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Research Article

Fertility decline, changes in age structure, and the potential for demographic dividends: A global analysis

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Fertility decline, changes in age structure, and the potential for demographic dividends: A global analysis

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Abstract

BACKGROUND
The demographic dividend, a concept that is widely used in development cooperation, describes the economic growth potential based on shifts towards a large share of working-age population in the course of the demographic transition. However, a long-term global country-level assessment of the underlying changes in the working-age population and associated demographic factors is missing.

OBJECTIVE
The aim of this paper is to identify and describe past, present, and future global patterns in changes in the share of the working-age population and to detect the relevance of associated demographic factors.

METHODS
Using cluster and linear regression analyses, we identify patterns in trajectories of working-age populations and detect associated demographic factors. We perform these analyses for 148 countries, using data from the UN World Population Prospects 2022 (1950–2100).

RESULTS
Our results expose distinct trajectories of changes in the share of working-age population. We find noticeable differences between countries that are already further along the demographic transition and those still with relatively high levels of fertility. In addition to fertility, changes in the share of working-age population are associated with migration and population momentum.

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CONCLUSIONS
A large proportion of countries that are still in the earlier stages of the demographic transition show changes in the share of working-age population that differ substantially from countries that experienced significant fertility decline in the past.

CONTRIBUTION
Besides exposing distinct trajectories of changes in the share of working-age population, our study reveals the relevance of migration and population momentum to potential benefits from a demographic dividend – two factors that are not receiving enough attention in current discussions about the prospects for demographic dividends in countries that are yet to experience noticeable increases in the share of their working-age population.

1. Introduction

The demographic dividend describes the potential economic growth effect that can occur due to populations' changes in age composition in the course of the first demographic transition.[3] Decreasing mortality, followed by reductions in fertility, shift populations' age structure towards an increasing share of the working-age population. At the same time the share of children is reduced, while initially there is not much change in the share of the older population. In combination with factors such as investments in education and health, infrastructure, good governance, and the creation of productive employment opportunities, this shift presents potential for economic growth and development. Bloom and colleagues (Bloom and Williamson 1998; Bloom, Canning, and Sevilla 2003) introduced the concept of the demographic dividend more than two decades ago. Their work builds on previous research dealing with the question of the role demographics plays in economic growth. Kelley and Schmidt (2005) synthesize these earlier results, demonstrating that demographic change – depending on how it is specified – can account for a substantial share of economic growth. The crucial distinction between approaches in this regard is whether information on age-structure change is taken into account: If so, the empirical evidence clearly points towards demographic change having a significant impact on economic outcomes. There is now a well-established academic literature that estimates the size of the demographic dividend empirically, making use of a range of

[3] In our analyses we are interested in changes in age structure related to the first demographic transition, which is what most of the literature on the demographic dividend refers to. More generally, any situation where a significant change occurs in the working-age population has the potential for such a dividend, as did, for example, increases in the share of the working-age population in several countries after World War II, following decreasing fertility rates after the baby boom.

methods and data sources (e.g., Bloom and Williamson 1998; Mason 2003; Eastwood and Lipton 2012; Abrigo et al. 2016; Ghosh 2016; Lutz et al. 2019). While these studies employ differing variables to capture changes in age structure (e.g., share in the working-age population, dependency ratios, support ratios) and a range of estimation specifications, they are all based on the argument that changes in the share of working-age population are a key aspect of economic growth.

Fertility decline, changes in age structure, and the potential for a demographic dividend have been described in varying detail for selected countries or (sub-)regions (e.g., Bloom, Canning, and Sevilla 2003 for six world regions and selected countries; Spoorenberg 2008 for selected Asian countries; Eastwood and Lipton 2011 for Asia and sub-Saharan Africa; Drummond, Thakoor, and Yu 2014 for world regions and countries in sub-Saharan Africa; Mason et al. 2017 for five world regions). Fertility decline is a prerequisite for a change in age structure, and the speed of fertility decline has been linked to the duration of a potential demographic dividend (Mason et al. 2017). Yet a global country-level assessment of the demographic developments that are the foundation of a potential demographic dividend is missing. Considering the prominent role that changes in the share of the working-age population can play in economic growth and development, it is surprising that, to our knowledge, no comprehensive analysis of the development of this age group in the course of the demographic transition exists.

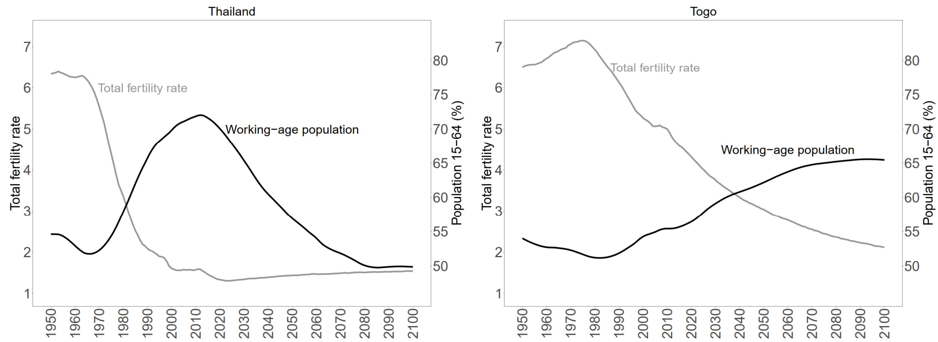
The objective of this paper is to identify and describe past, present, and future global patterns of change in working-age populations and to assess the relevance of associated demographic factors. The questions we address are: How uniform are changes in the share of working-age population across countries? Is it possible to detect distinct trajectories? Are there differences between countries which are already further along the demographic transition and those that still have relatively high levels of fertility? Which demographic factors (e.g., level of fertility at onset of fertility decline, speed of fertility decline, migration) are associated with the trajectory of the share of the working-age population? What do our results imply for the prospect of reaping demographic dividends in countries that still have relatively high levels of fertility?

The demographic dividend is a concept that is widely used in development cooperation (Hilbig, Loichinger, and Köppen 2022). Its underlying assumption is that selected countries' positive experiences in the past are replicable in other contexts. Based on the prototypical experience of Asian countries such as the 'tiger states' of Hong Kong, Singapore, South Korea, and Taiwan, but also of countries like Thailand, changes in age structure are expected to be important drivers of economic growth in countries that still have relatively high levels of fertility, provided that a supportive institutional environment and effective policies for productive employment are in place (e.g., Ahmed et al. 2016; Bloom, Kuhn, and Prettner 2017). It is also due to these expectations that a solid understanding of the global patterns of fertility decline, changes in the working-age population, and associated demographic factors is essential to contextualize the demographic foundations of potential demographic dividends.

Figure 1 shows exemplarily the total fertility rate and the share of working-age population in Thailand and Togo, two countries presently at very different stages of the demographic transition. Thailand experienced a fast fertility decline from more than 6 births per woman to below 2.5 births per woman within a little over 20 years. This was followed by an increase in the share of working-age population that resembles an inverted u-shape and reached a maximum of about 72% after just over 40 years of increase. By contrast, a slower, longer, and lower-peaking increase is projected for Togo. Following a slower fertility decline, which began at a higher level and is still ongoing, after nearly 100 years of increase the share of working-age population in Togo is expected to peak at around 65%. Admittedly, the differences in the changes in age structure between the two countries we have chosen as examples are extreme. Nevertheless, these differences underline the importance of a detailed exploration of the global patterns of change in the working-age population and an assessment of related demographic factors. While research exists on the relationship between the speed of fertility decline and the subsequent increase in the older population (Bengtsson 2010; Preston and Stokes 2012) – faster declines in fertility levels lead to faster population ageing – there are no comprehensive analyses that take a close look at how this is related to the trajectory of change in the working-age population or the maximum of the working-age population that can be attained. Our analyses fill this gap and hence provide crucial empirical evidence for present and future endeavours to achieve demographic dividends in countries where the fertility transition is still ongoing.

The remainder of the paper is structured as follows. In the Data and Indicators section we introduce the data and the demographic indicators we use. The subsequent Methods section outlines the empirical strategy of this study before we present our main results, including a series of robustness checks. Finally, in the Discussion and Conclusion section we summarize our findings and consider the wider implications of our results for the potential for demographic dividends in countries that are yet to experience substantial increases in the shares of their working-age populations.

Figure 1: Total fertility rate and share of working-age population in Thailand and Togo (1950–2100)



Source: UN DESA 2022b (medium variant).

2. Data and indicators

2.1 Data

We use the following data from the United Nations' World Population Prospects (UN WPP) 2022: population by broad age group, total fertility rate, net migration rate, total number of births, and life expectancy at birth (UN DESA 2022b). These annual data are available for 237 countries or areas,[4] covering the period from 1950 to 2100. The UN's WPP 2022 estimates from 1950 to 2021 are based on population and household censuses, vital and population registration systems, surveys, and other sources (e.g., UNHCR data on refugees) (UN DESA 2022a). The medium projection scenario provides data from 2022 to 2100, assuming medium fertility and mortality (based on the median of probabilistic projections of fertility and mortality), as well as medium migration (UN DESA 2022a). All of our calculations presented in this paper are based on this scenario. The UN deals with the inherent uncertainty in the medium projections by applying probabilistic projections and providing 80% and 95% prediction intervals (UN DESA 2022a). We take into account the less certain outcomes of the results based on projections by performing calculations that are based on the upper and lower bound of the 95% prediction intervals. We provide these results for our key parameters of the increase in

[4] In this paper we refer to the statistical units the UN provides simply as 'countries' without expressing any opinion on the legal status of these territories.

the share of working-age population (see Appendix, Tables A-5–A-6, Tables A-10–A-11). Other parameters (such as pre-transitional fertility and speed of fertility decline) fully or partly rely on observed data that has less uncertainty. The quality of demographic estimates tends to be lower in small countries and fertility patterns can be affected by migration dynamics (Bongaarts and Hodgson 2022). For this reason, we follow the UN's definition of small countries and exclude from our analysis 34 countries with populations smaller than 90,000 in 2021. In addition, as we are interested in examining the fertility decline during the first demographic transition, we only include countries that entered the fertility transition in the period covered by our data. A country is considered to be in the pre-transitional phase if its total fertility rate has not dropped below 5 births per woman (Bongaarts and Hodgson 2022). The UN refers to these countries as 'high fertility' (UN DESA 2021). Hence, we exclude 55 countries whose total fertility rate (TFR) stays below 5 births per woman during the whole period between 1950 and 2021. By not only considering the fertility level in the year 1950 we take into account that the TFR in a pre-transitional country can be slightly below 5 births per woman in 1950, but then increase again before finally declining substantially (Alkema et al. 2011). This results in a total of 148 countries included in our analysis. Another UN definition of countries which have not started fertility transition prior to 1950 (TFR $\geq$ 5.5 births per woman; UN DESA 2022a) is used for a robustness check.

A defining parameter of our analysis is the maximum share of the working-age population, as described later in this subsection. Our sample contains 45 countries that have already reached their maximum share of working-age population (i.e., between 1950 and 2021) and 103 countries which are projected to reach it in the future (i.e., between 2022 and 2100). In the following, we refer to these two country subgroups as 'observed countries' and 'prospective countries', respectively. We split our sample this way because one question we are interested in is how far expected future changes in the share of working-age population resemble past experiences. Moreover, results for prospective countries are at least partly based on the UN WPP's assumptions regarding fertility, mortality, and migration and are less certain than population estimates for the past. Hence, they should be treated separately from observed data. Table 1 shows the number of countries by country subgroup and SDG region. Our sample represents seven Sustainable Development Goal (SDG) regions (UN 2021).[5] For a full list of the countries, country subgroups, and SDG regions in this sample, see Appendix, Table A-1.

[5] The SDG region 'Europe and Northern America' in our sample includes only European countries, so we refer to this SDG region as Europe. The SDG region 'Oceania' in our sample includes only Oceanian countries (excluding Australia and New Zealand).

Table 1: Number of countries by country subgroup and SDG region

SDG region	Observed countries	Prospective countries	Total
Central and Southern Asia	4	9	13
Eastern and South-Eastern Asia	10	7	17
Europe	3	1	4
Latin America and the Caribbean	11	21	32
Northern Africa and Western Asia	11	10	21
Oceania	3	9	12
Sub-Saharan Africa	3	46	49
Total	45	103	148

Note: 'Observed countries' and 'prospective countries' refer to countries with maximum shares of their population aged 15–64 between 1950 and 2021 and between 2022 and 2100, respectively.

2.2 Fertility transition

We consider four different indicators to capture countries' distinct fertility transitions: time of onset of fertility decline, pre-transition fertility level, speed of fertility decline, and speed of further fertility change. The onset of fertility transition is defined as the year in which two conditions are met. The first condition is that fertility begins to decline substantially in the following years. Similar to Bryant (2007), we define a substantial decline as an annual decrease in the total fertility rate (TFR) of more than 0.02 births per woman for five consecutive years. The second condition is that fertility must not rise again after this decline (Bongaarts and Hodgson 2022; Bryant 2007). This is important, as fertility can increase again before it declines steadily (Casterline 2001). Hence, in 11 countries with strong fluctuations at a high level, the onset was shifted to the beginning of a TFR decline which is not followed by a second peak.[6]

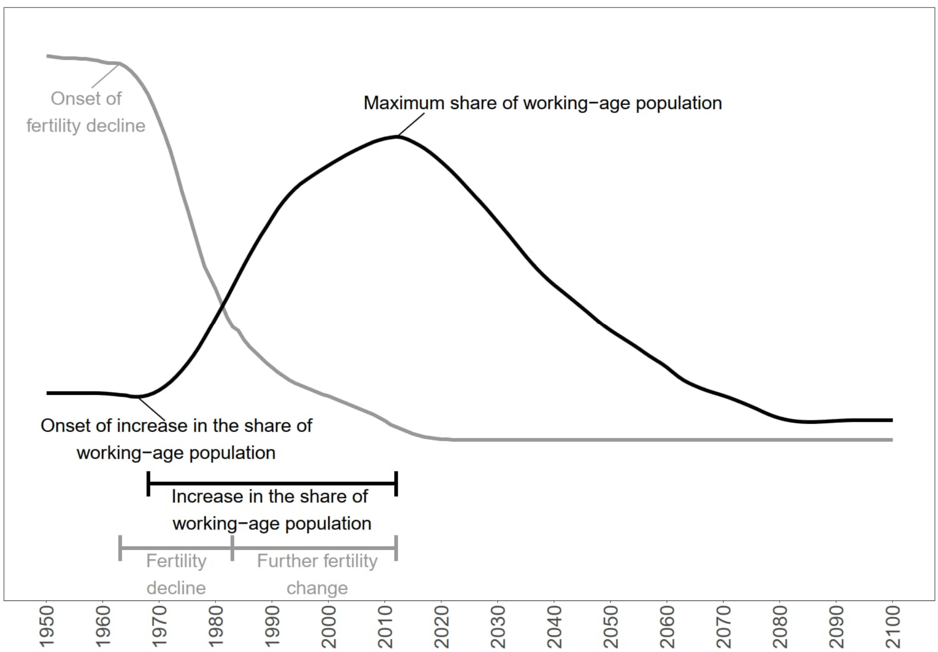
We compare countries based on the phase of fertility transition rather than time period. That is, the fertility decline in country A which started in 1960 is compared to the fertility decline in country B which started in 1990. Pre-transition fertility is the total fertility rate at the onset of fertility transition. The speed of fertility decline is measured as the mean annual decline in the TFR over a 20-year period following the onset of the fertility transition (see Figure 2). This assigns larger positive values to countries with faster fertility decline. We set the duration of the fertility decline at 20 years, as this is

[6] These countries are: Cambodia, China, Ethiopia, Gambia, Guam, Iran, Puerto Rico, Somalia, Syria, Timor-Leste, Trinidad and Tobago.

approximately the minimum time it took for the TFR to stabilize in the countries with the fastest observed fertility declines (such as Iran, China, Mauritius, Singapore, Thailand).

To take further fertility change into account, we consider the fertility change after the initial 20 years of fertility decline. To capture all fertility variations possibly related to changes in the share of working-age population, the speed of further fertility change is defined as the mean annual TFR decrease from 20 years after the onset of fertility transition until the year the maximum share of working-age population is reached (see Figure 2). Analogous to the speed of fertility decline, a positive value in the speed of further fertility change indicates a further TFR decrease.

Figure 2: Schematic trajectory of total fertility rate (grey line), share of working-age population (black line), and related indicators



2.3 Working-age population

In this paper 'working-age population' refers to the population aged 15 to 64. This is a common definition, also used by the OECD (OECD 2023) and ILO (Harasty and Ostermeier 2020). Persons in this age group are likely to be economically active, whereas children under 15 and persons aged 65 and older are more likely to be economically dependent. The average ages at which persons enter and leave the labour force can shift over time, due to, for example, changes in the education system (which can result in earlier or later entry into the labour market) or the introduction or reform of pension systems (which usually affects the age of exit from the labour market) (ILO 2023). Hence, there is no universal definition that accurately reflects the variation in economic activity across age that can be found across space and time. Further definitions where we vary the age of the working-age population (ages 20–64, ages 15–59) are applied for robustness checks.

