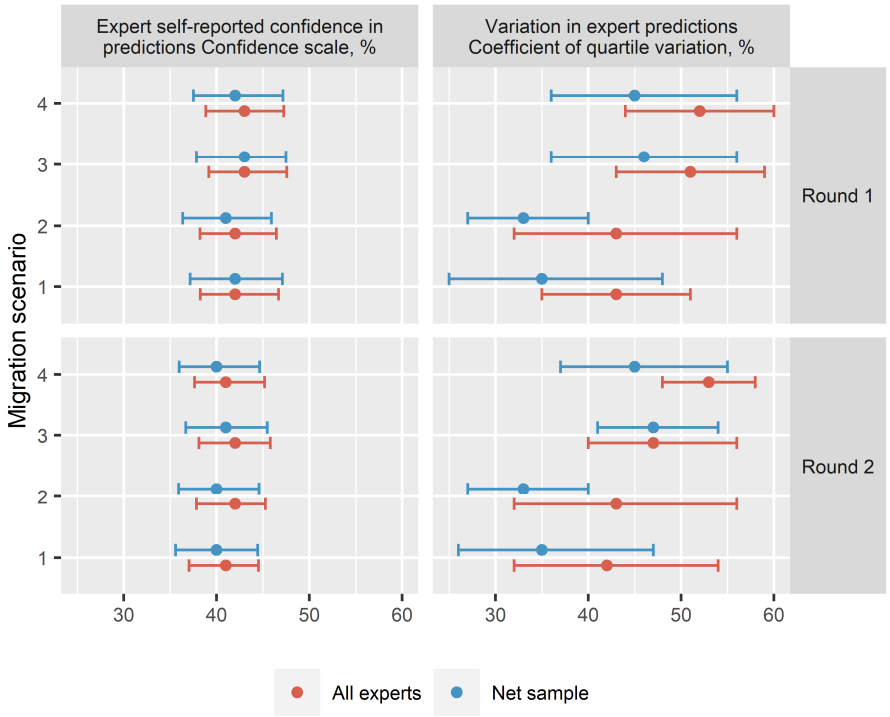
Appendix B

Figure B-1: Variation in predictions and average confidence by expert sample, survey round, and migration flow type



Note: Data collected by the authors. Only experts who responded to both rounds 1 and 2 (i.e., complete panel) are included. 95% confidence intervals are represented by the error bars.

Figure B-2: Variation in predictions and average confidence for irregular migration flows, by expert sample and scenario



Note: Data collected by the authors. Only experts who responded to both rounds 1 and 2 (i.e., complete panel), are included. 95% confidence intervals are represented by the error bars.

Table B-3: Coefficient of quartile variation broken down by flow type, survey round, and demographic

		Total		Irregular		Asylum		High-skilled		Labour	
Variable	Level	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Academic background	Demography	32	20	40	35	35	32	28	25	26	23
	Economics	20	20	43	43	40	40	31	31	30	30
	Law	25	20	43	43	41	41	33	33	38	31
	Political science	28	25	43	43	45	45	27	25	30	23
	Sociology	31	27	50	54	39	33	34	33	27	26
Expertise in future migration method	Drivers	25	25	47	54	45	45	29	26	23	23
	Forecasting	28	27	44	38	31	30	26	25	23	23
	Scenarios	27	25	50	50	33	33	28	25	29	26
Region of expertise	Africa	32	32	43	43	40	33	33	27	24	20
	Americas	31	25	43	43	45	45	33	29	18	18
	Asia	40	36	43	50	54	39	33	29	26	23
	Europe	25	25	44	43	43	36	29	25	26	23
	Oceania	29	29	36	36	48	37	28	26	15	15
Sex	Male	25	25	50	50	45	45	36	33	33	33
	Female	33	25	43	43	40	33	26	27	26	23
Stakeholder	Other	32	32	50	50	33	27	46	35	30	28
	Practitioner	39	33	50	45	44	36	33	33	29	27
	Scholar	27	25	46	43	43	43	26	25	26	23
Years of experience	>=20	27	25	33	33	43	36	33	26	26	26
	15–19	27	25	45	45	23	23	19	18	29	29
	10–14	38	37	50	50	59	55	26	25	36	31
	5–9	25	20	36	36	45	41	29	27	24	20
	0–4	27	21	55	61	34	34	30	30	34	34

Source: Own calculations based on the Delphi survey.

