HELLENIC REPUBLIC

HELLENIC STATISTICAL AUTHORITY

Piraeus, 18 December 2025

Methodological note for the estimation of migration flows for the years 2022, 2023 and 2024 and population on 1st January of 2023, 2024 and 2025

In the context of the post-census revision of population estimates on 1st January of the years 2012 – 2021, a review of the migration estimation models was carried out. The existing models were revised taking into account the final results of the 2021 Population Census, the revised population data for the years 2012 – 2021 and the basic demographic equation, according to which, for each reference year t, the population at the beginning of the following year $\mathbf{P_{t+1}}$ is deducted as follows:

$$\mathbf{P_{t+1} = P_t + B_t - D_t + I_t - E}$$

where:

$\mathbf{P_t}$: population at the beginning of year t,

$\mathbf{B_t}$: live births during year t,

$\mathbf{D_t}$: deaths during year t,

$\mathbf{I_t}$: immigration flow during year t,

$\mathbf{E_t}$: emigration flow during year t.

The key points of the estimated migration flows revision process are as follows:

- The population of 1st January 2022 (10,461,627) is defined as a fixed reference point, as both total population and population distributions are largely based on 2021 Population Census with a reference date of 22.10.2021.
- The annual immigration for the period 2012 - 2021 was considered reliable, as its estimation, apart from the use of a regression model, is also based on administrative data.
- The revision of emigration, which is also challenging to be recorded statistically at the international level, was considered necessary. For the years 2011 – 2021, the annual emigration was estimated as the difference deducted from the demographic equation based on annual natural balance, immigration and the revised population totals, as they resulted from the revision process of the years 2012 – 2021.

- The existing immigration data and emigration data resulting from the above process for the years up to 2021 were used to feed statistical models in order to estimate migration flows for the years from 2022 onwards.

According to the above, migration flows were estimated for the year 2024 and revised for the years 2022 and 2023. Following the consideration of data on natural balance for these years, as well as the distributions from 2021 Population Census, new population distributions were compiled for the 1st January 2023, 2024, and 2025 in terms of the basic demographic variables, sex and age, and other variables such as place of usual residence, country of citizenship and country of birth.

More details on the revision of population data for the years 2012 – 2021 are available at the link: https://www.statistics.gr/en/statistics/-/publication/SPO18/-

IMMIGRATION

Taking into account the advantages and disadvantages of the models examined, the model to be selected includes as independent variables the annual immigration flow of the previous year and the percentage change in Gross Domestic Product, also of the previous year.

The equation[1] that has been selected is:

$$\ln(\hat{I}_t) = 2.621 + 0.765 * \ln(I_{t-1}) + 0.007 * GDP_{t-1}$$

where:

I_t : Total annual immigration

I_{t-1}: Total annual immigration of the previous year

GDP_{t-1}: Percentage change in Gross Domestic Product in current prices of the previous year

The resulting estimates also include persons with usual residence in the Country who meet the requirements of European Regulation (EC) 862/2007 on migration and international protection statistics to be considered as immigrants.

[1] The parameters and other information for the selected equation are presented in the annex.

The above estimates are summarized in the following table:

Year	% GDP Change	Immigrants (except beneficiaries of international/ temporary protection)	Beneficiaries of international protection	Beneficiaries of temporary protection (from Ukraine)	Total Immigration
2021	10.2	48,375	8,745		57,120
2022	12.6	56,722	17,122	21,530	95,374
2023	8.3	65,176	46,095	5,320	116,591
2024	5.5	70,348	56,066	5,735	132,149

Immigration (excluding beneficiaries of international protection) for the year 2021 (48,375) was recorded in the 2021 Population Census and is considered a reliable figure. International and temporary protection data are drawn from administrative sources, specifically from the Ministry of Migration and Asylum.

The distribution of immigrants and persons seeking international protection by sex, age, group of country of citizenship/birth/previous residence is based on the 2021 Population Census data, while the distribution of persons from Ukraine is based on data from the Ministry of Migration and Asylum.

EMIGRATION

The estimate of emigration was based on data of Germany on immigration from Greece, given that Germany has historically been the most popular destination country for Greek emigrants and that relevant data from other countries are either not timely available or their reliability is not guaranteed. These data were used as input for the regression models to estimate total emigration.

The equation[2] that has been selected is:

$$\mathbf{\widehat{E}_t = 13{,}804.3 + 3.32 * D_t}$$

[2] The parameters and other information for the selected equation are presented in the annex.

where:

E_t : total emigration in year t and

D_t : immigration to Germany from Greece in the same year, based on data from the Statistical Office of Germany (DESTATIS).