The potential for a demographic dividend depends on how quickly the share of working-age population increases (Bloom, Canning, and Sevilla 2003; Drummond, Thakoor, and Yu 2014; Eastwood and Lipton 2011; Mason et al. 2017; Spoorenberg 2008), how long it increases for (Mason et al. 2017; Spoorenberg 2008), and the level at which it peaks (Drummond, Thakoor, and Yu 2014; Kotschy, Suarez Urtaza, and Sunde 2020; Spoorenberg 2008). Thus, we use the speed and duration of increase in the share of working-age population and the maximum level as variables to approximate the potential for the demographic dividend. The speed of increase is defined as the mean annual change in the share of the working-age population during the period of increase. The duration of increase refers to the time span between the onset of increase and the year in which the maximum share is reached (see Figure 2). The start of the increase in the share of the working-age population is sometimes also referred to as the opening of a window of opportunity to reap the benefits of a potential demographic dividend (Joe, Kumar, and Rajpal 2018).

Analogous to the onset of the fertility decline, the onset of increase is the year in which the share of working-age population starts to increase substantially. Substantial growth is defined as an annual increase of more than 0.1 percentage points for five consecutive years. This definition takes into account that the data show smaller fluctuations in the share of working-age population that do not indicate a substantial increase. Nevertheless, in seven countries this results in misleading starting points with an extremely slow increasing share of working-age population or short increases followed by a decrease. In these countries the starting points were shifted to the onset of the increase which could be considered substantial.[7]

[7] These countries are: Antigua and Barbuda, Eritrea, Iran, Mali, Mauritania, Mozambique, Vanuatu.

The maximum share of working-age population corresponds to the end point of the increase and is defined as the global maximum in the share of population aged 15 to 64 between 1950 and 2100. In four countries the global maximum is preceded by a phase of smaller deviations in which values slightly below the global maximum are reached. To avoid false conclusions regarding the duration and the speed of the increase in the share of working-age population, for these countries we use the corresponding local maximum to define the end point of the increase and the maximum share of working-age population, respectively.[8] For an overview of all the indicators of fertility change and change in age structure that we apply, see Figure 2 and Appendix Table A-2.

2.4 Mortality, migration, and population momentum

Changes in age structure are not only the consequence of a declining number of births per woman but are also shaped by mortality, migration, and population momentum – the latter being a measure of the effect of age structure itself.

In general, age-specific mortality can affect a population's age structure in various ways. Infant and child mortality (ages 0–14) reduces the population in this age group, and thus the number of persons reaching working age. Mortality in the working-age population (ages 15–64) immediately decreases the size of this age group and reduces the number of persons reaching age 65. Finally, old-age mortality diminishes the size of the 65+ age group. Hence, the specific mortality of a country must be considered when analysing changes in its age structure. This is even the case when comparing countries which are at the same stage of the demographic transition. Riley (2005) shows that both the timing and the pace of the mortality transition vary between countries. Thus, some countries seem to have completed their mortality transition when fertility started to decline, while at the same time other countries apparently had not reached the same mortality improvements. In our data, life expectancy at birth (both sexes) at the onset of fertility decline ranges between 32.2 (South Sudan) and 66.9 years (Hong Kong), showing a standard deviation of 6.5 years (mean: 53.5 years). To control for countries' mortality levels in our analyses we include mean life expectancy at birth during the period from the onset of fertility decline to when the maximum share of working-age population is reached.

In- and out-migration can have a direct effect on a country's age structure (e.g., Blanchet 1989; Espenshade, Bouvier, and Arthur 1982; Fernandes, Turra, and Rios Neto 2023).[9] The share of working-age population increases through positive net migration in

[8] These countries are Grenada, Kyrgyzstan, Morocco, and Syria.

[9] Migration can also have an indirect impact on the age structure by changing the number of women of childbearing age, which in turn can affect fertility (Fihel, Janicka, and Kloc-Nowak 2018).

the age group 15–64 and negative net migration at younger and older ages. As there are no detailed country-level data on annual migration by age group, in our analyses we include estimates for total net migration. For the purpose of our study this can be considered a reliable estimate, as a large part of international migration happens at working ages. In our analyses the variable ‘net migration’ is defined as mean unweighted annual net migration (per 1,000 population) from the onset of fertility decline until the maximum share of working-age population is reached.

Finally, population momentum is an important factor to consider when analysing the consequences of the demographic transition for population size and age structure (Blue and Espenshade 2011; Kim and Schoen 1997; Rowland 1996). Population momentum is a change in population size that is observed even with constant mortality rates, zero net migration, and instantaneous fertility at replacement level (Bongaarts and Bulatao 1999). During the demographic transition, population momentum occurs because “a history of high fertility has resulted in a high proportion of women in the reproductive ages, and these ensure high crude birth rates long after the age-specific rates have dropped” (Keyfitz 1971: 71). The speed with which fertility declines is the most important factor affecting population momentum (Li and Tuljapurkar 1999). Generally, Blue und Espenshade (2011) show that population momentum increases as the demographic transition begins and decreases as the transition concludes.

To calculate population momentum, detailed data on survivorship ratios are required (Blue and Espenshade 2011). Given the lack of reliable data in many developing countries and the complexity of calculating population momentum for such a large set of countries, we use a readily available variable to detect and capture population momentum: the mean annual change in the total number of births (in %) during the fertility decline. Controlling for mortality, migration, and fertility, this indicator reflects the extent to which the number of births depends on the age structure at the onset of fertility decline: The higher the indicator, the larger the population momentum.

3. Methods

3.1 Descriptive analysis

To introduce our main indicators, we present descriptive statistics on the fertility transition and the increase in the share of working-age population by SDG region and country subgroup. Plots containing group means, 95% confidence intervals, and single-country values are used for group comparison. The significance of group differences is detected using simple linear regressions (results not shown here). Additional statistics on the fertility transition, the increase in the share of working-age population, and other characteristics such as migration and mortality, by country, country subgroup, and SDG region, are provided in the Appendix, Tables A-3–A-5. In these tables we also provide the key parameters that describe the changes in the working-age population based on the lower and upper bounds of the 95% prediction intervals (Appendix, Tables A-5–A-6 and Tables A-10–A-11).

3.2 Cluster analysis

We performed cluster analyses to identify different patterns of country-specific age-structure trajectories. As described above, the three variables we employed to describe the characteristics of the increase in the share of working-age population are the maximum level in the share of working-age population, speed of increase, and duration of increase. As these indicators are highly correlated to each other, using all three would make it hard to identify patterns in the data. Hence, after a visual inspection of the scatterplots, we chose to include in our cluster analyses the standardized maximum share and speed of increase in the share of the working-age population.

Separate cluster analyses were conducted for the two country subgroups, i.e., for those with observed and prospective maxima in their working-age population. We applied an Agglomerative Hierarchical Clustering algorithm using a dissimilarity matrix based on the squared Euclidian distance and Ward's minimum variance criterion, which uses the sum of squares between two clusters as the distance. At each step of the Agglomerative Hierarchical Clustering, the pair of clusters with the smallest intergroup dissimilarity is merged into one single cluster (Hastie, Tibshirani, and Friedman 2009). We decided on Ward's method based on a comparison of the agglomerative coefficients and the visual inspection of cluster results using different linkage methods (single, complete, average, centroid).[10] The number of clusters was chosen based on the dendrograms and the Calinksi-Harabasz Pseudo-F (see Appendix, Figures A-1–A-2 and Table A-17). This resulted in a six-cluster solution for the observed countries and a four-cluster solution for the prospective countries. Descriptive statistics by cluster are compiled in the Appendix, Tables A-19–A-24.

[10] Agglomerative coefficients (AC) using Ward's method: 0.972 (observed countries), 0.984 (prospective countries). As stated by Kaufman and Rousseeuw (1990), an AC value close to 1 indicates a clear clustering structure. This procedure was accompanied by a visual inspection of the cluster results. For the AC values for different linkage methods see Appendix, Table A-16.

3.3 Regression analysis

To detect associations between the characteristics of the increase in the share of working-age population and relevant demographic factors, we applied linear regression models. We used the three characteristics of the increase in the share of working-age population as dependent variables: maximum level, speed of increase, and duration of increase. For each of these variables we conducted four regression models. In the first model, the relationship between the respective variable and the speed of fertility decline was analysed. In the second model, the speed of further fertility change was added. In the third model, we additionally included pre-transitional fertility. Finally, in the fourth model all the control variables (net migration, change in number of births, life expectancy at birth) were added. In all models, country subgroup (observed/prospective) was included as a control variable. Various additional model specifications were run as robustness checks.

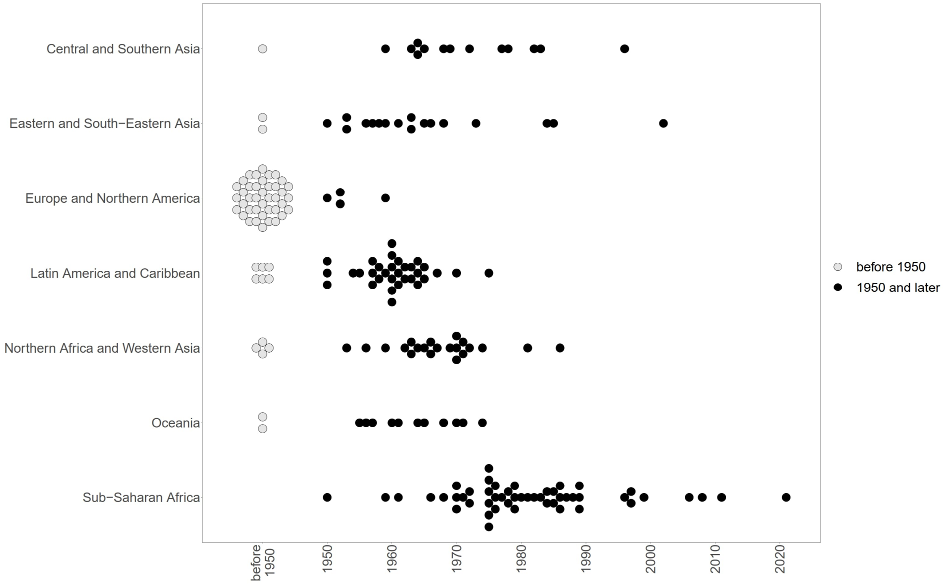
4. Results

4.1 Fertility decline

Starting from a global perspective and not restricting the sample to countries that started their fertility transition after 1950, the conclusion is that all 203 countries had already started their fertility transition by 2021.[11] Figure 3 shows that fertility started to decline before 1950 in most countries in Europe and Northern America (represented by the grey dots). This is also the case in some countries in other regions. In the vast majority of countries in the sample examined in this study (represented by the black dots), fertility started to decline between 1950 and 1990. The onset of fertility decline tends to be later in countries in sub-Saharan Africa than in other regions.

[11] Countries with a population of at least 90,000 in 2021.

Figure 3: Timing of the onset of fertility decline by SDG region



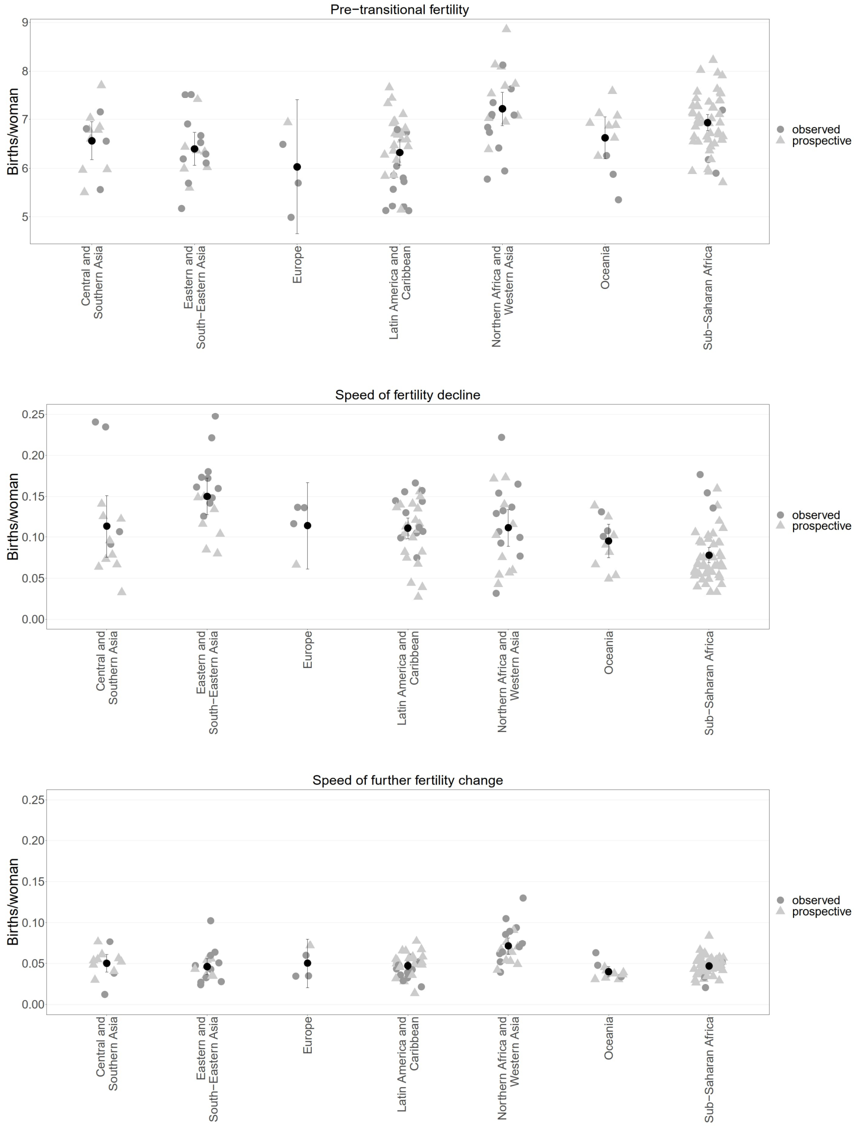
Source: UN DESA 2022b, authors' own calculations.

Turning to our restricted sample of 148 countries that started their fertility transition after 1950, Figure 4 shows the country-level differences in the level of pre-transitional fertility, speed of fertility decline, and speed of further fertility change, by region. First of all, the variance between countries' pre-transitional fertility decline is considerable. It ranges from just over 5 births per woman to extremely high values of more than 8 births per woman in some countries in Northern Africa, sub-Saharan Africa, and Western Asia. There are also large differences between countries within regions. Nevertheless, average pre-transitional fertility was highest in Northern Africa and Western Asia (7.2 births per woman) and sub-Saharan Africa (6.9 births per woman). Pre-transitional fertility is on average higher in countries with prospective maximum shares of working-age population (see Appendix, Table A-8) and is to some extent related to the timing of the onset of fertility decline. Pearson's correlation coefficient reveals a small association between these two variables ($r = 0.30$, $n = 148$, $p = 0.00$). That is, countries entering the demographic transition relatively late (as in sub-Saharan Africa) tend to have higher pre-transitional fertility.

Not only does the level of pre-transitional fertility differ between countries, but also the speed of the subsequent fertility decline (Casterline 2001; UN DESA 2002). Most countries reach an annual fertility decline of 0.05 to 0.15 births per woman (Figure 4). Extremely fast declines of more than 0.20 births per woman per year are found in five Asian countries, namely China, Iran, Maldives, Oman, and Singapore. This means that during a 20-year period the TFR in these countries dropped by more than 4 births per woman, while in other countries during the same period it decreased by less than 1 birth per woman. In contrast to earlier studies based on smaller samples of countries (e.g., UN DESA 2002), no correlation was found between the speed of fertility decline and pre-transitional fertility (Pearson's correlation coefficient: $r = –0.00$, $n = 148$, $p = 0.96$). Correlation between the speed of fertility decline and the timing of the onset of fertility decline is small (Pearson's correlation coefficient: $r = –0.21$, $n = 148$, $p = 0.05$) and corresponds to the result shown by Casterline (2001). However, the average speed of fertility decline is higher in observed countries than in prospective countries (see Appendix, Table A-8). Sub-Saharan Africa, as the region in which fertility started to decline relatively late, also stands out as the region with the slowest average fertility decline, which is consistent with earlier studies (e.g., Bongaarts and Casterline 2013). The highest average speed of fertility decline is found in Eastern and South-Eastern Asia.

Finally, the speed of further fertility change after 20 years of fertility decline is relatively low in observed and prospective countries. Only a few countries – mostly in Northern Africa and Western Asia – show a slightly higher speed (Figure 4).

