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The Impact of Migration on Future Population Change
Technical Information

Thomas Buettner and Rainer Muenz

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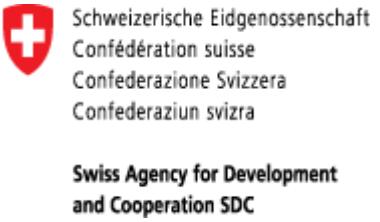

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The Impact of Migration on Future Population Change*
Technical Information

Thomas Buettner and Rainer Muenz †

Abstract

The supplementary information in this document contains a more detailed account of data, methods and results developed in the KNOMAD Working Paper No 59, Th. Buettner, R. Muenz. 2024. "The Impact of Migration on Future Population Global demographic projections with integrated immigration and emigration assumptions." This technical paper covers the data used, their preparation for an integrated multi-state population projection, and more results of both forecasting of bilateral migration estimates and population projections until 2050 for 194 countries.

*****This paper has been produced for KNOMAD's Thematic Working Group (TWG) on Data and Demographics. KNOMAD is headed by Pablo A. Acosta (World Bank) and the TWG on Data and Demographics is chaired by Rainer Muenz (Central European University, Vienna) and Marie McAuliffe (International Organization for Migration, Geneva). The KNOMAD focal point for this TWG is Sonia Plaza (World Bank).

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1 Data

The data for this exercise are of very different scope and detail, as discussed below. Combining them to prepare forecasts poses many challenges, but this paper is not about lamenting the deficiencies of the data - only occasionally. Its aim is to test the recently produced migration flow data by gender (Abel and Cohen 2022) for its usefulness for population forecasting. As a first step towards the integration of estimates of international movements into demographic analysis, and in particular global population projections, the coarse and irregular nature of the migration flow data seems acceptable. Further refinements and better statistics are certainly called for. As the history of the United Nations World Population Prospects has shown, repeated evaluation end re-evaluation is improving quality and coverage of such endeavors.

For a more convenient presentation of the data, the data for 194 countries (migration flows) or 188 countries covered by two major thematic groups (regions and income groups) have been aggregated into these groups. The underlying data cleaning, interpolation and, most importantly, forecasting was performed for all countries separately.[1]

1.1 Data sources

This paper uses data from mainly three sources:

1. Migration flow data from Abel and Cohen (Abel and Cohen 2022)
2. Demographic data from the 2022 Revision of the UN's World Population Prospects (United Nations Population Division 2022)
3. World development data from the World Bank World Bank (2023)

1.1.1 Migration flow data

The migration flow estimates for 231 countries of the world are from Abel and Cohen (2019, 2022). Abel (2009) and Abel and Sander (2014) pioneered the estimation of global migration flow matrices, and Azose and Raftery (2019) further developed the estimation methodology by employing a pseudo-Bayes model that allowed for the consideration of return and transit migration between pairs of countries. All estimation approaches are being informed by changes of stocks of foreign-born or non-nationals, obtained by periodic censuses, hence the name "stock-to-flow method".

The Abel and Cohen (2019, 2022) papers explored the performance of six stock-to-flow methods, among them the Azose and Raftery method, which appeared to capture the (implicit) migratory movements best and is used in this paper exclusively. The Abel and Cohen dataset contains up-to 231 sending and 231 receiving countries,[2] a remarkable feat given the challenging data situation. Abel and Cohen based their calculations on data from the United Nations *International Migrant Stock* series (United Nations 2020) and a parallel series produced by the World Bank 2023).[3]

[1] An alternative approach to project such a large ensemble of data would be to project the aggregates first, and then distribute their members by, for example, a log-ratio model. These two forecasts would then, in a last step, combined to country specific forecast. Such an approach would have the benefit of more numeric stability and robustness, but with the possible lack of some country-specific properties.

[2] The Coverage varies by estimation period: 225 countries for 1990-1994, 1995-1999, and 2000-2004, 226 countries for 2005-2009, countries 229 for 2010-2014, and 231 countries for the last period 2015-2019.

[3] See the World Development Report (WDR) 2023 on "Migrants, Refugees, and Societies" based on the most recent migrants stock data (World Bank 2023). The total number of migrants displayed in the WDR is, however,

The data by Abel and Cohen are available by gender, that is for males and females separately. The gender ratios of the estimates exhibit a very wide range, from almost exclusively male to almost exclusively female. These extremes are not necessarily artefacts but reflect specific types of labour migration. However, the plausibility of the gender ratios should, in the future, be verified.