Table B-4: Average confidence in expert estimates by flow type, survey round, and demographic

		Total		Irregular		Asylum		High-skilled		Labour	
Variable	Level	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Academic background	Demography	46	42	43	40	41	39	47	45	47	44
	Economics	44	43	43	43	40	39	45	45	42	41
	Law	48	46	53	51	49	47	52	50	47	46
	Political science	42	41	41	41	42	41	44	43	43	42
	Sociology	49	46	43	41	42	41	48	45	50	48
Expertise in future migration method	Drivers	44	42	41	40	41	40	44	43	44	43
	Forecasting	45	43	41	41	41	41	44	42	45	43
	Scenarios	46	44	41	40	40	38	46	44	46	45
Region of expertise	Africa	46	44	45	44	41	40	47	46	46	44
	Americas	46	46	45	45	41	41	47	47	47	46
	Asia	44	42	43	42	41	39	45	44	44	41
	Europe	44	42	42	40	41	39	45	43	45	43
	Oceania	48	47	42	45	39	39	47	49	49	46
Sex	Male	44	43	42	41	41	41	44	44	45	44
	Female	46	43	44	41	42	39	48	45	47	43
Stakeholder	Other	50	45	50	47	48	44	50	47	53	48
	Practitioner	47	46	46	45	46	45	47	46	47	45
	Scholar	43	41	40	39	39	38	45	43	44	42
Years of experience	>=20	45	44	44	42	43	41	47	45	47	46
	15–19	43	42	42	41	42	41	45	43	41	40
	10–14	47	44	43	41	40	39	46	45	47	44
	5–9	42	40	41	41	40	39	43	42	43	41
	0–4	50	46	45	41	44	41	50	49	49	47

Source: Own calculations based on the Delphi survey.

Table B-5: Coefficient of quartile variation of irregular migration estimates broken down by scenario, survey round, and demographic

		1: Unilateralism and convergence		2: Multilateralism and convergence		3: Unilateralism and divergence		4: Multilateralism and divergence	
Variable	Category	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Academic background	Demography	36	35	25	25	32	41	37	41
	Economics	14	14	45	45	29	29	47	46
	Law	43	43	36	36	20	20	27	27
	Political science	33	33	50	50	54	51	54	54
	Sociology	50	40	43	43	47	45	52	53
Expertise in future migration method	Drivers	30	25	34	32	54	51	56	54
	Forecasting	36	36	38	38	33	31	55	51
	Scenarios	33	33	36	36	43	41	62	54
Region of expertise	Africa	35	35	43	43	37	42	35	37
	Americas	43	43	30	30	36	36	45	36
	Asia	43	43	32	35	43	48	40	45
	Europe	35	35	39	39	51	48	45	45
	Oceania	25	25	23	23	32	32	43	41
Sex	Male	47	47	43	43	38	38	54	54
	Female	33	25	35	35	54	48	41	45
Stakeholder	Other	28	28	30	30	54	51	50	48
	Practitioner	48	43	35	35	33	33	50	47
	Scholar	35	35	40	40	54	48	54	54
Years of experience	>=20	33	33	33	33	40	37	43	41
	15–19	25	25	43	43	50	43	48	43
	10–14	43	33	50	50	67	61	50	56
	5–9	33	33	42	42	34	34	38	38
	0–4	39	39	33	41	64	64	62	62