Figure 4: Characteristics of the fertility transition by SDG region and country subgroup

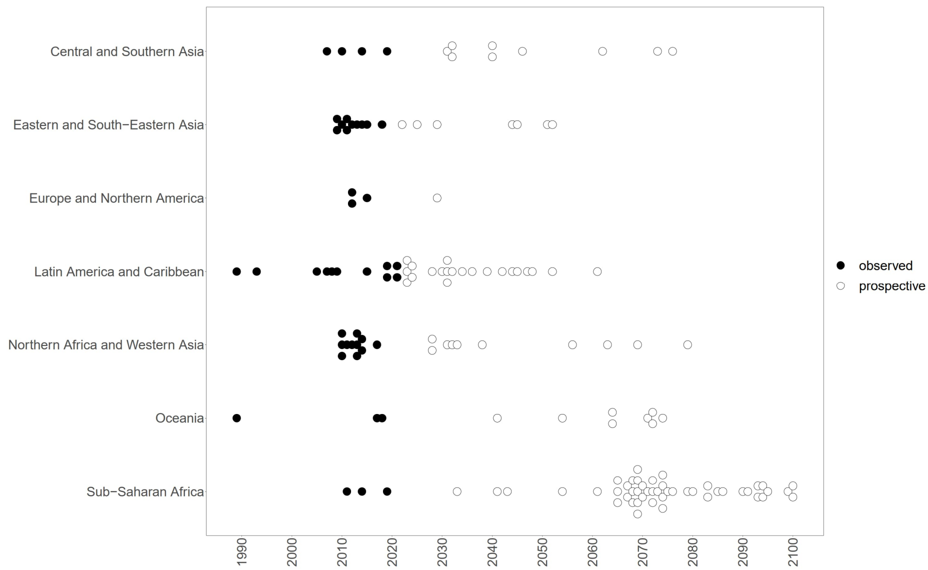


Note: Figure shows single country values, mean values, and 95% confidence intervals (error bars).
Source: UN DESA 2022b, authors' own calculations.

4.2 Changes in age structure

Figure 5 visualizes the timing of the maximum share of working-age population, by region and country subgroup, for the 148 countries in which fertility started to decline after 1950. With only a few exceptions, observed countries (represented by black dots) experienced the peak in their share of working-age population between 2005 and 2021. In the next three decades, 41 of 103 prospective countries (represented by hollow dots) will follow and reach their maximum share by 2050. Mostly in sub-Saharan Africa and Oceania, the share of working-age population is projected to peak later in the second half of the 21st century.

Figure 5: Timing of maximum share of working-age population by SDG region and country subgroup

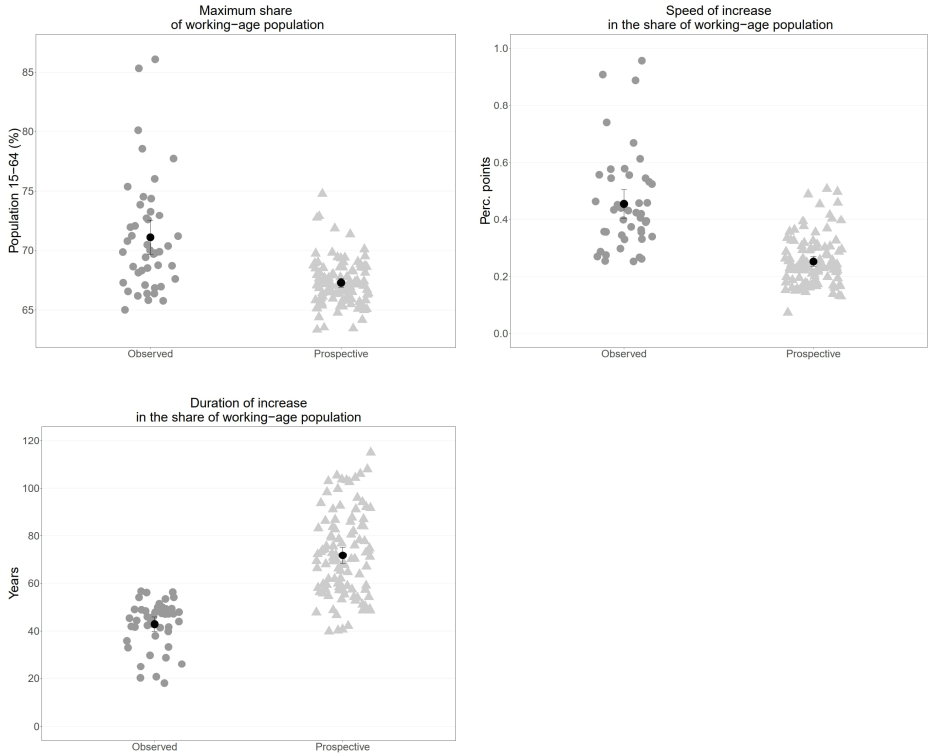


Note: 'Observed countries' and 'prospective countries' refer to those countries with maximum shares of population aged 15–64 between 1950 and 2021 and maximum shares between 2022 and 2100, respectively.
Source: UN DESA 2022b, authors' own calculations.

Late (projected) maximum shares of working-age population are strongly related to later onsets of fertility decline (Pearson's correlation coefficient: $r = 0.68$, $n = 148$, $p = 0.00$). However, countries do not only differ in the timing of fertility decline. Rather, a prospective maximum share of working-age population after 2021 is related to a previous lower maximum share and slower and longer increase before reaching the maximum (Figure 6). While the mean maximum share in observed countries is 71.1%, prospective countries are projected to reach a mean of 67.3%. Corresponding to the UN projections, on average it will take prospective countries over 71.7 years to reach this maximum, whereas in observed countries it was reached after 42.8 years (see Appendix, Table A-9). Finally, on average the speed of increase is projected to be 0.25 percentage points per year in prospective countries, and hence substantially slower than the mean annual increase in observed countries (0.46 percentage points per year).

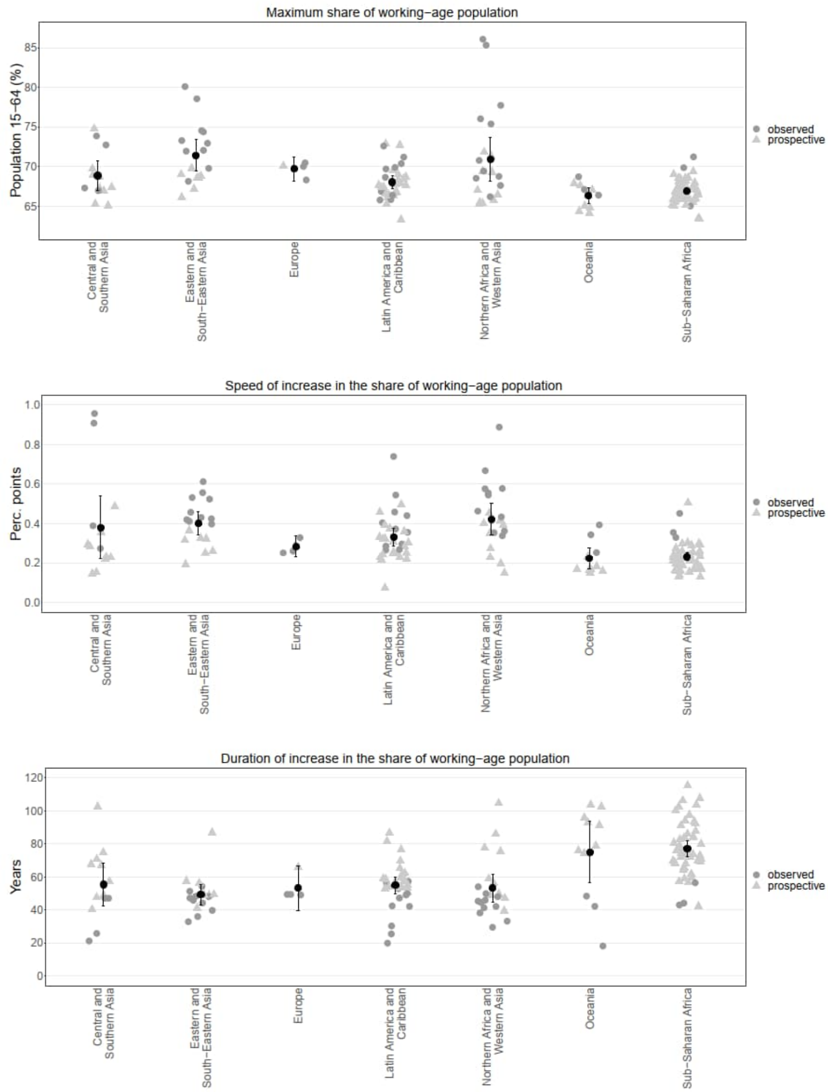
A comparison of the changes in age structure by region of both observed and prospective countries reveals distinct features in two regions: Countries in sub-Saharan Africa and Oceania show on average a lower maximum share, a slower speed, and a longer duration of the increase than those in other regions (Figure 7). These differences are unsurprising, given the large number of prospective countries in these regions and the characteristics of prospective countries shown above. There are fewer differences between the other regions. Only in Eastern and South-Eastern Asia, Northern Africa, and Western Asia is the average maximum share of working-age population noticeably higher than in other regions. This is due in part to outlier countries with very high maximum shares, such as Qatar and the United Arab Emirates, where the share of working-age population peaks at more than 85%. Remarkable outliers are also found when comparing the speed of increase in the share of working-age population. In Iran, Oman, and the Maldives, the mean annual increase ranges between 0.89 and 0.96 percentage points.

Figure 6: Characteristics of the increase in the share of working-age population by country subgroup



Note: 'Observed countries' and 'prospective countries' refer to countries with maximum shares of population aged 15–64 between 1950 and 2021 and maximum shares between 2022 and 2100, respectively. Figure shows single country values, mean values, and 95% confidence intervals (error bars).
Source: UN DESA 2022b, authors' own calculations.

Figure 7: Characteristics of the increase in the share of working-age population by SDG region and country subgroup



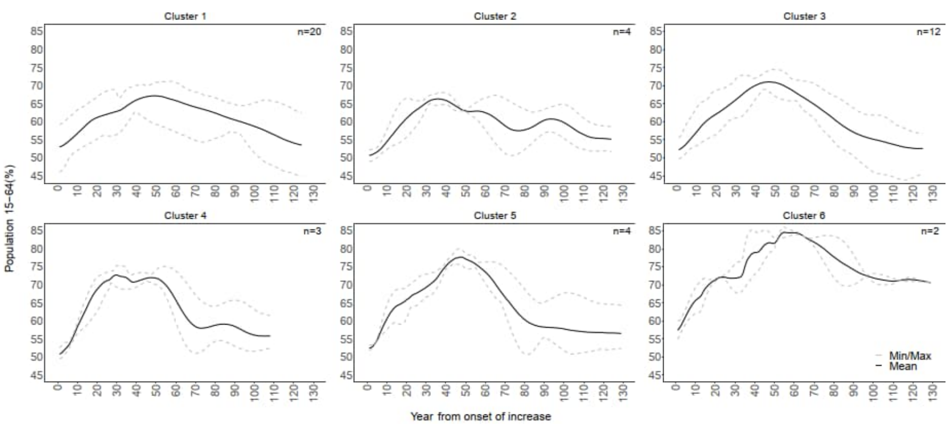
Note: 'Observed countries' and 'prospective countries' refer to countries with maximum shares of population aged 15–64 between 1950 and 2021 and maximum shares between 2022 and 2100, respectively. Figure shows single country values, mean values, and 95% confidence intervals (error bars).
Source: UN DESA 2022b, authors' own calculations.

4.3 Classification of countries

We used the maximum level and the speed of increase in the share of working-age population to detect distinct trajectories of working-age shares and found six distinct clusters for the subgroup of observed countries. A full list of countries by cluster, a comparison of summary statistics of these clusters, and further plots are provided in the Appendix, Tables A-18–A-24 and Figures A-3–A-4. Figure 8 shows the mean trajectories of changes in the share of working-age population for each cluster. The year in which the share of working-age population started to increase was set to 0 for each country.

A large share of countries (Cluster 1, n = 20) shows relatively low maximum shares of working-age population as well as a slower and longer increase than observed in other clusters (Figure 8). The trajectories in cluster 2 (n = 4) are also shaped by relatively low maximum shares. In comparison to cluster 1, these maximum shares are reached after a faster and shorter increase. The pattern shown by cluster 3 (n = 12) is close to the prototypical pattern described earlier. Moreover, the average maximum share, speed of increase, and duration of increase in this cluster correspond approximately to the average of all observed countries. In cluster 4 (n = 3) the maximum level of the share of working-age population is similar to that in cluster 3 but comes with a steeper and shorter increase. High maximum shares of working-age population can be observed in cluster 5 (n = 4), along with a relatively steep but long increase. Finally, two countries reached a share of working-age population of more than 85% (Cluster 6, n = 2).

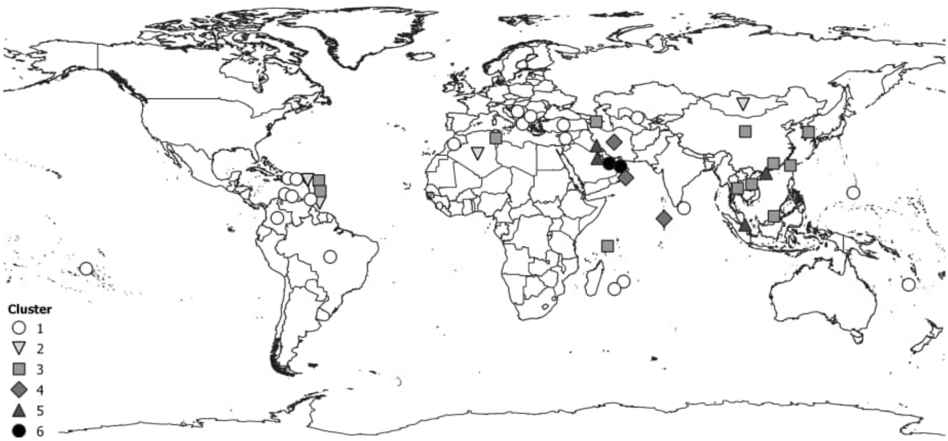
Figure 8: Share of working-age population over time by cluster (Observed countries)



Note: Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021. Year 0 corresponds to first year in which the share of working-age population increases.
Source: UN DESA 2022b, authors' own calculations.

Figure 9 shows the geographical distribution of the six clusters. Countries with low maximum shares of working-age population (Clusters 1 and 2) are widely spread across world regions, whereas higher maximum shares (Clusters 4 to 6) are found exclusively in Asia. The prototypical pattern (Cluster 3) is detected particularly in Eastern and South-Eastern Asia but also in four Caribbean and African countries. Three of the four Asian tiger states are in this cluster (South Korea, Hong Kong, Taiwan), as is Thailand. The three countries with an extremely fast increase in working-age population (Cluster 4) are located in Western and Southern Asia (Iran, Oman, the Maldives). High (Cluster 5) and extremely high (Cluster 6) maximum shares of working-age population are found in the Arab Gulf States and in Macao and Singapore in Eastern and South-Eastern Asia.

Figure 9: Classification of countries by pattern of change in the share of working-age population (Observed countries)



Note: Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021.
Source: Minnesota Population Center 2020 (Map), UN DESA 2022b, authors' own calculations.

Turning to those 103 countries whose maximum share of working-age population is yet to materialize, only 8 countries are projected to undergo a trajectory similar to the prototypical pattern (Cluster 4, see Appendix, Figure A-5). This cluster contains exclusively countries with projected peaks during the decade 2023–2033, located mainly in Northern Africa and Western Asia (see Appendix, Table A-18). A look at the other clusters, however, confirms our earlier finding that in most of the prospective countries, lower maximum shares and a slower increase in the share of working-age population are expected than in the observed countries (cf. Appendix, Tables A-20 and A-23).

4.4 Associated demographic factors

We now turn to the evaluation of factors that are related to observed and prospective changes in the share of working-age population. On the one hand, the speed of fertility decline is positively correlated with the speed of increase and the maximum share of working-age population (Tables 2–3). On the other hand, it is negatively correlated with the duration of increase (Table 4). Similar effects are found for the speed of further fertility change. That is, changes in age structure are affected not only by the speed of fertility decline during the first two decades of fertility transition but also by the speed of fertility changes over the longer term. Additionally, pre-transitional fertility, i.e., the fertility level at the onset of fertility decline, seems to have a negative effect on the maximum share of working-age population and a positive effect on the time span needed to reach it. Hence, countries in which the fertility transition started at higher levels are more likely to undergo a long dividend phase resulting in a low peak. However, pre-transitional fertility does not seem to be correlated with the speed of increase.

Besides fertility, there are two major factors that affect changes in the age structure. First, positive net migration is strongly related to high maximum shares. Given the fact that the highest maximum shares are found in high-immigration countries such as the United Arab Emirates and Qatar, this is unsurprising (see Appendix, Table A-7). Additional analyses show that this effect persists even when countries with high positive or high negative net migration are excluded from the analysis (results not shown here). Moreover, positive net migration seems to contribute to the share of working-age population increasing at a higher speed, whereas no clear effect is found between net migration and the duration of increase. The effect of the second factor, population momentum, seems to work contrary to the effect of net migration: The higher the change in the total number of births – even when controlling for fertility changes, mortality, and net migration – the lower the resulting maximum share and speed of increase. Population momentum is the result of populations' age structure at the onset of fertility decline. Hence, population trends (fertility, migration, mortality) preceding the fertility transition are also important for the increase in the share of working-age population. However, the mortality level during the fertility transition does not seem to have an effect on the increase in the share of working-age population.