1.1.2 United Nations World Population Data

The demographic data for this exercise are from the 2022 Revision of the United Nations *World Population Prospects*. By responding to demands from member states and other users, the United Nations transitioned to a single-by single age and time format. This allows for a far better coverage of past, actual and future demographic change, including monitoring the progress made in achieving the Sustainable Development Goals (United Nations General Assembly 2015; United Nations 2017). All previous twenty-six Revisions of *World Population Prospects* format employed a coarser data format, beginning with total figures and later implementing a five-by-five year format. Beginning with the 2022 Revision, data in single-by-single year and age are available for 237 countries or areas, and for 101 age groups (0 to last age 100 and beyond. From 1950 to 2022 these are estimates and projections from 2022 to 2100 (in different variants and scenarios).

Like the World Bank's nomenclature, the UN's geographic settings are based on the most recent situation – that is, for the year 2022. For example: It presents a united Germany, Sudan split in two successor states, for the whole period back to 1950. The geographic settings are also kept constant for the projections.

1.1.3 World Bank Development Data

This report uses the World Bank's nomenclature for grouping countries into income groups and regional aggregates. The nomenclature for the fiscal year 2022-2023 was used (Hamadeh, Van Rompaey, Metreau, and Eapen 2022) [4] Two different grouping nomenclatures are applied for summarizing the projection results; by region and by income, both as established and used by the World Bank. It is worth noting that the WB grouping, whether by income or by region, are not static. This is obvious for the classification by GNI per capita - economic performance varies by country and over time. The classification of countries into regional groups also changed, mainly for analytical and statistical purposes.[5] The layout of geographic and income-based groupings is somewhat inconsistent in official data provided by the world bank. This is regarding the number of mutually exclusive groupings. A decision was made to use the grouping schema with the smallest number of members while still covering the whole group of countries.

1.2 Data evaluation and cleaning

The empirical data used for this forecasting projecting exercise are of very different quality. They are either based on official statistics that are often incomplete and biased or they are the results of estimation procedures.

Certain adjustments and transformation were required to have a harmonized and consistent set of data. First, the data did not have the exact same geographic coverage. The UN provides the largest geographic coverage with 235 countries or areas.

much smaller than the number published by the United Nations (2020). The reason for this is: the world Bank`s WRD does not account for migrants who naturalise in the receiving country.

[4] On June 30, 2023, an updated version of the classification became available for the fiscal year 2023-2024.

[5] Example Middle income vs. lower and upper middle income, Africa vs. sub-Saharan Africa or vs. Eastern and Southern Africa and Western and Central Africa

1.2.1 Identification problems in stock data estimates

Producing comparable and consistent migrant stock estimates is confronted with a number of difficult problems (for a brief discussion see United Nations 2020). Besides classification problems stock estimates are affected by identification problems that then can lead to a misidentification as moves. Major problems are related to China and India and Pakistan, Israel and Middle East, USA and Puerto Rico (for a brief discussion, see Köppen, Buettner, and Muenz 2023).

1.2.2 Spurious and missing migration flow estimates

The migration estimates pose the severest challenges. Many assumptions had to be made by AC to arrive at a reasonably consistent dataset. First, the migrant stock data provided by the UN (United Nations 2020) are to a significant amount themselves the result of adjustments and harmonization: National census results were statistically moved from their actual date to a 5-year grid. As far as possible, differences in definitions (foreigners vs. foreign born) and concepts (de-jure vs. de-facto population) were harmonized by the UN. The resulting stock data are the basis for the subsequent estimation of flows. Because the migration flows are covering events spanning a 5-year period, they are masking the oftentimes large temporal variability of migration streams[6]. But even that "smoothing-out" of the effect result occasionally stark changes that let the interpolation procedures fail such that the aggregation of the interpolated series cannot reproduce the original grouped data. How the strong fluctuations (sudden events, …) are treated is discussed in the next section. Besides methodological challenges and empirical data scarcity, results of the stock-to-flow estimates by Abel are set with numerical artefacts. There are numerous estimated values that are less than one, that is, less than one person is shown to have moved between country A to country B during a 5-year period. The presence of non-integer estimates is probably the side-effect of some iterative fitting process. This is undesirable for demographic count data and should be removed. We removed these artefacts by using a special routine developed by Arriaga (Arriaga, Johnson, and Jamison 1994, p. 377] named progressive rounding for the integerization of the flow data. The procedure transforms time series of real-valued numbers (the flow estimates) into a sequence of integers which assures that the total sum is also an integer value.