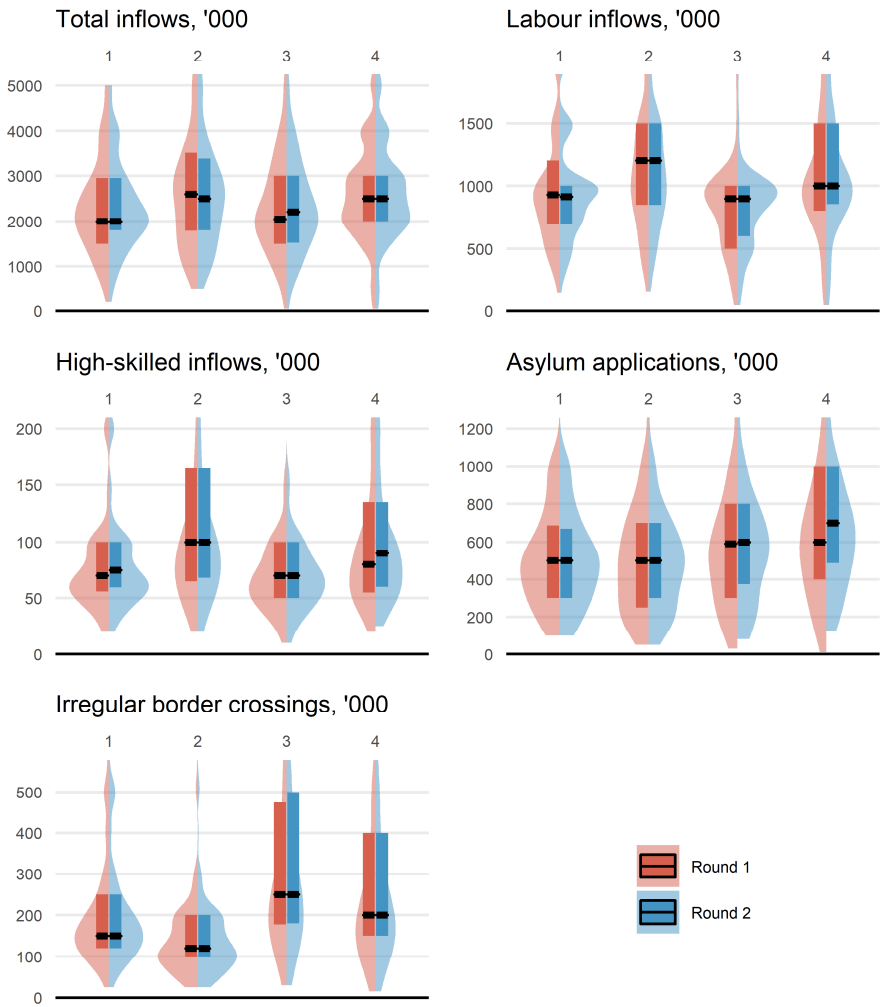
Source: Own calculations based on the Delphi survey.

Table B-6: Average confidence of irregular migration estimates broken down by scenario, survey round, and demographic

		1: Unilateralism and convergence		2: Multilateralism and convergence		3: Unilateralism and divergence		4: Multilateralism and divergence	
Variable	Category	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Academic background	Demography	42	40	43	41	42	39	44	40
	Economics	46	45	44	44	42	42	41	42
	Law	53	50	52	49	57	53	51	52
	Political science	40	39	40	40	41	41	44	42
	Sociology	41	38	43	42	43	42	44	42
Expertise in future migration method	Drivers	41	40	42	41	41	40	41	40
	Forecasting	42	41	41	41	44	43	38	39
	Scenarios	40	39	43	42	42	41	41	40
Region of expertise	Africa	45	44	44	43	46	46	44	43
	Americas	45	45	42	42	46	47	47	47
	Asia	44	41	45	44	44	42	41	40
	Europe	41	40	41	40	43	41	42	40
	Oceania	44	47	41	43	42	45	41	45
Sex	Male	42	41	42	42	42	41	42	42
	Female	44	41	43	41	46	43	45	41
Stakeholder	Other	46	44	54	50	50	46	48	46
	Practitioner	47	46	46	45	47	46	45	45
	Scholar	40	38	39	39	41	39	42	39
Years of experience	>=20	45	43	44	42	44	42	43	42
	15–19	44	42	43	43	42	41	38	38
	10–14	43	40	42	39	44	43	45	43
	5–9	38	38	39	40	42	42	44	42
	0–4	42	40	46	44	45	41	45	41

Source: Own calculations based on the Delphi survey.

Appendix B-7: Distribution and boxplot of expert estimates by round, type of flow, and scenario



Source: Own elaboration based on the Delphi survey. The boxplot shows the median and the first and third quartiles.