Finally, we included the country subgroup as a control variable in all our models. Whereas differences between prospective and observed countries seem to persist when considering only fertility-based predictors, there is no clear evidence for such an effect when all variables are included (Model 4). Hence, differences in maximum level, speed of increase, and duration of increase between the two country subgroups can be explained by differences in fertility, migration, population momentum, and mortality.[12]

Table 2: Regressions of the maximum share of working-age population

	(1)	(2)	(3)	(4)
	Maximum share working-age pop.			
Speed of fertility decline	0.20 (0.04, 0.37) p = 0.02	0.33 (0.18, 0.49) p = 0.00	0.49 (0.33, 0.65) p = 0.00	0.20 (0.05, 0.35) p = 0.02
Speed of further fertility change		0.39 (0.26, 0.52) p = 0.00	0.58 (0.43, 0.73) p = 0.00	0.39 (0.28, 0.50) p = 0.00
Pre-transitional fertility			–0.35 (–0.51, –0.19) p = 0.00	–0.18 (–0.29, –0.06) p = 0.01
Net migration				0.76 (0.65, 0.88) p = 0.00
Change in number of births				–0.54 (–0.70, –0.38) p = 0.00
Life expectancy				0.00 (–0.09, 0.09) p = 0.99
Prospective country (Ref. observed)	–0.39 (–0.55, –0.22) p = 0.00	–0.29 (–0.44, –0.13) p = 0.00	–0.06 (–0.24, 0.11) p = 0.50	0.11 (–0.01, 0.23) p = 0.09
AIC	379.10	349.51	333.19	220.09
R-Squared	0.28	0.42	0.48	0.77
Adj. R-Squared	0.27	0.40	0.47	0.76
Number of Cases	148	148	148	148

Note: Table shows standardized beta-coefficients with 95% confidence intervals in parentheses and p-values. A constant is included in all regressions.
Speed of fertility decline is defined as mean annual decrease of the total fertility rate (in births per woman) during 20 years starting from the onset of fertility decline.
Speed of further fertility change is defined as mean annual decrease in the total fertility rate (in births per woman) starting from 20 years after the onset of fertility decline up to the maximum share of population aged 15–64.
Pre-transitional fertility is defined as total fertility rate (in births per woman) at the onset of the fertility decline.
Net migration is defined as unweighted annual net migration (per 1,000 population) from the onset of fertility decline until the maximum share of population aged 15–64 is reached.
Change in number of births is defined as mean annual change in the total number of births (in %) during 20 years starting from the onset of fertility decline.
Life expectancy is defined as mean life expectancy at birth (both sexes) from the onset of fertility decline until the maximum share of population aged 15–64 is reached.
Source: UN DESA 2022b, authors' own calculations.

[12] See Appendix, Tables A-8–A-12 for a comparison of the demographic factors of observed and prospective countries. Further analyses reveal that prospective countries show a higher annual change in total number of births than observed countries even when controlling for fertility, migration, and mortality. This indicates that population momentum is more pronounced in those countries that still have relatively high levels of fertility.

Table 3: Regressions of the speed of increase in the share of working-age population

	(1)	(2)	(3)	(4)
	Speed of increase share working-age pop.			
Speed of fertility decline	0.49 (0.37, 0.62) p = 0.00	0.62 (0.51, 0.73) p = 0.00	0.67 (0.55, 0.80) p = 0.00	0.44 (0.29, 0.59) p = 0.00
Speed of further fertility change		0.38 (0.29, 0.47) p = 0.00	0.45 (0.33, 0.56) p = 0.00	0.42 (0.31, 0.53) p = 0.00
Pre-transitional fertility			–0.12 (-0.24, 0.00) p = 0.06	0.00 (–0.12, 0.12) p = 0.96
Net migration				0.31 (0.20, 0.43) p = 0.00
Change in number of births				–0.43 (–0.60, –0.27) p = 0.00
Life expectancy				–0.02 (–0.11, 0.08) p = 0.76
Prospective country (Ref. observed)	–0.36 (–0.48, –0.23) p = 0.00	–0.26 (–0.37, –0.15) p = 0.00	–0.18 (–0.32, –0.05) p = 0.01	–0.10 (–0.22, 0.03) p = 0.13
AIC	304.77	253.47	251.55	225.94
R-Squared	0.56	0.70	0.70	0.76
Adj. R-Squared	0.56	0.69	0.69	0.75
Number of Cases	148	148	148	148

Note: Table shows standardized beta-coefficients with 95% confidence intervals in parentheses and p-values. A constant is included in all regressions. For further notes, see Table 2.
Source: UN DESA 2022b, authors' own calculations.

Table 4: Regressions of the duration of increase in the share of working-age population

	(1)	(2)	(3)	(4)
	Duration of increase share working-age pop.			
Speed of fertility decline	–0.28 (–0.42, –0.14) p = 0.00	–0.38 (–0.52, –0.25) p = 0.00	–0.60 (–0.73, –0.48) p = 0.00	–0.54 (–0.71, –0.38) p = 0.00
Speed of further fertility change		–0.32 (–0.43, –0.20) p = 0.00	–0.58 (–0.70, –0.47) p = 0.00	–0.64 (–0.76, –0.52) p = 0.00
Pre-transitional fertility			0.49 (0.37, 0.61) p = 0.00	0.46 (0.33, 0.59) p = 0.00
Net migration				0.04 (–0.09, 0.17) p = 0.56
Change in number of births				0.16 (–0.02, 0.34) p = 0.08
Life expectancy				0.08 (–0.02, 0.18) p = 0.13
Prospective country (Ref. observed)	0.49 (0.35, 0.64) p = 0.00	0.41 (0.28, 0.55) p = 0.00	0.10 (–0.03, 0.24) p = 0.15	0.10 (–0.03, 0.24) p = 0.14
AIC	332.17	305.78	254.56	249.05
R-Squared	0.47	0.57	0.70	0.72
Adj. R-Squared	0.47	0.56	0.69	0.71
Number of Cases	148	148	148	148

Note: Table shows standardized beta-coefficients with 95% confidence intervals in parentheses and p-values. A constant is included in all regressions. For further notes, see Table 2.
Source: UN DESA 2022b, authors' own calculations.

4.5 Robustness checks

Sensitivity analyses were conducted to check the robustness of the results of our cluster analyses. First, we used two alternative definitions to define the working-age population variables: ages 15–59 and ages 20–64. Using these alternative definitions, we found that the classification of countries which show trajectories similar to the prototypical pattern and those with even higher maximum shares of working-age population remains almost unchanged. However, the countries with lower maximum shares were assigned to different clusters than when using the original definition (ages 15–64), suggesting that the composition of these clusters was somewhat sensitive to the definition of the working-age population. This sensitivity results from the fact that changing the definition of the upper and lower age limit of the working-age population entails noticeable shifts in the years when the working-age population increase begins and when it reaches its maximum.

The results of the regression analyses were also subjected to several robustness checks. First, we used the alternative definitions of the working-age population (15–59, 20–64) in all regression models. The results are consistent with those based on the original definition (15–64), suggesting that our findings are robust to different specifications of the working-age population. Second, we ran all regression models excluding outliers which were identified using Cook's distance (Cook 1977). We found that the coefficients of the various demographic factors remained largely unchanged and the overall fit of the model was only slightly affected, indicating that our results were not driven by extreme values. However, when outliers are excluded, pre-transitional fertility seems to also contribute to a slower speed of increase, while population momentum seems to expand the duration of increase. However, the size of these effects is relatively small. Third, we added the SDG region and the initial share of working-age population at the onset of fertility decline as control variables in all models. The results were also consistent with those of the original models. Fourth, we re-ran all regression models using an alternative UN definition of countries which had not entered the second phase of the demographic transition prior to 1950 (TFR $\geq$ 5.5 births per woman; UN DESA 2022a).[13] The results based on this smaller sample were also consistent with those found using the full sample. Overall, these robustness checks support the validity of our regression analyses and suggest that our results are not overly sensitive to variations in the model specifications.

5. Discussion and conclusion

The objective of our analyses was to identify and describe global patterns of change in working-age populations and to assess the relevance of associated demographic factors, given the importance of changes in the age structure for potential demographic dividends. To this end, we described in detail similarities and differences in fertility decline and changes in the working-age population of countries that entered their fertility decline after 1950. We also identified demographic factors that are associated with changes in the share of the working-age population.

What sets our analyses apart from the existing literature is its scope in terms of countries and time period covered, the detail with which we looked at changes in the

[13] This definition leads to a sample of 141 countries. The following seven countries reached a maximum total fertility rate of less than 5.5 births per woman 1950–2021 and hence in this modified specification were excluded from the original sample of 148 countries: Antigua and Barbados, Bosnia and Herzegovina, Curacao, French Guiana, Hong Kong, New Caledonia, Puerto Rico.

share of the working-age population following fertility decline, and the context in which we present and discuss our results. Building on existing research on age-structure changes, our analyses reveal that changes in age structure are not as uniform across countries as sometimes expected. Rather, distinct patterns of changes in the share of working-age population can be found in countries that had already experienced a peak in the share of their working-age population as a result of previous fertility decline. A large proportion of these countries show changes in the share of working-age population – described by the maximum, the speed of increase, and the duration of increase in the share of working-age population – that vary substantially from the often-used pattern, which is based on the prototypical experience of selected Asian countries. We were also interested in exploring the extent to which these patterns of age-structure change in the past are comparable to present and future declines; i.e., the extent to which the observed patterns can be expected to be found in countries that are still at earlier stages of the demographic transition. Here we find noticeable differences between the two groups. This means that many countries that currently still have relatively high levels of fertility cannot expect to undergo the same development regarding changes in the share of their working-age population as was experienced by other countries. Rather, most of these countries face a slower, longer, and lower-peaking increase in the share of their working-age population. Hence, in order to properly assess the specific demographic circumstances of countries that are yet to experience noticeable shifts in age structure that will form the basis of potential benefits of the demographic dividend, it is important to pay attention to individual demographic situations.

Our results also show that changes in the share of working-age population in the course of the demographic transition are not only attributed to changes in fertility but are also associated with net migration and population momentum. Some of the countries that saw exceptional maxima in the share of their working-age populations, such as the United Arab Emirates and Qatar, are high-immigration countries. While the specific experience of these two countries might be unique, it exemplifies the potential impact of migration. Population momentum is negatively associated with the maximum share of the working-age population and the duration of increase, which shows the importance of age structure in populations at the onset of fertility decline. These two demographic factors should receive much more attention in research on demographic dividends than is currently the case. Our comparative analysis of ‘observed’ and ‘prospective’ countries shows differences between these groups in two indicators: on average, annual net migration was higher and population momentum was lower in ‘observed’ than in ‘prospective’ countries. It must be kept in mind, however, that these averages mask large ranges in both indicators and that the prospective analyses are based on population projections.

The changes in countries’ age structure which we assess in this paper are the precondition for a demographic dividend. However, various other factors influence whether and to what degree the potential for a demographic dividend can be turned into actual economic benefit: for example, investments in educational attainment (Lee and Mason 2010; Crespo Cuaresma, Lutz, and Sanderson 2014; Lutz et al. 2019; Kotschy, Suarez Urtaza, and Sunde 2020), the creation of productive employment opportunities (Bloom, Canning, and Sevilla 2003), gender equality and female labour force participation (Bloom, Canning, and Sevilla 2003; Bloom et al. 2009; Marois, Zhelenkova, and Ali 2022), and the quality of institutions and a supportive policy environment (Bloom, Kuhn, and Prettner 2017). These economic, educational, and social transformations that are necessary to realize a potential demographic dividend can take time to yield results. Hence, a longer potential dividend phase based on a slower increase in the share of working-age population could also be interpreted as being beneficial for a demographic dividend (Spoorenberg 2008). More births mean more young people will enter the potential workforce, its age structure will be younger, and policymakers will have more time to decide which policies to implement to deal with a prospectively ageing population. Mason (2005) shows that a long dividend phase is associated with a smaller annual boost to economic growth than rapid transitions, but that the total gain through the dividend can be of the same magnitude. At the same time, longer durations between the beginning of the increase in the share of working-age population and its maximum that are due to slower fertility declines mean higher population growth and higher necessary investments in the education and health of the young population – investments that will not be available to spend in other sectors and on infrastructure (Pool 2007). In our analyses we saw that slow increases in the share of working-age population were associated with lower shares of the young population (below age 15) and higher shares of the older population (aged 65 and above) when the maximum of the working-age population is reached than when the working-age population increases rapidly. This result holds true for the full sample and when we restrict our sample to the observed countries, and is further testimony to the trade-off that countries face.

In our analysis we focused on the period between the onset of fertility decline and the maximum share of working-age population. Our analyses also revealed differences in the further trajectories of the share of the working-age population after this maximum share is reached. While we did not investigate this in this study, for the most part these are likely due to (assumed) distinct projected patterns of fertility and migration, and to a much lesser degree to differences in mortality. Future research should also take a closer look at the trajectories of the share of the working-age population after the maximum is reached. The experience of the Asian role-model countries, where rapid decreases in fertility decline and sharp increases in the share of the working-age population are now followed by rapid decreases in the share of working-age population and fast increases of the older population, is only one of several patterns.

Our analyses are based on the estimates and medium projections of the UN World Population Prospects 2022, which are subject to some uncertainties. First, the accuracy of the estimates depends on the country-specific quality of data sources (Liu and Raftery 2020; Pelletier 2020). Second, the projections are based on specific assumptions regarding fertility, mortality, and migration, which will in all likelihood not turn out exactly as projected. For instance, the UN assumptions regarding future net migration of developing countries are mostly set slightly above or below zero. In this regard, our calculations of the maximum share and the speed of increase in the share of working-age population are possibly overly optimistic and form an upper bound for those countries with actual significant negative migration in the future. At the same time, they form a lower bound for those countries that experience increased levels of in-migration in the future. One factor that could lead to increased out- as well as in-migration is climate change. However, migration is only one adaptation strategy and the actual effect of climate change on international migration is complex and hard to predict (Cattaneo et al. 2019), and is not explicitly factored into the UN assumptions. Bloom, Kuhn, and Prettner (2017) see climate change as one of the factors that could pose the biggest risk for reaping the potential benefits of a demographic dividend in sub-Saharan African countries. They identify several direct and indirect impacts of climate change, with two of the direct impacts affecting both internal and international migration. In the examples in our analyses of ‘observed’ countries with high immigration in the past, it was labour migration that by its very nature augmented increases in working-age shares. Different forms of migration, e.g., related to climate change, might show different age patterns and also have different effects on age structure in both host countries and countries of origin. This exemplifies that migration should be a more prominent factor in discussions about demographic trends and their potential for future demographic dividends. Besides migration assumptions, the fertility assumptions that enter our calculations (UN WPP 2022 medium variant) need to be assessed with necessary prudence. Accelerations or stalls in the projected fertility declines in countries that currently still have relatively high levels of fertility could lead to trajectories other than those projected. In the case of faster fertility declines the duration of increase will be shorter and the speed of increase and the maximum shares of working-age population will be higher than in our analyses. The opposite is true in the case of slower fertility declines. Finally, different actual developments of age-specific mortality can influence the age distribution at various ages. While changes in life expectancy happen rather gradually in the absence of events like wars or pandemics, trajectories different from those in the UN WPP 2022 medium variant will affect future age compositions and hence our results. Our analyses using the UN’s 95% prediction intervals underline that uncertainty increases the further the projections extend into the future. The largest fluctuations of the key parameters that describe the changes in the working-age population can be found in countries in sub-Saharan Africa and Oceania. These uncertainties in the future development also depend on the quality of available data for the past (UN DESA 2022a). For instance, in countries with lower data quality, uncertainty in fertility indicators is already relatively large in 2022.

Demographers are well aware of differences between countries when it comes to demographic developments and consider these differences when discussing them in the context of the demographic dividend (Drummond, Thakoor, and Yu 2014; Eastwood and Lipton 2011; Pool 2007). However, it is also important that development planners of national and international organizations and local political decision-makers are cognisant of the associations between changes in the working-age population and fertility decline – the core focus of the present article – as well as the role of migration and population momentum in this context. These associations should be more explicit than they are at present in framings of the role of demographic developments in possible economic growth effects through the demographic dividend. Otherwise, the importance of rather fast fertility decline for speedy changes in the working-age population and high maxima will be misjudged and the potential for development and economic growth overestimated.