In addition, zeros and very small integer numbers may also be artefacts of the estimation procedures used by AC. While numbers smaller than one are impossible, very small numbers larger than one or zero are not easy to classify as artefacts. Several heuristics are possible; we employed the following rules: Accept all bilateral migration flow estimates that are zero at every interval. Set all single estimates where the total sum of migration estimates between 1990 and 2019 is less than 600 to missing.[7]

But even figures less than 500 may seem unrealistic or questionable. A quick analysis of the raw data table reveals the large presence of small numbers, some probably residuals from the estimation procedure. On the other hand, the presence of zero migrants is not necessary an indication of missingness, as the migrants of any country are not moving to all other countries. Still, applying an arbitrary threshold bear problem as well. If a data stream or corridor contains figures around such arbitrary threshold, figures below the threshold would be censored, and those above the threshold would remain. This would yield data islands, an undesirable result if we are interested in forecasting. It was decided to use another heuristic to clean migration estimates based on the complete estimation period from 1990 to 2019. If the total number of migrants from country A to country B over the 30-

[6] Most censuses as the sources on migrant stock data are conducted at 10-year intervals, thus missing much of short- and midterm mobility.

[7] Using the aggregated number of migrants avoids removing time series with large number migrants that also contain some migration figures falling below a threshold of, say, 100,

year period is less than, say 1,000, this whole corridor would be deleted. Finally, remaining corridors may still have periods with zero estimates; we consider these single estimates as missing and try to impute them using standard procedures. There are 85 migration corridors with zero migration in any quinquennial periods between 1990 and 2019.

Table 1: Estimates/data points by size class and gender

Range	Males	Females	Male (%)	Female (%)
0	190,212	192,108	84.2%	85.1%
<1	0	0	0.0%	0.0%
1 to <100	3,454	2,966	1.5%	1.3%
100 to <500	10,520	9,742	4.7%	4.3%
>500	21,630	21,000	9.6%	9.3%
Total	225,816	225,816	100.0%	100.0%

Table 2: Number of migrants by size class and gender

Range	Males	Females	Male (%)	Female (%)
0	0	0	0.0%	0.0%
<1	0	0	0.0%	0.0%
1 to <100	157,900	143,332	0.1%	0.1%
100 to <500	2,877,993	2,677,395	1.1%	1.1%
>500	253,124,399	231,997,259	98.8%	98.8%
Total	256,160,292	234,817,986	100.0%	100.0%

1.2.3 Annualized migration flow data

Ultimately, it would be necessary and appropriate to handle all demographic data, and migration data in particular, in an annualized format. No doubt, this is a challenge for many countries where the statistical base is not strong. For almost seven decades, the Population Division of the United Nations Secretariat produced global estimates and projection in quinquennial time and age format due to the deficiencies of many national statistical data. Only recently, with 2022 Revision of their "World Population Prospects", the data format has become annual United Nations Population Division 2022).

For migration data, the challenges to obtain, estimate and project migration in an annual format are probably highest. It would also the most appropriate data format for migration due to the quite often irregular trends and sudden changes in direction and volume of migration flows. For that reason, the base data - available in quinquennial format - have been transformed into single year estimates. The results and experiences could inform both National Statistical Offices and the research community.

The transformation of the original data format of total migrants over a period of five years into a single-year format has shown that standard interpolation methods preferred by demographers - osculatory interpolation - sometimes fail. The idea behind osculatory methods - that the interpolants are smooth and without breaks between adjacent periods - may not imperative when preparing base data for forecasting, It is therefore a worthwhile option to smooth the raw data split into one-fifth of the quinquennial raw data.

2 Methodology

2.1 Bilateral Migration Projections

The methodology employed in this paper is kept simple. Standard time series models were used for forecasting migration flows, both for total migration figures by gender and for crude migration rates by gender (Section 4). The forecasted migration figures are then imported into a multistate cohort-component projection model. The base population and the remaining demographic components for

the projection period - fertility and mortality - were taken from the 2022 Revision of the UN's World Population Prospects (United Nations Population Division 2022).