The results are summarized in the table below:

Year	Immigration to Germany from Greece	Total emigration estimation
2022	23,295	91,137
2023	21,981	86,775
2024	19,342	78,014

Estimated population on 1st January of the years 2023, 2024 and 2025

According to the above and based on the basic demographic equation, population on 1st January for each year t is deducted as follows:

	P_t	B_t - D_t	I_t	E_t
2022	10,461,627	-63,996	95,374	91,137
2023	10,401,868	-55,920	116,591	86,775
2024	10,375,764	-57,564	132,149	78,014
2025	10,372,335			

ANNEX

Post-census migration models

This analysis is part of an ongoing effort to monitor and record migration flows to and from Greece, using models that have already been used in previous methodological approaches by ELSTAT. The selection of these specific models is based on their ability to capture both the dynamic behavior of migration flows and the impact of key economic factors.

The aim of the analysis is not to introduce new models, but to review and validate the existing coefficients of the immigration and emigration models, based on updated data resulting from the revision of population data. Maintaining the same structure of the equations allows for the comparability of results over time and ensures consistency with the previous methodological framework.

In this context, the model coefficients were re-estimated using the Ordinary Least Squares (OLS) method, while the prescribed residual diagnostics (i.e., simultaneous satisfaction of non-autocorrelation, homoscedasticity, and normality) were tested to confirm that the basic assumptions of the method were not violated. This ensures that the updated estimates are theoretically consistent, statistically reliable, and suitable for use in updated analyses and forecasts of migration flows.

1. Modeling Immigration

The immigration model's dependent variable is immigration ($\mathrm{I_t}$) and the explanatory variables are the immigration of the previous year ($\mathrm{I_{t-1}}$) and the percentage change in GDP (Source: ELSTAT) of the previous year ($\mathrm{GDP_{t-1}}$). The reason for choosing these explanatory variables is that they reflect both the dynamic behavior of migration flows and the way in which economic conditions influence migration decisions. Immigration of the previous year ($\mathrm{I_{t-1}}$) is included to capture the time dependence, as the volume of migration in the previous year serves as an indicator of existing conditions and trends that directly influence how many immigrants are likely to enter the country in the current year. At the same time, the percentage change in GDP of the previous year is incorporated into the model to take into account the impact of economic conditions in the host country.

The above functional form allows for the capture of both the economic and dynamic dimensions of immigration flows. The analysis is performed on logarithmic values in order to limit the phenomenon of heteroscedasticity.

Using the OLS method, the following results are obtained from the estimation of the immigration model, where the exact significance levels of the model variables (p-values) are shown in parentheses:

$$\ln(\widehat{\mathrm{I}_t}) = \underset{(0.0114)}{2.621435} + \underset{(0.0000)}{0.765123} \cdot \ln \hat{\mathrm{I}}_{t-1} + \underset{(0.0001)}{0.007012} \cdot \mathrm{GDP}_{t-1}$$

Where: I_t = total annual immigration

I_{t-1} = total annual immigration of the previous year

GDP_{t-1} = percentage change in GDP in current prices with 2020 as the base year and 2021 as the reference (of the previous year)

The signs of the explanatory variables remain unchanged and are consistent with the theoretically expected effects, as lagged immigration positively affects current immigration flows, confirming the positive time dependence of the phenomenon, while the percentage change in GDP also shows a positive relationship with immigration, which suggests that economic growth and migration flows move in the same direction, in line with the relevant economic theory.

The necessary residual diagnostics of the regression model were tested, and it was found that none of the basic assumptions were violated, since the residuals do not show autocorrelation, are characterized by homoscedasticity, and follow a normal distribution, which allows for reliable conclusions. The results show that both the constant term and the explanatory variables of lagged immigration and the percentage change in GDP of the previous year are statistically significant at a 5% significance level, while the overall regression model is statistically significant. Meanwhile, the high coefficient of determination (R^2=0.988043) demonstrates the very good fit of the model to the data, as almost all of the variability in immigration is explained by the variables included in the model.

2. Modeling Emigration

The emigration model's dependent variable is emigration (E_t) and the explanatory variable is the immigration to Germany from Greece in the same year, based on data from the Statistical Office of Germany (DESTATIS), which is symbolized as D_t.

The reason why this explanatory variable was chosen is that Germany is consistently the main destination for Greek emigrants.

Using the OLS method, the following results are obtained from the estimation of the emigration model, where the exact significance levels of the model variables (p-values) are shown in parentheses:

$$\widehat{E_t} = 13{,}804.30 + 3.319701 \cdot D_t$$
$$(0.2314) \qquad (0.0000)$$

Όπου: E_t = total emigration in year t

D_t = immigration to Germany from Greece in the same year

The signs of the estimated coefficients are consistent with theory, as emigration to Germany has a positive and amplifying effect on total emigration, suggesting a strong positive relationship between the two variables. The necessary residual diagnostics of the regression model were tested and no violation of the basic assumptions of the model was found, since the residuals do not show autocorrelation, are characterized by homoscedasticity, and follow a normal distribution. The estimation results show that the explanatory variable of immigration to Germany from Greece is statistically significant and adequate to explain emigration, while the model fits the data very well, as reflected in the high value of the coefficient of determination (R^2=0.904750).