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Appendix

Table A-1: SDG region and country subgroup by country

Country	SDG region	Country subgroup
Afghanistan	Central and Southern Asia	prospective
Albania	Europe and Northern America	observed
Algeria	Northern Africa and Western Asia	observed
Angola	Sub-Saharan Africa	prospective
Antigua and Barbuda	Latin America and Caribbean	observed
Aruba	Latin America and Caribbean	observed
Azerbaijan	Northern Africa and Western Asia	observed
Bahrain	Northern Africa and Western Asia	observed
Bangladesh	Central and Southern Asia	prospective
Belize	Latin America and Caribbean	prospective
Benin	Sub-Saharan Africa	prospective
Bhutan	Central and Southern Asia	prospective
Bolivia	Latin America and Caribbean	prospective
Bosnia and Herzegovina	Europe and Northern America	observed
Botswana	Sub-Saharan Africa	prospective
Brazil	Latin America and Caribbean	observed
Brunei Darussalam	Eastern and South-Eastern Asia	observed
Burkina Faso	Sub-Saharan Africa	prospective
Burundi	Sub-Saharan Africa	prospective
Cabo Verde	Sub-Saharan Africa	prospective
Cambodia	Eastern and South-Eastern Asia	prospective
Cameroon	Sub-Saharan Africa	prospective
Central African Republic	Sub-Saharan Africa	prospective
Chad	Sub-Saharan Africa	prospective
China	Eastern and South-Eastern Asia	observed
Colombia	Latin America and Caribbean	observed
Comoros	Sub-Saharan Africa	prospective
Congo	Sub-Saharan Africa	prospective
Congo (Democratic Republic)	Sub-Saharan Africa	prospective
Costa Rica	Latin America and Caribbean	prospective
Côte d'Ivoire	Sub-Saharan Africa	prospective
Curaçao	Latin America and Caribbean	observed
Djibouti	Sub-Saharan Africa	prospective
Dominican Republic	Latin America and Caribbean	prospective
Ecuador	Latin America and Caribbean	prospective
Egypt	Northern Africa and Western Asia	prospective
El Salvador	Latin America and Caribbean	prospective
Equatorial Guinea	Sub-Saharan Africa	prospective
Eritrea	Sub-Saharan Africa	prospective
Eswatini	Sub-Saharan Africa	prospective
Ethiopia	Sub-Saharan Africa	prospective
Fiji	Oceania	prospective
French Guiana	Latin America and Caribbean	prospective
French Polynesia	Oceania	observed
Gabon	Sub-Saharan Africa	prospective
Gambia	Sub-Saharan Africa	prospective
Ghana	Sub-Saharan Africa	prospective
Grenada	Latin America and Caribbean	observed

Table A-1: (Continued)

Country	SDG region	Country subgroup
Guadeloupe	Latin America and Caribbean	observed
Guam	Oceania	observed
Guatemala	Latin America and Caribbean	prospective
Guinea	Sub-Saharan Africa	prospective
Guinea-Bissau	Sub-Saharan Africa	prospective
Guyana	Latin America and Caribbean	prospective
Haiti	Latin America and Caribbean	prospective
Honduras	Latin America and Caribbean	prospective
Hong Kong	Eastern and South-Eastern Asia	observed
India	Central and Southern Asia	prospective
Indonesia	Eastern and South-Eastern Asia	prospective
Iran	Central and Southern Asia	observed
Iraq	Northern Africa and Western Asia	prospective
Jamaica	Latin America and Caribbean	prospective
Jordan	Northern Africa and Western Asia	prospective
Kenya	Sub-Saharan Africa	prospective
Kiribati	Oceania	prospective
Korea (Republic)	Eastern and South-Eastern Asia	observed
Kosovo	Europe and Northern America	prospective
Kuwait	Northern Africa and Western Asia	observed
Kyrgyzstan	Central and Southern Asia	prospective
Lao	Eastern and South-Eastern Asia	prospective
Lebanon	Northern Africa and Western Asia	observed
Lesotho	Sub-Saharan Africa	prospective
Liberia	Sub-Saharan Africa	prospective
Libya	Northern Africa and Western Asia	prospective
Macao	Eastern and South-Eastern Asia	observed
Madagascar	Sub-Saharan Africa	prospective
Malawi	Sub-Saharan Africa	prospective
Malaysia	Eastern and South-Eastern Asia	prospective
Maldives	Central and Southern Asia	observed
Mali	Sub-Saharan Africa	prospective
Martinique	Latin America and Caribbean	observed
Mauritania	Sub-Saharan Africa	prospective
Mauritius	Sub-Saharan Africa	observed
Mayotte	Sub-Saharan Africa	prospective
Mexico	Latin America and Caribbean	prospective
Micronesia (Fed. States of)	Oceania	prospective
Mongolia	Eastern and South-Eastern Asia	observed
Morocco	Northern Africa and Western Asia	observed
Mozambique	Sub-Saharan Africa	prospective
Myanmar	Eastern and South-Eastern Asia	prospective
Namibia	Sub-Saharan Africa	prospective
Nepal	Central and Southern Asia	prospective
New Caledonia	Oceania	observed
Nicaragua	Latin America and Caribbean	prospective
Niger	Sub-Saharan Africa	prospective
Nigeria	Sub-Saharan Africa	prospective
North Macedonia	Europe and Northern America	observed
Oman	Northern Africa and Western Asia	observed

Table A-1: (Continued)

Country	SDG region	Country subgroup
Pakistan	Central and Southern Asia	prospective
Palestine	Northern Africa and Western Asia	prospective
Panama	Latin America and Caribbean	prospective
Papua New Guinea	Oceania	prospective
Paraguay	Latin America and Caribbean	prospective
Peru	Latin America and Caribbean	prospective
Philippines	Eastern and South-Eastern Asia	prospective
Puerto Rico	Latin America and Caribbean	observed
Qatar	Northern Africa and Western Asia	observed
Réunion	Sub-Saharan Africa	observed
Rwanda	Sub-Saharan Africa	prospective
Saint Lucia	Latin America and Caribbean	prospective
Saint Vincent and the Grenadines	Latin America and Caribbean	prospective
Samoa	Oceania	prospective
Sao Tome and Principe	Sub-Saharan Africa	prospective
Saudi Arabia	Northern Africa and Western Asia	prospective
Senegal	Sub-Saharan Africa	prospective
Seychelles	Sub-Saharan Africa	observed
Sierra Leone	Sub-Saharan Africa	prospective
Singapore	Eastern and South-Eastern Asia	observed
Solomon Islands	Oceania	prospective
Somalia	Sub-Saharan Africa	prospective
South Africa	Sub-Saharan Africa	prospective
South Sudan	Sub-Saharan Africa	prospective
Sri Lanka	Central and Southern Asia	observed
Sudan	Northern Africa and Western Asia	prospective
Suriname	Latin America and Caribbean	prospective
Syrian Arab Republic	Northern Africa and Western Asia	prospective
Taiwan	Eastern and South-Eastern Asia	observed
Tajikistan	Central and Southern Asia	prospective
Tanzania	Sub-Saharan Africa	prospective
Thailand	Eastern and South-Eastern Asia	observed
Timor-Leste	Eastern and South-Eastern Asia	prospective
Togo	Sub-Saharan Africa	prospective
Tonga	Oceania	prospective
Trinidad and Tobago	Latin America and Caribbean	observed
Tunisia	Northern Africa and Western Asia	observed
Turkey	Northern Africa and Western Asia	observed
Turkmenistan	Central and Southern Asia	prospective
Uganda	Sub-Saharan Africa	prospective
United Arab Emirates	Northern Africa and Western Asia	observed
Uzbekistan	Central and Southern Asia	observed
Vanuatu	Oceania	prospective
Venezuela	Latin America and Caribbean	prospective
Viet Nam	Eastern and South-Eastern Asia	observed
Virgin Islands	Latin America and Caribbean	observed
Western Sahara	Northern Africa and Western Asia	prospective
Yemen	Northern Africa and Western Asia	prospective
Zambia	Sub-Saharan Africa	prospective
Zimbabwe	Sub-Saharan Africa	prospective

Source: UN DESA 2022.

Table A-2: List of indicators and definitions

Indicator	Definition	Regression analysis	Cluster analysis
Pre-transitional fertility	Total fertility rate (in births per woman) at the onset of the fertility decline	X	
Speed of fertility decline	Mean annual decrease in the total fertility rate (in births per woman) during 20 years starting from the onset of fertility decline	X	
Speed of further fertility change	Mean annual decrease in the total fertility rate (in births per woman) starting from 20 years after the onset of fertility decline up to the maximum share of population aged 15–64	X	
Net migration	Unweighted annual net migration (per 1,000 population) from the onset of fertility decline until the maximum share of population aged 15–64 is reached	X	
Change in number of births	Mean annual change in the total number of births (in %) during 20 years starting from the onset of fertility decline	X	
Life expectancy	Mean life expectancy at birth (both sexes) from the onset of fertility decline until the maximum share of population aged 15–64 is reached	X	
Maximum share of working-age population	Maximum share of population aged 15–64	X	X
Speed of increase in the share of working-age population	Mean annual change in the share of population aged 15–64 between the onset of increase and the year in which the maximum share is reached	X	X
Duration of increase in the share of working-age population	Years between the onset of increase and the year in which the maximum share is reached	X	

Table A-3: Characteristics of the fertility decline by country

Country	Year onset fertility decline	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/ year)
Afghanistan	1996	7.71	0.12	0.05
Albania	1959	6.49	0.14	0.06
Algeria	1970	7.64	0.15	0.09
Angola	1986	7.44	0.05	0.05
Antigua and Barbuda	1950	5.12	0.07	0.04
Aruba	1950	5.80	0.14	0.03
Azerbaijan	1963	5.95	0.13	0.04
Bahrain	1964	7.06	0.14	0.07
Bangladesh	1972	6.85	0.14	0.06
Belize	1975	6.28	0.12	0.05
Benin	1984	7.02	0.06	0.04
Bhutan	1977	6.61	0.13	0.08
Bolivia	1960	6.36	0.04	0.05
Bosnia and Herzegovina	1952	4.99	0.12	0.03
Botswana	1975	6.58	0.14	0.03
Brazil	1961	6.04	0.11	0.06
Brunei Darussalam	1958	6.91	0.13	0.06
Burkina Faso	1985	7.24	0.05	0.06
Burundi	1989	7.39	0.05	0.07
Cabo Verde	1970	6.94	0.08	0.08
Cambodia	1984	6.34	0.15	0.04
Cameroon	1986	6.59	0.06	0.04
Central African Republic	2021	5.98	0.10	0.04
Chad	2006	7.12	0.06	0.05
China	1963	7.51	0.25	0.03
Colombia	1960	6.74	0.14	0.05
Comoros	1982	7.07	0.09	0.04
Congo	1972	6.44	0.07	0.03
Congo (D.R.)	2011	6.58	0.06	0.05
Costa Rica	1960	6.71	0.16	0.05
Côte d'Ivoire	1975	7.91	0.09	0.04
Curaçao	1955	5.21	0.13	0.02
Djibouti	1972	6.85	0.05	0.06
Dominican Republic	1957	7.67	0.14	0.05
Ecuador	1960	6.72	0.10	0.06
Egypt	1953	7.03	0.06	0.05
El Salvador	1964	6.68	0.11	0.06
Equatorial Guinea	1997	5.94	0.07	0.05
Eritrea	1983	6.65	0.08	0.05
Eswatini	1976	6.74	0.12	0.03
Ethiopia	1986	7.36	0.08	0.06
Fiji	1956	6.87	0.14	0.03
French Guiana	1964	5.14	0.08	0.01
French Polynesia	1965	5.88	0.10	0.06
Gabon	1985	5.71	0.08	0.03
Gambia	1984	6.37	0.03	0.05
Ghana	1971	6.94	0.07	0.04

Table A-3: (Continued)

Country	Year onset fertility decline	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/year)
Grenada	1959	6.79	0.16	0.04
Guadeloupe	1962	5.86	0.17	0.04
Guam	1957	6.26	0.13	0.05
Guatemala	1960	6.96	0.04	0.07
Guinea	1989	6.66	0.06	0.05
Guinea-Bissau	1987	6.72	0.07	0.05
Guyana	1958	6.45	0.12	0.03
Haiti	1964	6.18	0.03	0.06
Honduras	1965	7.44	0.08	0.07
Hong Kong	1961	5.17	0.16	0.03
India	1964	5.98	0.07	0.05
Indonesia	1966	5.60	0.10	0.03
Iran	1982	6.55	0.23	0.01
Iraq	1970	7.08	0.06	0.05
Jamaica	1967	5.85	0.14	0.05
Jordan	1971	8.09	0.14	0.07
Kenya	1970	8.02	0.09	0.05
Kiribati	1961	6.63	0.08	0.03
Korea (Republic)	1957	6.19	0.16	0.05
Kosovo	1952	6.94	0.07	0.07
Kuwait	1966	7.34	0.16	0.07
Kyrgyzstan	1963	5.51	0.07	0.03
Lao	1985	6.36	0.13	0.04
Lebanon	1963	5.78	0.10	0.05
Lesotho	1976	5.93	0.09	0.03
Liberia	1979	6.92	0.05	0.05
Libya	1971	8.13	0.17	0.06
Macao	1950	5.70	0.18	0.02
Madagascar	1970	7.27	0.06	0.05
Malawi	1980	7.57	0.08	0.06
Malaysia	1959	6.44	0.12	0.05
Maldives	1983	7.15	0.24	0.04
Mali	1989	7.28	0.03	0.06
Martinique	1957	5.73	0.16	0.04
Mauritania	1979	6.65	0.06	0.04
Mauritius	1961	6.18	0.18	0.03
Mayotte	1975	7.58	0.10	0.04
Mexico	1965	6.82	0.14	0.05
Micronesia (Fed. States of)	1971	6.93	0.10	0.05
Mongolia	1968	7.52	0.14	0.10
Morocco	1962	7.09	0.08	0.09
Mozambique	1975	6.69	0.04	0.04
Myanmar	1965	5.99	0.08	0.06
Namibia	1975	6.54	0.11	0.03
Nepal	1968	5.97	0.03	0.06
New Caledonia	1964	5.36	0.11	0.03
Nicaragua	1963	7.11	0.07	0.07
Niger	2008	7.54	0.06	0.06
Nigeria	1978	6.92	0.04	0.05

Table A-3: (Continued)

Country	Year onset fertility decline	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/ year)
North Macedonia	1950	5.70	0.14	0.03
Oman	1981	8.13	0.22	0.06
Pakistan	1978	6.78	0.06	0.05
Palestine	1967	7.74	0.04	0.07
Panama	1963	5.87	0.11	0.03
Papua New Guinea	1970	6.25	0.05	0.04
Paraguay	1962	6.47	0.07	0.05
Peru	1961	6.92	0.10	0.06
Philippines	1953	7.42	0.08	0.05
Puerto Rico	1950	5.22	0.10	0.04
Qatar	1966	6.74	0.11	0.10
Réunion	1950	7.19	0.14	0.05
Rwanda	1979	8.23	0.11	0.06
Saint Lucia	1960	6.97	0.11	0.08
Saint Vincent and the Grenadines	1958	7.33	0.15	0.06
Samoa	1968	7.59	0.13	0.03
Sao Tome and Principe	1977	6.50	0.06	0.04
Saudi Arabia	1972	7.54	0.10	0.09
Senegal	1981	7.28	0.09	0.04
Seychelles	1968	5.90	0.15	0.02
Sierra Leone	1996	6.55	0.10	0.05
Singapore	1956	6.53	0.22	0.03
Solomon Islands	1974	7.13	0.09	0.04
Somalia	1999	7.63	0.06	0.06
South Africa	1959	6.18	0.07	0.04
South Sudan	1997	7.97	0.16	0.05
Sri Lanka	1959	5.57	0.09	0.05
Sudan	1974	6.95	0.05	0.04
Suriname	1961	6.59	0.14	0.04
Syrian Arab Republic	1970	7.69	0.12	0.08
Taiwan	1953	6.67	0.17	0.05
Tajikistan	1969	7.03	0.08	0.04
Tanzania	1978	6.98	0.06	0.04
Thailand	1963	6.29	0.17	0.04
Timor-Leste	2002	6.02	0.15	0.03
Togo	1976	7.14	0.08	0.03
Tonga	1960	6.89	0.07	0.04
Trinidad and Tobago	1954	5.57	0.11	0.05
Tunisia	1965	7.10	0.13	0.09
Turkey	1959	6.42	0.09	0.06
Turkmenistan	1964	6.79	0.10	0.05
Uganda	1988	7.11	0.04	0.06
United Arab Emirates	1956	6.84	0.03	0.13
Uzbekistan	1965	6.81	0.11	0.08
Vanuatu	1955	7.08	0.05	0.04
Venezuela	1957	6.59	0.10	0.05
Viet Nam	1973	6.11	0.15	0.06
Virgin Islands	1970	5.13	0.11	0.03

Table A-3: (Continued)

Country	Year onset fertility decline	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/ year)
Western Sahara	1969	6.39	0.08	0.06
Yemen	1986	8.86	0.17	0.05
Zambia	1975	7.39	0.06	0.05
Zimbabwe	1966	7.24	0.08	0.04

Source: UN DESA 2022, authors' own calculations.