The quality of forecasting bilateral migration flows depends to a large extent on the quality of the migration data. Statistical forecasting methods, like those employed here, tend to get more reliable results with longer time series. If the underlying data exhibit a strong saisonability, it could also help to strengthen forecasting results. In our case, both strengthening characteristics are not available. The original time series consist of six observations of grouped data, covering 30 calendar years. We have inflated the original time series by actualizing it into estimates containing 30 data points.

For an assessment of time series forecasting international migration for the UK, see Bijak et al. (2019). Our paper concurs with Bijak conclusion about the "… weak predictability of migration" (Bijak et al. 2019: 1). Thus, we avoid recommending methods best suited as forecasting tools. We have, still, experimented with several time series forecasting models available in the R Package "*forecast*"(Hyndman and Khandakar 2008; Hyndman et al. 2024). For this paper we chose Holt's linear forecasting method that appeared to be less influenced by sudden changes in the past. In addition, we chose to dampened the trend and apply a relatively strong smoothing.[8]

2.2 The Population Projection Model

This paper employs a established multidimensional mathematical model for population projections. It was first intended as a device to analyze and project regional, e.g., subnational, population dynamics. Its advantage is that it works on a system of interconnected populations simultaneously. One projection step moves the whole system forward in time, keeping its internal consistency. Developed primarily by Rogers (1967; Rogers 1995; Rogers and Willekens 1976), the multistate population projection model (MSPM) has rarely been used for international analysis and projections (as opposed to subnational entities). See also Buettner and Muenz (2018b, 2018a) for special considerations of international migration flows.

The MSPM is mathematically elegant - formulated as matrix model (Caswell 2001) and suitable for rigorous mathematical treatment. It is also quite demanding when implementing it into software, especially reading storage/memory space. The projection model used in our exercise had to accommodate data for 194 countries, with 101 age groups, two gender for Population, mortality and fertility, plus the matrix of age-specific migration rates for 194 by 194 countries.

We present in this paper just three variants or scenarios of population projection, two of which are taken from the 2022 Revision of World Population Prospects:

1. No migration scenario from the UN. This scenario may be used to gauge the effect of migration on the overall projection outcomes, most visibly in the size and composition of populations. Such a scenario is already part of the UN's 2022 Revision of World Population Prospects and is included in order to show the larger or smaller impact of migration on future population size.

2. Medium UN projection. This variant is combining the assumption of the UN for fertility, mortality and net migration. It serves a reference compared to our own projection.

3. Bilateral migration variant. Our variant combines the UN's assumptions regarding fertility and mortality with our projections of total migrants. The projection of bilateral migrants was performed in three steps: As a first step, total migration, male and female migrants combined,

[8] Holt's method in the R-package *forecast* provides the parameter damped and phi that are useful for our purpose. We set damped = TRUE and phi = 0.8 (for smoothing).

was projected for each bilateral flow between the 194 countries. In a second step, the mean gender ratio of past bilateral migrants was used to split the forecasted total migrants into male and female migrants for the future. After the total migrants for males and females were obtained, they were each split into single year age groups using a standard mathematical model.[9] Finally, the total migrants by age and gender were transformed into age-specific migration rates to be used in the multistate projection model.

3 Forecasting Migration Flows

The migration forecasts are presented aggregated into 5-year sums, for readability. We begin by showing the results of forecasting total emigration and total immigration, for both gender combined.