Table A-4: Characteristics of the increase in the share of working-age population by country

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Afghanistan	2008	2076	67.29	0.29	68
Albania	1966	2015	68.30	0.33	49
Algeria	1977	2010	67.60	0.54	33
Angola	2018	2083	66.42	0.22	65
Antigua and Barbuda	1970	2019	71.18	0.40	49
Aruba	1963	2005	70.36	0.37	42
Azerbaijan	1967	2012	70.77	0.46	45
Bahrain	1969	2013	77.72	0.58	44
Bangladesh	1983	2031	68.69	0.36	48
Belize	1975	2034	69.52	0.38	59
Benin	1997	2100	65.49	0.14	103
Bhutan	1992	2032	74.78	0.49	40
Bolivia	1997	2048	67.69	0.23	51
Bosnia and Herzegovina	1963	2012	70.00	0.26	49
Botswana	1975	2041	68.25	0.31	66
Brazil	1964	2021	69.88	0.30	57
Brunei Darussalam	1964	2018	71.94	0.41	54
Burkina Faso	1996	2074	67.07	0.22	78
Burundi	1997	2070	66.84	0.26	73
Cabo Verde	1991	2033	69.40	0.51	42
Cambodia	1995	2044	67.22	0.32	49
Cameroon	1994	2094	65.84	0.16	100
Central African Republic	2022	2086	68.58	0.30	64
China	1976	2009	72.94	0.52	33
Chad	2016	2100	67.33	0.21	84
Colombia	1965	2021	69.68	0.36	56
Comoros	2002	2074	65.01	0.21	72
Congo	1979	2094	65.96	0.13	115
Congo (D.R.)	2024	2093	66.70	0.23	69
Costa Rica	1964	2023	69.01	0.31	59
Côte d'Ivoire	1987	2095	66.01	0.16	108
Curaçao	1966	2019	68.63	0.27	53
Djibouti	1984	2054	67.48	0.22	70
Dominican Republic	1966	2036	66.13	0.25	70
Ecuador	1968	2030	67.42	0.26	62
Egypt	1989	2038	65.79	0.23	49
El Salvador	1970	2032	67.92	0.29	62
Equatorial Guinea	1998	2072	68.58	0.20	74
Eritrea	2001	2061	66.71	0.24	60
Eswatini	1984	2067	68.64	0.25	83
Ethiopia	2001	2069	65.90	0.24	68
Fiji	1962	2041	67.93	0.23	79
French Guiana	1974	2061	63.34	0.07	87
French Polynesia	1970	2018	68.70	0.34	48

Table A-4: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Gabon	1992	2073	66.53	0.18	81
Gambia	2012	2069	67.42	0.28	57
Ghana	1971	2069	65.96	0.17	98
Grenada	1968	2015	66.84	0.44	47
Guadeloupe	1968	1993	65.82	0.54	25
Guam	1971	1989	66.37	0.39	18
Guatemala	1992	2045	68.49	0.33	53
Guinea	2005	2074	66.75	0.23	69
Guinea-Bissau	1990	2069	67.15	0.25	79
Guyana	1970	2052	66.77	0.22	82
Haiti	1992	2047	67.71	0.25	55
Honduras	1985	2042	68.73	0.34	57
Hong Kong	1963	2011	74.53	0.40	48
India	1975	2032	68.92	0.23	57
Indonesia	1973	2029	68.55	0.25	56
Iran	1989	2010	72.72	0.96	21
Iraq	1977	2063	65.40	0.20	86
Jamaica	1971	2024	72.89	0.46	53
Jordan	1975	2031	66.48	0.35	56
Kenya	1977	2065	67.22	0.24	88
Kiribati	1969	2072	66.31	0.15	103
Korea (Republic)	1967	2015	73.27	0.42	48
Kosovo	1963	2029	70.09	0.29	66
Kuwait	1972	2013	76.02	0.56	41
Kyrgyzstan	1965	2040	65.12	0.15	75
Lao	1996	2045	68.81	0.33	49
Lebanon	1964	2014	68.74	0.36	50
Lesotho	1990	2076	68.01	0.17	86
Liberia	1984	2068	66.85	0.17	84
Libya	1973	2032	69.43	0.42	59
Macao	1965	2011	80.10	0.61	46
Madagascar	1980	2072	65.15	0.17	92
Malawi	2011	2068	66.52	0.29	57
Malaysia	1964	2022	69.82	0.33	58
Maldives	1993	2019	73.86	0.91	26
Mali	2017	2090	67.09	0.24	73
Martinique	1969	1989	66.55	0.74	20
Mauritania	1990	2070	65.68	0.17	80
Mauritius	1963	2019	71.21	0.36	56
Mayotte	1978	2069	63.51	0.19	91
Mexico	1971	2031	68.32	0.31	60
Micronesia (Fed. States of)	1980	2054	67.63	0.23	74
Mongolia	1973	2009	68.13	0.53	36
Morocco	1968	2014	66.18	0.35	46
Mozambique	2012	2080	67.17	0.22	68
Myanmar	1976	2025	68.59	0.26	49
Namibia	1982	2074	67.02	0.20	92
Nepal	1997	2046	69.74	0.30	49

Table A-4: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
New Caledonia	1975	2017	67.09	0.25	42
Nicaragua	1985	2039	67.78	0.32	54
Niger	2023	2099	65.85	0.22	76
Nigeria	1989	2083	67.74	0.17	94
North Macedonia	1963	2012	70.46	0.25	49
Oman	1984	2013	75.37	0.89	29
Pakistan	1995	2062	66.95	0.22	67
Palestine	1978	2056	65.27	0.23	78
Panama	1970	2028	65.29	0.23	58
Papua New Guinea	1973	2064	67.07	0.16	91
Paraguay	1967	2044	66.78	0.22	77
Peru	1974	2031	66.36	0.25	57
Philippines	1964	2051	66.15	0.19	87
Puerto Rico	1959	2009	65.76	0.27	50
Qatar	1972	2010	85.32	0.67	38
Réunion	1967	2011	65.01	0.33	44
Rwanda	1995	2068	66.08	0.26	73
Saint Lucia	1969	2023	72.76	0.50	54
Saint Vincent and the Grenadines	1969	2024	67.37	0.39	55
Samoa	1968	2072	64.17	0.18	104
Sao Tome and Principe	1993	2067	66.41	0.22	74
Saudi Arabia	1978	2028	71.84	0.40	50
Senegal	1988	2071	63.45	0.16	83
Seychelles	1971	2014	69.85	0.45	43
Sierra Leone	2006	2065	68.13	0.26	59
Singapore	1963	2010	78.55	0.56	47
Solomon Islands	1978	2074	64.79	0.17	96
Somalia	2020	2091	67.16	0.24	71
South Africa	1971	2043	68.53	0.20	72
South Sudan	2003	2065	69.05	0.30	62
Sri Lanka	1960	2007	66.95	0.27	47
Sudan	1974	2079	65.49	0.15	105
Suriname	1969	2023	66.40	0.36	54
Syrian Arab Republic	1981	2028	69.35	0.45	47
Taiwan	1963	2014	74.37	0.43	51
Tajikistan	1970	2073	65.31	0.15	103
Tanzania	1985	2079	65.13	0.16	94
Thailand	1968	2012	72.04	0.46	44
Timor-Leste	2011	2052	69.01	0.37	41
Togo	1987	2093	65.58	0.13	106
Tonga	1971	2064	65.08	0.17	93
Trinidad and Tobago	1966	2008	72.58	0.46	42
Tunisia	1969	2011	69.42	0.43	42
Turkey	1969	2017	68.51	0.34	48
Turkmenistan	1969	2040	67.42	0.23	71
Uganda	2005	2075	68.10	0.29	70
United Arab Emirates	1956	2010	86.08	0.58	54
Uzbekistan	1967	2014	67.28	0.39	47

Table A-4: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Vanuatu	1995	2071	64.41	0.17	76
Venezuela	1966	2031	66.57	0.24	65
Viet Nam	1973	2013	69.76	0.42	40
Virgin Islands	1977	2007	66.37	0.29	30
Western Sahara	1993	2033	71.35	0.40	40
Yemen	1993	2069	67.04	0.28	76
Zambia	1981	2085	65.83	0.18	104
Zimbabwe	1988	2072	67.47	0.23	84

Source: UN DESA 2022, authors' own calculations.

Table A-5: Characteristics of the increase in the share of working-age population by country (prospective countries) – lower bound of 95% prediction interval

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Afghanistan	2008	2083	61.37	0.18	75
Angola	2018	2098	59.99	0.10	80
Bangladesh	1983	2023	67.97	0.41	40
Belize	1975	2025	67.34	0.40	50
Benin	1997	2100	59.94	0.09	103
Bhutan	1992	2029	73.12	0.48	37
Bolivia	1997	2023	64.19	0.32	26
Botswana	1975	2040	64.74	0.26	65
Burkina Faso	1996	2093	61.06	0.12	97
Burundi	1997	2093	60.37	0.13	96
Cabo Verde	1991	2024	68.24	0.61	33
Cambodia	1995	2022	65.10	0.50	27
Cameroon	1994	2098	60.61	0.10	104
Central African Republic	2022	2100	60.99	0.15	78
Chad	1976	2100	56.90	0.09	84
Comoros	2002	2076	60.21	0.14	74
Congo	1979	2093	60.71	0.09	114
Congo (Democratic Republic)	2024	2100	55.13	0.06	76
Costa Rica	1964	2022	68.92	0.31	58
Cote d'Ivoire	1987	2100	60.68	0.10	113
Djibouti	1984	2022	64.85	0.33	38
Dominican Republic	1966	2022	65.40	0.30	56
Ecuador	1968	2022	66.39	0.28	54
Egypt	1989	2032	63.16	0.20	43
El Salvador	1970	2023	66.31	0.31	53
Equatorial Guinea	1998	2083	61.64	0.09	85
Eritrea	2001	2075	59.75	0.10	74
Eswatini	1984	2067	63.92	0.20	83
Ethiopia	2001	2079	60.76	0.14	78
Fiji	1962	2022	65.37	0.26	60
French Guiana	1974	2022	61.81	0.10	48
Gabon	1992	2078	61.16	0.11	86
Gambia	2012	2081	60.73	0.13	69
Ghana	1971	2067	60.91	0.12	96
Guatemala	1992	2034	64.99	0.33	42
Guinea	2005	2096	60.90	0.11	91
Guinea-Bissau	1990	2082	61.52	0.15	92
Guyana	1970	2022	64.99	0.31	52
Haiti	1992	2048	63.38	0.17	56
Honduras	1985	2023	65.46	0.42	38
India	1975	2025	67.84	0.24	50
Indonesia	1973	2022	67.84	0.27	49
Iraq	1977	2030	59.93	0.22	53
Jamaica	1971	2022	72.63	0.47	51
Jordan	1975	2026	64.44	0.35	51

Table A-5: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Kenya	1977	2062	61.88	0.19	85
Kiribati	1969	2073	61.59	0.11	104
Kosovo	1963	2026	69.11	0.29	63
Kyrgyzstan	1965	2035	62.03	0.12	70
Lao	1996	2044	65.17	0.26	48
Lesotho	1990	2078	63.10	0.11	88
Liberia	1984	2087	60.55	0.08	103
Libya	1973	2027	67.47	0.42	54
Madagascar	1980	2085	59.91	0.10	105
Malawi	2011	2085	60.63	0.15	74
Malaysia	1964	2022	69.73	0.33	58
Mali	2017	2098	58.83	0.12	81
Mauritania	1990	2085	59.76	0.08	95
Mayotte	1978	2068	58.42	0.13	90
Mexico	1971	2025	67.18	0.33	54
Micronesia (Fed. States of)	1980	2022	63.33	0.31	42
Mozambique	2012	2092	60.47	0.11	80
Myanmar	1976	2022	68.42	0.28	46
Namibia	1982	2077	62.27	0.14	95
Nepal	1997	2046	66.67	0.24	49
Nicaragua	1985	2022	64.80	0.39	37
Niger	2023	2100	54.55	0.07	77
Nigeria	1989	2098	60.90	0.08	109
Pakistan	1995	2055	61.63	0.16	60
Palestine	1978	2053	60.06	0.17	75
Panama	1970	2022	65.01	0.25	52
Papua New Guinea	1973	2022	62.37	0.20	49
Paraguay	1967	2022	64.72	0.27	55
Peru	1974	2022	65.46	0.27	48
Philippines	1964	2022	64.09	0.26	58
Rwanda	1995	2080	60.90	0.16	85
Saint Lucia	1969	2022	72.58	0.50	53
Saint Vincent and the Grenadines	1969	2022	67.14	0.40	53
Samoa	1968	2078	58.66	0.12	110
Sao Tome and Principe	1993	2083	60.42	0.12	90
Saudi Arabia	1978	2022	71.14	0.44	44
Senegal	1988	2086	58.35	0.08	98
Sierra Leone	2006	2081	62.53	0.13	75
Solomon Islands	1978	2086	59.50	0.10	108
Somalia	2020	2100	59.25	0.12	80
South Africa	1971	2025	65.61	0.21	54
South Sudan	2003	2091	61.63	0.13	88
Sudan	1974	2092	59.94	0.09	118
Suriname	1969	2022	66.26	0.37	53
Syrian Arab Republic	1981	2026	67.06	0.42	45
Tajikistan	1970	2078	60.35	0.09	108
Tanzania	1985	2090	59.07	0.09	105
Timor-Leste	2011	2051	64.10	0.25	40

Table A-5: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Togo	1987	2098	59.37	0.07	111
Tonga	1971	2063	59.94	0.11	92
Turkmenistan	1969	2034	63.80	0.20	65
Uganda	2005	2084	61.68	0.18	79
Vanuatu	1995	2079	58.60	0.08	84
Venezuela	1966	2027	64.93	0.23	61
Western Sahara	1993	2022	69.69	0.49	29
Yemen	1993	2077	61.92	0.19	84
Zambia	1981	2098	59.62	0.11	117
Zimbabwe	1988	2080	62.21	0.15	92

Source: UN DESA 2022, authors' own calculations.

Table A-6: Characteristics of the increase in the share of working-age population by country (prospective countries) – upper bound of 95% prediction interval

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Afghanistan	2008	2063	72.72	0.45	55
Angola	2018	2069	72.62	0.41	51
Bangladesh	1983	2041	71.42	0.34	58
Belize	1975	2039	72.57	0.39	64
Benin	1997	2071	71.63	0.28	74
Bhutan	1992	2037	77.42	0.49	45
Bolivia	1997	2048	71.85	0.31	51
Botswana	1975	2042	72.07	0.36	67
Burkina Faso	1996	2067	73.61	0.34	71
Burundi	1997	2067	73.45	0.37	70
Cabo Verde	1991	2039	72.57	0.51	48
Cambodia	1995	2044	71.02	0.40	49
Cameroon	1994	2068	71.77	0.29	74
Central African Republic	2022	2087	73.51	0.37	65
Chad	1976	2073	73.47	0.42	57
Comoros	2002	2072	69.46	0.28	70
Congo	1979	2068	72.24	0.24	89
Congo (Democratic Republic)	2024	2075	72.53	0.43	51
Costa Rica	1964	2033	69.52	0.27	69
Cote d'Ivoire	1987	2071	71.40	0.27	84
Djibouti	1984	2037	72.43	0.38	53
Dominican Republic	1966	2039	69.11	0.28	73
Ecuador	1968	2037	69.85	0.27	69
Egypt	1989	2066	69.84	0.20	77
El Salvador	1970	2037	71.16	0.31	67
Equatorial Guinea	1998	2071	73.77	0.27	73
Eritrea	2001	2060	72.30	0.34	59
Eswatini	1984	2066	72.66	0.31	82
Ethiopia	2001	2059	71.15	0.37	58
Fiji	1962	2041	71.83	0.28	79
French Guiana	1974	2062	67.10	0.12	88
Gabon	1992	2069	71.33	0.25	77
Gambia	2012	2066	72.65	0.39	54
Ghana	1971	2067	70.50	0.22	96
Guatemala	1992	2043	72.38	0.41	51
Guinea	2005	2056	72.65	0.43	51
Guinea-Bissau	1990	2063	72.98	0.35	73
Guyana	1970	2052	70.23	0.26	82
Haiti	1992	2044	72.20	0.35	52
Honduras	1985	2038	72.76	0.44	53
India	1975	2038	71.50	0.25	63
Indonesia	1973	2036	70.92	0.26	63
Iraq	1977	2062	70.71	0.26	85
Jamaica	1971	2032	74.26	0.42	61
Jordan	1975	2036	70.19	0.39	61