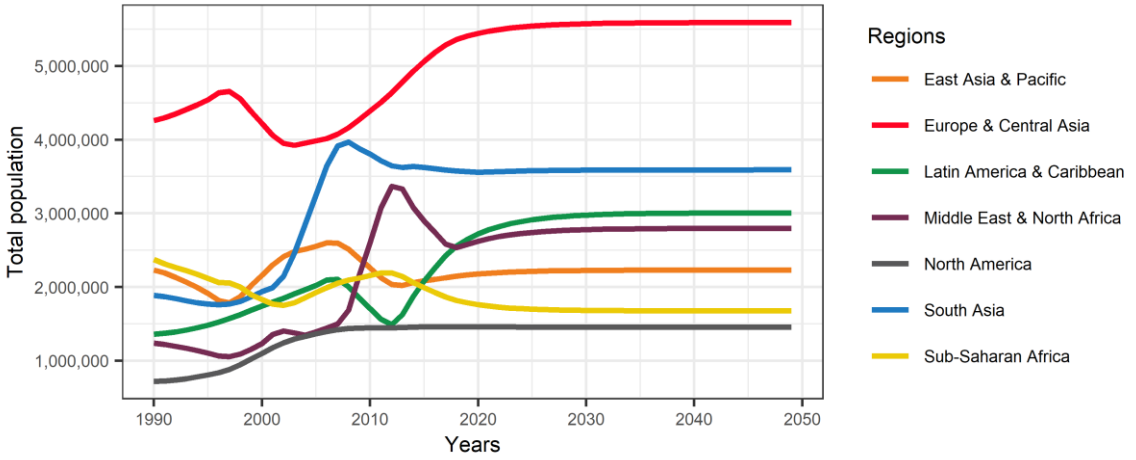
3.1 Migrants by Geographic Regions, both Gender combined, 1990-2050

3.1.1 Emigrants

Table 3: Total Emigrants by Geographic Regions.

Years	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub-Saharan Africa
1990-1994	10,625,657	21,827,324	6,992,579	5,993,294	3,722,127	9,216,491	11,569,835
1995-1999	9,441,067	22,811,277	7,916,308	5,519,870	4,510,867	9,112,512	10,265,480
2000-2004	11,876,306	20,142,873	9,265,121	6,834,595	6,147,403	11,433,668	9,178,273
2005-2009	12,661,083	20,555,553	10,104,811	8,361,580	7,065,966	18,715,988	10,267,700
2010-2014	10,524,609	23,287,754	8,432,635	15,571,365	7,257,763	18,437,631	10,783,153
2015-2019	10,638,707	26,342,431	11,981,301	13,450,303	7,300,455	17,978,896	9,417,536
2020-2024	10,987,719	27,664,217	13,948,231	13,681,551	7,304,526	18,138,563	9,011,400
2025-2029	11,136,153	28,125,930	13,116,986	13,601,753	7,371,328	18,224,248	9,041,241
2030-2034	11,247,755	28,548,293	12,253,895	13,184,244	7,425,517	18,081,348	8,999,115
2035-2039	11,304,161	28,757,717	11,672,506	12,747,214	7,467,632	17,921,428	8,943,132
2040-2044	11,320,538	28,884,261	11,163,180	12,455,213	7,520,095	17,753,586	8,880,893
2045-2049	11,340,638	29,014,016	10,712,102	12,281,699	7,573,067	17,575,720	8,810,863

Figure 1: Total Emigrants by Geographic Regions.



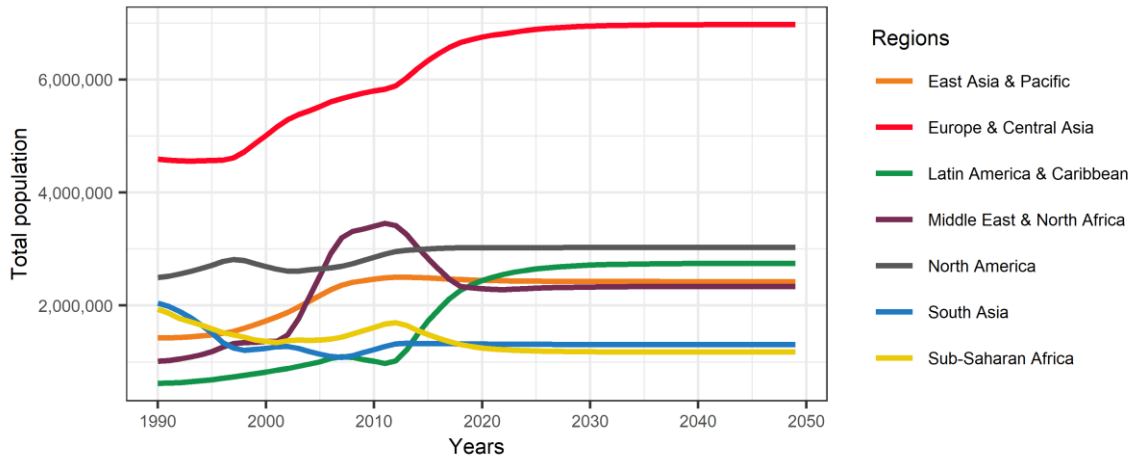
[9] See Castro (2004); Rogers and Castro (1981).

3.1.2 Immigrants

Table 4: Total Immigrants by Geographic Regions.

Years	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub-Saharan Africa
1990-1994	7,220,426	22,877,346	3,203,579	5,349,532	12,842,547	9,374,373	9,040,757
1995-1999	7,813,653	23,446,418	3,697,667	6,549,859	13,844,337	6,596,267	7,585,219
2000-2004	9,470,891	26,338,759	4,452,980	8,294,781	13,205,130	6,216,082	6,922,464
2005-2009	11,692,073	28,548,556	5,316,321	15,610,936	13,597,242	5,607,619	7,347,066
2010-2014	12,467,135	29,792,721	5,901,095	16,705,754	14,701,779	6,494,111	8,225,580
2015-2019	12,366,684	32,885,215	10,425,309	12,801,473	15,111,521	6,627,570	6,875,991
2020-2024	12,324,683	35,078,163	12,563,229	12,297,059	15,341,154	6,723,193	6,389,936
2025-2029	12,390,256	35,636,256	11,864,291	12,289,856	15,273,285	6,750,981	6,390,815
2030-2034	12,426,394	35,793,140	11,092,070	12,140,355	15,161,572	6,721,998	6,380,699
2035-2039	12,426,225	35,720,815	10,577,537	11,960,131	15,054,677	6,683,957	6,365,880
2040-2044	12,413,817	35,616,048	10,146,992	11,812,033	14,961,466	6,655,137	6,347,746
2045-2049	12,411,659	35,554,699	9,777,388	11,692,797	14,889,690	6,632,715	6,324,821

Figure 2: Total Immigrants by Geographic Regions.



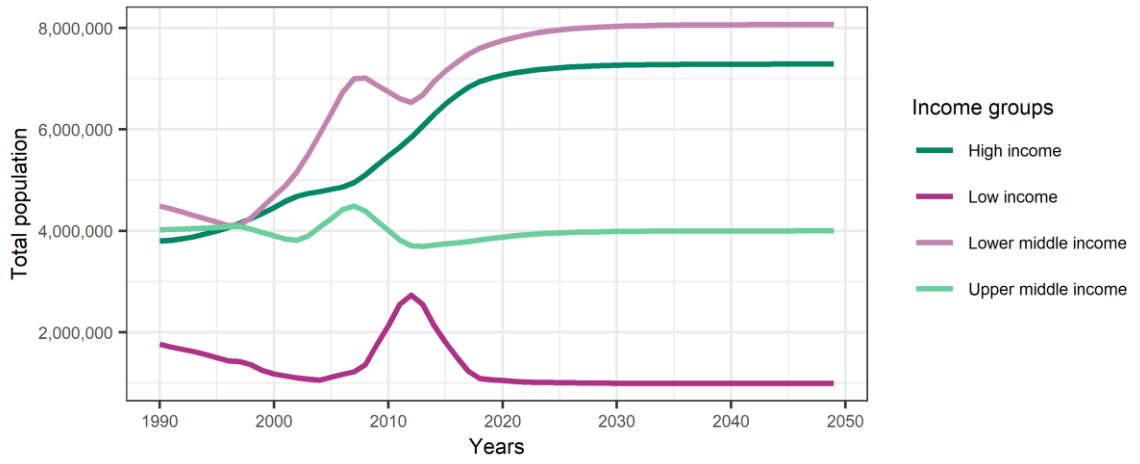
3.2 Migrants by Income Groups, both Gender combined, 1990-2050

3.2.1 Emigrants

Table 5: Total Emigrants by Income Group.