Table A-6: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Kenya	1977	2063	71.96	0.31	86
Kiribati	1969	2072	70.84	0.20	103
Kosovo	1963	2030	71.37	0.31	67
Kyrgyzstan	1965	2071	69.76	0.15	106
Lao	1996	2044	72.55	0.41	48
Lesotho	1990	2071	72.31	0.23	81
Liberia	1984	2062	73.05	0.27	78
Libya	1973	2034	72.63	0.46	61
Madagascar	1980	2059	71.04	0.27	79
Malawi	2011	2066	72.80	0.42	55
Malaysia	1964	2037	71.89	0.29	73
Mali	2017	2074	73.36	0.42	57
Mauritania	1990	2063	72.07	0.28	73
Mayotte	1978	2069	68.15	0.24	91
Mexico	1971	2034	70.29	0.33	63
Micronesia (Fed. States of)	1980	2054	71.38	0.29	74
Mozambique	2012	2068	73.10	0.38	56
Myanmar	1976	2037	71.95	0.27	61
Namibia	1982	2074	71.71	0.25	92
Nepal	1997	2046	73.65	0.38	49
Nicaragua	1985	2037	72.06	0.42	52
Niger	2023	2073	72.26	0.47	50
Nigeria	1989	2070	73.66	0.27	81
Pakistan	1995	2059	71.93	0.31	64
Palestine	1978	2054	70.05	0.30	76
Panama	1970	2037	67.22	0.23	67
Papua New Guinea	1973	2061	71.84	0.22	88
Paraguay	1967	2043	70.38	0.27	76
Peru	1974	2037	69.52	0.27	63
Philippines	1964	2054	70.15	0.23	90
Rwanda	1995	2067	70.93	0.33	72
Saint Lucia	1969	2025	73.54	0.49	56
Saint Vincent and the Grenadines	1969	2036	69.20	0.35	67
Samoa	1968	2069	69.28	0.24	101
Sao Tome and Principe	1993	2065	72.08	0.31	72
Saudi Arabia	1978	2031	73.54	0.41	53
Senegal	1988	2065	69.24	0.25	77
Sierra Leone	2006	2061	73.37	0.37	55
Solomon Islands	1978	2069	70.29	0.24	91
Somalia	2020	2072	73.72	0.46	52
South Africa	1971	2043	72.02	0.24	72
South Sudan	2003	2064	76.03	0.42	61
Sudan	1974	2070	71.05	0.22	96
Suriname	1969	2048	68.48	0.27	79
Syrian Arab Republic	1981	2056	73.11	0.33	75
Tajikistan	1970	2074	70.04	0.19	104
Tanzania	1985	2069	71.22	0.25	84
Timor-Leste	2011	2052	73.44	0.48	41

Table A-6: (Continued)

Country	Year onset increase working-age population	Year Maximum share working-age population	Maximum share working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Togo	1987	2069	71.30	0.24	82
Tonga	1971	2064	70.07	0.22	93
Turkmenistan	1969	2042	70.83	0.27	73
Uganda	2005	2065	73.36	0.43	60
Vanuatu	1995	2069	69.93	0.25	74
Venezuela	1966	2061	69.36	0.20	95
Western Sahara	1993	2036	75.36	0.46	43
Yemen	1993	2044	72.63	0.52	51
Zambia	1981	2065	72.16	0.30	84
Zimbabwe	1988	2063	72.13	0.32	75

Source: UN DESA 2022, authors' own calculations.

Table A-7: Further demographic characteristics by country

Country	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
Afghanistan	–0.49	2.03	66.61
Albania	–6.65	0.69	70.77
Algeria	0.67	0.99	62.92
Angola	1.17	2.82	61.84
Antigua and Barbuda	–5.55	0.04	71.19
Aruba	–1.16	–1.17	69.03
Azerbaijan	–1.97	–0.18	62.78
Bahrain	16.01	1.91	71.94
Bangladesh	–3.13	0.45	63.60
Belize	–0.34	1.09	71.30
Benin	0.08	2.45	63.45
Bhutan	–1.29	–0.17	63.80
Bolivia	–1.25	1.62	61.03
Bosnia and Herzegovina	–5.72	–1.27	68.43
Botswana	3.42	1.81	61.39
Brazil	–0.02	0.98	65.89
Brunei Darussalam	6.63	2.65	69.63
Burkina Faso	–1.13	2.29	60.37
Burundi	–1.08	2.71	61.09
Cabo Verde	–8.24	0.80	69.05
Cambodia	–0.16	–0.47	66.32
Cameroon	–0.26	2.34	63.54
Central African Republic	–0.81	1.38	61.35
China	0.14	2.34	58.35
Chad	–0.26	–1.92	65.81
Colombia	–1.05	0.64	68.67
Comoros	–2.63	1.09	65.13
Congo	–0.08	1.98	63.78
Congo (D.R.)	–0.04	2.52	65.30
Costa Rica	1.71	0.88	74.00
Côte d'Ivoire	–0.14	3.04	60.80
Curaçao	–4.91	–1.21	71.31
Djibouti	10.37	6.18	60.76
Dominican Republic	–2.92	0.93	66.47
Ecuador	–0.62	1.71	68.93
Egypt	–0.58	1.11	62.35
El Salvador	–8.06	0.95	64.43
Equatorial Guinea	5.97	3.20	63.14
Eritrea	–4.44	0.99	65.27
Eswatini	–2.66	1.11	59.70
Ethiopia	0.72	2.12	64.58
Fiji	–6.44	0.81	65.38
French Guiana	9.15	3.53	74.83
French Polynesia	–0.71	1.89	73.47
Gabon	1.74	1.82	67.03
Gambia	0.12	2.94	63.60
Ghana	–0.58	1.95	62.67
Grenada	–13.49	–2.21	69.76
Guadeloupe	–6.36	–2.48	68.63
Guam	–4.08	1.75	66.38
Guatemala	–2.67	2.18	65.27

Table A-7: (Continued)

Country	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
Guinea	–0.97	1.70	60.73
Guinea–Bissau	–1.37	1.59	60.32
Guyana	–11.19	0.19	65.94
Haiti	–2.98	1.55	58.69
Honduras	–1.60	2.19	67.50
Hong Kong	5.77	–1.27	76.41
India	–0.20	1.37	61.41
Indonesia	–0.01	0.35	64.18
Iran	1.66	–2.63	67.76
Iraq	–0.16	2.30	69.06
Jamaica	–7.68	–0.16	70.69
Jordan	5.93	2.65	71.62
Kenya	–1.01	2.58	62.65
Kiribati	–5.32	0.37	65.45
Korea (Republic)	–0.39	–0.99	69.44
Kosovo	–9.77	1.56	70.83
Kuwait	20.73	4.15	73.20
Kyrgyzstan	–2.83	1.36	66.20
Lao	–2.41	0.27	64.95
Lebanon	5.21	1.58	67.90
Lesotho	–2.87	0.86	56.23
Liberia	–0.58	1.76	59.28
Libya	1.66	1.61	69.79
Macao	4.79	–6.28	73.33
Madagascar	–0.09	2.60	63.87
Malawi	0.16	2.24	60.50
Malaysia	2.64	0.96	69.70
Maldives	6.58	–2.05	71.43
Mali	–1.70	2.67	62.06
Martinique	–8.05	–2.71	67.55
Mauritania	–0.72	2.26	66.21
Mauritius	–2.18	–0.89	67.96
Mayotte	3.16	4.87	78.02
Mexico	–2.61	1.06	70.24
Micronesia (Fed. States of)	–9.81	1.34	70.49
Mongolia	–1.38	1.93	59.01
Morocco	–2.86	1.27	59.91
Mozambique	–0.56	2.12	59.78
Myanmar	–1.38	0.85	58.71
Namibia	–0.66	1.89	63.03
Nepal	–2.90	1.65	62.69
New Caledonia	2.96	0.92	70.06
Nicaragua	–3.84	2.25	66.04
Niger	0.00	3.12	69.25
Nigeria	–0.02	2.09	55.15
North Macedonia	–3.26	–1.42	66.38
Oman	13.53	0.05	71.77
Pakistan	–0.91	2.62	65.86
Palestine	–4.78	1.88	71.49
Panama	0.12	1.05	72.54

Table A-7: (Continued)

Country	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
Papua New Guinea	0.35	1.33	64.32
Paraguay	–2.86	1.82	69.84
Peru	–1.72	1.40	66.83
Philippines	–1.50	2.20	67.89
Puerto Rico	–7.77	–1.15	72.18
Qatar	50.68	5.34	72.48
Réunion	0.16	0.45	67.10
Rwanda	–0.37	1.61	62.80
Saint Lucia	–8.06	–0.06	69.02
Saint Vincent and the Grenadines	–13.84	–0.88	70.28
Samoa	–11.62	–0.12	72.28
Sao Tome and Principe	–4.96	1.98	67.11
Saudi Arabia	7.39	2.67	71.24
Senegal	–1.75	1.65	68.60
Seychelles	–0.64	–0.44	67.90
Sierra Leone	0.37	1.23	59.98
Singapore	9.97	–2.07	73.01
Solomon Islands	–1.80	2.55	70.29
Somalia	–0.89	2.69	61.40
South Africa	1.41	2.23	61.37
South Sudan	0.29	1.02	57.73
Sri Lanka	–2.46	0.88	68.39
Sudan	–0.97	2.15	63.37
Suriname	–6.36	–0.29	65.02
Syrian Arab Republic	–0.77	2.04	69.14
Taiwan	–0.11	–0.05	71.64
Tajikistan	–2.42	3.05	68.87
Tanzania	–0.68	2.26	65.70
Thailand	1.62	–0.43	67.25
Timor-Leste	–3.28	–0.37	69.62
Togo	–0.36	1.77	63.10
Tonga	–12.81	0.65	69.90
Trinidad and Tobago	–6.11	–0.09	66.77
Tunisia	–1.58	0.68	66.88
Turkey	–0.57	1.03	65.83
Turkmenistan	–0.61	1.77	65.34
Uganda	–1.25	2.35	62.52
United Arab Emirates	61.20	6.71	66.52
Uzbekistan	0.06	2.01	64.79
Vanuatu	–1.49	2.49	67.87
Venezuela	–1.34	1.69	69.47
Viet Nam	–0.72	0.57	69.78
Virgin Islands	–1.32	–0.83	70.43
Western Sahara	19.85	4.79	60.07
Yemen	–1.21	1.60	67.32
Zambia	–0.76	2.62	61.55
Zimbabwe	–2.45	2.77	59.77

Source: UN DESA 2022, authors' own calculations.

Table A-8: Characteristics of the fertility decline by country subgroup

Subgroup	N	Pre-transitional fertility (births/woman)	Speed of fertility decline (-births/woman/year)	Speed of further fertility change (-births/woman/year)
Observed	45	6.31 (0.78)	0.14 (0.05)	0.05 (0.02)
Prospective	103	6.87 (0.65)	0.09 (0.04)	0.05 (0.01)
Total	*148*	*6.69 (0.73)*	*0.10 (0.05)*	*0.05 (0.02)*

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-9: Characteristics of the increase in the share of working-age population by country subgroup

Country subgroup	N	Maximum working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Observed	45	71.08 (4.79)	0.46 (0.17)	42.82 (9.86)
Prospective	103	67.27 (1.92)	0.25 (0.09)	71.75 (17.75)
Total	*148*	*68.43 (3.54)*	*0.31 (0.15)*	*62.95 (20.64)*

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-10: Characteristics of the increase in the share of working-age population (prospective countries) – lower bound of 95% prediction interval

Country subgroup	N	Maximum working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Prospective	103	63.11 (3.70)	0.21 (0.13)	70.90 (23.99)

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-11: Characteristics of the increase in the share of working-age population (prospective countries) – upper bound of 95% prediction interval

Country subgroup	N	Maximum working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Prospective	103	71.71 (1.69)	0.32 (0.09)	69.51 (15.20)

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-12: Further demographic characteristics by country subgroup

Country subgroup	N	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
Observed	45	2.60 (13.26)	0.11 (2.21)	68.66 (3.51)
Prospective	103	–1.35 (4.41)	1.76 (1.10)	65.22 (4.35)
Total	*148*	*–0.15 (8.33)*	*1.26 (1.70)*	*66.26 (4.40)*

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-13: Characteristics of the fertility decline by SDG region

Region	N	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/year)
Central and Southern Asia	13	6.56 (0.64)	0.11 (0.06)	0.05 (0.02)
Eastern and South-Eastern Asia	17	6.40 (0.66)	0.15 (0.04)	0.05 (0.02)
Europe	4	6.03 (0.86)	0.11 (0.03)	0.05 (0.02)
Latin America and Caribbean	32	6.32 (0.71)	0.11 (0.04)	0.05 (0.01)
Northern Africa and Western Asia	21	7.22 (0.76)	0.11 (0.05)	0.07 (0.02)
Oceania	12	6.62 (0.64)	0.10 (0.03)	0.04 (0.01)
Sub-Saharan Africa	49	6.93 (0.58)	0.08 (0.03)	0.05 (0.01)
Total	*148*	*6.70 (0.73)*	*0.10 (0.05)*	*0.05 (0.02)*

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-14: Characteristics of the increase in the share of working-age population by SDG region

Region	N	Maximum working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
Central and Southern Asia	13	68.85 (3.12)	0.38 (0.26)	55.31 (21.82)
Eastern and South-Eastern Asia	17	71.40 (3.88)	0.40 (0.11)	49.18 (11.76)
Europe	4	69.71 (0.96)	0.28 (0.03)	53.25 (8.50)
Latin America and Caribbean	32	68.03 (2.23)	0.33 (0.12)	54.84 (13.89)
Northern Africa and Western Asia	21	70.91 (6.06)	0.42 (0.17)	53.14 (18.6)
Oceania	12	66.32 (1.53)	0.22 (0.08)	74.91 (27.8)
Sub-Saharan Africa	49	66.90 (1.49)	0.23 (0.07)	77.08 (16.79)
Total	*148*	*68.43 (3.54)*	*0.31 (0.15)*	*62.95 (20.64)*

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-15: Further demographic characteristics by SDG region

Region	N	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
Central and Southern Asia	13	–0.69 (2.60)	0.95 (1.69)	65.9 (2.76)
Eastern and South-Eastern Asia	17	1.17 (3.62)	–0.24 (2.05)	68.04 (4.68)
Europe	4	–6.35 (2.69)	–0.11 (1.47)	69.11 (2.13)
Latin America and Caribbean	32	–3.90 (4.59)	0.45 (1.48)	68.43 (3.43)
Northern Africa and Western Asia	21	8.92 (17.42)	2.21 (1.73)	67.50 (4.22)
Oceania	12	–4.62 (5.12)	1.27 (0.85)	68.72 (3.03)
Sub-Saharan Africa	49	–0.39 (2.59)	2.07 (1.11)	63.08 (3.87)
Total	*148*	*–0.15 (8.33)*	*1.26 (1.70)*	*66.26 (4.40)*

Note: Table shows unweighted means. Standard errors reported in parentheses.
Source: UN DESA 2022, authors' own calculations.

Table A-16: Agglomerative coefficients by cluster methods and country subgroups

Cluster method	Observed maximum shares of working-age population	Prospective maximum shares of working-age population
Average linkage	0.908	0.944
Single linkage	0.867	0.834
Complete linkage	0.935	0.974
Ward's method	0.972	0.985
Weighted average linkage	0.900	0.956

Table A-17: Calinski and Harabasz-Pseudo-F by number of clusters and country subgroup

Number of clusters	Observed maximum shares of working-age population	Prospective maximum shares of working-age population
2	56.09	77.35
3	47.62	121.22
4	55.61	139.51
5	63.82	125.74
6	73.37	118.13
7	80.74	116.05
8	81.54	117.68
9	86.09	119.43
10	96.05	120.43

Table A-18: Cluster by country

Country	Cluster (observed)	Cluster (prospective)
Afghanistan	.	2
Albania	1	.
Algeria	2	.
Angola	.	2
Antigua and Barbuda	3	.
Aruba	1	.
Azerbaijan	3	.
Bahrain	5	.
Bangladesh	.	3
Belize	.	3
Benin	.	1
Bhutan	.	4
Bolivia	.	2
Bosnia and Herzegovina	1	.
Botswana	.	3
Brazil	1	.
Brunei Darussalam	3	.
Burkina Faso	.	2
Burundi	.	2
Cabo Verde	.	4
Cambodia	.	3
Cameroon	.	1
Central African Republic	.	3
Chad	.	2
China	3	.
Colombia	1	.
Comoros	.	1
Congo	.	1
Congo (Democratic Republic)	.	2
Costa Rica	.	3
Côte d'Ivoire	.	1
Curaçao	1	.
Djibouti	.	2
Dominican Republic	.	2
Ecuador	.	2
Egypt	.	1
El Salvador	.	3
Equatorial Guinea	.	2
Eritrea	.	2
Eswatini	.	2
Ethiopia	.	1
Fiji	.	2
French Guiana	.	1
French Polynesia	1	.
Gabon	.	1
Gambia	.	2
Ghana	.	1
Grenada	1	.
Guadeloupe	2	.
Guam	1	.
Guatemala	.	3

Table A-18 (Continued)

Country	Cluster (observed)	Cluster (prospective)
Guinea	.	2
Guinea-Bissau	.	2
Guyana	.	2
Haiti	.	2
Honduras	.	3
Hong Kong	3	.
India	.	2
Indonesia	.	2
Iran	4	.
Iraq	.	1
Jamaica	.	4
Jordan	.	3
Kenya	.	2
Kiribati	.	1
Korea (Republic)	3	.
Kosovo	.	3
Kuwait	5	.
Kyrgyzstan	.	1
Lao	.	3
Lebanon	1	.
Lesotho	.	2
Liberia	.	1
Libya	.	4
Macao	5	.
Madagascar	.	1
Malawi	.	2
Malaysia	.	3
Maldives	4	.
Mali	.	2
Martinique	2	.
Mauritania	.	1
Mauritius	1	.
Mayotte	.	1
Mexico	.	3
Micronesia (Fed. States of)	.	2
Mongolia	2	.
Morocco	1	.
Mozambique	.	2
Myanmar	.	2
Namibia	.	2
Nepal	.	3
New Caledonia	1	.
Nicaragua	.	3
Niger	.	1
Nigeria	.	2
North Macedonia	1	.
Oman	4	.
Pakistan	.	2
Palestine	.	1
Panama	.	1
Papua New Guinea	.	1

Table A-18 Cluster by country

Country	Cluster (observed)	Cluster (prospective)
Paraguay	.	2
Peru	.	2
Philippines	.	1
Puerto Rico	1	.
Qatar	6	.
Réunion	1	.
Rwanda	.	2
Saint Lucia	.	4
Saint Vincent and the Grenadines	.	3
Samoa	.	1
Sao Tome and Principe	.	2
Saudi Arabia	.	4
Senegal	.	1
Seychelles	3	.
Sierra Leone	.	2
Singapore	5	.
Solomon Islands	.	1
Somalia	.	2
South Africa	.	2
South Sudan	.	3
Sri Lanka	1	.
Sudan	.	1
Suriname	.	3
Syrian Arab Republic	.	4
Taiwan	3	.
Tajikistan	.	1
Tanzania	.	1
Thailand	3	.
Timor-Leste	.	3
Togo	.	1
Tonga	.	1
Trinidad and Tobago	3	.
Tunisia	3	.
Turkey	1	.
Turkmenistan	.	2
Uganda	.	3
United Arab Emirates	6	.
Uzbekistan	1	.
Vanuatu	.	1
Venezuela	.	2
Viet Nam	3	.
Virgin Islands	1	.
Western Sahara	.	4
Yemen	.	2
Zambia	.	1
Zimbabwe	.	2

Source: UN DESA 2022, authors' own calculations.