Years	Low income	Lower middle income	Upper middle income	High income
1990-1994	8,321,567	21,839,053	20,190,797	19,285,437
1995-1999	6,978,387	21,136,087	20,248,310	20,803,923
2000-2004	5,554,982	26,177,388	19,538,001	23,238,833
2005-2009	6,624,677	33,940,442	21,737,863	25,034,648
2010-2014	12,111,469	33,506,247	18,957,900	29,326,564
2015-2019	6,703,481	37,251,349	18,976,852	33,969,082
2020-2024	5,132,711	39,270,571	19,600,510	35,709,674
2025-2029	5,013,470	39,995,400	19,875,064	36,209,108
2030-2034	4,980,234	40,234,031	19,965,041	36,372,763
2035-2039	4,969,343	40,312,226	19,994,525	36,426,389
2040-2044	4,965,774	40,337,849	20,004,186	36,443,962
2045-2049	4,964,605	40,346,245	20,007,352	36,449,720

Figure 3: Total Emigrants by Income Groups.

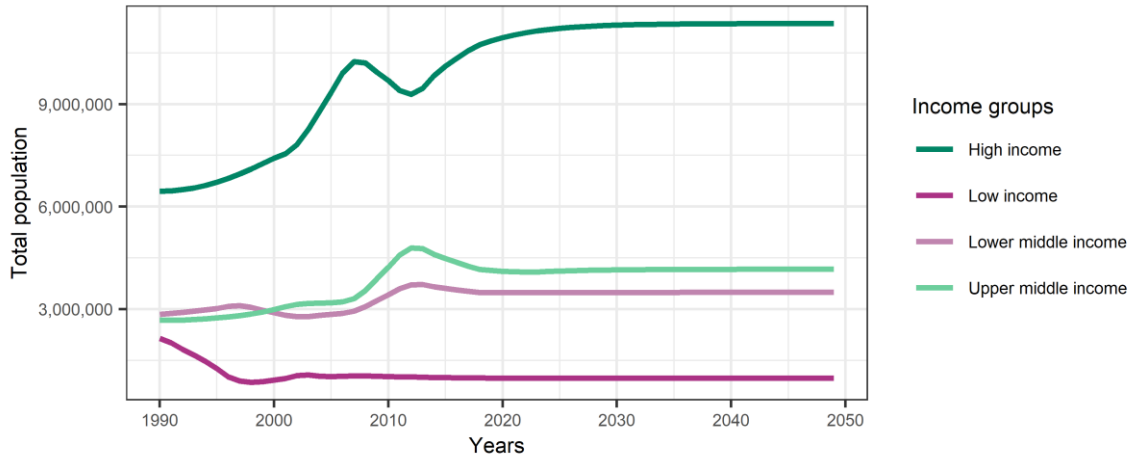


3.2.2 Immigrants

Table 6: Total Immigrants by Income Groups.

Years	Low income	Lower middle income	Upper middle income	High income
1990-1994	9,184,259	14,611,278	13,480,665	32,632,358
1995-1999	5,094,994	15,330,063	14,120,779	34,987,584
2000-2004	5,192,743	14,144,628	15,634,546	39,929,170
2005-2009	5,276,353	15,153,275	17,540,520	49,749,665
2010-2014	5,223,290	18,136,166	23,180,613	47,748,106
2015-2019	4,978,088	17,743,858	21,685,189	52,686,628
2020-2024	5,148,400	17,673,201	22,049,654	55,846,162
2025-2029	5,296,459	17,666,262	21,153,579	56,479,439
2030-2034	5,266,121	17,662,780	20,434,551	56,352,776
2035-2039	5,191,180	17,640,344	19,946,316	56,011,382
2040-2044	5,128,021	17,633,582	19,519,489	55,672,146
2045-2049	5,082,367	17,640,662	19,150,991	55,409,749

Figure 4: Total Immigrants by Income Groups.



3.3 Migration Flow Estimates and Projections by Origin and Destination

3.3.1 World Bank Income Groups[10]

Table 7: World Bank income groups, 2020-2025

		Origins			
Destinations	**Periods**	**High income**	**Low income**	**Lower middle income**	**Upper middle income**
High income	2020-2025	19,546,686	1,675,868	23,217,575	11,581,805
Low income	2020-2025	872,427	1,138,955	2,154,974	983,429
Lower middle income	2020-2025	7,509,253	2,390,978	4,260,917	3,523,924
Upper middle income	2020-2025	8,089,192	229,385	10,086,237	3,842,225