Table A-19: Characteristics of the fertility decline by cluster (observed countries)

Cluster	N	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/year)
1	20	6.03 (0.68)	0.12 (0.03)	0.05 (0.02)
2	4	6.68 (1.03)	0.15 (0.01)	0.07 (0.03)
3	12	6.21 (0.74)	0.15 (0.04)	0.05 (0.02)
4	3	7.28 (0.79)	0.23 (0.01)	0.04 (0.02)
5	4	6.66 (0.72)	0.18 (0.04)	0.05 (0.03)
6	2	6.79 (0.07)	0.07 (0.05)	0.12 (0.02)
Total	*45*	*6.31 (0.78)*	*0.14 (0.05)*	*0.05 (0.02)*

Note: Table shows unweighted means. Standard errors reported in parentheses. Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021.
Source: UN DESA 2022, authors' own calculations.

Table A-20: Characteristics of the increase in the share of working-age population by cluster (observed countries)

Cluster	N	Maximum working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
1	20	68.12 (1.78)	0.33 (0.05)	46.40 (8.92)
2	4	67.02 (1.04)	0.59 (0.10)	28.50 (7.33)
3	12	71.89 (1.74)	0.44 (0.03)	44.92 (5.58)
4	3	73.98 (1.33)	0.92 (0.04)	25.33 (4.04)
5	4	78.10 (1.70)	0.58 (0.03)	44.50 (2.65)
6	2	85.70 (0.53)	0.62 (0.06)	46.00 (11.31)
Total	*45*	*71.08 (4.79)*	*0.46 (0.17)*	*42.82 (9.86)*

Note: Table shows unweighted means. Standard errors reported in parentheses. Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021.
Source: UN DESA 2022, authors' own calculations.

Table A-21: Further demographic characteristics by cluster (observed countries)

Cluster	N	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
1	20	–2.49 (4.02)	0.20 (1.32)	68.23 (3.00)
2	4	–3.78 (4.1)	–0.57 (2.37)	64.53 (4.44)
3	12	–0.28 (3.75)	–0.12 (1.14)	68.79 (3.44)
4	3	7.26 (5.96)	–1.54 (1.41)	70.32 (2.22)
5	4	12.88 (6.96)	–0.57 (4.59)	72.87 (0.63)
6	2	55.94 (7.44)	6.03 (0.96)	69.50 (4.21)
Total	*45*	*2.60 (13.26)*	*0.11 (2.21)*	*68.66 (3.51)*

Note: Table shows unweighted means. Standard errors reported in parentheses. Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021.
Source: UN DESA 2022, authors' own calculations.

Table A-22: Characteristics of the fertility decline by cluster (prospective countries)

Cluster	N	Pre-transitional fertility (births/woman)	Speed of fertility decline (births/woman/year)	Speed of further fertility change (births/woman/year)
1	32	6.91 (0.64)	0.07 (0.02)	0.04 (0.01)
2	42	6.85 (0.66)	0.08 (0.03)	0.05 (0.01)
3	21	6.79 (0.58)	0.11 (0.04)	0.05 (0.01)
4	8	7.01 (0.75)	0.11 (0.03)	0.07 (0.01)
Total	103	6.87 (0.65)	0.09 (0.04)	0.05 (0.01)

Note: Table shows unweighted means. Standard errors reported in parentheses. Sample restricted to countries with prospective maximum shares of population aged 15–64 between 2022 and 2100.
Source: UN DESA 2022, authors' own calculations.

Table A-23: Characteristics of the increase in the share of working-age population by cluster (prospective countries)

Cluster	N	Maximum working-age population (%)	Speed of increase working-age population (perc. points/year)	Duration of increase working-age population (years)
1	32	65.40 (0.89)	0.17 (0.03)	88.94 (15.13)
2	42	67.32 (0.73)	0.24 (0.03)	70.67 (11.01)
3	21	68.45 (1.01)	0.33 (0.03)	56.71 (7.12)
4	8	71.47 (1.99)	0.45 (0.04)	48.12 (7.08)
Total	*103*	*67.27 (1.92)*	*0.25 (0.09)*	*71.75 (17.75)*

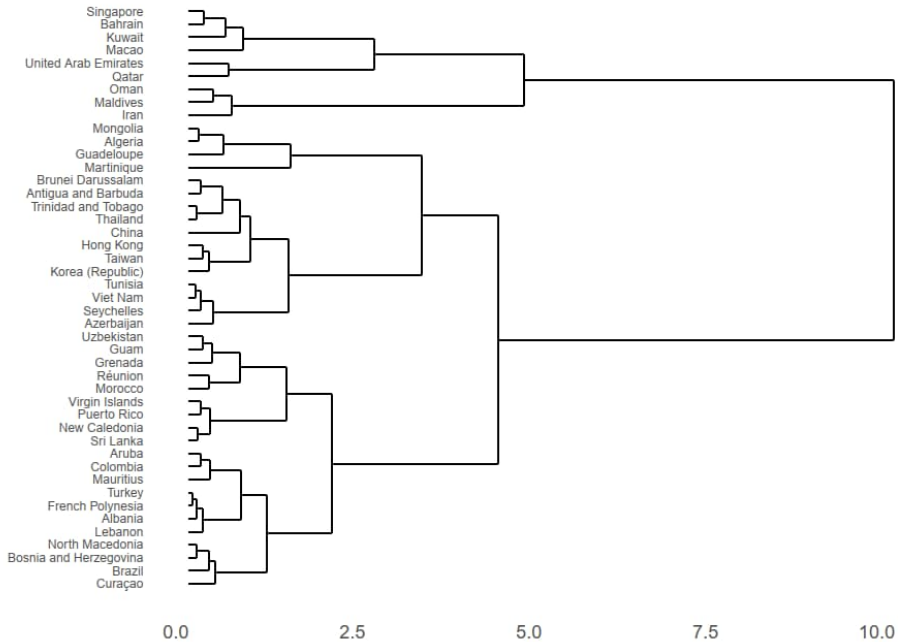
Note: Table shows unweighted means. Standard errors reported in parentheses. Sample restricted to countries with prospective maximum shares of population aged 15–64 between 2022 and 2100.
Source: UN DESA 2022, authors' own calculations.

Table A-24: Further demographic characteristics by cluster (prospective countries)

Cluster	N	Annual net migration (per 1,000 population)	Annual change in total number of births (%)	Mean life expectancy at birth (both sexes)
1	32	–1.24 (3.74)	2.05 (0.96)	66.66 (4.24)
2	42	–1.27 (3.33)	1.93 (0.98)	62.97 (3.66)
3	21	–2.34 (4.49)	1.08 (1.01)	66.50 (4.20)
4	8	0.36 (9.60)	1.44 (1.73)	67.85 (3.87)
Total	*103*	*–1.35 (4.41)*	*1.76 (1.10)*	*65.22 (4.35)*

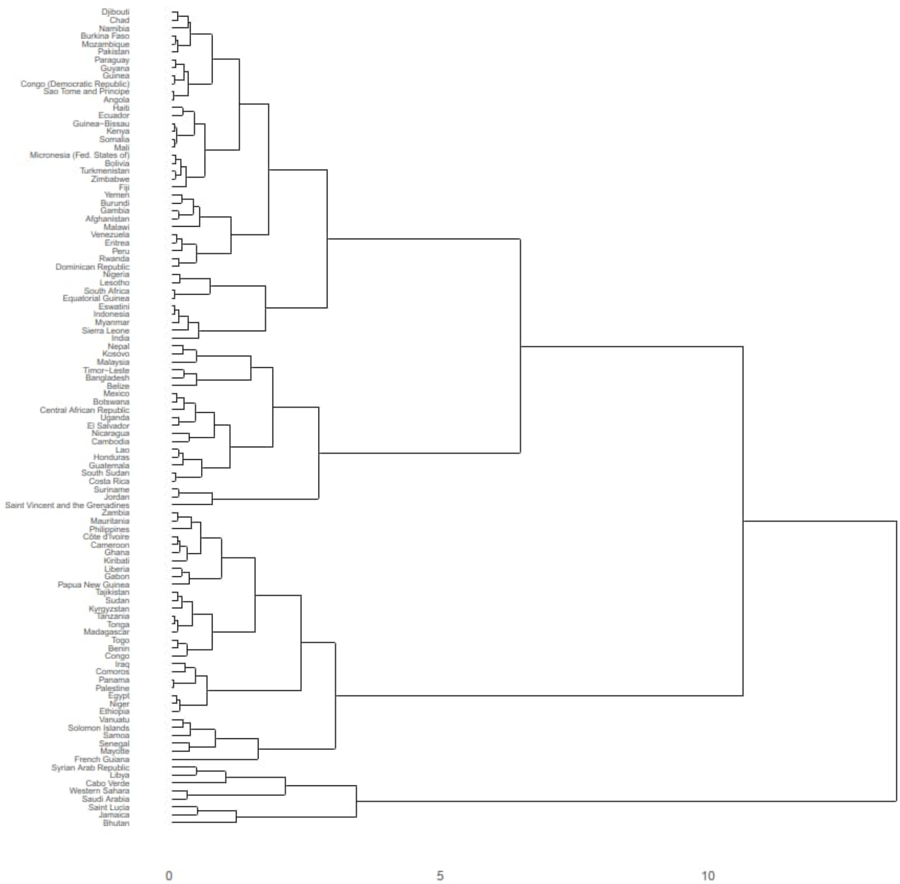
Note: Table shows unweighted means. Standard errors reported in parentheses. Sample restricted to countries with prospective maximum shares of population aged 15–64 between 2022 and 2100.
Source: UN DESA 2022, authors' own calculations.

Figure A-1: Cluster dendrogram (observed countries)



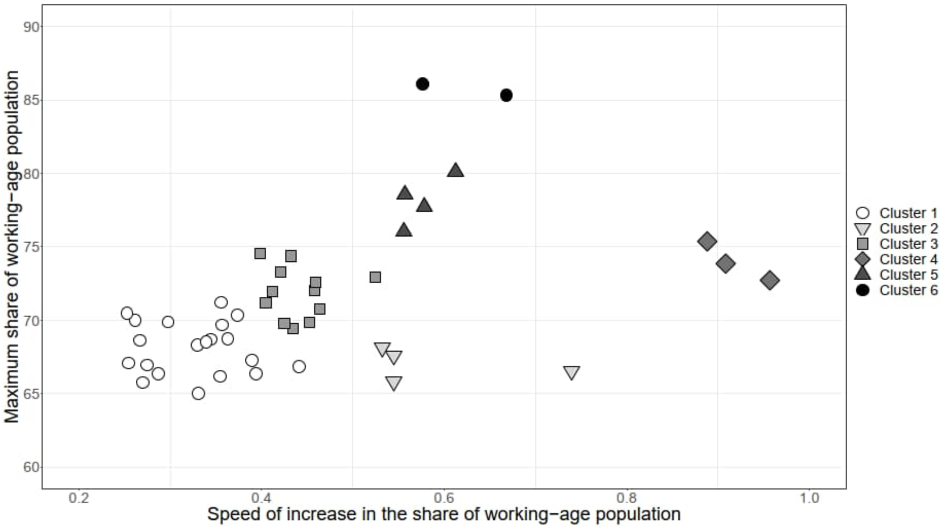
Note: Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021.
Source: UN DESA 2022, authors' own calculations.

Figure A-2: Cluster dendrogram (prospective countries)



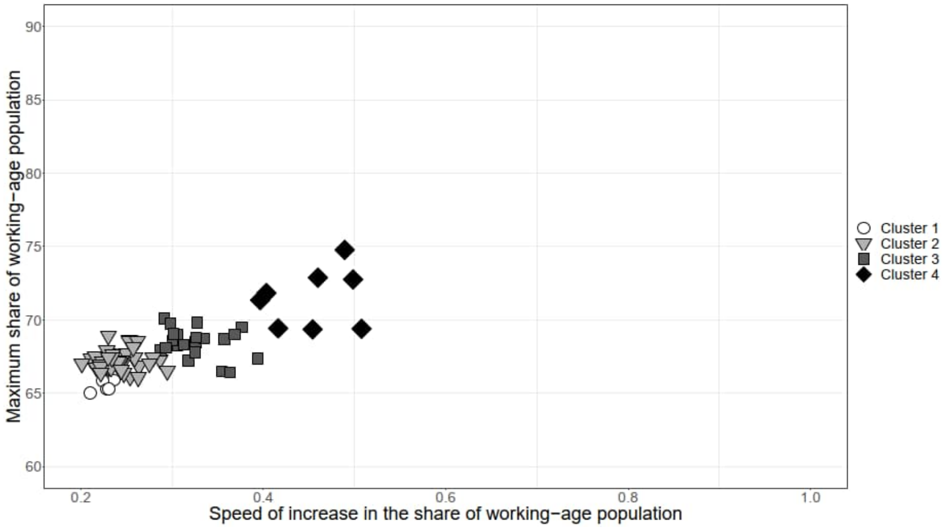
Note: Sample restricted to countries with prospective maximum shares of population aged 15–64 between 2022 and 2100.
Source: UN DESA 2022, authors' own calculations.

Figure A-3: Maximum share of working-age population and speed of increase by cluster (observed countries)



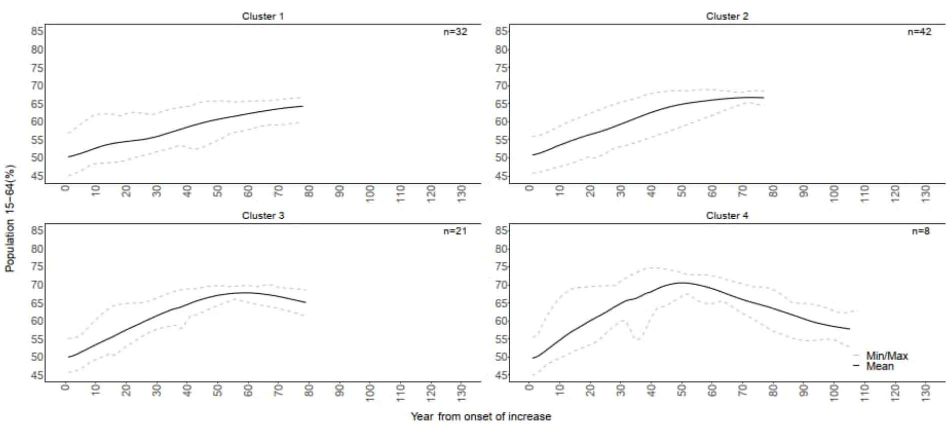
Note: Sample restricted to countries with observed maximum shares of population aged 15–64 between 1950 and 2021.
Source: UN DESA 2022, authors' own calculations.

Figure A-4: Maximum share of working-age population and speed of increase by cluster (prospective countries)



Note: Sample restricted to countries with prospective maximum shares of population aged 15–64 between 2022 and 2100.
Source: UN DESA 2022, authors' own calculations.

Figure A-5: Share of working-age population over time by cluster (prospective countries)



Note: Sample restricted to countries with prospective maximum shares of population aged 15–64 between 2022 and 2100. Year 0 corresponds to first year in which the share of working-age population increases to the next year.
Source: UN DESA 2022, authors' own calculations.