Table 8: World Bank income groups, 2025-2030

		Origins			
Destinations	**Periods**	**High income**	**Low income**	**Lower middle income**	**Upper middle income**
High income	2025-2030	20,156,258	1,682,878	23,803,900	11,832,344
Low income	2025-2030	905,488	1,117,314	2,248,965	1,090,961
Lower middle income	2025-2030	7,599,455	2,394,583	4,201,072	3,575,914
Upper middle income	2025-2030	8,198,935	235,390	10,585,846	3,855,863

Table 9: World Bank income groups, 2030-2035

		Origins			
Destinations	**Periods**	**High income**	**Low income**	**Lower middle income**	**Upper middle income**
High income	2030-2035	20,369,491	1,692,413	24,009,160	11,923,611
Low income	2030-2035	916,403	1,115,927	2,279,818	1,126,311
Lower middle income	2030-2035	7,629,411	2,396,977	4,181,673	3,595,220
Upper middle income	2030-2035	8,247,116	237,384	10,759,736	3,861,386

Table 10: World Bank income groups, 2035-2040

		Origins			
Destinations	**Periods**	**High income**	**Low income**	**Lower middle income**	**Upper middle income**
High income	2035-2040	20,440,014	1,695,803	24,081,084	11,956,867
Low income	2035-2040	919,978	1,117,662	2,289,947	1,137,893
Lower middle income	2035-2040	7,639,219	2,397,783	4,175,333	3,601,561
Upper middle income	2035-2040	8,263,100	238,064	10,817,222	3,864,499

Table 11: World Bank income groups, 2040-2045

		Origins			
Destinations	**Periods**	**High income**	**Low income**	**Lower middle income**	**Upper middle income**
High income	2040-2045	20,463,340	1,696,905	24,104,955	11,967,762
Low income	2040-2045	921,190	1,118,733	2,293,283	1,141,701
Lower middle income	2040-2045	7,642,478	2,398,044	4,173,261	3,603,653
Upper middle income	2040-2045	8,268,343	238,301	10,836,076	3,865,605

[10] Tabulation for World Bank Regions are in the main paper (KNOMAD Working Paper Nr. 59)

Table 12: World Bank income groups, 2045-2050

		Origins			
Destinations	**Periods**	**High income**	**Low income**	**Lower middle income**	**Upper middle income**
High income	2045-2050	20,470,973	1,697,279	24,112,839	11,971,367
Low income	2045-2050	921,561	1,119,080	2,294,351	1,142,944
Lower middle income	2045-2050	7,643,503	2,398,131	4,172,573	3,604,351
Upper middle income	2045-2050	8,270,003	238,384	10,842,251	3,865,956

4 Population Projections

4.1 Total Population by Geographic Regions

Table 13: Total Population by Geographic Region.

Year	East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	North America	South Asia	Sub-Saharan Africa
2020	2,349,211,854	911,897,014	647,884,316	476,891,912	373,146,470	1,871,795,550	1,081,966,600
2025	2,379,482,818	917,672,758	670,380,546	510,369,229	382,735,252	1,967,469,123	1,227,057,823
2030	2,399,738,023	926,292,275	692,437,382	543,357,510	394,687,423	2,061,248,234	1,382,494,315
2035	2,408,067,103	932,185,288	711,427,849	575,236,740	405,551,334	2,145,755,734	1,546,160,813
2040	2,405,475,196	936,310,385	726,745,365	606,481,547	414,976,430	2,219,264,125	1,715,288,674
2045	2,392,481,648	938,869,540	737,826,846	636,084,765	422,717,648	2,280,454,823	1,886,809,067
2050	2,366,066,858	938,940,035	744,815,791	662,768,167	428,943,116	2,329,218,951	2,057,945,726

4.2 Total Population by Income Groups

Table 14: Total Population by Income Groups.

Year	Lower income	Lower middle income	Upper middle income	High income
2020	635,166,179	3,363,220,388	2,498,040,236	1,216,366,913
2025	726,270,879	3,558,396,579	2,533,982,019	1,236,518,073
2030	824,289,731	3,757,229,408	2,560,764,044	1,257,971,979
2035	927,512,953	3,946,494,191	2,574,804,124	1,275,573,593
2040	1,034,076,711	4,123,661,182	2,577,739,387	1,289,064,443
2045	1,142,418,493	4,284,786,319	2,569,594,305	1,298,445,220
2050	1,251,257,818	4,427,123,778	2,546,615,026	1,303,702,023

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